Lab – Configuring Per-Interface Inter-VLAN Routing (Solution)

1. Topology



1. Addressing Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Device | Interface | IP Address | Subnet Mask | Default Gateway |
| R1 | G0/0 | 192.168.20.1 | 255.255.255.0 | N/A |
|  | G0/1 | 192.168.10.1 | 255.255.255.0 | N/A |
| S1 | VLAN 10 | 192.168.10.11 | 255.255.255.0 | 192.168.10.1 |
| S2 | VLAN 10 | 192.168.10.12 | 255.255.255.0 | 192.168.10.1 |
| PC-A | NIC | 192.168.10.3 | 255.255.255.0 | 192.168.10.1 |
| PC-B | NIC | 192.168.20.3 | 255.255.255.0 | 192.168.20.1 |

1. Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Configure Switches with VLANs and Trunking

Part 3: Verify Trunking, VLANs, Routing, and Connectivity

1. Background / Scenario

Legacy inter-VLAN routing is seldom used in today’s networks; however, it is helpful to configure and understand this type of routing before moving on to router-on-a-stick (trunk-based) inter-VLAN routing or configuring Layer-3 switching. Also, you may encounter per-interface inter-VLAN routing in organizations with very small networks. One of the benefits of legacy inter-VLAN routing is ease of configuration.

In this lab, you will set up one router with two switches attached via the router Gigabit Ethernet interfaces. Two separate VLANs will be configured on the switches, and you will set up routing between the VLANs.

**Note**: This lab provides minimal assistance with the actual commands necessary to configure the router and switches. The required switch VLAN configuration commands are provided in Appendix A of this lab. Test your knowledge by trying to configure the devices without referring to the appendix.

**Note**: The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS, Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS, Release 15.0(2) (lanbasek9 image). Other routers, switches and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

**Note**: Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

1. Required Resources
* 1 Router (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
* 2 Switches (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
* 2 PCs (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
* Console cables to configure the Cisco IOS devices via the console ports
* Ethernet cables as shown in the topology
1. Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and clear any configurations, if necessary.

* 1. Cable the network as shown in the topology.
	2. Initialize and reload the router and switches.
	3. Configure basic settings for R1.
		1. Console into R1 and enter global configuration mode.
		2. Copy the following basic configuration and paste it to the running-configuration on R1.

no ip domain-lookup

hostname R1

service password-encryption

enable secret class

banner motd #

Unauthorized access is strictly prohibited. #

line con 0

password cisco

login

logging synchronous

line vty 0 4

password cisco

login

* + 1. Configure addressing on G0/0 and G0/1 and enable both interfaces.
		2. Copy the running configuration to the startup configuration.
	1. Configure basic settings on both switches.
		1. Console into the switch and enter global configuration mode.
		2. Copy the following basic configuration and paste it to running-configuration on the switch.

no ip domain-lookup

service password-encryption

enable secret class

banner motd #

Unauthorized access is strictly prohibited. #

Line con 0

password cisco

login

logging synchronous

line vty 0 15

password cisco

login

exit

* + 1. Configure the host name as shown in the topology.
		2. Copy the running configuration to the startup configuration.
	1. Configure basic settings on PC-A and PC-B.

Configure PC-A and PC-B with IP addresses and a default gateway address according to the Addressing Table.

1. Configure Switches with VLANs and Trunking

In Part 2, you will configure the switches with VLANs and trunking.

* 1. Configure VLANs on S1.
		1. On S1, create VLAN 10. Assign **Student** as the VLAN name.
		2. Create VLAN 20. Assign **Faculty-Admin** as the VLAN name.
		3. Configure F0/1 as a trunk port.
		4. Assign ports F0/5 and F0/6 to VLAN 10 and configure both F0/5 and F0/6 as access ports.
		5. Assign an IP address to VLAN 10 and enable it. Refer to the Addressing Table.
		6. Configure the default gateway according to the Addressing Table.
	2. Configure VLANs on S2.
		1. On S2, create VLAN 10. Assign **Student** as the VLAN name.
		2. Create VLAN 20. Assign **Faculty-Admin** as the VLAN name.
		3. Configure F0/1 as a trunk port.
		4. Assign ports F0/11 and F0/18 to VLAN 20 and configure both F0/11 and F0/18 as access ports.
		5. Assign an IP address to VLAN 10 and enable it. Refer to the Addressing Table.
		6. Configure the default gateway according to the Addressing Table.
1. Verify Trunking, VLANs, Routing, and Connectivity
	1. Verify the R1 routing table.
		1. On R1, issue the **show ip route** command. What routes are listed on R1?

