Catalyst 2960-X Switch VLAN Configuration Guide, Cisco IOS Release 15.0(2)EX

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Preface

This guide describes configuration information and examples for VLANs on the switch.

Document Conventions

This document uses the following conventions:

Convention	Description
^ or Ctrl	Both the ^ symbol and Ctrl represent the Control (Ctrl) key on a keyboard. For example, the key combination **^D** or **Ctrl-D** means that you hold down the Control key while you press the D key. (Keys are indicated in capital letters but are not case sensitive.)
bold font	Commands and keywords and user-entered text appear in **bold** font.
Italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
`Courier font`	Terminal sessions and information the system displays appear in `courier` font.
`Bold Courier font`	Bold Courier font indicates text that the user must enter.
[x]	Elements in square brackets are optional.
...	An ellipsis (three consecutive nonbolded periods without spaces) after a syntax element indicates that the element can be repeated.
|	A vertical line, called a pipe, indicates a choice within a set of keywords or arguments.

Convention	Description
[x | y]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
{x | y}	Required alternative keywords are grouped in braces and separated by vertical bars.
[x {y | z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Reader Alert Conventions

This document uses the following conventions for reader alerts:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Tip Means *the following information will help you solve a problem.*

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Timesaver Means *the described action saves time.* You can save time by performing the action described in the paragraph.

Warning **Means *reader be warned.* In this situation, you might perform an action that could result in bodily injury.**

Related Documentation

Note Before installing or upgrading the switch, refer to the release notes.

- Catalyst 2960-X Switch, located at http://www.cisco.com/go/cat2960x_docs.
- Cisco SFP and SFP+ modules documentation, including compatibility matrixes, located at:

  http://www.cisco.com/en/US/products/hw/modules/ps5455/tsd_products_support_series_home.html

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

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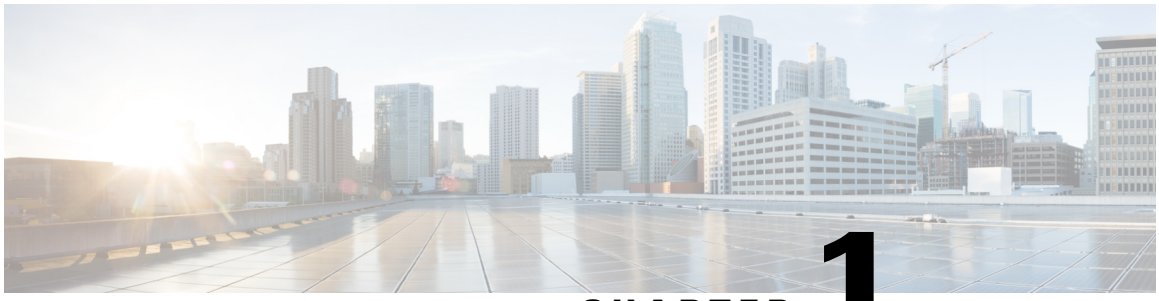


CHAPTER 1

Using the Command-Line Interface

This chapter contains the following topics:

Information About Using the Command-Line Interface

This section describes the Cisco IOS command-line interface (CLI) and how to use it to configure your switch.

Command Modes

The Cisco IOS user interface is divided into many different modes. The commands available to you depend on which mode you are currently in. Enter a question mark (?) at the system prompt to obtain a list of commands available for each command mode.

You can start a CLI session through a console connection, through Telnet, a SSH, or by using the browser.

When you start a session, you begin in user mode, often called user EXEC mode. Only a limited subset of the commands are available in user EXEC mode. For example, most of the user EXEC commands are one-time commands, such as **show** commands, which show the current configuration status, and **clear** commands, which clear counters or interfaces. The user EXEC commands are not saved when the switch reboots.

To have access to all commands, you must enter privileged EXEC mode. Normally, you must enter a password to enter privileged EXEC mode. From this mode, you can enter any privileged EXEC command or enter global configuration mode.

Using the configuration modes (global, interface, and line), you can make changes to the running configuration. If you save the configuration, these commands are stored and used when the switch reboots. To access the various configuration modes, you must start at global configuration mode. From global configuration mode, you can enter interface configuration mode and line configuration mode.

This table describes the main command modes, how to access each one, the prompt you see in that mode, and how to exit the mode.

Table 1: Command Mode Summary

Mode	Access Method	Prompt	Exit Method	About This Mode
User EXEC	Begin a session using Telnet, SSH, or console.	`Switch>`	Enter **logout** or **quit**.	Use this mode to • Change terminal settings. • Perform basic tests. • Display system information.
Privileged EXEC	While in user EXEC mode, enter the **enable** command.	`Switch#`	Enter **disable** to exit.	Use this mode to verify commands that you have entered. Use a password to protect access to this mode.
Global configuration	While in privileged EXEC mode, enter the **configure** command.	`Switch(config)#`	To exit to privileged EXEC mode, enter **exit** or **end**, or press **Ctrl-Z**.	Use this mode to configure parameters that apply to the entire switch.
VLAN configuration	While in global configuration mode, enter the **vlan** *vlan-id* command.	`Switch(config-vlan)#`	To exit to global configuration mode, enter the **exit** command. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure VLAN parameters. When VTP mode is transparent, you can create extended-range VLANs (VLAN IDs greater than 1005) and save configurations in the switch startup configuration file.
Interface configuration	While in global configuration mode, enter the **interface** command (with a specific interface).	`Switch(config-if)#`	To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure parameters for the Ethernet ports.

Mode	Access Method	Prompt	Exit Method	About This Mode
Line configuration	While in global configuration mode, specify a line with the **line vty** or **line console** command.	`Switch(config-line)#`	To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure parameters for the terminal line.

Using the Help System

You can enter a question mark (?) at the system prompt to display a list of commands available for each command mode. You can also obtain a list of associated keywords and arguments for any command.

SUMMARY STEPS

1. **help**
2. *abbreviated-command-entry* **?**
3. *abbreviated-command-entry* <Tab>
4. **?**
5. *command* **?**
6. *command keyword* **?**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**help** **Example:** `Switch# help`	Obtains a brief description of the help system in any command mode.

Step 2	*abbreviated-command-entry* **?**
	Example:
	`Switch# di?`
	`dir disable disconnect`
		Obtains a list of commands that begin with a particular character string.

Step 3	*abbreviated-command-entry* <Tab>
	Example:
	`Switch# sh conf<tab>`
	`Switch# show configuration`
		Completes a partial command name.

	Command or Action	Purpose
Step 4	**?** **Example:** `Switch> ?`	Lists all commands available for a particular command mode.
Step 5	*command* **?** **Example:** `Switch> show ?`	Lists the associated keywords for a command.

Step 6	*command keyword* **?**
	
	Example:
	`Switch(config)# cdp holdtime ?`
	`  <10-255> Length of time (in sec) that receiver must keep this packet`
		Lists the associated arguments for a keyword.

Understanding Abbreviated Commands

You need to enter only enough characters for the switch to recognize the command as unique.

This example shows how to enter the **show configuration** privileged EXEC command in an abbreviated form:

```
Switch# show conf
```

No and default Forms of Commands

Almost every configuration command also has a **no** form. In general, use the **no** form to disable a feature or function or reverse the action of a command. For example, the **no shutdown** interface configuration command reverses the shutdown of an interface. Use the command without the keyword **no** to reenable a disabled feature or to enable a feature that is disabled by default.

Configuration commands can also have a **default** form. The **default** form of a command returns the command setting to its default. Most commands are disabled by default, so the **default** form is the same as the **no** form. However, some commands are enabled by default and have variables set to certain default values. In these cases, the **default** command enables the command and sets variables to their default values.

CLI Error Messages

This table lists some error messages that you might encounter while using the CLI to configure your switch.

Table 2: Common CLI Error Messages

Error Message	Meaning	How to Get Help
`% Ambiguous command: "show con"`	You did not enter enough characters for your switch to recognize the command.	Reenter the command followed by a question mark (?) with a space between the command and the question mark. The possible keywords that you can enter with the command appear.
`% Incomplete command.`	You did not enter all the keywords or values required by this command.	Reenter the command followed by a question mark (?) with a space between the command and the question mark. The possible keywords that you can enter with the command appear.
`% Invalid input detected at '^' marker.`	You entered the command incorrectly. The caret (^) marks the point of the error.	Enter a question mark (?) to display all the commands that are available in this command mode. The possible keywords that you can enter with the command appear.

Configuration Logging

You can log and view changes to the switch configuration. You can use the Configuration Change Logging and Notification feature to track changes on a per-session and per-user basis. The logger tracks each configuration command that is applied, the user who entered the command, the time that the command was entered, and the parser return code for the command. This feature includes a mechanism for asynchronous notification to registered applications whenever the configuration changes. You can choose to have the notifications sent to the syslog.

Note Only CLI or HTTP changes are logged.

How to Use the CLI to Configure Features

Configuring the Command History

The software provides a history or record of commands that you have entered. The command history feature is particularly useful for recalling long or complex commands or entries, including access lists. You can customize this feature to suit your needs.

Changing the Command History Buffer Size

By default, the switch records ten command lines in its history buffer. You can alter this number for a current terminal session or for all sessions on a particular line. This procedure is optional.

SUMMARY STEPS

1. **terminal history** [**size** *number-of-lines*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal history** [**size** *number-of-lines*] **Example:** `Switch# terminal history size 200`	Changes the number of command lines that the switch records during the current terminal session in the privileged EXEC mode. You can configure the size from 0 through 256.

Recalling Commands

To recall commands from the history buffer, perform one of the actions listed in this table. These actions are optional.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

SUMMARY STEPS

1. **Ctrl-P** or use the **up arrow** key
2. **Ctrl-N** or use the **down arrow** key
3. **show history**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**Ctrl-P** or use the **up arrow** key	Recalls commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Step 2	**Ctrl-N** or use the **down arrow** key	Returns to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the up arrow key. Repeat the key sequence to recall successively more recent commands.

	Command or Action	Purpose
Step 3	**show history** **Example:** `Switch# show history`	Lists the last several commands that you just entered in privileged EXEC mode. The number of commands that appear is controlled by the setting of the **terminal history** global configuration command and the **history** line configuration command.

Disabling the Command History Feature

The command history feature is automatically enabled. You can disable it for the current terminal session or for the command line. This procedure is optional.

SUMMARY STEPS

1. **terminal no history**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal no history** **Example:** `Switch# terminal no history`	Disables the feature during the current terminal session in the privileged EXEC mode.

Enabling and Disabling Editing Features

Although enhanced editing mode is automatically enabled, you can disable it, and reenable it.

SUMMARY STEPS

1. **terminal editing**
2. **terminal no editing**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal editing** **Example:** `Switch# terminal editing`	Reenables the enhanced editing mode for the current terminal session in the privileged EXEC mode.

	Command or Action	Purpose
Step 2	**terminal no editing** **Example:** `Switch# terminal no editing`	Disables the enhanced editing mode for the current terminal session in the privileged EXEC mode.

Editing Commands through Keystrokes

The keystrokes help you to edit the command lines. These keystrokes are optional.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

Table 3: Editing Commands

Editing Commands	Description
Ctrl-B or use the **left arrow** key	Moves the cursor back one character.
Ctrl-F or use the **right arrow** key	Moves the cursor forward one character.
Ctrl-A	Moves the cursor to the beginning of the command line.
Ctrl-E	Moves the cursor to the end of the command line.
Esc B	Moves the cursor back one word.
Esc F	Moves the cursor forward one word.
Ctrl-T	Transposes the character to the left of the cursor with the character located at the cursor.
Delete or **Backspace** key	Erases the character to the left of the cursor.
Ctrl-D	Deletes the character at the cursor.
Ctrl-K	Deletes all characters from the cursor to the end of the command line.
Ctrl-U or **Ctrl-X**	Deletes all characters from the cursor to the beginning of the command line.
Ctrl-W	Deletes the word to the left of the cursor.

Esc D	Deletes from the cursor to the end of the word.
Esc C	Capitalizes at the cursor.
Esc L	Changes the word at the cursor to lowercase.
Esc U	Capitalizes letters from the cursor to the end of the word.
Ctrl-V or **Esc Q**	Designates a particular keystroke as an executable command, perhaps as a shortcut.
Return key	Scrolls down a line or screen on displays that are longer than the terminal screen can display. **Note** The More prompt is used for any output that has more lines than can be displayed on the terminal screen, including **show** command output. You can use the **Return** and **Space** bar keystrokes whenever you see the More prompt.
Space bar	Scrolls down one screen.
Ctrl-L or **Ctrl-R**	Redisplays the current command line if the switch suddenly sends a message to your screen.

Editing Command Lines That Wrap

You can use a wraparound feature for commands that extend beyond a single line on the screen. When the cursor reaches the right margin, the command line shifts ten spaces to the left. You cannot see the first ten characters of the line, but you can scroll back and check the syntax at the beginning of the command. The keystroke actions are optional.

To scroll back to the beginning of the command entry, press **Ctrl-B** or the left arrow key repeatedly. You can also press **Ctrl-A** to immediately move to the beginning of the line.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

The following example shows how to wrap a command line that extend beyond a single line on the screen.

SUMMARY STEPS

1. **access-list**
2. **Ctrl-A**
3. **Return** key

DETAILED STEPS

	Command or Action	Purpose

Step 1	**access-list**
	
	Example:
	`Switch(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35`
	`Switch(config)# $ 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35 255.25`
	`Switch(config)# $t tcp 10.15.22.25 255.255.255.0 131.108.1.20 255.255.255.0 eq`
	`Switch(config)# $15.22.25 255.255.255.0 10.15.22.35 255.255.255.0 eq 45`
		Displays the global configuration command entry that extends beyond one line.
		
		When the cursor first reaches the end of the line, the line is shifted ten spaces to the left and redisplayed. The dollar sign ($) shows that the line has been scrolled to the left. Each time the cursor reaches the end of the line, the line is again shifted ten spaces to the left.

Step 2	**Ctrl-A** **Example:** `Switch(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.2$`	Checks the complete syntax. The dollar sign ($) appears at the end of the line to show that the line has been scrolled to the right.
Step 3	**Return** key	Execute the commands. The software assumes that you have a terminal screen that is 80 columns wide. If you have a different width, use the **terminal width** privileged EXEC command to set the width of your terminal. Use line wrapping with the command history feature to recall and modify previous complex command entries.

Searching and Filtering Output of show and more Commands

You can search and filter the output for **show** and **more** commands. This is useful when you need to sort through large amounts of output or if you want to exclude output that you do not need to see. Using these commands is optional.

SUMMARY STEPS

1. {**show** | **more**} *command* | {**begin** | **include** | **exclude**} *regular-expression*

DETAILED STEPS

	Command or Action	Purpose
Step 1	{**show** | **more**} *command* | {**begin** | **include** | **exclude**} *regular-expression*	Searches and filters the output.

	Command or Action	Purpose

	Example:
	`Switch# show interfaces | include protocol`
	`Vlan1 is up, line protocol is up`
	`Vlan10 is up, line protocol is down`
	`GigabitEthernet1/0/1 is up, line protocol is down`
	`GigabitEthernet1/0/2 is up, line protocol is up`
		Expressions are case sensitive. For example, if you enter **| exclude output**, the lines that contain **output** are not displayed, but the lines that contain **output** appear.

Accessing the CLI through a Console Connection or through Telnet

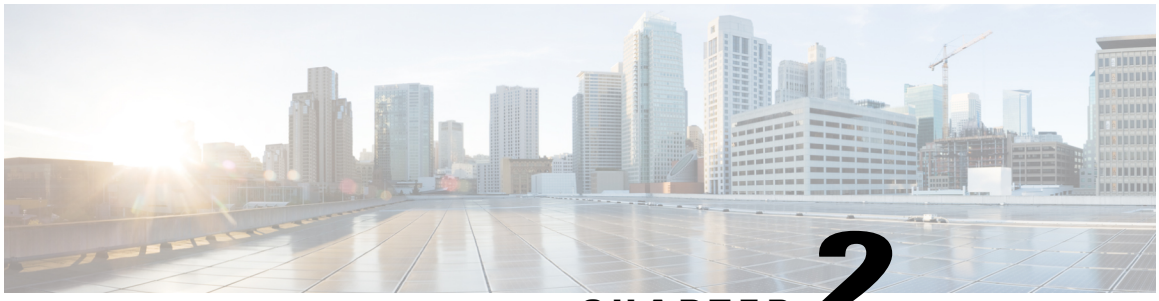
Before you can access the CLI, you must connect a terminal or a PC to the switch console or connect a PC to the Ethernet management port and then power on the switch, as described in the hardware installation guide that shipped with your switch.

If your switch is already configured, you can access the CLI through a local console connection or through a remote Telnet session, but your switch must first be configured for this type of access.

You can use one of these methods to establish a connection with the switch:

- Connect the switch console port to a management station or dial-up modem, or connect the Ethernet management port to a PC. For information about connecting to the console or Ethernet management port, see the switch hardware installation guide.
- Use any Telnet TCP/IP or encrypted Secure Shell (SSH) package from a remote management station. The switch must have network connectivity with the Telnet or SSH client, and the switch must have an enable secret password configured.
    - The switch supports up to 16 simultaneous Telnet sessions. Changes made by one Telnet user are reflected in all other Telnet sessions.
    - The switch supports up to five simultaneous secure SSH sessions.

  After you connect through the console port, through the Ethernet management port, through a Telnet session or through an SSH session, the user EXEC prompt appears on the management station.



