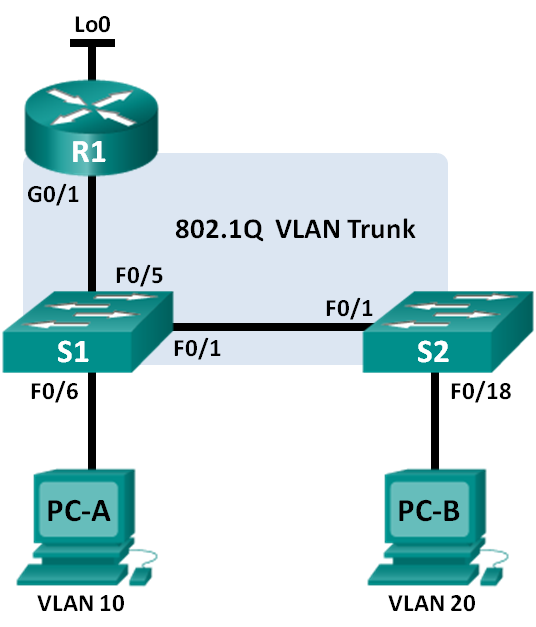
Lab – Configuring 802.1Q Trunk-Based Inter-VLAN Routing (Instructor Version – Optional Lab)

**Instructor Note**: Red font color or gray highlights indicate text that appears in the instructor copy only. Optional activities are designed to enhance understanding and/or to provide additional practice.

1. Topology



1. Addressing Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Device | Interface | IP Address | Subnet Mask | Default Gateway |
| R1 | G0/1.1 | 192.168.1.1 | 255.255.255.0 | N/A |
|  | G0/1.10 | 192.168.10.1 | 255.255.255.0 | N/A |
|  | G0/1.20 | 192.168.20.1 | 255.255.255.0 | N/A |
|  | Lo0 | 209.165.200.225 | 255.255.255.224 | N/A |
| S1 | VLAN 1 | 192.168.1.11 | 255.255.255.0 | 192.168.1.1 |
| S2 | VLAN 1 | 192.168.1.12 | 255.255.255.0 | 192.168.1.1 |
| 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 |

Switch Port Assignment Specifications

|  |  |  |
| --- | --- | --- |
| Ports | Assignment | Network |
| S1 F0/1 | 802.1Q Trunk | N/A |
| S2 F0/1 | 802.1Q Trunk | N/A |
| S1 F0/5 | 802.1Q Trunk | N/A |
| S1 F0/6 | VLAN 10 – Students | 192.168.10.0/24 |
| S2 F0/18 | VLAN 20 – Faculty | 192.168.20.0/24 |

Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Configure Switches with VLANs and Trunking

Part 3: Configure Trunk-Based Inter-VLAN Routing

1. Background / Scenario

A second method of providing routing and connectivity for multiple VLANs is through the use of an 802.1Q trunk between one or more switches and a single router interface. This method is also known as router-on-a-stick inter-VLAN routing. In this method, the physical router interface is divided into multiple subinterfaces that provide logical pathways to all VLANs connected.

In this lab, you will configure trunk-based inter-VLAN routing and verify connectivity to hosts on different VLANs as well as with a loopback on the router.

**Note**: This lab provides minimal assistance with the actual commands necessary to configure trunk-based inter-VLAN routing. However, the required 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 the 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.

**Instructor Note**: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

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 configure basic settings on the PC hosts, switches, and router.

* 1. Cable the network as shown in the topology.
  2. Configure PC hosts.
  3. Initialize and reload the router and switches as necessary.
  4. Configure basic settings for each switch.
     1. Console into the switch and enter global configuration mode.
     2. Copy the following basic configuration and paste it to the 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 device name as shown in the topology.
    2. Configure the IP address listed in the Addressing Table for VLAN 1 on the switch.
    3. Configure the default gateway on the switch.
    4. Administratively deactivate all unused ports on the switch.
    5. Copy the running configuration to the startup configuration.
  1. Configure basic settings for the router.
     1. Console into the router and enter global configuration mode.
     2. Copy the following basic configuration and paste it to the running-configuration on the router.

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 the Lo0 IP address as shown in the Address Table. Do not configure sub-interfaces at this time. They will be configured in Part 3.
    2. Copy the running configuration to the startup configuration.

1. Configure Switches with VLANs and Trunking

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

**Note**: The required commands for Part 2 are provided in Appendix A. Test your knowledge by trying to configure S1 and S2 without referring to the appendix.

* 1. Configure VLANs on S1.
     1. On S1, configure the VLANs and names listed in the Switch Port Assignment Specifications table. Write the commands you used in the space provided.

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S1(config)# **vlan 10**

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

S1(config-vlan)# **vlan 20**

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

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

* + 1. On S1, configure the interface connected to R1 as a trunk. Also configure the interface connected to S2 as a trunk. Write the commands you used in the space provided.

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S1(config)# **interface f0/5**

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

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

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

* + 1. On S1, assign the access port for PC-A to VLAN 10. Write the commands you used in the space provided.

