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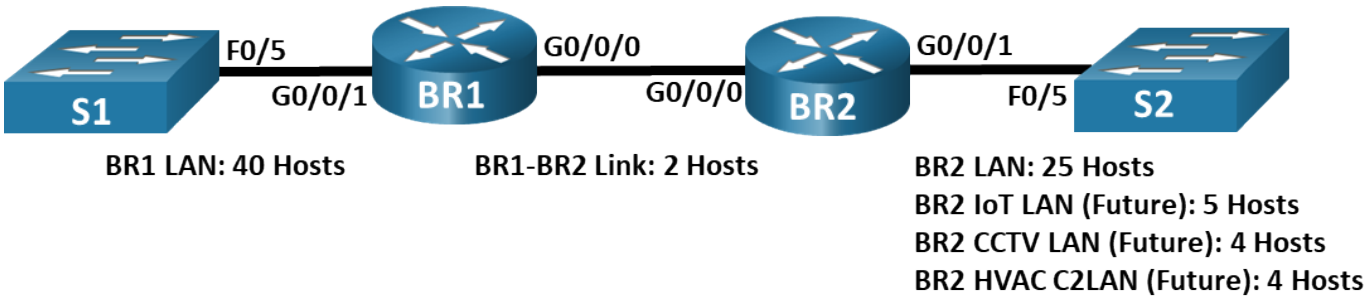
Lab - Design and Implement a VLSM Addressing Scheme

Topology



Objectives

Part 1: Examine Network Requirements

Part 2: Design the VLSM Address Scheme

Part 3: Cable and Configure the IPv4 Network

Background / Scenario

Variable Length Subnet Mask (VLSM) was designed to avoid wasting IP addresses. With VLSM, a network is subnetted and then re-subnetted. This process can be repeated multiple times to create subnets of various sizes based on the number of hosts required in each subnet. Effective use of VLSM requires address planning.

In this lab, use the 192.168.33.128/25 network address to develop an address scheme for the network displayed in the topology diagram. VLSM is used to meet the IPv4 addressing requirements. After you have designed the VLSM address scheme, you will configure the interfaces on the routers with the appropriate IP address information. The future LANS at BR2 will need to have addresses allocated, but no interfaces will be configured at this time.

Note: The routers used with CCNA hands-on labs are Cisco 4221 with Cisco IOS XE Release 16.9.4 (universalk9 image). The switches used in the labs are Cisco Catalyst 2960s with Cisco IOS Release 15.2(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 the 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 have been erased and have no startup configurations. If you are unsure, contact your instructor.

Required Resources

- 2 Routers (Cisco 4221 with Cisco IOS XE Release 16.9.4 universal image or comparable)

- 2 Switches (Cisco 2960 with Cisco IOS Release 15.2(2) lanbasek9 image or comparable)
- 1 PCs (Windows with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology
- Windows Calculator (optional)

Instructions

Part 1: Examine Network Requirements

In Part 1, you will examine the network requirements to develop a VLSM address scheme for the network displayed in the topology diagram using the 192.168.33.128/25 network address.

Note: You can use the Windows Calculator application and search the internet for an IP subnet calculator to help with your calculations.

Step 1: Determine how many host addresses and subnets are available.

Questions:

How many host addresses are available in a /25 network?

2^7 – 2 = 126 usable host addresses

What is the total number of host addresses needed in the topology diagram?

80 hosts are needed

How many subnets are needed in the network topology?

6 subnets are needed

Step 2: Determine the largest subnet.

Questions:

What is the subnet description (e.g. BR1 LAN or BR1-BR2 link)?

BR1 LAN : 40 Hosts, BR1-BR2 Link: 2 Hosts

How many IP addresses are required in the largest subnet?

40 Hosts

What subnet mask can support that many host addresses?

/26

How many total host addresses can that subnet mask support?

62 usable host addresses (2^6 – 2 = 62)

Can you subnet the 192.168.33.128/25 network address to support this subnet?

Yes.

What are the network addresses that would result from this subnetting?

Network ID = 192.168.33.128 Usable Host Range = 192.168.33.129-192.168.33.190 Broadcast ID = 192.168.33.191

Use the first network address for this subnet.

Step 3: Determine the second largest subnet.