CHAPTER 2

Configuring VTP

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for VTP

Before you create VLANs, you must decide whether to use the VLAN Trunking Protocol (VTP) in your network. Using VTP, you can make configuration changes centrally on one or more switches and have those changes automatically communicated to all the other switches in the network. Without VTP, you cannot send information about VLANs to other switches.

VTP is designed to work in an environment where updates are made on a single switch and are sent through VTP to other switches in the domain. It does not work well in a situation where multiple updates to the VLAN

database occur simultaneously on switches in the same domain, which would result in an inconsistency in the VLAN database.

The switch supports a total of 1000 VLANs. However, the number of routed ports, SVIs, and other configured features affects the usage of the switch hardware. If the switch is notified by VTP of a new VLAN and the switch is already using the maximum available hardware resources, it sends a message that there are not enough hardware resources available and shuts down the VLAN. The output of the **show vlan** user EXEC command shows the VLAN in a suspended state.

Because trunk ports send and receive VTP advertisements, you must ensure that at least one trunk port is configured on the switch or switch stack and that this trunk port is connected to the trunk port of another switch. Otherwise, the switch cannot receive any VTP advertisements.

Restrictions for VTP

Note Before adding a VTP client switch to a VTP domain, always verify that its VTP configuration revision number is lower than the configuration revision number of the other switches in the VTP domain. Switches in a VTP domain always use the VLAN configuration of the switch with the highest VTP configuration revision number. If you add a switch that has a revision number higher than the revision number in the VTP domain, it can erase all VLAN information from the VTP server and VTP domain.

The following are restrictions for configuring VTPs:

- 1K VLAN is supported only on switches running the LAN Base image with the lanbase-default template set.
- To avoid warning messages of high CPU utilization with a normal-range VLAN configuration, we recommended to have no more than 256 VLANs.

  In such cases, approximately 10 access interfaces or 5 trunk interfaces can flap simultaneously with negligible impact to CPU utilization (if there are more interfaces that flap simultaneously, then CPU usage may be excessively high.)

Information About VTP

VTP

VTP is a Layer 2 messaging protocol that maintains VLAN configuration consistency by managing the addition, deletion, and renaming of VLANs on a network-wide basis. VTP minimizes misconfigurations and configuration inconsistencies that can cause several problems, such as duplicate VLAN names, incorrect VLAN-type specifications, and security violations.

VTP functionality is supported across the stack, and all switches in the stack maintain the same VLAN and VTP configuration inherited from the active switch. When a switch learns of a new VLAN through VTP messages or when a new VLAN is configured by the user, the new VLAN information is communicated to all switches in the stack.

When a switch joins the stack or when stacks merge, the new switches get VTP information from the active switch.

VTP version 1 and version 2 support only normal-range VLANs (VLAN IDs 1 to 1005). VTP version 3 supports the entire VLAN range (VLANs 1 to 4094). Extended range VLANs (VLANs 1006 to 4094) are supported only in VTP version 3. You cannot convert from VTP version 3 to VTP version 2 if extended VLANs are configured in the domain.

VTP Domain

A VTP domain (also called a VLAN management domain) consists of one switch or several interconnected switches or switch stacks under the same administrative responsibility sharing the same VTP domain name. A switch can be in only one VTP domain. You make global VLAN configuration changes for the domain.

By default, the switch is in the VTP no-management-domain state until it receives an advertisement for a domain over a trunk link (a link that carries the traffic of multiple VLANs) or until you configure a domain name. Until the management domain name is specified or learned, you cannot create or modify VLANs on a VTP server, and VLAN information is not propagated over the network.

If the switch receives a VTP advertisement over a trunk link, it inherits the management domain name and the VTP configuration revision number. The switch then ignores advertisements with a different domain name or an earlier configuration revision number.

Note Before adding a VTP client switch to a VTP domain, always verify that its VTP configuration revision number is lower than the configuration revision number of the other switches in the VTP domain. Switches in a VTP domain always use the VLAN configuration of the switch with the highest VTP configuration revision number. If you add a switch that has a revision number higher than the revision number in the VTP domain, it can erase all VLAN information from the VTP server and VTP domain.

When you make a change to the VLAN configuration on a VTP server, the change is propagated to all switches in the VTP domain. VTP advertisements are sent over all IEEE trunk connections, including IEEE 802.1Q. VTP dynamically maps VLANs with unique names and internal index associates across multiple LAN types. Mapping eliminates excessive device administration required from network administrators.

If you configure a switch for VTP transparent mode, you can create and modify VLANs, but the changes are not sent to other switches in the domain, and they affect only the individual switch. However, configuration changes made when the switch is in this mode are saved in the switch running configuration and can be saved to the switch startup configuration file.

Related Topics

Adding a VTP Client Switch to a VTP Domain, on page 33

Prerequisites for VTP

VTP Modes

Table 4: VTP Modes

VTP Mode	Description
VTP server	In VTP server mode, you can create, modify, and delete VLANs, and specify other configuration parameters (such as the VTP version) for the entire VTP domain. VTP servers advertise their VLAN configurations to other switches in the same VTP domain and synchronize their VLAN configurations with other switches based on advertisements received over trunk links. VTP server is the default mode. In VTP server mode, VLAN configurations are saved in NVRAM. If the switch detects a failure while writing a configuration to NVRAM, VTP mode automatically changes from server mode to client mode. If this happens, the switch cannot be returned to VTP server mode until the NVRAM is functioning.
VTP client	A VTP client functions like a VTP server and transmits and receives VTP updates on its trunks, but you cannot create, change, or delete VLANs on a VTP client. VLANs are configured on another switch in the domain that is in server mode. In VTP versions 1 and 2 in VTP client mode, VLAN configurations are not saved in NVRAM. In VTP version 3, VLAN configurations are saved in NVRAM in client mode.
VTP transparent	VTP transparent switches do not participate in VTP. A VTP transparent switch does not advertise its VLAN configuration and does not synchronize its VLAN configuration based on received advertisements. However, in VTP version 2 or version 3, transparent switches do forward VTP advertisements that they receive from other switches through their trunk interfaces. You can create, modify, and delete VLANs on a switch in VTP transparent mode. In VTP versions 1 and 2, the switch must be in VTP transparent mode when you create extended-range VLANs. VTP version 3 also supports creating extended-range VLANs in client or server mode. When the switch is in VTP transparent mode, the VTP and VLAN configurations are saved in NVRAM, but they are not advertised to other switches. In this mode, VTP mode and domain name are saved in the switch running configuration, and you can save this information in the switch startup configuration file by using the **copy running-config startup-config** privileged EXEC command. In a switch stack, the running configuration and the saved configuration are the same for all switches in a stack.
VTP off	A switch in VTP off mode functions in the same manner as a VTP transparent switch, except that it does not forward VTP advertisements on trunks.

Related Topics

Prerequisites for VTP
Configuring VTP Mode, on page 25

Example: Configuring Switch as VTP Server, on page 36

VTP Advertisements

Each switch in the VTP domain sends periodic global configuration advertisements from each trunk port to a reserved multicast address. Neighboring switches receive these advertisements and update their VTP and VLAN configurations as necessary.

Because trunk ports send and receive VTP advertisements, you must ensure that at least one trunk port is configured on the switch stack and that this trunk port is connected to the trunk port of another switch. Otherwise, the switch cannot receive any VTP advertisements.

VTP advertisements distribute this global domain information:

- VTP domain name
- VTP configuration revision number
- Update identity and update timestamp
- MD5 digest VLAN configuration, including maximum transmission unit (MTU) size for each VLAN
- Frame format

VTP advertisements distribute this VLAN information for each configured VLAN:

- VLAN IDs (including IEEE 802.1Q)
- VLAN name
- VLAN type
- VLAN state
- Additional VLAN configuration information specific to the VLAN type

In VTP version 3, VTP advertisements also include the primary server ID, an instance number, and a start index.

Related Topics

Prerequisites for VTP

VTP Version 2

If you use VTP in your network, you must decide which version of VTP to use. By default, VTP operates in version 1.

VTP version 2 supports these features that are not supported in version 1:

- Token Ring support—VTP version 2 supports Token Ring Bridge Relay Function (TrBRF) and Token Ring Concentrator Relay Function (TrCRF) VLANs.
- Unrecognized Type-Length-Value (TLV) support—A VTP server or client propagates configuration changes to its other trunks, even for TLVs it is not able to parse. The unrecognized TLV is saved in NVRAM when the switch is operating in VTP server mode.

- Version-Dependent Transparent Mode—In VTP version 1, a VTP transparent switch inspects VTP messages for the domain name and version and forwards a message only if the version and domain name match. Although VTP version 2 supports only one domain, a VTP version 2 transparent switch forwards a message only when the domain name matches.
- Consistency Checks—In VTP version 2, VLAN consistency checks (such as VLAN names and values) are performed only when you enter new information through the CLI or SNMP. Consistency checks are not performed when new information is obtained from a VTP message or when information is read from NVRAM. If the MD5 digest on a received VTP message is correct, its information is accepted.

Related Topics

Enabling the VTP Version, on page 29

VTP Version 3

VTP version 3 supports these features that are not supported in version 1 or version 2:

- Enhanced authentication—You can configure the authentication as **hidden** or **secret**. When **hidden**, the secret key from the password string is saved in the VLAN database file, but it does not appear in plain text in the configuration. Instead, the key associated with the password is saved in hexadecimal format in the running configuration. You must reenter the password if you enter a takeover command in the domain. When you enter the **secret** keyword, you can directly configure the password secret key.
- Support for extended range VLAN (VLANs 1006 to 4094) database propagation—VTP versions 1 and 2 propagate only VLANs 1 to 1005. If extended VLANs are configured, you cannot convert from VTP version 3 to version 1 or 2.

Note VTP pruning still applies only to VLANs 1 to 1005, and VLANs 1002 to 1005 are still reserved and cannot be modified.

- Support for any database in a domain—In addition to propagating VTP information, version 3 can propagate Multiple Spanning Tree (MST) protocol database information. A separate instance of the VTP protocol runs for each application that uses VTP.
- VTP primary server and VTP secondary servers—A VTP primary server updates the database information and sends updates that are honored by all devices in the system. A VTP secondary server can only back up the updated VTP configurations received from the primary server to its NVRAM.

  By default, all devices come up as secondary servers. You can enter the **vtp primary** privileged EXEC command to specify a primary server. Primary server status is only needed for database updates when the administrator issues a takeover message in the domain. You can have a working VTP domain without any primary servers. Primary server status is lost if the device reloads or domain parameters change, even when a password is configured on the switch.
- The option to turn VTP on or off on a per-trunk (per-port) basis—You can enable or disable VTP per port by entering the [**no**] **vtp** interface configuration command. When you disable VTP on trunking ports, all VTP instances for that port are disabled. You cannot set VTP to *off* for the MST database and *on* for the VLAN database on the same port.

When you globally set VTP mode to off, it applies to all the trunking ports in the system. However, you can specify on or off on a per-VTP instance basis. For example, you can configure the switch as a VTP server for the VLAN database but with VTP *off* for the MST database.

Related Topics

Enabling the VTP Version, on page 29

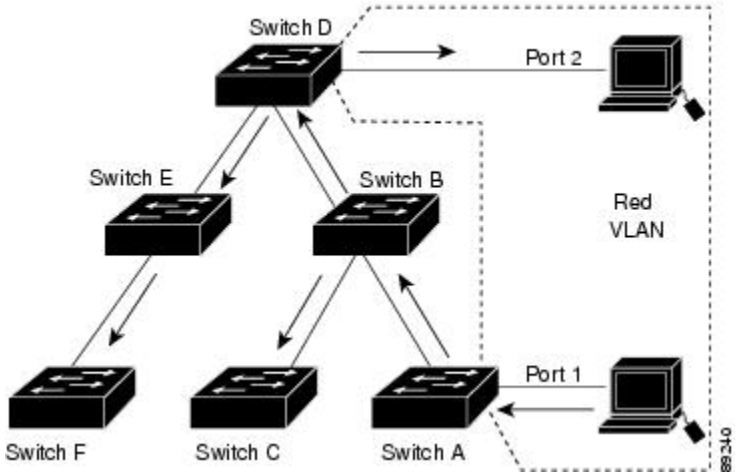
VTP Pruning

VTP pruning increases network available bandwidth by restricting flooded traffic to those trunk links that the traffic must use to reach the destination devices. Without VTP pruning, a switch floods broadcast, multicast, and unknown unicast traffic across all trunk links within a VTP domain even though receiving switches might discard them. VTP pruning is disabled by default.

VTP pruning blocks unneeded flooded traffic to VLANs on trunk ports that are included in the pruning-eligible list. Only VLANs included in the pruning-eligible list can be pruned. By default, VLANs 2 through 1001 are pruning eligible switch trunk ports. If the VLANs are configured as pruning-ineligible, the flooding continues. VTP pruning is supported in all VTP versions.

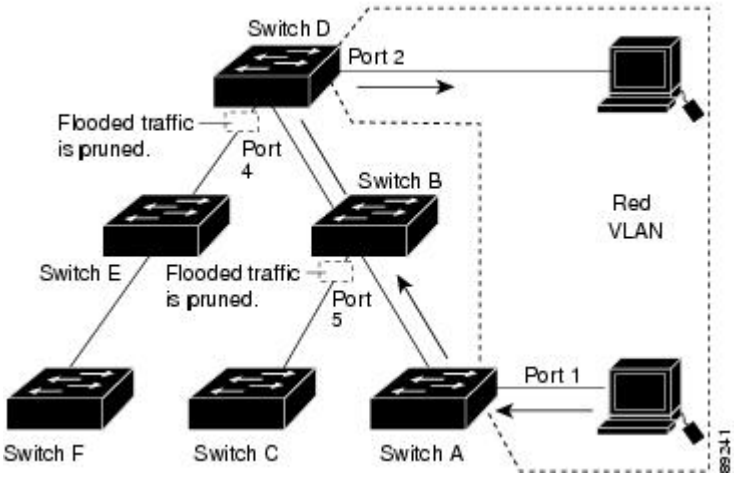
VTP pruning is disabled in the switched network. Port 1 on Switch A and Port 2 on Switch D are assigned to the Red VLAN. If a broadcast is sent from the host connected to Switch A, Switch A floods the broadcast and every switch in the network receives it, even though Switches C, E, and F have no ports in the Red VLAN.

Figure 1: Flooding Traffic without VTP Pruning



VTP pruning is enabled in the switched network. The broadcast traffic from Switch A is not forwarded to Switches C, E, and F because traffic for the Red VLAN has been pruned on the links shown (Port 5 on Switch B and Port 4 on Switch D).

Figure 2: Optimized Flooded Traffic VTP Pruning



Enabling VTP pruning on a VTP server enables pruning for the entire management domain. Making VLANs pruning-eligible or pruning-ineligible affects pruning eligibility for those VLANs on that trunk only (not on all switches in the VTP domain).

VTP pruning takes effect several seconds after you enable it. VTP pruning does not prune traffic from VLANs that are pruning-ineligible. VLAN 1 and VLANs 1002 to 1005 are always pruning-ineligible; traffic from these VLANs cannot be pruned. Extended-range VLANs (VLAN IDs higher than 1005) are also pruning-ineligible.

Related Topics

Enabling VTP Pruning, on page 30

VTP and Switch Stacks

Note The switch supports homogeneous stacking and mixed stacking. Mixed stacking is supported only with the Catalyst 2960-S switches. A homogenous stack can have up to eight stack members, while a mixed stack can have up to four stack members. All switches in a switch stack must be running the LAN Base image.

VTP configuration is the same in all members of a switch stack. When the switch stack is in VTP server or client mode, all switches in the stack carry the same VTP configuration. When VTP mode is transparent, the stack is not taking part in VTP.

- When a switch joins the stack, it inherits the VTP and VLAN properties of the active switch.
- All VTP updates are carried across the stack.

- When VTP mode is changed in a switch in the stack, the other switches in the stack also change VTP mode, and the switch VLAN database remains consistent.

VTP version 3 functions the same on a standalone switch or a stack except when the switch stack is the primary server for the VTP database. In this case, the MAC address of the active switch is used as the primary server ID. If the active switch reloads or is powered off, a new active switch is elected.

- If you do not configure the persistent MAC address feature, when the new active switch is elected, it sends a takeover message with the new active MAC address as the primary server.
- If a persistent MAC address is configured, the new active switch waits for the configured timer value. If the previous active switch does not rejoin the stack during this time, then the new active switch issues the takeover message.

VTP Configuration Guidelines

VTP Configuration Requirements

When you configure VTP, you must configure a trunk port so that the switch can send and receive VTP advertisements to and from other switches in the domain.

In VTP versions 1 and 2, when you configure extended-range VLANs on the switch, the switch must be in VTP transparent mode. VTP version 3 also supports creating extended-range VLANs in client or server mode.

VTP Settings

The VTP information is saved in the VTP VLAN database. When VTP mode is transparent, the VTP domain name and mode are also saved in the switch running configuration file, and you can save it in the switch startup configuration file by entering the **copy running-config startup-config** privileged EXEC command. You must use this command if you want to save VTP mode as transparent, even if the switch resets.

When you save VTP information in the switch startup configuration file and reboot the switch, the switch configuration is selected as follows:

- If the VTP mode is transparent in the startup configuration and the VLAN database and the VTP domain name from the VLAN database matches that in the startup configuration file, the VLAN database is ignored (cleared), and the VTP and VLAN configurations in the startup configuration file are used. The VLAN database revision number remains unchanged in the VLAN database.
- If the VTP mode or domain name in the startup configuration do not match the VLAN database, the domain name and VTP mode and configuration for VLAN IDs 1 to 1005 use the VLAN database information.

