USER'S MANUAL

English Version

24 Port 10/100Mbps Switch

FMS-24K

PLANEX COMMUNICATIONS INC.

Management Guide

24-Port Fast Ethernet Switch

Intelligent Fast Ethernet Switch
with 24 10BASE-T / 100BASE-TX Ports,
and Optional 100BASE-FX/1000BASE-X Modules

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Configuration Options

This 24-Port Layer 2 Switch includes a built-in network management agent. The agent offers a variety of management options, including SNMP, RMON and a Web-based interface. A PC may also be connected directly to the switch for configuration and monitoring via a command line interface (CLI).

Note: The IP address for this switch is assigned via DHCP by default. To change this address, see "Setting an IP Address" on page 1-4.

The switch's HTTP Web agent allows you to configure switch parameters, monitor port connections, and display statistics graphically using a standard Web browser such as Netscape Navigator version 6.2 and higher or Microsoft IE version 5.0 and higher. The switch's Web management interface can be accessed from any computer attached to the network.

The switch's management agent is based on SNMP (Simple Network Management Protocol). This SNMP agent permits the switch to be managed from any system in the network using management software.

The CLI program can be accessed by a direct connection to the RS-232 serial console port on the switch, or remotely by a Telnet connection over the network.

The switch's CLI configuration program, Web interface, and SNMP agent allow you to perform the following management functions:

• Set user names and passwords
• Set an IP interface for a management VLAN
• Configure SNMP parameters
• Enable/disable any port
• Set the speed/duplex mode for any port
• Configure the bandwidth of any port by rate limiting
• Configure up to 255 IEEE 802.1Q VLANs
• Enable GVRP automatic VLAN registration
• Configure IGMP multicast filtering
• Upload and download system firmware via TFTP
• Upload and download switch configuration files via TFTP
• Configure Spanning Tree parameters
• Configure Class of Service (CoS) priority queuing

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- Configure up to six static or LACP trunks
- Enable port mirroring
- Set broadcast storm control on any port
- Display system information and statistics

Required Connections

The switch provides an RS-232 serial port that enables a connection to a PC or terminal for monitoring and configuring the switch. A null-modem console cable is provided with the switch.

Note: When FMS-24K switches are stacked together, you must connect to the RS-232 port on the Master unit to be able to access the CLI.

Attach a VT100-compatible terminal, or a PC running a terminal emulation program to the switch. You can use the console cable provided with this package, or use a null-modem cable that complies with the wiring assignments shown in "Console Port Pin Assignments" on page B-1 of the Installation Guide.

To connect a terminal to the console port, complete the following steps:

1. Connect the console cable to the serial port on a terminal, or a PC running terminal emulation software, and tighten the captive retaining screws on the DB-9 connector.

2. Connect the other end of the cable's to the RS-232 serial port on the switch.

3. Make sure the terminal emulation software is set as follows:

    - Select the appropriate serial port (COM port 1 or COM port 2).

    - Set the data rate to 9600 baud.

    - Set the data format to 8 data bits, 1 stop bit, and no parity.

    - Set flow control to none.

    - Set the emulation mode to VT100.

    - When using HyperTerminal, select Terminal keys, not Windows keys.

Notes: 1. When using HyperTerminal with Microsoft® Windows® 2000, make sure that you have Windows 2000 Service Pack 2 or later installed. Windows 2000 Service Pack 2 fixes the problem of arrow keys not functioning in HyperTerminal's VT100 emulation. See www.microsoft.com for information on Windows 2000 service packs.

   2. Refer to "Line Commands" on page 3-47 for a complete description of console configuration options.

   3. Once you have set up the terminal correctly, the console login screen will be displayed.

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For a description of how to use the CLI, see "Using the Command Line Interface" on page 3-1. For a list of all the CLI commands and detailed information on using the CLI, refer to "Command Groups" on page 3-8.

Remote Connections

Prior to accessing the switch's onboard agent via a network connection, you must first configure it with a valid IP address, subnet mask, and default gateway using a console connection, DHCP or BOOTP protocol.

The IP address for this switch is assigned via DHCP by default. To manually configure this address or enable dynamic address assignment via DHCP or BOOTP, see "Setting an IP Address" on page 1-4.

Note: This switch supports four concurrent Telnet sessions.

After configuring the switch's IP parameters, you can access the onboard configuration program from anywhere within the attached network. The onboard configuration program can be accessed using Telnet from any computer attached to the network. The switch can also be managed by any computer using a Web browser (Internet Explorer 5.0 or above, or Netscape Navigator 6.2 or above), or from a network computer using network management software.

Note: The onboard program only provides access to basic configuration functions. To access the full range of SNMP management functions, you must use SNMP-based network management software.

Basic Configuration

Console Connection

The CLI program provides two different command levels — normal access level (Normal Exec) and privileged access level (Privileged Exec). The commands available at the Normal Exec level are a limited subset of those available at the Privileged Exec level and allow you to only display information and use basic utilities. To fully configure switch parameters, you must access the CLI at the Privileged Exec level.

Access to both CLI levels are controlled by user names and passwords. The switch has a default user name and password for each level. To log into the CLI at the Privileged Exec level using the default user name and password, perform these steps:

1. To initiate your console connection, press <Enter>. The "User Access Verification" procedure starts.

2. At the Username prompt, enter "admin."

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3. At the Password prompt, also enter "admin." (The password characters are not displayed on the console screen.)

4. The session is opened and the CLI displays the "Console#" prompt indicating you have access at the Privileged Exec level.

Setting Passwords

Note: If this is your first time to log into the CLI program, you should define new passwords for both default user names using the "username" command, record them and put them in a safe place.

Passwords can consist of up to 8 alphanumeric characters and are case sensitive. To prevent unauthorized access to the switch, set the passwords as follows:

1. Open the console interface with the default user name and password "admin" to access the Privileged Exec level.

2. Type "configure" and press <Enter>.

3. Type "username guest password 0 *password*," for the Normal Exec level, where *password* is your new password. Press <Enter>.

4. Type "username admin password 0 *password*," for the Privileged Exec level, where *password* is your new password. Press <Enter>.

```
Username: admin
Password:
CLI session with the host is opened.
To end the CLI session, enter [Exit].
Console#configure
Console(config)#username guest password 0 [password]
Console(config)#username admin password 0 [password]
Console(config)#
```

Setting an IP Address

You must establish IP address information for the switch to obtain management access through the network. This can be done in either of the following ways:

Manual — You have to input the information, including IP address and subnet mask. If your management station is not in the same IP subnet as the switch, you will also need to specify the default gateway router.

Dynamic — The switch sends IP configuration requests to BOOTP or DHCP address allocation servers on the network.

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Note: Only one VLAN interface can be assigned an IP address (the default is VLAN 1). This defines the management VLAN, the only VLAN through which you can gain management access to the switch. If you assign an IP address to any other VLAN, the new IP address overrides the original IP address and this becomes the new management VLAN.

Manual Configuration

You can manually assign an IP address to the switch. You may also need to specify a default gateway that resides between this device and management stations that exist on another network segment.

Valid IP addresses consist of four decimal numbers, 0 to 255, separated by periods. Anything outside this format will not be accepted by the CLI program.

Note: The IP address for this switch is assigned via DHCP by default.

Before you can assign an IP address to the switch, you must obtain the following information from your network administrator:

• IP address for the switch
• Default gateway for the network
• Network mask for this network

To assign an IP address to the switch, complete the following steps:

1. From the Privileged Exec level global configuration mode prompt, type "interface vlan 1" to access the interface-configuration mode. Press <Enter>.

2. Type "ip address *ip-address netmask*," where "ip-address" is the switch IP address and "netmask" is the network mask for the network. Press <Enter>.

3. Type "exit" to return to the global configuration mode prompt. Press <Enter>.

4. To set the IP address of the default gateway for the network to which the switch belongs, type "ip default-gateway *gateway*," where "gateway" is the IP address of the default gateway. Press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#exit
Console(config)#ip default-gateway 192.168.1.254
Console(config)#
```

Dynamic Configuration

If you select the "bootp" or "dhcp" option, IP will be enabled but will not function until a BOOTP or DHCP reply has been received. You therefore need to use the "ip dhcp restart" command to start broadcasting service requests. Requests will be sent periodically in an effort to obtain IP configuration information. (BOOTP and DHCP

values can include the IP address, subnet mask, and default gateway.)

If the "bootp" or "dhcp" option is saved to the startup-config file, then the switch will start broadcasting service requests as soon as it is powered on.

To automatically configure the switch by communicating with BOOTP or DHCP address allocation servers on the network, complete the following steps:

1. From the Privileged Exec level global configuration mode prompt, type "interface vlan 1" to access the interface-configuration mode. Press <Enter>.

2. At the interface-configuration mode prompt, use one of the following commands:

   • To obtain IP settings through DHCP, type "ip address dhcp" and press <Enter>.

   • To obtain IP settings through BOOTP, type "ip address bootp" and press <Enter>.

3. Type "exit" to return to the global configuration mode. Press <Enter>.

4. Type "ip dhcp restart" to begin broadcasting service requests. Press <Enter>.

5. Wait a few minutes, and then check the IP configuration settings by typing the "show ip interface" command. Press <Enter>.

6. Then save your configuration changes by typing "copy running-config startup-config." Enter the startup file name and press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#exit
Console#ip dhcp restart
Console#show ip interface
IP interface vlan
 IP address and netmask: 10.1.0.54 255.255.255.0 on VLAN 1,
 and address mode: User specified.
Console#copy running-config startup-config
Startup configuration file name []: startup

Console#
```

Enabling SNMP Management Access

The switch can be configured to accept management commands from Simple Network Management Protocol (SNMP) applications. You can configure the switch to (1) respond to SNMP requests or (2) generate SNMP traps.

When SNMP management stations send requests to the switch (either to return information or to set a parameter), the switch provides the requested data or sets the specified parameter. The switch can also be configured to send information to SNMP managers (without being requested by the managers) through trap messages, which inform the manager that certain events have occurred.

Community Strings

Community strings are used to control management access to SNMP stations, as well as to authorize SNMP stations to receive trap messages from the switch. You therefore need to assign community strings to specified users or user groups, and set the access level.

The default strings are:

- **public** - Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.
- **private** - Specifies read-write access. Authorized management stations are able to both retrieve and modify MIB objects.

Note: If you do not intend to utilize SNMP, it is recommended that you delete both of the default community strings. If there are no community strings, then SNMP management access to the switch is disabled.

To prevent unauthorized access to the switch via SNMP, it is recommended that you change the default community strings.

To configure a community string, complete the following steps:

1. From the Privileged Exec level global configuration mode prompt, type "snmp-server community *string mode*," where "string" is the community access string and "mode" is **rw** (read/write) or **ro** (read only). Press <Enter>.

2. To remove an existing string, simply type "no snmp-server community *string*," where "string" is the community access string to remove. Press <Enter>.

```
Console(config)#snmp-server community abc rw
Console(config)#snmp-server community private
Console(config)#
```

Trap Receivers

You can also specify SNMP stations that are to receive traps from the switch.

To configure a trap receiver, complete the following steps:

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1. From the Privileged Exec level global configuration mode prompt, type "snmp-server host *host-address community-string*," where "host-address" is the IP address for the trap receiver and "community-string" is the string associated with that host. Press <Enter>.

2. In order to configure the switch to send SNMP notifications, you must enter at least one snmp-server enable traps command. Type "snmp-server enable traps *type*," where "type" is either **authentication** or **link-up-down**. Press <Enter>.

```
Console(config)#snmp-server enable traps link-up-down
Console(config)#
```

Saving Configuration Settings

Configuration commands only modify the running configuration file and are not saved when the switch is rebooted. To save all your configuration changes in nonvolatile storage, you must copy the running configuration file to the start-up configuration file using the "copy" command.

To save the current configuration settings, enter the following command:

1. From the Privileged Exec mode prompt, type "copy running-config startup-config" and press <Enter>.

2. Enter the name of the start-up file. Press <Enter>.

```
Console#copy running-config startup-config
Startup configuration file name []: startup

Console#
```

Managing System Files

The switch's flash memory supports three types of system files that can be managed by the CLI program, Web interface, or SNMP. The switch's file system allows files to be uploaded and downloaded, copied, deleted, and set as a start-up file.

The three types of files are:

• **Configuration** — These files store system configuration information and are created when configuration settings are saved. Saved configuration files can be selected as a system start-up file or can be uploaded via TFTP to a server for backup. A file named "Factory_Default_Config.cfg" contains all the system default settings and cannot be deleted from the system. See "Saving or Restoring Configuration Settings" on page 2-16 for more information.

• **Operation Code** — System software that is executed after boot-up, also known as

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run-time code. This code runs the switch operations and provides the CLI, Web and SNMP management interfaces. See "Managing Firmware" on page 2-15 for more information.

• **Diagnostic Code** — Software that is run during system boot-up, also known as POST (Power On Self-Test). This code also provides a facility to upload firmware files to the system directly through the console port. See "Upgrading Firmware via the Serial Port" on page A-1.

Due to the size limit of the flash memory, the switch supports only two operation code files, and two diagnostic code files. However, you can have as many configuration files as available flash memory space allows.

In the system flash memory, one file of each type must be set as the start-up file. During a system boot, the diagnostic and operation code files set as the start-up file are run, and then the start-up configuration file is loaded.

System Defaults

The switch's system defaults are provided in the configuration file "Factory_Default_Config.cfg" To reset the switch defaults, this file should be set as the startup configuration file. (See "Setting the Startup Configuration File" on page 2-17.)

The following table lists some of the basic system defaults.

Table 1-1. System Defaults		
Function	Parameter	Default
IP Settings	Management VLAN	1
	DHCP	Enabled
	BOOTP	Disabled
	User Specified	Disabled
	IP Address	0.0.0.0
	Subnet Mask	255.0.0.0
	Default Gateway	0.0.0.0
Web Management	HTTP Server	Enabled
	HTTP Port Number	80
SNMP	Community Strings	"public" (read only) "private" (read/write)
	Authentication Failure Traps	Enabled
	Link-up-Down Traps	Enabled

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Table 1-1. System Defaults		
Function	**Parameter**	**Default**
Security	Privileged Exec Level	Username "admin" Password "admin"
	Normal Exec Level	Username "guest" Password "guest"
	Enable Privileged Exec from Normal Exec Level	Password "super"
	Authentication	Local
Console Port Connection	Baud Rate	9600
	Data bits	8
	Stop bits	1
	Parity	none
	Local Console Timeout	0 (disabled)
Port Status	Admin Status	Enabled
	Auto-negotiation	Enabled
	Flow Control	Disabled
		10BASE-T – 10 Mbps half duplex 10 Mbps full duplex Full-duplex flow control disabled 100BASE-TX/FX – 10 Mbps half duplex 10 Mbps full duplex 100 Mbps half duplex 100 Mbps full duplex Full-duplex flow control disabled 1000BASE-T – 10 Mbps half duplex 10 Mbps full duplex 100 Mbps half duplex 100 Mbps full duplex 1000 Mbps full duplex Full-duplex flow control disabled Symmetric flow control disabled 1000BASE-X – 1000 Mbps full duplex Full-duplex flow control disabled Symmetric flow control disabled
Link Aggregation	Static Trunks	None
	LACP (all ports)	Disabled

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Table 1-1. System Defaults		
Function	**Parameter**	**Default**
Spanning Tree Protocol	Status	Enabled (Defaults: All parameters based on IEEE 802.1D)
	Fast Forwarding	Disabled
Address Table	Aging Time	300 seconds
Virtual LANs	Default VLAN	1
	PVID	1
	Acceptable Frame Type	All
	Ingress Filtering	Disabled
	GVRP (global)	Disabled
	GVRP (port interface)	Disabled
	Private VLAN	No Private VLAN
Class of Service	Ingress Port Priority	0
	Weighted Round Robin	Class 0: 1 Class 1: 4 Class 2: 16 Class 3: 64
	IP Precedence Priority	Disabled
	IP DSCP Priority	Disabled
	IP Port Priority	Disabled
Multicast Filtering	IGMP Snooping	Enabled
	Act as Querier	Enabled
Broadcast Storm Protection	Status	Enabled (all ports)
	Broadcast Limit Rate	500 packets per second
System Log	Status	Enabled
	Messages Logged	Levels 0-7 (all)
	Messages Logged to Flash	Levels 0-3
Rate Limit	Status	Disabled
802.1x	Re-authentication	Disabled
	Status	Disabled
	Mode	Force-Authorized (all ports)

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Chapter 2: Configuring the Switch

Using the Web Interface

This switch provides an embedded HTTP Web agent. Using a Web browser you can configure the switch and view statistics to monitor network activity. The Web agent can be accessed by any computer on the network using a standard Web browser (Internet Explorer 5.0 or above, or Netscape Navigator 6.2 or above).

Note: You can also use the Command Line Interface (CLI) to manage the switch over a serial connection to the console port or via Telnet. For more information on using the CLI, refer to Chapter 3: "Command Line Interface."

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

1. Configure the switch with a valid IP address, subnet mask, and default gateway using an out-of-band serial connection, BOOTP or DHCP protocol (see "Setting the IP Address" on page 2-8).

2. Set user names and passwords using an out-of-band serial connection. Access to the Web agent is controlled by the same user names and passwords as the onboard configuration program. (See "Configuring the Logon Password" on page 2-11.)

Note: If you log into the Web interface as guest (Normal Exec level), you can view page information but only change the guest password. If you log in as admin (Privileged Exec level), you can apply changes on all pages.

3. After you enter a user name and password, you will have access to the system configuration program.

Note: If the path between your management station and this switch does not pass through any device that uses the Spanning Tree Algorithm, then you can set the switch port attached to your management station to fast forwarding to improve the switch's response time to management commands issued through the Web interface. (See "Displaying Interface Settings" on page 2-38.)

Navigating the Web Browser Interface

To access the Web-browser interface you must first enter a user name and password. The administrator has Read/Write access to all configuration parameters and statistics. The default user name and password for the administrator is "admin."

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Home Page

When your Web browser connects with the switch's Web agent, the home page is displayed as shown below. The home page displays the Main Menu on the left side of the screen and System Information on the right side. The Main Menu links are used to navigate to other menus, and display configuration parameters and statistics.
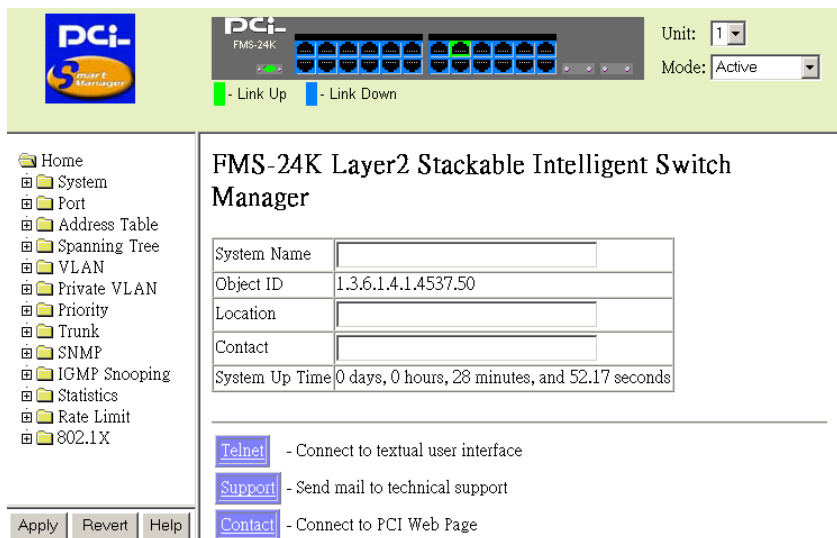
Figure 2-1. Home Page

If this is your first time to access the management agent, you should define a new Administrator user name and password, record them and put them in a safe place. Select Security from the Main Menu, and then enter a new user name and password for the Administrator. Note that user names and passwords can consist of up to 8 alphanumeric characters and are case sensitive.

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

Configuration Options

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

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Table 2-1. Configuration Options	
Button	**Action**
Apply	Sets specified values to the system.
Revert	Cancels specified values and restores current values prior to pressing Apply.
Help	Links directly to webhelp.

Panel Display

The Web agent displays an image of the switch's ports, indicating whether each link is up or down. Clicking on the image of a port opens the Port Configuration page as described on page 2-24.
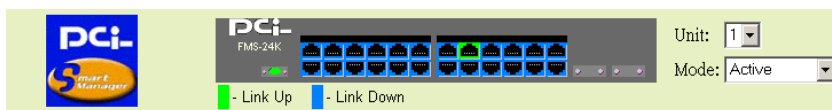
Figure 2-2. Front Panel Indicators

Main Menu

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

Table 2-2. Main Menu		
Menu	**Description**	**Page**
System		2-6
System Information	Provides basic system description, including contact information	2-6
IP	Sets the IP address for management access	2-8
Passwords	Assigns a new password for the logon user name	2-11
Authentication Settings	Configures RADIUS/TACACS+ authentication parameters	2-12
Firmware	Manages code image files	2-15
Configuration	Manages switch configuration files	2-16
Reset	Restarts the switch	2-18
Bridge Extension	Shows the configuration for bridge extension commands; enables GVRP multicast protocol	2-18

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Table 2-2. Main Menu		
Menu	Description	Page
Switch Information	Shows the number of ports, hardware/firmware version numbers, and power status	2-20
Port		2-22
Port Information	Displays port connection status	2-22
Trunk Information	Displays trunk connection status	2-22
Port Configuration	Configures port connection settings	2-24
Trunk Configuration	Configures trunk connection settings	2-24
Port Broadcast Control	Sets the broadcast storm threshold for each port	2-26
Mirror	Sets the source and target ports for mirroring	2-27
Address Table		2-28
Static Addresses	Displays entries for interface, address or VLAN	2-28
Dynamic Addresses	Displays or edits static entries in the Address Table	2-29
Address Aging	Sets timeout for dynamically learned entries	2-31
Spanning Tree		2-31
STA Information	Displays STA values used for the bridge	2-32
STA Configuration	Configures global bridge settings for STA	2-32
STA Port Information	Displays individual port settings for STA	2-38
STA Trunk Information	Displays individual trunk settings for STA	2-38
STA Port Configuration	Configures individual port settings for STA	2-41
STA Trunk Configuration	Configures individual trunk settings for STA	2-41
VLAN		2-44
VLAN Basic Information	Displays basic information on the VLAN type supported by this switch	2-47
VLAN Current Table	Shows the current port members of each VLAN and whether or not the port supports VLAN tagging	2-48
VLAN Static List	Used to create or remove VLAN groups	2-50
VLAN Static Table	Modifies the settings for an existing VLAN	2-51
VLAN Static Membership	Configures membership type for interfaces, including tagged, untagged or forbidden	2-52
VLAN Port Configuration	Specifies default PVID and VLAN attributes	2-53
VLAN Trunk Configuration	Specifies default trunk VID and VLAN attributes	2-53
Private VLAN		2-55
Private VLAN Information	Displays Private VLAN feature information	2-56
Private VLAN Configuration	This page is used to create/remove primary or community VLANs	2-57
Private VLAN Association	Each community VLAN must be associated with a primary VLAN	2-58

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Table 2-2. Main Menu		
Menu	Description	Page
Private VLAN Port/Trunk Information	Displays the interfaces associated with private VLANs	2-59
Private VLAN Port/Trunk Configuration	Sets the private VLAN interface type, and associates the interfaces with a private VLAN	2-60
Priority		2-61
Default Port Priority	Sets the default priority for each port	2-62
Default Trunk Priority	Sets the default priority for each trunk	2-62
Traffic Classes	Maps IEEE 802.1p priority tags to output queues	2-63
Queue Scheduling	Configures Weighted Round Robin queueing	2-65
IP Precedence/DSCP Priority Status	Globally selects IP Precedence or DSCP Priority , or disables both	2-66
IP Precedence Priority	Sets IP Type of Service priority, mapping the precedence tag to a class-of-service value	2-67
IP DSCP Priority	Sets IP Differentiated Services Code Point priority, mapping a DSCP tag to a class-of-service value	2-69
IP Port Priority Status	Globally enables or disables IP Port Priority	2-71
IP Port Priority	Sets TCP/UDP port priority, defining the socket number and associated class-of-service value	2-71
Trunk		2-73
LACP Configuration	Allows ports to dynamically join trunks	2-74
Trunk Configuration	Specifies ports to group into static trunks	2-75
SNMP	Configures community strings and related trap functions	2-77
IGMP Snooping		2-80
IGMP Configuration	Enables multicast filtering; configures parameters for multicast query	2-81
Multicast Router Port Information	Displays the ports that are attached to a neighboring multicast router/switch for each VLAN ID	2-83
Static Multicast Router Port Configuration	Assigns ports that are attached to a neighboring multicast router/switch	2-83
IP Multicast Registration Table	Displays all multicast groups active on this switch, including multicast IP addresses and VLAN ID	2-84
IGMP Member Port Table	Indicates multicast addresses associated with the selected VLAN	2-85
Statistics	Lists Ethernet and RMON port statistics	2-86
Rate Limit		2-91
Rate Limit Status	Enables or disables the rate limit feature	2-91
Rate Limit Port Configuration	Sets the rate limit for each port	2-91
dot1X (IEEE 802.1x)	Port Authentication	2-92

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Table 2-2. Main Menu		
Menu	Description	Page
dot1X Information	Displays general port authentication status information	2-93
dot1X Configuration	Enables the changing of general port authentication features	2-95
dot1X Port Configuration	Enables the changing of port authentication features	2-96
dot1X Statistics	Displays a per-port statistical readout	2-97

Basic Configuration

Displaying System Information

You can easily identify the system by providing a descriptive name, location and contact information.

Command Attributes

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

These additional parameters are displayed for the CLI.

- **MAC Address** – The physical layer address for this switch.
- **Web server** – Shows if management access via HTTP is enabled.
- **Web server port** – Shows the TCP port number used by the web interface.
- **POST result** – Shows results of the power-on self-test.

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Web – Click System, System Information. Specify the system name, location, and contact information for the system administrator, then click Apply. (This page also includes a Telnet button that allows you to access the Command Line Interface via Telnet.)

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System Name	
Object ID	1.3.6.1.4.1.4537.50
Location	
Contact	
System Up Time	0 days, 0 hours, 28 minutes, and 52.17 seconds

Telnet – Connect to textual user interface

Support – Send mail to technical support

Contact – Connect to PCI Web Page

Figure 2-3. Displaying System Information

CLI – Specify the hostname, location and contact information.

```
Console(config)#hostname FMS-24K                               3-20
Console(config)#snmp-server location TPS - 3rd Floor           3-37
Console(config)#snmp-server contact Geoff                      3-37
Console#show system                                            3-33
System description: FMS-24K Layer2 Stackable Intelligent Switch
System OID string: 1.3.6.1.4.1.202.20.24
System information
 System Up time: 0 days, 2 hours, 4 minutes, and 7.13 seconds
 System Name            : FMS-24K
 System Location        : TPS - 3rd Floor
 System Contact         : Geoff
 MAC address            : 00-30-f1-47-58-3a
 Web server             : enable
 Web server port        : 80
 POST result            :
UART Loopback Test......................PASS
Timer Test..............................PASS
DRAM Test ..............................PASS
I2C Initialization......................PASS
Runtime Image Check ....................PASS
PCI Device Check .......................PASS
Switch Driver Initialization............PASS
Switch Internal Loopback Test...........PASS
------------------ DONE --------------------
Console#
```

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Setting the IP Address

An IP address may be used for management access to the switch over your network. By default, the switch uses DHCP to assign IP settings to VLAN 1 on the switch. If you wish to manually configure IP settings, you need to change the switch's user-specified defaults (IP address 0.0.0.0 and netmask 255.0.0.0) to values that are compatible with your network. You may also need to establish a default gateway between the switch and management stations that exist on another network segment.

You can manually configure a specific IP address, or direct the device to obtain an address from a BOOTP or DHCP server when it is powered on. Valid IP addresses consist of four decimal numbers, 0 to 255, separated by periods. Anything outside this format will not be accepted by the CLI program.

Command Attributes

- **Management VLAN** – This is the only VLAN through which you can gain management access to the switch. By default, all ports on the switch are members of VLAN 1, so a management station can be connected to any port on the switch. However, if other VLANs are configured and you change the Management VLAN, you may lose management access to the switch. In this case, you should reconnect the management station to a port that is a member of the Management VLAN.
- **IP Address Mode** – Specifies whether IP functionality is enabled via manual configuration (Static), Dynamic Host Configuration Protocol (DHCP), or Boot Protocol (BOOTP). If DHCP/BOOTP is enabled, IP will not function until a reply has been received from the server. Requests will be broadcast periodically by the switch for an IP address. (DHCP/BOOTP values can include the IP address, subnet mask, and default gateway.)
- **IP Address** – Address of the VLAN interface that is allowed management access. Valid IP addresses consist of four numbers, 0 to 255, separated by periods.
- **Subnet Mask** – This mask identifies the host address bits used for routing to specific subnets.
- **Gateway IP Address** – IP address of the gateway router between this device and management stations that exist on other network segments.
- **MAC Address** – The MAC address of this switch.

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Manual Configuration

Web – Click System, IP. Specify the management interface, IP address and default gateway, then click Apply.

IP Configuration

Management VLAN	1 ▾
IP Address Mode	Static ▾
IP Address	10.1.0.90
Subnet Mask	255.255.255.0
Gateway IP Address	0.0.0.0
MAC Address	00-30-F1-6E-0D-E0

Restart DHCP

Figure 2-4. IP Configuration

CLI – Specify the management interface, IP address and default gateway.

```
Console#config
Console(config)#interface vlan 1
Console(config-if)#ip address 10.2.13.30 255.255.255.0          3-43
Console(config-if)#exit
Console(config)#ip default-gateway 192.168.1.254               3-44
Console(config)#
```

Using DHCP/BOOTP

If your network provides DHCP/BOOTP services, you can configure the switch to be dynamically configured by these services.

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Web – Click System, IP. Specify the Management VLAN, set the IP Address Mode to DHCP or BOOTP. Then click Apply to save your changes. The switch will broadcast a request for IP configuration settings on the next power reset. Otherwise, you can click Restart DHCP to immediately request a new address.

Note: If you lose your management connection, use a console connection and enter "show ip interface" to determine the new switch address.

CLI – Specify the management interface, and set the IP Address Mode to DHCP or BOOTP.

```
Console#config
Console(config)#interface vlan 1                              3-85
Console(config-if)#ip address dhcp                            3-43
Console(config-if)#end
Console#ip dhcp restart                                       3-41
Console#show ip interface                                     3-44
IP address and netmask: 10.1.0.54 255.255.255.0 on VLAN 1,
 and address mode: User specified.
Console#
```

Renewing DCHP – DHCP may lease addresses to clients indefinitely or for a specific period of time. If the address expires or the switch is moved to another network segment, you will lose management access to the switch. In this case, you can reboot the switch or submit a client request to restart DHCP service.

Web – If the address assigned by DHCP is no longer functioning, you will not be able to renew the IP settings via the Web interface. You can only restart DHCP service via the Web interface if the current address is still available.

CLI – Enter the following command to restart DHCP service.

```
Console#ip dhcp restart                                       3-41
Console#
```

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Security

Use the Passwords or RADIUS/TACACS+ menu to restrict management access based on specified user names and passwords. You can manually configure access rights on the switch (Passwords menu), or you can use a remote access authentication server based on the RADIUS/TACACS+ protocol. After you set up user names and passwords on the RADIUS/TACACS+ server, you can use IEEE 802.1x port authentication to control access to specific ports (dot1X menu).

Configuring the Logon Password

The guest only has read access for most configuration parameters. However, the administrator has write access for all parameters governing the onboard agent. You should therefore assign a new administrator password as soon as possible, and store it in a safe place. (If for some reason your password is lost, you can delete all the user-defined configuration files to restore the factory defaults and the default password as described in "Upgrading Firmware via the Serial Port" on page A-1.)

The default guest name is "guest" with the password "guest." The default administrator name is "admin" with the password "admin." Note that user names can only be assigned via the CLI.

Command Attributes

• **User Name*** – The name of the user.

(Maximum length: 8 characters; maximum number of users: 5)
• **Access Level*** – Specifies the user level.

(Options: Normal and Privileged)
• **Password** – Specifies the user password.

(Range: 0-8 characters plain text, case sensitive)

* CLI only.

Web – Click System, Passwords. Enter the old password, enter the new password, confirm it by entering it again, then click Apply.

Figure 2-5. Configuring a New Password

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CLI – Assign a user name to access-level 15 (i.e., administrator), then specify the password.

```
Console(config)#username bob access-level 15                    3-21
Console(config)#username bob password 0 smith
Console(config)#
```

Configuring RADIUS/TACACS Logon Authentication

You can configure this switch to authenticate users logging into the system for management access using local, RADIUS, or TACACS+ authentication methods.

RADIUS and TACACS+ are logon authentication protocols that use software running on a central server to control access to RADIUS-aware or TACACS+-aware devices on the network. An authentication server contains a database of multiple user name/ password pairs with associated privilege levels for each user that requires management access to a switch.

Like RADIUS, Terminal Access Controller Access Control System Plus (TACACS+) is a system that uses a central server to control authentication for access to switches on the network.

Command Usage

• By default, management access is always checked against the authentication database stored on the local switch. If a remote authentication server is used, you must specify the authentication sequence and the corresponding parameters for the remote authentication protocol.

• RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

• RADIUS and TACACS+ logon authentication control management access via the console port, Web browser, or Telnet. These access options must be configured on the authentication server.

• RADIUS and TACACS+ logon authentication assign a specific privilege level for each user name/password pair. The user name, password, and privilege level must be configured on the authentication server.

• You can specify up to three authentication methods for any user to indicate the authentication sequence. For example, if you select (1) RADIUS, (2) TACACS+ and (3) Local, the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted using the TACACS+ server, and finally the local user name and password is checked.

Command Attributes

• **Authentication** – Select the authentication, or authentication sequence required:
  - **RADIUS** – User authentication is performed using a RADIUS server only.

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- **TACACS** – User authentication is performed using a TACACS+ server only.
- **Local** – User authentication is performed only locally by the switch.
- **[authentication sequence]** – User authentication is performed by up to three authentication methods in the indicated sequence.

RADIUS Settings

- **Server IP Address** – Address of the RADIUS server.
  (Default: 10.1.0.1)
- **Server Port Number** – Network (UDP) port of the RADIUS server used for authentication messages.
  (Range: 1-65535; Default: 1812)
- **Secret Text String** – Encryption key used to authenticate logon access for client. Do not use blank spaces in the string.
  (Maximum length: 20 characters)
- **Number of Server Transmits** – Number of times the switch will try to authenticate logon access via the RADIUS server.
  (Range: 1-30; Default: 2)
- **Timeout for a reply (secs)** – The number of seconds the switch waits for a reply from the RADIUS server before it resends the request.
  (Range: 1-65535; Default: 5)

TACACS+ Settings

- **Server IP Address** – Address of the TACACS+ server.
  (Default: 10.1.0.1)
- **Server Port Number** – Network (TCP) port of TACACS+ server used for authentication messages.
  (Range: 1-65535; Default: 1812)
- **Secret Text String** – Encryption key used to authenticate logon access for client. Do not use blank spaces in the string.
  (Maximum length: 20 characters)

Note: The local switch user database has to be set up by manually entering user names and passwords using the CLI.

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Web – Click System, Authentication Settings. Specify the authentication sequence, server address, port number and other parameters, then click Apply.

Authentication Settings

Authentication	Local

RADIUS Settings:

Server IP Address	10.1.0.1
Server Port Number	1812
Secret Text String	
Number of Server Transmits	2
Timeout for a reply (sec)	5

TACACS Settings:

Server IP Address	10.11.12.13
Server Port Number	49
Secret Text String	

Figure 2-6. Authentication Settings

CLI – Specify all the required parameters to enable login authentication.

```
Console(config)#authentication login radius                      3-129
Console(config)#radius-server host 192.168.1.25                  3-131
Console(config)#radius-server port 181                           3-131
Console(config)#radius-server key green                          3-132
Console(config)#radius-server retransmit 5                       3-132
Console(config)#radius-server timeout 10                         3-133
Console#show radius-server                                       3-133
Server IP address: 192.168.1.25
 Communication key with radius server: green
 Server port number: 181
 Retransmit times: 5
 Request timeout: 10
Console(config)#
Console(config)#authentication login tacacs                      3-129
Console(config)#tacacs-server host 10.20.30.40                   3-134
Console(config)#tacacs-server port 200                           3-135
Console(config)#tacacs-server key green                          3-135
Console#show tacacs-server                                       3-136
Server IP address: 10.20.30.40
 Communication key with tacacs server: green
 Server port number: 200
Console(config)#
```

Managing Firmware

You can upload/download firmware to or from a TFTP server. By saving runtime code to a file on a TFTP server, that file can later be downloaded to the switch to restore operation. You can also set the switch to use new firmware without overwriting the previous version.

Command Attributes

- **TFTP Server IP Address** – The IP address of a TFTP server.
- **Destination File Name** – The file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 127 characters or 31 characters for files on the switch. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

Note: Up to two copies of the system software (i.e., the runtime firmware) can be stored in the file directory on the switch. The currently designated startup version of this file cannot be deleted.

Downloading System Software from a Server

When downloading runtime code, you can specify the Destination File Name to replace the current image, or first download the file using a different name from the current runtime code file, and then set the new file as the startup file.

Web – Click System, Firmware. Enter the IP address of the TFTP server, enter the file name of the software to download, select a file on the switch to overwrite or specify a new file name, then click Transfer from Server. To start the new firmware, reboot the system via the System/Reset menu.

Figure 2-7. Downloading Firmware to the Switch

If you download to a new destination file, then select the file from the drop-down box for the operation code used at startup, and click Apply Changes. To start the new firmware, reboot the system via the System/Reset menu.

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Figure 2-8. Setting the Start-Up file

CLI – Enter the IP address of the TFTP server, select "config" or "opcode" file type, then enter the source and destination file names, set the new file to start up the system, and then restart the switch.

```
Console#copy tftp file                                       3-15
TFTP server ip address: 10.1.0.99
Choose file type:
 1. config:  2. opcode: <1-2>: 2
Source file name: MCD0121.bix
Destination file name: mcd0121.bix
/
Console#config
Console(config)#boot system opcode: mcd0121.bix              3-19
Console(config)#exit
Console#reload                                               3-12
```

To start the new firmware, enter the "reload" command or reboot the system.

Saving or Restoring Configuration Settings

You can upload/download configuration settings to/from a TFTP server. The configuration file can be later downloaded to restore the switch's settings.

Command Attributes

• **TFTP Server IP Address** — The IP address of a TFTP server.
• **Destination File Name** —The configuration file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 127 characters or 31 characters for files on the switch. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

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

Downloading Configuration Settings from a Server

You can save the configuration file under a new file name and then set it as the startup file, or you can specify the current startup configuration file as the destination file to directly replace it. Note that the file "Factory_Default_Config.cfg" can be copied to the TFTP server, but cannot be used as a destination file name on the switch.

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Web – Click System, Configuration. Enter the IP address of the TFTP server, enter the name of the file to download, select a file on the switch to overwrite or specify a new file name, and then click Transfer from Server.

Figure 2-9. Downloading Configuration Settings

Setting the Startup Configuration File

If you download to a new file name, then select the new file from the drop-down box for Startup Configuration File, and press Apply Changes. To use the new settings, reboot the system via the System/Reset menu.

