



## Configuring VLANs

---

This chapter describes how to configure your access point to operate with the VLANs set up on your wired LAN. These sections describe how to configure your access point to support VLANs:

- [Understanding VLANs, page 8-2](#)
- [Configuring VLANs, page 8-4](#)
- [VLAN Configuration Example, page 8-9](#)

# Understanding VLANs

A VLAN is a switched network that is logically segmented, by functions, project teams, or applications rather than on a physical or geographical basis. For example, all workstations and servers used by a particular workgroup team can be connected to the same VLAN, regardless of their physical connections to the network or the fact that they might be intermingled with other teams. You use VLANs to reconfigure the network through software rather than physically unplugging and moving devices or wires.

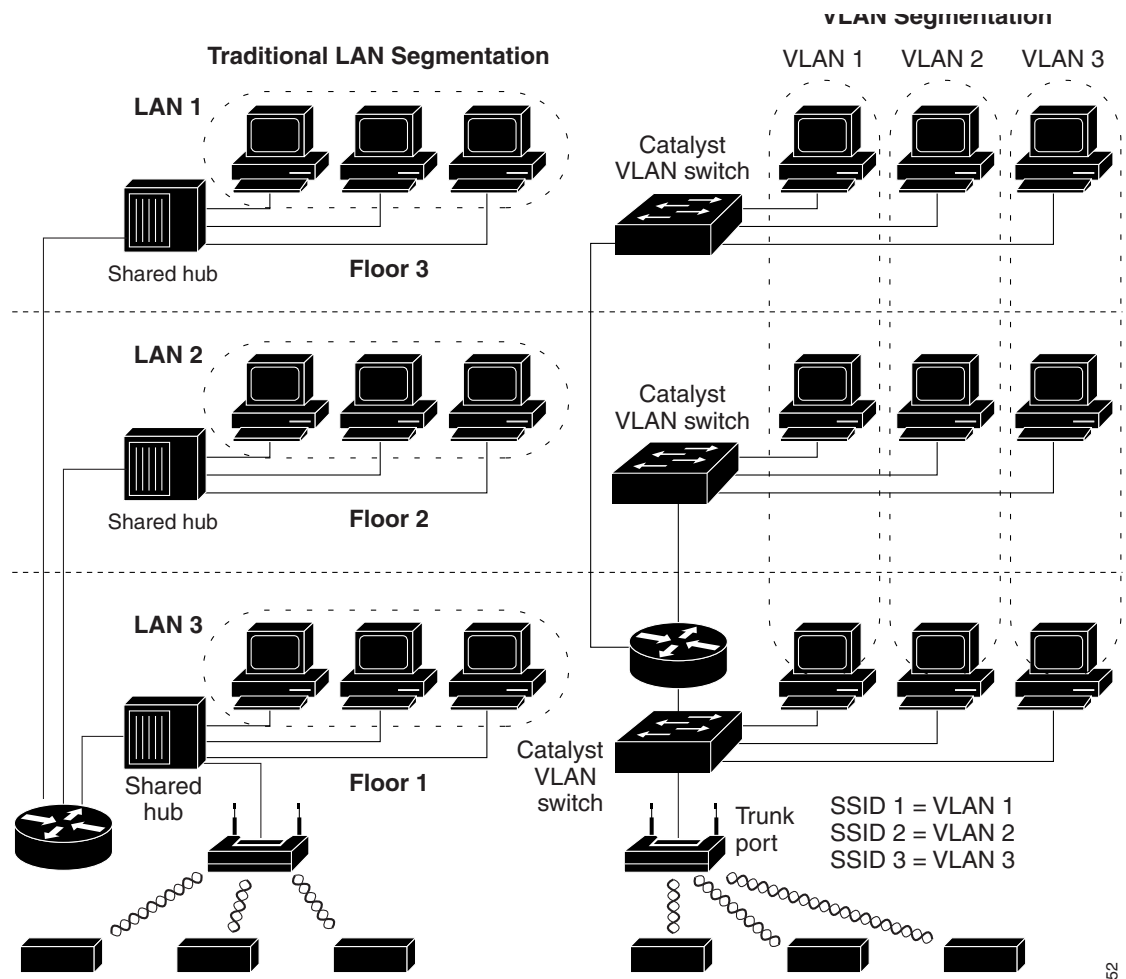
A VLAN can be thought of as a broadcast domain that exists within a defined set of switches. A VLAN consists of a number of end systems, either hosts or network equipment (such as bridges and routers), connected by a single bridging domain. The bridging domain is supported on various pieces of network equipment such as LAN switches that operate bridging protocols between them with a separate group for each VLAN.