Related Topics

Configuring VTP on a Per-Port Basis, on page 31

Configuring a VTP Version 3 Primary Server, on page 28

Domain Names for Configuring VTP

When configuring VTP for the first time, you must always assign a domain name. You must configure all switches in the VTP domain with the same domain name. Switches in VTP transparent mode do not exchange VTP messages with other switches, and you do not need to configure a VTP domain name for them.

Note If the NVRAM and DRAM storage is sufficient, all switches in a VTP domain should be in VTP server mode.

Caution Do not configure a VTP domain if all switches are operating in VTP client mode. If you configure the domain, it is impossible to make changes to the VLAN configuration of that domain. Make sure that you configure at least one switch in the VTP domain for VTP server mode.

Related Topics

Adding a VTP Client Switch to a VTP Domain, on page 33

Passwords for the VTP Domain

You can configure a password for the VTP domain, but it is not required. If you do configure a domain password, all domain switches must share the same password and you must configure the password on each switch in the management domain. Switches without a password or with the wrong password reject VTP advertisements.

If you configure a VTP password for a domain, a switch that is booted without a VTP configuration does not accept VTP advertisements until you configure it with the correct password. After the configuration, the switch accepts the next VTP advertisement that uses the same password and domain name in the advertisement.

If you are adding a new switch to an existing network with VTP capability, the new switch learns the domain name only after the applicable password has been configured on it.

Caution When you configure a VTP domain password, the management domain does not function properly if you do not assign a management domain password to each switch in the domain.

Related Topics

Configuring a VTP Version 3 Password, on page 27
Example: Configuring a Switch as the Primary Server, on page 36

VTP Version

Follow these guidelines when deciding which VTP version to implement:

- All switches in a VTP domain must have the same domain name, but they do not need to run the same VTP version.

- A VTP version 2-capable switch can operate in the same VTP domain as a switch running VTP version 1 if version 2 is disabled on the version 2-capable switch (version 2 is disabled by default).
- If a switch running VTP version 1, but capable of running VTP version 2, receives VTP version 3 advertisements, it automatically moves to VTP version 2.
- If a switch running VTP version 3 is connected to a switch running VTP version 1, the VTP version 1 switch moves to VTP version 2, and the VTP version 3 switch sends scaled-down versions of the VTP packets so that the VTP version 2 switch can update its database.
- A switch running VTP version 3 cannot move to version 1 or 2 if it has extended VLANs.
- Do not enable VTP version 2 on a switch unless all of the switches in the same VTP domain are version-2-capable. When you enable version 2 on a switch, all of the version-2-capable switches in the domain enable version 2. If there is a version 1-only switch, it does not exchange VTP information with switches that have version 2 enabled.
- Cisco recommends placing VTP version 1 and 2 switches at the edge of the network because they do not forward VTP version 3 advertisements.
- If there are TrBRF and TrCRF Token Ring networks in your environment, you must enable VTP version 2 or version 3 for Token Ring VLAN switching to function properly. To run Token Ring and Token Ring-Net, disable VTP version 2.
- VTP version 1 and version 2 do not propagate configuration information for extended range VLANs (VLANs 1006 to 4094). You must configure these VLANs manually on each device. VTP version 3 supports extended-range VLANs. You cannot convert from VTP version 3 to VTP version 2 if extended VLANs are configured.
- When a VTP version 3 device trunk port receives messages from a VTP version 2 device, it sends a scaled-down version of the VLAN database on that particular trunk in VTP version 2 format. A VTP version 3 device does not send VTP version 2-formatted packets on a trunk unless it first receives VTP version 2 packets on that trunk port.
- When a VTP version 3 device detects a VTP version 2 device on a trunk port, it continues to send VTP version 3 packets, in addition to VTP version 2 packets, to allow both kinds of neighbors to coexist on the same trunk.
- A VTP version 3 device does not accept configuration information from a VTP version 2 or version 1 device.
- Two VTP version 3 regions can only communicate in transparent mode over a VTP version 1 or version 2 region.
- Devices that are only VTP version 1 capable cannot interoperate with VTP version 3 devices.
- For VTP version 1 and version 2, if extended-range VLANs are configured on the switch stack, you cannot change VTP mode to client or server. You receive an error message, and the configuration is not allowed. VTP version 1 and version 2 do not propagate configuration information for extended range VLANs (VLANs 1006 to 4094). You must manually configure these VLANs on each device.

Note For VTP version 1 and 2, before you create extended-range VLANs (VLAN IDs 1006 to 4094), you must set VTP mode to transparent by using the **vtp mode transparent** global configuration command. Save this configuration to the startup configuration so that the switch starts in VTP transparent mode. Otherwise, you lose the extended-range VLAN configuration if the switch resets and boots up in VTP server mode (the default).

- VTP version 3 supports extended-range VLANs. If extended VLANs are configured, you cannot convert from VTP version 3 to VTP version 2.
- If you configure the switch for VTP client mode, the switch does not create the VLAN database file (vlan.dat). If the switch is then powered off, it resets the VTP configuration to the default. To keep the VTP configuration with VTP client mode after the switch restarts, you must first configure the VTP domain name before the VTP mode.

Caution If all switches are operating in VTP client mode, do not configure a VTP domain name. If you do, it is impossible to make changes to the VLAN configuration of that domain. Therefore, make sure you configure at least one switch as a VTP server.

Related Topics

Enabling the VTP Version, on page 29

Default VTP Configuration

The following table shows the default VTP configuration.

Table 5: Default VTP Configuration

Feature	Default Setting
VTP domain name	Null
VTP mode (VTP version 1 and version 2)	Server
VTP mode (VTP version 3)	The mode is the same as the mode in VTP version 1 or 2 before conversion to version 3.
VTP version	Version 1
MST database mode	Transparent
VTP version 3 server type	Secondary
VTP password	None
VTP pruning	Disabled

How to Configure VTP

Configuring VTP Mode

You can configure VTP mode as one of these:

- When a switch is in VTP server mode, you can change the VLAN configuration and have it propagated throughout the network.
- When a switch is in VTP client mode, you cannot change its VLAN configuration. The client switch receives VTP updates from a VTP server in the VTP domain and then modifies its configuration accordingly.
- When you configure the switch for VTP transparent mode, VTP is disabled on the switch. The switch does not send VTP updates and does not act on VTP updates received from other switch. However, a VTP transparent switch running VTP version 2 does forward received VTP advertisements on its trunk links.
- VTP off mode is the same as VTP transparent mode except that VTP advertisements are not forwarded.

When you configure a domain name, it cannot be removed; you can only reassign a switch to a different domain.

SUMMARY STEPS

1. **configure terminal**
2. **vtp domain** *domain-name*
3. **vtp mode** {**client** | **server** | **transparent** | **off**} {**vlan** | **mst** | **unknown**}
4. **vtp password** *password*
5. **end**
6. **show vtp status**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 2	**vtp domain** *domain-name* **Example:** `Switch(config)# vtp domain eng_group`	Configures the VTP administrative-domain name. The name can be 1 to 32 characters. All switches operating in VTP server or client mode under the same administrative responsibility must be configured with the same domain name. This command is optional for modes other than server mode. VTP server mode requires a domain name. If the switch has a trunk connection to a VTP domain, the switch learns the domain name from the VTP server in the domain. You should configure the VTP domain before configuring other VTP parameters. **Note**
Step 3	**vtp mode** {**client** | **server** | **transparent** | **off**} {**vlan** | **mst** | **unknown**} **Example:** `Switch(config)# vtp mode server`	Configures the switch for VTP mode (client, server, transparent, or off). • **vlan—**The VLAN database is the default if none are configured. • **mst—**The multiple spanning tree (MST) database. • **unknown—**An unknown database type.
Step 4	**vtp password** *password* **Example:** `Switch(config)# vtp password mypassword`	(Optional) Sets the password for the VTP domain. The password can be 8 to 64 characters. If you configure a VTP password, the VTP domain does not function properly if you do not assign the same password to each switch in the domain.
Step 5	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 6	**show vtp status** **Example:** `Switch# show vtp status`	Verifies your entries in the *VTP Operating Mode* and the *VTP Domain Name* fields of the display.
Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves the configuration in the startup configuration file. Only VTP mode and domain name are saved in the switch running configuration and can be copied to the startup configuration file.

Related Topics

VTP Modes, on page 16
Example: Configuring Switch as VTP Server, on page 36

Configuring a VTP Version 3 Password

You can configure a VTP version 3 password on the switch.

SUMMARY STEPS

1. **configure terminal**
2. **vtp password** *password* [**hidden** | **secret**]
3. **end**
4. **show vtp password**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vtp password** *password* [**hidden**	**secret**] **Example:** `Switch(config)# vtp password mypassword hidden`	(Optional) Sets the password for the VTP domain. The password can be 8 to 64 characters. • (Optional) **hidden—**Saves the secret key generated from the password string in the nvam:vlan.dat file. If you configure a takeover by configuring a VTP primary server, you are prompted to reenter the password. • (Optional) **secret—**Directly configures the password. The secret password must contain 32 hexadecimal characters.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show vtp password** **Example:** `Switch# show vtp password`	Verifies your entries. The output appears like this: VTP password: 89914640C8D90868B6A0D8103847A733

	Command or Action	Purpose
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves the configuration in the startup configuration file.

Related Topics

Passwords for the VTP Domain, on page 22
Example: Configuring a Switch as the Primary Server, on page 36

Configuring a VTP Version 3 Primary Server

When you configure a VTP server as a VTP primary server, the takeover operation starts.

SUMMARY STEPS

1. **vtp primary** [**vlan** | **mst**] [**force**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**vtp primary** [**vlan**	**mst**] [**force**] **Example:** `Switch# vtp primary vlan force`	Changes the operational state of a switch from a secondary server (the default) to a primary server and advertises the configuration to the domain. If the switch password is configured as **hidden**, you are prompted to reenter the password. • (Optional) **vlan**—Selects the VLAN database as the takeover feature. This is the default. • (Optional) **mst**—Selects the multiple spanning tree (MST) database as the takeover feature. • (Optional) **force**—Overwrites the configuration of any conflicting servers. If you do not enter **force**, you are prompted for confirmation before the takeover.

Related Topics

VTP Settings, on page 21

Enabling the VTP Version

VTP version 2 and version 3 are disabled by default.

- When you enable VTP version 2 on a switch , every VTP version 2-capable switch in the VTP domain enables version 2. To enable VTP version 3, you must manually configure it on each switch
- With VTP versions 1 and 2, you can configure the version only on switches in VTP server or transparent mode. If a switch is running VTP version 3, you can change to version 2 when the switch is in client mode if no extended VLANs exist, and no hidden password was configured.

Caution VTP version 1 and VTP version 2 are not interoperable on switches in the same VTP domain. Do not enable VTP version 2 unless every switch in the VTP domain supports version 2.

- In TrCRF and TrBRF Token Ring environments, you must enable VTP version 2 or VTP version 3 for Token Ring VLAN switching to function properly. For Token Ring and Token Ring-Net media, disable VTP version 2.

Caution In VTP version 3, both the primary and secondary servers can exist on an instance in the domain.

SUMMARY STEPS

1. **configure terminal**
2. **vtp version** {**1** | **2** | **3**}
3. **end**
4. **show vtp status**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vtp version** {**1**	**2**	**3**} **Example:** `Switch(config)# vtp version 2`	Enables the VTP version on the switch. The default is VTP version 1.

	Command or Action	Purpose
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show vtp status** **Example:** `Switch# show vtp status`	Verifies that the configured VTP version is enabled.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves the configuration in the startup configuration file.

Related Topics

VTP Version, on page 22
VTP Version 2, on page 17
VTP Version 3, on page 18

Enabling VTP Pruning

Pruning increases available bandwidth by restricting flooded traffic to those trunk links that the traffic must use to access the destination devices. You can only enable VTP pruning on a switch in VTP server mode.

With VTP versions 1 and 2, when you enable pruning on the VTP server, it is enabled for the entire VTP domain. In VTP version 3, you must manually enable pruning on each switch in the domain.

Only VLANs included in the pruning-eligible list can be pruned. By default, VLANs 2 through 1001 are pruning-eligible on trunk ports. Reserved VLANs and extended-range VLANs cannot be pruned.

Before You Begin

VTP pruning is not designed to function in VTP transparent mode. If one or more switches in the network are in VTP transparent mode, you should do one of these:

- Turn off VTP pruning in the entire network.
- Turn off VTP pruning by making all VLANs on the trunk of the switch upstream to the VTP transparent switch pruning ineligible.

To configure VTP pruning on an interface, use the **switchport trunk pruning vlan** interface configuration command. VTP pruning operates when an interface is trunking. You can set VLAN pruning-eligibility, whether

or not VTP pruning is enabled for the VTP domain, whether or not any given VLAN exists, and whether or not the interface is currently trunking.

SUMMARY STEPS

1. **configure terminal**
2. **vtp pruning**
3. **end**
4. **show vtp status**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vtp pruning** **Example:** `Switch(config)# vtp pruning`	Enables pruning in the VTP administrative domain. By default, pruning is disabled. You need to enable pruning on only one switch in VTP server mode.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show vtp status** **Example:** `Switch# show vtp status`	Verifies your entries in the *VTP Pruning Mode* field of the display.

Related Topics

VTP Pruning, on page 19

Configuring VTP on a Per-Port Basis

With VTP version 3, you can enable or disable VTP on a per-port basis. You can enable VTP only on ports that are in trunk mode. Incoming and outgoing VTP traffic are blocked, not forwarded.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **vtp**
4. **end**
5. **show running-config interface** *interface-id*
6. **show vtp status**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Identifies an interface, and enters interface configuration mode.
Step 3	**vtp** **Example:** `Switch(config)# vtp`	Enables VTP on the specified port.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config interface** *interface-id* **Example:** `Switch# show running-config interface gigabitethernet1/0/1`	Verifies the change to the port.
Step 6	**show vtp status** **Example:** `Switch# show vtp status`	Verifies the configuration.

Related Topics

VTP Settings, on page 21

Adding a VTP Client Switch to a VTP Domain

Follow these steps to verify and reset the VTP configuration revision number on a switch *before* adding it to a VTP domain.

Before You Begin

Before adding a VTP client to a VTP domain, always verify that its VTP configuration revision number is *lower* than the configuration revision number of the other switches in the VTP domain. Switches in a VTP domain always use the VLAN configuration of the switch with the highest VTP configuration revision number. With VTP versions 1 and 2, adding a switch that has a revision number higher than the revision number in the VTP domain can erase all VLAN information from the VTP server and VTP domain. With VTP version 3, the VLAN information is not erased.

You can use the **vtp mode transparent** global configuration command to disable VTP on the switch and then to change its VLAN information without affecting the other switches in the VTP domain.

SUMMARY STEPS

1. **show vtp status**
2. **configure terminal**
3. **vtp domain** *domain-name*
4. **end**
5. **show vtp status**
6. **configure terminal**
7. **vtp domain** *domain-name*
8. **end**
9. **show vtp status**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show vtp status** **Example:** `Switch# show vtp status`	Checks the VTP configuration revision number. If the number is 0, add the switch to the VTP domain. If the number is greater than 0, follow these sub steps: • Write down the domain name. • Write down the configuration revision number.

	Command or Action	Purpose
		• Continue with the next steps to reset the switch configuration revision number.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 3	**vtp domain** *domain-name* **Example:** `Switch(config)# vtp domain domain123`	Changes the domain name from the original one displayed in Step 1 to a new name.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. The VLAN information on the switch is updated and the configuration revision number is reset to 0.
Step 5	**show vtp status** **Example:** `Switch# show vtp status`	Verifies that the configuration revision number has been reset to 0.
Step 6	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 7	**vtp domain** *domain-name* **Example:** `Switch(config)# vtp domain domain012`	Enters the original domain name on the switch
Step 8	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode. The VLAN information on the switch is updated.

	Command or Action	Purpose
Step 9	**show vtp status** **Example:** `Switch# show vtp status`	(Optional) Verifies that the domain name is the same as in Step 1 and that the configuration revision number is 0.

Related Topics

VTP Domain, on page 15
Prerequisites for VTP
Domain Names for Configuring VTP, on page 22

Monitoring VTP

This section describes commands used to display and monitor the VTP configuration.

You monitor VTP by displaying VTP configuration information: the domain name, the current VTP revision, and the number of VLANs. You can also display statistics about the advertisements sent and received by the switch.

Table 6: VTP Monitoring Commands

Command	Purpose
show vtp counters	Displays counters about VTP messages that have been sent and received.
show vtp devices [**conflict**]	Displays information about all VTP version 3 devices in the domain. Conflicts are VTP version 3 devices with conflicting primary servers. The **show vtp devices** command does not display information when the switch is in transparent or off mode.
show vtp interface [*interface-id*]	Displays VTP status and configuration for all interfaces or the specified interface.
show vtp password	Displays the VTP password. The form of the password displayed depends on whether or not the **hidden** keyword was entered and if encryption is enabled on the switch.
show vtp status	Displays the VTP switch configuration information.