Questions:

What is the subnet description?

BR2 LAN: 25 Hosts

How many IP addresses are required for the second largest subnet?

At least 25, using /27 can support 30 total usable hosts.

What subnet mask can support that many host addresses?

/27

How many total host addresses can that subnet mask support?

30 total usable hosts.

Can you subnet the remaining subnet again and still support this subnet?

No, the next host would require a subnet of /29.

What are the network addresses that would result from this subnetting?

Network ID= 192.168.33.192 Usable Host Range: 192.168.33.193-192.168.33.222 Broadcast ID= 192.168.33.223

Use the first network address for this subnet.

Step 4: Determine the third largest subnet.

Questions:

What is the subnet description?

BRT IoT Lan (Future): 5 Hosts

How many IP addresses are required for the next largest subnet?

At least 5 hosts.

What subnet mask can support that many host addresses?

/29

How many total host addresses can that subnet mask support?

6 total usable hosts

Can you subnet the remaining subnet again and still support this subnet?

Yes

What are the network addresses that would result from this subnetting?

Network ID= 192.168.33.224 Usable Host Range= 192.168.33.225-192.168.33.230 Broadcast ID=192.168.33.231

Use the first network address for this subnet.

Use the second network address for the CCTV LAN.

Use the third network address for the HVAC C2 LAN.

Step 5: Determine the fourth largest subnet.

Questions:

What is the subnet description?

BRT1-BRT2 Link : 2 Hosts

How many IP addresses are required for the next largest subnet?

At least 2

What subnet mask can support that many host addresses?

/30

How many total host addresses can that subnet mask support?

2 Total Usable Hosts

Can you subnet the remaining subnet again and still support this subnet?

No

What are the network addresses that would result from this subnetting?

Network ID= 192.168.33.248 Usable Host Range: 192.168.33.249-192.168.33.250 Broadcast ID = 192.168.33.251

Use the first network address for this subnet.

Part 2: Design the VLSM Address Scheme

Step 1: Calculate the subnet information.

Use the information that you obtained in Part 1 to fill in the following table.

Subnet Description	Number of Hosts Needed	Network Address /CIDR	First Host Address	Broadcast Address
BR1 LAN	40	**192.168.33.128**	**192.168.33.129**	**192.168.33.191**
BR2 LAN	25	**192.168.33.192**	**192.168.33.193**	**192.168.33.223**
BR2 IoT LAN	5	**192.168.33.224**	**192.168.33.225**	**192.168.33.231**
BR2 CCTV LAN	4	**192.168.33.232**	**192.168.33.233**	**192.168.33.239**
BR2 HVAC C2LAN	4	**192.168.33.240**	**192.168.33.241**	**192.168.33.247**
BR1-BR2 Link	2	**192.168.33.248**	**192.168.33.249**	**192.168.33.251**

Step 2: Complete the device interface address table.

Assign the first host address in the subnet to the Ethernet interfaces. BR1 should be assigned the first host address in the BR1-BR2 Link.

Device	Interface	IP Address	Subnet Mask	Device Interface
BR1	G0/0/0	192.168.33.249	255.255.255.252	BR1-BR2 Link
BR1	G0/0/1	192.168.33.129	255.255.255.192	40 Host LAN
BR2	G0/0/0	192.168.33.250	255.255.255.252	BR1-BR2 Link
BR2	G0/0/1	192.168.33.193	255.255.255.224	25 Host LAN

Part 3: Cable and Configure the IPv4 Network

In Part 3, you will cable the network to match the topology and configure the three routers using the VLSM address scheme that you developed in Part 2.

Step 1: Cable the network as shown in the topology.

Step 2: Configure basic settings on each router.

Open a configuration window

a. Assign the device name to the routers.

While in global config mode, hostname BR1

b. Disable DNS lookup to prevent the routers from attempting to translate incorrectly entered commands as though they were hostnames.

No ip domain-lookup

c. Assign **class** as the privileged EXEC encrypted password for both routers.

While in conf t, enable secret class

Service password-encryption

d. Assign **cisco** as the console password and enable login for the routers.

Line console 0, password cisco, login

e. Assign **cisco** as the VTY password and enable login for the routers.

Line vty 0 15, password cisco, login

f. Encrypt the plaintext passwords for the routers.