VLANs provide the segmentation services traditionally provided by routers in LAN configurations. VLANs address scalability, security, and network management. You should consider several key issues when designing and building switched LAN networks:

- LAN segmentation
- Security
- Broadcast control
- Performance
- Network management
- Communication between VLANs

You extend VLANs into a wireless LAN by adding IEEE 802.11Q tag awareness to the access point. Frames destined for different VLANs are transmitted by the access point wirelessly on different SSIDs with different WEP keys. Only the clients associated with that VLAN receive those packets. Conversely, packets coming from a client associated with a certain VLAN are 802.11Q tagged before they are forwarded onto the wired network.

[Figure 8-1](#) shows the difference between traditional physical LAN segmentation and logical VLAN segmentation with wireless devices connected.

**Figure 8-1 LAN and VLAN Segmentation with Wireless Devices**

52

## Related Documents

These documents provide more detailed information pertaining to VLAN design and configuration:

- *Cisco IOS Switching Services Configuration Guide*. Click this link to browse to this document: [http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fswtch\\_c/index.htm](http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fswtch_c/index.htm)
- *Cisco Internetwork Design Guide*. Click this link to browse to this document: <http://www.cisco.com/univercd/cc/td/doc/cisintwk/idg4/index.htm>
- *Cisco Internetworking Technology Handbook*. Click this link to browse to this document: [http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito\\_doc/index.htm](http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/index.htm)
- *Cisco Internetworking Troubleshooting Guide*. Click this link to browse to this document: [http://www.cisco.com/univercd/cc/td/doc/cisintwk/itg\\_v1/index.htm](http://www.cisco.com/univercd/cc/td/doc/cisintwk/itg_v1/index.htm)

## Incorporating Wireless Devices into VLANs

The basic wireless components of a VLAN consist of an access point and a client associated to it using wireless technology. The access point is physically connected through a trunk port to the network VLAN switch on which the VLAN is configured. The physical connection to the VLAN switch is through the access point's Ethernet port.

In fundamental terms, the key to configuring an access point to connect to a specific VLAN is to configure its SSID to recognize that VLAN. Because VLANs are identified by a VLAN ID or name, it follows that if the SSID on an access point is configured to recognize a specific VLAN ID or name, a connection to the VLAN is established. When this connection is made, associated wireless client devices having the same SSID can access the VLAN through the access point. The VLAN processes data to and from the clients the same way that it processes data to and from wired connections. You can configure up to 16 SSIDs on your access point, so you can support up to 16 VLANs. You can assign only one SSID to a VLAN.

You can use the VLAN feature to deploy wireless devices with greater efficiency and flexibility. For example, one access point can now handle the specific requirements of multiple users having widely varied network access and permissions. Without VLAN capability, multiple access points would have to be employed to serve classes of users based on the access and permissions they were assigned.

These are two common strategies for deploying wireless VLANs:

- **Segmentation by user groups:** You can segment your wireless LAN user community and enforce a different security policy for each user group. For example, you can create three wired and wireless VLANs in an enterprise environment for full-time and part-time employees and also provide guest access.
- **Segmentation by device types:** You can segment your wireless LAN to allow different devices with different security capabilities to join the network. For example, some wireless users might have handheld devices that support only static WEP, and some wireless users might have more sophisticated devices using dynamic WEP. You can group and isolate these devices into separate VLANs.