Configuration Examples for VTP

Example: Configuring a Switch as the Primary Server

This example shows how to configure a switch as the primary server for the VLAN database (the default) when a hidden or secret password was configured:

```
Switch# vtp primary vlan
Enter VTP password: mypassword
This switch is becoming Primary server for vlan feature in the VTP  domain

VTP Database Conf Switch ID      Primary Server Revision System Name
------------ ---- --------------- -------------- -------- --------------------
VLANDB       Yes  00d0.00b8.1400=00d0.00b8.1400 1        stp7

Do you want to continue (y/n) [n]? y
```

Related Topics

Configuring a VTP Version 3 Password, on page 27

Passwords for the VTP Domain, on page 22

Example: Configuring Switch as VTP Server

This example shows how to configure the switch as a VTP server with the domain name *eng_group* and the password *mypassword*:

```
Switch(config)# vtp domain eng_group
Setting VTP domain name to eng_group.

Switch(config)# vtp mode server
Setting device to VTP Server mode for VLANS.

Switch(config)# vtp password mypassword
Setting device VLAN database password to mypassword.
Switch(config)# end
```

Related Topics

Configuring VTP Mode, on page 25

VTP Modes, on page 16

Example: Enabling VTP on the Interface

To enable VTP on the interface, use the **vtp** interface configuration command. To disable VTP on the interface, use the **no vtp** interface configuration command.

```
Switch(config)# interface gigabitethernet 1/0/1
Switch(config-if)# vtp
Switch(config-if)# end
```

Example: Creating the VTP Password

The follow is an example of creating the VTP password.

```
Switch(config)# vtp password mypassword hidden
Generating the secret associated to the password.
Switch(config)# end
Switch# show vtp password
VTP password: 89914640C8D90868B6A0D8103847A733
```

Where to Go Next

After configuring VTP, you can configure the following:

- VLANS
- VLAN Trunking
- VLAN Membership Policy Server (VMPS)
- Voice VLANs

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-X Switch VLAN Management Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

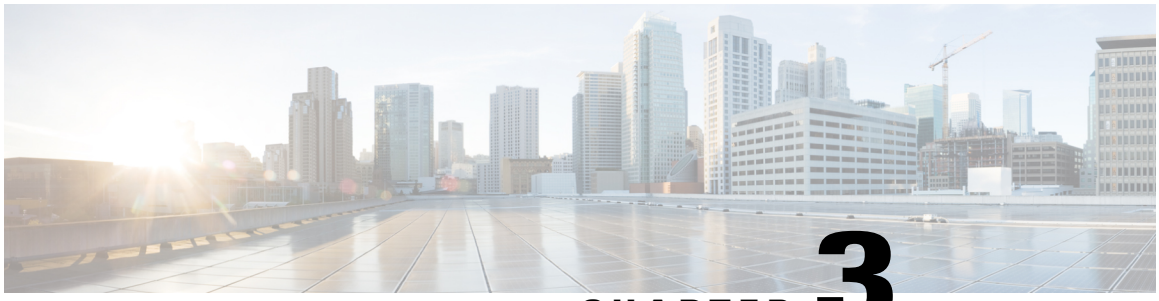
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for VTP

Release	Modification
Cisco IOS 15.0(2)EX	This feature was introduced.



CHAPTER 3

Configuring VLANs

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for VLANs

The following are prerequisites and considerations for configuring VLANs:

- Before you create VLANs, you must decide whether to use VLAN Trunking Protocol (VTP) to maintain global VLAN configuration for your network.
- The switch supports 1000 VLANs in VTP client, server, and transparent modes.

Note On using the LAN Base image, only the lanbase-default template supports 1000 VLANs. The remaining templates (default and lanbase-routing) only supports 255 VLANs. Up to 64 VLANs are supported when the switch is running the LAN Lite image.

- The switch supports homogeneous stacking and mixed stacking. Mixed stacking is supported only with the Catalyst 2960-S switches. A homogenous stack can have up to eight stack members, while a mixed stack can have up to four stack members. All switches in a switch stack must be running the LAN Base image.

Restrictions for VLANs

The following are restrictions for configuring VLANs:

- 1K VLAN is supported only on switches running the LAN Base image with the lanbase-default template set.
- To avoid warning messages of high CPU utilization with a normal-range VLAN configuration, we recommend that you have no more than 256 VLANs. In such cases, approximately 10 access interfaces or 5 trunk interfaces can flap simultaneously with negligible impact to CPU utilization (if there are more interfaces that flap simultaneously, then CPU usage may be excessively high.)
- Private VLANs are not supported on the switch.

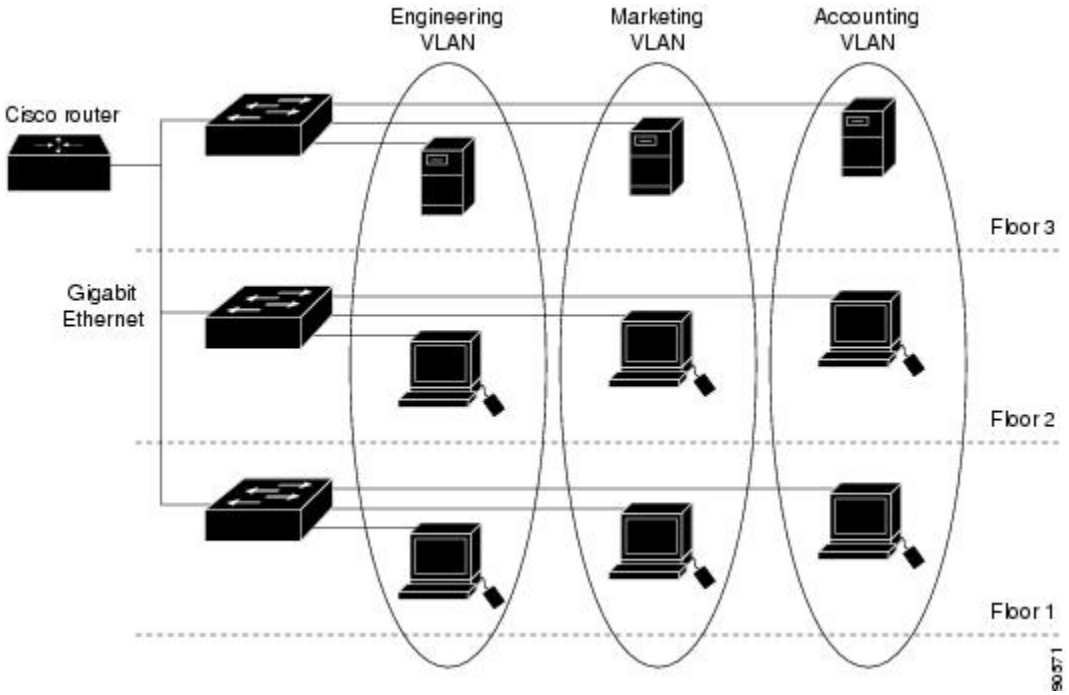
Information About VLANs

Logical Networks

A VLAN is a switched network that is logically segmented by function, project team, or application, without regard to the physical locations of the users. VLANs have the same attributes as physical LANs, but you can group end stations even if they are not physically located on the same LAN segment. Any switch port can belong to a VLAN, and unicast, broadcast, and multicast packets are forwarded and flooded only to end stations in the VLAN. Each VLAN is considered a logical network, and packets destined for stations that do not belong to the VLAN must be forwarded through a router or a switch supporting fallback bridging. In a switch stack, VLANs can be formed with ports across the stack. Because a VLAN is considered a separate

logical network, it contains its own bridge Management Information Base (MIB) information and can support its own implementation of spanning tree.

Figure 3: VLANs as Logically Defined Networks



VLANs are often associated with IP subnetworks. For example, all the end stations in a particular IP subnet belong to the same VLAN. Interface VLAN membership on the switch is assigned manually on an interface-by-interface basis. When you assign switch interfaces to VLANs by using this method, it is known as interface-based, or static, VLAN membership.

Traffic between VLANs must be routed .

The switch can route traffic between VLANs by using switch virtual interfaces (SVIs). An SVI must be explicitly configured and assigned an IP address to route traffic between VLANs.

Supported VLANs

The switch supports VLANs in VTP client, server, and transparent modes. VLANs are identified by a number from 1 to 4094. VLAN IDs 1002 through 1005 are reserved for Token Ring and FDDI VLANs.

VTP version 1 and version 2 support only normal-range VLANs (VLAN IDs 1 to 1005). In these versions, the switch must be in VTP transparent mode when you create VLAN IDs from 1006 to 4094. Cisco IOS Release 12.2(52)SE and later support VTP version 3. VTP version 3 supports the entire VLAN range (VLANs 1 to 4094). Extended range VLANs (VLANs 1006 to 4094) are supported only in VTP version 3. You cannot convert from VTP version 3 to VTP version 2 if extended VLANs are configured in the domain.

Although the switch stack supports a total of 1,000 (normal range and extended range) VLANs, the number of configured features affects the use of the switch hardware.

Note On using the LAN Base image, only the lanbase-default template supports 1000 VLANs. The remaining templates (default and lanbase-routing) only supports 255 VLANs. Up to 64 VLANs are supported when the switch is running the LAN Lite image.

The switch supports per-VLAN spanning-tree plus (PVST+) or rapid PVST+ with a maximum of 128 spanning-tree instances. One spanning-tree instance is allowed per VLAN. The switch supports only IEEE 802.1Q trunking methods for sending VLAN traffic over Ethernet ports.

Note Up to 64 spanning-tree instances are supported when the switch is running the LAN Lite image.

VLAN Port Membership Modes

You configure a port to belong to a VLAN by assigning a membership mode that specifies the kind of traffic the port carries and the number of VLANs to which it can belong.

When a port belongs to a VLAN, the switch learns and manages the addresses associated with the port on a per-VLAN basis.

Table 7: Port Membership Modes and Characteristics

Membership Mode	VLAN Membership Characteristics	VTP Characteristics
Static-access	A static-access port can belong to one VLAN and is manually assigned to that VLAN.	VTP is not required. If you do not want VTP to globally propagate information, set the VTP mode to transparent. To participate in VTP, there must be at least one trunk port on the switch or the switch stack connected to a trunk port of a second switch or switch stack.
Trunk (IEEE 802.1Q) : • IEEE 802.1Q—Industry-standard trunking encapsulation.	A trunk port is a member of all VLANs by default, including extended-range VLANs, but membership can be limited by configuring the allowed-VLAN list. You can also modify the pruning-eligible list to block flooded traffic to VLANs on trunk ports that are included in the list.	VTP is recommended but not required. VTP maintains VLAN configuration consistency by managing the addition, deletion, and renaming of VLANs on a network-wide basis. VTP exchanges VLAN configuration messages with other switches over trunk links.

Membership Mode	VLAN Membership Characteristics	VTP Characteristics
Dynamic access	A dynamic-access port can belong to one VLAN (VLAN ID 1 to 4094) and is dynamically assigned by a VLAN Member Policy Server (VMPS). The VMPS can be a Catalyst 6500 series switch, for example, but never a Catalyst 2960, 2960-S, or 2960-C switch. The Catalyst 2960, 2960-S, or 2960-C switch is a VMPS client. You can have dynamic-access ports and trunk ports on the same switch, but you must connect the dynamic-access port to an end station or hub and not to another switch.	VTP is required. Configure the VMPS and the client with the same VTP domain name. To participate in VTP, at least one trunk port on the switch or a switch stack must be connected to a trunk port of a second switch or switch stack.
Voice VLAN	A voice VLAN port is an access port attached to a Cisco IP Phone, configured to use one VLAN for voice traffic and another VLAN for data traffic from a device attached to the phone.	VTP is not required; it has no effect on a voice VLAN.

VLAN Configuration Files

Configurations for VLAN IDs 1 to 1005 are written to the vlan.dat file (VLAN database), and you can display them by entering the **show vlan** privileged EXEC command. The vlan.dat file is stored in flash memory. If the VTP mode is transparent, they are also saved in the switch running configuration file.

In a switch stack, the whole stack uses the same vlan.dat file and running configuration. On some switches, the vlan.dat file is stored in flash memory on the active switch.

You use the interface configuration mode to define the port membership mode and to add and remove ports from VLANs. The results of these commands are written to the running-configuration file, and you can display the file by entering the **show running-config** privileged EXEC command.

When you save VLAN and VTP information (including extended-range VLAN configuration information) in the startup configuration file and reboot the switch, the switch configuration is selected as follows:

- If the VTP mode is transparent in the startup configuration, and the VLAN database and the VTP domain name from the VLAN database matches that in the startup configuration file, the VLAN database is ignored (cleared), and the VTP and VLAN configurations in the startup configuration file are used. The VLAN database revision number remains unchanged in the VLAN database.

- If the VTP mode or domain name in the startup configuration does not match the VLAN database, the domain name and VTP mode and configuration for the VLAN IDs 1 to 1005 use the VLAN database information.
- In VTP versions 1 and 2, if VTP mode is server, the domain name and VLAN configuration for VLAN IDs 1 to 1005 use the VLAN database information. VTP version 3 also supports VLANs 1006 to 4094.

Normal-Range VLAN Configuration Guidelines

Normal-range VLANs are VLANs with IDs from 1 to 1005. VTP 1 and 2 only support normal-range VLANs.

Follow these guidelines when creating and modifying normal-range VLANs in your network:

- Normal-range VLANs are identified with a number between 1 and 1001. VLAN numbers 1002 through 1005 are reserved for Token Ring and FDDI VLANs.
- VLAN configuration for VLANs 1 to 1005 are always saved in the VLAN database. If the VTP mode is transparent, VTP and VLAN configuration are also saved in the switch running configuration file.
- If the switch is in VTP server or VTP transparent mode, you can add, modify or remove configurations for VLANs 2 to 1001 in the VLAN database. (VLAN IDs 1 and 1002 to 1005 are automatically created and cannot be removed.)
- With VTP versions 1 and 2, the switch supports VLAN IDs 1006 through 4094 only in VTP transparent mode (VTP disabled). These are extended-range VLANs and configuration options are limited. Extended-range VLANs created in VTP transparent mode are not saved in the VLAN database and are not propagated. VTP version 3 supports extended range VLAN (VLANs 1006 to 4094) database propagation in VTP server and transparent mode. If extended VLANs are configured, you cannot convert from VTP version 3 to version 1 or 2.
- Before you can create a VLAN, the switch must be in VTP server mode or VTP transparent mode. If the switch is a VTP server, you must define a VTP domain or VTP will not function.
- The switch does not support Token Ring or FDDI media. The switch does not forward FDDI, FDDI-Net, TrCRF, or TrBRF traffic, but it does propagate the VLAN configuration through VTP.
- The switch supports 128 spanning tree instances. If a switch has more active VLANs than supported spanning-tree instances, spanning tree can be enabled on 128 VLANs and is disabled on the remaining VLANs. If you have already used all available spanning-tree instances on a switch, adding another VLAN anywhere in the VTP domain creates a VLAN on that switch that is not running spanning-tree. If you have the default allowed list on the trunk ports of that switch (which is to allow all VLANs), the new VLAN is carried on all trunk ports. Depending on the topology of the network, this could create a loop in the new VLAN that would not be broken, particularly if there are several adjacent switches that all have run out of spanning-tree instances. You can prevent this possibility by setting allowed lists on the trunk ports of switches that have used up their allocation of spanning-tree instances.

  If the number of VLANs on the switch exceeds the number of supported spanning-tree instances, we recommend that you configure the IEEE 802.1s Multiple STP (MSTP) on your switch to map multiple VLANs to a single spanning-tree instance.
- When a switch in a stack learns a new VLAN or deletes or modifies an existing VLAN (either through VTP over network ports or through the CLI), the VLAN information is communicated to all stack members.
- When a switch joins a stack or when stacks merge, VTP information (the vlan.dat file) on the new switches will be consistent with the active switch.

Related Topics

Creating or Modifying an Ethernet VLAN
Example: Creating a VLAN Name, on page 55

Extended-Range VLAN Configuration Guidelines

VTP 3 only supports extended-range VLANs. Extended-range VLANs are VLANs with IDs from 1006 to 4094.

Follow these guidelines when creating extended-range VLANs:

- VLAN IDs in the extended range are not saved in the VLAN database and are not recognized by VTP unless the switch is running VTP version 3.
- You cannot include extended-range VLANs in the pruning eligible range.
- In VTP version 1 and 2, a switch must be in VTP transparent mode when you create extended-range VLANs. If VTP mode is server or client, an error message is generated, and the extended-range VLAN is rejected. VTP version 3 supports extended VLANs in server and transparent modes.
- For VTP version 1 or 2, you can set the VTP mode to transparent in global configuration mode. You should save this configuration to the startup configuration so that the switch boots up in VTP transparent mode. Otherwise, you lose the extended-range VLAN configuration if the switch resets. If you create extended-range VLANs in VTP version 3, you cannot convert to VTP version 1 or 2.
- STP is enabled by default on extended-range VLANs, but you can disable it by using the **no spanning-tree vlan** *vlan-id* global configuration command. When the maximum number of spanning-tree instances are on the switch, spanning tree is disabled on any newly created VLANs. If the number of VLANs on the switch exceeds the maximum number of spanning-tree instances, we recommend that you configure the IEEE 802.1s Multiple STP (MSTP) on your switch to map multiple VLANs to a single spanning-tree instance.
- Although the switch stack supports a total of 1000 (normal-range and extended-range) VLANs, the number of configured features affects the use of the switch hardware. If you try to create an extended-range VLAN and there are not enough hardware resources available, an error message is generated, and the extended-range VLAN is rejected.
- In a switch stack, the whole stack uses the same running configuration and saved configuration, and extended-range VLAN information is shared across the stack.

Related Topics

Creating an Extended-Range VLAN, on page 52
Example: Creating an Extended-Range VLAN, on page 56

Default VLAN Configurations

Default Ethernet VLAN Configuration

The following table displays the default configuration for Ethernet VLANs.

