CHAPTER 4

Configuring VLAN Trunks

This chapter provides the following information about configuring VLAN trunks on the Cisco Industrial Ethernet 2000U Series (IE 2000U) and Connected Grid Switches, hereafter referred to as *switch*:

Note For complete syntax and usage information for the commands used in this chapter, see the documents listed in the "Related Documents" section on page 4-13.

Information About Trunks

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. The switch supports the 802.1Q industry-standard trunking encapsulation.

You can configure a trunk on a single Ethernet interface or on an EtherChannel bundle. For more information about EtherChannels, see the "Configuring EtherChannels and Link State Tracking" chapter in the *High Availability and Redundancy Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches*.

Ethernet interfaces support different trunking modes (see Table 4-1). You can set an interface as trunking or nontrunking.

- If you do not intend to trunk across links, use the **switchport mode access** interface configuration command to disable trunking.
- To enable trunking, use the **switchport mode trunk** interface configuration command to change the interface to a trunk.

Table 4-1 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. This is the default 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 mode dot1q-tunnel	Configures the interface as a tunnel (nontrunking) port to be connected in an asymmetric link with an 802.1Q trunk port. The 802.1Q tunneling is used to maintain customer VLAN integrity across a service provider network. See Chapter 10, "Configuring Layer 2 Protocol Tunneling," for more information on tunnel ports.
switchport mode private-vlan	Configure the interface as a private VLAN host or promiscuous port (only NNIs can be configured as promiscuous ports). For information about private VLANs, see Chapter 7, "Configuring Private VLANs."

Prerequisites

- Be familiar with the information in the "Information About Trunks" section on page 4-1 and "Guidelines and Limitations" section on page 4-2.
- Ensure that your network strategy and planning for your network are complete.

Guidelines and Limitations

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

- In a network of Cisco switches connected through 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 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 802.1Q switch. However, spanning-tree information for each VLAN is maintained by Cisco switches separated by a cloud of non-Cisco 802.1Q switches. The non-Cisco 802.1Q cloud separating the Cisco switches is treated as a single trunk link between the switches.
- Make sure that the native VLAN for an 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 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 802.1Q trunk or disable spanning tree on every VLAN in the network. Make sure that your network is loop-free before disabling spanning tree.

Interaction with Other Features

Trunking interacts with other features in these ways:

- A trunk port cannot be a secure port.
- A trunk port cannot be a tunnel 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.

Note STP is supported by default on NNIs, but must be enabled on ENIs. STP is not supported on UNIs.

  - trunk status: if one port in a port group ceases to be a trunk, all ports cease to be trunks.
- If you try to enable 802.1x on a trunk port, an error message appears, and 802.1x is not enabled. If you try to change the mode of an 802.1x-enabled port to trunk, the port mode is not changed.

Default Settings

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

Feature	Default Setting
Interface mode	**switchport mode access**
Allowed VLAN range	VLANs 1 to 4094
Default VLAN (for access ports)	VLAN 1
Native VLAN (for 802.1Q trunks)	VLAN 1

Configuring VLAN Trunks

This section includes the following topics:

- Configuring a Trunk Port, page 4-4
- Defining the Allowed VLANs on a Trunk, page 4-5
- Configuring the Native VLAN for Untagged Traffic, page 4-6
- Configuring Trunk Ports for Load Sharing, page 4-7

Configuring a Trunk Port

Follow this procedure to configure a a port as an 802.1Q trunk port.

BEFORE YOU BEGIN

Review the "Guidelines and Limitations" section on page 4-2.