Figure 2-10. Setting the Start-Up File

CLI – Enter the IP address of the TFTP server, specify the source file on the server, set the startup file name on the switch, and then restart the switch.

```
Console#copy tftp startup-config                                  3-15
TFTP server ip address: 192.168.1.19
Source configuration file name: startup2.0
Startup configuration file name [startup] : startup2.0
/
Console#
Console#config
Console(config)#boot system config: startup2.0                    3-19
Console(config)#exit
Console#reload
```

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Copying the Running Configuration to a File

You can copy the running configuration to a file.

```
Copy Running Config to File                                          ▲

File Name [                    ]

[ Copy to File ]
                                                                     ▼
```

Figure 2-11. Copying the Running Config to File

CLI – If you copy the running configuration to a file, you can set this file as the startup file at a later time, and then restart the switch.

```
Console#copy running-config file                              3-15
destination file name : 051902.cfg
/
Console#
Console#config
Console(config)#boot system config: 051902.cfg               3-19
Console(config)#exit
Console#reload                                                3-12
```

Resetting the System

Web – Select System, Reset to reboot the switch. When prompted, confirm that you want reset the switch.

```
Reset the switch by selecting 'Reset'.

[ Reset ]
```

Figure 2-12. Resetting the System

CLI – Use the reload command to reboot the system.

```
Console#reload                                                3-12
System will be restarted, continue <y/n>? y
```

Displaying Bridge Extension Capabilities

The Bridge MIB includes extensions for managed devices that support Multicast Filtering, Traffic Classes, and Virtual LANs. You can access these extensions to display default settings for the key variables, or to configure the global setting for GARP VLAN Registration Protocol (GVRP).

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Command Attributes

- **Extended Multicast Filtering Services** – This switch does not support the filtering of individual multicast addresses based on GMRP (GARP Multicast Registration Protocol).
- **Traffic Classes** – This switch provides mapping of user priorities to multiple traffic classes. (Refer to "Class of Service Configuration" on page 2-61.)
- **Static Entry Individual Port** – This switch allows static filtering for unicast and multicast addresses. (Refer to "Setting Static Addresses" on page 2-28.)
- **VLAN Learning** – This switch uses Independent VLAN Learning (IVL), where each port maintains its own filtering database.
- **Configurable PVID Tagging** – This switch allows you to override the default Port VLAN ID (PVID used in frame tags) and egress status (VLAN-Tagged or Untagged) on each port. (Refer to "VLAN Configuration" on page 2-44.)
- **Local VLAN Capable** – This switch does not support multiple local bridges (i.e., multiple Spanning Trees).
- **GMRP** – GARP Multicast Registration Protocol (GMRP) allows network devices to register endstations with multicast groups. This switch does not support GMRP; it uses the Internet Group Management Protocol (IGMP) to provide automatic multicast filtering.
- **GVRP** – GARP VLAN Registration Protocol (GVRP) defines a way for switches to exchange VLAN information in order to register necessary VLAN members on ports across the network. This function should be enabled to permit VLAN groups which extend beyond the local switch.

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Web – Click System, Bridge Extension.

Bridge Extension Configuration

Bridge Capability

Extended Multicast Filtering Services	No
Traffic Classes	Enabled
Static Entry Individual Port	Yes
VLAN Learning	IVL
Configurable PVID Tagging	Yes
Local VLAN Capable	No

Traffic Classes	☑ Enable
GMRP	☐ Enable
GVRP	☐ Enable

Figure 2-13. Bridge Extension Configuration

CLI – Enter the following command.

```
Console#show bridge-ext                                   3-100
 Max support vlan numbers: 255
 Max support vlan ID: 4094
 Extended multicast filtering services: No
 Static entry individual port: Yes
 VLAN learning: IVL
 Configurable PVID tagging: Yes
 Local VLAN capable: No
 Traffic classes: Enabled
 Global GVRP status: Enabled
 GMRP: Disabled
Console#
```

Displaying Switch Hardware/Software Versions

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

Command Attributes

Main Board
• **Serial Number** – The serial number of the switch.
• **Number of Ports** – Number of built-in RJ-45 ports and expansion ports.
• **Hardware Version** – Hardware version of the main board.

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

* CLI only.

Management Software
- **Loader Version** – Version number of loader code.
- **Boot-ROM Version** – Version number of Power-On Self-Test (POST) and boot code.
- **Operation Code Version** – Version number of runtime code.
- **Role** – Shows if the switch is stacked or operating stand-alone.

Expansion Slot
- **Expansion Slot 1/2** – Slots for extender modules.

Web – Click System, Switch Information.

Switch Information

Main Board:

Serial Number	A249019367
Number of Ports	25
Hardware Version	R02
Internal Power Status	Active

Management Software:

Loader Version	1.0.0.2
Boot-ROM Version	1.1.0.2
Operation Code Version	2.0.1.3
Role	Master

Expansion Slot:

Expansion Slot 1	Stacking Module
Expansion Slot 2	not present

Figure 2-14. Switch Information

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CLI – Use the following command to display version information.

```
Console#show version                                                 3-35
Unit1
 Serial number          :A224029499
 Service tag            :
 Hardware version       :R0A
 Module A type          :not present
 Module B type          :not present
 Number of ports        :24
 Main power status      :up
 Redundant power status :not present
Agent(master)
 Unit id                :1
 Loader version         :0.0.6.5
 Boot rom version       :1.0.1.4
 Operation code version :0.1.2.1
Console#
```

Port Configuration

Displaying Connection Status

You can use the Port Information or Trunk Information pages to display the current connection status, including link state, speed/duplex mode, flow control, and auto-negotiation.

Command Attributes (Web)

- **Name** – Interface label.
- **Type** – Indicates the port type (10BASE-T, 100BASE-TX, 100BASE-FX, 1000BASE-SX, 1000BASE-LX, 1000BASE-GBIC or 1000Base-SFP).
- **Admin Status** – Shows if the interface is enabled or disabled.
- **Oper Status** – Indicates if the link is Up or Down.
- **Speed Duplex Status** – Shows the current speed and duplex mode. (Auto, or fixed choice)
- **Flow Control Status** – Indicates the type of flow control currently in use. (IEEE 802.3x, Back-Pressure or None)
- **Autonegotiation** – Shows if auto-negotiation is enabled or disabled.
- **Trunk Member** – Shows if port is a trunk member. (Port Information only.)
- **Creation** – Shows if a trunk is manually configured. (Trunk Information only.).

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Web – Click Port, Port Information or Trunk Information.

Port Information

Port	Name	Type	Admin Status	Oper Status	Speed Duplex Status	Flow Control Status	Autonegotiation	Trunk Member
1		100Base-TX	Enabled	Down	100full	None	Enabled	
2		100Base-TX	Enabled	Down	100full	None	Enabled	
3		100Base-TX	Enabled	Down	100full	None	Enabled	
4		100Base-TX	Enabled	Down	100full	None	Enabled	
5		100Base-TX	Enabled	Up	100full	None	Enabled	
6		100Base-TX	Enabled	Down	100full	None	Enabled	

Figure 2-15. Displaying Port Information

CLI – This example shows the connection status for Port 13.

```
Console#show interfaces status ethernet 1/13                    3-63
 Information of Eth 1/13
  Basic information:
   Port type: 100tx
   Mac address: 00-30-f1-47-58-46
  Configuration:
   Name:
   Port admin: Up
   Speed-duplex: Auto
   Capabilities: 10half, 10full, 100half, 100full,
   Broadcast storm: Enabled
   Broadcast storm limit: 500 packets/second
   Flow control: Disabled
   Lacp: Disabled
  Current status:
   Link status: Down
   Operation speed-duplex: 100full
   Flow control type: None
Console#
```

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Field Attributes (CLI)

Basic Information:

• **Port type** – Indicates the port type. (100BASE-TX, 1000BASE-T, or SFP)
• **MAC address** – The physical layer address for this port. (To access this item on the web, see "Setting the IP Address" on page 2-8.)

Configuration:

• **Name** – Interface label.
• **Port admin** – Shows if the interface is enabled or disabled (i.e., up or down).
• **Speed-duplex** – Shows the current speed and duplex mode. (Auto, or fixed choice)
• **Capabilities** – Specifies the capabilities to be advertised for a port during auto-negotiation. (To access this item on the web, see "Configuring Interface Connections" on page 3-48.) The following capabilities are supported.
    - **10half** - Supports 10 Mbps half-duplex operation
    - **10full** - Supports 10 Mbps full-duplex operation
    - **100half** - Supports 100 Mbps half-duplex operation
    - **100full** - Supports 100 Mbps full-duplex operation
    - **1000full** - Supports 1000 Mbps full-duplex operation
    - **Sym** - Transmits and receives pause frames for flow control
    - **FC** - Supports flow control
• **Broadcast storm** – Shows if broadcast storm control is enabled or disabled.
• **Broadcast storm limit** – Shows the broadcast storm threshold. (64-95232000 octets per second)
• **Flow control** – Shows if flow control is enabled or disabled.
• **LACP** – Shows if LACP is enabled or disabled.
• **Port Security** – Shows if port security is enabled or disabled.

Current Status:

• **Link Status** – Indicates if the link is up or down.
• **Port Operation Status** – Provides detailed information on port state. (Displayed only when the link is up.)
• **Operation speed-duplex** – Shows the current speed and duplex mode.
• **Flow control type** – Indicates the type of flow control currently in use. (IEEE 802.3x, Back-Pressure or none)

Configuring Interface Connections

You can use the Port Configuration or Trunk Configuration page to enable/disable an interface, set auto-negotiation and the interface capabilities to advertise, or manually fix the speed, duplex mode, and flow control.

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Command Attributes

- **Name** – Allows you to label an interface. (Range: 1-64 characters)
- **Admin** – Allows you to manually disable an interface. You can disable an interface due to abnormal behavior (e.g., excessive collisions), and then reenable it after the problem has been resolved. You may also disable an interface for security reasons.
- **Speed/Duplex** – Allows manual selection of port speed and duplex mode (i.e., with auto-negotiation disabled).
- **Flow Control** – Allows automatic or manual selection of flow control.
- **Autonegotiation** (Port Capabilities) – Allows auto-negotiation to be enabled/ disabled. When auto-negotiation is enabled, you need to specify the capabilities to be advertised. When auto-negotiation is disabled, you can force the settings for speed, mode, and flow control.The following capabilities are supported.
    - **10half** - Supports 10 Mbps half-duplex operation
    - **10full** - Supports 10 Mbps full-duplex operation
    - **100half** - Supports 100 Mbps half-duplex operation
    - **100full** - Supports 100 Mbps full-duplex operation
    - **1000full** - Supports 1000 Mbps full-duplex operation
    - **Sym** (Gigabit only) - When specified, the port transmits and receives pause frames; when not specified, the port will auto-negotiate to determine the sender and receiver for asymmetric pause frames. (The current switch chip only supports symmetric pause frames.)
    - **FC** - Supports flow control
    - Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3x for full-duplex operation. (Avoid using flow control on a port connected to a hub unless it is actually required to solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.)
- (Default: Autonegotiation enabled; Advertised capabilities for 100BASE-TX – 10half, 10full, 100half, 100full; 1000BASE-T – 10half, 10full, 100half, 100full, 1000full; 1000BASE-SX/LX/LH – 1000full)
- **Trunk** – Indicates if a port is a member of a trunk. To create trunks and select port members, see "Trunk Configuration" on page 2-73.

Note: Autonegotiation must be disabled before you can configure or force the interface to use the Speed/Duplex Mode or Flow Control options.

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Web – Click Port, Port Configuration or Trunk Configuration. Modify the required interface settings, and click Apply.

Port Configuration

Port	Name	Admin	Speed Duplex	Flow Control	Autonegotiation				Trunk
1		☑ Enable	100full ▾	Disabled ▾	Enabled ▾	☑ 10h ☑ 100h ☐ 1000h ☐ Sym	☑ 10f ☑ 100f ☐ 1000f ☐ FC		
2		☑ Enable	100full ▾	Disabled ▾	Enabled ▾	☑ 10h ☑ 100h ☐ 1000h ☐ Sym	☑ 10f ☑ 100f ☐ 1000f ☐ FC		
3		☑ Enable	100full ▾	Disabled ▾	Enabled ▾	☑ 10h ☑ 100h ☐ 1000h ☐ Sym	☑ 10f ☑ 100f ☐ 1000f ☐ FC		
4		☑ Enable	100full ▾	Disabled ▾	Enabled ▾	☑ 10h ☑ 100h ☐ 1000h ☐ Sym	☑ 10f ☑ 100f ☐ 1000f ☐ FC		
5		☑ Enable	100full ▾	Disabled ▾	Enabled ▾	☑ 10h ☑ 100h ☐ 1000h ☐ Sym	☑ 10f ☑ 100f ☐ 1000f ☐ FC		

Figure 2-16. Port Configuration

CLI – Select the interface, and then enter the required settings.

```
Console(config)#interface ethernet 1/13
Console(config-if)#description RD SW#13                    3-56
Console(config-if)#shutdown                                3-61
.
Console(config-if)#no shutdown
Console(config-if)#no negotiation                          3-58
Console(config-if)#speed-duplex 100half                    3-57
Console(config-if)#flowcontrol                             3-60
.
Console(config-if)#negotiation
Console(config-if)#capabilities 100half                    3-59
Console(config-if)#capabilities 100full
Console(config-if)#capabilities flowcontrol
```

Setting Broadcast Storm Thresholds

Broadcast storms may occur when a device on your network is malfunctioning, or if application programs are not well designed or properly configured. If there is too much broadcast traffic on your network, performance can be severely degraded or everything can come to complete halt.

You can protect your network from broadcast storms by setting a threshold for broadcast traffic for each port. Any broadcast packets exceeding the specified threshold will then be dropped.

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Command Usage

• Broadcast Storm Control is enabled by default.

• The default threshold is 500 packets per second.

• Broadcast control does not effect IP multicast traffic.

• The specified threshold applies to all ports on the switch.

Command Attributes

• **Threshold** – Threshold as percentage of port bandwidth.
  (Options: 500-262143 packets per second; Default: 500 packets per second)

• **Broadcast Control Status** – Shows whether or not broadcast storm control has been enabled on this interface. (Default: Enabled)

Web – Click Port, Port Broadcast Control. Set the threshold for all ports, click Apply.

Broadcast Control

Threshold (packets/sec) 500

Broadcast Control Status Enabled

Figure 2-17. Enabling Broadcast Control

CLI – Specify an interface, and then enter the threshold. This threshold will then be set for all ports. The following sets broadcast suppression at 1000 packets per second.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport broadcast packet-rate 100          3-62
Console(config-if)#
```

Configuring Port Mirroring

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

Command Usage

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

• All mirror sessions have to share the same destination port.

• When mirroring port traffic, the target port must be included in the same VLAN as the source port.

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Command Attributes

- **Mirror Sessions** – Displays a list of current mirror sessions.
- **Source Unit** – The unit whose traffic will be monitored.
- **Source Port** – The port whose traffic will be monitored.
- **Type** – Allows you to select which traffic to mirror to the target port, Rx (receive), Tx (transmit), or Both.
- **Target Port** – The port that will "duplicate" or "mirror" the traffic on the source port.

Web – Click Port, Mirror. Specify the source port, the traffic type to be mirrored, and the monitor port, then click Add.

Mirror Port Configuration

Mirror Sessions: New:

(none)   Source Unit 1 ▾

            <<Add   Source Port 1 ▾

            Remove   Type   Rx ▾

                        Target Unit 1 ▾

                        Target Port 1 ▾

Figure 2-18. Mirror Port Configuration

CLI – Use the interface command to select the monitor port, then use the port monitor command to specify the source port. Note that default mirroring under the CLI is for both received and transmitted packets.

```
Console(config)#interface ethernet 1/10
Console(config-if)#port monitor ethernet 1/13                    3-124
Console(config-if)#
```

Address Table Settings

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

Setting Static Addresses

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

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Command Attributes

- **Static Address Counts*** – The number of manually configured addresses.
- **Current Static Address Table** – Lists all the static addresses.
- **Interface** – Port or trunk associated with the device assigned a static address.
- **MAC Address** – Physical address of a device mapped to this interface.
- **VLAN** – ID of configured VLAN (1-4094).

* Web Only

Web – Click Address Table, Static Addresses. Specify the interface, the MAC address and VLAN, then click Add Static Address.

Static Addresses

Static Address Counts	0
Current Static Address Table	(none)
Interface	⊙ Port 1 ▼ ○ Trunk 1 ▼
MAC Address (XX-XX-XX-XX-XX-XX)	
VLAN	1 ▼

| Add Static Address | Remove Static Address |

Figure 2-19. Configuring a Static Address Table

CLI – This example adds an address to the static address table, but sets it to be deleted when the switch is reset.

```
Console(config)#mac-address-table static 00-e0-29-94-34-de ethernet 1/1
vlan 1 delete-on-reset                                            3-67
Console(config)#
```

Displaying the Address Table

The Dynamic Address Table contains the MAC addresses learned by monitoring the source address for traffic entering the switch. When the destination address for inbound traffic is found in the database, the packets intended for that address are forwarded directly to the associated port. Otherwise, the traffic is flooded to all ports.

Command Attributes

- **Interface** – Indicates a port or trunk.

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- • **MAC Address** – Physical address associated with this interface.
- • **VLAN** – ID of configured VLAN (1-4094).
- • **Address Table Sort Key** – You can sort the information displayed based on interface (port or trunk) or MAC address.
- • **Dynamic Address Counts** – The number of addresses dynamically learned.
- • **Current Dynamic Address Table** – Lists all the dynamic addresses.

Web – Click Address Table, Dynamic Addresses. Specify the search type (i.e., Interface, MAC Address, or VLAN), the method of sorting the displayed addresses, then click Query.

Make this into one screen,

For example, the following screen shows the dynamic addresses for port 7.

Figure 2-20. Configuring a Dynamic Address Table

CLI – This example also displays the address table entries for port 11.

```
Console#show mac-address-table ethernet 1/11                    3-68
 Interface Mac Address        Vlan Type
 --------- ----------------- ---- -----------------
  Eth 1/11 00-10-b5-62-03-74    1 Learned
Console#
```

Changing the Aging Time

You can change the aging time for entries in the dynamic address table.

Command Attributes

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

Web – Click Address Table, Address Aging. Specify the new aging time, then click Apply.

Address Aging

Aging Time (10-1000000): 300   seconds

Figure 2-21. Setting the Address Aging Time

CLI – This example sets the aging time to 300 seconds.

```
Console(config)#mac-address-table aging-time 300            3-69
Console(config)#
Console#
Console#show mac-address-table aging-time                   3-69
 Aging time: 300 sec.
Console#
```

Spanning Tree Algorithm Configuration

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

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

• STP – Spanning Tree Protocol (IEEE 802.1D)
• RSTP – Rapid Spanning Tree Protocol (IEEE 802.1w)

STA uses a distributed algorithm to select a bridging device (STA-compliant switch, bridge or router) that serves as the root of the spanning tree network. It selects a root port on each bridging device (except for the root device) which incurs the lowest path cost when forwarding a packet from that device to the root device.
Then it selects a designated bridging device from each LAN which incurs the lowest path cost when forwarding a packet from that LAN to the root device. All ports

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connected to designated bridging devices are assigned as designated ports. After determining the lowest cost spanning tree, it enables all root ports and designated ports, and disables all other ports. Network packets are therefore only forwarded between root ports and designated ports, eliminating any possible network loops.

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

RSTP is designed as a general replacement for the slower, legacy STP. RSTP achieves must faster reconfiguration (i.e., around one tenth of the time required by STP) by reducing the number of state changes before active ports start learning, predefining an alternate route that can be used when a node or port fails, and retaining the forwarding database for ports insensitive to changes in the tree structure when reconfiguration occurs.

Displaying Global Settings

Command Attributes

- **Spanning Tree State** – Shows if the switch is enabled to participate in an STA-compliant network.
- **Bridge ID** – A unique identifier for this bridge, consisting of the bridge priority and MAC address (where the address is taken from the switch system).
- **Max Age** – The maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconfigure. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network. (References to "ports" in this section mean "interfaces," which includes both ports and trunks.)
- **Hello Time** – Interval (in seconds) at which the root device transmits a configuration message.
- **Forward Delay** – The maximum time (in seconds) the root device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a discarding state; otherwise, temporary data loops might result.

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- **Designated Root** – The priority and MAC address of the device in the Spanning Tree that this switch has accepted as the root device.
  - **Root Port** – The number of the port on this switch that is closest to the root. This switch communicates with the root device through this port. If there is no root port, then this switch has been accepted as the root device of the Spanning Tree network.
  - **Root Path Cost** – The path cost from the root port on this switch to the root device.
  - **Root Hello Time*** – Interval (in seconds) at which this device transmits a configuration message.
  - **Root Maximum Age*** – The maximum time (in seconds) this device can wait without receiving a configuration message before attempting to reconfigure. All device ports (except for designated ports) should receive configuration messages at regular intervals. If the root port ages out STA information (provided in the last configuration message), a new root port is selected from among the device ports attached to the network. (References to "ports" in this section means "interfaces," which includes both ports and trunks.)
  - **Root Forward Delay*** – The maximum time (in seconds) this device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a discarding state; otherwise, temporary data loops might result.
  - **Root Hold Time*** – The interval (in seconds) during which no more than two bridge configuration protocol data units shall be transmitted by this node.
  - **Configuration Changes** – The number of times the Spanning Tree has been reconfigured.
  - **Last Topology Change** – Time since the Spanning Tree was last reconfigured.

  * CLI only.

Web – Click Spanning Tree, STA Information.

STA Information

Spanning Tree:

Spanning Tree State	Disabled	Designated Root	32768.00E0DEADBE00
Bridge ID	32768.00E0DEADBE00	Root Port	0
Max Age	20	Root Path Cost	0
Hello Time	2	Configuration Changes	0
Forward Delay	15	Last Topology Change	0 d 4 h 34 min 58 s

Figure 2-22. Displaying Spanning Tree Information

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CLI – This command displays global STA settings, followed by settings for each port.

```
Console#show spanning-tree                                    3-81
Bridge-group information
------------------------------------------------------------
Spanning tree protocol :IEEE Std 8021D
Spanning tree enable/disable :enable
Priority :32768
Hello Time (sec.) :2
Max Age (sec.) :20
Forward Delay (sec.) :15
Designated Root :32768.0030f147583a
Current root port :0
Current root cost :0
Number of topology changes :1
Last topology changes time (sec.):26696
Hold times (sec.) :1
------------------------------------------------------------
Eth 1/ 1 information
------------------------------------------------------------
Admin status : enable
STA state : broken
Path cost : 18
Priority : 128
Designated cost : 0
Designated port : 128.1
Designated root : 32768.0030f147583a
Designated bridge : 32768.0030f147583a
Fast forwarding : disable
Forward transitions : 0
...
```

Note: The current root port and current root cost display as zero when this device is not connected to the network.

Configuring Global Settings

Global settings apply to the entire switch.

Command Usage

• Spanning Tree Protocol

  Uses RSTP for the internal state machine, but sends only 802.1D BPDUs.

• Rapid Spanning Tree Protocol

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

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

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BPDU after the migration delay expires, RSTP restarts the migration delay timer and begins using RSTP BPDUs on that port.

Command Attributes

Basic Configuration of Global Settings

- **Spanning Tree State** – Enables/disables STA on this switch. (Default: Enabled)
- **Spanning Tree Type** – Specifies the type of spanning tree used on this switch:
  - **STP**: Spanning Tree Protocol (IEEE 802.1D; i.e., when this option is selected, the switch will use RSTP set to STP forced compatibility mode)
  - **RSTP**: Rapid Spanning Tree (IEEE 802.1w) RSTP is the default.
- **Priority** – Bridge priority is used in selecting the root device, root port, and designated port. The device with the highest priority becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.
  - Default: 32768
  - Range: 0-61440, in steps of 4096
  - Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440

Root Device Configuration

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

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• **Forward Delay** – The maximum time (in seconds) this device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a discarding state; otherwise, temporary data loops might result.

- Default: 15
- Minimum: The higher of 4 or [(Max. Message Age / 2) + 1]
- Maximum: 30

Advanced Configuration Settings for RSTP

• **Path Cost Method** – The path cost is used to determine the best path between devices. The path cost method is used to determine the range of values that can be assigned to each interface.

- Long: Specifies 32-bit based values that range from 1-200,000,000.
- Short: Specifies 16-bit based values that range from 1-65535.

• **Transmission Limit** – The maximum transmission rate for BPDUs is specified by setting the minimum interval between the transmission of consecutive protocol messages. (Range: 1-10; Default: 3)

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Web – Click Spanning Tree, STA Configuration. Modify the required attributes, click Apply.

STA Configuration

Switch:

Spanning Tree State	Disabled ▼
Spanning Tree Type	○ STP ● RSTP
Priority (0-61440)	32768

When the Switch Becomes Root:

Input Format: 2 * (hello time + 1) <= max age <= 2 * (forward delay - 1)

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

Advanced:

Path Cost Method	○ Short ● Long
Transmission Limit (1-10)	3

Figure 2-23. Configuring Spanning Tree

CLI – This example enables Spanning Tree Protocol, and then sets the indicated attributes.

```
Console(config)#spanning-tree                                    3-71
Console(config)#spanning-tree mode                               3-71
Console(config)#spanning-tree priority 40000                     3-74
Console(config)#spanning-tree hello-time 5                       3-73
Console(config)#spanning-tree max-age 38                         3-73
Console(config)#spanning-tree forward-time 20                    3-72
Console(config)#spanning-tree pathcost method long               3-75
Console(config)#spanning-tree transmission-limit 5               3-75
Console(config)#
```

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Displaying Interface Settings

The STP Port Information and STP Trunk Information pages display the current status of ports and trunks in the Spanning Tree.

Command Attributes

The following attributes are read-only and cannot be changed:

• **STA Status** – Displays current state of this port within the Spanning Tree:
  - **Discarding** - Port receives STA configuration messages, but does not forward packets.
  - **Learning** - Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses.
  - **Forwarding** - Port forwards packets, and continues learning addresses.

  The rules defining port status are:
  - A port on a network segment with no other STA compliant bridging device is always forwarding.
  - If two ports of a switch are connected to the same segment and there is no other STA device attached to this segment, the port with the smaller ID forwards packets and the other is discarding.
  - All ports are discarding when the switch is booted, then some of them change state to learning, and then to forwarding.

• **Forward Transitions** – The number of times this port has changed from the Learning state to the Forwarding state.

• **Designated Cost** – The cost for a packet to travel from this port to the root in the current Spanning Tree configuration. The slower the media, the higher the cost.

• **Designated Bridge** – The bridge priority and MAC address of the device through which this port must communicate to reach the root of the Spanning Tree.

• **Designated Port** – The port priority and number of the port on the designated bridging device through which this switch must communicate with the root of the Spanning Tree.

• **Oper Link Type** – The operational point-to-point status of the LAN segment attached to this interface. This parameter is determined by manual configuration or by auto-detection, as described for Admin Link Type in STA Port Configuration on page 2-41.

• **Oper Edge Port** – This parameter is initialized to the setting for Admin Edge Port in STA Port Configuration on page 2-41 (i.e., true or false), but will be set to false if a BPDU is received, indicating that another bridge is attached to this port.

• **Port Role** – Roles are assigned according to whether the port is part of the active topology connecting the bridge to the root bridge (i.e., **root** port), connecting a LAN through the bridge to the root bridge (i.e., **designated** port); or is an **alternate** or

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backup port that may provide connectivity if other bridges, bridge ports, or LANs fail or are removed. The role is set to disabled (i.e., **disabled** port) if a port has no role within the spanning tree.

- **Trunk Member** – Indicates if a port is a member of a trunk.
  (STA Port Information only)

These additional parameters are only displayed for the CLI:

- **Admin status** – Shows if STA has been enabled on this interface.
- **Path Cost** – This parameter is used by the STA to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. (Path cost takes precedence over port priority.)
- **Priority** – Defines the priority used for this port in the Spanning Tree Algorithm. If the path cost for all ports on a switch is the same, the port with the highest priority (i.e., lowest value) will be configured as an active link in the Spanning Tree. This makes a port with higher priority less likely to be blocked if the Spanning Tree Algorithm is detecting network loops. Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled.
- **Designated root** – The priority and MAC address of the device in the Spanning Tree that this switch has accepted as the root device.
- **Fast forwarding** – This field provides the same as Admin Edge port, and is only included for backward compatibility with earlier products.
- **Admin Link Type** – The link type attached to this interface.
  - Point-to-Point – A connection to exactly one other bridge.
  - Shared – A connection to two or more bridges.
  - Auto – The switch automatically determines if the interface is attached to a point-to-point link or to shared media.

Admin Edge Port – You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes **cannot** cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related timeout problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device.

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Web – Click Spanning Tree, STA Port Information or STA Trunk Information.

STA Port Information

Port	STA Status	Forward Transitions	Designated Cost	Designated Bridge	Designated Port	Oper Link Type	Oper Edge Port	Port Role	Trunk Member
1	Discarding	0	0	32768.00E0DEADBE00	128.1	Point-to-Point	Disabled	Disabled	
2	Discarding	0	0	32768.00E0DEADBE00	128.2	Point-to-Point	Disabled	Disabled	
3	Discarding	0	0	32768.00E0DEADBE00	128.3	Point-to-Point	Disabled	Disabled	
4	Discarding	0	0	32768.00E0DEADBE00	128.4	Point-to-Point	Disabled	Disabled	
5	Discarding	0	0	32768.00E0DEADBE00	128.5	Point-to-Point	Disabled	Disabled	

Figure 2-24. Displaying Spanning Tree Information

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CLI – This example shows general STA configuration and attributes for all ports.

```
Console#show spanning-tree ethernet 1/5                          3-81
Console#show spanning-tree
Spanning-tree information
--------------------------------------------------------------
 Spanning tree mode                :RSTP
 Spanning tree enable/disable      :enable
 Priority                          :32768
 Bridge Hello Time (sec.)          :2
 Bridge Max Age (sec.)             :20
 Bridge Forward Delay (sec.)       :15
 Root Hello Time (sec.)            :2
 Root Max Age (sec.)               :20
 Root Forward Delay (sec.)         :15
 Designated Root                   :32768.00A0CA445566
 Current root port                 :0
 Current root cost                 :0
 Number of topology changes        :2
 Last topology changes time (sec.):2209
 Transmission limit                :5
 Path Cost Method                  :long
--------------------------------------------------------------
Eth  1/ 1 information
--------------------------------------------------------------
 Admin status        : enable
 Role                : disable
 State               : discarding
 Path cost           : 100000
 Priority            : 128
 Designated cost     : 0
 Designated port     : 128.1
 Designated root     : 32768.00A0CA445566
 Designated bridge   : 32768.00A0CA445566
 Forward transitions : 0
 Fast forwarding     : disable
 Admin edge port     : disable
 Oper edge port      : disable
 Admin Link type     : auto
 Oper Link type      : point-to-point
---More---
```

Configuring Interface Settings

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

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Command Attributes

The following attributes are read-only and cannot be changed:

- **Port** – Ports only; i.e., no trunks or trunk port members.
- **STA State** – Displays current state of this port within the Spanning Tree:
  - **Discarding** - Port receives STA configuration messages, but does not forward packets.
  - **Learning** - Port has transmitted configuration messages for an interval set by the Forward Delay parameter without receiving contradictory information. Port address table is cleared, and the port begins learning addresses.
  - **Forwarding** - Port forwards packets, and continues learning addresses.
- **Trunk** – Indicates if a port is a member of a trunk.
  (STA Port Configuration only)

The following interface attributes can be configured:

- **Priority** – Defines the priority used for this port in the Spanning Tree Protocol. If the path cost for all ports on a switch are the same, the port with the highest priority (i.e., lowest value) will be configured as an active link in the Spanning Tree. This makes a port with higher priority less likely to be blocked if the Spanning Tree Protocol is detecting network loops. Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled.
  - Default: 128
  - Range: 0-240, in steps of 16

- **Path Cost** – This parameter is used by the STP to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. (Path cost takes precedence over port priority.) Note that when the Path Cost Method is set to short (page 3-75), the maximum path cost is 65,535.
  - Range –
    - Ethernet: 200,000-20,000,000
    - Fast Ethernet: 20,000-2,000,000
    - Gigabit Ethernet: 2,000-200,000
  - Default –
    - Ethernet – half duplex: 2,000,000; full duplex: 1,000,000; trunk: 500,000
    - Fast Ethernet – half duplex: 200,000; full duplex: 100,000; trunk: 50,000
    - Gigabit Ethernet – full duplex: 10,000; trunk: 5,000

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- **Admin Link Type** – The link type attached to this interface.
  - Point-to-Point – A connection to exactly one other bridge.
  - Shared – A connection to two or more bridges.
  - Auto – The switch automatically determines if the interface is attached to a point-to-point link or to shared media.
- **Admin Edge Port** (Fast Forwarding) – You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes **cannot** cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related timeout problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device. (Default: Disabled)
- **Migration** – If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the Protocol Migration button to manually re-check the appropriate BPDU format (RSTP or STP-compatible) to send on the selected interfaces. (Default: Disabled)

Web – Click Spanning Tree, STA Port Configuration or STA Trunk Configuration. Modify the required attributes, then click Apply.

STA Port Configuration

Port	STA State	Priority (0-240)	Path Cost (1-200000000)	Admin Link Type	Admin Edge Port (Fast Forwarding)	Migration	Trunk
1	Discarding	128	100000	Auto	☐ Enabled	☐ Enabled	
2	Discarding	128	100000	Auto	☐ Enabled	☐ Enabled	
3	Discarding	128	100000	Auto	☐ Enabled	☐ Enabled	
4	Discarding	128	100000	Auto	☐ Enabled	☐ Enabled	
5	Discarding	128	100000	Auto	☐ Enabled	☐ Enabled	
6	Discarding	128	100000	Auto	☐ Enabled	☐ Enabled	

Figure 2-25. Configuring Spanning Tree per Port

CLI – This example sets STA attributes for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-priority 0          3-77
Console(config-if)#spanning-tree cost 50                  3-76
Console(config-if)#spanning-tree portfast                 3-77
Console(config-if)#
```

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VLAN Configuration

Overview

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

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

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

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

This switch supports the following VLAN features:

- Up to 255 VLANs based on the IEEE 802.1Q standard
- Distributed VLAN learning across multiple switches using explicit or implicit tagging and GVRP protocol
- Port overlapping, allowing a port to participate in multiple VLANs
- End stations can belong to multiple VLANs
- Passing traffic between VLAN-aware and VLAN-unaware devices
- Priority tagging

Assigning Ports to VLANs

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

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Note: VLAN-tagged frames can pass through VLAN-aware or VLAN-unaware network
interconnection devices, but the VLAN tags should be stripped off before passing it
on to any end-node host that does not support VLAN tagging.
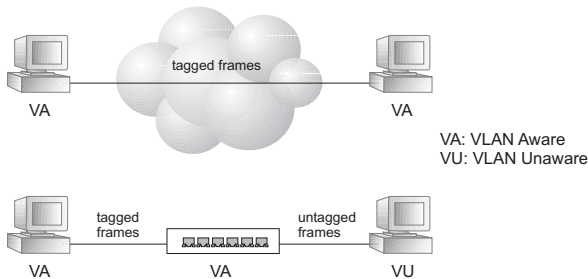
Figure 2-26. VLAN Frame Tagging

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

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

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

Automatic VLAN Registration – GVRP (GARP VLAN Registration Protocol)
defines a system whereby the switch can automatically learn the VLANs to which
each end station should be assigned. If an end station (or its network adapter)
supports the IEEE 802.1Q VLAN protocol, it can be configured to broadcast a
message to your network indicating the VLAN groups it wants to join. When this
switch receives these messages, it will automatically place the receiving port in the
specified VLANs, and then forward the message to all other ports. When the
message arrives at another switch that supports GVRP, it will also place the
receiving port in the specified VLANs, and pass the message on to all other ports.
VLAN requirements are propagated in this way throughout the network. This allows

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GVRP-compliant devices to be automatically configured for VLAN groups based solely on endstation requests.

To implement GVRP in a network, first add the host devices to the required VLANs (using the operating system or other application software), so that these VLANs can be propagated onto the network. For both the edge switches attached directly to these hosts, and core switches in the network, enable GVRP on the links between these devices. You should also determine security boundaries in the network and disable GVRP on ports to prevent advertisements being propagated, or forbid ports from joining restricted VLANs.

Note: If you have host devices that do not support GVRP, you should configure static or untagged VLANs for the switch ports connected to these devices (as described in "Adding Static Members to VLANs (VLAN Index)" on page 2-51). But you can still enable GVRP on these edge switches, as well as on the core switches in the network.
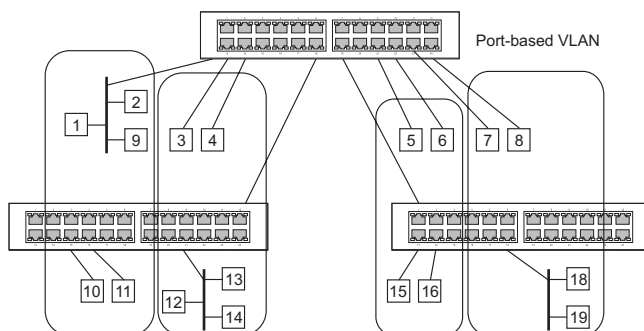
Figure 2-27. Enabling GVRP on Edge Switches

Forwarding Tagged/Untagged Frames

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

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

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VLAN-unaware device, it first decides where to forward the frame, and then inserts a VLAN tag reflecting the ingress port's default VID.

Enabling or Disabling GVRP (Global Setting)

GARP VLAN Registration Protocol (GVRP) defines a way for switches to exchange VLAN information in order to register VLAN members on ports across the network. VLANs are dynamically configured based on join messages issued by host devices and propagated throughout the network. GVRP must be enabled to permit automatic VLAN registration, and to support VLANs which extend beyond the local switch. (Default: Disabled)

Web – Click System, Bridge Extension. Enable or disable GVRP, click Apply.

Bridge Extension Configuration

Bridge Capability

Extended Multicast Filtering Services	No
Traffic Classes	Enabled
Static Entry Individual Port	Yes
VLAN Learning	IVL
Configurable PVID Tagging	Yes
Local VLAN Capable	No

Traffic Classes	☑ Enable
GMRP	☐ Enable
GVRP	☐ Enable

Figure 2-28. Globally Enabling GVRP

CLI – This example enables GVRP for the switch.

```
Console(config)#bridge-ext gvrp                               3-100
Console(config)#
```

Displaying Basic VLAN Information

The VLAN Basic Information page displays basic information on the VLAN type supported by the switch.

Command Attributes

• **VLAN Version Number*** – The VLAN version used by this switch as specified in the IEEE 802.1Q standard. (Web interface only.)

- **Maximum VLAN ID** – Maximum VLAN ID recognized by this switch.
- **Maximum Number of Supported VLANs** – Maximum number of VLANs that can be configured on this switch.

  * Web only.

Web – Click VLAN, VLAN Base Information.

VLAN Basic Information

VLAN Version Number	1
Maximum VLAN ID	4093
Maximum Number of Supported VLANs	255

Figure 2-29. Displaying Basic VLAN Information

CLI – Enter the following command.

```
Console#show bridge-ext                                    3-100
 Max support vlan numbers: 255
 Max support vlan ID: 4094
 Extended multicast filtering services: No
 Static entry individual port: Yes
 VLAN learning: IVL
 Configurable PVID tagging: Yes
 Local VLAN capable: No
 Traffic classes: Enabled
 Global GVRP status: Enabled
 GMRP: Disabled
Console#
```

Displaying Current VLANs

The VLAN Current Table shows the current port members of each VLAN and whether or not the port supports VLAN tagging. Ports assigned to a large VLAN group that crosses several switches should use VLAN tagging. However, if you just want to create a small port-based VLAN for one or two switches, you can disable tagging.

Command Attributes (Web)

- **VLAN ID** – ID of configured VLAN (1-4094).
- **Up Time at Creation** – Time this VLAN was created (i.e., System Up Time).
- **Status** – Shows how this VLAN was added to the switch.
  - **Dynamic GVRP**: Automatically learned via GVRP.
  - **Permanent**: Added as a static entry.
- **Egress Ports** – Shows all the VLAN port members.
- **Untagged Ports** – Shows the untagged VLAN port members.

