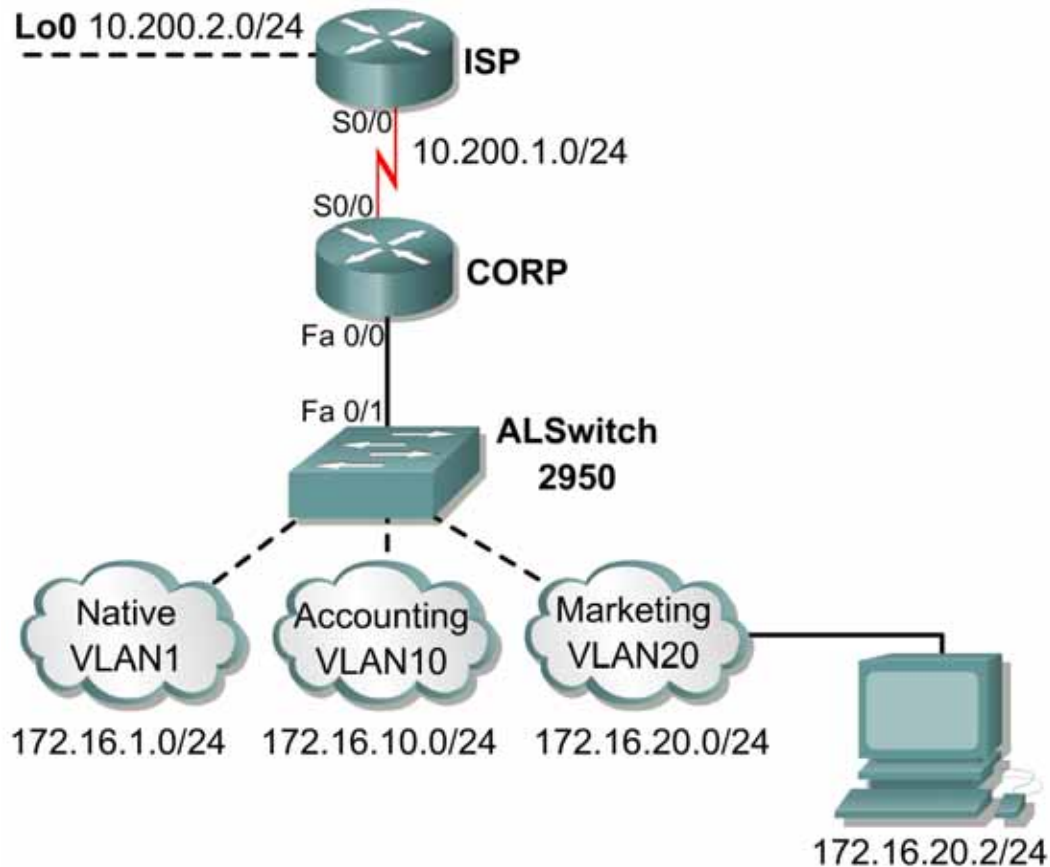


## Lab 5.1.4 Inter-VLAN Routing with an External Router



### Objective

The purpose of this lab is to configure an external router to route Inter-VLAN traffic. An external router is also called Router-on-a-Stick.

### Scenario

Network loads and management issues require the segmentation of a network from a single broadcast domain into three functional areas. This will be accomplished by implementing VLANs throughout the switched network. The VLAN names are Accounting and Marketing for the users and the default names for the native network management VLAN.

After deciding on the subnet ranges and VTP configuration, a Cisco 2600 series router will be used to implement Inter-VLAN routing. Inter-VLAN routing will allow individuals and servers on the VLANs to exchange information. The 2600 Series WAN router already facilitates a WAN connection to the ISP and a 100 Mbps Ethernet private zone. Since there is only one Ethernet connection available on a private network, the router must be configured using the Router-on-a-Stick method to support Inter-VLAN routing.

The VTP design information is as follows:

VTP Domain	VTP Mode
CORP	Server

The VLAN configuration information is as follows:

VLAN ID	VLAN Name	VLAN Subnet	VLAN Gateway	Switch Ports
1	Native	172.16.1.0	172.16.1.1/24	Fa0/1-4 Fa0/13-24
10	Accounting	172.16.10.0	172.16.10.1/24	Fa0/5-8
20	Marketing	172.16.20.0	172.16.20.1/24	FA0/9-12
Trunk				802.1Q

The 2600 Interface configuration information is as follows:

Interface	IP Address	VLAN
FastEthernet 0/0.1	172.16.1.1	1 Native
FastEthernet 0/0.10	172.16.10.1	10
FastEthernet 0/0.20	172.16.20.1	20
Serial0/0	10.200.1.2	

## Step 1

Do not cable the lab until the router configurations, switch configurations, and switch **vlan.dat** file have been erased.