**Note**

You cannot configure multiple VLANs on repeater access points. Repeater access points support only the native VLAN.

## Configuring VLANs

These sections describe how to configure VLANs on your access point:

- [Configuring a VLAN, page 8-5](#)
- [Assigning Names to VLANs, page 8-7](#)
- [Using a RADIUS Server to Assign Users to VLANs, page 8-7](#)
- [Viewing VLANs Configured on the Access Point, page 8-8](#)

## Configuring a VLAN



### Note

When you configure VLANs on access points, the Native VLAN must be VLAN1. In a single architecture, client traffic received by the access point is tunneled through an IP-GRE tunnel, which is established on the access point's Ethernet interface native VLAN. Because of the IP-GRE tunnel, some users may configure another switch port as VLAN1. This misconfiguration causes errors on the switch port.

Configuring your access point to support VLANs is a three-step process:

1. Enable the VLAN on the radio and Ethernet ports.
2. Assign SSIDs to VLANs.
3. Assign authentication settings to SSIDs.

This section describes how to assign SSIDs to VLANs and how to enable a VLAN on the access point radio and Ethernet ports. For detailed instructions on assigning authentication types to SSIDs, see [Chapter 6, “Configuring Authentication Types.”](#) For instructions on assigning other settings to SSIDs, see [Chapter 3, “Configuring Multiple SSIDs.”](#)

You can configure up to 16 SSIDs on the access point, so you can support up to 16 VLANs that are configured on your LAN.

Beginning in privileged EXEC mode, follow these steps to assign an SSID to a VLAN and enable the VLAN on the access point radio and Ethernet ports:

|        | Command                               | Purpose                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | <b>configure terminal</b>             | Enter global configuration mode.                                                                                                                                                                                                                                                                                                                                                                                |
| Step 2 | <b>interface dot11radio 0   1</b>     | Enter interface configuration mode for the radio interface.                                                                                                                                                                                                                                                                                                                                                     |
| Step 3 | <b>ssid <i>ssid-string</i></b>        | Create an SSID and enter SSID configuration mode for the new SSID. The SSID can consist of up to 32 alphanumeric characters. SSIDs are case sensitive.<br><br><b>Note</b> You use the <b>ssid</b> command's authentication options to configure an authentication type for each SSID. See <a href="#">Chapter 6, “Configuring Authentication Types,”</a> for instructions on configuring authentication types.  |
| Step 4 | <b>vlan <i>vlan-id</i></b>            | (Optional) Assign the SSID to a VLAN on your network. Client devices that associate using the SSID are grouped into this VLAN. Enter a VLAN ID from 1 to 4095. You can assign only one SSID to a VLAN.<br><br><b>Tip</b> If your network uses VLAN names, you can also assign names to the VLANs on your access point. See the <a href="#">“Assigning Names to VLANs”</a> section on page 8-7 for instructions. |
| Step 5 | <b>exit</b>                           | Return to interface configuration mode for the radio interface.                                                                                                                                                                                                                                                                                                                                                 |
| Step 6 | <b>interface dot11radio 0.x   1.x</b> | Enter interface configuration mode for the radio VLAN sub interface.                                                                                                                                                                                                                                                                                                                                            |

|         | Command                                                        | Purpose                                                                                                                                        |
|---------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 7  | <b>encapsulation dot1q</b> <i>vlan-id</i><br>[ <b>native</b> ] | Enable a VLAN on the radio interface.<br><br>(Optional) Designate the VLAN as the native VLAN. On many networks, the native VLAN is VLAN 1.    |
| Step 8  | <b>exit</b>                                                    | Return to global configuration mode.                                                                                                           |
| Step 9  | <b>interface fastEthernet0.x</b>                               | Enter interface configuration mode for the Ethernet VLAN subinterface.                                                                         |
| Step 10 | <b>encapsulation dot1q</b> <i>vlan-id</i><br>[ <b>native</b> ] | Enable a VLAN on the Ethernet interface.<br><br>(Optional) Designate the VLAN as the native VLAN. On many networks, the native VLAN is VLAN 1. |
| Step 11 | <b>end</b>                                                     | Return to privileged EXEC mode.                                                                                                                |
| Step 12 | <b>copy running-config startup-config</b>                      | (Optional) Save your entries in the configuration file.                                                                                        |