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Web – Click VLAN, VLAN Current Table. Select any ID from the scroll-down list.

VLAN Current Table

VLAN ID: 1 ▾

Up Time at Creation	0 d 0 h 0 min 28 s
Status	Permanent

Egress Ports

Unit1 Port1
Unit1 Port2
Unit1 Port3
Unit1 Port4
Unit1 Port5
Unit1 Port6
Unit1 Port9
Unit1 Port10 ▾

Untagged Ports

Unit1 Port1
Unit1 Port2
Unit1 Port3
Unit1 Port4
Unit1 Port5
Unit1 Port6
Unit1 Port9
Unit1 Port10 ▾

Figure 2-30. Displaying Current VLANs

Command Attributes (CLI)

- **VLAN** – ID of configured VLAN (1-4094, no leading zeroes).
- **Type** – Shows how this VLAN was added to the switch.
  - **Dynamic**: Automatically learned via GVRP.
  - **Static**: Added as a static entry.
- **Name** – Name of the VLAN (1 to 32 characters).
- **Status** – Shows if this VLAN is enabled or disabled.
  - **Active**: VLAN is operational.
  - **Suspend**: VLAN is suspended; i.e., does not pass packets.
- **Ports / Channel groups** – Shows the VLAN interface members.

CLI – Current VLAN information can be displayed with the following command.

```
Console#show vlan id 1                                    3-91
VLAN Type    Name             Status    Ports/Channel groups
  1  Static  DefaultVlan     Suspended Eth1/ 1 Eth1/ 2 Eth1/ 3 Eth1/ 4
                                       Eth1/ 5 Eth1/ 6 Eth1/ 7 Eth1/ 8
                                       Eth1/ 9 Eth1/10 Eth1/11 Eth1/12
                                       Eth1/13 Eth1/14 Eth1/15 Eth1/16
                                       Eth1/17 Eth1/18 Eth1/19 Eth1/20
                                       Eth1/21 Eth1/22 Eth1/23 Eth1/24
 Console#
```

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Creating VLANs

Use the VLAN Static List to create or remove VLAN groups. To propagate information about VLAN groups used on this switch to external network devices, you must specify a VLAN ID for each of these groups.

Command Attributes

- **Current** – Lists all the current VLAN groups created for this system. Up to 255 VLAN groups can be defined. VLAN 1 is the default untagged VLAN.
- **New** – Allows you to specify the name and numeric identifier for a new VLAN group. (The VLAN name is only used for management on this system; it is not added to the VLAN tag.)
- **VLAN ID** – ID of configured VLAN (1-4094, no leading zeroes).
- **VLAN Name** – Name of the VLAN (1 to 32 characters).
- **Status** (Web) – Enables or disables the specified VLAN.
  - **Enable**: VLAN is operational.
  - **Disable**: VLAN is suspended; i.e., does not pass packets.
- **State** (CLI) – Enables or disables the specified VLAN.
  - **Active**: VLAN is operational.
  - **Suspend**: VLAN is suspended; i.e., does not pass packets.
- **Add** – Adds a new VLAN group to the current list.
- **Remove** – Removes a VLAN group from the current list. If any port is assigned to this group as untagged, it will be reassigned to VLAN group 1 as untagged.

Web – Click VLAN, VLAN Static List. To create a new VLAN, enter the VLAN ID and VLAN name, mark the Enable checkbox to activate the VLAN, and then click Add.

Figure 2-31. Configuring a VLAN Static List

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CLI – This example creates a new VLAN.

```
Console(config)#vlan database                                              3-83
Console(config)#vlan 2 name R&D media ethernet state active                3-84
Console(config)#end
Console#show vlan                                                          3-91
VLAN Type     Name              Status    Ports/Channel groups
---- ------- ---------------- --------- --------------------------------------
   1 Static     DefaultVlan    Active Eth1/ 1 Eth1/ 2 Eth1/ 3 Eth1/ 4 Eth1/ 5
                                      Eth1/ 6 Eth1/ 7 Eth1/ 8 Eth1/ 9 Eth1/10
                                      Eth1/11 Eth1/12 Eth1/13 Eth1/14 Eth1/15
                                      Eth1/16 Eth1/17 Eth1/18 Eth1/19 Eth1/20
                                      Eth1/21 Eth1/22 Eth1/23 Eth1/24 Eth1/25
                                      Eth1/26
   2 Static                R&D   Active
Console(config-vlan)
```

Adding Static Members to VLANs (VLAN Index)

Use the VLAN Static Table to configure port members for the selected VLAN index.
Assign ports as tagged if they are connected to 802.1Q VLAN compliant devices, or
untagged they are not connected to any VLAN-aware devices. Or configure a port
as forbidden to prevent the switch from automatically adding it to a VLAN via the
GVRP protocol.

Notes: 1. You can also use the VLAN Static Membership by Port page to configure
VLAN groups based on the port index (page 2-52). However, note that this
configuration page can only add ports to a VLAN as tagged members.

2. VLAN 1 is the default untagged VLAN containing all ports on the switch, and
can only be modified by first reassigning the default port VLAN ID as
described under "Configuring VLAN Behavior for Interfaces" on page 2-53.

Command Attributes

- **VLAN** – ID of configured VLAN (1-4094, no leading zeroes).
- **Name** – Name of the VLAN (1 to 32 characters).
- **Status** – Enables or disables the specified VLAN.
  - **Enable**: VLAN is operational.
  - **Disable**: VLAN is suspended; i.e., does not pass packets.
- **Port** – Port identifier.
- **Membership Type** – Select VLAN membership for each interface by marking the
  appropriate radio button for a port or trunk:
  - **Tagged**: Interface is a member of the VLAN. All packets transmitted by the port
    will be tagged, that is, carry a tag and therefore carry VLAN or CoS information.
  - **Untagged**: Interface is a member of the VLAN. All packets transmitted by the
    port will be untagged, that is, not carry a tag and therefore not carry VLAN or
    CoS information. Note that an interface must be assigned to at least one group
    as an untagged port.
  - **Forbidden**: Interface is forbidden from automatically joining the VLAN via

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GVRP. For more information, see "Automatic VLAN Registration" on page 2-45.

- - **None**: Interface is not a member of the VLAN. Packets associated with this VLAN will not be transmitted by the interface.
- • **Trunk Member** – Indicates if a port is a member of a trunk. To add a trunk to the selected VLAN, use the last table on the VLAN Static Table page.

Web – Click VLAN, VLAN Static Table. Select a VLAN ID from the scroll-down list. Modify the VLAN name and status if required. Select the membership type by marking the appropriate radio button in the list of ports or trunks. Click Apply.

VLAN Static Table

VLAN: 1

Name DefaultVlan

Status ☐ Enable

Port	Tagged	Untagged	Forbidden	None	Trunk Member
1	○	◉	○	○	
2	○	◉	○	○	
3	○	◉	○	○	
4	○	◉	○	○	
5	○	◉	○	○	
6	○	◉	○	○	

Figure 2-32. Configuring a VLAN Static Table

CLI – The following example adds tagged and untagged ports to VLAN 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 2 tagged          3-89
Console(config-if)#exit
Console(config)#interface ethernet 1/2
Console(config-if)#switchport allowed vlan add 2 untagged
Console(config-if)#exit
Console(config)#interface ethernet 1/13
Console(config-if)#switchport allowed vlan add 2 tagged
```

Adding Static Members to VLANs (Port Index)

Use the VLAN Static Membership by Port menu to assign VLAN groups to the selected interface as a tagged member.

Command Attributes

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

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- **Member** – VLANs for which the selected interface is a tagged member.
- **Non-Member** – VLANs for which the selected interface is not a tagged member.

Web – Open VLAN, VLAN Static Membership. Select an interface from the scroll-down box (Port or Trunk). Click Query to display membership information for the interface. Select a VLAN ID, and then click Add to add the interface as a tagged member, or click Remove to remove the interface. After configuring VLAN membership for each interface, click Apply.

VLAN Static Membership by Port

Interface ⦿ Port 1 ▾ ○ Trunk 1 ▾

Query

Member:
Vlan 1

<< Add
Remove >>

Non-Member:
(none)

Figure 2-33. VLAN Static Membership by Port

CLI – This example adds Port 3 to VLAN 1 as a tagged port, and removes Port 3 from VLAN 2.

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport allowed vlan add 1 tagged         3-89
Console(config-if)#switchport allowed vlan remove 2
```

Configuring VLAN Behavior for Interfaces

You can configure VLAN behavior for specific interfaces, including the default VLAN identifier (PVID), accepted frame types, ingress filtering, GVRP status, and GARP timers.

Command Usage

- **GVRP** – GARP VLAN Registration Protocol defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network.
- **GARP** – Group Address Registration Protocol is used by GVRP to register or deregister client attributes for client services within a bridged LAN. The default values for the GARP timers are independent of the media access method or data rate. These values should not be changed unless you are experiencing difficulties with GVRP registration/deregistration.

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Command Attributes

- **PVID** – VLAN ID assigned to untagged frames received on the interface. (Default: 1)
  - If an interface is not a member of VLAN 1 and you assign its PVID to this VLAN, the interface will automatically be added to VLAN 1 as an untagged member. For all other VLANs, an interface must first be configured as an untagged member before you can assign its PVID to that group.
- **Acceptable Frame Type** – Sets the interface to accept all frame types, including tagged or untagged frames, or only tagged frames. When set to receive all frame types, any received frames that are untagged are assigned to the default VLAN. (Option: All, Tagged; Default: All)
- **Ingress Filtering** – If ingress filtering is enabled, incoming frames for VLANs which do not include this ingress port in their member set will be discarded at the ingress port. (Default: Disabled)
  - Ingress filtering only affects tagged frames.
  - If ingress filtering is disabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be flooded to all other ports (except for those VLANs explicitly forbidden on this port).
  - If ingress filtering is enabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be discarded.
  - Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STP. However, it does affect VLAN dependent BPDU frames, such as GMRP.
- **GVRP Status** – Enables/disables GVRP for the interface. GVRP must be globally enabled for the switch before this setting can take effect. (See "Displaying Bridge Extension Capabilities" on page 2-18.) When disabled, any GVRP packets received on this port will be discarded and no GVRP registrations will be propagated from other ports. (Default: Disabled)
- **GARP Join Timer*** – The interval between transmitting requests/queries to participate in a VLAN group. (Range: 20-1000 centiseconds; Default: 20)
- **GARP Leave Timer*** – The interval a port waits before leaving a VLAN group. This time should be set to more than twice the join time. This ensures that after a Leave or LeaveAll message has been issued, the applicants can rejoin before the port actually leaves the group. (Range: 60-3000 centiseconds; Default: 60)
- **GARP LeaveAll Timer*** – The interval between sending out a LeaveAll query message for VLAN group participants and the port leaving the group. This interval should be considerably larger than the Leave Time to minimize the amount of traffic generated by nodes rejoining the group.
  (Range: 500-18000 centiseconds; Default: 1000)

*   Timer settings must follow this rule: 2 x (join timer) < leave timer < leaveAll timer

- **Trunk Member** – Indicates if a port is a member of a trunk. To add a trunk to the selected VLAN, use the last table on the VLAN Static Table page.

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• **Mode** – Indicates VLAN membership mode for an interface. (Default: 1Q Trunk)
  - **1Q Trunk** – Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that identify the source VLAN. However, note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are sent untagged.
  - **Hybrid** – Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames.

Web – Click VLAN, VLAN Port Configuration or VLAN Trunk Configuration. Fill in the required settings for each interface, click Apply.

Port	PVID	Acceptable Frame Type	Ingress Filtering	GVRP Status	GARP Join Timer (Centi Seconds) (20-1000)	GARP Leave Timer (Centi Seconds) (60-3000)	GARP LeaveAll Timer (Centi Seconds) (500-18000)	Mode	Trunk Member
1	1	ALL	☐ Enabled	☐ Enabled	20	60	1000	Hybrid	
2	1	ALL	☐ Enabled	☐ Enabled	20	60	1000	Hybrid	
3	1	ALL	☐ Enabled	☐ Enabled	20	60	1000	Hybrid	
4	1	ALL	☐ Enabled	☐ Enabled	20	60	1000	Hybrid	
5	1	ALL	☐ Enabled	☐ Enabled	20	60	1000	Hybrid	

Figure 2-34. Configuring VLANs per Port

CLI – This example sets port 1 to accept only tagged frames, assigns PVID 3 as the native VLAN ID, enables GVRP, sets the GARP timers, and then sets the switchport mode to hybrid.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport acceptable-frame-types tagged      3-87
Console(config-if)#switchport ingress-filtering                  3-87
Console(config-if)#switchport native vlan 3                      3-88
Console(config-if)#switchport gvrp                               3-97
Console(config-if)#garp timer join 10                            3-98
Console(config-if)#garp timer leave 90                           3-98
Console(config-if)#garp timer leaveall 2000                      3-98
Console(config-if)#switchport mode hybrid                        3-86
Console(config-if)#
```

Configuring Private VLANs

Private VLANs provide port-based security and isolation between ports within the assigned VLAN. This switch supports two types of private VLAN ports: promiscuous, and community ports. A promiscuous port can communicate with all interfaces within a private VLAN. Community ports can only communicate with other ports in their

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own community VLAN, and with their designated promiscuous ports. (Note that private VLANs and normal VLANs can exist simultaneously within the same switch.)

Uplink Ports
Primary VLAN
(promiscuous ports)

Downlink Ports
Secondary VLAN
(private ports)
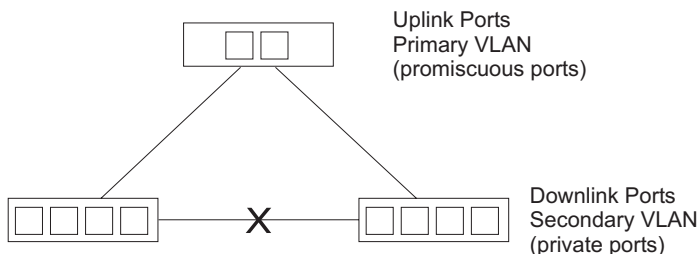
Figure 2-35. Promiscuous and Community VLAN Ports

Each private VLAN consists of two components: a primary VLAN and one or more community VLANs. A primary VLAN allows traffic to pass between promiscuous ports, and between promiscuous ports and community ports subordinate to the primary VLAN. A community VLAN conveys traffic between community ports, and from the community ports to their associated promiscuous ports. Multiple primary VLANs can be configured on this switch, and multiple community VLANs can be configured within each primary VLAN.

To configure private VLANs, follow these steps:

1. Use the Private VLAN Configuration menu (page 2-57) to designate one or more community VLANs and the primary VLAN that will channel traffic outside of the community groups.
2. Use the Private VLAN Association menu (page 2-58) to map the secondary (i.e., community) VLAN(s) to the primary VLAN.
3. Use the Private VLAN Port Configuration menu (page 2-60) to set the port type to promiscuous (i.e., having access to all ports in the primary VLAN) or host (i.e., having access restricted to community VLAN members, and channeling all other traffic through a promiscuous port). Then assign any promiscuous ports to a primary VLAN and any host ports a secondary VLAN (i.e., community VLAN).

Displaying Current Private VLANs

The Private VLAN Information page displays information on the private VLANs configured on the switch, including primary and community VLANs, and their associated interfaces.

Command Attributes
- **VLAN ID** – ID of configured VLAN (1-4093, no leading zeroes).
- **Primary VLAN** – The primary VLAN with which the selected VLAN is associated. (Note that this displays as VLAN 0 if the selected VLAN is itself a primary VLAN.)

• **Ports List** – The list of ports (and assigned type) in the selected private VLAN.

Web – Click Private VLAN, Private VLAN Information. Select the desired port from the VLAN ID drop-down menu.

Private VLAN Information

VLAN ID: (none) ▼

Primary Vlan Vlan

Ports List

(none)

Figure 2-36. Displaying Private VLAN Information

CLI – This example shows the switch configured with primary VLAN 5 and secondary VLAN 6. Port 3 has been configured as a promiscuous port and mapped to VLAN 5, while ports 4 and 5 have been configured as a host ports and are associated with VLAN 6. This means that traffic for port 4 and 5 can only pass through port 3.

```
Console#show vlan private-vlan                                      3-91
Primary    Secondary      Type       Interfaces
--------   -----------   ----------   -------------------------------------
    5                    primary      Eth1/ 3
    5          6         community    Eth1/ 4 Eth1/ 5
Console#
```

Configuring Private VLANs

The Private VLAN Configuration page is used to create/remove primary or community VLANs.

Command Attributes

• **VLAN ID** – ID of configured VLAN (1-4094, no leading zeroes).
• **Type** – There are two types of VLANs within a private VLAN:
  • **Primary VLANs** - Conveys traffic between promiscuous ports, and to community ports within secondary VLANs.
  • **Community VLANs** - Conveys traffic between community ports, and to their

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associated promiscuous ports.

- **Current** – Displays a list of the currently configured VLANs.

Web – Click Private VLAN, Private VLAN Configuration. Enter the VLAN ID number, select Primary or Community type, then click Add. To remove a private VLAN from the switch, highlight an entry in the Current list box and then click Remove. Note that all member ports must be removed from the VLAN before it can be deleted.

Private VLAN Configuration

Current:
(none)

<<Add   New:
Remove   VLAN ID (1-4093)
         Type   Primary ▼

Figure 2-37. Configuring Private VLANs

CLI – This example configures VLAN 5 as a primary VLAN, and VLAN 6 and 7 as community VLANs.

```
Console(config)#vlan database                                3-83
Console(config-vlan)#private-vlan 5 primary                  3-93
Console(config-vlan)#private-vlan 6 community
Console(config-vlan)#private-vlan 7 community
Console(config-vlan)#
```

Associating Community VLANs

Each community VLAN must be associated with a primary VLAN.

Command Attributes

- **Primary VLAN ID** – ID of primary VLAN (1-4094, no leading zeroes).
- **Association** – Community VLANs associated with the selected primary VLAN.
- **Non-Association** – Community VLANs not associated with the selected primary VLAN.

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Web – Click Private VLAN, Private VLAN Association. Select the required primary VLAN from the scroll-down box, highlight one or more community VLANs in the Non-Association list box, and click Add to associate these entries with the selected primary VLAN. (A community VLAN can only be associated with one primary VLAN.)

Private VLAN Association

Primary VLAN ID: (none)

Association: Non-Association:

(none)   <<Add   (none)
          Remove

Figure 2-38. Private VLAN Association

CLI – This example associates community VLANs 6 and 7 with primary VLAN 5.

```
Console(config)#vlan database                                      3-83
Console(config-vlan)#private-vlan 5 association 6                  3-94
Console(config-vlan)#private-vlan 5 association 7
Console(config)#
```

Displaying Private VLAN Interface Information

Use the Private VLAN Port Information and Private VLAN Trunk Information menus to display the interfaces associated with private VLANs.

Command Attributes

- **Port/Trunk** – The switch interface.
- **PVLAN Port Type** – Displays private VLAN port types.
  - **Normal** – The port is not configured in a private VLAN.
  - **Host** – The port is a community port and can only communicate with other ports in its own community VLAN, and with the designated promiscuous port(s).
  - **Promiscuous** – A promiscuous port can communicate with all the interfaces within a private VLAN.
- **Primary VLAN** – Conveys traffic between promiscuous ports, and between promiscuous ports and community ports within the associated secondary VLANs.
- **Secondary VLAN** – On this switch all secondary VLANs are community VLANs. A community VLAN conveys traffic between community ports, and from community ports to their designated promiscuous ports.
- **Trunk** – The trunk identifier. (Private VLAN Port Information only)

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Web – Click Private VLAN, Private VLAN Port Information or Private VLAN Trunk Information.

Figure 2-39. Displaying Private VLANs

CLI – This example shows the switch configured with primary VLAN 5 and secondary VLAN 6. Port 3 has been configured as a promiscuous port and mapped to VLAN 5, while ports 4 and 5 have been configured as a host ports and associated with VLAN 6. This means that traffic for port 4 and 5 can only pass through port 3.

```
Console#show vlan private-vlan                                     3-96
Primary    Secondary      Type        Interfaces
--------   -----------   ----------   ------------------------------------
    5                    primary      Eth1/ 3
    5            6       community    Eth1/ 4 Eth1/ 5
Console#
```

Configuring Private VLAN Interfaces

Use the Private VLAN Port Configuration and Private VLAN Trunk Configuration menus to set the private VLAN interface type, and associate the interfaces with a private VLAN.

Command Attributes

• **Port/Trunk** – The switch interface.
• **PVLAN Port Type** – Sets the private VLAN port types.
    • **Normal** – The port is not configured into a private VLAN.
    • **Host** – The port is a community port and can only communicate with other ports in its own community VLAN, and with the designated promiscuous port(s).
    • **Promiscuous** – A promiscuous port can communicate with all interfaces within a private VLAN.
• **Primary VLAN** – Conveys traffic between promiscuous ports, and between promiscuous ports and community ports within the associated secondary VLANs. If PVLAN type is "Promiscuous," then specify the associated primary VLAN. For "Host" type, the Primary VLAN displayed is the one to which the selected secondary VLAN has been associated.

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• **Secondary VLAN** – On this switch, all secondary VLANs are community VLANs. A community VLAN conveys traffic between community ports, and from community ports to their designated promiscuous ports. If PVLAN Port Type is "Host," then specify the associated secondary VLAN.

Web – Click Private VLAN, Private VLAN Port Configuration or Private VLAN Trunk Configuration. Set the PVLAN Port Type for each port that will join a private VLAN. For promiscuous ports, set the associated primary VLAN. For host ports, set the associated secondary VLAN. After all the ports have been configured, click Apply.

Private VLAN Port Configuration

Port	PVLAN Port Type	Primary VLAN	Secondary VLAN	Trunk
1	Normal	(none)	(none)	
2	Normal	(none)	(none)	
3	Normal	(none)	(none)	
4	Normal	(none)	(none)	
5	Normal	(none)	(none)	
6	Normal	(none)	(none)	

Figure 2-40. Configuring Private VLAN Interfaces

CLI – This example shows the switch configured with primary VLAN 5 and secondary VLAN 6. Port 3 has been configured as a promiscuous port and mapped to VLAN 5, while ports 4 and 5 have been configured as a host ports and associated with VLAN 6. This means that traffic for port 4 and 5 can only pass through port 3.

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport mode private-vlan promiscuous       3-94
Console(config-if)#switchport private-vlan mapping 5              3-96
Console(config-if)#exit
Console(config)#interface ethernet 1/4
Console(config-if)#switchport mode private-vlan host              3-94
Console(config-if)#switchport private-vlan host-association 6     3-95
Console(config-if)#exit
Console(config)#interface ethernet 1/5
Console(config-if)#switchport mode private-vlan host
Console(config-if)#switchport private-vlan host-association 6
Console(config-if)#
```

Class of Service Configuration

Class of Service (CoS) allows you to specify which data packets have greater precedence when traffic is buffered in the switch due to congestion. This switch supports CoS with four priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues.

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You can set the default priority for each interface, and configure the mapping of frame priority tags to the switch's priority queues.

Setting the Default Priority for Interfaces

You can specify the default port priority for each interface on the switch. All untagged packets entering the switch are tagged with the specified default port priority, and then sorted into the appropriate priority queue at the output port.

Command Usage

• This switch provides four priority queues for each port. It uses Weighted Round Robin to prevent head-of-queue blockage.

• The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.

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

Command Attributes

• **Default Priority*** – The priority that is assigned to untagged frames received on the specified interface. (Range: 0 - 7, Default: 0)

• **Number of Egress Traffic Classes** – The number of queue buffers provided for each port.

*   CLI displays this information as "Priority for untagged traffic."

Web – Click Priority, Default Port Priority or Default Trunk Priority. Modify the default priority for any interface, then click Apply.

Port Priority Configuration

Port	Default Priority (0-7)	Number of Egress Traffic Classes	Trunk
1	0	4	
2	0	4	
3	0	4	
4	0	4	
5	0	4	
6	0	4	

Figure 2-41. Port Priority Configuration

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CLI – This example assigns a default priority of 5 to port 3.

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport priority default 5            3-111
Console(config-if)#end
Console#show interfaces switchport ethernet 1/5            3-65
Information of Eth 1/5
 Broadcast threshold: Enabled, 500 packets/second
 Lacp status: Disabled
 VLAN membership mode: Hybrid
 Ingress rule: Disabled
 Acceptable frame type: All frames
 Native VLAN: 1
 Priority for untagged traffic: 5
 Gvrp status: Disabled
 Allowed Vlan:    1(u),
 Forbidden Vlan:
Console#
```

Mapping CoS Values to Egress Queues

This switch processes Class of Service (CoS) priority tagged traffic by using four priority queues for each port, with service schedules based on Weighted Round Robin (WRR). Up to eight separate traffic priorities are defined in IEEE 802.1p. The default priority levels are assigned according to recommendations in the IEEE 802.1p standard as shown in the following table.

Table 2-3.   Mapping CoS Values to Egress Queues

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

The priority levels recommended in the IEEE 802.1p standard for various network applications are shown in the following table. However, you can map the priority levels to the switch's output queues in any way that benefits application traffic for your own network.

Table 2-4.   Priority Level Descriptions

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

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Command Attributes

- **Priority** – CoS value. (Range: 0-7, where 7 is the highest priority)
- **Traffic Class*** – Output queue buffer. (Range: 0-3, where 3 is the highest CoS priority queue)

* CLI shows Queue ID.

Web – Click Priority, Traffic Classes. Mark an interface and click Select to display the current mapping of CoS values to output queues. Assign priorities to the traffic classes (i.e., output queues) for the selected interface, then click Apply.

Traffic Classes

Interface   ⊙ Port 1 ▾   ○ Trunk 1 ▾
Select

Priority	Traffic Class (0-3)
0	0
1	0
2	0
3	1
4	2
5	2
6	3
7	3

Figure 2-42. Traffic Classes

CLI – The following example shows how to map CoS values 1 and 2 to CoS priority queue 0, value 0 and 3 to CoS priority queue 1, values 4 and 5 to CoS priority queue 2, and values 6 and 7 to CoS priority queue 3.

```
Console(config)#interface ethernet 1/1
Console(config)#queue cos-map 0 1 2                              3-113
Console(config)#queue cos-map 1 0 3
Console(config)#queue cos-map 2 4 5
Console(config)#queue cos-map 3 6 7
Console(config)#exit
Console#show queue cos-map ethernet 1/1                          3-114
Information of Eth 1/1
 Queue ID Traffic class
 -------- -------------
    0      1 2
    1      0 3
    2      4 5
    3      6 7
Console#
```

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Setting the Service Weight for Traffic Classes

This switch uses the Weighted Round Robin (WRR) algorithm to determine the frequency at which it services each priority queue. As described in "Mapping CoS Values to Egress Queues" on page 2-63, the traffic classes are mapped to one of the four egress queues provided for each port. You can assign a weight to each of these queues (and thereby to the corresponding traffic priorities). This weight sets the frequency at which each queue will be polled for service, and subsequently affects the response time for software applications assigned a specific priority value.

Command Attributes

• **WRR Setting Table*** – Displays a list of weights for each traffic class (i.e., queue).
• **Weight Value** – Set a new weight for the selected traffic class. (Range: 1-255)

*   CLI shows Queue ID.

Web – Click Priority, Queue Scheduling. Select a traffic class (i.e., output queue), enter a weight, then click Apply.

Queue Scheduling

WRR Setting Table	Traffic Class 0 - weight 1 Traffic Class 1 - weight 4 Traffic Class 2 - weight 16 Traffic Class 3 - weight 64
Weight Value (1-255)	240

Figure 2-43. Configuring Interfaces for Queue Scheduling

CLI – The following example shows how to assign WRR weights of 1, 4, 16 and 64 to the CoS priority queues 0, 1, 2 and 3.

```
Console(config)#queue bandwidth 1 4 16 64                        3-112
Console(config)#exit
Console#show queue bandwidth                                     3-114
 Queue ID Weight
 -------- ------
        0      1
        1      4
        2     16
        3     64
Console#
```

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Mapping Layer 3/4 Priorities to CoS Values

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

Because different priority information may be contained in the traffic, this switch maps priority values to the output queues in the following manner:

• The precedence for priority mapping is IP Port Priority, IP Precedence or DSCP Priority, and then Default Port Priority.
• IP Precedence and DSCP Priority cannot both be enabled. Enabling one of these priority types will automatically disable the other.
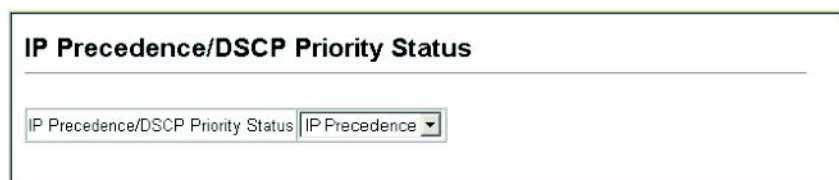
Selecting IP Precedence/DSCP Priority

The switch allows you to choose between using IP Precedence or DSCP priority. Select one of the methods or disable this feature.

Command Attributes

• **Disabled** – Disables both priority services. (This is the default setting.)
• **IP Precedence** – Maps layer 3/4 priorities using IP Precedence.
• **IP DSCP** – Maps layer 3/4 priorities using Differentiated Services Code Point Mapping.

Web – Click Priority, IP Precedence/DSCP Priority Status. Select Disabled, IP Precedence or IP DSCP from the scroll-down menu.

IP Precedence/DSCP Priority Status

IP Precedence/DSCP Priority Status [IP Precedence ▼]

Figure 2-44. IP Precedence/DSCP Priority Status

CLI – The following example enables IP Precedence service on the switch.

```
Console(config)#map ip precedence                              3-117
Console(config)#
```

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Mapping IP Precedence

The Type of Service (ToS) octet in the IPv4 header includes three precedence bits defining eight different priority levels ranging from highest priority for network control packets to lowest priority for routine traffic. The default IP Precedence values are mapped one-to-one to Class of Service values (i.e., Precedence value 0 maps to CoS value 0, and so forth). Bits 6 and 7 are used for network control, and the other bits for various application types. ToS bits are defined in the following table.

Table 2-5. Mapping IP Precedence	
Priority Level	Traffic Type
7	Network Control
6	Internetwork Control
5	Critical
4	Flash Override
3	Flash
2	Immediate
1	Priority
0	Routine

Command Attributes

- **IP Precedence Priority Table** – Shows the IP Precedence to CoS map.
- **Class of Service Value** – Maps a CoS value to the selected IP Precedence value. Note that "0" represents low priority and "7" represent high priority.

Note: IP Precedence settings apply to all interfaces.

Web – Click Priority, IP Precedence Priority. Select a port or trunk from the Interface field. Select an entry from the IP Precedence Priority Table, enter a value in the Class of Service Value field, and then click Apply.

IP Precedence Priority

Interface	⊙ Port 1 ▾ ○ Trunk 1 ▾

[Select]

IP Precedence Priority Table	IP Precedence 0 - CoS 0 IP Precedence 1 - CoS 1 IP Precedence 2 - CoS 2 IP Precedence 3 - CoS 3 IP Precedence 4 - CoS 4 IP Precedence 5 - CoS 5 IP Precedence 6 - CoS 6 IP Precedence 7 - CoS 7
Class of Service Value (0-7)	

[Restore Default]

Figure 2-45. Selecting IP Precedence Priority

*   Mapping specific values for IP Precedence is implemented as an interface configuration command, but any changes will apply to the all interfaces on the switch.

CLI – The following example globally enables IP Precedence service on the switch, maps IP Precedence value 1 to CoS value 0 on port 5, and then displays all the IP Precedence settings.

```
Console(config)#map ip precedence                            3-117
Console(config)#interface ethernet 1/5
Console(config-if)#map ip precedence 1 cos 0                 3-117
Console(config-if)#end
Console#show map ip precedence ethernet 1/5                  3-121
Precedence mapping status: disabled

 Port      Precedence COS
 --------- ---------- ---
  Eth 1/ 5          0   0
  Eth 1/ 5          1   0
  Eth 1/ 5          2   2
  Eth 1/ 5          3   3
  Eth 1/ 5          4   4
  Eth 1/ 5          5   5
  Eth 1/ 5          6   6
  Eth 1/ 5          7   7
Console#
```

*   Mapping specific values for IP Precedence is implemented as an interface configuration command, but any changes will apply to the all interfaces on the switch.

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Mapping DSCP Priority

The DSCP is six bits wide, allowing coding for up to 64 different forwarding behaviors. The DSCP replaces the ToS bits, and it retains backward compatibility with the three precedence bits so that non-DSCP compliant, ToS-enabled devices, will not conflict with the DSCP mapping. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding. The DSCP default values are defined in the following table. Note that all the DSCP values that are not specified are mapped to CoS value 0.

Table 2-6. Mapping DSCP Priority Values	
IP DSCP Value	CoS Value
0	0
8	1
10, 12, 14, 16	2
18, 20, 22, 24	3
26, 28, 30, 32, 34, 36	4
38, 40, 42	5
48	6
46, 56	7

Command Attributes

• **DSCP Priority Table –** Shows the DSCP Priority to CoS map.

• **Class of Service Value –** Maps a CoS value to the selected DSCP Priority value. Note that "0" represents low priority and "7" represent high priority.

Note: IP DSCP settings apply to all interfaces.

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Web – Click Priority, IP DSCP Priority. Select a port or trunk from the Interface field. Select an entry from the DSCP table, enter a value in the Class of Service Value field, then click Apply.

IP DSCP Priority

Interface	⊙ Port 1 ▾	○ Trunk 1 ▾

Select

DSCP Priority Table	DSCP 0 - CoS 0 ▲ DSCP 1 - CoS 0 DSCP 2 - CoS 0 DSCP 3 - CoS 0 DSCP 4 - CoS 0 DSCP 5 - CoS 0 DSCP 6 - CoS 0 ▾
Class of Service Value	___ (0-7)

Restore Default

Figure 2-46. Mapping IP DSCP Priority Values

*   Mapping specific values for IP Precedence is implemented as an interface configuration
command, but any changes will apply to the all interfaces on the switch.

CLI – The following example globally enables DSCP Priority service on the switch, maps DSCP value 1 to CoS value 0 on port 5, and then displays all the DSCP Priority settings.

```
Console(config)#map ip dscp                                        3-118
Console(config)#interface ethernet 1/5
Console(config-if)#map ip dscp 1 cos 0                             3-119
Console(config-if)#end
Console#show map ip dscp ethernet 1/5                              3-122
DSCP mapping status: disabled

 Port      DSCP COS
 --------- ---- ---
  Eth 1/ 5    0    0
  Eth 1/ 5    1    0
  Eth 1/ 5    2    0
  Eth 1/ 5    3    0
:
:
  Eth 1/ 5   61    0
  Eth 1/ 5   62    0
  Eth 1/ 5   63    0
Console#
```

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* Mapping specific values for IP Precedence is implemented as an interface configuration command, but any changes will apply to the all interfaces on the switch.

Mapping IP Port Priority

You can also map network applications to Class of Service values based on the IP port number (i.e., TCP/UDP port number) in the frame header. Some of the more common TCP service ports include: HTTP: 80, FTP: 21, Telnet: 23 and POP3: 110.

Command Attributes

• **IP Port Priority Status** – Enables or disables the IP port priority.
• **Interface** – Selects the port or trunk interface to which the settings apply.
• **IP Port Priority Table** – Shows the IP port to CoS map.
• **IP Port Number (TCP/UDP)** – Set a new IP port number.
• **Class of Service Value** – Sets a CoS value for a new IP port. Note that "0" represents low priority and "7" represent high priority.

Note: IP Port Priority settings apply to all interfaces.

Web – Click Priority, IP Port Status. Set IP Port Priority Status to Enabled.

IP Port Status

IP Port Priority Global Status Disabled ▼

Figure 2-47. Enabling IP Port Priority Status

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Web – Click Priority, IP Port Priority. Select a port or trunk from the Interface field. Enter the port number for a network application in the IP Port Number box and the new CoS value in the Class of Service box, and then click Add IP Port.

IP Port Priority

Interface	● Port 1 ▼ ○ Trunk 1 ▼
Select	

IP Port Priority Table	(none)
IP Port Number (TCP/UDP)	
Class of Service Value (0-7)	

Remove IP Port

Figure 2-48. Mapping IP Port Priority to Interfaces

* Mapping specific values for IP Precedence is implemented as an interface configuration command, but any changes will apply to the all interfaces on the switch.

CLI – The following example globally enables IP Port Priority service on the switch, maps HTTP traffic on port 5 to CoS value 0, and then displays all the IP Port Priority settings for that port.

```
Console(config)#map ip port                                     3-116
Console(config)#interface ethernet 1/5
Console(config-if)#map ip port 80 cos 0                         3-116
Console(config-if)#end
Console#show map ip port ethernet 1/5                           3-120
TCP port mapping status: disabled

 Port       Port no. COS
 --------- -------- ---
   Eth 1/ 5       80   0
Console#
```

* Mapping specific values for IP Port Priority is implemented as an interface configuration command, but any changes will apply to the all interfaces on the switch.

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Trunk Configuration

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

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

Command Usage

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

• Finish configuring port trunks before you connect the corresponding network cables between switches to avoid creating a loop.

• You can create up to six trunks on the switch, with up to four ports per trunk.

• The ports at both ends of a connection must be configured as trunk ports.

• When configuring static trunks on switches of different types, they must be compatible with the Cisco EtherChannel standard.

• When configuring static trunks, you may not be able to link switches of different types, depending on the manufacturer's implementation.

• The ports at both ends of a trunk must be configured in an identical manner, including communication mode (i.e., speed, duplex mode and flow control), VLAN assignments, and CoS settings.

• All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN.

• STP, VLAN, and IGMP settings can only be made for the entire trunk.

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Dynamically Configuring a Trunk

Command Usage

- To avoid creating a loop in the network, be sure you enable LACP before connecting the ports, and also disconnect the ports before disabling LACP.
- If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.
- A trunk formed with another switch using LACP will automatically be assigned the next available trunk ID.
- If more than four ports attached to the same target switch have LACP enabled, the additional ports will be placed in standby mode, and will only be enabled if one of the active links fails.
- All ports on both ends of an LACP trunk must be configured for full duplex, either by forced mode or auto-negotiation.

Web – Click Trunk, LACP Configuration. Select any of the switch ports from the scroll-down port list and click Add. After you have completed adding ports to the member list, click Apply.

Figure 2-49. LACP Configuration

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CLI – The following example enables LACP for ports 17 and 18. Just connect these ports to two LACP-enabled trunk ports on another switch to form a trunk.

```
Console(config)#interface ethernet 1/17
Console(config-if)#lacp                                              3-126
Console(config-if)#exit
Console(config)#interface ethernet 1/18
Console(config-if)#lacp
Console(config-if)#end
Console#show interfaces status port-channel 1                        3-63
Information of Trunk 1
 Basic information:
  Port type: 100tx
  Mac address: 22-22-22-22-22-2d
 Configuration:
  Name:
  Port admin status: Up
  Speed-duplex: Auto
  Capabilities: 10half, 10full, 100half, 100full,
  Flow control status: Disabled
 Current status:
  Created by: Lacp
  Link status: Up
  Port operation status: Up
  Operation speed-duplex: 100full
  Flow control type: None
  Member Ports: Eth1/17, Eth1/18,
Console#
```

Statically Configuring a Trunk

Command Usage

• When configuring static trunks, you may not be able to link switches of different types, depending on the manufacturer's implementation. However, note that the static trunks on this switch are Cisco EtherChannel compatible.

• To avoid creating a loop in the network, be sure you add a static trunk via the configuration interface before connecting the ports, and also disconnect the ports before removing a static trunk via the configuration interface.

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Web – Click Trunk, Trunk Configuration. Enter a trunk ID of 1-6 in the Trunk field, select any of the switch ports from the scroll-down port list, and click Add. After you have completed adding ports to the member list, click Apply.

Trunk Configuration

Member List:

Current:	New:
Trunk1, Unit1 Port7 Trunk1, Unit1 Port8	

<<Add
Remove

Trunk (1-6) [   ]
Port [1 ▼]

Figure 2-50. Configuring Port Trunks

CLI – This example creates trunk 1 with ports 11 and 12. Just connect these ports to two static trunk ports on another switch to form a trunk.