Note The switch supports Ethernet interfaces exclusively. Because FDDI and Token Ring VLANs are not locally supported, you only configure FDDI and Token Ring media-specific characteristics for VTP global advertisements to other switches.

Table 8: Ethernet VLAN Defaults and Range

Parameter	Default	Range
VLAN ID	1	1 to 4094. **Note** Extended-range VLANs (VLAN IDs 1006 to 4094) are only saved in the VLAN database in VTP version 3.
VLAN name	VLANxxxx, where xxxx represents four numeric digits (including leading zeros) equal to the VLAN ID number	No range
IEEE 802.10 SAID	100001 (100000 plus the VLAN ID)	1 to 4294967294
MTU Size	1500	576-18190
Translational bridge 1	0	0 to 1005
Translational bridge 2	0	0 to 1005
VLAN state	active	active, suspend
Remote SPAN	disabled	enabled, disabled

Default VLAN Configuration

You can change only the MTU size and the remote SPAN configuration state on extended-range VLANs; all other characteristics must remain at the default state.

Note The switch must be running the LAN Base image to support remote SPAN.

How to Configure VLANs

How to Configure Normal-Range VLANs

You can set these parameters when you create a new normal-range VLAN or modify an existing VLAN in the VLAN database:

- VLAN ID
- VLAN name
- VLAN type
  - Ethernet
  - Fiber Distributed Data Interface [FDDI]
  - FDDI network entity title [NET]
  - TrBRF or TrCRF
  - Token Ring
  - Token Ring-Net
- VLAN state (active or suspended)
- Maximum transmission unit (MTU) for the VLAN
- Security Association Identifier (SAID)
- Bridge identification number for TrBRF VLANs
- Ring number for FDDI and TrCRF VLANs
- Parent VLAN number for TrCRF VLANs
- Spanning Tree Protocol (STP) type for TrCRF VLANs
- VLAN number to use when translating from one VLAN type to another

You can cause inconsistency in the VLAN database if you attempt to manually delete the vlan.dat file. If you want to modify the VLAN configuration, follow the procedures in this section.

Creating or Modifying an Ethernet VLAN

Each Ethernet VLAN in the VLAN database has a unique, 4-digit ID that can be a number from 1 to 1001. VLAN IDs 1002 to 1005 are reserved for Token Ring and FDDI VLANs. To create a normal-range VLAN to be added to the VLAN database, assign a number and name to the VLAN.

Note With VTP version 1 and 2, if the switch is in VTP transparent mode, you can assign VLAN IDs greater than 1006, but they are not added to the VLAN database.

SUMMARY STEPS

1. **configure terminal**
2. **vlan** *vlan-id*
3. **name** *vlan-name*
4. **mtu** *mtu-size*
5. **remote-span**
6. **end**
7. **show vlan** {**name** *vlan-name* | **id** *vlan-id*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vlan** *vlan-id* **Example:** `Switch(config)# vlan 20`	Enters a VLAN ID, and enters VLAN configuration mode. Enter a new VLAN ID to create a VLAN, or enter an existing VLAN ID to modify that VLAN. **Note** The available VLAN ID range for this command is 1 to 4094.
Step 3	**name** *vlan-name* **Example:** `Switch(config-vlan)# name test20`	(Optional) Enters a name for the VLAN. If no name is entered for the VLAN, the default is to append the *vlan-id* value with leading zeros to the word VLAN. For example, VLAN0004 is a default VLAN name for VLAN 4.
Step 4	**mtu** *mtu-size* **Example:** `Switch(config-vlan)# mtu 256`	(Optional) Changes the MTU size (or other VLAN characteristic).
Step 5	**remote-span** **Example:** `Switch(config-vlan)# remote-span`	(Optional) Configures the VLAN as the RSPAN VLAN for a remote SPAN session.
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 7	**show vlan** {**name** *vlan-name* | **id** *vlan-id*} **Example:** `Switch# show vlan name test20 id 20`	Verifies your entries.

Deleting a VLAN

When you delete a VLAN from a switch that is in VTP server mode, the VLAN is removed from the VLAN database for all switches in the VTP domain. When you delete a VLAN from a switch that is in VTP transparent mode, the VLAN is deleted only on that specific switch or a switch stack.

You cannot delete the default VLANs for the different media types: Ethernet VLAN 1 and FDDI or Token Ring VLANs 1002 to 1005.

Caution When you delete a VLAN, any ports assigned to that VLAN become inactive. They remain associated with the VLAN (and thus inactive) until you assign them to a new VLAN.

SUMMARY STEPS

1. **configure terminal**
2. **no vlan** *vlan-id*
3. **end**
4. **show vlan brief**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**no vlan** *vlan-id* **Example:** `Switch(config)# no vlan 4`	Removes the VLAN by entering the VLAN ID.

	Command or Action	Purpose
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show vlan brief** **Example:** `Switch# show vlan brief`	Verifies the VLAN removal.

Related Topics

Monitoring VLANs

Assigning Static-Access Ports to a VLAN

You can assign a static-access port to a VLAN without having VTP globally propagate VLAN configuration information by disabling VTP (VTP transparent mode).

If you assign an interface to a VLAN that does not exist, the new VLAN is created.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport mode access**
4. **switchport access vlan** *vlan-id*
5. **end**
6. **show running-config interface** *interface-id*
7. **show interfaces** *interface-id* **switchport**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet2/0/1`	Enters the interface to be added to the VLAN.
Step 3	**switchport mode access** **Example:** `Switch(config-if)# switchport mode access`	Defines the VLAN membership mode for the port (Layer 2 access port).
Step 4	**switchport access vlan** *vlan-id* **Example:** `Switch(config-if)# switchport access vlan 2`	Assigns the port to a VLAN. Valid VLAN IDs are 1 to 4094.
Step 5	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config interface** *interface-id* **Example:** `Switch# copy running-config startup-config`	Verifies the VLAN membership mode of the interface.
Step 7	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet2/0/1`	Verifies your entries in the *Administrative Mode* and the *Access Mode VLAN* fields of the display.

Related Topics

Example: Configuring a Port as Access Port, on page 56

How to Configure Extended-Range VLANs

With VTP version 1 and version 2, when the switch is in VTP transparent mode (VTP disabled), you can create extended-range VLANs (in the range 1006 to 4094). VTP version supports extended-range VLANs in server or transparent move. Extended-range VLANs enable service providers to extend their infrastructure to

a greater number of customers. The extended-range VLAN IDs are allowed for any **switchport** commands that allow VLAN IDs.

With VTP version 1 or 2, extended-range VLAN configurations are not stored in the VLAN database, but because VTP mode is transparent, they are stored in the switch running configuration file, and you can save the configuration in the startup configuration file by using the **copy running-config startup-config** privileged EXEC command. Extended-range VLANs created in VTP version 3 are stored in the VLAN database.

Creating an Extended-Range VLAN

You create an extended-range VLAN in global configuration mode by entering the **vlan** global configuration command with a VLAN ID from 1006 to 4094. The extended-range VLAN has the default Ethernet VLAN characteristics and the MTU size, and RSPAN configuration are the only parameters you can change. See the description of the **vlan** global configuration command in the command reference for the default settings of all parameters. In VTP version 1 or 2, if you enter an extended-range VLAN ID when the switch is not in VTP transparent mode, an error message is generated when you exit VLAN configuration mode, and the extended-range VLAN is not created.

In VTP version 1 and 2, extended-range VLANs are not saved in the VLAN database; they are saved in the switch running configuration file. You can save the extended-range VLAN configuration in the switch startup configuration file by using the **copy running-config startup-config** privileged EXEC command. VTP version 3 saves extended-range VLANs in the VLAN database.

SUMMARY STEPS

1. **configure terminal**
2. **vtp mode transparent**
3. **vlan** *vlan-id*
4. **mtu** *mtu size*
5. **remote-span**
6. **end**
7. **show vlan id** *vlan-id*
8. **copy running-config startup config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vtp mode transparent** **Example:** `Switch(config)# vtp mode transparent`	Configures the switch for VTP transparent mode, disabling VTP. **Note** This step is not required for VTP version 3.

	Command or Action	Purpose

Step 3	**vlan** *vlan-id*
	
	Example:
	`Switch(config)# vlan 2000`
	`Switch(config-vlan)#`
		Enters an extended-range VLAN ID and enters VLAN configuration mode. The range is 1006 to 4094.

Step 4	**mtu** *mtu size* **Example:** `Switch(config-vlan)# mtu 1024`	Modifies the VLAN by changing the MTU size.
Step 5	**remote-span** **Example:** `Switch(config-vlan)# remote-span`	(Optional) Configures the VLAN as the RSPAN VLAN.
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 7	**show vlan id** *vlan-id* **Example:** `Switch# show vlan id 2000`	Verifies that the VLAN has been created.
Step 8	**copy running-config startup config** **Example:** `Switch# copy running-config startup-config`	Saves your entries in the switch startup configuration file. To save an extended-range VLAN configuration, you need to save the VTP transparent mode configuration and the extended-range VLAN configuration in the switch startup configuration file. Otherwise, if the switch resets, it will default to VTP server mode, and the extended-range VLAN IDs will not be saved. **Note** This step is not required for VTP version 3 because VLANs are saved in the VLAN database.

Related Topics

Extended-Range VLAN Configuration Guidelines, on page 45

Example: Creating an Extended-Range VLAN, on page 56

Monitoring VLANs

Table 9: Privileged EXEC show Commands

Command	Purpose
show interfaces [**vlan** *vlan-id*]	Displays characteristics for all interfaces or for the specified VLAN configured on the switch.
show vlan [**brief** | **group** [**group-name** *name*] |**id** *vlan-id* | **ifindex** | **internal** | **mtu** | **name** *name* |**remote-span** | **summary**]]	Displays parameters for all VLANs or the specified VLAN on the switch. The following command options are available: • **brief—**Displays VTP VLAN status in brief. • **group—**Displays the VLAN group with its name and the connected VLANs that are available. • **id—**Displays VTP VLAN status by identification number. • **ifindex—**Displays SNMP ifIndex. • **mtu—**Displays VLAN MTU information. • **name—**Display the VTP VLAN information by specified name. • **remote-span–**Displays the remote SPAN VLANs. • **summary—**Displays a summary of VLAN information.

Command	Purpose
show vlan [**access-log** {**config** | **flow** | **statistics**} | **access-map** *name* | **brief** | **dot1q** { **tag native** } | **filter** [**access-map** | **vlan**] | **group** [**group-name** *name*] | **id** *vlan-id* | **ifindex** | **internal usage** | **mtu** | **name** *name* | **private-vlan type** | **remote-span** | **summary**]	Displays parameters for all VLANs or the specified VLAN on the switch . The following command options are available: • **access-log—**Displays the VACL logging. • **access-map—**Displays the VLAN access-maps. • **brief—**Displays VTP VLAN status in brief. • **dot1q—**Displays the dot1q parameters. • **filter—**Displays VLAN filter information. • **group—**Displays the VLAN group with its name and the connected VLANs that are available. • **id—**Displays VTP VLAN status by identification number. • **ifindex—**Displays SNMP ifIndex. • **mtu—**Displays VLAN MTU information. • **name—**Display the VTP VLAN information by specified name. • **private-vlan—**Displays private VLAN information. • **remote-span–**Displays the remote SPAN VLANs. • **summary—**Displays a summary of VLAN information.

Configuration Examples

Example: Creating a VLAN Name

This example shows how to create Ethernet VLAN 20, name it test20, and add it to the VLAN database:

```
Switch# configure terminal
Switch(config)# vlan 20
Switch(config-vlan)# name test20
Switch(config-vlan)# end
```

Related Topics

Creating or Modifying an Ethernet VLAN

Normal-Range VLAN Configuration Guidelines, on page 44

Example: Configuring a Port as Access Port

This example shows how to configure a port as an access port in VLAN 2:

```
Switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# interface gigabitethernet2/0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 2
Switch(config-if)# end
```

Related Topics

Assigning Static-Access Ports to a VLAN, on page 50

Example: Creating an Extended-Range VLAN

This example shows how to create a new extended-range VLAN with all default characteristics, enter VLAN configuration mode, and save the new VLAN in the switch startup configuration file:

```
Switch(config)# vtp mode transparent
Switch(config)# vlan 2000
Switch(config-vlan)# end
Switch# copy running-config startup config
```

Related Topics

Creating an Extended-Range VLAN, on page 52

Extended-Range VLAN Configuration Guidelines, on page 45

Where to Go Next

After configuring VLANs, you can configure the following:

- VLAN Trunking Protocol (VTP)
- VLAN trunks
- VLAN Membership Policy Server (VMPS)
- Voice VLANs

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-X Switch VLAN Management Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

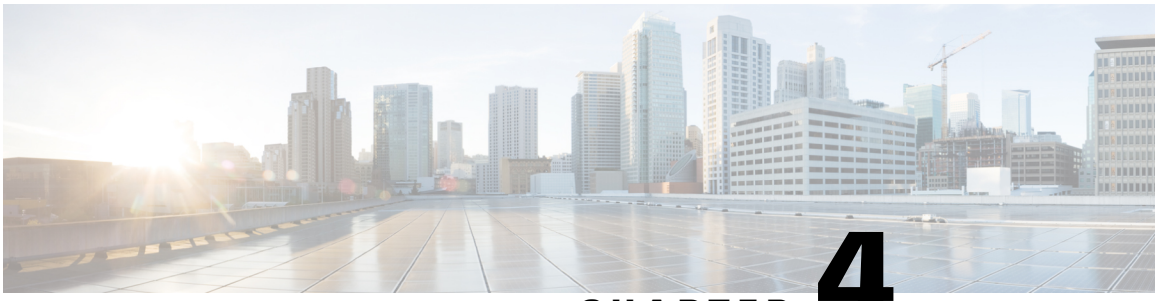
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for VLAN

Release	Modification
Cisco IOS 15.0(2)EX	This feature was introduced.



CHAPTER 4

Configuring VLAN Trunks

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for VLAN Trunks

The IEEE 802.1Q trunks impose these limitations on the trunking strategy for a network:

- In a network of Cisco switches connected through IEEE 802.1Q trunks, the switches maintain one spanning-tree instance for each VLAN allowed on the trunks. Non-Cisco devices might support one spanning-tree instance for all VLANs.

  When you connect a Cisco switch to a non-Cisco device through an IEEE 802.1Q trunk, the Cisco switch combines the spanning-tree instance of the VLAN of the trunk with the spanning-tree instance of the non-Cisco IEEE 802.1Q switch. However, spanning-tree information for each VLAN is maintained by Cisco switches separated by a cloud of non-Cisco IEEE 802.1Q switches. The non-Cisco IEEE 802.1Q cloud separating the Cisco switches is treated as a single trunk link between the switches.

- Make sure the native VLAN for an IEEE 802.1Q trunk is the same on both ends of the trunk link. If the native VLAN on one end of the trunk is different from the native VLAN on the other end, spanning-tree loops might result.
- Disabling spanning tree on the native VLAN of an IEEE 802.1Q trunk without disabling spanning tree on every VLAN in the network can potentially cause spanning-tree loops. We recommend that you leave spanning tree enabled on the native VLAN of an IEEE 802.1Q trunk or disable spanning tree on every VLAN in the network. Make sure your network is loop-free before disabling spanning tree.

Information About VLAN Trunks

Trunking Overview

A trunk is a point-to-point link between one or more Ethernet switch interfaces and another networking device such as a router or a switch. Ethernet trunks carry the traffic of multiple VLANs over a single link, and you can extend the VLANs across an entire network.

Note You can configure a trunk on a single Ethernet interface or on an EtherChannel bundle.

Trunking Modes

Ethernet trunk interfaces support different trunking modes. You can set an interface as trunking or nontrunking or to negotiate trunking with the neighboring interface. To autonegotiate trunking, the interfaces must be in the same VTP domain.

Trunk negotiation is managed by the Dynamic Trunking Protocol (DTP), which is a Point-to-Point Protocol (PPP). However, some internetworking devices might forward DTP frames improperly, which could cause misconfigurations.

Related Topics

Configuring a Trunk Port, on page 65
Layer 2 Interface Modes, on page 60

Layer 2 Interface Modes

Table 10: Layer 2 Interface Modes

Mode	Function
switchport mode access	Puts the interface (access port) into permanent nontrunking mode and negotiates to convert the link into a nontrunk link. The interface becomes a nontrunk interface regardless of whether or not the neighboring interface is a trunk interface.

Mode	Function
switchport mode dynamic auto	Makes the interface able to convert the link to a trunk link. The interface becomes a trunk interface if the neighboring interface is set to **trunk** or **desirable** mode. The default switchport mode for all Ethernet interfaces is **dynamic auto**.
switchport mode dynamic desirable	Makes the interface actively attempt to convert the link to a trunk link. The interface becomes a trunk interface if the neighboring interface is set to **trunk**, **desirable**, or **auto** mode.
switchport mode trunk	Puts the interface into permanent trunking mode and negotiates to convert the neighboring link into a trunk link. The interface becomes a trunk interface even if the neighboring interface is not a trunk interface.
switchport nonegotiate	Prevents the interface from generating DTP frames. You can use this command only when the interface switchport mode is **access** or **trunk**. You must manually configure the neighboring interface as a trunk interface to establish a trunk link.

Related Topics

Configuring a Trunk Port, on page 65
Trunking Modes, on page 60

Allowed VLANs on a Trunk

By default, a trunk port sends traffic to and receives traffic from all VLANs. All VLAN IDs, 1 to 4094, are allowed on each trunk. However, you can remove VLANs from the allowed list, preventing traffic from those VLANs from passing over the trunk.