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S1(config)# **interface f0/6**

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

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

* 1. Configure VLANs on Switch 2.
     1. On S2, configure the VLANs and names listed in the Switch Port Assignment Specifications table.
     2. On S2, verify that the VLAN names and numbers match those on S1. Write the command you used in the space provided.

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S2# **show vlan brief**

S2# **show vlan brief**

VLAN Name Status Ports

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

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

Fa0/6, 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 Students active

20 Faculty active

1002 fddi-default active

1003 token-ring-default active

1004 fddinet-default active

1005 trnet-default active

* + 1. On S2, assign the access port for PC-B to VLAN 20.
    2. On S2, configure the interface connected to S1 as a trunk.

1. Configure Trunk-Based Inter-VLAN Routing

In Part 3, you will configure R1 to route to multiple VLANs by creating subinterfaces for each VLAN. This method of inter-VLAN routing is called router-on-a-stick.

**Note**: The required commands for Part 3 are provided in Appendix A. Test your knowledge by trying to configure trunk-based or router-on-a-stick inter-VLAN routing without referring to the appendix.

* 1. Configure a subinterface for VLAN 1.
     1. Create a subinterface on R1 G0/1 for VLAN 1 using 1 as the subinterface ID. Write the command you used in the space provided.

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R1(config)# **interface g0/1.1**

* + 1. Configure the subinterface to operate on VLAN 1. Write the command you used in the space provided.

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R1(config-subif)# **encapsulation dot1Q 1**

* + 1. Configure the subinterface with the IP address from the Address Table. Write the command you used in the space provided.

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R1(config-subif)# **ip address 192.168.1.1 255.255.255.0**

* 1. Configure a subinterface for VLAN 10.
     1. Create a subinterface on R1 G0/1 for VLAN 10 using 10 as the subinterface ID.
     2. Configure the subinterface to operate on VLAN 10.
     3. Configure the subinterface with the address from the Address Table.
  2. Configure a subinterface for VLAN 20.
     1. Create a subinterface on R1 G0/1 for VLAN 20 using 20 as the subinterface ID.
     2. Configure the subinterface to operate on VLAN 20.
     3. Configure the subinterface with the address from the Address Table.
  3. Enable the G0/1 interface.

Enable the G0/1 interface. Write the commands you used in the space provided.

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R1(config)# **interface g0/1**

R1(config-if)# **no shutdown**

* 1. Verify connectivity.

Enter the command to view the routing table on R1. What networks are listed?

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192.168.1.0, 192.168.10.0, 192.168.20.0, and 209.165.200.224

R1# **show ip route**

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, E - EGP

i - IS-IS, 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

Gateway of last resort is not set

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks

C 192.168.1.0/24 is directly connected, GigabitEthernet0/1.1

L 192.168.1.1/32 is directly connected, GigabitEthernet0/1.1

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

C 192.168.10.0/24 is directly connected, GigabitEthernet0/1.10

L 192.168.10.1/32 is directly connected, GigabitEthernet0/1.10

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

C 192.168.20.0/24 is directly connected, GigabitEthernet0/1.20

L 192.168.20.1/32 is directly connected, GigabitEthernet0/1.20

209.165.200.0/24 is variably subnetted, 2 subnets, 2 masks

C 209.165.200.224/27 is directly connected, Loopback0

L 209.165.200.225/32 is directly connected, Loopback0

From PC-A, is it possible to ping the default gateway for VLAN 10? \_\_\_\_\_ Yes

From PC-A, is it possible to ping PC-B? \_\_\_\_\_ Yes

From PC-A, is it possible to ping Lo0? \_\_\_\_\_ Yes

From PC-A, is it possible to ping S2? \_\_\_\_\_ Yes

If the answer is **no** to any of these questions, troubleshoot the configurations and correct any errors.

1. Reflection

What are the advantages of trunk-based or router-on-a-stick inter-VLAN routing?

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Router-on-a-stick inter-VLAN routing allows for one interface to route to multiple VLANs unlike the legacy inter-VLAN method which requires one port per VLAN.

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. | | | | |

Appendix A – Configuration Commands

1. Switch S1

S1(config)# **vlan 10**

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

S1(config-vlan)# **vlan 20**

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

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

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

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

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

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

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

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

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

1. Switch S2

S2(config)# **vlan 10**

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

S2(config-vlan)# **vlan 20**

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

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

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

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

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

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

1. Router R1

R1(config)# **interface g0/1.1**

R1(config-subif)# **encapsulation dot1Q 1**

R1(config-subif)# **ip address 192.168.1.1 255.255.255.0**

R1(config-subif)# **interface g0/1.10**

R1(config-subif)# **encapsulation dot1Q 10**

R1(config-subif)# **ip address 192.168.10.1 255.255.255.0**

R1(config-subif)# **interface g0/1.20**

R1(config-subif)# **encapsulation dot1Q 20**

R1(config-subif)# **ip address 192.168.20.1 255.255.255.0**

R1(config-subif)# **exit**

R1(config)# **interface g0/1**

R1(config-if)# **no shutdown**

Device Configs

**Instructor Note**: The VLANs configured do not display in the switch running configuration but are stored in the vlan.dat file. The output from the **show vlan brief** command is provided.