```
Console(config)#interface port-channel 1                        3-56
Console(config-if)#exit
Console(config)#interface ethernet 1/11
Console(config-if)#channel-group 1                              3-126
Console(config-if)#exit
Console(config)#interface ethernet 1/12
Console(config-if)#channel-group 1
Console(config-if)#end
Console#show interfaces status port-channel 1                   3-63
Information of Trunk 1
 Basic information:
  Port type: 100tx
  Mac address: 22-22-22-22-22-2c
 Configuration:
  Name:
  Port admin status: Up
  Speed-duplex: Auto
  Capabilities: 10half, 10full, 100half, 100full,
  Flow control status: Disabled
 Current status:
  Created by: User
  Link status: Up
  Port operation status: Up
  Operation speed-duplex: 100full
  Flow control type: None
  Member Ports: Eth1/11, Eth1/12,
Console#
```

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Simple Network Management Protocol

Simple Network Management Protocol (SNMP) is a communication protocol designed specifically for managing devices on a network. Equipment commonly managed with SNMP includes switches, routers and host computers. SNMP is typically used to configure these devices for proper operation in a network environment, as well as to monitor them to evaluate performance or detect potential problems.

The switch includes an onboard agent that continuously monitors the status of its hardware, as well as the traffic passing through its ports, based on the Simple Network Management Protocol (SNMP). A network management station can access this information using software such as HP OpenView. Access rights to the onboard agent are controlled by community strings. To communicate with the switch, the management station must first submit a valid community string for authentication. The options for configuring community strings and related trap functions are described in the following sections.
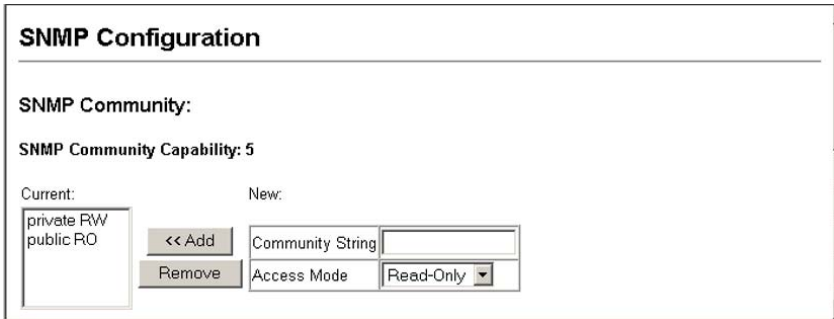
Setting Community Access Strings

You may configure up to five community strings authorized for management access. All community strings used for IP Trap Managers should be listed in this table. For security reasons, you should consider removing the default strings.

Command Attributes

- **SNMP Community Capability** – Indicates that the switch supports up to five community strings.
- **Community String** – A community string that acts like a password and permits access to the SNMP protocol.
  Default strings: "public" (read-only access), "private" (read/write access)
  Range: 1-32 characters, case sensitive

- **Access Mode**
  - **Read-Only** – Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.
  - **Read/Write** – Specifies read-write access. Authorized management stations are able to both retrieve and modify MIB objects.

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Web – Click SNMP, SNMP Configuration. Add new community strings as required, select the access rights from the Access Mode drop-down list, then click Add.

SNMP Configuration

SNMP Community:

SNMP Community Capability: 5

Current:		New:
private RW public RO	<< Add Remove	Community String [ ] Access Mode [Read-Only ▼]

Figure 2-51. Configuring SNMP

CLI – The following example adds the string "spiderman" with read/write access.

```
Console(config)#snmp-server community spiderman rw          3-36
Console(config)#
```

Specifying Trap Managers

Traps indicating status changes are issued by the switch to specified trap managers. You must specify trap managers so that key events are reported by this switch to your management station (using network management platforms such as HP OpenView). You can specify up to five management stations that will receive authentication failure messages and other trap messages from the switch.

Command Usage

• You can enable or disable authentication messages via the Web interface.

• You can enable or disable authentication messages, link-up-down messages, or all notification types via the CLI.

Command Attributes

• **Trap Manager Capability** – Indicates that the switch supports up to five trap managers.

• **Current** – Displays a list of the trap managers currently configured.

• **Trap Manager IP Address** – IP address of a new management station to receive trap messages.

• **Trap Manager Community String** – Specifies a valid community string for the new trap manager entry. Though you can set this string in the Trap Managers table, we recommend that you define this string in the SNMP Protocol table as well. (Range: 1-32 characters, case sensitive)

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- **Trap Version** – Indicates if the user is running version 1 or version 2c.
- **Enable Authentication Traps** – Issues a trap message to specified IP trap managers whenever authentication of an SNMP request fails. (The default is enabled.)
- **Enable Link-up and Link-down Traps** – Issues a trap message whenever a port link is established or broken.

Web – Click SNMP, SNMP Configuration. Fill in the Trap Manager IP Address box and the Trap Manager Community String box, mark Enable Authentication Traps if required, and then click Add.

Figure 2-52. Configuring IP Trap Managers

CLI – This example adds a trap manager and enables authentication traps.

```
Console(config)#snmp-server host 10.1.19.23 batman          3-38
Console(config)#snmp-server enable traps authentication      3-39
```

Multicast Filtering

Multicasting is used to support real-time applications such as video conferencing or streaming audio. A multicast server does not have to establish a separate connection with each client. It merely broadcasts its service to the network, and any hosts that want to receive the multicast register with their local multicast switch/router. Although this approach reduces the network overhead required by a multicast server, the broadcast traffic must be carefully pruned at every multicast switch/router it passes through to ensure that traffic is only passed on the hosts which subscribed to this service.

This switch uses IGMP (Internet Group Management Protocol) to query for any attached hosts that want to receive a specific multicast service. It identifies the ports containing hosts requesting to join the service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service. This procedure is called multicast filtering.

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

Layer 2 IGMP (Snooping and Query)

IGMP Snooping and Query – If multicast routing is not supported on other switches in your network, you can use IGMP Snooping and IGMP Query (page 2-81) to monitor IGMP service requests passing between multicast clients and servers, and dynamically configure the switch ports which need to forward multicast traffic.

Static IGMP Router Interface – If IGMP snooping cannot locate the IGMP querier, you can manually designate a known IGMP querier (i.e., a multicast router/switch) connected over the network to an interface on your switch (page 2-83). This interface will then join all the current multicast groups supported by the attached router/switch to ensure that multicast traffic is passed to all appropriate interfaces within the switch.

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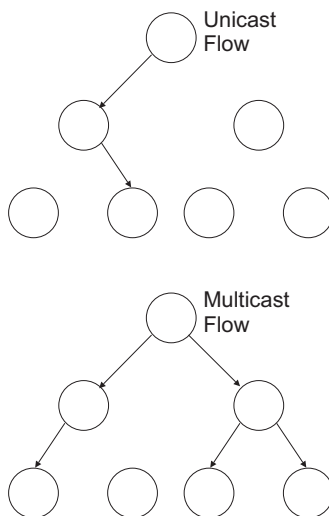
Static IGMP Host Interface – For multicast applications that you need to control more carefully, you can manually assign a multicast service to specific interfaces on the switch (page 2-85).

Configuring IGMP Snooping and Query Parameters

You can configure the switch to forward multicast traffic intelligently. Based on the IGMP query and report messages, the switch forwards traffic only to the ports that request multicast traffic. This prevents the switch from broadcasting the traffic to all ports and possibly disrupting network performance.

Command Usage

• **IGMP Snooping** – This switch can passively snoop on IGMP Query and Report packets transferred between IP multicast routers/switches and IP multicast host groups to identify the IP multicast group members. It simply monitors the IGMP packets passing through it, picks out the group registration information, and configures multicast filters accordingly.

• **IGMP Query** – A router, or multicast-enabled switch, can periodically ask their hosts if they want to receive multicast traffic. If there is more than one router/switch on the LAN performing IP multicasting, one of these devices is elected "querier" and assumes the role of querying the LAN for group members. It then propagates the service requests on to any adjacent multicast switch/router to ensure that it will continue to receive the multicast service.

Note: Multicast routers use this information, along with a multicast routing protocol such as DVMRP or PIM, to support IP multicasting across the Internet.

Command Attributes

• **IGMP Status** — When enabled, the switch will monitor network traffic to determine which hosts want to receive multicast traffic. This is also referred to as IGMP Snooping. (Default: Enabled)

• **Act as IGMP Querier** — When enabled, the switch can serve as the Querier, which is responsible for asking hosts if they want to receive multicast traffic. (Default: Enabled)

• **IGMP Query Count** — Sets the maximum number of queries issued for which there has been no response before the switch takes action to solicit reports. (Range: 2 - 10; Default: 2)

• **IGMP Query Interval** — Sets the frequency (in seconds) at which the switch sends IGMP host-query messages. (Range: 60 - 125; Default: 125)

• **IGMP Report Delay** — Sets the time (in seconds) between receiving an IGMP Report for an IP multicast address on a port before the switch sends an IGMP Query out of that port and removes the entry from its list. (Default: 10, Range: 5-30)

• **IGMP Query Timeout** — Sets the time (in seconds) the switch waits after the previous querier has stopped querying before it takes over as the querier. (Default: 300 seconds, Range: 300 - 500)

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• **IGMP Version** — Sets the protocol version for compatibility with other devices on the network. (Default: 2, Range: 1 - 2)

Notes: 1. All systems on the subnet must support the same version.

2. Some attributes are only enabled for IGMPv2, including IGMP Report Delay and IGMP Query Timeout.

Web – Click IGMP, IGMP Configuration. Adjust the IGMP settings as required, and then click Apply. (The default settings are shown below.)

IGMP Configuration

IGMP Status	☑ Enable
Act as IGMP Querier	☑ Enable
IGMP Query Count (2-10)	2
IGMP Query Interval (60-125)	125 seconds
IGMP Report Delay (5-30)	10 seconds
IGMP Query Timeout (300-500)	300 seconds
IGMP Version (1,2)	2

Figure 2-53. IGMP Configuration

CLI – This example modifies the settings for multicast filtering, and then displays the current status.

```
Console(config)#ip igmp snooping                                3-102
Console(config)#ip igmp snooping querier                        3-106
Console(config)#ip igmp snooping query-count 10                 3-106
Console(config)#ip igmp snooping query-interval 100             3-107
Console(config)#ip igmp snooping query-max-response-time 20     3-107
Console(config)#ip igmp snooping query-time-out 300             3-108
Console(config)#ip igmp snooping version 2                      3-103
Console(config)#exit
Console#show ip igmp snooping                                   3-104
 Igmp Snooping Configuration
 --------------------------------------------
 Service status          : Enabled
 Querier status          : Enabled
 Query count             : 10
 Query interval          : 100 sec
 Query max response time : 20 sec
 Query time-out          : 300 sec
 IGMP snooping version   : Version 2
Console#
```

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Displaying Interfaces Attached to a Multicast Router

Multicast routers that are attached to ports on the switch use information obtained from IGMP, along with a multicast routing protocol such as DVMRP, to support IP multicasting across the Internet. These routers may be dynamically discovered by the switch or statically assigned to an interface on the switch.

You can use the Multicast Router Port Information page to display the ports on this switch attached to a neighboring multicast router/switch for each VLAN ID.

Command Attributes

• **VLAN ID** – ID of configured VLAN (1-4094).
• **Multicast Router List** – Multicast routers dynamically discovered by this switch or those that are statically assigned to an interface on this switch.

Web – Click IGMP, Multicast Router Port Information. Select the required VLAN ID from the scroll-down list to display the associated multicast routers.

Figure 2-54. Displaying Multicast Router Port Information

CLI – This example shows that Port 11 has been statically configured as a port attached to a multicast router.

```
Console#show ip igmp snooping mrouter vlan 1                      3-110
 VLAN M'cast Router Port Type
 ---- ------------------ -------
    1          Eth 1/11 Static
Console#
```

Specifying Interfaces Attached to a Multicast Router

Depending on your network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router/ switch connected over the network to an interface (port or trunk) on your switch, you can manually configure that interface to join all the current multicast groups. This

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can ensure that multicast traffic is passed to all the appropriate interfaces within the switch.

Command Attributes

• **Interface** – Activates the Port or Trunk scroll down list.
• **VLAN ID** – Selects the VLAN to propagate all multicast traffic coming from the attached multicast router/switch.
• **Port** or **Trunk** – Specifies the interface attached to a multicast router.

Web – Click IGMP, Static Multicast Router Port Configuration. Specify the interfaces attached to a multicast router, indicate the VLAN which will forward all the corresponding multicast traffic, and then click Add. After you have completed adding interfaces to the list, click Apply.

Figure 2-55. Static Multicast Router Port Configuration

CLI – This example configures port 11 as a multicast router port within VLAN 1.

```
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11      3-109
Console(config)#exit
Console#show ip igmp snooping mrouter vlan 1                       3-110
 VLAN M'cast Router Port Type
 ---- ------------------ -------
    1          Eth 1/11  Static
Console#
```

Displaying Port Members of Multicast Services

You can display the port members associated with a specified VLAN and multicast IP address.

Command Attributes

• **VLAN ID** – Selects the VLAN for which to display port members.
• **Multicast IP Address** – The IP address for a specific multicast service

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- **Multicast Group Port List** – Shows the interfaces that have already been assigned to the selected VLAN to propagate a specific multicast service.

Web – Click IGMP, IP Multicast Registration Table. Select the VLAN ID and multicast IP address. The switch will display all the ports that are propagating this multicast service.

IP Multicast Registration Table

VLAN ID: 1 ▾
Multicast IP Address: (none) ▾

Multicast Group Port List:

(none)

Figure 2-56. IP Multicast Registration Table

CLI – This example displays all the known multicast services supported on VLAN 1, along with the ports propagating the corresponding services. The type field shows if this entry was learned dynamically or was statically configured.

```
Console#show mac-address-table multicast vlan 1              3-105
 VLAN M'cast IP addr. Member ports Type
 ---- --------------- ------------ -------
    1     224.0.0.12     Eth1/12    USER
    1     224.1.2.3      Eth1/12    IGMP
Console#
```

Adding Ports to Multicast Services

Multicast filtering can be dynamically configured using IGMP Snooping and IGMP Query messages as described in "Configuring IGMP Snooping and Query Parameters" on page 2-81. For certain applications that require tighter control, you may need to statically configure a multicast service on the switch. First add all the ports attached to participating hosts to a common VLAN, and then assign the multicast service to that VLAN group.

Command Usage

- Static multicast addresses are never aged out.
- When a multicast address is assigned to specific VLAN, the corresponding traffic can only be forwarded to ports within that VLAN.

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Command Attributes

• **Interface** – Activates the Port or Trunk scroll down list.
• **VLAN ID** – Selects the VLAN to propagate all multicast traffic coming from the attached multicast router/switch.
• **Multicast IP** – The IP address for a specific multicast service.
• **Port** or **Trunk** – Specifies the interface attached to a multicast router.

Web – Click IGMP, IGMP Member Port Table. Specify the interface attached to a multicast service (via an IGMP-enabled switch or multicast router), indicate the VLAN that will propagate the multicast service, specify the multicast IP address, and then click Add. After you have completed adding ports to the member list, click Apply.

Figure 2-57. IGMP Member Port Table

CLI – This example assigns a multicast address to VLAN 1, and then displays all the known multicast services supported on VLAN 1.

```
Console(config)#ip igmp snooping vlan 1 static 224.0.0.12
ethernet 1/12                                                   3-103
Console(config)#exit
Console#show mac-address-table multicast vlan 1                 3-105
 VLAN M'cast IP addr. Member ports Type
 ---- -------------- ------------ -------
    1      224.0.0.12      Eth1/12    USER
    1      224.1.2.3       Eth1/12    IGMP
Console#
```

Showing Port Statistics

You can display standard statistics on network traffic from the Interfaces Group and Ethernet-like MIBs, as well as a detailed breakdown of traffic based on the RMON MIB. Interfaces and Ethernet-like statistics display errors on the traffic passing through each port. This information can be used to identify potential problems with the switch (such as a faulty port or unusually heavy loading). RMON statistics provide access to a broad range of statistics, including a total count of different

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frame types and sizes passing through each port. All values displayed have been accumulated since the last system reboot, and are shown as counts per second. Statistics are refreshed every 60 seconds by default.

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

Statistical Values

Table 2-7. Port Statistics	
Parameter	Description
Interface Statistics	
Received Octets	The total number of octets received on the interface, including framing characters.
Received Unicast Packets	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
Received Multicast Packets	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer.
Received Broadcast Packets	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer.
Received Discarded Packets	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Received Unknown Packets	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
Received Errors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Transmit Octets	The total number of octets transmitted out of the interface, including framing characters.
Transmit Unicast Packets	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.
Transmit Multicast Packets	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a multicast address at this sub-layer, including those that were discarded or not sent.
Transmit Broadcast Packets	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent.
Transmit Discarded Packets	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Transmit Errors	The number of outbound packets that could not be transmitted because of errors.
Etherlike Statistics	

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Table 2-7. Port Statistics	
Parameter	Description
Alignment Errors	The number of alignment errors (missynchronized data packets).
Late Collisions	The number of times that a collision is detected later than 512 bit-times into the transmission of a packet.
FCS Errors	A count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check. This count does not include frames received with frame-too-long or frame-too-short error.
Excessive Collisions	A count of frames for which transmission on a particular interface fails due to excessive collisions. This counter does not increment when the interface is operating in full-duplex mode.
Single Collision Frames	The number of successfully transmitted frames for which transmission is inhibited by exactly one collision.
Internal MAC Transmit Errors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error.
Multiple Collision Frames	A count of successfully transmitted frames for which transmission is inhibited by more than one collision.
Carrier Sense Errors	The number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
SQE Test Errors	A count of times that the SQE TEST ERROR message is generated by the PLS sublayer for a particular interface.
Frames Too Long	A count of frames received on a particular interface that exceed the maximum permitted frame size.
Deferred Transmissions	A count of frames for which the first transmission attempt on a particular interface is delayed because the medium was busy.
Internal MAC Receive Errors	A count of frames for which reception on a particular interface fails due to an internal MAC sublayer receive error.
RMON Statistics	
Drop Events	The total number of events in which packets were dropped due to lack of resources.
Jabbers	The total number of frames received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS or alignment error.
Received Bytes	Total number of bytes of data received on the network. This statistic can be used as a reasonable indication of Ethernet utilization.
Collisions	The best estimate of the total number of collisions on this Ethernet segment.
Received Frames	The total number of frames (bad, broadcast and multicast) received.
Broadcast Frames	The total number of good frames received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Frames	The total number of good frames received that were directed to this multicast address.
CRC/Alignment Errors	The number of CRC/alignment errors (FCS or alignment errors).

Table 2-7. Port Statistics	
Parameter	Description
Undersize Frames	The total number of frames received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
Oversize Frames	The total number of frames received that were longer than 1518 octets (excluding framing bits, but including FCS octets) and were otherwise well formed.
Fragments	The total number of frames received that were less than 64 octets in length (excluding framing bits, but including FCS octets) and had either an FCS or alignment error.
64 Bytes Frames	The total number of frames (including bad packets) received and transmitted that were 64 octets in length (excluding framing bits but including FCS octets).
65-127 Byte Frames 128-255 Byte Frames 256-511 Byte Frames 512-1023 Byte Frames 1024-1518 Byte Frames 1519-1536 Byte Frames	The total number of frames (including bad packets) received and transmitted where the number of octets fall within the specified range (excluding framing bits but including FCS octets).

Web – Click Statistics, Port Statistics. Select the required interface, and then click Query. You can also use the Refresh button at the bottom of the page to update the screen.

Etherlike Statistics:

Alignment Errors	0	Late Collisions	0
FCS Errors	0	Excessive Collisions	0
Single Collision Frames	0	Internal MAC Transmit Errors	0
Multiple Collision Frames	0	Carrier Sense Errors	0
SQE Test Errors	0	Frames Too Long	0
Deferred Transmissions	0	Internal MAC Receive Errors	0

RMON Statistics:

Drop Events	0	Jabbers	0
Received Bytes	0	Collisions	0
Received Frames	0	64 Bytes Frames	0
Broadcast Frames	0	65-127 Bytes Frames	0
Multicast Frames	0	128-255 Bytes Frames	0
CRC/Alignment Errors	0	256-511 Bytes Frames	0
Undersize Frames	0	512-1023 Bytes Frames	0
Oversize Frames	0	1024-1518 Bytes Frames	0
Fragments	0		

Refresh

Figure 2-58. Port Statistics

CLI – This example shows statistics for port 13.

```
Console#show interfaces counters ethernet 1/13                    3-64
Ethernet 1/13
 Iftable stats:
  Octets input: 868453, Octets output: 3492122
  Unicast input: 7315, Unicast output: 6658
  Discard input: 0, Discard output: 0
  Error input: 0, Error output: 0
  Unknown protos input: 0, QLen output: 0
 Extended iftable stats:
  Multi-cast input: 0, Multi-cast output: 17027
  Broadcast input: 231, Broadcast output: 7
 Ether-like stats:
  Alignment errors: 0, FCS errors: 0
  Single Collision frames: 0, Multiple collision frames: 0
  SQE Test errors: 0, Deferred transmissions: 0
  Late collisions: 0, Excessive collisions: 0
  Internal mac transmit errors: 0, Internal mac receive errors: 0
  Frame too longs: 0, Carrier sense errors: 0
  Symbol errors: 0
 RMON stats:
  Drop events: 0, Octets: 4422579, Packets: 31552
  Broadcast pkts: 238, Multi-cast pkts: 17033
  Undersize pkts: 0, Oversize pkts: 0
  Fragments: 0, Jabbers: 0
  CRC align errors: 0, Collisions: 0
  Packet size <= 64 octets: 25568, Packet size 65 to 127 octets: 1616
Packet size 128 to 255 octets: 1249, Packet size 256 to 511 octets: 1449
Packet size 512 to 1023 octets: 802, Packet size 1024 to 1518 octets: 871
Console#
```

Rate Limit Configuration

This function allows the network manager to control the maximum rate for traffic transmitted or received on a port. Rate limiting is configured on ports at the edge of a network to limit traffic into or out of the network. Traffic that falls within the rate limit is transmitted, while packets that exceed the acceptable amount of traffic are dropped.

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

Command Usage

• Input and output rate limit can be enabled or disabled for individual interfaces.
• For Fast Ethernet interfaces, the rate limit range is 1-100 Mbps, in intervals of 1.
• For Gigabit Ethernet interfaces, the rate limit range is 1-1000 Mbps, in intervals of 8.

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Command Attributes

- **Port/Trunk**– Displays the port number.
- **Rate Limit Status** – Enables or disables the rate limit.(Default: Disabled)
- **Rate Limit (Mbps)** – Sets the rate limit in Mbps.

Web - Click Rate Limit, Input/Output Rate Limit Port/Trunk Configuration. Enable the Rate Limit Status for the required interfaces, set the Rate Limit to one of the options shown in the preceding table, and click Apply.

Input Rate Limit Port Configuration

Port	Iutput Rate Limit Status	Input Rate Limit(Mbps)	Trunk
1	Disabled	100	
2	Disabled	100	
3	Disabled	100	
4	Disabled	100	
5	Disabled	100	
6	Disabled	100	
7	Disabled	100	1
8	Disabled	100	1

Figure 2-59. Input Rate Limit Port Configuration

CLI - This example sets the rate limit for input and output traffic passing through port 3 and 4.

```
Console(config)#interface ethernet 1/3                          3-56
Console(config-if)#rate-limit input 3                          3-127
Console(config-if)#rate-limit output 3                         3-127
Console(config-if)#exit
Console(config)#interface ethernet 1/4
Console(config-if)#rate-limit input 6
Console(config-if)#rate-limit output 6
Console(config-if)#
```

Configuring 802.1x Port Authentication

Network switches can provide open and easy access to network resources by simply attaching a client PC. Although this automatic configuration and access is a desirable feature, it also allows unauthorized personnel to easily intrude and possibly gain access to sensitive network data.

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The IEEE 802.1x (dot1x) standard defines a port-based access control procedure that prevents unauthorized access to a network by requiring users to first submit credentials for authentication. Access to all switch ports in a network can be centrally controlled from a server, which means that authorized users can use the same credentials for authentication from any point within the network.

This switch uses the Extensible Authentication Protocol over LAN (EAPOL) with MD5 authentication to exchange authentication protocol messages with the client, and a remote RADIUS authentication server to verify user identity and access rights. When a client (i.e., Supplicant) connects to a switch port, the switch (i.e., Authenticator) responds with an EAPOL identity request.
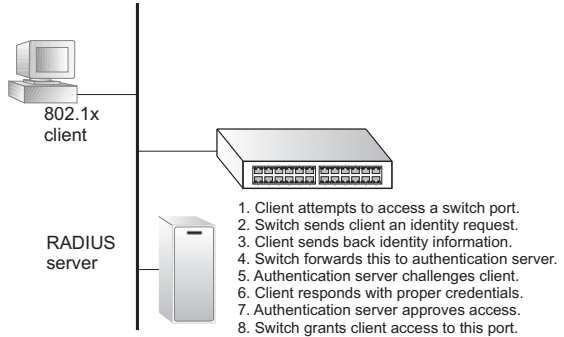
802.1x client

RADIUS server

1. Client attempts to access a switch port.
2. Switch sends client an identity request.
3. Client sends back identity information.
4. Switch forwards this to authentication server.
5. Authentication server challenges client.
6. Client responds with proper credentials.
7. Authentication server approves access.
8. Switch grants client access to this port.

The client provides its identity (such as a user name) in an EAPOL response to the switch, which it forwards to the RADIUS server. The RADIUS server verifies the client identity and sends an access challenge back to the client. The EAP packet from the RADIUS server contains not only the challenge, but the authentication method to be used. The client can reject the authentication method and request another, depending on the configuration of the client software and the RADIUS server. The authentication method must be MD5. The client responds to the appropriate method with its credentials, such as a password or certificate. The RADIUS server verifies the client credentials and responds with an accept or reject packet. If authentication is successful, the switch allows the client to access the network. Otherwise, network access is denied and the port remains blocked.

The operation of dot1x on the switch requires the following:

• The switch must have an IP address assigned.
• Logon authentication (page 2-12) must be enabled on the switch and the IP address of the authentication server specified.
• Each switch port that will be used must be set to dot1x "Auto" mode.
• Each client that needs to be authenticated must have dot1x client software installed and properly configured.

Displaying 802.1x Global Settings

The dot1x protocol includes global parameters that control the client authentication process that runs between the client and the switch (i.e., authenticator), as well as

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the client identity lookup process that runs between the switch and authentication server. These parameters are described in this section.

Command Attributes

- **dot1x Re-authentication -** Indicates if switch ports require a client to be re-authenticated after a certain period of time.
- **dot1x Max Request Count -** The maximum number of times the switch port will retransmit an EAP request packet to the client before it times out the authentication session.
- **Timeout for Quiet Period -** Indicates the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client.
- **Timeout for Re-authentication Period -** Indicates the time period after which a connected client must be re-authenticated.
- **Timeout for TX Period -** The time period during an authentication session that the switch waits before re-transmitting an EAP packet.
- **Supplicant timeout -** The time the switch waits for a client response to an EAP request.
- **Server timeout -** The time the switch waits for a response from the RADIUS server to an authentication request.
- **Re-authentication Max Count -** The number of times the switch will attempt to re-authenticate a connected client before the port becomes unauthorized.

Web - Click 802.1X, 802.1X Information.

802.1X Information

802.1X Re-authentication	Disabled
802.1X Max Request Count	2
Timeout for Quiet Period	60 seconds
Timeout for Re-authentication Period	3600 seconds
Timeout for Tx Period	30 seconds
Supplicant timeout	30 seconds
Server timeout	30 seconds
Re-authentication Max Count	2

Figure 2-60. Displaying 802.1x Information

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CLI – This example shows the default protocol settings for dot1x. For a description of the additional entries displayed in the CLI, see "show dot1x" on page 3-141.

```
Console#show dot1x                                                3-141
Global 802.1X Parameters
reauth-enabled: n/a
reauth-period:  3600
quiet-period:   60
tx-period:      30
supp-timeout:   30
server-timeout: 30
reauth-max:     2
max-req:        2

802.1X Port Summary
 Port Name      Status         Mode           Authorized
        1        disabled    ForceAuthorized          n/a
        2        disabled    ForceAuthorized          yes
        3        disabled    ForceAuthorized          n/a
        4        disabled    ForceAuthorized          n/a
        ..............................................
        23       disabled    ForceAuthorized          n/a
        24       disabled    ForceAuthorized          n/a
Console#
```

Configuring Global dot1x Parameters

The dot1x protocol includes global parameters that control the client authentication process that runs between the client and the switch (i.e., authenticator), as well as the client identity lookup process that runs between the switch and authentication server. The configuration options for parameters are described in this section.

Command Attributes

- **dot1X Re-authentication -** Sets the client to be re-authenticated after the interval specified by the Timeout for Re-authentication Period. Re-authentication can be used to detect if a new device is plugged into a switch port. (Default: Disabled)
- **dot1X Max Request Count -** Sets the maximum number of times the switch port will retransmit an EAP request packet to the client before it times out the authentication session. (Range: 1-10; Default 2)
- **Timeout for Quiet Period -** Sets the time that a switch port waits after the dot1X Max Request Count has been exceeded before attempting to acquire a new client. (Range: 1-65535 seconds; Default: 60 seconds)
- **Timeout for Re-authentication Period -** Sets the time period after which a connected client must be re-authenticated. (Range: 1-65535 seconds; Default: 3600 seconds)
- **Timeout for TX Period -** Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet. (Range: 1-65535; Default: 30 seconds)

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• **authentication dot1x*** – Sets the default authentication server type. Note the specified authentication server type must be enabled and properly configured for dot1x to function properly. (Options: radius)

* CLI only.

Web - Select 802.1X, 802.1X Configuration. Enable dot1x globally for the switch, modify any of the parameters as required, and then click Apply.

802.1X Configuration

802.1X Re-authentication	☐ Enable	
802.1X Max Request Count (1-10)	2	
Timeout for Quiet Period (0-65535)	60	seconds
Timeout for Re-authentication Period (0-65535)	3600	seconds
Timeout for Tx Peroid (1-65535)	30	seconds

Figure 2-61. Configuring 802.1x

CLI – This example enables re-authentication and sets all of the global parameters for dot1x.

```
Console(config)#dot1x max-req 5                              3-137
Console(config)#dot1x re-authentication                      3-139
Console(config)#dot1x timeout quiet-period 40                3-139
Console(config)#dot1x timeout re-auth 5                       3-140
Console(config)#dot1x timeout tx-period 40                    3-140
Console(config)#authentication dot1x default radius          3-137
Console(config)#
```

Configuring Port Authorization Mode

When dot1x is enabled, you need to specify the dot1x authentication mode configured for each port.

Command Attributes

• **Status** - Indicates if authentication is enabled or disabled on the port.
• **Mode** – Sets the authentication mode to one of the following options:
  - **Auto** – Requires a dot1x-aware client to be authorized by the authentication server. Clients that are not dot1x-aware will be denied access.
  - **Force-Authorized** – Forces the port to grant access to all clients, either dot1x-aware or otherwise.
  - **Force-Unauthorized** – Forces the port to deny access to all clients, either dot1x-aware or otherwise.

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- **Authorized** –
  - **Yes** – Connected client is authorized.
  - **No** – Connected client is not authorized.
  - *Blank* – Displays nothing when dot1x is disabled on a port.
- **Supplicant** – Indicates the MAC address of a connected client.
- **Trunk** – Indicates if the port is configured as a trunk port.

Web - Select 802.1X, 802.1X Port Configuration.

802.1X Port Configuration

Port	Status	Mode	Autheorized	Supplicant	Trunk
1	Disabled	Force-Authorized		00-00-00-00-00-00	
2	Disabled	Force-Authorized		00-00-00-00-00-00	
3	Disabled	Force-Authorized		00-00-00-00-00-00	
4	Disabled	Force-Authorized		00-00-00-00-00-00	
5	Disabled	Force-Authorized		00-00-00-00-00-00	

Figure 2-62. 802.1x Port Configuration

CLI - In Interface mode type dot1x port-control auto, or use the no form to disable.

```
Console(config)#interface ethernet 1/2
Console(config-if)#dot1x port-control auto                    3-138
Console(config-if)#
```

Displaying 802.1x Statistics

This switch can display statistics for dot1x protocol exchanges for any port.

Statistical Values

Table 2-8. 802.1x Statistics	
Parameter	Description
Rx EXPOL Start	The number of EAPOL Start frames that have been received by this Authenticator.
Rx EAPOL Logoff	The number of EAPOL Logoff frames that have been received by this Authenticator.
Rx EAPOL Invalid	The number of EAPOL frames that have been received by this Authenticator in which the frame type is not recognized.
Rx EAPOL Total	The number of valid EAPOL frames of any type that have been received by this Authenticator.
Rx EAP Resp/Id	The number of EAP Resp/Id frames that have been received by this Authenticator.

Table 2-8. 802.1x Statistics	
Parameter	Description
Rx EAP Resp/Oth	The number of valid EAP Response frames (other than Resp/Id frames) that have been received by this Authenticator.
Rx EAP LenError	The number of EAPOL frames that have been received by this Authenticator in which the Packet Body Length field is invalid.
Rx Last EAPOLVer	The protocol version number carried in the most recently received EAPOL frame.
Rx Last EAPOLSrc	The source MAC address carried in the most recently received EAPOL frame.
Tx EAPOL Total	The number of EAPOL frames of any type that have been transmitted by this Authenticator.
Tx EAP Req/Id	The number of EAP Req/Id frames that have been transmitted by this Authenticator.
Tx EAP Req/Oth	The number of EAP Request frames (other than Rq/Id frames) that have been transmitted by this Authenticator.

Web – Select 802.1X, 802.1X Statistics. Select the required port and then click Query. Click Refresh to update the statistics.

Figure 2-63. Displaying 802.1x Port Statistics

CLI – This example displays the dot1x statistics for port 2.

```
Console#show dot1x statistics                                      3-141

Eth 1/2
Rx: EXPOL      EAPOL       EAPOL       EAPOL      EAP      EAP      EAP
    Start      Logoff      Invalid     Total    Resp/Id  Resp/Oth LenError
        0           0           0           0        0        0        0


    Last       Last
EAPOLVer       EAPOLSrc
        0      30-30-30-30-30-30

Tx: EAPOL       EAP        EAP
    Total      Req/Id    Req/Oth
       29         21          0
Console#
```

Chapter 3: Command Line Interface

This chapter describes how to use the Command Line Interface (CLI).

Using the Command Line Interface

Accessing the CLI

When accessing the management interface for the switch over a direct connection to the server's console port, or via a Telnet connection, the switch can be managed by entering command keywords and parameters at the prompt. Using the switch's command-line interface (CLI) is very similar to entering commands on a UNIX system.

Note: When FMS-24K switches are stacked together, you must connect to the RS-232 port on the Master unit to be able to access the CLI.

Console Connection

To access the switch through the console port, perform these steps:

1. At the console prompt, enter the user name and password. (The default user names are "admin" and "guest" with corresponding passwords of "admin" and "guest.") When the administrator user name and password is entered, the CLI displays the "Console#" prompt and enters privileged access mode (i.e., Privileged Exec). But when the guest user name and password is entered, the CLI displays the "Console>" prompt and enters normal access mode (i.e., Normal Exec).

2. Enter the necessary commands to complete your desired tasks.

3. When finished, exit the session with the "quit" or "exit" command.

After connecting to the system through the console port, the login screen displays:

```
User Access Verification

Username: admin
Password:

     CLI session with the Intelligent Switch is opened.
     To end the CLI session, enter [Exit].

Console#
```

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Telnet Connection

Telnet operates over the IP transport protocol. In this environment, your management station and any network device you want to manage over the network must have a valid IP address. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Each address consists of a network portion and host portion. For example, the IP address assigned to this switch, 10.1.0.1, consists of a network portion (10.1.0) and a host portion (1).

Note: The IP address for this switch is unassigned by default.

To access the switch through a Telnet session, you must first set the IP address for the switch, and set the default gateway if you are managing the switch from a different IP subnet. For example,

```
Console(config)#interface vlan 1
Console(config-if)#ip address 10.1.0.1 255.255.255.0
Console(config-if)#exit
Console(config)#ip default-gateway 10.1.0.254
```

If your corporate network is connected to another network outside your office or to the Internet, you need to apply for a registered IP address. However, if you are attached to an isolated network, then you can use any IP address that matches the network segment to which you are attached.

After you configure the switch with an IP address, you can open a Telnet session by performing these steps.

1. From the remote host, enter the Telnet command and the IP address of the device you want to access.

2. At the prompt, enter the user name and system password. The CLI will display the "Vty-0#" prompt for the administrator to show that you are using privileged access mode (i.e., Privileged Exec), or "Vty-0>" for the guest to show that you are using normal access mode (i.e., Normal Exec).

3. Enter the necessary commands to complete your desired tasks.

4. When finished, exit the session with the "quit" or "exit" command.

After entering the Telnet command, the login screen displays:

```
Username: admin
Password:

      CLI session with the Intelligent Switch is opened.
      To end the CLI session, enter [Exit].

Console#
```

Note: You can open up to four sessions to the device via Telnet.

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Entering Commands

This section describes how to enter CLI commands.

Keywords and Arguments
A CLI command is a series of keywords and arguments. Keywords identify a command, and arguments specify configuration parameters. For example, in the command "show interfaces status ethernet 1/5," **show interfaces** and **status** are keywords, **ethernet** is an argument that specifies the interface type, and **1/5** specifies the unit/port.

You can enter commands as follows:

• To enter a simple command, enter the command keyword.
• To enter multiple commands, enter each command in the required order. For example, to enable Privileged Exec command mode, and display the startup configuration, enter:
```
Console>enable
Console#show startup-config
```

• To enter commands that require parameters, enter the required parameters after the command keyword. For example, to set a password for the administrator, enter:
```
Console(config)#username admin password 0 smith
```

Minimum Abbreviation
The CLI will accept a minimum number of characters that uniquely identify a command. For example, the command "configure" can be entered as **con**. If an entry is ambiguous, the system will prompt for further input.

Command Completion
If you terminate input with a Tab key, the CLI will print the remaining characters of a partial keyword up to the point of ambiguity. In the "logging history" example, typing **log** followed by a tab will result in printing the command up to "**logging**."

Getting Help on Commands
You can display a brief description of the help system by entering the **help** command. You can also display command syntax by using the "?" character to list keywords or parameters.

Showing Commands
If you enter a "?" at the command prompt, the system will display the first level of keywords for the current command class (Normal Exec or Privileged Exec) or configuration class (Global, Interface, Line, or VLAN Database). You can also

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display a list of valid keywords for a specific command. For example, the command "**show ?**" displays a list of possible show commands:

```
Console#show ?
 bridge-ext        Bridge extend information
 calendar          Date information
 dot1x             Show 802.1x content
 garp              Garp property
 gvrp              Show gvrp information of interface
 history           Information of history
 interfaces        Information of interfaces
 ip                IP information
 line              TTY line information
 logging           Show the contents of logging buffers
 mac-address-table Set configuration of the address table
 map               Map priority
 port              Characteristics of the port
 queue             Information of priority queue
 radius-server     Radius server information
 running-config    The system configuration of running
 snmp              SNMP statistics
 spanning-tree     Specify spanning-tree
 startup-config    The system configuration of starting up
 system            Information of system
 tacacs-server     Login by tacacs server
 users             Display information about terminal lines
 version           System hardware and software status
 vlan              Switch VLAN Virtual Interface
Console#show
```

The command "**show interfaces ?**" will display the following information:

```
Console>show interfaces ?
  counters    Information of interfaces counters
  status      Information of interfaces status
  switchport  Information of interfaces switchport
```

Partial Keyword Lookup

If you terminate a partial keyword with a question mark, alternatives that match the initial letters are provided. (Remember not to leave a space between the command and question mark.) For example "**s?**" shows all the keywords starting with "s."

