Configuring Routing Between VLANs with IEEE 802.1Q Encapsulation

This chapter describes the required and optional tasks for configuring routing between VLANs with IEEE 802.1Q encapsulation. For a complete description of VLAN commands used in this chapter, refer to the “Cisco IOS Switching Commands” chapter in the Cisco IOS Switching Services Command Reference. For documentation of other commands that appear in this chapter, you can use the command reference master index or search online.

The IEEE 802.1Q protocol is used to interconnect multiple switches and routers and for defining VLAN topologies. IEEE 802.1Q support is currently available for Fast Ethernet interfaces.

IEEE 802.1Q Encapsulation Configuration Task List

You can configure routing between any number of VLANs in your network. This section documents the configuration tasks for each protocol supported with IEEE 802.1Q encapsulation. The basic process is the same, regardless of the protocol being routed. It involves:

- Enabling the protocol on the router.
- Enabling the protocol on the interface.
- Defining the encapsulation format as IEEE 802.1Q.
- Customizing the protocol according to the requirements for your environment.

The configuration processes documented in this chapter include the following:

- Configuring AppleTalk Routing over IEEE 802.1Q
- Configuring IP Routing over IEEE 802.1Q
- Configuring IPX Routing over IEEE 802.1Q

Configuring AppleTalk Routing over IEEE 802.1Q

AppleTalk can be routed over virtual LAN (VLAN) subinterfaces using the IEEE 802.1Q VLAN encapsulation protocol. AppleTalk Routing provides full-feature Cisco IOS software AppleTalk support on a per-VLAN basis, allowing standard AppleTalk capabilities to be configured on VLANs.
To route AppleTalk over IEEE 802.1Q between VLANs, you need to customize the subinterface to create the environment in which it will be used. Perform these tasks in the order in which they appear:

- Enabling AppleTalk Routing
- Defining the VLAN Encapsulation Format
- Configuring AppleTalk on the Subinterface

### Enabling AppleTalk Routing

To enable AppleTalk routing on IEEE 802.1Q interfaces, use the following command in global configuration mode:

```
appletalk routing [eigrp router-number]
```

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>appletalk routing</td>
<td>Enables AppleTalk routing globally.</td>
</tr>
</tbody>
</table>

**Note**
For more information on configuring AppleTalk, see the “Configuring AppleTalk” chapter in the *Cisco IOS AppleTalk and Novell IPX Configuration Guide*.

### Configuring AppleTalk on the Subinterface

After you enable AppleTalk globally and define the encapsulation format, you need to enable it on the subinterface by specifying the cable range and naming the AppleTalk zone for each interface. To enable the AppleTalk protocol on the subinterface, use the following commands in interface configuration mode:

```
Step 1
appletalk cable-range cable-range [network.node]
```

```
Step 2
appletalk zone zone-name
```

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 appletalk cable-range</td>
<td>Assigns the AppleTalk cable range and zone for the subinterface.</td>
</tr>
<tr>
<td>Step 2 appletalk zone zone-name</td>
<td>Assigns the AppleTalk zone for the subinterface.</td>
</tr>
</tbody>
</table>

### Defining the VLAN Encapsulation Format

To define the VLAN encapsulation format as IEEE 802.1Q, use the following commands in interface configuration mode:

```
Step 1 interface fastethernet slot/port.subinterface-number
```

```
Step 2 encapsulation dot1q vlan-identifier
```

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 interface fastethernet slot/port.subinterface-number</td>
<td>Specifies the subinterface the VLAN will use.</td>
</tr>
<tr>
<td>Step 2 encapsulation dot1q vlan-identifier</td>
<td>Defines the encapsulation format as IEEE 802.1Q (dot1q), and specify the VLAN identifier.</td>
</tr>
</tbody>
</table>
Configuring IP Routing over IEEE 802.1Q

IP routing over IEEE 802.1Q extends IP routing capabilities to include support for routing IP frame types in VLAN configurations using the IEEE 802.1Q encapsulation.