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured for trunking, and enter interface configuration mode.
Step 3	**no shutdown**	Enable the port, if necessary. By default, UNIs and ENIs are disabled, and NNIs are enabled.
Step 4	**switchport mode trunk**	Configure the interface as a Layer 2 trunk.
Step 5	**switchport access vlan** *vlan-id*	(Optional) Specify the default VLAN, which is used if the interface stops trunking.
Step 6	**switchport trunk native vlan** *vlan-id*	Specify the native VLAN for 802.1Q trunks.
Step 7	**end**	Return to privileged EXEC mode.
Step 8	**show interfaces** *interface-id* **switchport**	Display the switchport configuration of the interface in the *Administrative Mode* field of the display.
Step 9	**show interfaces** *interface-id* **trunk**	Display the trunk configuration of the interface.
Step 10	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return an interface to its default configuration, use the **default interface** *interface-id* interface configuration command. To reset all trunking characteristics of a trunking interface to the defaults, use the **no switchport trunk** interface configuration command. To disable trunking, use the **switchport mode access** interface configuration command to configure the port as a static-access port.

EXAMPLE

This example shows how to configure a port as an 802.1Q trunk with VLAN 33 as the native VLAN:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface fastethernet0/2
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk native vlan 33
Switch(config-if)# end
```

Defining the 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 restrict the traffic a trunk carries, use the **switchport trunk allowed vlan remove** *vlan-list* interface configuration command to remove specific VLANs from the allowed list.

Note 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. The VLAN 1 minimization feature allows you 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. You do this by removing VLAN 1 from the allowed VLAN list.

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), and Link Aggregation Control Protocol (LACP) 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 is 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 and if the VLAN is in the allowed list for the port.

BEFORE YOU BEGIN

Review the "Guidelines and Limitations" section on page 4-2.

DETAILED STEPS

Beginning in privileged EXEC mode, follow these steps to modify the allowed list of an IEEE 802.1Q trunk:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**no shutdown**	Enable the port, if necessary. By default, UNIs and ENIs are disabled, and NNIs are enabled.
Step 4	**switchport mode trunk**	Configure the interface as a VLAN trunk port.

	Command	Purpose
Step 5	**switchport trunk allowed vlan** {**add** | **all** | **except** | **remove**} *vlan-list*	(Optional) Configure the list of VLANs allowed on the trunk. For explanations about using the **add**, **all**, **except**, and **remove** keywords, see the command reference for this release. The *vlan-list* parameter is either a single VLAN number from 1 to 4094 or a range of VLANs described by two VLAN 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 6	**end**	Return to privileged EXEC mode.
Step 7	**show interfaces** *interface-id* **switchport**	Verify your entries in the *Trunking VLANs Enabled* field of the display.
Step 8	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default allowed VLAN list of all VLANs, use the **no switchport trunk allowed vlan** interface configuration command.

EXAMPLE

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

```
Switch(config)# interface fastethernet0/1
Switch(config-if)# switchport trunk allowed vlan remove 2
Switch(config-if)# end
```

Configuring the Native VLAN for Untagged Traffic

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

Note The native VLAN can be assigned any VLAN ID.

For information about 802.1Q configuration issues, see the "Guidelines and Limitations" section on page 4-2.

BEFORE YOU BEGIN

Configure a trunk port as described in the "Configuring a Trunk Port" procedure on page 4-4.

DETAILED STEPS

Beginning in privileged EXEC mode, follow these steps to configure the native VLAN on an IEEE 802.1Q trunk:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Define the interface that is configured as the 802.1Q trunk, and enter interface configuration mode.
Step 3	**no shutdown**	Enable the port, if necessary. By default, UNIs and ENIs are disabled and NNIs are enabled.
Step 4	**switchport trunk native vlan** *vlan-id*	Configure the VLAN that is sending and receiving untagged traffic on the trunk port. For *vlan-id*, the range is 1 to 4094.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**show interfaces** *interface-id* **switchport**	Verify your entries in the *Trunking Native Mode VLAN* field.
Step 7	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default native VLAN, VLAN 1, use the **no switchport trunk native vlan** interface configuration command.

EXAMPLE

This example configures VLAN 100 as the native VLAN for the trunk port:

```
Switch(config)# interface fastethernet5/1
Switch(config-if)# switchport trunk native vlan 100
Switch(config-if)# end
```

Configuring Trunk Ports for Load Sharing

Load sharing divides the bandwidth supplied by parallel trunks that connect 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 the VLAN to which the traffic belongs.

You configure load sharing on trunk ports that have STP enabled 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. For more information about STP, see Chapter 11, "Configuring STP."

Load Sharing Using STP Port Priorities

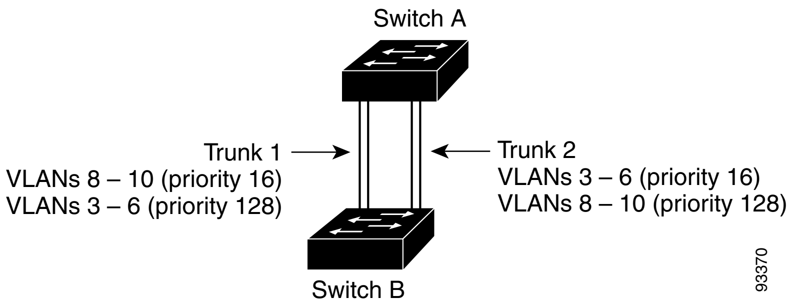
When two ports on the same switch form a loop, the switch uses the STP port priority to decide which port is enabled and which port is in a blocking state. You can set the priorities on a parallel STP trunk port so that the port carries all the traffic for a given VLAN. The trunk port with the higher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

Figure 4-1 shows two trunks connecting supported switches. In this example, the switches are configured as follows:

- 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.

In this way, 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.

Figure 4-1 Load Sharing by Using STP Port Priorities


Switch A
Trunk 1
VLANs 8 – 10 (priority 16)
VLANs 3 – 6 (priority 128)
Trunk 2
VLANs 3 – 6 (priority 16)
VLANs 8 – 10 (priority 128)
Switch B
93370

Follow this procedure on Switch A to configure the network shown in Figure 4-1. Note that you can use any interface numbers; those shown are examples only.

BEFORE YOU BEGIN

If you configure the port as an ENI, you must also enable STP on the port by entering the **spanning-tree** interface configuration command.

DETAILED STEPS

	Command	Purpose
Step 1	**show vlan**	Verify that the referenced VLANs exist on Switch A. If not, create the VLANs by entering the VLAN IDs.
Step 2	**configure terminal**	Enter global configuration mode.
Step 3	**interface gigabitethernet 0/1**	Define the interface to be configured as the Trunk 1 interface, and enter interface configuration mode.
Step 4	**port-type** {**nni** | **eni**}	Configure the interface as an NNI or ENI. UNIs do not support STP.
Step 5	**switchport mode trunk**	Configure the port as a trunk port.
Step 6	**spanning-tree vlan 8-10 port-priority 16**	Assign the port priority of 16 for VLANs 8 through 10 on Trunk 1.
Step 7	**end**	Return to privileged EXEC mode.
Step 8	**show interfaces gigabitethernet 0/1 switchport**	Verify the port configuration.
Step 9	**configure terminal**	Enter global configuration mode.

	Command	Purpose
Step 10	**interface gigabitethernet 0/2**	Define the interface to be configured as the Trunk 2 interface, and enter interface configuration mode.
Step 11	**port-type** {**nni** | **eni**}	Configure the interface as an NNI or ENI. UNIs do not support STP. If you configure the port as an ENI, you must also enable STP on the port by entering the **spanning-tree** interface configuration command.
Step 12	**switchport mode trunk**	Configure the port as a trunk port.
Step 13	**spanning-tree vlan 3-6 port-priority 16**	Assign the port priority of 16 for VLANs 3 through 6 on Trunk 2.
Step 14	**end**	Return to privileged EXEC mode.
Step 15	**show interfaces gigabitethernet 0/2 switchport**	Verify the port configuration.
Step 16	**show running-config**	Verify your entries.
Step 17	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Follow the same steps on Switch B to configure the trunk port for Trunk 1 with a spanning-tree port priority of 16 for VLANs 8 through 10, and configure the trunk port for Trunk 2 with a spanning-tree port priority of 16 for VLANs 3 through 6.

EXAMPLE

This example configures Switch A for the network shown in Figure 4-1.