```
Console#show s?
snmp             spanning-tree  startup-config  system
```

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Negating the Effect of Commands

For many configuration commands you can enter the prefix keyword "**no**" to cancel the effect of a command or reset the configuration to the default value. For example, the **logging** command will log system messages to a host server. To disable logging, specify the **no logging** command. This guide describes the negation effect for all applicable commands.

Using Command History

The CLI maintains a history of commands that have been entered. You can scroll back through the history of commands by pressing the up arrow key. Any command displayed in the history list can be executed again, or first modified and then executed.

Using the **show history** command displays a longer list of recently executed commands.

Understanding Command Modes

The command set is divided into Exec and Configuration classes. Exec commands generally display information on system status or clear statistical counters. Configuration commands, on the other hand, modify interface parameters or enable certain switching functions. These classes are further divided into different modes. Available commands depend on the selected mode. You can always enter a question mark "**?**" at the prompt to display a list of the commands available for the current mode. The command classes and associated modes are displayed in the following table:

Table 3-1. Command Modes		
Class	Mode	
Exec	Normal Privileged	
Configuration	Global*	Interface Line VLAN Database

 * You must be in Privileged Exec mode to access any of the configuration modes.
   You must be in Global Configuration mode to access any of the other configuration modes.

Exec Commands

When you open a new console session on the switch with the user name and password "guest," the system enters the Normal Exec command mode (or guest mode), displaying the "Console>" command prompt. Only a limited number of the commands are available in this mode. You can access all commands only from the Privileged Exec command mode (or administrator mode). To access Privilege Exec mode, open a new console session with the user name and password "admin." The

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system will now display the "Console#" command prompt. You can also enter Privileged Exec mode from within Normal Exec mode, by entering the **enable** command, followed by the privileged level password "super" (page 3-9).

To enter Privileged Exec mode, enter the following commands and passwords:

```
Username: admin
Password: [system login password]

      CLI session with the Intelligent Switch is opened.
      To end the CLI session, enter [Exit].

Console#
```

```
Username: guest
Password: [system login password]

      CLI session with the Intelligent Switch is opened.
      To end the CLI session, enter [Exit].

Console#enable
Password: [privileged level password if so configured]
Console#
```

Configuration Commands

Configuration commands are privileged level commands used to modify switch settings. These commands modify the running configuration only and are not saved when the switch is rebooted. To store the running configuration in nonvolatile storage, use the **copy running-config startup-config** command.

The configuration commands are organized into different modes:

- Global Configuration - These commands modify the system level configuration, and include commands such as **hostname** and **snmp-server community**.
- Access Control List Configuration - These commands are used for packet filtering.
- DHCP Configuration - These commands are used to configure the DHCP server.
- Interface Configuration - These commands modify the port configuration such as **speed-duplex** and **negotiation**.
- Line Configuration - These commands modify the console port and Telnet configuration, and include commands such as **parity** and **databits**.
- Router Configuration - These commands configure global settings for unicast and multicast routing protocols.
- VLAN Configuration - Includes the command to create VLAN groups.

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To enter the Global Configuration mode, enter the command **configure** in Privileged Exec mode. The system prompt will change to "Console(config)#" which gives you access privilege to all Global Configuration commands.

```
Console#configure
Console(config)#
```

To enter the other modes, at the configuration prompt type one of the following commands. Use the **exit** or **end** command to return to the Privileged Exec mode.

Table 3-2. Configuration Modes

Mode	Command	Prompt	Page
Line	line {console	vty}	Console(config-line)#	3-47
Interface	interface {ethernet *port*	port-channel *id*| vlan *id*}	Console(config-if)#	3-55
VLAN	vlan database	Console(config-vlan)	3-83

For example, you can use the following commands to enter interface configuration mode, and then return to Privileged Exec mode

```
Console(config)#interface ethernet 1/5
.
.
.
Console(config-if)#exit
Console(config)#
```

Command Line Processing
Commands are not case sensitive. You can abbreviate commands and parameters as long as they contain enough letters to differentiate them from any other currently available commands or parameters. You can use the Tab key to complete partial commands, or enter a partial command followed by the "?" character to display a list of possible matches. You can also use the following editing keystrokes for command-line processing:

Table 3-3. Command Line Processing

Keystroke	Function
Ctrl-A	Shifts cursor to start of command line.
Ctrl-B	Shifts cursor to the left one character.
Ctrl-E	Shifts cursor to end of command line.
Ctrl-F	Shifts cursor to the right one character.
Ctrl-P	Shows the last command.
Ctrl-U	Deletes the entire line.

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Table 3-3. Command Line Processing	
Keystroke	Function
Ctrl-W	Deletes the last word typed.
Delete key or backspace key	Erases a mistake when entering a command.

Command Groups

The system commands can be broken down into the functional groups shown below.

Table 3-4. Command Groups		
Command Group	Description	Page
General	Basic commands for entering privileged access mode, restarting the system, or quitting the CLI	3-9
Flash/File	Manages code image or switch configuration files	3-15
System Management	Controls system logs, system passwords, user name, browser management options, and a variety of other system information	3-20
SNMP	Activates authentication failure traps; configures community access strings, and trap managers	3-36
IP Interface	Configures the IP address and gateway for management access, DHCP server and relay service for server blades, displays the default gateway, or pings a specified device	3-42
Line	Sets communication parameters for the serial port, including baud rate and console time-out	3-47
Interface	Configures the connection parameters for all Ethernet ports, aggregated links, and VLANs	3-55
Address Table	Configures the address table for filtering specified addresses, displaying current entries, clearing the table, or setting the aging time	3-67
Spanning Tree	Configures Spanning Tree settings for the switch	3-70
VLANs	Configures VLAN settings, and defines port membership for VLAN groups	3-83
PVLAN	Enables or configures private VLANs	3-91
GVRP and Bridge Extension	Configures GVRP settings that permit automatic VLAN learning; shows the configuration for bridge extension MIB	3-97
Multicast Filtering	Configures IGMP multicast filtering, query parameters, and specifies ports attached to a multicast router	3-101
Priority	Sets port priority for untagged frames, relative weight for each priority queue, also sets priority for TCP/UDP traffic types, IP precedence, and DSCP	3-111
Mirror Port	Mirrors data to another port for analysis without affecting the data passing through or the performance of the monitored port	3-123
Link Aggregation	Statically groups multiple ports into a single logical trunk; configures Link Aggregation Control Protocol for port trunks	3-125

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Table 3-4. Command Groups		
Command Group	Description	Page
Rate Limiting	Controls the maximum rate for traffic transmitted or received on a port	3-127
Authentication	Configures RADIUS and TACACS+ client-server authentication for logon access and commands for IEEE 802.1x port access control.	3-129

The access mode shown in the following tables is indicated by these abbreviations:

NE (Normal Exec)   **IC** (Interface Configuration)
PE (Privileged Exec)   **LC** (Line Configuration)
GC (Global Configuration)   **VC** (VLAN Database Configuration)

General Commands

Table 3-5. General Commands			
Command	Function	Mode	Page
enable	Activates privileged mode	NE	3-9
disable	Returns to normal mode from privileged mode	PE	3-10
configure	Activates global configuration mode	PE	3-11
show history	Shows the contents of the command history buffer	NE, PE	3-11
reload	Restarts the system	PE	3-12
prompt	Customizes the CLI prompt	GC	3-13
end	Returns to Privileged Exec mode	any config. mode	3-13
exit	Returns to the previous configuration mode, or exits the CLI	any	3-13
quit	Exits a CLI session	NE, PE	3-14
help	Shows how to use help	any	NA
?	Shows options for command completion (context sensitive)	any	NA

enable
Use this command to activate Privileged Exec mode. In privileged mode, additional commands are available, and certain commands display additional information. See "Understanding Command Modes" on page 3-5.

Syntax

enable [*level*]

level - Privilege level to log into the device.

The device has two predefined privilege levels: 0: Normal Exec,
15: Privileged Exec. Enter level 15 to access Privileged Exec mode.

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Default Setting

Level 15

Command Mode

Normal Exec

Command Usage

- "super" is the default password required to change the command mode from Normal Exec to Privileged Exec. (To set this password, see the **enable password** command on page 3-22.)
- The "#" character is appended to the end of the prompt to indicate that the system is in privileged access mode.

Example

```
Console> enable
Password: [privileged level password]
Console#
```

Related Commands

disable (3-10)
enable password (3-22)

disable

Use this command to return to Normal Exec mode from privileged mode. In normal access mode, you can only display basic information on the switch's configuration or Ethernet statistics. To gain access to all commands, you must use the privileged mode. See "Understanding Command Modes" on page 3-5.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

The ">" character is appended to the end of the prompt to indicate that the system is in normal access mode.

Example

```
Console#disable
Console>
```

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Related Commands

enable (3-9)

configure

Use this command to activate Global Configuration mode. You must enter this mode to modify any settings on the switch. You must also enter Global Configuration mode prior to enabling some of the other configuration modes, including Interface Configuration, Line Configuration, and VLAN Database Configuration. See "Understanding Command Modes" on page 3-5.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#configure
Console(config)#
```

Related Commands

end (3-13)

show history

Use this command to show the contents of the command history buffer.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The history buffer size is fixed at 10 Execution commands and 10 Configuration commands.

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Example

In this example, the show history command lists the contents of the command history buffer:

```
Console#show history
Execution command history:
 2 config
 1 show history

Configuration command history:
 4 interface vlan 1
 3 exit
 2 interface vlan 1
 1 end

Console#
```

The **!** command repeats commands from the Execution command history buffer when you are in Normal Exec or Privileged Exec Mode, and commands from the Configuration command history buffer when you are in any of the configuration modes. In this example, the **!2** command repeats the second command in the Execution history buffer (**config**).

```
Console#!2
Console#config
Console(config)#
```

reload

Use this command to restart the system.

Note: When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory by the **copy running-config startup-config** command.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

This command resets the entire system.

Example

This example shows how to reset the switch:

```
Console#reload
System will be restarted, continue <y/n>? y
```

prompt

Use this command to customize the CLI prompt. Use the **no** form to revert to the default prompt.

Syntax

prompt *string*
no prompt

string - Any alphanumeric string to use for the command prompt.
(Maximum length: 255 characters)

Default Setting

Console

Command Mode

Global Configuration

Example

```
Console(config)#prompt FMS-24K
FMS-24K(config)#
```

end

Use this command to return to Privileged Exec mode.

Default Setting

None

Command Mode

Global Configuration, Interface Configuration, Line Configuration, VLAN Database Configuration

Example

This example shows how to return to the Privileged Exec mode from the Interface Configuration mode:

```
Console(config-if)#end
Console#
```

exit

Use this command to return to the previous configuration mode or exit the configuration program.

Default Setting

None

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Command Mode

Any

Example

This example shows how to return to the Privileged Exec mode from the Global Configuration mode, and then quit the CLI session:

```
Console(config)#exit
Console#exit

Press ENTER to start session

User Access Verification

Username:
```

quit

Use this command to exit the configuration program.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The **quit** and **exit** commands can both exit the configuration program.

Example

This example shows how to quit a CLI session:

```
Console#quit

Press ENTER to start session

User Access Verification

Username:
```

Flash/File Commands

These commands are used to manage the system code or configuration files.

<div align="center">Table 3-6. Flash/File Commands</div>

Command	Function	Mode	Page
copy	Copies a code image or a switch configuration to or from flash memory or a TFTP server	PE	3-15
delete	Deletes a file or code image	PE	3-17
dir	Displays a list of files in flash memory	PE	3-18
whichboot	Displays the files booted	PE	3-19
boot system	Specifies the file or image used to start up the system	GC	3-19

copy

Use this command to move (upload/download) a code image or configuration file between the switch's flash memory and a TFTP server. When you save the system code or configuration settings to a file on a TFTP server, that file can later be downloaded to the switch to restore system operation. The success of the file transfer depends on the accessibility of the TFTP server and the quality of the network connection.

Syntax

> **copy file** {**file** | **running-config** | **startup-config** | **tftp**}
> **copy running-config** {**file** | **startup-config** | **tftp**}
> **copy startup-config** {**file** | **running-config** | **tftp**}
> **copy tftp** {**file** | **running-config** | **startup-config**}

- **file** - Keyword that allows you to copy to/from a file.
- **running-config** - Keyword that allows you to copy to/from the current running configuration.
- **startup-config** - The configuration used for system initialization.
- **tftp** - Keyword that allows you to copy to/from a TFTP server.

Default Setting

None

Command Mode

Privileged Exec

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Command Usage

- The system prompts for data required to complete the copy command.
- The destination file name should not contain slashes (\ or /), the leading letter of the file name should not be a period (.), and the maximum length for file names on the TFTP server is 127 characters or 31 characters for files on the switch. (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")
- Due to the size limit of the flash memory, the switch supports only two operation code files.
- The maximum number of user-defined configuration files depends on available memory.
- You can use "Factory_Default_Config.cfg" as the source to copy from the factory default configuration file, but you cannot use it as the destination.
- To replace the startup configuration, you must use **startup-config** as the destination.
- The Boot ROM image cannot be uploaded or downloaded from the TFTP server. You must use a direct console connection and access the download menu during a boot up to download the Boot ROM (or diagnostic) image. See "Upgrading Firmware via the Serial Port" on page A-1 for more details.

Example

The following example shows how to upload the configuration settings to a file on the TFTP server:

```
Console#copy file tftp
Choose file type:
 1. config:  2. opcode: <1-2>: 1
Source file name: startup
TFTP server ip address: 10.1.0.99
Destination file name: startup.01
/
Console#
```

The following example shows how to copy the running configuration to a startup file.

```
Console#copy running-config file
destination file name : startup
Write to FLASH Programming.
\Write to FLASH finish.
Success.

Console#
```

The following example shows how to download a configuration file:

```
Console#copy tftp startup-config
TFTP server ip address: 10.1.0.99
Source configuration file name: startup.01
Startup configuration file name [startup]:
Write to FLASH Programming.

\Write to FLASH finish.
Success.

Console#
```

delete

Use this command to delete a file or image.

Syntax

    delete *filename*

       filename - Name of the configuration file or image name.

Default Setting

    None

Command Mode

    Privileged Exec

Command Usage

- If the file type is used for system startup, then this file cannot be deleted.
- "Factory_Default_Config.cfg" cannot be deleted.

Example

This example shows how to delete the test2.cfg configuration file from flash memory.

```
Console#delete test2.cfg
Console#
```

Related Commands

    dir (3-18)

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dir

Use this command to display a list of files in flash memory.

Syntax

dir [**boot-rom** | **config** | **opcode** [:*filename*]]

The type of file or image to display includes:

- **boot-rom** - Boot ROM (or diagnostic) image file
- **config** - Switch configuration file
- **opcode** - Run-time operation code image file.
- *filename* - Name of the file or image. If this file exists but contains errors, information on this file cannot be shown.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- If you enter the command **dir** without any parameters, the system displays all files.
- File information is shown below:

Table 3-7. Directory Parameter	
Column Heading	Description
file name	The name of the file.
file type	File types: Boot-Rom, Operation Code, and Config file.
startup	Shows if this file is used when the system is started.
size	The length of the file in bytes.

Example

```
Console#dir
                      file name      file type startup size (byte)
-------------------------------- -------------- ------- -----------
                      diag_0060 Boot-Rom image     Y       111360
                      run_01642 Operation Code     N      1074304
                       run_0200 Operation Code     Y      1083008
    Factory_Default_Config.cfg    Config File      N         2574
                        startup    Config File     Y         2710
------------------------------------------------------------------
                                    Total free space:          0
Console#
```

whichboot

Use this command to display which files were booted when the system powered up.

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows the information displayed by the **whichboot** command. See the table under the **dir** command for a description of the file information displayed by this command.

```
Console#whichboot
      file name      file type startup size (byte)
----------------- -------------- ------- -----------
     diag_0060 Boot-Rom image     Y       111360
      run_0200 Operation Code     Y      1083008
       startup   Config File      Y         2710
Console#
```

boot system

Use this command to specify the file or image used to start up the system.

Syntax

boot system {**boot-rom**| **config** | **opcode**}: *filename*

The type of file or image to set as a default includes:

- **boot-rom** - Boot ROM
- **config** - Configuration file
- **opcode** - Run-time operation code

The colon (:) is required.

filename - Name of the configuration file or image name.

Default Setting

None

Command Mode

Global Configuration

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Command Usage

- A colon (:) is required after the specified file type.
- If the file contains an error, it cannot be set as the default file.

Example

```
Console(config)#boot system config: startup
Console(config)#
```

Related Commands

dir (3-18)
whichboot (3-19)

System Management Commands

These commands are used to control system logs, passwords, user names, browser configuration options, and display or configure a variety of other system information.

Table 3-8. System Management Commands		
Command Group	Function	Page
Device Designation	Configures information that uniquely identifies this switch	3-20
User Access	Configures the basic user names and passwords for management access	3-21
Time (System Clock)	Sets the system clock automatically via NTP/SNTP server or manually	3-23
Web Server	Enables management access via a Web browser	3-25
Event Logging	Controls logging of error messages	3-26
System Status	Displays system configuration, active managers, and version information	3-29

Device Designation Commands

Table 3-9. Device Designation Commands			
Command	Function	Mode	Page
hostname	Specifies the host name for the switch	GC	3-20
snmp-server contact	Sets the system contact string	GC	3-37
snmp-server location	Sets the system location string	GC	3-37

hostname
Use this command to specify or modify the host name for this device. Use the **no** form to restore the default host name.

Syntax

hostname *name*
no hostname

> *name* - The name of this host. (Maximum length: 255 characters)

Default Setting

> None

Command Mode

> Global Configuration

Example

```
Console(config)#hostname FMS-24K
Console(config)#
```

User Access Commands

The basic commands required for management access are listed in this section.
This switch also includes other options for password checking via the console or a
Telnet connection (page 3-47), user authentication via a remote authentication
server (page 3-129), and host access authentication for specific ports (page 4-75).

Table 3-10. User Access Commands			
Command	Function	Mode	Page
username	Establishes a user name-based authentication system at login	GC	3-21
enable password	Sets a password to control access to the Privileged Exec level	GC	3-22

username

This command adds named users, requires authentication at login, specifies or
changes a user's password (or specify that no password is required), or specifies or
changes a user's access level. Use the **no** form to remove a user name.

Syntax

username *name* {**access-level** *level* | **nopassword** |
  password {**0** | **7**} *password*}
no username *name*

- *name* - The name of the user.
  (Maximum length: 8 characters, case sensitive. Maximum users: 16)
- **access-level** *level* - Specifies the user level.
  The device has two predefined privilege levels:
  0: Normal Exec, **15**: Privileged Exec.
- **nopassword** - No password is required for this user to log in.

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- {**0** | **7**} - 0 means plain password, 7 means encrypted password.
- **password** *password* - The authentication password for the user.
  (Maximum length: 8 characters plain text, 32 encrypted, case sensitive)

Default Setting

- The default access level is Normal Exec.
- The factory defaults for the user names and passwords are:

username	access-level	password
Table 3-11. User Access Levels		
guest admin	0 15	guest admin

Command Mode

Global Configuration

Command Usage

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

This example shows how to set the access level and password for a user.

```
Console(config)#username bob access-level 15
Console(config)#username bob password 0 smith
Console(config)#
```

enable password

After initially logging onto the system, you should set the Privileged Exec password. Remember to record it in a safe place. This command controls access to the Privileged Exec level from the Normal Exec level. Use the **no** form to reset the default password.

Syntax

enable password [**level** *level*] {**0** | **7**} *password*
no enable password [**level** *level*]

- **level** *level* - Level 15 for Privileged Exec. (Levels 0-14 are not used.)
- {**0** | **7**} - 0 means plain password, 7 means encrypted password.
- *password* - password for this privilege level.
  (Maximum length: 8 characters plain text, 32 encrypted, case sensitive)

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Default Setting
- The default is level 15.
- The default password is "super"

Command Mode

Global Configuration

Command Usage
- You cannot set a null password. You will have to enter a password to change the command mode from Normal Exec to Privileged Exec with the **enable** command (page 3-9).
- The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

```
Console(config)#enable password level 15 0 admin
Console(config)#
```

Related Commands

enable (3-9)

Time Commands

The system clock can be dynamically set by polling a set of specified time servers (NTP or SNTP), or by using information broadcast by local time servers.

Table 3-12. User Access Commands

Command	Function	Mode	Page
calendar set	Sets the system date and time	PE	3-23
show calendar	Displays the current date and time setting	NE, PE	3-24

calendar set

Use this command to set the date and time of the system clock.

Syntax

calendar set *hour min sec* {*month day year | day month year*}

- *hour* - Hour in 24-hour format. (Range: 0 - 23)
- *minute* - Minute. (Range: 0 - 59)
- *sec* - Second. (Range: 0 - 59)

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- *month* - **January** | **February** | **March** | **April** | **May** | **June** | **July** | **August** | **September** | **October** | **November** | **December**
- *day* - Day of month. (Range: 1 - 31)
- *year* - Year (4-digit). (Range: 2001 - 2101)

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows how to set the system clock to 15:12:34, March 21st, 2003.

```
Console#calendar set 15 12 34 march 21 2003
Console#
```

show calendar
Use this command to display the system clock.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Example

This example shows how to display the current system clock setting.

```
Console#show calendar
15:12:50 March 21 2003
Console#
```

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Web Server Commands

Table 3-13. Unit ID Command			
Command	Function	Mode	Page
ip http port	Specifies the port to be used by the Web browser interface	GC	3-25
ip http server	Allows the switch to be monitored or configured from a browser	GC	

ip http port
Use this command to specify the TCP port number used by the Web browser interface. Use the **no** form to use the default port.

Syntax

ip http port *port-number*
no ip http port

port-number - The TCP port to be used by the browser interface.
(Range: 1-65535)

Default Setting

80

Command Mode

Global Configuration

Example

```
Console(config)#ip http port 769
Console(config)#
```

Related Commands

ip http server (3-25)

ip http server
Use this command to allow this device to be monitored or configured from a browser. Use the **no** form to disable this function.

Syntax

ip http server
no ip http server

Default Setting

Enabled

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Command Mode

Global Configuration

Example

```
Console(config)#ip http server
Console(config)#
```

Related Commands

ip http port (3-25)

Event Logging Commands

Table 3-14. Event Logging Commands			
Command	Function	Mode	Page
logging on	Controls logging of error messages	GC	3-26
logging history	Limits syslog messages saved to switch memory based on severity	GC	3-27
clear logging	Clears messages from the logging buffer	GC	3-28
show logging	Displays the state of logging configuration	GC	3-28

logging on

Use this command to control logging of error messages. This command sends debug or error messages to switch memory. The **no** form disables the logging process.

Syntax

[**no**] **logging on**

Default Setting

None

Command Mode

Global Configuration

Command Usage

The logging process controls error messages saved to switch memory. You can use the **logging history** command to control the type of error messages that are stored.

Example

```
Console(config)#logging on
Console(config)#
```

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Related Commands

logging history (3-27)
clear logging (3-28)

logging history
Use this command to limit syslog messages saved to switch memory based on severity. The **no** form returns the logging of syslog messages to the default level.

Syntax

logging history {**flash** | **ram**} *level*
no logging history {**flash** | **ram**}

- **flash** - Event history stored in flash memory (i.e., permanent memory).
- **ram** - Event history stored in temporary RAM (i.e., memory flushed on power reset).
- *level* - One of the level arguments listed in the following table. Messages sent include the selected level down to level 0.

Table 3-15. Logging Levels		
Level Argument	Level	Description
debugging	7	Debugging messages
informational	6	Informational messages only
notifications	5	Normal but significant condition, such as cold start
warnings	4	Warning conditions (e.g., return false, unexpected return)
errors	3	Error conditions (e.g., invalid input, default used)
critical	2	Critical conditions (e.g., memory allocation, or free memory error - resource exhausted)
alerts	1	Immediate action needed
emergencies	0	System unusable

* There are only Level 2, 5 and 6 error messages for the current firmware release.

Default Setting

Flash: errors (level 3 - 0)
RAM: warnings (level 7 - 0)

Command Mode

Global Configuration

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Command Usage

The message level specified for flash memory must be a higher priority (i.e., numerically lower) than that specified for RAM.

Example

```
Console(config)#logging history ram 0
Console(config)#
```

clear logging

Use this command to clear messages from the log buffer.

Syntax

clear logging [flash | ram]

- **flash** - Event history stored in flash memory (i.e., permanent memory).
- **ram** - Event history stored in temporary RAM (i.e., memory flushed on power reset).

Default Setting

Flash and RAM

Command Mode

Privileged Exec

Example

```
Console#clear logging
Console#
```

Related Commands

show logging (3-28)

show logging

Use this command to display the logging configuration, along with any system and event messages stored in memory.

Syntax

show logging {**flash** | **ram**}

- **flash** - Event history stored in flash memory (i.e., permanent memory).
- **ram** - Event history stored in temporary RAM (i.e., memory flushed on power reset).

Default Setting

None

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Command Mode

Privileged Exec

Command Usage

This command shows the following information:

- Syslog logging – Whether or not system logging has been enabled via the **logging on** command.
- History logging in FLASH/RAM – The message level(s) that are reported based on the **logging history** command.
- Any system and event messages stored in memory.

Example

The following example shows that system logging is enabled, the message level for flash memory is "errors" (i.e., default level 3 - 0), the message level for RAM is "debugging" (i.e., default level 7 - 0), and lists one sample error

```
Console#show logging flash
Syslog logging: Enable
History logging in FLASH: level errors
[0] 0:0:5 1/1/1
   "PRI_MGR_InitDefault function fails."
   level: 3, module: 13, function: 0, and event no.: 0
Console#show logging ram
Syslog logging: Enable
History logging in RAM: level debugging
[0] 0:0:5 1/1/1
   "PRI_MGR_InitDefault function fails."
   level: 3, module: 13, function: 0, and event no.: 0
Console#
```

System Status Commands

Table 3-16. System Status Commands			
Command	Function	Mode	Page
light unit	Displays the unit ID of a switch using its front-panel LED indicators	NE, PE	3-30
show startup-config	Displays the contents of the configuration file (stored in flash memory) that is used to start up the system	PE	3-30
show running-config	Displays the configuration data currently in use	PE	3-32
show system	Displays system information	NE, PE	3-33
show users	Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet clients	NE, PE	3-34
show version	Displays version information for the system	NE, PE	3-35

light unit
Use this command to display the unit ID of a switch using its front-panel LED
indicators.

Syntax

> **light unit** *unit*
>
> > *unit* - Specifies a unit in a switch stack to light the panel LEDs.

Default Setting

> None

Command Mode

> Normal Exec, Privileged Exec

Command Usage

> The unit ID is displayed using the port status LED indicators for ports 1 to 8.
> When the light unit command is entered, the LED corresponding to the
> switch's ID will flash for about 15 seconds.

Example

```
Console#light unit 1
Console#
```

show startup-config
Use this command to display the configuration file stored in non-volatile memory that
is used to start up the system.

Default Setting

> None

Command Mode

> Privileged Exec

Command Usage

> - Use this command in conjunction with the **show running-config** command to
>   compare the information in running memory to the information stored in
>   non-volatile memory.
>
> - This command displays settings for key command modes. Each mode group
>   is separated by "!" symbols, and includes the configuration mode command,
>   and corresponding commands. This command displays the following
>   information:

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- SNMP community strings
- Users (names and access levels)
- VLAN database (VLAN ID, name and state)
- VLAN configuration settings for each interface
- IP address configured for VLANs
- Spanning tree settings
- Any configured settings for the console port and Telnet

Example

```
Console#show startup-config
building startup-config, please wait.....
!
!
username admin access-level 15
username admin password 0 admin
!
username guest access-level 0
username guest password 0 guest
!
enable password level 15 0 super
!
snmp-server community public ro
snmp-server community private rw
!
vlan database
 vlan 1 name DefaultVlan media ethernet state active
!
!
interface ethernet 1/1
 switchport allowed vlan add 1 untagged
 switchport native vlan 1
.
.
.
interface vlan 1
 ip address 0.0.0.0 255.0.0.0
 ip address dhcp
!
line console
!
line vty
!
end

Console#
```

Related Commands

show running-config (3-32)

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show running-config

Use this command to display the configuration information currently in use.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- Use this command in conjunction with the **show startup-config** command to compare the information in running memory to the information stored in non-volatile memory.

- This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:

  - SNMP community strings
  - Users (names, access levels, and encrypted passwords)
  - VLAN database (VLAN ID, name and state)
  - VLAN configuration settings for each interface
  - IP address configured for VLANs
  - Spanning tree settings
  - Any configured settings for the console port and Telnet

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Example

```
Console#show running-config
building running-config, please wait.....
!
!
snmp-server community private rw
snmp-server community public ro
!
!
username admin access-level 15
username admin password 7 21232f297a57a5a743894a0e4a801fc3
username guest access-level 0
username guest password 7 084e0343a0486ff05530df6c705c8bb4
enable password level 15 7 1b3231655cebb7a1f783eddf27d254ca
!
vlan database
 vlan 1 name DefaultVlan media ethernet state active
!
!
interface ethernet 1/1
 switchport allowed vlan add 1 untagged
 switchport native vlan 1
.
.
!
interface vlan 1
 ip address 10.1.0.1 255.255.255.0
!
!
authentication login local
!
!
line console
!
line vty
!
end
Console#
```

Related Commands

show startup-config (3-30)

show system
Use this command to display system information.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

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Command Usage

- For a description of the items shown by this command, refer to "Displaying System Information" on page 2-6.
- The POST results should all display "PASS." If any POST test indicates "FAIL," contact your distributor for assistance.

Example

```
Console#show system
System description: FMS-24K
System OID string: 1.3.6.1.4.1.259.6.10.45
System information
 System Up time: 0 days, 1 hours, 1 minutes, and 1.93 seconds
 System Name          : [NONE]
 System Location      : [NONE]
 System Contact       : [NONE]
 MAC address          : 00-30-F1-6E-0D-E0
 Web server           : enable
 Web server port      : 80
 POST result
UART Loopback Test......................PASS
Timer Test..............................PASS
DRAM Test ..............................PASS
I2C Initialization......................PASS
Runtime Image Check ....................PASS
PCI Device Check .......................PASS
Switch Driver Initialization............PASS
Switch Internal Loopback Test...........PASS
------------------ DONE -------------------

Console#
```

show users

Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet client.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The session used to execute this command is indicated by a "*" symbol next to the Line (i.e., session) index number.

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Example

```
Console#show users
 Username accounts:
  Username Privilege
  -------- ---------
     guest        0
     admin       15

 Online users:
  Line        Username Idle time (h:m:s) Remote IP addr.
  ----------- -------- ----------------- ---------------
* 0   console   admin           0:00:00
  1    vty 0    admin           0:04:37      10.1.0.19

Console#
```

show version

Use this command to display hardware and software version information for the system.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

See "Displaying Switch Hardware/Software Versions" on page 2-20 for detailed information on software items.

Example

```
Console#show version
Unit1
 Serial number        :1111111111
 Service tag          :
 Hardware version     :R0A
 Number of ports      :26
 Main power status    :up
 Redundant power status :not present
Agent(master)
 Unit id              :1
 Loader version       :1.0.0.0
 Boot rom version     :1.0.0.0
 Operation code version :1.0.1.3
Console#
```

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SNMP Commands

Controls access to this switch from management stations using the Simple Network Management Protocol (SNMP), as well as the error types sent to trap managers.

Table 3-17. SNMP Commands			
Command	Function	Mode	Page
snmp-server community	Sets up the community access string to permit access to SNMP commands	GC	3-36
snmp-server contact	Sets the system contact string	GC	3-37
snmp-server location	Sets the system location string	GC	3-37
snmp-server host	Specifies the recipient of an SNMP notification operation	GC	3-38
snmp-server enable traps	Enables the device to send SNMP traps (i.e., SNMP notifications)	GC	3-39
show snmp	Displays the status of SNMP communications	NE, PE	3-40

snmp-server community
Use this command to define the community access string for the Simple Network Management Protocol. Use the **no** form to remove the specified community string.

Syntax

snmp-server community *string* [**ro**|**rw**]
no snmp-server community *string*

- *string* - Community string that acts like a password and permits access to the SNMP protocol. (Maximum length: 32 characters, case sensitive; Maximum number of strings: 5)
- **ro** - Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.
- **rw** - Specifies read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

Default Setting

- public - Read-only access. Authorized management stations are only able to retrieve MIB objects.
- private - Read-write access. Authorized management stations are able to both retrieve and modify MIB objects.

Command Mode

Global Configuration

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Command Usage

The first **snmp-server community** command you enter enables SNMP (SNMPv1). The **no snmp-server community** command disables SNMP.

Example

```
Console(config)#snmp-server community alpha rw
Console(config)#
```

snmp-server contact

Use this command to set the system contact string. Use the **no** form to remove the system contact information.

Syntax

snmp-server contact *string*
no snmp-server contact

string - String that describes the system contact information.
(Maximum length: 255 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server contact Paul
Console(config)#
```

Related Commands

snmp-server location (3-37)

snmp-server location

Use this command to set the system location string. Use the **no** form to remove the location string.

Syntax

snmp-server location *text*
no snmp-server location

text - String that describes the system location.
(Maximum length: 255 characters)

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Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server location WC-19
Console(config)#
```

Related Commands

snmp-server contact (3-37)

snmp-server host

Use this command to specify the recipient of a Simple Network Management Protocol notification operation. Use the **no** form to remove the specified host.

Syntax

snmp-server host *host-addr community-string*
no snmp-server host *host-addr*

- *host-addr* - Internet address of the host (the targeted recipient). (Maximum host addresses: 5 trap destination IP address entries)
- *community-string* - Password-like community string sent with the notification operation. Although you can set this string using the **snmp-server host** command by itself, we recommend that you define this string using the **snmp-server community** command prior to using the **snmp-server host** command. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- If you do not enter an **snmp-server host** command, no notifications are sent. In order to configure the switch to send SNMP notifications, you must enter at least one **snmp-server host** command. In order to enable multiple hosts, you must issue a separate **snmp-server host** command for each host.
- The **snmp-server host** command is used in conjunction with the **snmp-server enable traps** command. Use the **snmp-server enable traps** command to specify which SNMP notifications are sent globally. For a host to

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receive notifications, at least one **snmp-server enable traps** command and the **snmp-server host** command for that host must be enabled.

• However, some notification types cannot be controlled with the **snmp-server enable traps** command. For example, some notification types are always enabled.

Example

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#
```

Related Commands

snmp-server enable traps (3-39)

snmp-server enable traps

Use this command to enable this device to send Simple Network Management Protocol traps (SNMP notifications). Use the **no** form to disable SNMP notifications.

Syntax

snmp-server enable traps [**authentication** | **link-up-down**]
no snmp-server enable traps [**authentication** | **link-up-down**]

• **authentication** - Keyword to issue authentication failure traps.
• **link-up-down** - Keyword to issue link-up or link-down traps.
  The link-up-down trap can only be enabled/disabled via the CLI.

Default Setting

Issue authentication and link-up-down traps.

Command Mode

Global Configuration

Command Usage

• If you do not enter an **snmp-server enable traps** command, no notifications controlled by this command are sent. In order to configure this device to send SNMP notifications, you must enter at least one **snmp-server enable traps** command. If you enter the command with no keywords, both authentication and link-up-down notifications are enabled. If you enter the command with a keyword, only the notification type related to that keyword is enabled.
• The **snmp-server enable traps** command is used in conjunction with the **snmp-server host** command. Use the **snmp-server host** command to specify which host or hosts receive SNMP notifications. In order to send notifications, you must configure at least one **snmp-server host** command.

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Example

```
Console(config)#snmp-server enable traps link-up-down
Console(config)#
```

Related Commands

snmp-server host (3-38)

show snmp

Use this command to check the status of SNMP communications.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

This command provides information on the community access strings, counter information for SNMP input and output protocol data units, and whether or not SNMP logging has been enabled with the **snmp-server enable traps** command.

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Example

```
Console#show snmp

SNMP traps:
 Authentication: enable
   Link-up-down: enable

SNMP communities:
   1. private, and the privilege is read-write
   2. public, and the privilege is read-only

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

SNMP logging: disabled
Console#
```

DHCP Client

Table 3-18. DHCP Client Commands			
Command	Function	Mode	Page
ip dhcp restart	Submits a BOOTP or DHCP client request	PE	3-45

ip dhcp restart

This command submits a BOOTP or DHCP client request.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- This command issues a BOOTP or DHCP client request for any IP interface that has been set to BOOTP or DHCP mode via the **ip address** command.

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- DHCP requires the server to reassign the client's last address if available.
- If the BOOTP or DHCP server has been moved to a different domain, the network portion of the address provided to the client will be based on this new domain.

Example

In the following example, the device is reassigned the same address.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#end
Console#ip dhcp restart
Console#show ip interface
 IP address and netmask: 192.168.1.54 255.255.255.0 on VLAN 1,
 and address mode: DHCP.
Console#
```

Related Commands

ip address (3-43)

IP Interface Commands

There are no IP addresses assigned to this switch by default. You must manually configure a new address to manage the switch over your network or to connect the switch to existing IP subnets. You may also need to a establish a default gateway between this device and management stations or other devices that exist on another network segment.

Basic IP Configuration

Table 3-19. IP Interface Commands			
Command	Function	Mode	Page
ip address	Sets the IP address for the current interface	IC	3-43
ip default-gateway	Defines the default gateway through which an in-band management station can reach this device	GC	3-44
show ip interface	Displays the IP settings for this device	PE	3-44
show ip redirects	Displays the default gateway configured for this device	PE	3-45
ping	Sends ICMP echo request packets to another node on the network	NE, PE	3-45

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ip address

Use this command to set the IP address for the currently selected VLAN interface. Use the **no** form to restore the default IP address.

Syntax

> **ip address** {*ip-address netmask* | **bootp** | **dhcp**}
> **no ip address**

- *ip-address* - IP address
- *netmask* - Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.
- **bootp** - Obtains IP address from BOOTP.
- **dhcp** - Obtains IP address from DHCP.

Default Setting

> IP address: 0.0.0.0
> Netmask: 255.0.0.0

Command Mode

> Interface Configuration (VLAN)

Command Usage

- You must assign an IP address to this device to gain management access over the network. You can manually configure a specific IP address, or direct the device to obtain an address from a BOOTP or DHCP server. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Anything outside this format will not be accepted by the configuration program.
- If you select the **bootp** or **dhcp** option, IP is enabled but will not function until a BOOTP or DHCP reply has been received. Requests will be broadcast periodically by this device in an effort to learn its IP address. (BOOTP and DHCP values can include the IP address, default gateway, and subnet mask).
- You can start broadcasting BOOTP or DHCP requests by entering an **ip dhcp restart** command, or by rebooting the switch.

Note: Only one VLAN interface can be assigned an IP address (the default is VLAN 1). This defines the management VLAN, the only VLAN through which you can gain management access to the switch. If you assign an IP address to any other VLAN, the new IP address overrides the original IP address and this becomes the new management VLAN.

Example

In the following example, the device is assigned an address in VLAN 1.