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The 192.168.10.0/24 and 192.168.20.0/24 networks are listed on R1.

R1# **show ip route**

\*Mar 25 15:05:00.003: %SYS-5-CONFIG\_I: Configured from console by console

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

 E1 - OSPF external type 1, E2 - OSPF external type 2

 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

 ia - IS-IS inter area, \* - candidate default, U - per-user static route

 o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP

 + - replicated route, % - next hop override

Gateway of last resort is not set

 192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.10.0/24 is directly connected, GigabitEthernet0/1

L 192.168.10.1/32 is directly connected, GigabitEthernet0/1

 192.168.20.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.20.0/24 is directly connected, GigabitEthernet0/0

L 192.168.20.1/32 is directly connected, GigabitEthernet0/0

* + 1. On both S1 and S2, issue the **show interface trunk** command. Is the F0/1 port on both switches set to trunk? \_\_\_\_\_\_ Yes

S1# **show interface trunk**

Port Mode Encapsulation Status Native vlan

Fa0/1 on 802.1q trunking 1

Port Vlans allowed on trunk

Fa0/1 1-4094

Port Vlans allowed and active in management domain

Fa0/1 1,10,20

Port Vlans in spanning tree forwarding state and not pruned

Fa0/1 1,10,20

* + 1. Issue a **show vlan brief** command on both S1 and S2. Verify that VLANs 10 and 20 are active and that the proper ports on the switches are in the correct VLANs. Why is F0/1 not listed in any of the active VLANs?

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It is a trunk port and is not assigned to a VLAN.

S1# **show vlan brief**

VLAN Name Status Ports

---- -------------------------------- --------- -------------------------------

1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/7

 Fa0/8, Fa0/9, Fa0/10, Fa0/11

 Fa0/12, Fa0/13, Fa0/14, Fa0/15

 Fa0/16, Fa0/17, Fa0/18, Fa0/19

 Fa0/20, Fa0/21, Fa0/22, Fa0/23

 Fa0/24, Gi0/1, Gi0/2

10 Student active Fa0/5, Fa0/6

20 Faculty-Admin active

1002 fddi-default act/unsup

1003 token-ring-default act/unsup

1004 fddinet-default act/unsup

1005 trnet-default act/unsup

S2# **show vlan brief**

VLAN Name Status Ports

---- -------------------------------- --------- -------------------------------

1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5

 Fa0/6, Fa0/7, Fa0/8, Fa0/9

 Fa0/10, Fa0/12, Fa0/13, Fa0/14

 Fa0/15, Fa0/16, Fa0/17, Fa0/19

 Fa0/20, Fa0/21, Fa0/22, Fa0/23

 Fa0/24, Gi0/1, Gi0/2

10 Student active

20 Faculty-Admin active Fa0/11, Fa0/18

1002 fddi-default act/unsup

1003 token-ring-default act/unsup

1004 fddinet-default act/unsup

1005 trnet-default act/unsup

* + 1. Ping from PC-A in VLAN 10 to PC-B in VLAN 20. If Inter-VLAN routing is functioning correctly, the pings between the 192.168.10.0 network and the 192.168.20.0 should be successful.

**Note**: It may be necessary to disable the PC firewall to ping between PCs.

* + 1. Verify connectivity between devices. You should be able to ping between all devices. Troubleshoot if you are not successful.
1. Reflection

What is an advantage of using legacy inter-VLAN routing?

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Answers may vary. Configuration of both the router and switches is relatively easy and straightforward. No subinterfaces are required on the router and trunking does NOT have to be configured between the router and switch.