Service password-encryption

g. Create a banner that will warn anyone accessing the device that unauthorized access is prohibited on both routers.

Banner motd #Unauthorized access is prohibited#

Step 3: Configure the interfaces on each router.

a. Assign an IP address and subnet mask to each interface using the table that you completed in Part 2.

Interface fastEthernet 0/0, interface fastEthernet 0/1, ip address <ip address> <subnet> no shutdown

b. Configure an interface description for each interface.

Description <name of interface>

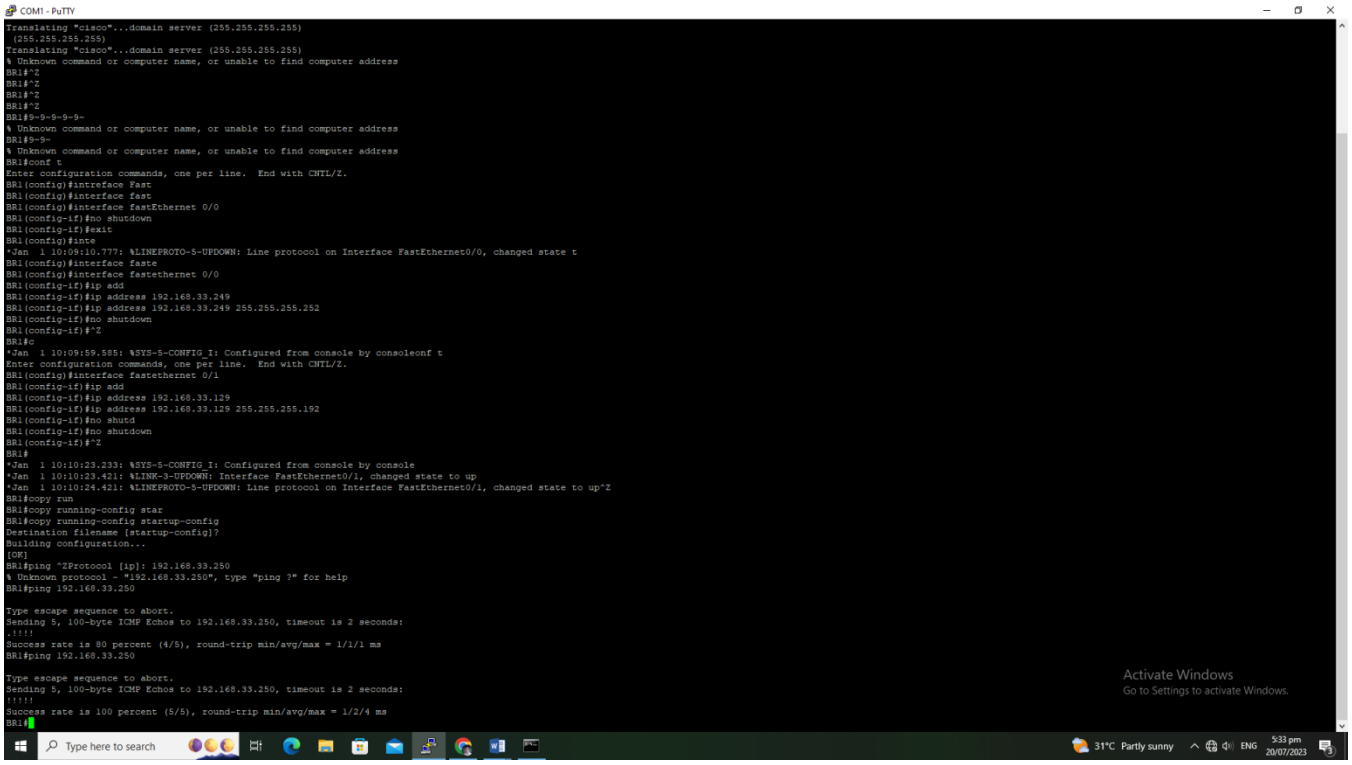
c. Activate the interfaces.