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#
```

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Related Commands

ip dhcp restart (3-43)

ip default-gateway

Use this command to a establish a static route between this device and
management stations that exist on another network segment. Use the **no** form to
remove the static route.

Syntax

ip default-gateway *gateway*
no ip default-gateway

gateway - IP address of the default gateway

Default Setting

No static route is established.

Command Mode

Global Configuration

Command Usage

A gateway must be defined if the management station is located in a different
IP segment.

Example

The following example defines a default gateway for this device:

```
Console(config)#ip default-gateway 10.1.0.254
Console(config)#
```

Related Commands

show ip redirects (3-45)

show ip interface

Use this command to display the settings of an IP interface.

Default Setting

All interfaces

Command Mode

Privileged Exec

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Example

```
Console#show ip interface
 IP address and netmask: 10.1.0.254 255.255.255.0 on VLAN 1,
 and address mode: User specified.
Console#
```

Related Commands

show ip redirects (3-45)

show ip redirects
Use this command to show the default gateway configured for this device.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show ip redirects
ip default gateway 10.1.0.254
Console#
```

Related Commands

ip default-gateway (3-44)

ping
Use this command to send ICMP echo request packets to another node on the network.

Syntax

ping *host* [**count** *count*][**size** *size*]

- *host* - IP address or IP alias of the host.
- *count* - Number of packets to send. (Range: 1-16, default: 5)
- *size* - Number of bytes in a packet. (Range: 32-512, default: 32)
  The actual packet size will be eight bytes larger than the size specified because the switch adds header information.

Default Setting

This command has no default for the host.

Command Mode

Normal Exec, Privileged Exec

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Command Usage

- Use the **ping** command to see if another site on the network can be reached.
- Following are some results of the **ping** command:
  - *Normal response* - The normal response occurs in one to ten seconds, depending on network traffic.
  - *Destination does not respond* - If the host does not respond, a "timeout" appears in ten seconds.
  - *Destination unreachable* - The gateway for this destination indicates that the destination is unreachable.
  - *Network or host unreachable* - The gateway found no corresponding entry in the route table.
- Press <Esc> to stop pinging.

Example

```
Console#ping 10.1.0.9
Type ESC to abort.
PING to 10.1.0.9, by 5 32-byte payload ICMP packets, timeout is 5 seconds
response time: 10 ms
response time: 10 ms
response time: 10 ms
response time: 10 ms
response time: 0 ms
Ping statistics for 10.1.0.9:
 5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
 Minimum = 0 ms, Maximum = 10 ms, Average = 8 ms
Console#
```

Line Commands

You can access the onboard configuration program by attaching a VT100 compatible device to the server's serial port. These commands are used to set communication parameters for the serial port or Telnet (i.e., a virtual terminal).

Table 3-20. Line Commands			
Command	Function	Mode	Page
line	Identifies a specific line for configuration and starts the line configuration mode	GC	3-47
login	Enables password checking at login	LC	3-48
password	Specifies a password on a line	LC	3-49
exec-timeout	Sets the interval that the command interpreter waits until user input is detected	LC	3-50
password-thresh	Sets the password intrusion threshold, which limits the number of failed logon attempts	LC	3-50
silent-time*	Sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the **password-thresh** command	LC	3-51
databits*	Sets the number of data bits per character that are interpreted and generated by hardware	LC	3-52
parity*	Defines the generation of a parity bit	LC	3-53
speed*	Sets the terminal baud rate	LC	3-53
stopbits*	Sets the number of the stop bits transmitted per byte	LC	3-54
show line	Displays a terminal line's parameters	NE, PE	3-54

* These commands only apply to the serial port.

line
Use this command to identify a specific line for configuration, and to process subsequent line configuration commands.

Syntax

line {**console** | **vty**}

- **console** - Console terminal line.
- **vty** - Virtual terminal for remote console access (i.e., Telnet).

Default Setting

There is no default line.

Command Mode

Global Configuration

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Command Usage

Telnet is considered a virtual terminal connection and will be shown as "Vty" in screen displays such as **show users**. However, the serial communication parameters (e.g., databits) do not affect Telnet connections.

Example

To enter console line mode, enter the following command:

```
Console(config)#line console
Console(config-line)#
```

Related Commands

show line (3-54)
show users (3-34)

login

Use this command to enable password checking at login. Use the **no** form to disable password checking and allow connections without a password.

Syntax

login [**local**]
no login

local - Selects local password checking. Authentication is based on the user name specified with the **username** command.

Default Setting

login local

Command Mode

Line Configuration

Command Usage

- There are three authentication modes provided by the switch itself at login:
  - **login** selects authentication by a single global password as specified by the **password** line configuration command. When using this method, the management interface starts in Normal Exec (NE) mode.
  - **login local** selects authentication via the user name and password specified by the **username** command (i.e., default setting). When using this method, the management interface starts in Normal Exec (NE) or Privileged Exec (PE) mode, depending on the user's privilege level (0 or 15 respectively).
  - **no login** selects no authentication. When using this method, the management interface starts in Normal Exec (NE) mode.

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- This command controls login authentication via the switch itself. To configure user names and passwords for remote authentication servers, you must use the RADIUS/TACACS software installed on those servers.

Example

```
Console(config-line)#login local
Console(config-line)#
```

Related Commands

username (3-23)
password (3-49)

password

Use this command to specify the password for a line. Use the **no** form to remove the password.

Syntax

password {**0** | **7**} *password*
no password
- {**0** | **7**} - 0 means plain password, 7 means encrypted password
- *password* - Character string that specifies the line password.
(Maximum length: 8 characters plain text, 32 encrypted, case sensitive)

Default Setting

No password is specified.

Command Mode

Line Configuration

Command Usage

- When a connection is started on a line with password protection, the system prompts for the password. If you enter the correct password, the system shows a prompt. You can use the **password-thresh** command to set the number of times a user can enter an incorrect password before the system terminates the line connection and returns the terminal to the idle state.
- The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

```
Console(config-line)#password 0 secret
Console(config-line)#
```

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Related Commands

login (3-48)
password-thresh (3-50)

exec-timeout
Use this command to set the interval that the system waits until user input is detected. Use the **no** form to restore the default.

Syntax

exec-timeout *seconds*
no exec-timeout

seconds - Integer that specifies the number of seconds.
(Range: 0 - 65535 seconds; 0: no timeout)

Default Setting

CLI: No timeout
Telnet: 10 minutes

Command Mode

Line Configuration

Command Usage

- If user input is detected within the timeout interval, the session is kept open; otherwise the session is terminated.
- This command applies to both the local console and Telnet connections.
- The timeout for Telnet cannot be disabled.

Example

To set the timeout to two minutes, enter this command:

```
Console(config-line)#exec-timeout 120
Console(config-line)#
```

password-thresh
Use this command to set the password intrusion threshold which limits the number of failed logon attempts. Use the **no** form to remove the threshold value.

Syntax

password-thresh *threshold*
no password-thresh

threshold - The number of allowed password attempts.
(Range: 1-120; 0: no threshold)

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Default Setting

The default value is three attempts.

Command Mode

Line Configuration

Command Usage

- When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time before allowing the next logon attempt. (Use the **silent-time** command to set this interval.) When this threshold is reached for Telnet, the Telnet logon interface shuts down.
- This command applies to both the local console and Telnet connections.

Example

To set the password threshold to five attempts, enter this command:

```
Console(config-line)#password-thresh 5
Console(config-line)#
```

Related Commands

silent-time (3-51)

silent-time

Use this command to set the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the **password-thresh** command. Use the **no** form to remove the silent time value.

Syntax

silent-time *seconds*
no silent-time

seconds - The number of seconds to disable console response. (Range: 0-65535; 0: no silent-time)

Default Setting

The default value is no silent-time.

Command Mode

Line Configuration

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Example

To set the silent time to 60 seconds, enter this command:

```
Console(config-line)#silent-time 60
Console(config-line)#
```

Related Commands

password-thresh (3-50)

databits

Use this command to set the number of data bits per character that are interpreted and generated by the console port. Use the **no** form to restore the default value.

Syntax

databits {**7** | **8**}
no databits

- 7 - Seven data bits per character.
- 8 - Eight data bits per character.

Default Setting

8 data bits per character

Command Mode

Line Configuration

Command Usage

The **databits** command can be used to mask the high bit on input from devices that generate 7 data bits with parity. If parity is being generated, specify 7 data bits per character. If no parity is required, specify 8 data bits per character.

Example

To specify 7 data bits, enter this command:

```
Console(config-line)#databits 7
Console(config-line)#
```

Related Commands

parity (3-53)

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parity

Use this command to define generation of a parity bit. Use the **no** form to restore the default setting.

Syntax

> **parity** {**none** | **even** | **odd**}
> **no parity**
>
> - **none** - No parity
> - **even** - Even parity
> - **odd** - Odd parity

Default Setting

> No parity

Command Mode

> Line Configuration

Command Usage

> Communication protocols provided by devices such as terminals and modems often require a specific parity bit setting.

Example

To specify no parity, enter this command:

```
Console(config-line)#parity none
Console(config-line)#
```

speed

Use this command to set the terminal line's baud rate. This command sets both the transmit (to terminal) and receive (from terminal) speeds. Use the **no** form to restore the default setting.

Syntax

> **speed** *bps*
> **no speed**
>
> *bps* - Baud rate in bits per second.
> (Options: 9600, 57600, 38400, 19200, 115200 bps)

Default Setting

> 9600 bps

Command Mode

> Line Configuration

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Command Usage

Set the speed to match the baud rate of the device connected to the serial port. Some baud rates available on devices connected to the port might not be supported. The system indicates if the speed you selected is not supported.

Example

To specify 57600 bps, enter this command:

```
Console(config-line)#speed 57600
Console(config-line)#
```

stopbits

Use this command to set the number of the stop bits transmitted per byte. Use the **no** form to restore the default setting.

Syntax

stopbits {**1** | **2**}

* 1 - One stop bit
* 2 - Two stop bits

Default Setting

1 stop bit

Command Mode

Line Configuration

Example

To specify 2 stop bits, enter this command:

```
Console(config-line)#stopbits 2
Console(config-line)#
```

show line

Use this command to display the terminal line's parameters.

Syntax

show line [**console** | **vty**]

* **console** - Console terminal line.
* **vty** - Virtual terminal for remote console access.

Default Setting

Shows all lines

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Command Mode

Normal Exec, Privileged Exec

Example

To show all lines, enter this command:

```
Console#show line
 Console configuration:
  Password threshold: 3 times
  Interactive timeout: Disabled
  Silent time: Disabled
  Baudrate: 9600
  Databits: 8
  Parity: none
  Stopbits: 1

Vty configuration:
  Password threshold: 3 times
  Interactive timeout: 65535
Console#
```

Interface Commands

These commands are used to display or set communication parameters for an Ethernet port, aggregated link, or VLAN.

Command	Function	Mode	Page
interface	Configures an interface type and enters interface configuration mode	GC	3-56
description	Adds a description to an interface configuration	IC	3-56
speed-duplex	Configures the speed and duplex operation of a given interface when autonegotiation is disabled	IC	3-57
negotiation	Enables autonegotiation of a given interface	IC	3-58
capabilities	Advertises the capabilities of a given interface for use in autonegotiation	IC	3-59
flowcontrol	Enables flow control on a given interface	IC	3-60
clear counters	Clears the statistics on a given interface	PE	3-61
shutdown	Disables an interface	IC	3-61
switchport broadcast packet-rate	Configures broadcast storm threshold	IC	3-62
show interfaces status	Displays status for the specified interface	NE, PE	3-63
show interfaces counters	Displays statistics for the specified interfaces	NE, PE	3-64
show interfaces switchport	Displays the administrative and operational status of an interface	NE, PE	3-65

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interface

Use this command to configure an interface type and enter interface configuration mode. Use the **no** form to remove a trunk.

Syntax

interface *interface*
no interface port-channel *channel-id*

   interface

• **ethernet** *unit*/*port*
    - *unit* - This is device 1.
    - *port* - Port number.
• **port-channel** *channel-id* (Range: 1-6)
• **vlan** *vlan-id* (Range: 1-4094)

Default Setting

   None

Command Mode

Global Configuration

Example

To specify the port 25, enter the following command:

```
Console(config)#interface ethernet 1/25
Console(config-if)#
```

description

Use this command to add a description to an interface. Use the **no** form to remove the description.

Syntax

description *string*
no description

   string - Comment or a description to help you remember what is attached to this interface. (Range: 1-64 characters)

Default Setting

   None

Command Mode

   Interface Configuration (Ethernet, Port Channel)

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Example

The following example adds a description to port 25

```
Console(config)#interface ethernet 1/25
Console(config-if)#description RD-SW#3
Console(config-if)#
```

speed-duplex

Use this command to configure the speed and duplex mode of a given interface when autonegotiation is disabled. Use the **no** form to restore the default.

Syntax

speed-duplex {**1000full** | **100full** | **100half** | **10full** | **10half**}
no speed-duplex

- **1000full** - Forces 1000 Mbps full-duplex operation
- **100full** - Forces 100 Mbps full-duplex operation
- **100half** - Forces 100 Mbps half-duplex operation
- **10full** - Forces 10 Mbps full-duplex operation
- **10half** - Forces 10 Mbps half-duplex operation

Default Setting

- Auto-negotiation is enabled by default.
- When auto-negotiation is disabled, the default speed-duplex setting is 100half for 100BASE-TX ports and 1000full for Gigabit Ethernet ports.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- To force operation to the speed and duplex mode specified in a **speed-duplex** command, use the **no negotiation** command to disable auto-negotiation on the selected interface.
- When using the **negotiation** command to enable auto-negotiation, the optimal settings will be determined by the **capabilities** command. To set the speed/duplex mode under auto-negotiation, the required mode must be specified in the capabilities list for an interface.

Example

The following example configures port 5 to 100 Mbps, half-duplex operation.

```
Console(config)#interface ethernet 1/5
Console(config-if)#speed-duplex 100half
Console(config-if)#no negotiation
Console(config-if)#
```

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Related Commands

negotiation (3-58)
capabilities (3-59)

negotiation

Use this command to enable autonegotiation for a given interface. Use the **no** form to disable autonegotiation.

Syntax

[**no**] **negotiation**

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When auto-negotiation is enabled the switch will negotiate the best settings for a link based on the **capabilities** command. When auto-negotiation is disabled, you must manually specify the link attributes with the **speed-duplex** and **flowcontrol** commands.
- If autonegotiation is disabled, auto-MDI/MDI-X pin signal configuration will also be disabled for the RJ-45 ports.

Example

The following example configures port 11 to use autonegotiation

```
Console(config)#interface ethernet 1/11
Console(config-if)#negotiation
Console(config-if)#
```

negotiation (3-58)
speed-duplex (3-57)

capabilities

Use this command to advertise the port capabilities of a given interface during autonegotiation. Use the **no** form with parameters to remove an advertised capability, or the **no** form without parameters to restore the default values.

Syntax

capabilities {**1000full** | **100full** | **100half** | **10full** | **10half** | **flowcontrol** | **symmetric**}

no capabilities [**1000full** | **100full** | **100half** | **10full** | **10half** | **flowcontrol** | **symmetric**]

- **1000full** - Supports 1000 Mbps full-duplex operation
- **100full** - Supports 100 Mbps full-duplex operation
- **100half** - Supports 100 Mbps half-duplex operation
- **10full** - Supports 10 Mbps full-duplex operation
- **10half** - Supports 10 Mbps half-duplex operation
- **flowcontrol** - Supports flow control
- **symmetric** (Gigabit only) - When specified, the port transmits and receives pause frames; when not specified, the port will auto-negotiate to determine the sender and receiver for asymmetric pause frames. (*The current switch ASIC only supports symmetric pause frames.*)

Default Setting

- 100BASE-TX: 10half, 10full, 100half, 100full
- 1000BASE-T: 10half, 10full, 100half, 100full, 1000full
- 1000BASE-SX/LX/LH: 1000full

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When auto-negotiation is enabled with the **negotiation** command, the switch will negotiate the best settings for a link based on the **capabilities** command. When auto-negotiation is disabled, you must manually specify the link attributes with the **speed-duplex** and **flowcontrol** commands.

Example

The following example configures Ethernet port 5 capabilities to 100half, 100full and flow control

```
Console(config)#interface ethernet 1/5
Console(config-if)#capabilities 100half
Console(config-if)#capabilities 100full
Console(config-if)#capabilities flowcontrol
Console(config-if)#
```

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Related Commands

> negotiation (3-58)
> speed-duplex (3-57)
> flowcontrol (3-60)

flowcontrol

Use this command to enable flow control. Use the **no** form to disable flow control.

Syntax

> [**no**] **flowcontrol**

Default Setting

> Flow control enabled

Command Mode

> Interface Configuration (Ethernet, Port Channel)

Command Usage

- Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3x for full-duplex operation.
- To force flow control on or off (with the **flowcontrol** or **no flowcontrol** command), use the **no negotiation** command to disable auto-negotiation on the selected interface.
- When using the **negotiation** command to enable auto-negotiation, the optimal settings will be determined by the **capabilities** command. To enable flow control under auto-negotiation, "flowcontrol" must be included in the capabilities list for any port
- Avoid using flow control on a port connected to a hub unless it is actually required to solve a problem. Otherwise back pressure jamming signals may degrade overall performance for the segment attached to the hub.

Example

The following example enables flow control on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#flowcontrol
Console(config-if)#no negotiation
Console(config-if)#
```

Related Commands

> negotiation (3-58)
> capabilities (flowcontrol, symmetric) (3-59)

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clear counters

Use this command to clear statistics on an interface.

Syntax

> **clear counters** *interface*
>
> > *interface*
>
> - **ethernet** *unit*/*port*
>   - *unit* - This is device 1.
>   - *port* - Port number.
> - **port-channel** *channel-id* (Range: 1-6)

Default Setting

> None

Command Mode

> Privileged Exec

Command Usage

> Statistics are only initialized for a power reset. This command sets the base value for displayed statistics to zero for the current management session. However, if you log out and back into the management interface, the statistics displayed will show the absolute value accumulated since the last power reset.

Example

The following example clears statistics on Ethernet port 1/1

```
Console#clear counters ethernet 1/1
Console#
```

shutdown

Use this command to disable an interface. To restart a disabled interface, use the **no** form.

Syntax

> [**no**] **shutdown**

Default Setting

> All interfaces are enabled.

Command Mode

> Interface Configuration (Ethernet, Port Channel)

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Command Usage

This command allows you to disable a port due to abnormal behavior (e.g., excessive collisions), and then reenable it after the problem has been resolved. You may also want to disable a port for security reasons.

Example

The following example disables port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#shutdown
Console(config-if)#
```

switchport broadcast packet-rate
Use this command to configure broadcast storm control. Use the **no** form to disable broadcast storm control.

Syntax

switchport broadcast packet-rate *rate*
no switchport broadcast

rate - Threshold level as a rate; i.e., packets per second.
(Range: 500 - 262143)

Default Setting

Enabled for all ports
Packet-rate limit: 500 packets per second

Command Mode

Interface Configuration (Ethernet)

Command Usage

• When broadcast traffic exceeds the specified threshold, packets above that threshold are dropped.
• This command can enable or disable broadcast storm control for the selected interface. However, the specified threshold value applies to all ports on the switch.

Example

The following shows how to configure broadcast storm control at 600 packets per second on port 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#switchport broadcast packet-rate 600
Console(config-if)#
```

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show interfaces status

Use this command to display the status for an interface.

Syntax

show interfaces status [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)
- **vlan** *vlan-id* (Range: 1-4094)

Default Setting

Shows the status for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed. For a description of the items displayed by this command, see "Displaying Connection Status" on page 2-22.

Example

```
Console#show interfaces status ethernet 1/5
Information of Eth 1/5
 Basic information:
  Port type: 100TX
  Mac address: 00-00-AB-CD-00-01
 Configuration:
  Name:
  Port admin: Up
  Speed-duplex: Auto
  Capabilities: 10half, 10full, 100half, 100full,
  Broadcast storm: Enabled
  Broadcast storm limit: 500 packets/second
  Flow control: Disabled
  Lacp: Disabled
 Current status:
  Link status: Up
  Port operation status: Up
  Operation speed-duplex: 100full
  Flow control type: None
Console#show interfaces status vlan 1
 Information of VLAN 1
 MAC address: 00-00-AB-CD-00-00
Console#
```

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show interfaces counters

Use this command to display interface statistics.

Syntax

show interfaces counters [*interface*]

interface

- **ethernet** *unit/port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Default Setting

Shows the counters for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed. For a description of the items displayed by this command, see "Showing Port Statistics" on page 2-86.

Example

```
Console#show interfaces counters ethernet 1/7
Ethernet 1/7
 Iftable stats:
  Octets input: 30658, Octets output: 196550
  Unicast input: 6, Unicast output: 5
  Discard input: 0, Discard output: 0
  Error input: 0, Error output: 0
  Unknown protos input: 0, QLen output: 0
 Extended iftable stats:
  Multi-cast input: 0, Multi-cast output: 3064
  Broadcast input: 262, Broadcast output: 1
 Ether-like stats:
  Alignment errors: 0, FCS errors: 0
  Single Collision frames: 0, Multiple collision frames: 0
  SQE Test errors: 0, Deferred transmissions: 0
  Late collisions: 0, Excessive collisions: 0
  Internal mac transmit errors: 0, Internal mac receive errors: 0
  Frame too longs: 0, Carrier sense errors: 0
  Symbol errors: 0
 RMON stats:
  Drop events: 0, Octets: 227208, Packets: 3338
  Broadcast pkts: 263, Multi-cast pkts: 3064
  Undersize pkts: 0, Oversize pkts: 0
  Fragments: 0, Jabbers: 0
  CRC align errors: 0, Collisions: 0
  Packet size <= 64 octets: 3150, Packet size 65 to 127 octets: 139
  Packet size 128 to 255 octets: 49, Packet size 256 to 511 octets: 0
  Packet size 512 to 1023 octets: 0, Packet size 1024 to 1518 octets: 0
Console#
```

show interfaces switchport

Use this command to display the administrative and operational status of the specified interfaces.

Syntax

show interfaces switchport [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Default Setting

Shows all interfaces.

Command Mode

Normal Exec, Privileged Exec

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Command Usage

If no interface is specified, information on all interfaces is displayed.

Example

This example shows the configuration setting for port 25**.**

```
Console#show interfaces switchport ethernet 1/22
Information of Eth 1/22
 Broadcast threshold: Enabled, 500 packets/second
 Lacp status: Disabled
 Ingress rate limit: disable,100M bits per second
 Egress rate limit: disable,100M bits per second
 VLAN membership mode: Hybrid
 Ingress rule: Disabled
 Acceptable frame type: All frames
 Native VLAN: 1
 Priority for untagged traffic: 0
 Gvrp status: Disabled
 Allowed Vlan:    1(u),
 Forbidden Vlan:
 Private-vlan mode: NONE
 Private-vlan host-association: NONE
 Private-vlan mapping: NONE
Console#
```

Table 3-21. Interfaces Switchport Statistics	
Field	Description
Broadcast threshold	Shows if broadcast storm suppression is enabled or disabled; if enabled it also shows the threshold level (page 3-62).
Lacp status	Shows if Link Aggregation Control Protocol has been enabled or disabled (page 3-126).
VLAN membership mode	Indicates membership mode as Trunk or Hybrid (page 3-86).
Ingress rule	Shows if ingress filtering is enabled or disabled (page 3-87).
Acceptable frame type	Shows if acceptable VLAN frames include all types or tagged frames only (page 3-87).
Native VLAN	Indicates the default Port VLAN ID (page 3-88).
Priority for untagged traffic	Indicates the default priority for untagged frames (page 3-111).
Gvrp status	Shows if GARP VLAN Registration Protocol is enabled or disabled (page 3-97).
Allowed Vlan	Shows the VLANs this interface has joined, where "(u)" indicates untagged and "(t)" indicates tagged (page 3-89).
Forbidden Vlan	Shows the VLANs this interface can not dynamically join via GVRP (page 3-90).

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Address Table Commands

These commands are used to configure the address table for filtering specified addresses, displaying current entries, clearing the table, or setting the aging time.

Table 3-22. Address Table Commands			
Command	Function	Mode	Page
mac-address-table static	Maps a static address to a port in a VLAN	GC	3-67
show mac-address-table	Displays entries in the bridge-forwarding database	PE	3-68
clear mac-address-table dynamic	Removes any learned entries from the forwarding database	PE	3-69
mac-address-table aging-time	Sets the aging time of the address table	GC	3-69
show mac-address-table aging-time	Shows the aging time for the address table	PE	3-70

mac-address-table static
Use this command to map a static address to a destination port in a VLAN. Use the **no** form to remove an address.

Syntax

mac-address-table static *mac-address* **interface** *interface* **vlan** *vlan-id*
[*action*]
no mac-address-table static *mac-address* **vlan** *vlan-id*

- *mac-address* - MAC address.
- *interface*
    - **ethernet** *unit/port*
        - *unit* - This is device 1.
        - *port* - Port number.
    - **port-channel** *channel-id* (Range: 1-4)
- *vlan-id* - VLAN ID (Range: 1-4094)
- *action* -
    - **delete-on-reset** - Assignment lasts until the switch is reset.
    - **permanent** - Assignment is permanent.

Default Setting

No static addresses are defined. The default mode is **permanent**.

Command Mode

Global Configuration

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Command Usage

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

- Static addresses will not be removed from the address table when a given interface link is down.
- Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.
- A static address cannot be learned on another port until the address is removed with the **no** form of this command.

Example

```
Console(config)#mac-address-table static 00-e0-29-94-34-de interface
ethernet 1/1 vlan 1 delete-on-reset
Console(config)#
```

show mac-address-table

Use this command to view classes of entries in the bridge-forwarding database.

Syntax

show mac-address-table [**address** *mac-address* [*mask*]] [**interface** *interface*] [**vlan** *vlan-id*] [**sort** {**address** | **vlan** | **interface**}]

- *mac-address* - MAC address.
- *mask* - Bits to match in the address.
- *interface*
  - **ethernet** *unit*/*port*
    - *unit* - This is device 1.
    - *port* - Port number.
  - **port-channel** *channel-id* (Range: 1-4)
- *vlan-id* - VLAN ID (Range: 1-4094)
- **sort** - Sort by address, vlan or interface.

Default Setting

None

Command Mode

Privileged Exec

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Command Usage

- The MAC Address Table contains the MAC addresses associated with each interface. Note that the Type field may include the following types:
  - Learned - Dynamic address entries
  - Permanent - Static entry
  - Delete-on-reset - Static entry to be deleted when system is reset
- The mask should be hexadecimal numbers (representing an equivalent bit mask) in the form xx-xx-xx-xx-xx-xx that is applied to the specified MAC address. Enter hexadecimal numbers, where an equivalent binary bit "0" means to match a bit and "1" means to ignore a bit. For example, a mask of 00-00-00-00-00-00 means an exact match, and a mask of FF-FF-FF-FF-FF-FF means "any."
- The maximum number of address entries is 8191.

Example

```
Console#show mac-address-table
 Interface Mac Address        Vlan Type
 --------- ----------------- ---- ----------------
  Eth 1/ 1 00-E0-29-94-34-DE    1 Delete-on-reset
  Console#
```

clear mac-address-table dynamic
Use this command to remove any learned entries from the forwarding database and to clear the transmit and receive counts for any static or system configured entries.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#clear mac-address-table dynamic
Console#
```

mac-address-table aging-time
Use this command to set the aging time for entries in the address table. Use the **no** form to restore the default aging time.

Syntax

mac-address-table aging-time *seconds*

seconds - Time in number of seconds (10-1000000).

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Default Setting

300 seconds

Command Mode

Global Configuration

Command Usage

The aging time is used to age out dynamically learned forwarding information.

Example

```
Console(config)#mac-address-table aging-time 300
Console(config)#
```

Spanning Tree Commands

This section includes commands that configure the Spanning Tree Algorithm (STA) globally for the switch, and commands that configure STA for the selected interface.

Table 3-23. Spanning Tree Commands			
Command	Function	Mode	Page
spanning-tree	Enables the spanning tree protocol	GC	3-71
spanning-tree mode	Configures STP or RSTP mode	GC	3-71
spanning-tree forward-time	Configures the spanning tree bridge forward time	GC	3-72
spanning-tree hello-time	Configures the spanning tree bridge hello time	GC	3-73
spanning-tree max-age	Configures the spanning tree bridge maximum age	GC	3-73
spanning-tree priority	Configures the spanning tree bridge priority	GC	3-74
spanning-tree pathcost method	Configures the path cost method for RSTP	GC	3-75
spanning-tree transmission-limit	Configures the transmission limit for RSTP	GC	3-75
spanning-tree cost	Configures the spanning tree path cost of an interface	IC	3-76
spanning-tree port-priority	Configures the spanning tree priority of an interface	IC	3-77
spanning-tree portfast	Sets an interface to fast forwarding	IC	3-77
spanning-tree edge-port	Enables fast forwarding for edge ports	IC	3-78
spanning-tree protocol-migration	Re-checks the appropriate BPDU format	PE	3-79
spanning-tree link-type	Configures the link type for RSTP	IC	3-80
show spanning-tree	Shows spanning tree configuration for the overall bridge or a selected interface	PE	3-81

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spanning-tree

Use this command to enable the Spanning Tree Algorithm globally for the switch. Use the **no** form to disable it.

Syntax

[**no**] **spanning-tree**

Default Setting

Spanning tree is enabled.

Command Mode

Global Configuration

Command Usage

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

Example

This example shows how to enable the Spanning Tree Algorithm for the switch:

```
Console(config)#spanning-tree
Console(config)#
```

spanning-tree mode

Use this command to select the spanning tree mode for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree mode {**stp | rstp**}
no spanning-tree mode

- **stp** - Spanning Tree Protocol (IEEE 802.1D)
- **rstp** - Rapid Spanning Tree (IEEE 802.1w)

Default Setting

rstp

Command Mode

Global Configuration

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Command Usage

- Spanning Tree Protocol

  Uses RSTP for the internal state machine, but sends only 802.1D BPDUs.

- Rapid Spanning Tree Protocol

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

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

Example

The following example configures the switch to use Rapid Spanning Tree.

```
Console(config)#spanning-tree mode rstp
Console(config)#
```

spanning-tree forward-time

Use this command to configure the spanning tree bridge forward time globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree forward-time *seconds*
no spanning-tree forward-time

seconds - Time in seconds. (Range: 4 - 30 seconds)
The minimum value is the higher of 4 or [(max-age / 2) + 1].

Default Setting

15 seconds

Command Mode

Global Configuration

Command Usage

This command sets the maximum time (in seconds) the root device will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology

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changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to a blocking state; otherwise, temporary data loops might result.

Example

```
Console(config)#spanning-tree forward-time 20
Console(config)#
```

spanning-tree hello-time

Use this command to configure the spanning tree bridge hello time globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree hello-time *time*
no spanning-tree hello-time

time - Time in seconds, (Range: 1 - 10 seconds).
The maximum value is the lower of 10 or [(max-age / 2) -1].

Default Setting

2 seconds

Command Mode

Global Configuration

Command Usage

This command sets the time interval (in seconds) at which the root device transmits a configuration message.

Example

```
Console(config)#spanning-tree hello-time 5
Console(config)#
```

spanning-tree max-age

Use this command to configure the spanning tree bridge maximum age globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree max-age *seconds*
no spanning-tree max-age

seconds - Time in seconds. (Range: 6-40 seconds)
The minimum value is the higher of 6 or [2 x (hello-time + 1)].
The maximum value is the lower of 40 or [2 x (forward-time - 1)].

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Default Setting

    20 seconds

Command Mode

    Global Configuration

Command Usage

    This command sets the maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconfigure. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network.

Example

```
Console(config)#spanning-tree max-age 40
Console(config)#
```

spanning-tree priority

Use this command to configure the spanning tree priority globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree priority *priority*
no spanning-tree priority

    priority - Priority of the bridge. (Range: 0 - 65535)
    (Range – 0-61440, in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440)

Default Setting

    32768

Command Mode

    Global Configuration

Command Usage

    Bridge priority is used in selecting the root device, root port, and designated port. The device with the highest priority becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.

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Example

```
Console(config)#spanning-tree priority 40000
Console(config)#
```

spanning-tree pathcost method

Use this command to configure the path cost method used for Rapid Spanning Tree. Use the **no** form to restore the default.

Syntax

spanning-tree pathcost method {**long | short**}
no spanning-tree pathcost method

- **long** - Specifies 32-bit based values that range from 1-200,000,000.
- **short** - Specifies 16-bit based values that range from 1-65535.

Default Setting

short method

Command Mode

Global Configuration

Command Usage

The path cost method is used to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. Note that path cost (page 3-75) takes precedence over port priority (page 3-77).

Example

```
Console (config)# spanning-tree pathcost method long
Console (config)#
```

spanning-tree transmission-limit

Use this command to configure the minimum interval between the transmission of consecutive RSTP BPDUs. Use the **no** form to restore the default.

Syntax

spanning-tree transmission-limit *count*
no spanning-tree transmission-limit

count -The transmission limit in seconds. (Range: 1-10)

Default

3

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Command Mode

Global Configuration

Command Usage

This command limits the maximum transmission rate for BPDUs.

Example

```
Console(config)#spanning-tree transmission-limit 4
Console(config)#
```

spanning-tree cost

Use this command to configure the spanning tree path cost for the specified interface. Use the **no** form to restore the default.

Syntax

spanning-tree cost *cost*
no spanning-tree cost

cost - The path cost for the port. (Range: 1-200,000,000))
The recommended range is:

- Ethernet: 200,000-20,000,000
- Fast Ethernet: 20,000-2,000,000
- Gigabit Ethernet: 2,000-200,000

Default Setting

- Ethernet – half duplex: 2,000,000; full duplex: 1,000,000; trunk: 500,000
- Fast Ethernet – half duplex: 200,000; full duplex: 100,000; trunk: 50,000
- Gigabit Ethernet – full duplex: 10,000; trunk: 5,000

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command is used by the Spanning Tree Algorithm to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media.
- Path cost takes precedence over port priority.
- When the spanning-tree pathcost method (page 3-75) is set to short, the maximum value for path cost is 65,535.

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Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree cost 50
Console(config-if)#
```

spanning-tree port-priority

Use this command to configure the priority for the specified interface. Use the **no** form to restore the default.

Syntax

spanning-tree port-priority *priority*
no spanning-tree port-priority

  priority - The priority for a port. (Range: 0-240, in steps of 16)

Default Setting

  128

Command Mode

  Interface Configuration (Ethernet, Port Channel)

Command Usage

  • This command defines the priority for the use of a port in the Spanning Tree Algorithm. If the path cost for all ports on a switch are the same, the port with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.
  • Where more than one port is assigned the highest priority, the port with the lowest numeric identifier will be enabled.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-priority 0
Console(config-if)#
```

Related Commands

  spanning-tree cost (3-76)

spanning-tree portfast

Use this command to set an interface to fast forwarding. Use the **no** form to disable fast forwarding.

Syntax

spanning-tree portfast
no spanning-tree portfast

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Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command is used to enable/disable the fast spanning-tree mode for the selected port. In this mode, ports skip the Discarding and Learning states, and proceed straight to Forwarding.
- Since end-nodes cannot cause forwarding loops, they can be passed through the spanning tree state changes more quickly than allowed by standard convergence time. Fast forwarding can achieve quicker convergence for end-node workstations and servers, and also overcome other STA related timeout problems. (Remember that fast forwarding should only be enabled for ports connected to a LAN segment that is at the end of a bridged LAN or for an end-node device.)
- This command is the same as **spanning-tree edge-port**, and is only included for backward compatibility with earlier products. Note that this command may be removed for future software versions.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree portfast
Console(config-if)#
```

Related Commands

spanning-tree edge-port (3-78)

spanning-tree edge-port

Use this command to specify an interface as an edge port. Use the **no** form to restore the default.

Syntax

spanning-tree edge-port
no spanning-tree edge-port

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

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Command Usage

- You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes cannot cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related timeout problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device.
- This command has the same effect as the **spanning-tree portfast**.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#
```

Related Commands

spanning-tree portfast (3-77)

spanning-tree protocol-migration
Use this command to re-check the appropriate BPDU format to send on the selected interface.

Syntax

spanning-tree protocol-migration *interface*

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Command Mode

Privileged Exec

Command Usage

If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the

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spanning-tree protocol-migration command at any time to manually re-check the appropriate BPDU format to send on the selected interfaces (i.e., RSTP or STP-compatible).

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree protocol-migration
Console(config-if)#
```

spanning-tree link-type

Use this command to configure the link type for Rapid Spanning Tree. Use the **no** form to restore the default.

Syntax

spanning-tree link-type {**auto** | **point-to-point** | **shared**}
no spanning-tree link-type

- **auto** - Automatically derived from the duplex mode setting.
- **point-to-point** - Point-to-point link.
- **shared** - Shared medium.

Default Setting

auto

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Specify a point-to-point link if the interface can only be connected to exactly one other bridge, or a shared link if it can be connected to two or more bridges.
- When automatic detection is selected, the switch derives the link type from the duplex mode. A full-duplex interface is considered a point-to-point link, while a half-duplex interface is assumed to be on a shared link.
- RSTP only works on point-to-point links between two bridges. If you designate a port as a shared link, RSTP is forbidden.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree link-type point-to-point
Console(config-if)#
```

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show spanning-tree

Use this command to show the spanning tree configuration.

Syntax

show spanning-tree [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- Use the **show spanning-tree** command with no parameters to display the spanning tree configuration for the switch and for every interface in the tree.
- Use the **show spanning-tree** *interface* command to display the spanning tree configuration for an interface.
- For a description of the items displayed under "Spanning-tree information," see "Configuring Global Settings" on page 2-34. For a description of the items displayed for specific interfaces, see "Displaying Interface Settings" on page 2-38.

Example

```
Console#show spanning-tree
Spanning-tree information
-------------------------------------------------------------
 Spanning tree mode              :RSTP
 Spanning tree enable/disable    :enable
 Priority                        :32768
 Bridge Hello Time (sec.)        :2
 Bridge Max Age (sec.)           :20
 Bridge Forward Delay (sec.)     :15
 Root Hello Time (sec.)          :2
 Root Max Age (sec.)             :20
 Root Forward Delay (sec.)       :15
 Designated Root                 :32768.0000ABCD0000
 Current root port               :0
 Current root cost               :0
 Number of topology changes      :2
 Last topology changes time (sec.):1718
 Transmission limit              :3
 Path Cost Method                :long
-------------------------------------------------------------
Eth  1/ 1 information
-------------------------------------------------------------
 Admin status       : enable
 Role               : disable
 State              : discarding
 Path cost          : 100000
 Priority           : 128
 Designated cost    : 0
 Designated port    : 128.1
 Designated root    : 32768.0000ABCD0000
 Designated bridge  : 32768.0000ABCD0000
 Forward transitions : 0
 Fast forwarding    : disable
 Admin edge port    : disable
 Oper edge port     : disable
 Admin Link type    : auto
 Oper Link type     : point-to-point
.
.
.
Console#
```

VLAN Commands

A VLAN is a group of ports that can be located anywhere in the network, but communicate as though they belong to the same physical segment. This section describes commands used to create VLAN groups, add port members, specify how VLAN tagging is used, and enable automatic VLAN registration for the selected interface.

Table 3-24. VLANs		
Command Groups	Function	Page
Editing VLAN Groups	Sets up VLAN groups, including name, VID and state	3-83
Configuring VLAN Interfaces	Configures VLAN interface parameters, including ingress and egress tagging mode, ingress filtering, PVID, and GVRP	3-85
Displaying VLAN Information	Displays VLAN groups, status, port members, and MAC addresses	3-91
Configuring Private VLANs	Configures private VLANs, including uplink and downlink ports	4-150

Editing VLAN Groups

Table 3-25. Editing VLAN Groups			
Command	Function	Mode	Page
vlan database	Enters VLAN database mode to add, change, and delete VLANs	GC	3-83
vlan	Configures a VLAN, including VID, name and state	VC	3-84

vlan database
Use this command to enter VLAN database mode. All commands in this mode will take effect immediately.