1. Router Interface Summary Table

|  |
| --- |
| Router Interface Summary |
| Router Model | Ethernet Interface #1 | Ethernet Interface #2 | Serial Interface #1 | Serial Interface #2 |
| 1800 | Fast Ethernet 0/0 (F0/0) | Fast Ethernet 0/1 (F0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 1900 | Gigabit Ethernet 0/0 (G0/0) | Gigabit Ethernet 0/1 (G0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 2801 | Fast Ethernet 0/0 (F0/0) | Fast Ethernet 0/1 (F0/1) | Serial 0/1/0 (S0/1/0) | Serial 0/1/1 (S0/1/1) |
| 2811 | Fast Ethernet 0/0 (F0/0) | Fast Ethernet 0/1 (F0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| 2900 | Gigabit Ethernet 0/0 (G0/0) | Gigabit Ethernet 0/1 (G0/1) | Serial 0/0/0 (S0/0/0) | Serial 0/0/1 (S0/0/1) |
| **Note**: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface. |

1. Appendix A: Configuration Commands
2. Switch S1

S1(config)# **vlan 10**

S1(config-vlan)# **name Student**

S1(config-vlan)# **exit**

S1(config)# **vlan 20**

S1(config-vlan)# **name Faculty-Admin**

S1(config-vlan)# **exit**

S1(config)# **interface f0/1**

S1(config-if)# **switchport mode trunk**

S1(config-if)# **interface range f0/5 – 6**

S1(config-if-range)# **switchport mode access**

S1(config-if-range)# **switchport access vlan 10**

S1(config-if-range)# **interface vlan 10**

S1(config-if)# **ip address 192.168.10.11 255.255.255.0**

S1(config-if)# **no shut**

S1(config-if)# **exit**

S1(config)# **ip default-gateway 192.168.10.1**

1. Switch S2

S2(config)# **vlan 10**

S2(config-vlan)# **name Student**

S2(config-vlan)# **exit**

S2(config)# **vlan 20**

S2(config-vlan)# **name Faculty-Admin**

S2(config-vlan)# **exit**

S2(config)# **interface f0/1**

S2(config-if)# **switchport mode trunk**

S2(config-if)# **interface f0/11**

S2(config-if)# **switchport mode access**

S2(config-if)# **switchport access vlan 20**

S2(config-if)# **interface f0/18**

S2(config-if)# **switchport mode access**

S2(config-if)# **switchport access vlan 20**

S2(config-if-range)# **interface vlan 10**

S2(config-if)#**ip address 192.168.10.12 255.255.255.0**

S2(config-if)# **no shut**

S2(config-if)# **exit**

S2(config)# **ip default-gateway 192.168.10.1**

1. Device Configs

**Note**: The VLANs configured do not display in the switch running configuration but are stored in the vlan.dat file.

1. Router R1

R1#show run

Building configuration...

Current configuration : 1640 bytes

!

version 15.2

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname R1

!

boot-start-marker

boot-end-marker

!

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

!

!

!

!

no ip domain lookup

ip cef

no ipv6 cef

!

multilink bundle-name authenticated

!

!

!

!

redundancy

!

!

!

!

!

!

!

interface Embedded-Service-Engine0/0

 no ip address

 shutdown

!

interface GigabitEthernet0/0

 ip address 192.168.20.1 255.255.255.0

 duplex auto

 speed auto

!

interface GigabitEthernet0/1

 ip address 192.168.10.1 255.255.255.0

 duplex auto

 speed auto

!

interface Serial0/0/0

 no ip address

 shutdown

 clock rate 2000000

!

interface Serial0/0/1

 no ip address

 shutdown

!

ip forward-protocol nd

!

no ip http server

no ip http secure-server

!

!

!

!

control-plane

!

!