Delete the vlan database if it exists on any switches and clear the configuration.

```
Switch#delete flash:vlan.dat
Delete filename [vlan.dat]?
Delete flash:vlan.dat? [confirm]
Switch#
Switch#erase startup-config
Erasing the nvram filesystem will remove all files! Continue? [confirm]
Switch#reload

System configuration has been modified. Save? [yes/no]:n
Proceed with reload? [confirm]
```

Cable the lab according to the diagram.

## Step 2

Configure ISP for communication with the CORP router.

```
Router(config)#hostname ISP
ISP(config)#interface Loopback0
ISP(config-if)#ip address 10.200.2.1 255.255.255.0
ISP(config)#interface Serial0/0
ISP(config-if)#ip address 10.200.1.1 255.255.255.0
ISP(config-if)#clockrate 56000
ISP(config-if)#no shutdown
ISP(config)#ip route 172.16.0.0 255.255.0.0 10.200.1.2
```

The ISP router is not part of the main network. The static route will provide a path back to the local network.

Configure the CORP router to communicate with the ISP router.

```
Router(config)#hostname CORP
CORP(config)#interface Serial0/0
CORP(config-if)#ip address 10.200.1.2 255.255.255.0
CORP(config-if)#no shutdown
CORP(config-if)#exit
CORP(config-if)#ip route 10.200.2.0 255.255.255.0 10.200.1.1
CORP(config)#exit
```

Verify the connectivity between ISP and CORP router.

1. How was the connectivity verified?

## Step 3

Set the duplex mode to full and enable the interface.

The router must now use the same trunking protocol to communicate with the switch. The two primary trunking protocols are the Cisco proprietary InterSwitch Link (ISL) and 802.1q, or dot1q. Dot1q trunking will be used in this lab.

```
CORP(config)#interface fastethernet 0/0
CORP(config-if)#full-duplex
CORP(config-if)#no shutdown
```

The native VLAN cannot be configured on a subinterface for Cisco IOS releases that are earlier than 12.1(3)T. The native VLAN ip address will need to be configured on the physical interface. Other VLAN traffic will be configured on subinterfaces. Cisco IOS releases 12.1(3)T and later will support native VLAN configuration on a subinterface with the **encapsulation encapsulation vlan\_id native** command. This technique will be used in the lab configuration.

Create a sub-interface for each VLAN. Enable each sub-interface with the proper trunking protocol and tie it to a particular VLAN with the **encapsulation** command.

Assign an IP address to each sub-interface that hosts on the VLAN can use for a default gateway.

VLAN 1 interface

```
CORP(config)#interface fastethernet 0/0.1
CORP(config-subif)#description Management VLAN 1
CORP(config-subif)#encapsulation dot1q 1 native
CORP(config-subif)#ip address 172.16.1.1 255.255.255.0
```

## VLAN 10 interface

```
CORP(config-subif)#interface fastethernet 0/0.10
CORP(config-subif)#description Accounting VLAN 10
CORP(config-subif)#encapsulation dot1q 10
CORP(config-subif)#ip address 172.16.10.1 255.255.255.0
```

## VLAN 20 interface

```
CORP(config-subif)#interface fastethernet 0/0.20
CORP(config-subif)#description Marketing VLAN 20
CORP(config-subif)#encapsulation dot1q 20
CORP(config-subif)#ip address 172.16.20.1 255.255.255.0
CORP(config-subif)#^Z
```

Use the **show ip interface brief** command to verify proper interface configuration and status.

```
CORP#show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	unassigned	YES	unset	up	up
FastEthernet0/0.1	172.16.1.1	YES	manual	up	up
FastEthernet0/0.10	172.16.10.1	YES	manual	up	up
FastEthernet0/0.20	172.16.20.1	YES	manual	up	up
Serial0/0	10.200.1.2	YES	manual	up	up
Serial0/1	unassigned	YES	unset	administratively down	down

```
CORP#show vlan
```

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

```
vLAN Trunk Interface: FastEthernet0/0.1
```

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

Protocols Configured:	Address:	Received:	Transmitted:
IP	172.16.1.1	15	0

```
Virtual LAN ID: 10 (IEEE 802.1Q Encapsulation)
```

```
vLAN Trunk Interface: FastEthernet0/0.10
```

Protocols Configured:	Address:	Received:	Transmitted:
IP	172.16.10.1	0	0

```
Virtual LAN ID: 20 (IEEE 802.1Q Encapsulation)
```

```
vLAN Trunk Interface: FastEthernet0/0.20
```

Protocols Configured:	Address:	Received:	Transmitted:
IP	172.16.20.1	0	0

## Step 4

Configure the hostname, password, and Telnet access for the switch.