This example shows how to:

- Name an SSID
- Assign the SSID to a VLAN
- Enable the VLAN on the radio and Ethernet ports as the native VLAN

```

router# configure terminal
router(config)# interface dot11radio0
router(config-if)# ssid batman
router(config-ssid)# vlan 1
router(config-ssid)# exit
router(config)# interface dot11radio0.1
router(config-subif)# encapsulation dot1q 1 native
router(config-subif)# exit
router(config)# interface fastEthernet0.1
router(config-subif)# encapsulation dot1q 1 native
router(config-subif)# exit
router(config)# end

```

## Assigning Names to VLANs

You can assign a name to a VLAN in addition to its numerical ID. VLAN names can contain up to 32 ASCII characters. The access point stores each VLAN name and ID pair in a table.

### Guidelines for Using VLAN Names

Keep these guidelines in mind when using VLAN names:

- The mapping of a VLAN name to a VLAN ID is local to each access point, so across your network, you can assign the same VLAN name to a different VLAN ID.



#### Note

If clients on your wireless LAN require seamless roaming, Cisco recommends that you assign the same VLAN name to the same VLAN ID across all access points, or that you use only VLAN IDs without names.

- Every VLAN configured on your access point must have an ID, but VLAN names are optional.
- VLAN names can contain up to 32 ASCII characters. However, a VLAN name cannot be a number between 1 and 4095. For example, *vlan4095* is a valid VLAN name, but *4095* is not. The access point reserves the numbers 1 through 4095 for VLAN IDs.

### Creating a VLAN Name

Beginning in privileged EXEC mode, follow these steps to assign a name to a VLAN:

|        | Command                                                       | Purpose                                                                          |
|--------|---------------------------------------------------------------|----------------------------------------------------------------------------------|
| Step 1 | <b>configure terminal</b>                                     | Enter global configuration mode.                                                 |
| Step 2 | <b>dot11 vlan-name</b> <i>name</i> <b>vlan</b> <i>vlan-id</i> | Assign a VLAN name to a VLAN ID. The name can contain up to 32 ASCII characters. |
| Step 3 | <b>end</b>                                                    | Return to privileged EXEC mode.                                                  |
| Step 4 | <b>copy running-config startup-config</b>                     | (Optional) Save your entries in the configuration file.                          |

Use the **no** form of the command to remove the name from the VLAN. Use the **show dot11 vlan-name** privileged EXEC command to list all the VLAN name and ID pairs configured on the access point.

## Using a RADIUS Server to Assign Users to VLANs

You can configure your RADIUS authentication server to assign users or groups of users to a specific VLAN when they authenticate to the network. RADIUS-assigned VLANs are not supported when you enable multiple BSSIDs.



#### Note

Unicast and multicast cipher suites advertised in WPA information element (and negotiated during 802.11 association) may potentially mismatch with the cipher suite supported in an explicitly assigned VLAN. If the RADIUS server assigns a new vlan ID which uses a different cipher suite from the previously negotiated cipher suite, there is no way for the access point and client to switch back to the

new cipher suite. Currently, the WPA protocol does not allow the cipher suite to be changed after the initial 802.11 cipher negotiation phase. In this scenario, the client device is disassociated from the wireless LAN.

The VLAN-mapping process consists of these steps:

1. A client device associates to the access point using any SSID configured on the access point.
2. The client begins RADIUS authentication.
3. When the client authenticates successfully, the RADIUS server maps the client to a specific VLAN, regardless of the VLAN mapping defined for the SSID the client is using on the access point. If the server does not return any VLAN attribute for the client, the client is assigned to the VLAN specified by the SSID mapped locally on the access point.