To reduce the risk of spanning-tree loops or storms, you can disable VLAN 1 on any individual VLAN trunk port by removing VLAN 1 from the allowed list. When you remove VLAN 1 from a trunk port, the interface continues to send and receive management traffic, for example, Cisco Discovery Protocol (CDP), Port Aggregation Protocol (PAgP), Link Aggregation Control Protocol (LACP), DTP, and VTP in VLAN 1.

If a trunk port with VLAN 1 disabled is converted to a nontrunk port, it is added to the access VLAN. If the access VLAN is set to 1, the port will be added to VLAN 1, regardless of the **switchport trunk allowed** setting. The same is true for any VLAN that has been disabled on the port.

A trunk port can become a member of a VLAN if the VLAN is enabled, if VTP knows of the VLAN, and if the VLAN is in the allowed list for the port. When VTP detects a newly enabled VLAN and the VLAN is in the allowed list for a trunk port, the trunk port automatically becomes a member of the enabled VLAN. When VTP detects a new VLAN and the VLAN is not in the allowed list for a trunk port, the trunk port does not become a member of the new VLAN.

Related Topics

Defining the Allowed VLANs on a Trunk, on page 67

Load Sharing on Trunk Ports

Load sharing divides the bandwidth supplied by parallel trunks connecting switches. To avoid loops, STP normally blocks all but one parallel link between switches. Using load sharing, you divide the traffic between the links according to which VLAN the traffic belongs.

You configure load sharing on trunk ports by using STP port priorities or STP path costs. For load sharing using STP port priorities, both load-sharing links must be connected to the same switch. For load sharing using STP path costs, each load-sharing link can be connected to the same switch or to two different switches.

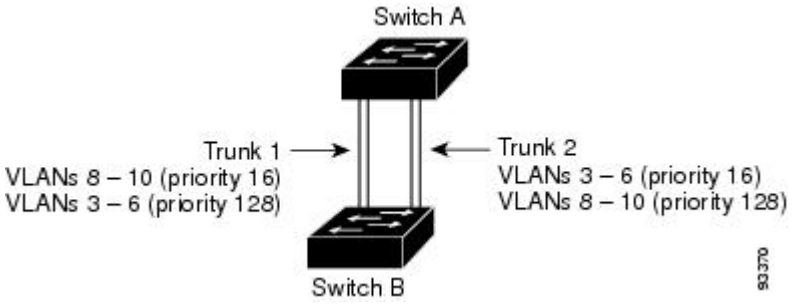
Network Load Sharing Using STP Priorities

When two ports on the same switch form a loop, the switch uses the STP port priority to decide which port is enabled and which port is in a blocking state. You can set the priorities on a parallel trunk port so that the port carries all the traffic for a given VLAN. The trunk port with the higher priority (lower values) for a VLAN is forwarding traffic for that VLAN. The trunk port with the lower priority (higher values) for the same VLAN remains in a blocking state for that VLAN. One trunk port sends or receives all traffic for the VLAN.

This figure shows two trunks connecting supported switches.

- VLANs 8 through 10 are assigned a port priority of 16 on Trunk 1.
- VLANs 3 through 6 retain the default port priority of 128 on Trunk 1.
- VLANs 3 through 6 are assigned a port priority of 16 on Trunk 2.
- VLANs 8 through 10 retain the default port priority of 128 on Trunk 2.

Figure 4: Load Sharing by Using STP Port Priorities



Trunk 1 carries traffic for VLANs 8 through 10, and Trunk 2 carries traffic for VLANs 3 through 6. If the active trunk fails, the trunk with the lower priority takes over and carries the traffic for all of the VLANs. No duplication of traffic occurs over any trunk port.

Related Topics

Configuring Load Sharing Using STP Port Priorities, on page 71

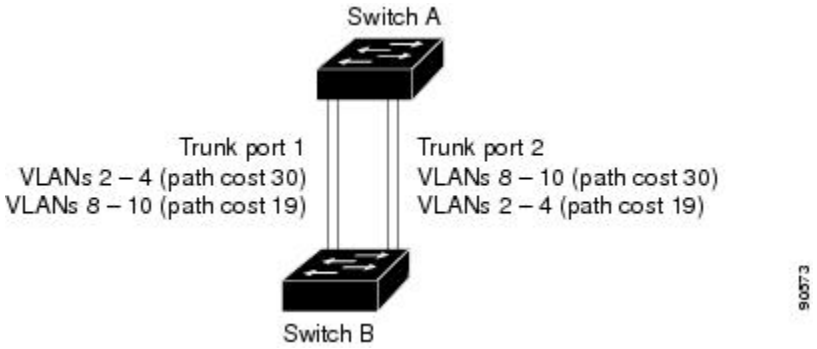
Network Load Sharing Using STP Path Cost

You can configure parallel trunks to share VLAN traffic by setting different path costs on a trunk and associating the path costs with different sets of VLANs, blocking different ports for different VLANs. The VLANs keep the traffic separate and maintain redundancy in the event of a lost link.

Trunk ports 1 and 2 are configured as 100BASE-T ports. These VLAN path costs are assigned:

- VLANs 2 through 4 are assigned a path cost of 30 on Trunk port 1.
- VLANs 8 through 10 retain the default 100BASE-T path cost on Trunk port 1 of 19.
- VLANs 8 through 10 are assigned a path cost of 30 on Trunk port 2.
- VLANs 2 through 4 retain the default 100BASE-T path cost on Trunk port 2 of 19.

Figure 5: Load-Sharing Trunks with Traffic Distributed by Path Cost



Related Topics

Configuring Load Sharing Using STP Path Cost, on page 75

Feature Interactions

Trunking interacts with other features in these ways:

- A trunk port cannot be a secure port.
- Trunk ports can be grouped into EtherChannel port groups, but all trunks in the group must have the same configuration. When a group is first created, all ports follow the parameters set for the first port to be added to the group. If you change the configuration of one of these parameters, the switch propagates the setting that you entered to all ports in the group:
  - Allowed-VLAN list.
  - STP port priority for each VLAN.
  - STP Port Fast setting.
  - Trunk status:

    If one port in a port group ceases to be a trunk, all ports cease to be trunks.

- We recommend that you configure no more than 24 trunk ports in Per VLAN Spanning Tree (PVST) mode and no more than 40 trunk ports in Multiple Spanning Tree (MST) mode.
- If you try to enable IEEE 802.1x on a trunk port, an error message appears, and IEEE 802.1x is not enabled. If you try to change the mode of an IEEE 802.1x-enabled port to trunk, the port mode is not changed.
- A port in dynamic mode can negotiate with its neighbor to become a trunk port. If you try to enable IEEE 802.1x on a dynamic port, an error message appears, and IEEE 802.1x is not enabled. If you try to change the mode of an IEEE 802.1x-enabled port to dynamic, the port mode is not changed.

Default Layer 2 Ethernet Interface VLAN Configuration

The following table shows the default Layer 2 Ethernet interface VLAN configuration.

Table 11: Default Layer 2 Ethernet Interface VLAN Configuration

Feature	Default Setting
Interface mode	**switchport mode dynamic auto**
Allowed VLAN range	VLANs 1 to 4094
VLAN range eligible for pruning	VLANs 2 to 1001
Default VLAN (for access ports)	VLAN 1
Native VLAN (for IEEE 802.1Q trunks)	VLAN 1

How to Configure VLAN Trunks

To avoid trunking misconfigurations, configure interfaces connected to devices that do not support DTP to not forward DTP frames, that is, to turn off DTP.

- If you do not intend to trunk across those links, use the **switchport mode access** interface configuration command to disable trunking.
- To enable trunking to a device that does not support DTP, use the **switchport mode trunk** and **switchport nonegotiate** interface configuration commands to cause the interface to become a trunk but to not generate DTP frames.

Configuring an Ethernet Interface as a Trunk Port

Configuring a Trunk Port

Because trunk ports send and receive VTP advertisements, to use VTP you must ensure that at least one trunk port is configured on the switch and that this trunk port is connected to the trunk port of a second switch. Otherwise, the switch cannot receive any VTP advertisements.

Before You Begin

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport mode** {**dynamic** {**auto** | **desirable**} | **trunk**}
4. **switchport access vlan** *vlan-id*
5. **switchport trunk native vlan** *vlan-id*
6. **end**
7. **show interfaces** *interface-id* **switchport**
8. **show interfaces** *interface-id* **trunk**
9. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/2`	Specifies the port to be configured for trunking, and enters interface configuration mode.
Step 3	**switchport mode** {**dynamic** {**auto**	**desirable**}	**trunk**} **Example:** `Switch(config-if)# switchport mode dynamic desirable`	Configures the interface as a Layer 2 trunk (required only if the interface is a Layer 2 access port or tunnel port or to specify the trunking mode). • **dynamic auto—**Sets the interface to a trunk link if the neighboring interface is set to trunk or desirable mode. This is the default.

	Command or Action	Purpose
		• **dynamic desirable—**Sets the interface to a trunk link if the neighboring interface is set to trunk, desirable, or auto mode. • **trunk—**Sets the interface in permanent trunking mode and negotiate to convert the link to a trunk link even if the neighboring interface is not a trunk interface.
Step 4	**switchport access vlan** *vlan-id* **Example:** `Switch(config-if)# switchport access vlan 200`	(Optional) Specifies the default VLAN, which is used if the interface stops trunking.
Step 5	**switchport trunk native vlan** *vlan-id* **Example:** `Switch(config-if)# switchport trunk native vlan 200`	Specifies the native VLAN for IEEE 802.1Q trunks.
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 7	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet1/0/2 switchport`	Displays the switch port configuration of the interface in the *Administrative Mode* and the *Administrative Trunking Encapsulation* fields of the display.
Step 8	**show interfaces** *interface-id* **trunk** **Example:** `Switch# show interfaces gigabitethernet1/0/2 trunk`	Displays the trunk configuration of the interface.
Step 9	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Trunking Modes, on page 60
Layer 2 Interface Modes, on page 60

Defining the Allowed VLANs on a Trunk

VLAN 1 is the default VLAN on all trunk ports in all Cisco switches, and it has previously been a requirement that VLAN 1 always be enabled on every trunk link. You can use the VLAN 1 minimization feature to disable VLAN 1 on any individual VLAN trunk link so that no user traffic (including spanning-tree advertisements) is sent or received on VLAN 1.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport mode trunk**
4. **switchport trunk allowed vlan** {**add** | **all** | **except** | **remove**} *vlan-list*
5. **end**
6. **show interfaces** *interface-id* **switchport**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Specifies the port to be configured, and enters interface configuration mode.
Step 3	**switchport mode trunk** **Example:** `Switch(config-if)# switchport mode trunk`	Configures the interface as a VLAN trunk port.
Step 4	**switchport trunk allowed vlan** {**add** | **all** | **except** | **remove**} *vlan-list*	(Optional) Configures the list of VLANs allowed on the trunk. The *vlan-list* parameter is either a single VLAN number from 1 to 4094 or a range of VLANs described by two VLAN

	Command or Action	Purpose
	Example: `Switch(config-if)# switchport trunk allowed vlan remove 2`	numbers, the lower one first, separated by a hyphen. Do not enter any spaces between comma-separated VLAN parameters or in hyphen-specified ranges. All VLANs are allowed by default.
Step 5	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 6	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet1/0/1`	Verifies your entries in the *Trunking VLANs Enabled* field of the display.
Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Allowed VLANs on a Trunk, on page 61

Changing the Pruning-Eligible List

The pruning-eligible list applies only to trunk ports. Each trunk port has its own eligibility list. VTP pruning must be enabled for this procedure to take effect.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport trunk pruning vlan** {**add** | **except** | **none** | **remove**} *vlan-list* [,*vlan* [,*vlan* [,,,]]
4. **end**
5. **show interfaces** *interface-id* **switchport**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet2/0/1`	Selects the trunk port for which VLANs should be pruned, and enters interface configuration mode.
Step 3	**switchport trunk pruning vlan** {**add** | **except** | **none** | **remove**} *vlan-list* [,*vlan* [,*vlan* [,,,]]	Configures the list of VLANs allowed to be pruned from the trunk. For explanations about using the **add**, **except**, **none**, and **remove** keywords, see the command reference for this release. Separate non-consecutive VLAN IDs with a comma and no spaces; use a hyphen to designate a range of IDs. Valid IDs are 2 to 1001. Extended-range VLANs (VLAN IDs 1006 to 4094) cannot be pruned. VLANs that are pruning-ineligible receive flooded traffic. The default list of VLANs allowed to be pruned contains VLANs 2 to 1001.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet2/0/1 switchport`	Verifies your entries in the *Pruning VLANs Enabled* field of the display.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the Native VLAN for Untagged Traffic

A trunk port configured with IEEE 802.1Q tagging can receive both tagged and untagged traffic. By default, the switch forwards untagged traffic in the native VLAN configured for the port. The native VLAN is VLAN 1 by default.

The native VLAN can be assigned any VLAN ID.

If a packet has a VLAN ID that is the same as the outgoing port native VLAN ID, the packet is sent untagged; otherwise, the switch sends the packet with a tag.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport trunk native vlan** *vlan-id*
4. **end**
5. **show interfaces** *interface-id* **switchport**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/2`	Defines the interface that is configured as the IEEE 802.1Q trunk, and enters interface configuration mode.
Step 3	**switchport trunk native vlan** *vlan-id* **Example:** `Switch(config-if)# switchport trunk native vlan 12`	Configures the VLAN that is sending and receiving untagged traffic on the trunk port. For *vlan-id*, the range is 1 to 4094.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet1/0/2 switchport`	Verifies your entries in the *Trunking Native Mode VLAN* field.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Trunk Ports for Load Sharing

Configuring Load Sharing Using STP Port Priorities

If your switch is a member of a switch stack, you must use the **spanning-tree** [**vlan** *vlan-id*] **cost** *cost* interface configuration command instead of the **spanning-tree** [**vlan** *vlan-id*] **port-priority** *priority* interface configuration command to select an interface to put in the forwarding state. Assign lower cost values to interfaces that you want selected first and higher cost values that you want selected last.

These steps describe how to configure a network with load sharing using STP port priorities.

SUMMARY STEPS

1. **configure terminal**
2. **vtp domain** *domain-name*
3. **vtp mode server**
4. **end**
5. **show vtp status**
6. **show vlan**
7. **configure terminal**
8. **interface** *interface-id*
9. **switchport mode trunk**
10. **end**
11. **show interfaces** *interface-id* **switchport**
12. Repeat the above steps on Switch A for a second port in the switch or switch stack.
13. Repeat the above steps on Switch B to configure the trunk ports that connect to the trunk ports configured on Switch A.
14. **show vlan**
15. **configure terminal**
16. **interface** *interface-id*
17. **spanning-tree vlan** *vlan-range* **port-priority** *priority-value*
18. **exit**
19. **interface** *interface-id*
20. **spanning-tree vlan** *vlan-range* **port-priority** *priority-value*
21. **end**
22. **show running-config**
23. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode on Switch A.
Step 2	**vtp domain** *domain-name* **Example:** `Switch(config)# vtp domain workdomain`	Configures a VTP administrative domain. The domain name can be 1 to 32 characters.

	Command or Action	Purpose
Step 3	**vtp mode server** **Example:** `Switch(config)# vtp mode server`	Configures Switch A as the VTP server.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show vtp status** **Example:** `Switch# show vtp status`	Verifies the VTP configuration on both Switch A and Switch B. In the display, check the *VTP Operating Mode* and the *VTP Domain Name* fields.
Step 6	**show vlan** **Example:** `Switch# show vlan`	Verifies that the VLANs exist in the database on Switch A.
Step 7	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 8	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Defines the interface to be configured as a trunk, and enters interface configuration mode.
Step 9	**switchport mode trunk** **Example:** `Switch(config-if)# switchport mode trunk`	Configures the port as a trunk port.
Step 10	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 11	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet1/0/1`	Verifies the VLAN configuration.

	Command or Action	Purpose
Step 12	Repeat the above steps on Switch A for a second port in the switch or switch stack.	
Step 13	Repeat the above steps on Switch B to configure the trunk ports that connect to the trunk ports configured on Switch A.	
Step 14	**show vlan** **Example:** `Switch# show vlan`	When the trunk links come up, VTP passes the VTP and VLAN information to Switch B. This command verifies that Switch B has learned the VLAN configuration.
Step 15	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode on Switch A.
Step 16	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Defines the interface to set the STP port priority, and enters interface configuration mode.
Step 17	**spanning-tree vlan** *vlan-range* **port-priority** *priority-value* **Example:** `Switch(config-if)# spanning-tree vlan 8-10 port-priority 16`	Assigns the port priority for the VLAN range specified. Enter a port priority value from 0 to 240. Port priority values increment by 16.
Step 18	**exit** **Example:** `Switch(config-if)# exit`	Returns to global configuration mode.
Step 19	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/2`	Defines the interface to set the STP port priority, and enters interface configuration mode.
Step 20	**spanning-tree vlan** *vlan-range* **port-priority** *priority-value* **Example:** `Switch(config-if)# spanning-tree vlan 3-6 port-priority 16`	Assigns the port priority for the VLAN range specified. Enter a port priority value from 0 to 240. Port priority values increment by 16.