```
Switch# configure terminal
Switch(config)# interface gigabitethernet 0/1
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# spanning-tree vlan 8-10 port-priority 16
Switch(config-if)# end
Switch# show interfaces gigabitethernet 0/1 switchport
.
.
.
Switch# configure terminal
Switch(config)# interface gigabitethernet 0/2
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# spanning-tree vlan 3-6 port-priority 16
Switch(config-if)# end
Switch# show interfaces gigabitethernet 0/2 switchport
.
.
.
```

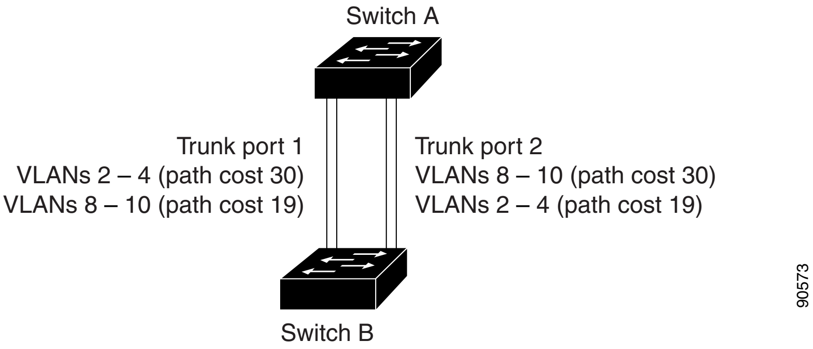
Load Sharing Using STP Path Cost

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. You can assign lower cost values to interfaces that you want selected first and higher cost values that you want selected last. (See the "Configuring Path Cost" section on page 11-22.) The VLANs keep the traffic separate and maintain redundancy in the event of a lost link.

In Figure 4-2, 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 4-2 Load-Sharing Trunks with Traffic Distributed by Path Cost


Switch A
Trunk port 1
VLANs 2 – 4 (path cost 30)
VLANs 8 – 10 (path cost 19)
Trunk port 2
VLANs 8 – 10 (path cost 30)
VLANs 2 – 4 (path cost 19)
Switch B
90573

Follow this procedure to configure the network shown in Figure 4-2.

BEFORE YOU BEGIN

If you configure the port as an ENI, you must also enable STP on the port by entering the **spanning-tree** interface configuration command.

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode on Switch A.
Step 2	**interface fastethernet0/1**	Define the interface to be configured as Trunk port 1, and enter interface configuration mode.
Step 3	**port-type** {**nni** | **eni**}	Configure the interface as an NNI or ENI. UNIs do not support STP.
Step 4	**switchport mode trunk**	Configure the port as a trunk port.
Step 5	**exit**	Return to global configuration mode.
Step 6	**interface fastethernet0/2**	Define the interface to be configured as Trunk port 2, and enter interface configuration mode.
Step 7	**port-type** {**nni** | **eni**}	Configure the interface as an NNI or ENI. UNIs do not support STP.
Step 8	**switchport mode trunk**	Configure the port as a trunk port.
Step 9	**end**	Return to privileged EXEC mode.
Step 10	**show running-config**	Verify your entries. In the display, make sure that the interfaces configured in Steps 2 and 7 are configured as trunk ports.

	Command	Purpose
Step 11	**show vlan**	Verify that VLANs 2 through 4 and 8 through 10 are configured on Switch A. If not, create these VLANs.
Step 12	**configure terminal**	Enter global configuration mode.
Step 13	**interface fastethernet0/1**	Enter interface configuration mode for Trunk port 1.
Step 14	**spanning-tree vlan 2-4 cost 30**	Set the spanning-tree path cost to 30 for VLANs 2 through 4.
Step 15	**exit**	Return to global configuration mode.
Step 16	**interface fastethernet0/2**	Enter interface configuration mode for Trunk port 2.
Step 17	**spanning-tree vlan 8-10 cost 30**	Set the spanning-tree path cost to 30 for VLANs 8 through 10.
Step 18	**end**	Return to privileged EXEC mode.
Step 19	**show running-config**	Verify your entries. In the display, verify that the path costs are set correctly for both trunk interfaces.
Step 20	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Follow the same steps on Switch B to configure the trunk port for Trunk 1 with a path cost of 30 for VLANs 2 through 4, and configure the trunk port for Trunk 2 with a path cost of 30 for VLANs 8 through 10.

EXAMPLE

This examples configures Switch A for the network shown in Figure 4-2.