```
Switch(config)#hostname ALSwitch
ALSwitch(config)#enable secret cisco
ALSwitch(config)#line vty 0 15
ALSwitch(config-line)#password cisco
ALSwitch(config-line)#login
```

```
ALSwitch(config-line)#exit
```

Create a virtual interface on the switch for VLAN 1 and assign an IP address. This will be the IP address for the switch. The switch will be set to 172.16.1.2 because the router gateway address is set to 172.16.1.1.

```
ALSwitch(config)#interface VLAN 1
ALSwitch(config-if)#ip address 172.16.1.2 255.255.255.0
ALSwitch(config-if)#no shutdown
ALSwitch(config-if)#exit
```

Create a default gateway that will be used to pass packets to the interface on the management VLAN router.

```
ALSwitch(config)#ip default-gateway 172.16.1.1
```

2. Why is the `ip default-gateway` command used?

## Step 5

Configure the switch for trunking and assign VLANs as specified in the table at the beginning of the lab.

Set the interface connected to the router to trunk with the router. The router is already set to trunk with the VLAN subinterfaces. The default encapsulation is 802.1Q. Therefore, the `switchport trunk encapsulation dot1q` command is not necessary.

```
ALSwitch(config)#interface fastethernet 0/1
ALSwitch(config-if)#switchport mode trunk
ALSwitch(config-if)#^Z
```

Look at the interface and CDP information to verify that the trunking is working properly.

```
ALSwitch#show interface fastethernet 0/1 switchport
```

```
ALSwitch#show interface fastethernet 0/1 switchport
```

```
Name: Fa0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
```

```
Appliance trust: none
ALSwitch#
```

```
ALSwitch#show cdp neighbors
```

```
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

Device ID         Local Intrfce   Holdtme    Capability  Platform  Port ID
CORP              Fas 0/1        127        R           2620      Fas 0/0.1
```

```
ALSwitch#show cdp entry CORP
```

```
-----
Device ID: CORP
Entry address(es):
  IP address: 172.16.1.1
Platform: cisco 2620, Capabilities: Router
Interface: FastEthernet0/1, Port ID (outgoing port): FastEthernet0/0.1
Holdtime : 162 sec

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-JK8S-M), Version 12.2(12b), RELEASE SOFTWARE (fc3)
Copyright (c) 1986-2002 by cisco Systems, Inc.
Compiled Tue 24-Dec-02 15:28 by kellythw

advertisement version: 2
Duplex: full

ALSwitch#
```

### 3. What is the IP address of the neighbor?

Place the ports in the correct VLAN and configure PortFast.

```
ALSwitch(config)#interface range fastethernet 0/5 - 8
ALSwitch(config-if)#switchport access vlan 10
ALSwitch(config-if)#spanning-tree portfast
ALSwitch(config)#interface range fastethernet 0/9 - 12
ALSwitch(config-if)#switchport access vlan 20
ALSwitch(config-if)#spanning-tree portfast

ALSwitch(config)#interface range fastethernet 0/5 - 8

ALSwitch(config-if-range)#switchport access vlan 10
% Access VLAN does not exist. Creating vlan 10

ALSwitch(config-if-range)#spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

%Portfast will be configured in 4 interfaces due to the range command
but will only have effect when the interfaces are in a non-trunking mode.

ALSwitch(config-if-range)#interface range fastethernet 0/9 - 12
```

```
ALSwitch(config-if-range)#switchport access vlan 20
```

```
% Access VLAN does not exist. Creating vlan 20
```

```
ALSwitch(config-if-range)#spanning-tree portfast
```

```
%Warning: portfast should only be enabled on ports connected to a single  
host. Connecting hubs, concentrators, switches, bridges, etc... to this  
interface when portfast is enabled, can cause temporary bridging loops.  
Use with CAUTION
```

```
%Portfast will be configured in 4 interfaces due to the range command but will only  
have effect when the interfaces are in a non-trunking mode.
```

## Step 6

Verify the configuration and host access after completing the configuration of the switch and router.

Ensure that the workstation is connected to a port on the switch that is set to VLAN 20 such as port 9. The workstation IP address should be set to 172.16.20.2/24 with a gateway of 172.16.20.1.

**Ping** the following addresses from a command prompt on the workstation.

```
C:\>ping 172.16.20.1  
C:\>ping 172.16.1.2  
C:\>ping 10.200.1.1  
C:\>ping 10.200.1.2  
C:\>ping 10.200.2.1
```

If a ping fails, return to the router and switch and take corrective action.

## Step 7

Verify that the switch can be managed from a workstation on VLAN 10 or VLAN 20. The workstation traffic must leave the VLAN at the router to connect to the switch. The router will forward the traffic to the switch management VLAN. The process is repeated in reverse for switch traffic that is destined for the workstation.

**Telnet** to the switch from the DOS command prompt on the workstation. Log in with the **cisco** password.

```
C:\>telnet 172.16.1.2
```

4. Did the Telnet work?