To route IP over IEEE 802.1Q between VLANs, you need to customize the subinterface to create the environment in which it will be used. Perform these tasks in the order in which they appear:

- Enabling IP Routing
- Defining the VLAN Encapsulation Format
- Assigning IP Address to Network Interface

Enabling IP Routing

IP routing is automatically enabled in the Cisco IOS software for routers. To reenable IP routing if it has been disabled, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ip routing</td>
<td>Enables IP routing on the router.</td>
</tr>
</tbody>
</table>

Once you have IP routing enabled on the router, you can customize the characteristics to suit your environment. If necessary, refer to the IP configuration chapters in the Cisco IOS IP and IP Routing Configuration Guide for guidelines on configuring IP.

Defining the VLAN Encapsulation Format

To define the encapsulation format as IEEE 802.1Q, use the following commands in interface configuration mode:

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>interface fastethernet slot/port.subinterface-number</td>
<td>Specifies the subinterface on which IEEE 802.1Q will be used.</td>
</tr>
<tr>
<td>Step 2</td>
<td>encapsulation dot1q vlanid</td>
<td>Defines the encapsulation format as IEEE 802.1Q (dot1q), and specify the VLAN identifier</td>
</tr>
</tbody>
</table>

Assigning IP Address to Network Interface

An interface can have one primary IP address. To assign a primary IP address and a network mask to a network interface, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ip address ip-address mask</td>
<td>Sets a primary IP address for an interface.</td>
</tr>
</tbody>
</table>

A mask identifies the bits that denote the network number in an IP address. When you use the mask to subnet a network, the mask is then referred to as a subnet mask.
Configuring IPX Routing over IEEE 802.1Q

IPX Routing over IEEE 802.1Q VLANs extends Novell NetWare routing capabilities to include support for routing Novell Ethernet_802.3 encapsulation frame types in VLAN configurations. Users with Novell NetWare environments can configure Novell Ethernet_802.3 encapsulation frames to be routed using IEEE 802.1Q encapsulation across VLAN boundaries.

To configure Cisco IOS software on a router with connected VLANs to exchange IPX Novell Ethernet_802.3 encapsulated frames, perform these tasks in the order in which they appear:

- Enabling NetWare Routing
- Defining the VLAN Encapsulation Format
- Configuring NetWare on the Subinterface

Enabling NetWare Routing

To enable IPX routing on IEEE 802.1Q interfaces, use the following command in global configuration mode:

```
ipx routing [node]
```

Purpose

Enables IPX routing globally.

Defining the VLAN Encapsulation Format

To define the encapsulation format as IEEE 802.1Q, use the following commands in interface configuration mode:

```
Step 1
interface fastethernet slot/port.subinterface-number
```

Purpose

Specifies the subinterface on which IEEE 802.1Q will be used.

```
Step 2
encapsulation dot1q vlan-identifier
```

Purpose

Defines the encapsulation format as IEEE 802.1Q and specify the VLAN identifier.

Configuring NetWare on the Subinterface

After you enable NetWare globally and define the VLAN encapsulation format, you may need to enable the subinterface by specifying the NetWare network number. Use this command in interface configuration mode:

```
ipx network network
```

Purpose

Specifies the IPX network number.
IEEE 802.1Q Encapsulation Configuration Examples

This section provides configuration examples for each of the protocols described in this feature guide. It includes these examples:

- Configuring AppleTalk over IEEE 802.1Q Example
- Configuring IP Routing over IEEE 802.1Q Example
- Configuring IPX Routing over IEEE 802.1Q Example

Configuring AppleTalk over IEEE 802.1Q Example

This configuration example shows AppleTalk being routed on VLAN 100.

```
!  appletalk routing
!  interface fastethernet 0/0.100
    encapsulation dot1q 100
    appletalk cable-range 100-100 100.1
    appletalk zone eng
!
```

Configuring IP Routing over IEEE 802.1Q Example

This configuration example shows IP being routed on VLAN 101.

```
!  ip routing
!  interface fastethernet 0/0.101
    encapsulation dot1q 101
    ip addr 10.0.0.11 255.0.0.0
!
```

