# VLANs


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## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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 64 VLANs in VTP client, server, and transparent modes.

## Restrictions for VLANs

The following are restrictions for configuring VLANs:

- 64 VLANs is supported only on switches running the LAN Lite feature set.

- To avoid warning messages of high CPU utilization with a normal-range VLAN configuration, we recommend that you have no more than 64 VLANs. If a large number of access interfaces or trunk interfaces flap simultaneously, then CPU usage may be excessively high.

# 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. 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.

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.

The switch supports per-VLAN spanning-tree plus (PVST+) or rapid PVST+ with a maximum of 64 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.

## 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 1: 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 connected to a trunk port of a second switch. |
| Trunk (IEEE 802.1Q) :<br>• 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. |
| 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).<br>The VMPS can be a Catalyst 6500 series switch, for example, but never a Catalyst switch. The Catalyst switch is a VMPS client.<br>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.<br>Configure the VMPS and the client with the same VTP domain name.<br>To participate in VTP, at least one trunk port on the switch must be connected to a trunk port of a second switch . |
| 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.

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.
- From image 15.0(02)SE6, on vtp transparent and off modes, vlans get created from startup-config even if they are not applied to the interface.

**Note** Ensure that you delete the vlan.dat file along with the configuration files before you reset the switch configuration using **write erase** command. This ensures that the switch reboots correctly on a reset.

# Normal-Range VLAN Configuration Guidelines

Normal-range VLANs are VLANs with IDs from 1 to 1005.

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 configurations for VLANs 1 to 1005 are always saved in the VLAN database. If the VTP mode is transparent, VTP and VLAN configurations 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.)
- 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 mode.
- 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 64 spanning tree instances. If a switch has more active VLANs than supported spanning-tree instances, spanning tree can be enabled on 64 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.

### Related Topics

Creating or Modifying an Ethernet VLAN
Deleting a VLAN , on page 8
Assigning Static-Access Ports to a VLAN
Monitoring VLANs
Example: Creating a VLAN Name, on page 14

# Extended-Range VLAN Configuration Guidelines

Extended-range VLANs are VLANs with IDs from 1006 to 4094.

VTP 3 only supports extended-range VLANs.

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.
- 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.

### Related Topics

Creating an Extended-Range VLAN
Creating an Extended-Range VLAN with an Internal VLAN ID
Monitoring VLANs
Creating an Extended-Range VLAN
Example: Creating an Extended-Range VLAN, on page 14

# 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 2: Ethernet VLAN Defaults and Range*

| Parameter | Default | Range |
|---|---|---|
| VLAN ID | 1 | 1 to 4094.<br>**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 |
| IEEE 802.10 SAID | 1500 | 576-18190 |

### 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.

# 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)
- 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.

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Switch> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Switch# configure terminal` | Enters global configuration mode. |
| **Step 3** | **vlan** *vlan-id*<br>**Example:** | 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. |

| | Command or Action | Purpose |
|---|---|---|
| | `Switch(config)# vlan 20` | **Note** The available VLAN ID range for this command is 1 to 4094. |
| **Step 4** | **name** *vlan-name*<br>**Example:**<br>`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 5** | **end**<br>**Example:**<br>`Switch(config)# end` | Returns to privileged EXEC mode. |
| **Step 6** | **show vlan** {**name** *vlan-name* \| **id** *vlan-id*}<br>**Example:**<br>`Switch# show vlan name test20 id 20` | Verifies your entries. |
| **Step 7** | **copy running-config startup-config**<br>**Example:**<br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

## 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 .

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.

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:** | Enables privileged EXEC mode.<br>• Enter your password if prompted. |

| | Command or Action | Purpose |
|---|---|---|
| | `Switch> enable` | |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Switch# configure terminal` | Enters global configuration mode. |
| **Step 3** | **no vlan** *vlan-id*<br>**Example:**<br>`Switch(config)# no vlan 4` | Removes the VLAN by entering the VLAN ID. |
| **Step 4** | **end**<br>**Example:**<br>`Switch(config)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show vlan brief**<br>**Example:**<br>`Switch# show vlan brief` | Verifies the VLAN removal. |
| **Step 6** | **copy running-config startup-config**<br>**Example:**<br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

**Related Topics**

Supported VLANs
Normal-Range VLAN Configuration Guidelines, on page 4
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.