No shutdown

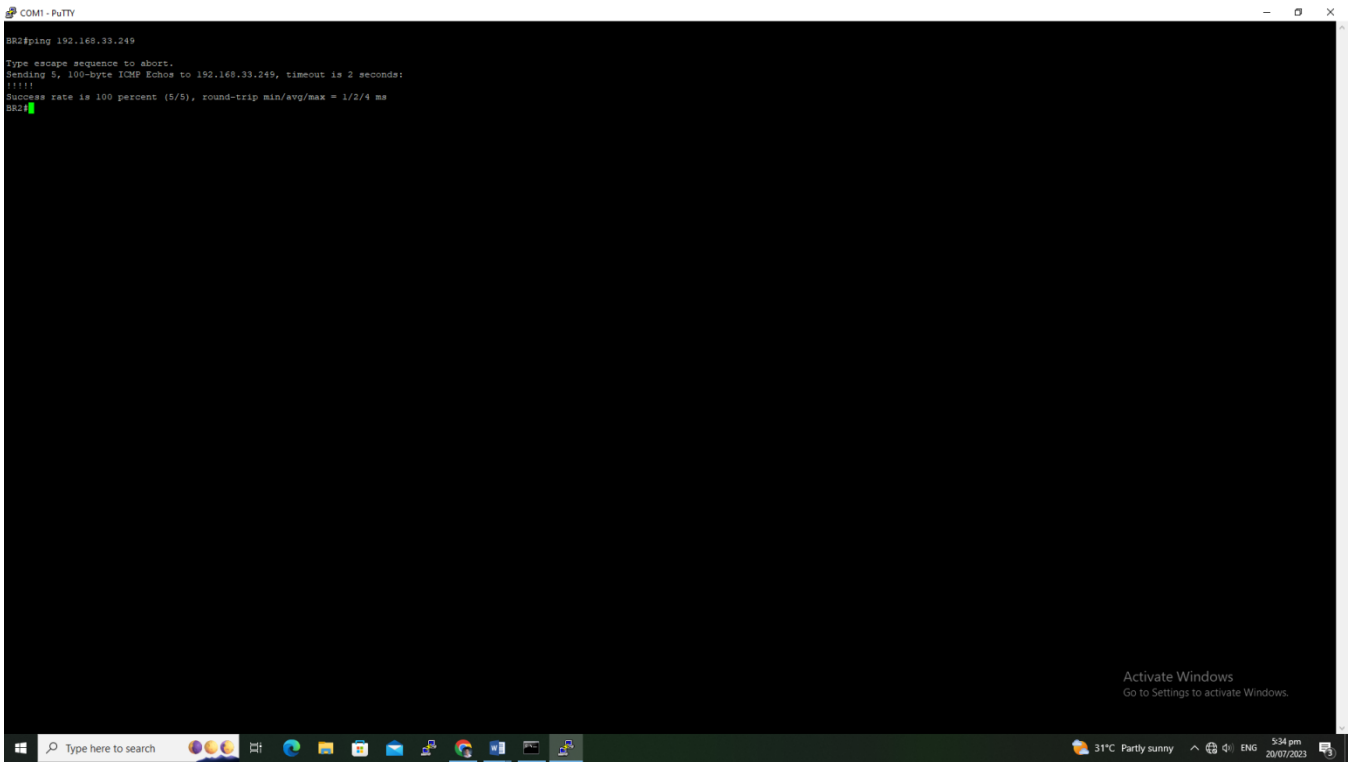
Step 4: Save the configuration on all devices.

Step 5: Test Connectivity.

a. From BR1, ping BR2's G0/0/0 interface.



b. From BR2, ping BR1's G0/0/0 interface.



c. Troubleshoot connectivity issues if pings were not successful.

Close a configuration window

Note: Pings to the GigabitEthernet LAN interfaces on other routers will not be successful. A routing protocol needs to be in place for other devices to be aware of those subnets. The GigabitEthernet interfaces also need

to be in an up/up state before a routing protocol can add the subnets to the routing table. The focus of this lab is on VLSM and configuring the interfaces.

Reflection Question

Can you think of a shortcut for calculating the network addresses of consecutive /30 subnets?

32-30 = 2, 2^2 = number of total hosts, assign first ip address to network id, last ip address to broadcast id, the rest to usable host range.

Router Interface Summary Table

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)
4221	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
4300	Gigabit Ethernet 0/0/0 (G0/0/0)	Gigabit Ethernet 0/0/1 (G0/0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)

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.

End of document