Configuring IPX Routing over IEEE 802.1Q Example

This configuration example shows IPX being routed on VLAN 102.

```
!  ipx routing
!  interface fastethernet 0/0.102
    encapsulation dot1q 102
    ipx network 100
!
```
VLAN Commands

This section provides an alphabetical listing of all the VLAN commands that are new or specific to the Cisco 1751 router. All other commands used with this feature are documented in the Cisco IOS Release 12.1T command reference documents.

clear vlan statistics

To remove virtual LAN statistics from any statically or system configured entries, use the clear vlan statistics privileged EXEC command.

```
clear vlan statistics
```

Syntax Description

This command has no arguments or keywords.

Default

No default behavior or values.

Command Mode

Privileged EXEC

Example

The following example clears VLAN statistics:

```
clear vlan statistics
```

debug vlan packet

Use the debug vlan packet privileged EXEC command to display general information on virtual LAN (VLAN) packets that the router received but is not configured to support. The no form of this command disables debugging output.

```
debug vlan packet
no debug vlan packet
```

Syntax Description

This command has no arguments or keywords.

Usage Guidelines

The debug vlan packet command displays only packets with a VLAN identifier that the router is not configured to support. This command allows you to identify other VLAN traffic on the network. Virtual LAN packets that the router is configured to route or switch are counted and indicated when you use the show vlans command.
Example

The following is sample output from the `debug vlan packet` output.
```
Router# debug vlan packet
Virtual LAN packet information debugging is on
```

**encapsulation dot1q**

To enable IEEE 802.1Q encapsulation of traffic on a specified subinterface in virtual LANs, use the `encapsulation dot1q` command in subinterface configuration mode. IEEE 802.1Q is a standard protocol for interconnecting multiple switches and routers and for defining VLAN topologies.

```
encapsulation dot1q vlan-id
```

**Syntax Description**

```
vlan-id
```
Virtual LAN identifier. The allowed range is from 1 to 1000.

**Default**

Disabled

**Command Mode**

Subinterface configuration

**Usage Guidelines**

IEEE 802.1Q encapsulation is configurable on Fast Ethernet interfaces.

**Example**

The following example encapsulates VLAN traffic using the IEEE 802.1Q protocol for VLAN 100:
```
interface fastethernet 0/0.100
encapsulation dot1q 100
```

**show vlans**

To view virtual LAN (VLAN) subinterfaces, use the `show vlans` privileged EXEC command.
```
show vlans
```

**Syntax Description**

This command has no arguments or keywords.
Command Mode

Privileged EXEC

Example

The following is sample output from the show vlans command:

```
1751_2# show vlans

Virtual LAN ID:1 (IEEE 802.1Q Encapsulation)
  vLAN Trunk Interface: FastEthernet0/0

  This is configured as native Vlan for the following interface(s):
    FastEthernet0/0

     Protocols Configured:  Address:           Received:        Transmitted:

Virtual LAN ID:100 (IEEE 802.1Q Encapsulation)
  vLAN Trunk Interface: FastEthernet0/0.100

     Protocols Configured:  Address:           Received:        Transmitted:
       IP            100.0.0.2           10            10

Virtual LAN ID:2500 (IEEE 802.1Q Encapsulation)
  vLAN Trunk Interface: FastEthernet0/0.200

     Protocols Configured:  Address:           Received:        Transmitted:
       IP            200.0.0.2            5              5
```

Table 1 describes the fields shown in the display.

**Table 1  show vlans Field Descriptions**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual LAN ID</td>
<td>Domain number of the VLAN.</td>
</tr>
<tr>
<td>vLAN Trunk Interface</td>
<td>Subinterface that carries the VLAN traffic.</td>
</tr>
<tr>
<td>Protocols Configured</td>
<td>Protocols configured on the VLAN.</td>
</tr>
<tr>
<td>Address</td>
<td>Network address.</td>
</tr>
<tr>
<td>Received</td>
<td>Packets received.</td>
</tr>
<tr>
<td>Transmitted</td>
<td>Packets transmitted.</td>
</tr>
</tbody>
</table>