Default Setting

None

Command Mode

Global Configuration

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Command Usage

- Use the VLAN database command mode to add, change, and delete VLANs. After finishing configuration changes, you can display the VLAN settings by entering the **show vlan** command.
- Use the **interface vlan** command mode to define the port membership mode and add or remove ports from a VLAN. The results of these commands are written to the running-configuration file, and you can display this file by entering the **show running-config** command.

Example

```
Console(config)#vlan database
Console(config-vlan)#
```

Related Commands

show vlan (3-91)

vlan

Use this command to configure a VLAN. Use the **no** form to restore the default settings or delete a VLAN.

Syntax

vlan *vlan-id* [**name** *vlan-name*] **media ethernet** [**state** {**active** | **suspend**}]
no vlan *vlan-id* [**name** | **state**]

- *vlan-id* - ID of configured VLAN. (Range: 1-4094, no leading zeroes)
- **name** - Keyword to be followed by the VLAN name.
  - *vlan-name* - ASCII string from 1 to 32 characters.
- **media ethernet** - Ethernet media type.
- **state** - Keyword to be followed by the VLAN state.
  - **active** - VLAN is operational.
  - **suspend** - VLAN is suspended. Suspended VLANs do not pass packets.

Default Setting

By default only VLAN 1 exists and is active.

Command Mode

VLAN Database Configuration

Command Usage

- **no vlan** *vlan-id* deletes the VLAN.
- **no vlan** *vlan-id* **name** removes the VLAN name.
- **no vlan** *vlan-id* **state** returns the VLAN to the default state (i.e., active).
- You can configure up to 255 VLANs on the switch.

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Example

The following example adds a VLAN, using VLAN ID 105 and name RD5. The VLAN is activated by default.

```
Console(config)#vlan database
Console(config-vlan)#vlan 105 name RD5 media ethernet
Console(config-vlan)#
```

Related Commands

show vlan (3-91)

Configuring VLAN Interfaces

Command	Function	Mode	Page
	Table 3-26. Configuring VLAN Interfaces		
interface vlan	Enters interface configuration mode for a specified VLAN	IC	3-85
switchport mode	Configures VLAN membership mode for an interface	IC	3-86
switchport acceptable-frame-types	Configures frame types to be accepted by an interface	IC	3-87
switchport ingress-filtering	Enables ingress filtering on an interface	IC	3-87
switchport native vlan	Configures the PVID (native VLAN) of an interface	IC	3-88
switchport allowed vlan	Configures the VLANs associated with an interface	IC	3-89
switchport gvrp	Enables GVRP for an interface	IC	3-97
switchport forbidden vlan	Configures forbidden VLANs for an interface	IC	3-90

interface vlan

Use this command to enter interface configuration mode for VLANs, and configure a physical interface.

Syntax

interface vlan *vlan-id*

vlan-id - ID of the configured VLAN. (Range: 1-4094, no leading zeroes)

Default Setting

None

Command Mode

Global Configuration

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Example

The following example shows how to set the interface configuration mode to VLAN 1, and then assign an IP address to the VLAN:

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.254 255.255.255.0
Console(config-if)#
```

Related Commands

shutdown (3-61)

switchport mode
Use this command to configure the VLAN membership mode for a port. Use the **no** form to restore the default.

Syntax

switchport mode {**trunk** | **hybrid**}
no switchport mode

- **trunk** - Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that identify the source VLAN. However, note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are sent untagged.
- **hybrid** - Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames.

Default Setting

All ports are in hybrid mode with the PVID set to VLAN 1.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

The following shows how to set the configuration mode to port 1, and then set the switchport mode to hybrid:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport mode hybrid
Console(config-if)#
```

Related Commands

switchport acceptable-frame-types (3-87)

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switchport acceptable-frame-types

Use this command to configure the acceptable frame types for a port. Use the **no** form to restore the default.

Syntax

> **switchport acceptable-frame-types** {**all** | **tagged**}
> **no switchport acceptable-frame-types**
>
> - **all** - The port accepts all frames, tagged or untagged.
> - **tagged** - The port only passes tagged frames.

Default Setting

> All frame types

Command Mode

> Interface Configuration (Ethernet, Port Channel)

Command Usage

> When set to receive all frame types, any received frames that are untagged are assigned to the default VLAN.

Example

The following example shows how to restrict the traffic passed on port 1 to tagged frames:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport acceptable-frame-types tagged
Console(config-if)#
```

Related Commands

> switchport mode (3-86)

switchport ingress-filtering

Use this command to enable ingress filtering for an interface. Use the **no** form to restore the default.

Syntax

> [**no**] **switchport ingress-filtering**

Default Setting

> Disabled

Command Mode

> Interface Configuration (Ethernet, Port Channel)

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Command Usage

- Ingress filtering only affects tagged frames.
- If ingress filtering is disabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be flooded to all other ports (except for those VLANs explicitly forbidden on this port).
- If ingress filtering is enabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be discarded.
- Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STA. However, they do affect VLAN dependent BPDU frames, such as GMRP.

Example

The following example shows how to set the interface to port 1 and then enable ingress filtering:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport ingress-filtering
Console(config-if)#
```

switchport native vlan

Use this command to configure the PVID (i.e., default VLAN ID) for a port. Use the **no** form to restore the default.

Syntax

switchport native vlan *vlan-id*
no switchport native vlan

vlan-id - Default VLAN ID for a port. (Range: 1-4094, no leading zeroes)

Default Setting

VLAN 1

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If an interface is not a member of VLAN 1 and you assign its PVID to this VLAN, the interface will automatically be added to VLAN 1 as an untagged member. For all other VLANs, an interface must first be configured as an untagged member before you can assign its PVID to that group.
- If acceptable frame types is set to **all** or switchport mode is set to **hybrid**, the PVID will be inserted into all untagged frames entering the ingress port.

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Example

The following example shows how to set the PVID for port 1 to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport native vlan 3
Console(config-if)#
```

switchport allowed vlan

Use this command to configure VLAN groups on the selected interface. Use the **no** form to restore the default.

Syntax

> **switchport allowed vlan** {**add** *vlan-list* [**tagged** | **untagged**] |
>   **remove** *vlan-list*}
> **no switchport allowed vlan**

> - **add** *vlan-list* - List of VLAN identifiers to add.
> - **remove** *vlan-list* - List of VLAN identifiers to remove.
> - *vlan-list* - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. Do not enter leading zeros. (Range: 1-4094).

Default Setting

> All ports are assigned to VLAN 1 by default.
> The default frame type is untagged.

Command Mode

> Interface Configuration (Ethernet, Port Channel)

Command Usage

> - A port, or a trunk with switchport mode set to **hybrid**, must be assigned to at least one VLAN as untagged.
> - If a trunk has switchport mode set to **trunk** (i.e., 1Q Trunk), then you can only assign an interface to VLAN groups as a tagged member.
> - Frames are always tagged within the switch. The tagged/untagged parameter used when adding a VLAN to an interface tells the switch whether to keep or remove the tag from a frame on egress.
> - If none of the intermediate network devices nor the host at the other end of the connection supports VLANs, the interface should be added to these VLANs as an untagged member. Otherwise, it is only necessary to add at most one VLAN as untagged, and this should correspond to the native VLAN for the interface.

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• If a VLAN on the forbidden list for an interface is manually added to that interface, the VLAN is automatically removed from the forbidden list for that interface.

Example

The following example shows how to add VLANs 1, 2, 5 and 6 to the allowed list as tagged VLANs for port 1:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 1,2,5,6 tagged
Console(config-if)#
```

switchport forbidden vlan

Use this command to configure forbidden VLANs. Use the **no** form to remove the list of forbidden VLANs.

Syntax

switchport forbidden vlan {**add** *vlan-list* | **remove** *vlan-list*}
no switchport forbidden vlan

• **add** *vlan-list* - List of VLAN identifiers to add.
• **remove** *vlan-list* - List of VLAN identifiers to remove.
• *vlan-list* - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. Do not enter leading zeros. (Range: 1-4094).

Default Setting

No VLANs are included in the forbidden list.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

• This command prevents a VLAN from being automatically added to the specified interface via GVRP.
• If a VLAN has been added to the set of allowed VLANs for an interface, then you cannot add it to the set of forbidden VLANs for that same interface.

Example

The following example shows how to prevent port 1 from being added to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport forbidden vlan add 3
Console(config-if)#
```

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Displaying VLAN Information

<table>
<tr><th colspan="4">Table 3-27. Show VLAN Commands</th></tr>
<tr><th>Command</th><th>Function</th><th>Mode</th><th>Page</th></tr>
<tr><td>show vlan</td><td>Shows VLAN information</td><td>NE, PE</td><td>3-91</td></tr>
<tr><td>show interfaces status vlan</td><td>Displays status for the specified VLAN interface</td><td>NE, PE</td><td>3-63</td></tr>
<tr><td>show interfaces switchport</td><td>Displays the administrative and operational status of an interface</td><td>NE, PE</td><td>3-65</td></tr>
</table>

show vlan

Use this command to show VLAN information.

Syntax

> **show vlan** [**id** *vlan-id* | **name** *vlan-name*]

- **id** - Keyword to be followed by the VLAN ID.
  - *vlan-id* - ID of the configured VLAN. (Range: 1-4094, no leading zeroes)
- **name** - Keyword to be followed by the VLAN name.
  - *vlan-name* - ASCII string from 1 to 32 characters.

Default Setting

> Shows all VLANs.

Command Mode

> Normal Exec, Privileged Exec

Example

The following example shows how to display information for VLAN 1:

```
Console#show vlan id 1
VLAN Type    Name        Status   Ports/Channel groups
---- ------- ----------- ------   ------------------------------------
1    Static  DefaultVlan Active Eth1/1  Eth1/2  Eth1/3  Eth1/4  Eth1/5
                                Eth1/6  Eth1/7  Eth1/8  Eth1/9  Eth1/10
                                Eth1/11 Eth1/12 Eth1/13 Eth1/14 Eth1/15
                                Eth1/16 Eth1/17 Eth1/18 Eth1/19 Eth1/20
                                Eth1/21 Eth1/22 Eth1/23 Eth1/24
Console#
```

Configuring Private VLANs

Private VLANs provide port-based security and isolation between ports within the assigned VLAN. This switch supports two types of private VLAN ports: promiscuous, and community ports. A promiscuous port can communicate with all interfaces within a private VLAN. Community ports can only communicate with other ports in their

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own community VLAN, and with their designated promiscuous ports. This section describes commands used to configure private VLANs.

Table 3-28. Private VLAN Commands			
Command	Function	Mode	Page
Edit Private VLAN Groups			
private-vlan	Adds or deletes primary and secondary VLANs	VC	3-93
private-vlan association	Associates a secondary with a primary VLAN	VC	3-93
Configure Private VLAN Interfaces			
switchport mode private-vlan	Sets an interface to host mode or promiscuous mode	IC	3-94
switchport private-vlan host-association	Associates an interface with a secondary VLAN	IC	3-95
switchport private-vlan mapping	Maps an interface to a primary VLAN	IC	3-96
Display Private VLAN Information			
show vlan private-vlan	Shows Private VLAN information	NE, PE	3-96

To configure private VLANs, follow these steps:

1. Use the **private-vlan** command to designate one or more community VLANs and the primary VLAN that will channel traffic outside the community groups.

2. Use the **private-vlan association** command to map the secondary (i.e., community) VLAN(s) to the primary VLAN.

3. Use the **switchport mode private-vlan** command to configure ports as promiscuous (i.e., having access to all ports in the primary VLAN) or host (i.e., having access restricted to community VLAN members, and channeling all other traffic through a promiscuous port).

4. Use the **switchport private-vlan host-association** command to assign a port to a secondary VLAN.

5. Use the **switchport private-vlan mapping** command to assign a port to a primary VLAN.

6. Use the **show vlan private-vlan** command to verify your configuration settings.

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private-vlan

Use this command to create a primary or secondary (i.e., community) private VLAN. Use the **no** form to remove the specified private VLAN.

Syntax

private-vlan *vlan-id* {**community** | **isolated** | **primary**}
no private-vlan *vlan-id*

- *vlan-id* - ID of private VLAN. (Range: 1-4093, no leading zeroes).
- **community** – Specifies a community VLAN.
- **primary** – Specifies a primary VLAN.
- **isolated** – Specifies an isolated VLAN.

Default Setting

None

Command Mode

VLAN Configuration

Command Usage

- Private VLANs are used to restrict traffic to ports within the same VLAN "community," and channel traffic passing outside the community through promiscuous ports that have been mapped to the associated "primary" VLAN.
- Port membership for private VLANs is static. Once a port has been assigned to a private VLAN, it cannot be dynamically moved to another VLAN via GVRP.
- Private VLAN ports cannot be set to trunked mode. (See "switchport mode" on page 3-86.)

Example

```
Console(config)#vlan database
Console(config-vlan)#private-vlan 2 primary
Console(config-vlan)#private-vlan 3 community
Console(config)#
```

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private-vlan association

Use this command to associate a primary VLAN with a secondary (i.e., community) VLAN. Use the **no** form to remove all associations for the specified primary VLAN.

Syntax

private-vlan *primary-vlan-id* **association** {*secondary-vlan-id* **| add** *secondary-vlan-id* **| remove** *secondary-vlan-id*}
no private-vlan *primary-vlan-id* **association**

- *primary-vlan-id* - ID of private VLAN.
  (Range: 2-4094, no leading zeroes).
- *secondary-vlan-id* - ID of private (i.e. community) VLAN.
  (Range: 2-4094, no leading zeroes).

Default Setting

None

Command Mode

VLAN Configuration

Command Usage

Secondary VLANs provide security for group members. The associated primary VLAN provides a common interface for access to other network resources within the primary VLAN (e.g., servers configured with promiscuous ports) and to resources outside of the primary VLAN (via promiscuous ports).

Example

```
Console(config-vlan)#private-vlan 2 association 3
Console(config)#
```

switchport mode private-vlan

Use this command to set the private VLAN mode for an interface. Use the **no** form to restore the default setting.

Syntax

switchport mode private-vlan {**host** | **promiscuous**}
no switchport mode private-vlan

- **host** – This port type can communicate with all other host ports assigned to the same secondary VLAN. All communications outside of this VLAN must pass through a promiscuous port in the associated primary VLAN.
- **promiscuous** – This port type can communicate with all other promiscuous ports in the same primary VLAN, as well as with all the ports in the associated secondary VLANs.

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Default Setting

Normal VLAN

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Promiscuous ports assigned to a primary VLAN can communicate with all other promiscuous ports in the same VLAN, as well as with all the ports in the associated secondary VLANs.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#switchport mode private-vlan promiscuous
Console(config)#exit
Console(config)#interface ethernet 1/3
Console(config-if)#switchport mode private-vlan host
Console(config)#
```

switchport private-vlan host-association
Use this command to associate an interface with a secondary VLAN. Use the **no** form to remove this association.

Syntax

switchport private-vlan host-association *secondary-vlan-id*
no switchport private-vlan host-association

- *secondary-vlan-id* – ID of secondary (i.e, community) VLAN. (Range: 1-4093, no leading zeroes).

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

All ports assigned to a secondary (i.e., community) VLAN can pass traffic between group members, but must communicate with resources outside of the group via a promiscuous port.

Example

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport private-vlan host-association 3
Console(config)#
```

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switchport private-vlan mapping

Use this command to map an interface to a primary VLAN. Use the **no** form to remove this mapping.

Syntax

> **switchport private-vlan mapping** *primary-vlan-id*
> **no switchport private-vlan mapping**
>
> > *primary-vlan-id* – ID of primary VLAN. (Range: 1-4093, no leading zeroes).

Default Setting

> None

Command Mode

> Interface Configuration (Ethernet, Port Channel)

Command Usage

> Promiscuous ports assigned to a primary VLAN can communicate with any other promiscuous ports in the same VLAN, and with the group members within any associated secondary VLANs.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#switchport private-vlan mapping 2
Console(config)#
```

show vlan private-vlan

Use this command to show the private VLAN configuration settings on this switch.

Syntax

> **show vlan private-vlan [community | primary]**
>
> - **community** – Displays all community VLANs, along with their associate primary VLAN and assigned host interfaces.
> - **primary** – Displays all primary VLANs, along with any assigned promiscuous interfaces.

Default Setting

> None

Command Mode

> Privileged Executive

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Example

```
Console#sh vlan private-vlan
Primary Secondary Type Interfaces
-------- ---------- ---------- -------------------------------------
2 primary Eth1/ 2
2 3 community Eth1/ 3
2 4 community Eth1/ 4
2 5 community Eth1/ 5
6 primary Eth1/ 6
6 7 community Eth1/ 7
6 8 community Eth1/ 8
6 9 community Eth1/ 9
Console#
```

GVRP and Bridge Extension Commands

GARP VLAN Registration Protocol defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network. This section describes how to enable GVRP for individual interfaces and globally for the switch, as well as how to display default configuration settings for the Bridge Extension MIB.

Table 3-29. GVRP and Bridge Extension Commands			
Command	Function	Mode	Page
switchport gvrp	Enables GVRP for an interface	IC	3-97
switchport forbidden vlan	Configures forbidden VLANs for an interface	IC	3-90
show gvrp configuration	Displays GVRP configuration for selected interface	NE, PE	3-98
garp timer	Sets the GARP timer for the selected function	IC	3-98
show garp timer	Shows the GARP timer for the selected function	NE, PE	3-99
bridge-ext gvrp	Enables GVRP globally for the switch	GC	3-100
show bridge-ext	Shows the global bridge extension configuration	PE	3-100

switchport gvrp

Use this command to enable GVRP for a port. Use the **no** form to disable it.

Syntax

[**no**] **switchport gvrp**

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

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Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport gvrp
Console(config-if)#
```

show gvrp configuration
Use this command to show if GVRP is enabled.

Syntax

show gvrp configuration [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Default Setting

Shows both global and interface-specific configuration.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show gvrp configuration ethernet 1/7
Eth 1/ 7:
 Gvrp configuration: Disabled
Console#
```

garp timer
Use this command to set the values for the join, leave and leaveall timers. Use the **no** form to restore the timers' default values.

Syntax

garp timer {**join** | **leave** | **leaveall**} *timer_value*
no garp timer {**join** | **leave** | **leaveall**}

- {**join** | **leave** | **leaveall**} - Which timer to set.
- *timer_value* - Value of timer.
  Ranges:
  join: 20-1000 centiseconds
  leave: 60-3000 centiseconds
  leavall: 500-18000 centiseconds

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Default Setting

- join: 20 centiseconds
- leave: 60 centiseconds
- leaveall: 1000 centiseconds

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Group Address Registration Protocol is used by GVRP and GMRP to register or deregister client attributes for client services within a bridged LAN. The default values for the GARP timers are independent of the media access method or data rate. These values should not be changed unless you are experiencing difficulties with GMRP or GVRP registration/deregistration.
- Timer values are applied to GVRP for all the ports on all VLANs.
- Timer values must meet the following restrictions:
  - leave >= (2 x join)
  - leaveall > leave

Note: Set GVRP timers on all Layer 2 devices connected in the same network to the same values. Otherwise, GVRP may not operate successfully.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#garp timer join 100
Console(config-if)#
```

Related Commands

show garp timer (3-99)

show garp timer
Use this command to show the GARP timers for the selected interface.

Syntax

show garp timer [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Default Setting

Shows all GARP timers.

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Command Mode

    Normal Exec, Privileged Exec

Example

```
Console#show garp timer ethernet 1/1
Eth 1/ 1 GARP timer status:
 Join timer: 20 centiseconds
 Leave timer: 60 centiseconds
 Leaveall timer: 1000 centiseconds

Console#
```

Related Commands

    garp timer (3-98)

bridge-ext gvrp

Use this command to enable GVRP globally for the switch. Use the **no** form to disable it.

Syntax

    [**no**] **bridge-ext gvrp**

Default Setting

    Disabled

Command Mode

    Global Configuration

Command Usage

    GVRP defines a way for switches to exchange VLAN information in order to register VLAN members on ports across the network. This function should be enabled to permit automatic VLAN registration, and to support VLANs which extend beyond the local switch.

Example

```
Console(config)#bridge-ext gvrp
Console(config)#
```

show bridge-ext

Use this command to show the configuration for bridge extension commands.

Default Setting

    None

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Command Mode

Privileged Exec

Command Usage

See "Displaying Basic VLAN Information" on page 2-47 and "Displaying Bridge Extension Capabilities" on page 2-18 for a description of the displayed items.

Example

```
Console#show bridge-ext
 Max support vlan numbers: 255
 Max support vlan ID: 4094
 Extended multicast filtering services: No
 Static entry individual port: Yes
 VLAN learning: IVL
 Configurable PVID tagging: Yes
 Local VLAN capable: No
 Traffic classes: Enabled
 Global GVRP status: Disabled
 GMRP: Disabled
Console#
```

Multicast Filtering Commands

This switch uses IGMP (Internet Group Management Protocol) to query for any attached hosts that want to receive a specific multicast service. It identifies the ports containing hosts requesting a service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service.

Table 3-30. Multicast Filtering Commands		
Command Groups	Function	Page
IGMP Snooping	Configures multicast groups via IGMP snooping or static assignment, sets the IGMP version, displays current snooping and query settings, and displays the multicast service and group members	3-102
IGMP Query (Layer 2)	Configures IGMP query parameters for multicast filtering at Layer 2	3-105
Static Multicast Routing	Configures static multicast router ports	3-109

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IGMP Snooping Commands

<table>
<tr><td colspan="4">Table 3-31. IGMP Snooping Commands</td></tr>
<tr><td>Command</td><td>Function</td><td>Mode</td><td>Page</td></tr>
<tr><td>ip igmp snooping</td><td>Enables IGMP snooping</td><td>GC</td><td>3-102</td></tr>
<tr><td>ip igmp snooping vlan static</td><td>Adds an interface as a member of a multicast group</td><td>GC</td><td>3-103</td></tr>
<tr><td>ip igmp snooping version</td><td>Configures the IGMP version for snooping</td><td>GC</td><td>3-103</td></tr>
<tr><td>show ip igmp snooping</td><td>Shows the IGMP snooping and query configuration</td><td>PE</td><td>3-104</td></tr>
<tr><td>show mac-address-table multicast</td><td>Shows the IGMP snooping MAC multicast list</td><td>PE</td><td>3-105</td></tr>
</table>

ip igmp snooping

Use this command to enable IGMP snooping on this switch. Use the **no** form to disable it.

Syntax

ip igmp snooping
no ip igmp snooping

Default Setting

Enabled

Command Mode

Global Configuration

Example

The following example enables IGMP snooping.

```
Console(config)#ip igmp snooping
Console(config)#
```

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ip igmp snooping vlan static
Use this command to add a port to a multicast group. Use the **no** form to remove the port.

Syntax

ip igmp snooping vlan *vlan-id* **static** *ip-address interface*
no ip igmp snooping vlan *vlan-id* **static** *ip-address interface*

- *vlan-id* - VLAN ID (Range: 1-4094)
- *ip-address* - IP address for multicast group
- *interface*
  - **ethernet** *unit*/*port*
    - *unit* - This is device 1.
    - *port* - Port number.
  - **port-channel** *channel-id* (Range: 1-6)

Default Setting

None

Command Mode

Global Configuration

Example

The following shows how to statically configure a multicast group on a port:

```
Console(config)#ip igmp snooping vlan 1 static 224.0.0.12 ethernet 1/5
Console(config)#
```

ip igmp snooping version
Use this command to configure the IGMP snooping version. Use the **no** form to restore the default.

Syntax

ip igmp snooping version {**1** | **2**}
no ip igmp snooping version

- **1** - IGMP Version 1
- **2** - IGMP Version 2

Default Setting

IGMP Version 2

Command Mode

Global Configuration

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Command Usage

- All systems on the subnet must support the same version. If there are legacy devices in your network that only support Version 1, you will also have to configure this switch to use Version 1.
- Some commands are only enabled for IGMPv2, including **ip igmp query-max-response-time** and **ip igmp query-timeout**.

Example

The following configures the switch to use IGMP Version 1:

```
Console(config)#ip igmp snooping version 1
Console(config)#
```

show ip igmp snooping

Use this command to show the IGMP snooping configuration.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

See "Configuring IGMP Snooping and Query Parameters" on page 2-74 for a description of the displayed items.

Example

The following shows the current IGMP snooping configuration:

```
Console#show ip igmp snooping
 Service status: Enabled
 Querier status: Enabled
 Query count: 2
 Query interval: 125 sec
 Query max response time: 10 sec
 Query time-out: 300 sec
 IGMP snooping version: Version 2
Console#
```

show mac-address-table multicast

Use this command to show known multicast addresses.

Syntax

show mac-address-table multicast [**vlan** *vlan-id*] [**user** | **igmp-snooping**]

- *vlan-id* - VLAN ID (1 to 4094)
- **user** - Display only the user-configured multicast entries.
- **igmp-snooping** - Display only entries learned through IGMP snooping.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Member types displayed include IGMP or USER, depending on selected options.

Example

The following shows the multicast entries learned through IGMP snooping for VLAN 1:

```
Console#show mac-address-table multicast vlan 1 igmp-snooping
 VLAN M'cast IP addr. Member ports Type
 ---- --------------- ------------ -------
    1      224.1.2.3      Eth1/11    IGMP
Console#
```

IGMP Query Commands (Layer 2)

Table 3-32. IGMP Query Commands (Layer 2)			
Command	Function	Mode	Page
ip igmp snooping querier	Allows this device to act as the querier for IGMP snooping	GC	3-106
ip igmp snooping query-count	Configures the query count	GC	3-106
ip igmp snooping query-interval	Configures the query interval	GC	3-107
ip igmp snooping query-max-response-time	Configures the report delay	GC	3-107
ip igmp snooping router-port-expire-time	Configures the query timeout	GC	3-108

ip igmp snooping querier

Use this command to enable the switch as an IGMP querier. Use the **no** form to disable it.

Syntax

[**no**] **ip igmp snooping querier**

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

If enabled, the switch will serve as querier if elected. The querier is responsible for asking hosts if they want to receive multicast traffic.

Example

```
Console(config)#ip igmp snooping querier
Console(config)#
```

ip igmp snooping query-count

Use this command to configure the query count. Use the **no** form to restore the default.

Syntax

ip igmp snooping query-count *count*
no ip igmp snooping query-count

count - The maximum number of queries issued for which there has been no response before the switch takes action to drop a client from the multicast group. (Range: 2-10)

Default Setting

2 times

Command Mode

Global Configuration

Command Usage

The query count defines how long the querier waits for a response from a multicast client before taking action. If a querier has sent a number of queries defined by this command, but a client has not responded, a countdown timer

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is started using the time defined by **ip igmp snooping query-max-response-time**. If the countdown finishes, and the client still has not responded, then that client is considered to have left the multicast group.

Example

The following shows how to configure the query count to 10:

```
Console(config)#ip igmp snooping query-count 10
Console(config)#
```

Related Commands

ip igmp snooping query-max-response-time (3-107)

ip igmp snooping query-interval
Use this command to configure the query interval. Use the **no** form to restore the default.

Syntax

ip igmp snooping query-interval *seconds*
no ip igmp snooping query-interval

seconds - The frequency at which the switch sends IGMP host-query messages. (Range: 60-125)

Default Setting

125 seconds

Command Mode

Global Configuration

Example

The following shows how to configure the query interval to 100 seconds:

```
Console(config)#ip igmp snooping query-interval 100
Console(config)#
```

ip igmp snooping query-max-response-time
Use this command to configure the snooping report delay. Use the **no** form of this command to restore the default.

Syntax

ip igmp snooping query-max-response-time *seconds*
no ip igmp snooping query-max-response-time

seconds - The report delay advertised in IGMP queries. (Range: 5-30)

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Default Setting

   10 seconds

Command Mode

   Global Configuration

Command Usage

   - The switch must be using IGMPv2 for this command to take effect.
   - This command defines the time after a query, during which a response is expected from a multicast client. If a querier has sent a number of queries defined by the **ip igmp snooping query-count**, but a client has not responded, a countdown timer is started using an initial value set by this command. If the countdown finishes, and the client still has not responded, then that client is considered to have left the multicast group.

Example

The following shows how to configure the maximum response time to 20 seconds:

```
Console(config)#ip igmp snooping query-max-response-time 20
Console(config)#
```

Related Commands

   ip igmp snooping version (3-103)
   ip igmp snooping query-max-response-time (3-107)

ip igmp snooping router-port-expire-time
Use this command to configure the query timeout. Use the no form of this command to restore the default.

Syntax

   ip igmp snooping router-port-expire-time *seconds*
   no ip igmp snooping router-port-expire-time

   seconds - The time the switch waits after the previous querier stops before it considers the router port (i.e., the interface which had been receiving query packets) to have expired.
   (Range: 300-500)

Default Setting

   300 seconds

Command Mode

   Global Configuration

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Command Usage

The switch must use IGMPv2 for this command to take effect.

Example

The following shows how to configure the default timeout to 300 seconds:

```
Console(config)#ip igmp snooping query-time-out 300
Console(config)#
```

Related Commands

ip igmp snooping version (3-103)

Static Multicast Routing Commands

Table 3-33. Static Multicast Routing Commands			
Command	Function	Mode	Page
ip igmp snooping vlan mrouter	Adds a multicast router port	GC	3-109
show ip igmp snooping mrouter	Shows multicast router ports	PE	3-110

ip igmp snooping vlan mrouter
Use this command to statically configure a multicast router port. Use the **no** form to remove the configuration.

Syntax

ip igmp snooping vlan *vlan-id* **mrouter** *interface*
no ip igmp snooping vlan *vlan-id* **mrouter** *interface*

- *vlan-id* - VLAN ID (Range: 1-4094)
- *interface*
  - **ethernet** *unit*/*port*
    - *unit* - This is device 1.
    - *port* - Port number.
  - **port-channel** *channel-id* (Range: 1-6)

Default Setting

No static multicast router ports are configured.

Command Mode

Global Configuration

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Command Usage

Depending on your network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router/switch connected over the network to an interface (port or trunk) on your switch, you can manually configure that interface to join all the current multicast groups.

Example

The following shows how to configure port 11 as a multicast router port within VLAN 1:

```
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11
Console(config)#
```

show ip igmp snooping mrouter

Use this command to display information on statically configured and dynamically learned multicast router ports.

Syntax

show ip igmp snooping mrouter [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

Displays multicast router ports for all configured VLANs.

Command Mode

Privileged Exec

Command Usage

Multicast router port types displayed include Static or Dynamic.

Example

The following shows the ports in VLAN 1 which are attached to multicast routers:

```
Console#show ip igmp snooping mrouter vlan 1
 VLAN M'cast Router Port   Type
 ---- ------------------- -------
   1           Eth 1/11  Static
Console#
```

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Priority Commands

The commands described in this section allow you to specify which data packets have greater precedence when traffic is buffered in the switch due to congestion. This switch supports CoS with four priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues. You can set the default priority for each interface, the relative weight of each queue, and the mapping of frame priority tags to the switch's priority queues.

Table 3-34. Priority Commands		
Command Groups	Function	Page
Priority (Layer 2)	Configures default priority for untagged frames, sets queue weights, and maps class of service tags to hardware queues	3-111
Priority (Layer 3 and 4)	Maps TCP ports, IP precedence tags, or IP DSCP tags to class of service values	3-115

Priority Commands (Layer 2)

Table 3-35. Priority Commands (Layer 2)			
Command	Function	Mode	Page
switchport priority default	Sets a port priority for incoming untagged frames	IC	3-111
queue bandwidth	Assigns round-robin weights to the priority queues	GC	3-112
queue cos map	Assigns class-of-service values to the priority queues	IC	3-113
show queue mode	Shows the current queue mode	PE	4-163
show queue bandwidth	Shows round-robin weights assigned to the priority queues	PE	3-114
show queue cos-map	Shows the class-of-service map	PE	3-114
show interfaces switchport	Displays the administrative and operational status of an interface	PE	3-65

switchport priority default
Use this command to set a priority for incoming untagged frames. Use the **no** form to restore the default value.

Syntax

switchport priority default *default-priority-id*
no switchport priority default

default-priority-id - The priority number for untagged ingress traffic. The priority is a number from 0 to 7. Seven is the highest priority.

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Default Setting

The priority is not set, and the default value for untagged frames received on the interface is zero.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
- The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.
- This switch provides four priority queues for each port. It is configured to use Weighted Round Robin, which can be viewed with the **show queue bandwidth** command. Inbound frames that do not have VLAN tags are tagged with the input port's default ingress user priority, and then placed in the appropriate priority queue at the output port. The default priority for all ingress ports is zero. Therefore, any inbound frames that do not have priority tags will be placed in queue 0 of the output port. (Note that if the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission.)

Example

The following example shows how to set a default priority on port 3 to 5:

```
Console(config)#interface ethernet 1/3
Console (config-if)#switchport priority default 5
```

queue bandwidth
Use this command to assign weighted round-robin (WRR) weights to the four class of service (CoS) priority queues. Use the **no** form to restore the default weights.

Syntax

queue bandwidth *weight1...weight4*
no queue bandwidth

weight1...weight4 - The ratio of weights for queues 0 - 3 determines the weights used by the WRR scheduler. (Range: 1 - 255)

Default Setting

Weights 1, 4, 16 and 64 are assigned to queue 0, 1, 2 and 3 respectively.

Command Mode

Global Configuration

Command Usage

WRR controls bandwidth sharing at the egress port by defining scheduling weights.

Example

The following example shows how to assign WRR weights of 1, 3, 5 and 7 to the CoS priority queues 0, 1, 2 and 3:

```
Console(config)#queue bandwidth 1 3 5 7
Console(config)#
```

Related Commands

show queue bandwidth (3-114)

queue cos-map

Use this command to assign class of service (CoS) values to the priority queues (i.e., hardware output queues 0 - 3). Use the **no** form to set the CoS map to the default values.

Syntax

queue cos-map *queue_id* [*cos1 ... cosn*]
no queue cos-map

- *queue_id* - The ID of the priority queue.
  Ranges are 0 to 3, where 3 is the highest priority queue.
- *cos1 .. cosn* - The CoS values that are mapped to the queue ID. It is a space-separated list of numbers. The CoS value is a number from 0 to 7, where 7 is the highest priority.

Default Setting

This switch supports Class of Service by using four priority queues, with Weighted Round Robin queuing for each port. Eight separate traffic classes are defined in IEEE 802.1p. The default priority levels are assigned according to recommendations in the IEEE 802.1p standard as shown below.

Table 3-36. Mapping CoS Values			
Queue	0	1	2	3
Priority	1, 2	0, 3	4, 5	6, 7

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Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

CoS assigned at the ingress port is used to select a CoS priority at the egress port.

Example

The following example shows how to map CoS values 0, 1 and 2 to priority queue 0, value 3 to queue 1, values 4 and 5 to queue 2, and values 6 and 7 to queue 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#queue cos-map 0 1 2
Console(config-if)#queue cos-map 1 0 3
Console(config-if)#queue cos-map 2 4 5
Console(config-if)#queue cos-map 3 6 7
Console(config-if)#
```

Related Commands

show queue cos-map (3-114)

show queue bandwidth

Use this command to display the weighted round-robin (WRR) bandwidth allocation for the priority queues.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show queue bandwidth
 Queue ID Weight
 -------- ------
        0      1
        1      4
        2     16
        3     64
Console#
```

show queue cos-map

Use this command to show the class of service priority map.

Syntax

show queue cos-map [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.
- **port-channel** *channel-id* (Range: 1-6)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show queue cos-map ethernet 1/11
Information of Eth 1/11
 Queue ID Traffic class
 -------- -------------
    0     1 2
    1     0 3
    2     4 5
    3     6 7
Console#
```

Priority Commands (Layer 3 and 4)

Table 3-37. Priority Commands (Layer 3 and 4)			
Command	Function	Mode	Page
map ip port	Enables TCP class of service mapping	GC	3-116
map ip port	Maps TCP socket to a class of service	IC	3-116
map ip precedence	Enables IP precedence class of service mapping	GC	3-117
map ip precedence	Maps IP precedence value to a class of service	IC	3-117
map ip dscp	Enables IP DSCP class of service mapping	GC	3-118
map ip dscp	Maps IP DSCP value to a class of service	IC	3-119
show map ip port	Shows the IP port map	PE	3-120
show map ip precedence	Shows the IP precedence map	PE	3-121
show map ip dscp	Shows the IP DSCP map	PE	3-122

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map ip port (Global Configuration)
Use this command to enable IP port mapping (i.e., class of service mapping for TCP/UDP sockets). Use the **no** form to disable IP port mapping.

Syntax

[**no**] **map ip port**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.

Example

The following example shows how to enable TCP/UDP port mapping globally:

```
Console(config)#map ip port
Console(config)#
```

map ip port (Interface Configuration)
Use this command to set IP port priority (i.e., TCP/UDP port priority). Use the **no** form to remove a specific setting.

Syntax

map ip port *port-number* **cos** *cos-value*
no map ip port *port-number*

* *port-number* - 16-bit TCP/UDP port number. (Range: 0-65535)
* *cos-value* - Class-of-Service value (Range: 0-7)

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

* The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
* This command sets the IP port priority for all interfaces.

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Example

The following example shows how to map HTTP traffic to CoS value 0:

```
Console(config)#interface ethernet 1/5
Console(config-if)#map ip port 80 cos 0
Console(config-if)#
```

map ip precedence (Global Configuration)

Use this command to enable IP precedence mapping (i.e., IP Type of Service). Use the **no** form to disable IP precedence mapping.

Syntax

   [**no**] **map ip precedence**

Default Setting

   Disabled

Command Mode

   Global Configuration

Command Usage

- The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
- IP Precedence and IP DSCP cannot both be enabled. Enabling one of these priority types will automatically disable the other type.

Example

The following example shows how to enable IP precedence mapping globally:

```
Console(config)#map ip precedence
Console(config)#
```

map ip precedence (Interface Configuration)

Use this command to set IP precedence priority (i.e., IP Type of Service priority). Use the **no** form to restore the default table.

Syntax

   map ip precedence *ip-precedence-value* **cos** *cos-value*
   no map ip precedence

- *precedence-value* - 3-bit precedence value. (Range: 0-7)
- *cos-value* - Class-of-Service value (Range: 0-7)

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Default Setting

The list below shows the default priority mapping

Table 3-38. Mapping IP Precedence Values								
IP Precedence Value	0	1	2	3	4	5	6	7
CoS Value	0	1	2	3	4	5	6	7

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
- IP Precedence values are mapped to default Class of Service values on a one-to-one basis according to recommendations in the IEEE 802.1p standard, and then subsequently mapped to the four hardware priority queues.
- This command sets the IP Precedence for all interfaces.

Example

The following example shows how to map IP precedence value 1 to CoS value 0:

```
Console(config)#interface ethernet 1/5
Console(config-if)#map ip precedence 1 cos 0
Console(config-if)#
```

map ip dscp (Global Configuration)
Use this command to enable IP DSCP mapping (i.e., Differentiated Services Code Point mapping). Use the **no** form to disable IP DSCP mapping.

Syntax

[**no**] **map ip dscp**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
- IP Precedence and IP DSCP cannot both be enabled. Enabling one of these priority types will automatically disable the other type.

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Example

The following example shows how to enable IP DSCP mapping globally:

```
Console(config)#map ip dscp
Console(config)#
```

map ip dscp (Interface Configuration)

Use this command to set IP DSCP priority (i.e., Differentiated Services Code Point priority). Use the **no** form to restore the default table.