```
Switch# configure terminal
Switch(config)# interface fastethernet0/1
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# exit
Switch(config)# interface fastethernet0/2
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# end
Switch# show running-config
.
.
.
Switch# show vlan
.
.
.
Switch# configure terminal
Switch(config)# interface fastethernet0/1
Switch(config-if)# spanning-tree vlan 2-4 cost 30
Switch(config-if)# exit
Switch(config)# interface fastethernet0/2
Switch(config-if)# spanning-tree vlan 8-10 cost 30
Switch(config-if)# end
Switch# show running config

.
.
.
```

Verifying Configuration

Command	Purpose
show interfaces *interface-id* **switchport**	Display the switchport configuration of the interface.
show interfaces *interface-id* **trunk**	Display the trunk configuration of the interface.
show running-config	Display interfaces configured as trunk ports.

Configuration Example

This example shows how to configure a port as an 802.1Q trunk with VLAN 33 as the native VLAN:

```
Switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)# interface fastethernet0/2
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk native vlan 33
Switch(config-if)# end
```

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

```
Switch(config)# interface fastethernet0/1
Switch(config-if)# switchport trunk allowed vlan remove 2
Switch(config-if)# end
```

This example configures VLAN 100 as the native VLAN for the trunk port:

```
Switch(config)# interface fastethernet5/1
Switch(config-if)# switchport trunk native vlan 100
Switch(config-if)# end
```

This example configures Switch A for the network shown in Figure 4-1.

```
Switch# configure terminal
Switch(config)# interface gigabitethernet 0/1
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# spanning-tree vlan 8-10 port-priority 16
Switch(config-if)# end
Switch# show interfaces gigabitethernet 0/1 switchport
.
.
.
Switch# configure terminal
Switch(config)# interface gigabitethernet 0/2
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# spanning-tree vlan 3-6 port-priority 16
Switch(config-if)# end
Switch# show interfaces gigabitethernet 0/2 switchport
.
.
.
```

This examples configures Switch A for the network shown in Figure 4-2.

```
Switch# configure terminal
Switch(config)# interface fastethernet0/1
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# exit
Switch(config)# interface fastethernet0/2
Switch(config-if)# port-type nni
Switch(config-if)# switchport mode trunk
Switch(config-if)# end
Switch# show running-config
.
.
.
Switch# show vlan
.
.
.
Switch# configure terminal
Switch(config)# interface fastethernet0/1
Switch(config-if)# spanning-tree vlan 2-4 cost 30
Switch(config-if)# exit
Switch(config)# interface fastethernet0/2
Switch(config-if)# spanning-tree vlan 8-10 cost 30
Switch(config-if)# end
Switch# show running config

.
.
.
```

Related Documents

- Cisco IOS Master Command List, All Releases
- Cisco IOS LAN Switching Command Reference
- Cisco IOS Interface and Hardware Component Command Reference
- High Availability and Redundancy Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches

Feature History

Platform	First Supported Release
IE 2000U	Cisco IOS Release 15.0(2)EH
CGS 2520 Switch	Cisco IOS Release 12.2(53)EX
Ethernet Switch Module (ESM) for CGR 2010	Cisco IOS Release 12.2(53)EX