	Command or Action	Purpose
Step 21	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 22	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 23	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Network Load Sharing Using STP Priorities, on page 62

Configuring Load Sharing Using STP Path Cost

These steps describe how to configure a network with load sharing using STP path costs.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport mode trunk**
4. **exit**
5. Repeat Steps 2 through 4 on a second interface in Switch A or in Switch A stack.
6. **end**
7. **show running-config**
8. **show vlan**
9. **configure terminal**
10. **interface** *interface-id*
11. **spanning-tree vlan** *vlan-range* **cost** *cost-value*
12. **end**
13. Repeat Steps 9 through 13 on the other configured trunk interface on Switch A, and set the spanning-tree path cost to 30 for VLANs 8, 9, and 10.
14. **exit**
15. **show running-config**
16. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode on Switch A.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Defines the interface to be configured as a trunk, and enters interface configuration mode.
Step 3	**switchport mode trunk** **Example:** `Switch(config-if)# switchport mode trunk`	Configures the port as a trunk port.

	Command or Action	Purpose
Step 4	**exit** **Example:** `Switch(config-if)# exit`	Returns to global configuration mode.
Step 5	Repeat Steps 2 through 4 on a second interface in Switch A or in Switch A stack.	
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries. In the display, make sure that the interfaces are configured as trunk ports.
Step 8	**show vlan** **Example:** `Switch# show vlan`	When the trunk links come up, Switch A receives the VTP information from the other switches. This command verifies that Switch A has learned the VLAN configuration.
Step 9	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 10	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Defines the interface on which to set the STP cost, and enters interface configuration mode.
Step 11	**spanning-tree vlan** *vlan-range* **cost** *cost-value* **Example:** `Switch(config-if)# spanning-tree vlan 2-4 cost 30`	Sets the spanning-tree path cost to 30 for VLANs 2 through 4.

	Command or Action	Purpose
Step 12	**end** **Example:** `Switch(config-if)# end`	Returns to global configuration mode.
Step 13	Repeat Steps 9 through 13 on the other configured trunk interface on Switch A, and set the spanning-tree path cost to 30 for VLANs 8, 9, and 10.	
Step 14	**exit** **Example:** `Switch(config)# exit`	Returns to privileged EXEC mode.
Step 15	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries. In the display, verify that the path costs are set correctly for both trunk interfaces.
Step 16	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Network Load Sharing Using STP Path Cost, on page 63

Configuration Examples for VLAN Trunking

Example: Configuring a Trunk Port

The following example shows how to configure a port as an IEEE 802.1Q trunk. The example assumes that the neighbor interface is configured to support IEEE 802.1Q trunking.

```
Switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# interface gigabitethernet1/0/2
Switch(config-if)# switchport mode dynamic desirable
Switch(config-if)# end
```

Example: Removing a VLAN from a Port

This example shows how to remove VLAN 2 from the allowed VLAN list on a port:

```
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# switchport trunk allowed vlan remove 2
Switch(config-if)# end
```

Where to Go Next

After configuring VLAN trunks, you can configure the following:

- VLANs
- VLAN Membership Policy Server (VMPS)
- Voice VLANs

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-X Switch VLAN Management Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

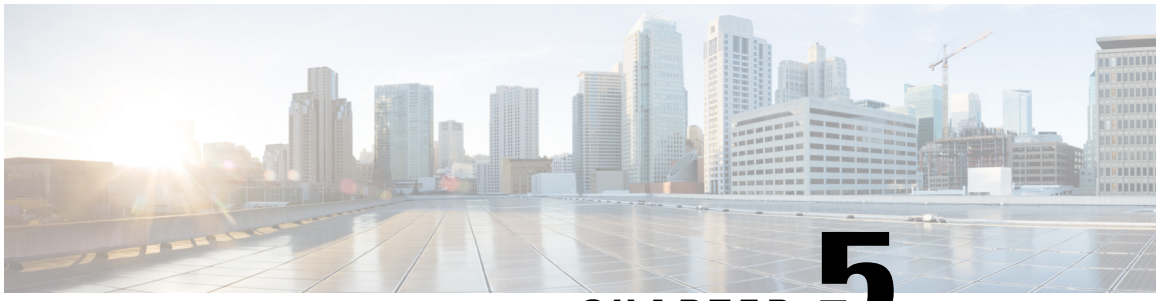
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for VLAN Trunks

Release	Modification
Cisco IOS 15.0(2)EX	This feature was introduced.



CHAPTER 5

Configuring VMPS

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for VMPS

You should configure the VLAN Membership Policy Server (VMPS) before you configure ports as dynamic-access ports.

When you configure a port as a dynamic-access port, the spanning-tree Port Fast feature is automatically enabled for that port. The Port Fast mode accelerates the process of bringing the port into the forwarding state.

The VTP management domain of the VMPS client and the VMPS server must be the same.

Restrictions for VMPS

The following are restrictions for configuring VMPS:

- IEEE 802.1x ports cannot be configured as dynamic-access ports. If you try to enable IEEE 802.1x on a dynamic-access (VQP) port, an error message appears, and IEEE 802.1x is not enabled. If you try to change an IEEE 802.1x-enabled port to dynamic VLAN assignment, an error message appears, and the VLAN configuration is not changed.
- Trunk ports cannot be dynamic-access ports, but you can enter the **switchport access vlan dynamic** interface configuration command for a trunk port. In this case, the switch retains the setting and applies it if the port is later configured as an access port. You must turn off trunking on the port before the dynamic-access setting takes effect.
- Dynamic-access ports cannot be monitor ports.
- Secure ports cannot be dynamic-access ports. You must disable port security on a port before it becomes dynamic.
- Dynamic-access ports cannot be members of an EtherChannel group.
- Port channels cannot be configured as dynamic-access ports.
- The VLAN configured on the VMPS server should not be a voice VLAN.
- 1K VLAN is supported only on switches running the LAN Base image with the lanbase-default template set.
- For a normal-range VLAN configuration, to avoid warning messages of high CPU utilization it is recommended to have no more than 256 VLANs. In such cases, approximately 10 access interfaces or 5 trunk interfaces can flap simultaneously with negligible impact to CPU utilization (if there are more interfaces that flap simultaneously, then CPU usage may be excessively high.)

Information About VMPS

Dynamic VLAN Assignments

The VLAN Query Protocol (VQP) is used to support dynamic-access ports, which are not permanently assigned to a VLAN, but give VLAN assignments based on the MAC source addresses seen on the port. Each time an unknown MAC address is seen, the switch sends a VQP query to a remote VLAN Membership Policy Server (VMPS); the query includes the newly seen MAC address and the port on which it was seen. The VMPS responds with a VLAN assignment for the port. The switch cannot be a VMPS server but can act as a client to the VMPS and communicate with it through VQP.

Each time the client switch receives the MAC address of a new host, it sends a VQP query to the VMPS. When the VMPS receives this query, it searches its database for a MAC-address-to-VLAN mapping. The server response is based on this mapping and whether or not the server is in open or secure mode. In secure mode, the server shuts down the port when an illegal host is detected. In open mode, the server denies the host access to the port.

If the port is currently unassigned (that is, it does not yet have a VLAN assignment), the VMPS provides one of these responses:

- If the host is allowed on the port, the VMPS sends the client a vlan-assignment response containing the assigned VLAN name and allowing access to the host.
- If the host is not allowed on the port and the VMPS is in open mode, the VMPS sends an access-denied response.
- If the VLAN is not allowed on the port and the VMPS is in secure mode, the VMPS sends a port-shutdown response.

If the port already has a VLAN assignment, the VMPS provides one of these responses:

- If the VLAN in the database matches the current VLAN on the port, the VMPS sends an success response, allowing access to the host.
- If the VLAN in the database does not match the current VLAN on the port and active hosts exist on the port, the VMPS sends an access-denied or a port-shutdown response, depending on the secure mode of the VMPS.

If the switch receives an access-denied response from the VMPS, it continues to block traffic to and from the host MAC address. The switch continues to monitor the packets directed to the port and sends a query to the VMPS when it identifies a new host address. If the switch receives a port-shutdown response from the VMPS, it disables the port. The port must be manually reenabled by using Network Assistant, the CLI, or SNMP.

Related Topics

Configuring Dynamic-Access Ports on VMPS Clients, on page 85

Example: VMPS Configuration, on page 91

Dynamic-Access Port VLAN Membership

A dynamic-access port can belong to only one VLAN with an ID from 1 to 4094. When the link comes up, the switch does not forward traffic to or from this port until the VMPS provides the VLAN assignment. The VMPS receives the source MAC address from the first packet of a new host connected to the dynamic-access port and attempts to match the MAC address to a VLAN in the VMPS database.

If there is a match, the VMPS sends the VLAN number for that port. If the client switch was not previously configured, it uses the domain name from the first VTP packet it receives on its trunk port from the VMPS. If the client switch was previously configured, it includes its domain name in the query packet to the VMPS to obtain its VLAN number. The VMPS verifies that the domain name in the packet matches its own domain name before accepting the request and responds to the client with the assigned VLAN number for the client. If there is no match, the VMPS either denies the request or shuts down the port (depending on the VMPS secure mode setting).

Multiple hosts (MAC addresses) can be active on a dynamic-access port if they are all in the same VLAN; however, the VMPS shuts down a dynamic-access port if more than 20 hosts are active on the port.

If the link goes down on a dynamic-access port, the port returns to an isolated state and does not belong to a VLAN. Any hosts that come online through the port are checked again through the VQP with the VMPS before the port is assigned to a VLAN.

Dynamic-access ports can be used for direct host connections, or they can connect to a network. A maximum of 20 MAC addresses are allowed per port on the switch. A dynamic-access port can belong to only one VLAN at a time, but the VLAN can change over time, depending on the MAC addresses seen.

Related Topics

Configuring Dynamic-Access Ports on VMPS Clients, on page 85
Example: VMPS Configuration, on page 91

Default VMPS Client Configuration

The following table shows the default VMPS and dynamic-access port configuration on client switches.

Table 12: Default VMPS Client and Dynamic-Access Port Configuration

Feature	Default Setting
VMPS domain server	None
VMPS reconfirm interval	60 minutes
VMPS server retry count	3
Dynamic-access ports	None configured

How to Configure VMPS

Entering the IP Address of the VMPS

Note If the VMPS is being defined for a cluster of switches, enter the address on the command switch.

Before You Begin

You must first enter the IP address of the server to configure the switch as a client.

SUMMARY STEPS

1. **configure terminal**
2. **vmps server** *ipaddress* **primary**
3. **vmps server** *ipaddress*
4. **end**
5. **show vmps**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vmps server** *ipaddress* **primary** **Example:** `Switch(config)# vmps server 10.1.2.3 primary`	Enters the IP address of the switch acting as the primary VMPS server.
Step 3	**vmps server** *ipaddress* **Example:** `Switch(config)# vmps server 10.3.4.5`	(Optional) Enters the IP address of the switch acting as a secondary VMPS server. You can enter up to three secondary server addresses.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show vmps** **Example:** `Switch# show vmps`	Verifies your entries in the *VMPS Domain Server* field of the display.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Dynamic-Access Ports on VMPS Clients

Caution Dynamic-access port VLAN membership is for end stations or hubs connected to end stations. Connecting dynamic-access ports to other switches can cause a loss of connectivity.

If you are configuring a port on a cluster member switch as a dynamic-access port, first use the **rcommand** privileged EXEC command to log in to the cluster member switch.

Before You Begin

You must have IP connectivity to the VMPS for dynamic-access ports to work. You can test for IP connectivity by pinging the IP address of the VMPS and verifying that you get a response.

Note To return an interface to its default configuration, use the **default interface** *interface-id* interface configuration command. To return an interface to its default switchport mode (dynamic auto), use the **no switchport mode** interface configuration command. To reset the access mode to the default VLAN for the switch, use the **no switchport access vlan** interface configuration command.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport mode access**
4. **switchport access vlan dynamic**
5. **end**
6. **show interfaces** *interface-id* **switchport**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the switch port that is connected to the end station, and enters interface configuration mode.
Step 3	**switchport mode access** **Example:** `Switch(config-if)# switchport mode access`	Sets the port to access mode.

	Command or Action	Purpose
Step 4	**switchport access vlan dynamic** **Example:** `Switch(config-if)# switchport access vlan dynamic`	Configures the port as eligible for dynamic VLAN membership. The dynamic-access port must be connected to an end station.
Step 5	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 6	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet 1/0/1 switchport`	Verifies your entries in the *Operational Mode* field of the display.
Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Dynamic VLAN Assignments, on page 82
Dynamic-Access Port VLAN Membership, on page 83
Example: VMPS Configuration, on page 91

Reconfirming VLAN Memberships

This task confirms the dynamic-access port VLAN membership assignments that the switch has received from the VMPS.

SUMMARY STEPS

1. **vmps reconfirm**
2. **show vmps**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**vmps reconfirm** **Example:** `Switch# vmps reconfirm`	Reconfirms dynamic-access port VLAN membership.
Step 2	**show vmps** **Example:** `Switch# show vmps`	Verifies the dynamic VLAN reconfirmation status.

Changing the Reconfirmation Interval

VMPS clients periodically reconfirm the VLAN membership information received from the VMPS. You can set the number of minutes after which reconfirmation occurs.

Note If you are configuring a member switch in a cluster, this parameter must be equal to or greater than the reconfirmation setting on the command switch. You also must first use the **rcommand** privileged EXEC command to log in to the member switch.

SUMMARY STEPS

1. **configure terminal**
2. **vmps reconfirm** *minutes*
3. **end**
4. **show vmps**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 2	**vmps reconfirm** *minutes* **Example:** `Switch(config)# vmps reconfirm 90`	Sets the number of minutes between reconfirmations of the dynamic VLAN membership. The range is 1 to 120. The default is 60 minutes.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show vmps** **Example:** `Switch# show vmps`	Verifies the dynamic VLAN reconfirmation status in the *Reconfirm Interval* field of the display.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Changing the Retry Count

Beginning in privileged EXEC mode, follow these steps to change the number of times that the switch attempts to contact the VMPS before querying the next server.

SUMMARY STEPS

1. **configure terminal**
2. **vmps retry** *count*
3. **end**
4. **show vmps**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**vmps retry** *count* **Example:** `Switch(config)# vmps retry 5`	Changes the retry count. The retry range is 1 to 10; the default is 3.
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show vmps** **Example:** `Switch# show vmps`	Verifies your entry in the *Server Retry Count* field of the display.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Troubleshooting Dynamic-Access Port VLAN Membership

Problem The VMPS shuts down a dynamic-access port under these conditions:

- **Problem** The VMPS is in secure mode, and it does not allow the host to connect to the port. The VMPS shuts down the port to prevent the host from connecting to the network.
- **Problem** More than 20 active hosts reside on a dynamic-access port.

Solution To reenable a disabled dynamic-access port, enter the **shutdown** interface configuration command followed by the **no shutdown** interface configuration command.

Monitoring the VMPS

You can display information about the VMPS by using the **show vmps** privileged EXEC command. The switch displays this information about the VMPS:

- VMPS VQP Version—The version of VQP used to communicate with the VMPS. The switch queries the VMPS that is using VQP Version 1.
- Reconfirm Interval—The number of minutes the switch waits before reconfirming the VLAN-to-MAC-address assignments.
- Server Retry Count—The number of times VQP resends a query to the VMPS. If no response is received after this many tries, the switch starts to query the secondary VMPS.
- VMPS domain server—The IP address of the configured VLAN membership policy servers. The switch sends queries to the one marked *current*. The one marked *primary* is the primary server.
- VMPS Action—The result of the most recent reconfirmation attempt. A reconfirmation attempt can occur automatically when the reconfirmation interval expires, or you can force it by entering the **vmps reconfirm** privileged EXEC command or its Network Assistant or SNMP equivalent.