1. Router R1

R1# show run

Building configuration...

Current configuration : 1731 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 Loopback0

ip address 209.165.200.225 255.255.255.224

!

interface Embedded-Service-Engine0/0

no ip address

shutdown

!

interface GigabitEthernet0/0

no ip address

shutdown

duplex auto

speed auto

!

interface GigabitEthernet0/1

no ip address

duplex auto

speed auto

!

interface GigabitEthernet0/1.1

encapsulation dot1Q 1

ip address 192.168.1.1 255.255.255.0

!

interface GigabitEthernet0/1.10

encapsulation dot1Q 10

ip address 192.168.10.1 255.255.255.0

!

interface GigabitEthernet0/1.20

encapsulation dot1Q 20

ip address 192.168.20.1 255.255.255.0

!

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

logging synchronous

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, Fa0/5

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 Students active Fa0/6

20 Faculty 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 : 1627 bytes

!

version 15.0

no service pad

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname S1

!

boot-start-marker

boot-end-marker

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

system mtu routing 1500

!

!

no ip domain-lookup

!

!

!

!

!

!

!

!

spanning-tree mode pvst

spanning-tree extend system-id

!

vlan internal allocation policy ascending

!

!

!

!

!

!

interface FastEthernet0/1

switchport mode trunk

!

interface FastEthernet0/2

shutdown

!

interface FastEthernet0/3

shutdown

!

interface FastEthernet0/4

shutdown

!

interface FastEthernet0/5

switchport mode trunk

!

interface FastEthernet0/6

switchport access vlan 10

switchport mode access

!

interface FastEthernet0/7

shutdown

!

interface FastEthernet0/8

shutdown

!

interface FastEthernet0/9

shutdown

!

interface FastEthernet0/10

shutdown

!

interface FastEthernet0/11

shutdown

!

interface FastEthernet0/12

shutdown

!

interface FastEthernet0/13

shutdown

!

interface FastEthernet0/14

shutdown

!

interface FastEthernet0/15

shutdown

!

interface FastEthernet0/16

shutdown

!

interface FastEthernet0/17

shutdown

!

interface FastEthernet0/18

shutdown

!

interface FastEthernet0/19

shutdown

!

interface FastEthernet0/20

shutdown

!

interface FastEthernet0/21

shutdown

!

interface FastEthernet0/22

shutdown

!

interface FastEthernet0/23

shutdown

!

interface FastEthernet0/24

shutdown

!

interface GigabitEthernet0/1

shutdown

!

interface GigabitEthernet0/2

shutdown

!

interface Vlan1

ip address 192.168.1.11 255.255.255.0

!

ip default-gateway 192.168.1.1

ip http server

ip http secure-server

!

!

!

line con 0

password cisco

logging synchronous

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, Fa0/11, 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 Students active

20 Faculty active Fa0/18

1002 fddi-default act/unsup

1003 token-ring-default act/unsup

1004 fddinet-default act/unsup

1005 trnet-default act/unsup

S2# show run

Building configuration...

Current configuration : 1633 bytes

!

version 15.0

no service pad

service timestamps debug datetime msec

service timestamps log datetime msec

no service password-encryption

!

hostname S2

!

boot-start-marker

boot-end-marker

!

enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2

!

no aaa new-model

system mtu routing 1500

!

!

no ip domain-lookup

!

!

!

!

!

!

!

!

spanning-tree mode pvst

spanning-tree extend system-id

!

vlan internal allocation policy ascending

!

!

!

!

!

!

interface FastEthernet0/1

switchport mode trunk

!

interface FastEthernet0/2

shutdown

!

interface FastEthernet0/3

shutdown

!

interface FastEthernet0/4

shutdown

!

interface FastEthernet0/5

shutdown

!

interface FastEthernet0/6

shutdown

!

interface FastEthernet0/7

shutdown

!

interface FastEthernet0/8

shutdown

!

interface FastEthernet0/9

shutdown

!

interface FastEthernet0/10

shutdown

!

interface FastEthernet0/11

shutdown

!

interface FastEthernet0/12

shutdown

!

interface FastEthernet0/13

shutdown

!

interface FastEthernet0/14

shutdown

!

interface FastEthernet0/15

shutdown

!

interface FastEthernet0/16

shutdown

!

interface FastEthernet0/17

shutdown

!

interface FastEthernet0/18

switchport access vlan 20

switchport mode access

!

interface FastEthernet0/19

shutdown

!

interface FastEthernet0/20

shutdown

!

interface FastEthernet0/21

shutdown

!

interface FastEthernet0/22

shutdown

!

interface FastEthernet0/23

shutdown

!

interface FastEthernet0/24

shutdown

!

interface GigabitEthernet0/1

shutdown

!

interface GigabitEthernet0/2

shutdown

!

interface Vlan1

ip address 192.168.1.12 255.255.255.0

!

ip default-gateway 192.168.1.1

ip http server

ip http secure-server

!

!

line con 0

password cisco

logging synchronous

login

line vty 0 4

password cisco

login

line vty 5 15

password cisco

login

!

end