These are the RADIUS user attributes used for vlan-id assignment. Each attribute must have a common tag value between 1 and 31 to identify the grouped relationship.

- IETF 64 (Tunnel Type): Set this attribute to **VLAN**
- IETF 65 (Tunnel Medium Type): Set this attribute to **802**
- IETF 81 (Tunnel Private Group ID): Set this attribute to *vlan-id*

## Viewing VLANs Configured on the Access Point

In privileged EXEC mode, use the **show vlan** command to view the VLANs that the access point supports. This is sample output from a **show vlan** command:

```
Virtual LAN ID: 1 (IEEE 802.1Q Encapsulation)
```

```
    vLAN Trunk Interfaces: Dot11Radio0
FastEthernet0
Virtual-Dot11Radio0
```

```
    This is configured as native Vlan for the following interface(s) :
Dot11Radio0
FastEthernet0
Virtual-Dot11Radio0
```

| Protocols Configured: | Address:       | Received: | Transmitted: |
|-----------------------|----------------|-----------|--------------|
| Bridging              | Bridge Group 1 | 201688    | 0            |
| Bridging              | Bridge Group 1 | 201688    | 0            |
| Bridging              | Bridge Group 1 | 201688    | 0            |

```
Virtual LAN ID: 2 (IEEE 802.1Q Encapsulation)
```

```
    vLAN Trunk Interfaces: Dot11Radio0.2
FastEthernet0.2
Virtual-Dot11Radio0.2
```

| Protocols Configured: | Address: | Received: | Transmitted: |
|-----------------------|----------|-----------|--------------|
|-----------------------|----------|-----------|--------------|

# VLAN Configuration Example

This example shows how to use VLANs to manage wireless devices on a college campus. In this example, three levels of access are available through VLANs configured on the wired network:

- Management access—Highest level of access; users can access all internal drives and files, departmental databases, top-level financial information, and other sensitive information. Management users are required to authenticate using Cisco LEAP.
- Faculty access—Medium level of access; users can access school's Intranet and Internet, access internal files, access student databases, and view internal information such as human resources, payroll, and other faculty-related material. Faculty users are required to authenticate using Cisco LEAP.
- Student access—Lowest level of access; users can access school's Intranet and the Internet, obtain class schedules, view grades, make appointments, and perform other student-related activities. Students are allowed to join the network using static WEP.

In this scenario, a minimum of three VLAN connections are required, one for each level of access. Because the access point can handle up to 16 SSIDs, you can use the basic design shown in [Table 8-1](#).

**Table 8-1** Access Level SSID and VLAN Assignment

| Level of Access | SSID  | VLAN ID |
|-----------------|-------|---------|
| Management      | boss  | 1       |
| Faculty         | teach | 2       |
| Student         | learn | 3       |

Managers configure their wireless client adapters to use SSID boss, faculty members configure their clients to use SSID teach, and students configure their wireless client adapters to use SSID learn. When these clients associate to the access point, they automatically belong to the correct VLAN.

You would complete these steps to support the VLANs in this example:

1. Configure or confirm the configuration of these VLANs on one of the switches on your LAN.
2. On the access point, assign an SSID to each VLAN.
3. Assign authentication types to each SSID.
4. Configure VLAN 1, the Management VLAN, on both the fastEthernet and dot11radio interfaces on the access point. You should make this VLAN the native VLAN.
5. Configure VLANs 2 and 3 on both the fastEthernet and dot11radio interfaces on the access point.
6. Configure the client devices.

Table 8-2 shows the commands needed to configure the three VLANs in this example.