### Procedure

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br>**Example:**<br>`Switch# configure terminal` | Enters global configuration mode. |
| **Step 2** | **interface** *interface-id*<br>**Example:**<br>`Switch(config)# interface gigabitethernet 0/1` | Enters the interface to be added to the VLAN. |
| **Step 3** | **switchport mode access**<br>**Example:**<br>`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*<br>**Example:**<br>`Switch(config-if)# switchport access vlan 2` | Assigns the port to a VLAN. Valid VLAN IDs are 1 to 4094. |
| **Step 5** | **end**<br>**Example:**<br>`Switch(config)# end` | Returns to privileged EXEC mode. |
| **Step 6** | **show running-config interface** *interface-id*<br>**Example:**<br>`Switch# show running-config interface gigabitethernet 0/1` | Verifies the VLAN membership mode of the interface. |
| **Step 7** | **show interfaces** *interface-id* **switchport**<br>**Example:**<br>`Switch# show interfaces gigabitethernet 0/1 switchport` | 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 14

# 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. 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.

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br>**Example:**<br>`Switch> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br>**Example:**<br>`Switch# configure terminal` | Enters global configuration mode. |
| **Step 3** | **vtp mode transparent**<br>**Example:**<br>`Switch(config)# vtp mode transparent` | Configures the switch for VTP transparent mode, disabling VTP.<br>**Note** This step is not required for VTP version 3. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 4** | **vlan** *vlan-id*<br>**Example:**<br>`Switch(config)# vlan 2000`<br>`Switch(config-vlan)#` | Enters an extended-range VLAN ID and enters VLAN configuration mode. The range is 1006 to 4094. |
| **Step 5** | **mtu** *mtu size*<br>**Example:** | Modifies the VLAN by changing the MTU size. |
| **Step 6** | **end**<br>**Example:**<br>`Switch(config)# end` | Returns to privileged EXEC mode. |
| **Step 7** | **show vlan id** *vlan-id*<br>**Example:**<br>`Switch# show vlan id 2000` | Verifies that the VLAN has been created. |
| **Step 8** | **copy running-config startup-config**<br>**Example:**<br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

# Monitoring VLANs

***Table 3: 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. |

| Command | Purpose |
|---|---|
| **show vlan** [**brief** \| **group** [**group-name** *name*] \|**id** *vlan-id* \| **ifindex** \| **internal** \| **mtu** \| **name** *name* **summary**]] | Displays parameters for all VLANs or the specified VLAN on the switch. The following command options are available:<br>• **brief**—Displays VTP VLAN status in brief.<br>• **group**—Displays the VLAN group with its name and the connected VLANs that are available.<br>• **id**—Displays VTP VLAN status by identification number.<br>• **ifindex**—Displays SNMP ifIndex.<br>• **mtu**—Displays VLAN MTU information.<br>• **name**—Display the VTP VLAN information by specified name.<br>• **summary**—Displays a summary of VLAN information. |
| **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* \| **summary** ] | Displays parameters for all VLANs or the specified VLAN on the switch . The following command options are available:<br>• **access-log**—Displays the VACL logging.<br>• **access-map**—Displays the VLAN access-maps.<br>• **brief**—Displays VTP VLAN status in brief.<br>• **dot1q**—Displays the dot1q parameters.<br>• **filter**—Displays VLAN filter information.<br>• **group**—Displays the VLAN group with its name and the connected VLANs that are available.<br>• **id**—Displays VTP VLAN status by identification number.<br>• **ifindex**—Displays SNMP ifIndex.<br>• **mtu**—Displays VLAN MTU information.<br>• **name**—Display the VTP VLAN information by specified name.<br>• **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 4

## 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 gigabitethernet 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 9

## 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
Extended-Range VLAN Configuration Guidelines, on page 5

# Where to Go Next

After configuring VLANs, you can configure the following:

- VLAN Trunking Protocol (VTP)
- VLAN trunks