Syntax

map ip dscp *dscp-value* **cos** *cos-value*
no map ip dscp

- *dscp-value* - 8-bit DSCP value. (Range: 0-255)
- *cos-value* - Class-of-Service value (Range: 0-7)

Default Setting

The DSCP default values are defined in the following table. Note that all the DSCP values that are not specified are mapped to CoS value 0.

Table 3-39. IP DSCP CoS Values	
IP DSCP Value	**CoS Value**
0	0
8	1
10, 12, 14, 16	2
18, 20, 22, 24	3
26, 28, 30, 32, 34, 36	4
38, 40, 42	5
48	6
46, 56	7

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The precedence for priority mapping is IP Port, IP Precedence or IP DSCP, and default switchport priority.
- DSCP priority values are mapped to default Class of Service values according to recommendations in the IEEE 802.1p standard, and then subsequently mapped to the four hardware priority queues.
- This command sets the IP DSCP priority for all interfaces.

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Example

The following example shows how to map IP DSCP value 1 to CoS value 0:

```
Console(config)#interface ethernet 1/5
Console(config-if)#map ip dscp 1 cos 0
Console(config-if)#
```

show map ip port

Use this command to show the IP port priority map.

Syntax

> **show map ip port** [*interface*]
>
> > *interface*
> >
> > - **ethernet** *unit*/*port*
> >   - *unit* - This is device 1.
> >   - *port* - Port number.
> > - **port-channel** *channel-id* (Range: 1-6)

Default Setting

> None

Command Mode

> Privileged Exec

Example

The following shows that HTTP traffic has been mapped to CoS value 0:

```
Console#show map ip port
TCP port mapping status: disabled

 Port       Port no. COS
 --------- -------- ---
  Eth 1/ 5      80    0
Console#
```

Related Commands

> map ip port (Global Configuration) (3-116)
> map ip port (Interface Configuration) (3-116)

show map ip precedence

Use this command to show the IP precedence priority map.

Syntax

> **show map ip precedence** [*interface*]
>
> > *interface*
> >
> > > • **ethernet** *unit*/*port*
> > >   - *unit* - This is device 1.
> > >   - *port* - Port number.
> > > • **port-channel** *channel-id* (Range: 1-6)

Default Setting

> None

Command Mode

> Privileged Exec

Example

```
Console#show map ip precedence ethernet 1/5
Precedence mapping status: disabled

 Port      Precedence COS
 --------- ---------- ---
  Eth 1/ 5          0   0
  Eth 1/ 5          1   1
  Eth 1/ 5          2   2
  Eth 1/ 5          3   3
  Eth 1/ 5          4   4
  Eth 1/ 5          5   5
  Eth 1/ 5          6   6
  Eth 1/ 5          7   7
Console#
```

Related Commands

> map ip precedence (Global Configuration) (3-117)
> map ip precedence (Interface Configuration) (3-117)

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show map ip dscp

Use this command to show the IP DSCP priority map.

Syntax

> **show map ip dscp** [*interface*]
>
>> *interface*
>>
>> - **ethernet** *unit*/*port*
>>   - *unit* - This is device 1.
>>   - *port* - Port number.
>> - **port-channel** *channel-id* (Range: 1-6)

Default Setting

> None

Command Mode

> Privileged Exec

Example

```
Console#show map ip dscp ethernet 1/1
DSCP mapping status: disabled

 Port      DSCP COS
 --------- ---- ---
  Eth 1/ 1    0   0
  Eth 1/ 1    1   0
  Eth 1/ 1    2   0
  Eth 1/ 1    3   0
.
.
.
  Eth 1/ 1   61   0
  Eth 1/ 1   62   0
  Eth 1/ 1   63   0
Console#
```

Related Commands

> map ip dscp (Global Configuration) (3-118)
> map ip dscp (Interface Configuration) (3-119)

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Mirror Port Commands

This section describes how to mirror traffic from a source port to a target port.

	Table 3-40. Mirror Port Commands		
Command	Function	Mode	Page
port monitor	Configures a mirror session	IC	3-123
show port monitor	Shows the configuration for a mirror port	PE	3-124

port monitor
Use this command to configure a mirror session. Use the **no** form to clear a mirror session.

Syntax

port monitor *interface* [**rx** | **tx** | **both**]
no port monitor *interface*

- *interface* - **ethernet** *unit*/*port* (source port)
  - *unit* - Switch (unit 1).
  - *port* - Port number.
- **rx** - Mirror received packets.
- **tx** - Mirror transmitted packets.
- **both** - Mirror both received and transmitted packets.

Default Setting

No mirror session is defined. When enabled, the default mirroring is for both received and transmitted packets.

Command Mode

Interface Configuration (Ethernet, destination port)

Command Usage

- You can mirror traffic from any source port to a destination port for real-time analysis. You can then attach a logic analyzer or RMON probe to the destination port and study the traffic crossing the source port in a completely unobtrusive manner.
- The destination port is set by specifying an Ethernet interface.
- The mirror port and monitor port speeds should match, otherwise traffic may be dropped from the monitor port.
- You can create multiple mirror sessions, but all sessions must share the same destination port. However, you should avoid sending too much traffic to the destination port from multiple source ports.

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Example

The following example configures the switch to mirror all packets from port 6 to port 11:

```
Console(config)#interface ethernet 1/11
Console(config-if)#port monitor ethernet 1/6 both
Console(config-if)#
```

show port monitor
Use this command to display mirror information.

Syntax

show port monitor [*interface*]

interface - **ethernet** *unit*/*port* (source port)

- *unit* - Switch (unit 1).
- *port* - Port number.

Default Setting

Shows all sessions.

Command Mode

Privileged Exec

Command Usage

This command displays the currently configured source port, destination port, and mirror mode (i.e., RX, TX, RX/TX).

Example

The following shows mirroring configured from port 6 to port 11:

```
Console(config)#interface ethernet 1/11
Console(config-if)#port monitor ethernet 1/6
Console(config-if)#end
Console#show port monitor
Port Mirroring
------------------------------------
 Destination port(listen port):Eth1/1
 Source port(monitored port)  :Eth1/6
 Mode                         :RX/TX
Console#
```

Link Aggregation Commands

Ports can be statically grouped into an aggregate link (i.e., trunk) to increase the bandwidth of a network connection or to ensure fault recovery. Or you can use the Link Aggregation Control Protocol (LACP) to automatically negotiate a trunk link between this switch and another network device. For static trunks, the switches have to comply with the Cisco EtherChannel standard. For dynamic trunks, the switches have to comply with LACP. This switch supports up to six trunks. For example, a trunk consisting of two 1000 Mbps ports can support an aggregate bandwidth of 4 Gbps when operating at full duplex.

Table 3-41. Link Aggregation Commands			
Command	Function	Mode	Page
Manual Configuration Commands			
interface port-channel	Configures a trunk and enters interface configuration mode for the trunk	GC	3-56
channel-group	Adds a port to a trunk	IC	3-126
Dynamic Configuration Command			
lacp	Configures LACP for the current interface	IC	3-126
Trunk Status Display Command			
show interfaces status port-channel	Shows trunk information	NE, PE	3-63

Guidelines for Creating Trunks

- Finish configuring port trunks before you connect the corresponding network cables between switches to avoid creating a loop.
- A trunk can have up to four 10/100 Mbps ports or up to two 1000 Mbps ports.
- The ports at both ends of a connection must be configured as trunk ports.
- All ports in a trunk must consist of the same media type (i.e., twisted-pair or fiber).
- All ports in a trunk must be configured in an identical manner, including communication mode (i.e., speed, duplex mode and flow control), VLAN assignments, and CoS settings.
- All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN via the specified port-channel.
- STP, VLAN, and IGMP settings can only be made for the entire trunk via the specified port-channel.

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channel-group

Use this command to add a port to a trunk. Use the **no** form to remove a port from a trunk.

Syntax

channel-group *channel-id*
no channel-group

channel-id - Trunk index (Range: 1-6)

Default Setting

The current port will be added to this trunk.

Command Mode

Interface Configuration (Ethernet)

Command Usage

- When configuring static trunks, the switches must comply with the Cisco EtherChannel standard.
- Use **no channel-group** to remove a port group from a trunk.
- Use **no interfaces port-channel** to remove a trunk from the switch.

Example

The following example creates trunk 1 and then adds port 11.

```
Console(config)#interface port-channel 1
Console(config-if)#exit
Console(config)#interface ethernet 1/11
Console(config-if)#channel-group 1
Console(config-if)#
```

lacp

Use this command to enable 802.3ad Link Aggregation Control Protocol (LACP) for the current interface. Use the **no** form to disable it.

Syntax

lacp
no lacp

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

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Command Usage

- The ports on both ends of an LACP trunk must be configured for full duplex, either by forced mode or auto-negotiation.
- A trunk formed with another switch using LACP will automatically be assigned the next available port-channel ID.
- If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.
- If more than four ports attached to the same target switch have LACP enabled, the additional ports will be placed in standby mode, and will only be enabled if one of the active links fails.

Example

The following shows LACP enabled on ports 11 - 13. Because LACP has also been enabled on the ports at the other end of the links, the **show interfaces status port-channel 1** command shows that Trunk1 has been established.

```
Console(config)#interface ethernet 1/11
Console(config-if)#lacp
Console(config-if)#exit
Console(config)#interface ethernet 1/12
Console(config-if)#lacp
Console(config-if)#exit
Console(config)#interface ethernet 1/13
Console(config-if)#lacp
Console(config-if)#exit
Console(config)#exit
Console#show interfaces status port-channel 1
Information of Trunk 1
 Basic information:
  Port type: 100tx
  Mac address: 00-00-e8-00-00-0b
 Configuration:
  Name:
  Port admin status: Up
  Speed-duplex: Auto
  Capabilities: 10half, 10full, 100half, 100full,
  Flow control status: Disabled
 Current status:
  Created by: lacp
  Link status: Up
  Operation speed-duplex: 100full
  Flow control type: None
  Member Ports: Eth1/11, Eth1/12, Eth1/13,
Console#
```

Rate Limit Commands

This function allows the network manager to control the maximum rate for traffic transmitted or received on an interface. Rate limiting is configured on interfaces at the edge of a network to limit traffic into or out of the network. Traffic that falls within

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the rate limit is transmitted, while packets that exceed the acceptable amount of traffic are dropped.

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

Table 3-42. Rate Limit Command			
Command	Function	Mode	Page
rate-limit	Configures the maximum input or output rate for a port	IC	3-128

rate-limit

Use this command to define the rate limit for a specific interface. Use this command without specifying a rate to restore the default rate. Use the **no** form to restore the default status of disabled.

Syntax

rate-limit {**input** | **output**} [*rate*]
no rate-limit {**input** | **output**}

- **input** – Input rate
- **output** – Output rate
- *rate* – Maximum value in Mbps.

Default Setting

Fast Ethernet interface – 100 Mbps
Gigabit Ethernet interface – 1000 Mbps

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The range is:
  - Fast Ethernet interface – 1 to 100 Mbps
  - Gigabit Ethernet interface – 8 to 1000 Mbps

- Resolution – The increment of change:
  - Fast Ethernet interface – 1 Mbps
  - Gigabit Ethernet interface – 8 Mbps

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rate-limit input 10
Console(config-if)#
```

Authentication Commands

You can configure this switch to authenticate users logging into the system for management access using local, RADIUS, or TACACS authentication methods. You can also enable port-based authentication for network client access using IEEE 802.1x.

Remote Authentication Dial-in User Service (RADIUS) and Terminal Access Controller Access Control System Plus (TACACS+) are logon authentication protocols that use software running on a central server to control access to RADIUS-aware or TACACS+-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

The switch supports IEEE 802.1x (dot1x) port-based access control that prevents unauthorized access to the network by requiring users to first enter a user ID and password for authentication. Client authentication is controlled centrally by an RADIUS server using EAPOL (Extensible Authentication Protocol Over LANs).

Command Group	Function	Page
Authentication Sequence	Defines logon authentication method and precedence	3-129
RADIUS Client	Configures settings for authentication via a RADIUS server	3-130
TACACS+ Client	Configures settings for authentication via a TACACS+ server	3-134
Port Authentication	Configures host authentication on specific ports using 802.1x	3-136

Table 3-43. Authentication Commands

Authentication Sequence

Command	Function	Mode	Page
authentication login	Defines logon authentication method and precedence	GC	3-129
authentication enable	Defines the authentication method and precedence for command mode change	GC	4-67

Table 3-44. Authentication Sequence

authentication login

Use this command to define the login authentication method and precedence. Use the **no** form to restore the default.

Syntax

authentication login {[**local**] [**radius**] [**tacacs**]}
no authentication login

- **local** - Use local password only.

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- **radius** - Use RADIUS server password only.
- **tacacs** - Use TACACS server password only.

Default Setting

Local

Command Mode

Global Configuration

Command Usage

- RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server.
- RADIUS and TACACS+ logon authentication can control management access via the console port, a Web browser, or Telnet. These access options must be configured on the authentication server.
- RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.
- You can specify three authentication methods in a single command to indicate the authentication sequence. For example, if you enter "**authentication login radius tacacs local**," the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.

Example

```
Console(config)#authentication login radius
Console(config)#
```

Related Commands

username (3-23)

RADIUS Client

Remote Authentication Dial-in User Service (RADIUS) is a logon authentication protocol that uses software running on a central server to control access to RADIUS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

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Table 3-45. RADIUS Client Commands			
Command	Function	Mode	Page
radius-server host	Specifies the RADIUS server	GC	3-131
radius-server port	Sets the RADIUS server network port	GC	3-131
radius-server key	Sets the RADIUS encryption key	GC	3-132
radius-server retransmit	Sets the number of retries	GC	3-132
radius-server timeout	Sets the interval between sending authentication requests	GC	3-133
show radius-server	Shows the current RADIUS settings	PE	3-133

radius-server host

Use this command to specify the RADIUS server. Use the **no** form to restore the default.

Syntax

radius-server host *host_ip_address*
no radius-server host

   host_ip_address - IP address of server.

Default Setting

   10.1.0.1

Command Mode

   Global Configuration

Example

```
Console(config)#radius-server host 192.168.1.25
Console(config)#
```

radius-server port

Use this command to set the RADIUS server network port. Use the **no** form to restore the default.

Syntax

radius-server port *port_number*
no radius-server port

   port_number - RADIUS server UDP port used for authentication
   messages. (Range: 1-65535)

Default Setting

   1812

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Command Mode

   Global Configuration

Example

```
Console(config)#radius-server port 181
Console(config)#
```

radius-server key

Use this command to set the RADIUS encryption key. Use the **no** form to restore the default.

Syntax

   radius-server key *key_string*
   no radius-server key

   key_string - Encryption key used to authenticate logon access for client.
   Do not use blank spaces in the string. (Maximum length: 20 characters)

Default Setting

   None

Command Mode

   Global Configuration

Example

```
Console(config)#radius-server key green
Console(config)#
```

radius-server retransmit

Use this command to set the number of retries. Use the **no** form to restore the default.

Syntax

   radius-server retransmit *number_of_retries*
   no radius-server retransmit

   number_of_retries - Number of times the switch will try to authenticate
   logon access via the RADIUS server. (Range: 1 - 30)

Default Setting

   2

Command Mode

   Global Configuration

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Example

```
Console(config)#radius-server retransmit 5
Console(config)#
```

radius-server timeout

Use this command to set the interval between transmitting authentication requests to the RADIUS server. Use the **no** form to restore the default.

Syntax

> **radius-server timeout** *number_of_seconds*
> **no radius-server timeout**
>
> *number_of_seconds* - Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

Default Setting

> 5

Command Mode

> Global Configuration

Example

```
Console(config)#radius-server timeout 10
Console(config)#
```

show radius-server

Use this command to display the current settings for the RADIUS server.

Default Setting

> None

Command Mode

> Privileged Exec

Example

```
Console#show radius-server
Remote radius server configuration:
 Server IP address: 10.1.0.1
 Communication key with radius server:
 Server port number: 1812
 Retransmit times: 2
 Request timeout: 5
Console#
```

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TACACS+ Client

Terminal Access Controller Access Control System (TACACS+) is a logon authentication protocol that uses software running on a central server to control access to TACACS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

Table 3-46. TACACS Commands			
Command	Function	Mode	Page
tacacs-server host	Specifies the TACACS+ server	GC	3-134
tacacs-server port	Specifies the TACACS+ server network port	GC	3-135
tacacs-server key	Sets the TACACS+ encryption key	GC	3-135
show tacacs-server	Shows the current TACACS+ settings	GC	3-136

tacacs-server host

Use this command to specify the TACACS+ server. Use the **no** form to restore the default.

Syntax

tacacs-server host *host_ip_address*
no tacacs-server host

host_ip_address - IP address of a TACACS+ server.

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#tacacs-server host 192.168.1.25
Console(config)#
```

tacacs-server port

Use this command to specify the TACACS+ server TCP port. Use the **no** form to restore the default.

Syntax

tacacs-server port *port_number*
no tacacs-server port

    port_number - TACACS+ server TCP port used for authentication messages. (Range: 1-65535)

Default Setting

    None

Command Mode

    Global Configuration

Example

```
Console(config)#tacacs-server port 181
Console(config)#
```

tacacs-server key

Use this command to set the TACACS+ encryption key. Use the **no** form to restore the default.

Syntax

tacacs-server key *key_string*
no tacacs-server key

    key_string - Encryption key used to authenticate logon access for the client. Do not use blank spaces in the string.
    (Maximum length: 20 characters)

Default Setting

    None

Command Mode

    Global Configuration

Example

```
Console(config)#tacacs-server key green
Console(config)#
```

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show tacacs-server

Use this command to display the current settings for the TACACS+ server.

Default Setting

None

Command Mode

Global Configuration

Example

```
Console#show tacacs-server
Remote TACACS server configuration:
 Server IP address: 10.11.12.13
 Communication key with tacacs server: green
 Server port number: 1824
Console
```

802.1x Port Authentication

The switch supports IEEE 802.1x (dot1x) port-based access control that prevents unauthorized access to the network by requiring users to first submit credentials for authentication. Client authentication is controlled centrally by a RADIUS server using EAP (Extensible Authentication Protocol).

Table 3-47. 802.1x Port Authentication			
Command	Function	Mode	Page
authentication dot1x default	Enables dot1x globally on the switch.	GC	3-137
dot1x default	Resets all dot1x parameters to their default values	GC	3-137
dot1x max-req	Sets the maximum number of times that the switch retransmits an EAP request/identity packet to the client before it times out the authentication session	IC	3-137
dot1x port-control	Sets dot1x mode for a port interface	IC	3-138
dot1x re-authenticate	Forces re-authentication on specific ports	PE	3-138
dot1x re-authentication	Enables re-authentication for all ports	IC	3-139
dot1x timeout quiet-period	Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client	IC	3-139
dot1x timeout re-authperiod	Sets the time period after which a connected client must be re-authenticated	IC	3-140
dot1x timeout tx-period	Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet	IC	3-140
show dot1x	Shows all dot1x related information	PE	3-141

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authentication dot1x default

Sets the default authentication server type. Use the **no** form to restore the default.

Syntax

> **authentication dot1x default radius**
> **no authentication dot1x**

Default Setting

> RADIUS

Command Mode

> Global Configuration

Example

```
Console(config)#authentication dot1x default radius
Console(config)#
```

dot1x default

Sets all configurable dot1x global and port settings to their default values.

Syntax

> **dot1x default**

Command Mode

> Global Configuration

Example

```
Console(config)#dot1x default
Console(config)#
```

dot1x max-req

Sets the maximum number of times the switch port will retransmit an EAP request packet to the client before it times out the authentication session. Use the **no** form to restore the default.

Syntax

> **dot1x max-req** *count*
> **no dot1x max-req**
>
> > *count* – The maximum number of requests (Range: 1-10)

Default

> 2

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Command Mode

Global Configuration

Example

```
Console(config)#dot1x max-req 2
Console(config)#
```

dot1x port-control

Sets the dot1x mode on a port interface. Use the **no** form to restore the default.

Syntax

dot1x port-control {**auto** | **force-authorized** | **force-unauthorized**}
no dot1x port-control

- **auto** – Requires a dot1x-aware connected client to be authorized by the RADIUS server. Clients that are not dot1x-aware will be denied access.
- **force-authorized** – Configures the port to grant access to all clients, either dot1x-aware or otherwise.
- **force-unauthorized** – Configures the port to deny access to all clients, either dot1x-aware or otherwise.

Default

force-authorized

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x port-control auto
Console(config-if)#
```

dot1x re-authenticate

Forces re-authentication on all ports or a specific interface.

Syntax

dot1x re-authenticate [*interface*]

interface

- **ethernet** *unit*/*port*
  - *unit* - This is device 1.
  - *port* - Port number.

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Command Mode

Privileged Exec

Example

```
Console#dot1x re-authenticate
Console#
```

dot1x re-authentication

Enables periodic re-authentication globally for all ports. Use the **no** form to disable re-authentication.

Syntax

[**no**] **dot1x re-authentication**

Command Mode

Global Configuration

Example

```
Console(config)#dot1x re-authentication
Console(config)#
```

dot1x timeout quiet-period

Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client. Use the **no** form of this command to reset the default.

Syntax

dot1x timeout quiet-period *seconds*
no dot1x timeout quiet-period *seconds*

seconds - The number of seconds. (Range: 1-65535)

Default

60 seconds

Command Mode

Global Configuration

Example

```
Console(config)#dot1x timeout quiet-period 350
Console(config)#
```

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dot1x timeout re-authperiod

Sets the time period after which a connected client must be re-authenticated.

Syntax

dot1x timeout re-authperiod *seconds*
no dot1x timeout re-authperiod

seconds - The number of seconds. (Range: 1-65535)

Default

3600 seconds

Command Mode

Global Configuration

Example

```
Console(config)#dot1x timeout re-authperiod 3600
Console(config)#
```

dot1x timeout tx-period

Sets the time that the switch waits during an authentication session before re-transmitting an EAP packet. Use the **no** form to reset to the default value.

Syntax

dot1x timeout tx-period *seconds*
no dot1x timeout tx-period

seconds - The number of seconds. (Range: 1-65535)

Default

30 seconds

Command Mode

Global Configuration

Example

```
Console(config)#dot1x timeout tx-period 300
Console(config)#
```

show dot1x

Use this command to show general port authentication related settings on the switch or a specific interface.

Syntax

show dot1x [**statistics**] [**interface** *interface*]

interface

- **ethernet** *unit*/*port*
    - *unit* - This is device 1.
    - *port* - Port number.

Command Mode

Privileged Exec

Command Usage

This command displays the following information:

- *Global 802.1X Parameters* – Displays the global port access control parameters that can be configured for this switch as described in the preceding pages, including reauth-period (page 3-140), quiet-period (page 3-139), tx-period (page 3-140), and max-req (page 3-137). It also displays the following global parameters which are set to a fixed value, including the following items:
    - supp-timeout   – Supplicant timeout.
    - server-timeout   – Server timeout.
    - reauth-max   – Maximum number of reauthentication attempts.

- *802.1X Port Summary* – Displays the port access control parameters for each interface, including the following items:
    - Status   – Administrative state for port access control.
    - Mode   – Dot1x port control mode (page 3-138).
    - Authorized   – Authorization status (yes or n/a - not authorized).

- *802.1X Port Details* – Displays detailed port access control settings for each interface as described in the preceding pages, including administrative status for port access control, Max request (page 3-137), Quiet period (page 3-139), Reauth period (page 3-140), and Tx period (page 3-140). It also displays the following information:
    - Status   – Authorization status (authorized or unauthorized).
    - Supplicant   – MAC address of authorized client.

- *Authenticator State Machine*
    - State   – Current state (including initialize, disconnected, connecting, authenticating, authenticated, aborting, held, force_authorized, force_unauthorized).

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- Reauth Count – Number of times connecting state is re-entered.
- *Backend State Machine*
  - State – Current state (including request, response, success, fail, timeout, idle, initialize).
  - Request Count – Number of EAP Request packets sent to the Supplicant without receiving a response.
  - Identifier(Server) – Identifier carried in the most recent EAP Success, Failure or Request packet received from the Authentication Server.
- *Reauthentication State Machine*
  - State – Current state (including initialize, reauthenticate).

Example

```
Console#show dot1x
Global 802.1X Parameters
 reauth-enabled: yes
 reauth-period:  300
 quiet-period:   350
 tx-period:      300
 supp-timeout:   30
 server-timeout: 30
 reauth-max:     2
 max-req:        2

802.1X Port Summary
 Port Name     Status         Mode         Authorized
        1      disabled    ForceAuthorized        n/a
        2      disabled    ForceAuthorized        n/a
:
       25      disabled    ForceAuthorized        yes
       26       enabled            Auto           yes

802.1X Port Details

802.1X is disabled on port 1
:
802.1X is enabled on port 26
Max request        2
Quiet period       350
Reauth period      300
Tx period          300
Status             Unauthorized
Port-control       Auto
Supplicant         00-00-00-00-00-00

Authenticator State Machine
State              Connecting
Reauth Count       3
Backend State Machine
State              Idle
Request Count      0
Identifier(Server) 0

Reauthentication State Machine
State              Initialize
Console#
```

Appendix A: Upgrading Firmware via the Serial Port

The switch contains three firmware components that can be upgraded; the diagnostics (or Boot-ROM) code, runtime operation code and the loader code. The runtime code can be upgraded via the switch's RS-232 serial console port, via a network connection to a TFTP server, or using SNMP management software. The diagnostics and the loader code can be upgraded only via the switch's RS-232 serial console port.

Note: You can use the switch's web interface to download runtime code via TFTP. Downloading large runtime code files via TFTP is normally much faster than downloading via the switch's serial port.

You can upgrade switch firmware by connecting a PC directly to the serial Console port on the switch's front panel and using VT100 terminal emulation software that supports the XModem protocol. (See "Required Connections" on page 1-2.)

1. Connect a PC to the switch's Console port using a null-modem or crossover RS-232 cable with a female DB-9 connector.

2. Configure the terminal emulation software's communication parameters to 9600 baud, 8 data bits, 1 stop bit, no parity, and set flow control to *none*.

3. Power cycle the switch.

4. When the switch initialization screen appears, enter firmware-download mode by pressing <Ctrl><u> immediately after power on or rebooting the switch. Screen text similar to that shown below displays:

```
File Name                        S/Up Type Size       Create Time
-------------------------------- ---- ---- ----------
$logfile_1                        0    3           64  00:00:16
$logfile_2                        0    3           64  00:00:33
Factory_Default_Config.cfg        0    5         2688  00:00:14
diag1011                          1    1        86944  00:00:00
mdc0115                           0    2      1120008  00:00:01
mdc0121.bix                       1    2      1135548  00:00:01
startup                           1    5         2783  00:03:28
-------------------------------- ---- ---- ----------
[X]modem Download  [D]elete File  [S]et Startup File
[C]hange Baudrate  [Q]uit
Select>
```

5. Press <c> to change the baud rate of the switch's serial connection.

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6. Press <b> to select the option for 115200 baud.

    There are two baud rate settings available, 9600 and 115200. Using the higher baud rate minimizes the time required to download firmware code files.

7. Set your PC's terminal emulation software to match the 115200 baud rate. Press Press <Enter> to reset communications with the switch.

```
Select>
Change baudrate [A]9600 [B]115200
Baudrate set to 115200
```

8. Check that the switch has sufficient flash memory space for the new code file before starting the download.

    You can store a maximum of only two runtime and two diagnostic code files in the switch's flash memory. Use the [**D]elete File** command to remove a runtime or diagnostic file.

9. Press <x> to start to download the new code file.

    If using Windows HyperTerminal, click the "Transfer" button, and then click "Send File...." Select the XModem Protocol and then use the "Browse" button to select the required firmware code file from your PC system. The "Xmodem file send" window displays the progress of the download procedure.

Note: The download file must be a binary software file for this switch.

10. After the file has been downloaded, you are prompted with "Update Image File:" to specify the type of code file. Press <r> for runtime code, <d> for diagnostic code, or <L> for loader code.

Caution: If you select <L> for loader code, be sure the file is a valid loader code file for the switch. If you download an invalid file, the switch will not be able to boot. Unless absolutely necessary, do not attempt to download loader code files.

11. Specify a name for the downloaded code file. File names are case-sensitive, should be 1 to 31 characters, should not contain slashes (\ or /), and the leading letter of the file name should not be a period (.). (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

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For example, the following screen text shows the download procedure for a runtime code file:

```
Select>x
Xmodem Receiving Start ::
        [R]untime
        [D]iagnostic
        [L]oader
Update Image File:r
Runtime Image Filename : run_1013
Updating file system.
File system updated.
[Press any key to continue]
```

12. To set the new downloaded file as the startup file, use the **[S]et Startup File** menu option.

13. When you have finished downloading code files, use the **[C]hange Baudrate** menu option to change the baud rate of the switch's serial connection back to 9600 baud.

14. Set your PC's terminal emulation software baud rate back to 9600 baud. Press <Enter> to reset communications with the switch.

15. Press <q> to quit the firmware-download mode and boot the switch.

Appendix B: Troubleshooting

Troubleshooting Chart	
Symptom	Action
Cannot connect using Telnet, Web browser, or SNMP software	• Be sure you have configured the agent with a valid IP address, subnet mask and default gateway. • If you are trying to connect to the agent via the IP address for a tagged VLAN group, your management station must include the appropriate tag in its transmitted frames. • Check that you have a valid network connection to the switch and that the port you are using has not been disabled. • Check network cabling between the management station and the switch. • If you cannot connect using Telnet, you may have exceeded the maximum number of concurrent Telnet sessions permitted. Try connecting again at a later time.
Cannot access the on-board configuration program via a serial port connection	• Be sure you have set the terminal emulator program to VT100 compatible, 8 data bits, 1 stop bit, no parity and 9600 bps. • Check that the null-modem serial cable conforms to the pin-out connections provided in Appendix B.
Forgot or lost the password	• Reinstall the switch defaults. Make a direct connection to the switch's console port and power cycle the switch. Immediately after powering on, press <Ctrl><u> to access the system file menu. Select <D> to delete all user-defined configuration files. Press <Q> to boot the switch.

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Appendix C: Software Specifications

Software Features

Authentication
  Local, RADIUS, TACACS, Port (802.1x), HTTPS, SSH, Port Security

Access Control Lists
  IP, MAC (up to 32 lists)

DHCP Client

Port Configuration
  100BASE-TX: 10/100 Mbps, half/full duplex
  1000BASE-T: 1000 Mbps, full duplex

Flow Control
  Full Duplex: IEEE 802.3x
  Half Duplex: Back pressure

Broadcast Storm Control
  Traffic throttled above a critical threshold

Port Mirroring
  Multiple source ports, one destination port

Rate Limits
  Input Limit
  Output limit
  Range (configured per port)

Port Trunking
  Static trunks (Cisco EtherChannel compliant)
  Dynamic trunks (Link Aggregation Control Protocol)

Spanning Tree Protocol
  Spanning Tree Protocol (STP, IEEE 802.1D)
  Rapid Spanning Tree Protocol (RSTP, IEEE 802.1w)

VLAN Support
  Up to 255 groups; port-based, protocol-based, or tagged (802.1Q),
  GVRP for automatic VLAN learning, private VLANs

Class of Service
  Supports four levels of priority and Weighted Round Robin Queueing
  (which can be configured by VLAN tag or port),
  Layer 3/4 priority mapping: IP Precedence, IP DSCP

Multicast Filtering
  IGMP Snooping (Layer 2)

Additional Features
   BOOTP client
   CIDR (Classless Inter-Domain Routing)
   SNTP (Simple Network Time Protocol)
   SNMP (Simple Network Management Protocol)
   RMON (Remote Monitoring, groups 1,2,3,9)

Management Features

In-Band Management
   Telnet, Web-based HTTP or HTTPS, SNMP manager, or Secure Shell

Out-of-Band Management
   RS-232 DB-9 console port

Software Loading
   TFTP in-band or XModem out-of-band

SNMP
   Management access via MIB database
   Trap management to specified hosts

RMON
   Groups 1, 2, 3, 9 (Statistics, History, Alarm, Event)

Standards

   IEEE 802.3 Ethernet,
   IEEE 802.3u Fast Ethernet
   IEEE 802.3x Full-duplex flow control (ISO/IEC 8802-3)
   IEEE 802.3z Gigabit Ethernet,
   IEEE 802.3ab 1000BASE-T
   IEEE 802.3ac VLAN tagging
   IEEE 802.1Q VLAN
   IEEE 802.3ad Link Aggregation Control Protocol
   IEEE 802.1D Spanning Tree Protocol and traffic priorities
   IEEE 802.1p Priority tags
   IEEE 802.1w Rapid Spanning Tree Protocol
   IEEE 802.1x Port Authentication
   DHCP (RFC 1541)
   ICMP (RFC 792)
   IGMP (RFC 1112)
   IGMPv2 (RFC 2236)
   RADIUS+ (RFC 2618)
   RMON (RFC 1757 groups 1,2,3,9)
   SNTP (RFC 2030)
   SNMP (RFC 1157)
   SNMPv2 (RFC 1907)

SSH (Version 1.5)

Management Information Bases

Bridge MIB (RFC 1493)
Entity MIB (RFC 2737)
Ethernet MIB (RFC 2665)
Ether-like MIB (RFC 1643)
Extended Bridge MIB (RFC 2674)
Extensible SNMP Agents MIB (RFC 2742)
Forwarding Table MIB (RFC 2096)
IGMP MIB (RFC 2933)
Interface Group MIB (RFC 2233)
Interfaces Evolution MIB (RFC 2863)
IP Multicasting related MIBs
MIB II (RFC 1213)
Port Access Entity MIB (IEEE 802.1x)
RADIUS Authentication Client MIB (RFC 2618)
TACACS+ Authentication Client MIB
RMON MIB (RFC 2819)
Trap (RFC 1215)
Private MIB

Glossary

10BASE-T
IEEE 802.3 specification for 10 Mbps Ethernet over two pairs of Category 3, 4, or 5 UTP cable.

100BASE-TX
IEEE 802.3u specification for 100 Mbps Fast Ethernet over two pairs of Category 5 UTP cable.

1000BASE-T
IEEE 802.3ab specification for Gigabit Ethernet over two pairs of Category 5, 5e 100-ohm UTP cable.

1000BASE-X
IEEE 802.3 shorthand term for any 1000 Mbps Gigabit Ethernet based on 8B/10B signaling.

Auto-negotiation
Signalling method allowing each node to select its optimum operational mode (e.g., 10 Mbps or 100 Mbps and half or full duplex) based on the capabilities of the node to which it is connected.

Bandwidth
The difference between the highest and lowest frequencies available for network signals. Also synonymous with wire speed, the actual speed of the data transmission along the cable.

BOOTP
Boot protocol used to load the operating system for devices connected to the network.

Dynamic Host Control Protocol (DHCP)
Provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.

End Station
A workstation, server, or other device that does not act as a network interconnection.

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Ethernet
A network communication system developed and standardized by DEC, Intel, and Xerox, using baseband transmission, CSMA/CD access, logical bus topology, and coaxial cable. The successor IEEE 802.3 standard provides for integration into the OSI model and extends the physical layer and media with repeaters and implementations that operate on fiber, thin coax and twisted-pair cable.

Fast Ethernet
A 100 Mbps network communication system based on Ethernet and the CSMA/CD access method.

Full Duplex
Transmission method that allows switch and network card to transmit and receive concurrently, effectively doubling the bandwidth of that link.

GARP VLAN Registration Protocol (GVRP)
Defines a way for switches to exchange VLAN information in order to register necessary VLAN members on ports along the Spanning Tree so that VLANs defined in each switch can work automatically over a Spanning Tree network.

Generic Attribute Registration Protocol (GARP)
GARP is a protocol that can be used by endstations and switches to register and propagate multicast group membership information in a switched environment so that multicast data frames are propagated only to those parts of a switched LAN containing registered endstations. Formerly called Group Address Registration Protocol.

Generic Multicast Registration Protocol (GMRP)
GMRP allows network devices to register endstations with multicast groups. GMRP requires that any participating network devices or endstations comply with the IEEE 802.1p standard.

Gigabit Ethernet
A 1000 Mbps network communication system based on Ethernet and the CSMA/CD access method.

Group Attribute Registration Protocol
See Generic Attribute Registration Protocol.

IEEE 802.1D
Specifies a general method for the operation of MAC bridges, including the Spanning Tree Protocol.

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IEEE 802.1Q

VLAN Tagging—Defines Ethernet frame tags which carry VLAN information. It allows switches to assign endstations to different virtual LANs, and defines a standard way for VLANs to communicate across switched networks.

IEEE 802.1p

An IEEE standard for providing quality of service (QoS) in Ethernet networks. The standard uses packet tags that define up to eight traffic classes and allows switches to transmit packets based on the tagged priority value.

IEEE 802.3

Defines carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

IEEE 802.3ab

Defines CSMA/CD access method and physical layer specifications for 1000BASE-T Fast Ethernet.

IEEE 802.3ac

Defines frame extensions for VLAN tagging.

IEEE 802.3u

Defines CSMA/CD access method and physical layer specifications for 100BASE-TX Fast Ethernet.

IEEE 802.3x

Defines Ethernet frame start/stop requests and timers used for flow control on full-duplex links.

IEEE 802.3z

Defines CSMA/CD access method and physical layer specifications for 1000BASE Gigabit Ethernet.

IGMP Snooping

Listening to IGMP Query and IGMP Report packets transferred between IP Multicast Routers and IP Multicast host groups to identify IP Multicast group members.

Internet Group Management Protocol (IGMP)

A protocol through which hosts can register with their local router for multicast services. If there is more than one multicast router on a given subnetwork, one of the

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routers is made the "querier" and assumes responsibility for keeping track of group membership.

In-Band Management

Management of the network from a station attached directly to the network.

IP Multicast Filtering

A process whereby this switch can pass multicast traffic along to participating hosts.

Layer 2

Data Link layer in the ISO 7-Layer Data Communications Protocol. This is related directly to the hardware interface for network devices and passes on traffic based on MAC addresses.

Layer 3

Network layer in the ISO 7-Layer Data Communications Protocol. This layer handles the routing functions for data moving from one open system to another.

Link Aggregation

See Port Trunk.

Link Aggregation Control Protocol (LACP)

Allows ports to automatically negotiate a trunked link with LACP-configured ports on another device.

Media Access Control (MAC)

A portion of the networking protocol that governs access to the transmission medium, facilitating the exchange of data between network nodes.

Management Information Base (MIB)

An acronym for Management Information Base. It is a set of database objects that contains information about a specific device.

Multicast Switching

A process whereby the switch filters incoming multicast frames for services for which no attached host has registered, or forwards them to all ports contained within the designated multicast VLAN group.

Out-of-Band Management

Management of the network from a station not attached to the network.

Port Mirroring

A method whereby data on a target port is mirrored to a monitor port for troubleshooting with a logic analyzer or RMON probe. This allows data on the target port to be studied unobstructively.

Port Trunk

Defines a network link aggregation and trunking method which specifies how to create a single high-speed logical link that combines several lower-speed physical links.

Remote Monitoring (RMON)

RMON provides comprehensive network monitoring capabilities. It eliminates the polling required in standard SNMP, and can set alarms on a variety of traffic conditions, including specific error types.

Simple Network Management Protocol (SNMP)

The application protocol in the Internet suite of protocols which offers network management services.

Spanning Tree Protocol (STP)

A technology that checks your network for any loops. A loop can often occur in complicated or backup linked network systems. Spanning Tree detects and directs data along the shortest available path, maximizing the performance and efficiency of the network.

Telnet

Defines a remote communication facility for interfacing to a terminal device over TCP/IP.

Transmission Control Protocol/Internet Protocol (TCP/IP)

Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.

Trivial File Transfer Protocol (TFTP)

A TCP/IP protocol commonly used for software downloads.

Virtual LAN (VLAN)

A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, and allows users to share information and resources as though located on the same LAN.

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XModem

A protocol used to transfer files between devices. Data is grouped in 128-byte blocks and error-corrected.

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