**Table 8-2 Configuration Commands for VLAN Example**

| Configuring VLAN 1                                                                                                                                                    | Configuring VLAN 2                                                                                                                                               | Configuring VLAN 3                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>router# configure terminal router(config)# interface dot11radio 0 router(config-if)# ssid boss router(config-ssid)# vlan 01 router(config-ssid)# end</pre>       | <pre>router# configure terminal router(config)# interface dot11radio 0 router(config-if)# ssid teach router(config-ssid)# vlan 02 router(config-ssid)# end</pre> | <pre>router# configure terminal router(config)# interface dot11radio 0 router(config-if)# ssid learn router(config-ssid)# vlan 03 router(config-ssid)# end</pre> |
| <pre>router configure terminal router(config) interface FastEthernet0.1 router(config-subif) encapsulation dot1Q 1 native router(config-subif) exit</pre>             | <pre>router(config) interface FastEthernet0.2 router(config-subif) encapsulation dot1Q 2 router(config-subif) bridge-group 2 router(config-subif) exit</pre>     | <pre>router(config) interface FastEthernet0.3 router(config-subif) encapsulation dot1Q 3 router(config-subif) bridge-group 3 router(config-subif) exit</pre>     |
| <pre>router(config)# interface Dot11Radio 0.1 router(config-subif)# encapsulation dot1Q 1 native router(config-subif) bridge-group 1 router(config-subif)# exit</pre> | <pre>router(config) interface Dot11Radio 0.2 router(config-subif) encapsulation dot1Q 2 router(config-subif) bridge-group 2 router(config-subif) exit</pre>      | <pre>router(config) interface Dot11Radio 0.3 router(config-subif) encapsulation dot1Q 3 router(config-subif) bridge-group 3 router(config-subif) exit</pre>      |

Table 8-3 shows the results of the configuration commands in Table 8-2. Use the **show running** command to display the running configuration on the access point.

**Table 8-3 Results of Example Configuration Commands**

| VLAN 1 Interfaces                                                                                                                                                                                                                                                                               | VLAN 2 Interfaces                                                                                                                                                                                                                                                                        | VLAN 3 Interfaces                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>interface Dot11Radio0.1 encapsulation dot1Q 1 native no ip route-cache no cdp enable bridge-group 1 bridge-group 1 subscriber-loop-control bridge-group 1 block-unknown-source no bridge-group 1 source-learning no bridge-group 1 unicast-flooding bridge-group 1 spanning-disabled</pre> | <pre>interface Dot11Radio0.2 encapsulation dot1Q 2 no ip route-cache no cdp enable bridge-group 2 bridge-group 2 subscriber-loop-control bridge-group 2 block-unknown-source no bridge-group 2 source-learning no bridge-group 2 unicast-flooding bridge-group 2 spanning-disabled</pre> | <pre>interface Dot11Radio0.3 encapsulation dot1Q 3 no ip route-cache bridge-group 3 bridge-group 3 subscriber-loop-control bridge-group 3 block-unknown-source no bridge-group 3 source-learning no bridge-group 3 unicast-flooding bridge-group 3 spanning-disabled</pre> |
| <pre>interface FastEthernet0.1 encapsulation dot1Q 1 native no ip route-cache bridge-group 1 no bridge-group 1 source-learning bridge-group 1 spanning-disabled</pre>                                                                                                                           | <pre>interface FastEthernet0.2 encapsulation dot1Q 2 no ip route-cache bridge-group 2 no bridge-group 2 source-learning bridge-group 2 spanning-disabled</pre>                                                                                                                           | <pre>interface FastEthernet0.3 encapsulation dot1Q 3 no ip route-cache bridge-group 3 no bridge-group 3 source-learning bridge-group 3 spanning-disabled</pre>                                                                                                             |

Notice that when you configure a bridge group on the radio interface, these commands are set automatically:

```
bridge-group 2 subscriber-loop-control
bridge-group 2 block-unknown-source
no bridge-group 2 source-learning
no bridge-group 2 unicast-flooding
bridge-group 2 spanning-disabled
```

When you configure a bridge group on the FastEthernet interface, these commands are set automatically:

```
no bridge-group 2 source-learning
bridge-group 2 spanning-disabled
```