This is an example of output for the **show vmps** privileged EXEC command:

```
Switch# show vmps
VQP Client Status:
--------------------
VMPS VQP Version:   1
Reconfirm Interval: 60 min
Server Retry Count: 3
VMPS domain server: 172.20.128.86 (primary, current)
                    172.20.128.87

Reconfirmation status
---------------------
VMPS Action:         other
```

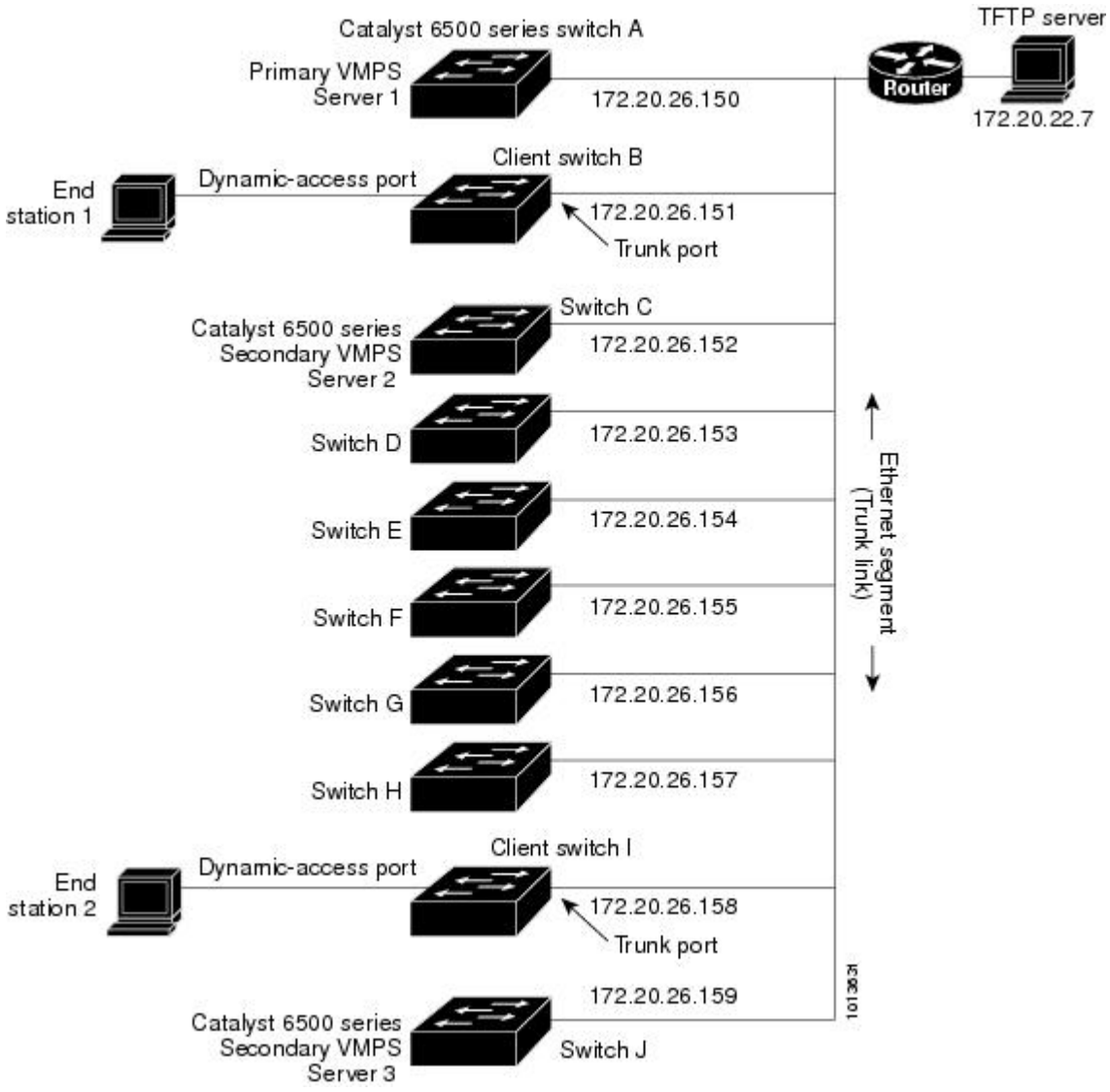
Configuration Example for VMPS

Example: VMPS Configuration

This network has a VMPS server switch and VMPS client switches with dynamic-access ports with this configuration:

- The VMPS server and the VMPS client are separate switches.
- The Catalyst 6500 series Switch A is the primary VMPS server.
- The Catalyst 6500 series Switch C and Switch J are secondary VMPS servers.
- End stations are connected to the clients, Switch B and Switch I.
- The database configuration file is stored on the TFTP server with the IP address 172.20.22.7.

Figure 6: Dynamic Port VLAN Membership Configuration



Related Topics

Configuring Dynamic-Access Ports on VMPS Clients, on page 85
Dynamic VLAN Assignments, on page 82
Dynamic-Access Port VLAN Membership, on page 83

Where to Go Next

You can configure the following:

- VTP

- VLANs
- VLAN Trunking
- Voice VLANs

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-X Switch VLAN Management Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

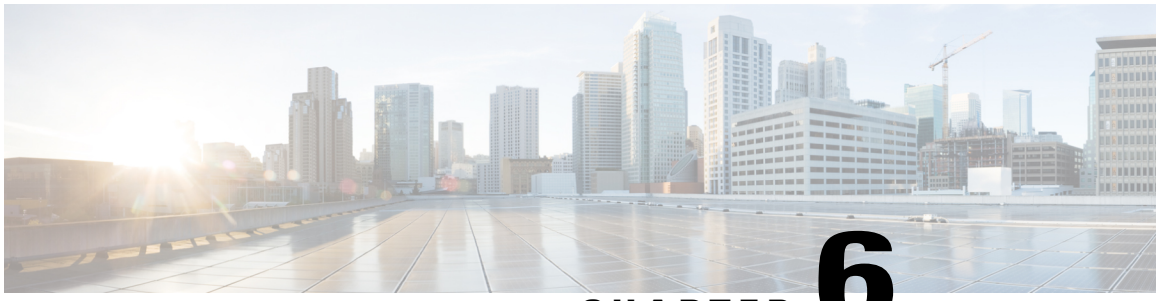
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for VMPS

Release	Modification
Cisco IOS 15.0(2)EX	This feature was introduced.



CHAPTER 6

Configuring Voice VLANs

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Voice VLANs

The following are the prerequisites for voice VLANs:

- Voice VLAN configuration is only supported on switch access ports; voice VLAN configuration is not supported on trunk ports.

Note Trunk ports can carry any number of voice VLANs, similar to regular VLANs. The configuration of voice VLANs is not supported on trunk ports.

- Before you enable voice VLAN, we recommend that you enable QoS on the switch by entering the **mls qos** global configuration command and configure the port trust state to trust by entering the **mls qos trust cos** interface configuration command. If you use the auto-QoS feature, these settings are automatically configured.
- You must enable CDP on the switch port connected to the Cisco IP Phone to send the configuration to the phone. (CDP is globally enabled by default on all switch interfaces.)

Restrictions for Voice VLANs

You cannot configure static secure MAC addresses in the voice VLAN.

Information About Voice VLAN

Voice VLANs

The voice VLAN feature enables access ports to carry IP voice traffic from an IP phone. When the switch is connected to a Cisco 7960 IP Phone, the phone sends voice traffic with Layer 3 IP precedence and Layer 2 class of service (CoS) values, which are both set to 5 by default. Because the sound quality of an IP phone call can deteriorate if the data is unevenly sent, the switch supports quality of service (QoS) based on IEEE 802.1p CoS. QoS uses classification and scheduling to send network traffic from the switch in a predictable manner.

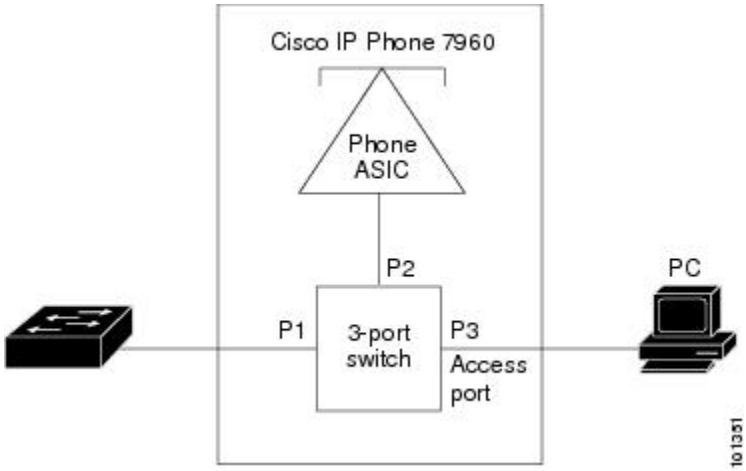
The Cisco 7960 IP Phone is a configurable device, and you can configure it to forward traffic with an IEEE 802.1p priority. You can configure the switch to trust or override the traffic priority assigned by a Cisco IP Phone.

This network configuration is one way to connect a Cisco 7960 IP Phone.

The Cisco IP Phone contains an integrated three-port 10/100 switch. The ports provide dedicated connections to these devices:

- Port 1 connects to the switch or other voice-over-IP (VoIP) device.
- Port 2 is an internal 10/100 interface that carries the IP phone traffic.
- Port 3 (access port) connects to a PC or other device.

Figure 7: Cisco 7960 IP Phone Connected to aSwitch



Cisco IP Phone Voice Traffic

You can configure an access port with an attached Cisco IP Phone to use one VLAN for voice traffic and another VLAN for data traffic from a device attached to the phone. You can configure access ports on the switch to send Cisco Discovery Protocol (CDP) packets that instruct an attached phone to send voice traffic to the switch in any of these ways:

- In the voice VLAN tagged with a Layer 2 CoS priority value
- In the access VLAN tagged with a Layer 2 CoS priority value
- In the access VLAN, untagged (no Layer 2 CoS priority value)

Note In all configurations, the voice traffic carries a Layer 3 IP precedence value (the default is 5 for voice traffic and 3 for voice control traffic).

Related Topics

Configuring Cisco IP Phone Voice Traffic
Example: Configuring Cisco IP Phone Voice Traffic, on page 103

Cisco IP Phone Data Traffic

The switch can also process tagged data traffic (traffic in IEEE 802.1Q or IEEE 802.1p frame types) from the device attached to the access port on the Cisco IP Phone. You can configure Layer 2 access ports on the switch to send CDP packets that instruct the attached phone to configure the phone access port in one of these modes:

- In trusted mode, all traffic received through the access port on the Cisco IP Phone passes through the phone unchanged.

- In untrusted mode, all traffic in IEEE 802.1Q or IEEE 802.1p frames received through the access port on the Cisco IP Phone receive a configured Layer 2 CoS value. The default Layer 2 CoS value is 0. Untrusted mode is the default.

Note Untagged traffic from the device attached to the Cisco IP Phone passes through the phone unchanged, regardless of the trust state of the access port on the phone.

Related Topics

Configuring the Priority of Incoming Data Frames, on page 101

Example: Configuring the Priority of Incoming Data Frames, on page 103

Voice VLAN Configuration Guidelines

- Because a Cisco 7960 IP Phone also supports a connection to a PC or other device, a port connecting the switch to a Cisco IP Phone can carry mixed traffic. You can configure a port to decide how the Cisco IP Phone carries voice traffic and data traffic.
- The voice VLAN should be present and active on the switch for the IP phone to correctly communicate on the voice VLAN. Use the **show vlan** privileged EXEC command to see if the VLAN is present (listed in the display). If the VLAN is not listed, create the voice VLAN.
- The Power over Ethernet (PoE) switches are capable of automatically providing power to Cisco pre-standard and IEEE 802.3af-compliant powered devices if they are not being powered by an AC power source.
- Before you enable voice VLAN, we recommend that you enable QoS on the switch by entering the **mls qos** global configuration command and configure the port trust state to trust by entering the **mls qos trust cos** interface configuration command. If you use the auto-QoS feature, these settings are automatically configured.
- You must enable CDP on the switch port connected to the Cisco IP Phone to send the configuration to the phone. (CDP is globally enabled by default on all switch interfaces.).
- The Port Fast feature is automatically enabled when voice VLAN is configured. When you disable voice VLAN, the Port Fast feature is not automatically disabled.
- If the Cisco IP Phone and a device attached to the phone are in the same VLAN, they must be in the same IP subnet. These conditions indicate that they are in the same VLAN:
  - They both use IEEE 802.1p or untagged frames.
  - The Cisco IP Phone uses IEEE 802.1p frames, and the device uses untagged frames.
  - The Cisco IP Phone uses untagged frames, and the device uses IEEE 802.1p frames.
  - The Cisco IP Phone uses IEEE 802.1Q frames, and the voice VLAN is the same as the access VLAN.
- The Cisco IP Phone and a device attached to the phone cannot communicate if they are in the same VLAN and subnet but use different frame types because traffic in the same subnet is not routed (routing would eliminate the frame type difference).

- Voice VLAN ports can also be these port types:
  - Dynamic access port.
  - IEEE 802.1x authenticated port.

  Note If you enable IEEE 802.1x on an access port on which a voice VLAN is configured and to which a Cisco IP Phone is connected, the phone loses connectivity to the switch for up to 30 seconds.

  - Protected port.
  - A source or destination port for a SPAN or RSPAN session.
  - Secure port.

  Note When you enable port security on an interface that is also configured with a voice VLAN, you must set the maximum allowed secure addresses on the port to two plus the maximum number of secure addresses allowed on the access VLAN. When the port is connected to a Cisco IP Phone, the phone requires up to two MAC addresses. The phone address is learned on the voice VLAN and might also be learned on the access VLAN. Connecting a PC to the phone requires additional MAC addresses.

Default Voice VLAN Configuration

The voice VLAN feature is disabled by default.

When the voice VLAN feature is enabled, all untagged traffic is sent according to the default CoS priority of the port.

The CoS value is not trusted for IEEE 802.1p or IEEE 802.1Q tagged traffic.

How to Configure Voice VLAN

Configuring Cisco IP Phone Voice Traffic

You can configure a port connected to the Cisco IP Phone to send CDP packets to the phone to configure the way in which the phone sends voice traffic. The phone can carry voice traffic in IEEE 802.1Q frames for a specified voice VLAN with a Layer 2 CoS value. It can use IEEE 802.1p priority tagging to give voice traffic a higher priority and forward all voice traffic through the native (access) VLAN. The Cisco IP Phone can also send untagged voice traffic or use its own configuration to send voice traffic in the access VLAN. In all configurations, the voice traffic carries a Layer 3 IP precedence value (the default is 5).

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **mls qos trust cos**
4. **switchport voice vlan** {*vlan-id* | **dot1p** | **none** | **untagged**}
5. **end**
6. Use one of the following:
   - **show interfaces** *interface-id* **switchport**
   - **show running-config interface** *interface-id*
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Specifies the interface connected to the phone, and enters interface configuration mode.
Step 3	**mls qos trust cos** **Example:** `Switch(config-if)# mls qos trust cos`	Configures the interface to classify incoming traffic packets by using the packet CoS value. For untagged packets, the port default CoS value is used. **Note** Before configuring the port trust state, you must first globally enable QoS by using the **mls qos** global configuration command.
Step 4	**switchport voice vlan** {*vlan-id* | **dot1p** | **none** | **untagged**} **Example:** `Switch(config-if)# switchport voice vlan dot1p`	Configures the voice VLAN. • *vlan-id*—Configures the phone to forward all voice traffic through the specified VLAN. By default, the Cisco IP Phone forwards the voice traffic with an IEEE 802.1Q priority of 5. Valid VLAN IDs are 1 to 4094. • **dot1p**—Configures the switch to accept voice and data IEEE 802.1p priority frames tagged with VLAN ID 0 (the native VLAN). By default, the switch drops all voice and data traffic tagged with VLAN 0. If configured for 802.1p the Cisco IP Phone forwards the traffic with an IEEE 802.1p priority of 5.

	Command or Action	Purpose
		• **none—**Allows the phone to use its own configuration to send untagged voice traffic. • **untagged—**Configures the phone to send untagged voice traffic.
Step 5	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.

Step 6	Use one of the following:
	• **show interfaces** *interface-id* **switchport**
	• **show running-config interface** *interface-id*
	
	Example:
	
	`Switch# show interfaces gigabitethernet1/0/1 switchport`
	
	or
	
	`Switch# show running-config interface gigabitethernet1/0/1`
		Verifies your voice VLAN entries or your QoS and voice VLAN entries.

Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the Priority of Incoming Data Frames

You can connect a PC or other data device to a Cisco IP Phone port. To process tagged data traffic (in IEEE 802.1Q or IEEE 802.1p frames), you can configure the switch to send CDP packets to instruct the phone how to send data packets from the device attached to the access port on the Cisco IP Phone. The PC can generate packets with an assigned CoS value. You can configure the phone to not change (trust) or to override (not trust) the priority of frames arriving on the phone port from connected devices.

Follow these steps to set the priority of data traffic received from the non-voice port on the Cisco IP Phone:

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport priority extend** {**cos** *value* | **trust**}
4. **end**
5. **show interfaces** *interface-id* **switchport**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet1/0/1`	Specifies the interface connected to the Cisco IP Phone, and enters interface configuration mode.
Step 3	**switchport priority extend** {**cos** *value* | **trust**} **Example:** `Switch(config-if)# switchport priority extend trust`	Sets the priority of data traffic received from the Cisco IP Phone access port: • **cos** *value*—Configures the phone to override the priority received from the PC or the attached device with the specified CoS value. The value is a number from 0 to 7, with 7 as the highest priority. The default priority is **cos** 0. • **trust**—Configures the phone access port to trust the priority received from the PC or the attached device.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show interfaces** *interface-id* **switchport** **Example:** `Switch# show interfaces gigabitethernet1/0/1 switchport`	Verifies your entries.

	Command or Action	Purpose
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Cisco IP Phone Data Traffic, on page 97
Example: Configuring the Priority of Incoming Data Frames, on page 103

Monitoring Voice VLAN

To display voice VLAN configuration for an interface, use the **show interfaces** *interface-id* **switchport** privileged EXEC command.

Configuration Examples

Example: Configuring Cisco IP Phone Voice Traffic

This example shows how to configure a port connected to a Cisco IP Phone to use the CoS value to classify incoming traffic and to accept voice and data priority traffic tagged with VLAN ID 0:

```
Switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# mls qos trust cos
Switch(config-if)# switchport voice vlan dot1p
Switch(config-if)# end
```

To return the port to its default setting, use the **no switchport voice vlan** interface configuration command.

Related Topics

Configuring Cisco IP Phone Voice Traffic
Cisco IP Phone Voice Traffic, on page 97

Example: Configuring the Priority of Incoming Data Frames

This example shows how to configure a port connected to a Cisco IP Phone to not change the priority of frames received from the PC or the attached device:

```
Switch# configure terminal
```

```
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# switchport priority extend trust
Switch(config-if)# end
```

To return the port to its default setting, use the **no switchport priority extend** interface configuration command.

Related Topics

Configuring the Priority of Incoming Data Frames, on page 101

Cisco IP Phone Data Traffic, on page 97

Where to Go Next

After configuring voice VLANs, you can configure the following:

- VLANs
- VLAN Trunking
- VLAN Membership Policy Server (VMPS)
- VTP

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-X Switch VLAN Management Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for Voice VLAN

Release	Modification
Cisco IOS 15.0(2)EX	This feature was introduced.

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