!

line con 0

 password cisco

 login

line aux 0

line 2

 no activation-character

 no exec

 transport preferred none

 transport input all

 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh

 stopbits 1

line vty 0 4

 password cisco

 login

 transport input all

!

scheduler allocate 20000 1000

!

end

1. Switch S1

S1# show vlan brief

VLAN Name Status Ports

---- -------------------------------- --------- -------------------------------

1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/7

 Fa0/8, Fa0/9, Fa0/10, Fa0/11

 Fa0/12, Fa0/13, Fa0/14, Fa0/15

 Fa0/16, Fa0/17, Fa0/18, Fa0/19

 Fa0/20, Fa0/21, Fa0/22, Fa0/23

 Fa0/24, Gi0/1, Gi0/2

10 Student active Fa0/5, Fa0/6

20 Faculty-Admin active

1002 fddi-default act/unsup

1003 token-ring-default act/unsup

1004 fddinet-default act/unsup

1005 trnet-default act/unsup

S1#show run

Building configuration...

Current configuration : 1644 bytes

!

version 15.0

no service pad

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname S1

!

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

system mtu routing 1500

!

!

no ip domain-lookup

!

interface FastEthernet0/1

 switchport mode trunk

!

interface FastEthernet0/2

!

interface FastEthernet0/3

!

interface FastEthernet0/4

!

interface FastEthernet0/5

 switchport access vlan 10

 switchport mode access

!

interface FastEthernet0/6

 switchport access vlan 10

 switchport mode access

!

interface FastEthernet0/7

!

interface FastEthernet0/8

!

interface FastEthernet0/9

!

interface FastEthernet0/10

!

interface FastEthernet0/11

!

interface FastEthernet0/12

!

interface FastEthernet0/13

!

interface FastEthernet0/14

!

interface FastEthernet0/15

!

interface FastEthernet0/16

!

interface FastEthernet0/17

!

interface FastEthernet0/18

!

interface FastEthernet0/19

!

interface FastEthernet0/20

!

interface FastEthernet0/21

!

interface FastEthernet0/22

!

interface FastEthernet0/23

!

interface FastEthernet0/24

!

interface GigabitEthernet0/1

!

interface GigabitEthernet0/2

!

interface Vlan1

 no ip address

 shutdown

!

interface Vlan10

 ip address 192.168.10.11 255.255.255.0

!

ip default-gateway 192.168.10.1

ip http server

ip http secure-server

!

!

line con 0

 password cisco

 login

line vty 0 4

 password cisco

 login

line vty 5 15

 password cisco

 login

!

end

1. Switch S2

S2# show vlan brief

VLAN Name Status Ports

---- -------------------------------- --------- -------------------------------

1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5

 Fa0/6, Fa0/7, Fa0/8, Fa0/9

 Fa0/10, Fa0/12, Fa0/13, Fa0/14

 Fa0/15, Fa0/16, Fa0/17, Fa0/19

 Fa0/20, Fa0/21, Fa0/22, Fa0/23

 Fa0/24, Gi0/1, Gi0/2

10 Student active

20 Faculty-Admin active Fa0/11, Fa0/18

1002 fddi-default act/unsup

1003 token-ring-default act/unsup

1004 fddinet-default act/unsup

1005 trnet-default act/unsup

S2#sh run

Building configuration...

Current configuration : 1644 bytes

!

version 15.0

no service pad

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname S2

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

system mtu routing 1500

!

!

no ip domain-lookup

!

interface FastEthernet0/1

 switchport mode trunk

!

<Output Omitted>

interface FastEthernet0/10

!

interface FastEthernet0/11

 switchport access vlan 20

 switchport mode access

!

interface FastEthernet0/12

!

interface FastEthernet0/13

!

interface FastEthernet0/14

!

interface FastEthernet0/15

!

interface FastEthernet0/16

!

interface FastEthernet0/17

!

interface FastEthernet0/18

 switchport access vlan 20

 switchport mode access

!

!interface FastEthernet0/19

!

interface FastEthernet0/20

!

interface FastEthernet0/21

!

interface FastEthernet0/22

!

interface FastEthernet0/23

!

interface FastEthernet0/24

!

interface GigabitEthernet0/1

!

interface GigabitEthernet0/2

!

interface Vlan1

 no ip address

 shutdown

!

interface Vlan10

 ip address 192.168.10.12 255.255.255.0

!

ip default-gateway 192.168.10.1

ip http server

ip http secure-server

!

line con 0

line vty 0 4

 password cisco

 login

line vty 5 15

 password cisco

 login

end