Department of Computer Science and Engineering
Islamic University of Technology (IUT)
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Lab Report 02

CSE 4512: Computer Networks Lab

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Title: Understanding the basics of IP subnetting and Variable Length Subnet Mask (VLSM) and to know Secure Shell (SSH) and Telnet basics.

Objectives:

TASK #01:

1. Understand the basics of IP Subnetting
2. Learn to subnet a network following given specifications
3. Understand Variable Length Subnet Mask (VLSM) addressing scheme
4. Learn to design and implement VLSM in a network
5. Get to know Secure Shell (SSH) and Telnet basics

TASK #02:

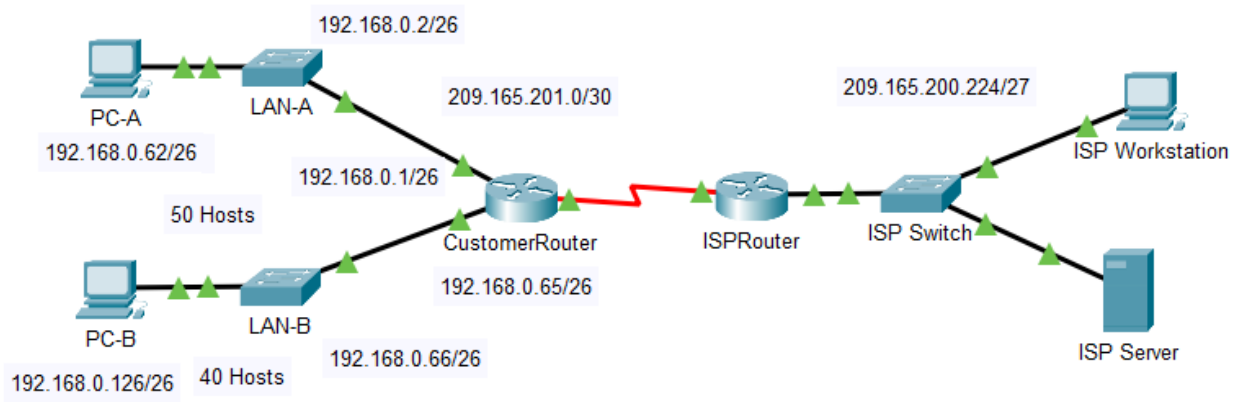
1. Examine Network Requirements
2. Design the VLSM Address Scheme
3. Cable and Configure the IPv4 Network

TASK #03:

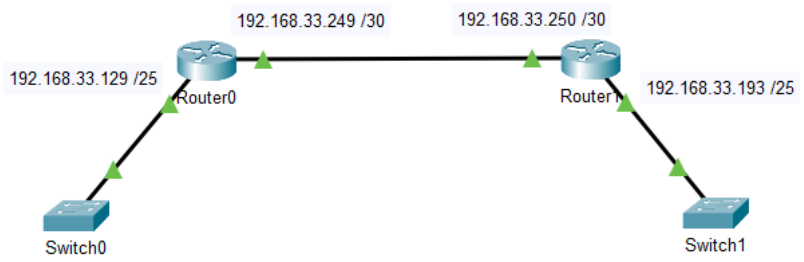
1. Configure Basic Telnet and SSH

Diagram of the experiment:

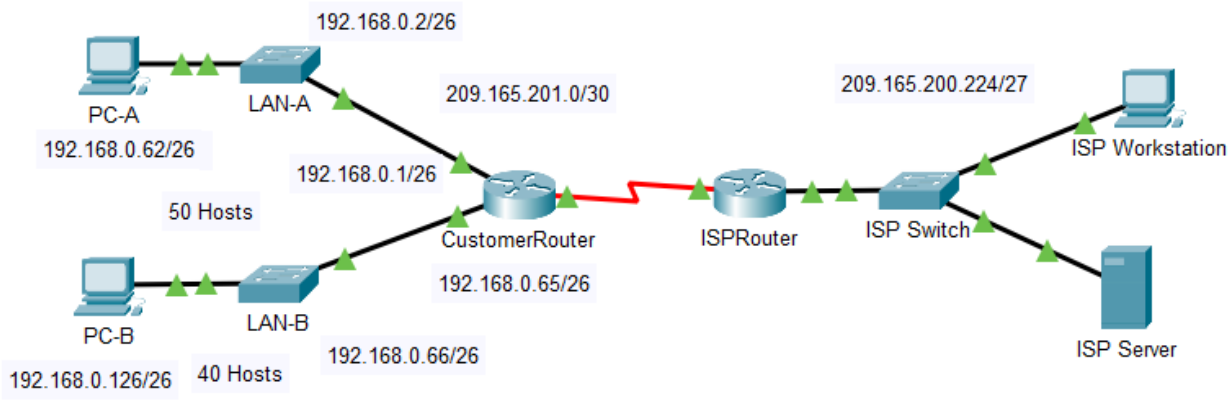
TASK #01:



TASK #02:



TASK #03:

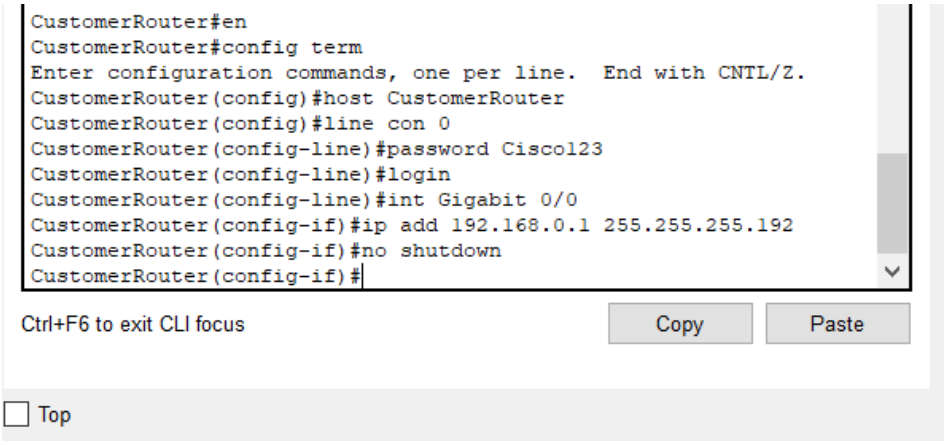


Working Procedure:

TASK #01:

1. Firstly, I answered all the lab questions related to task-1 and filled up the table which gave me the necessary subnet masks, IP addresses and default gateway.
2. Then, I double clicked on the router, went to the CLI tab and configured it according to the given commands by changing hostname, enabling password for both router login and console login, and then configuring the interfaces.

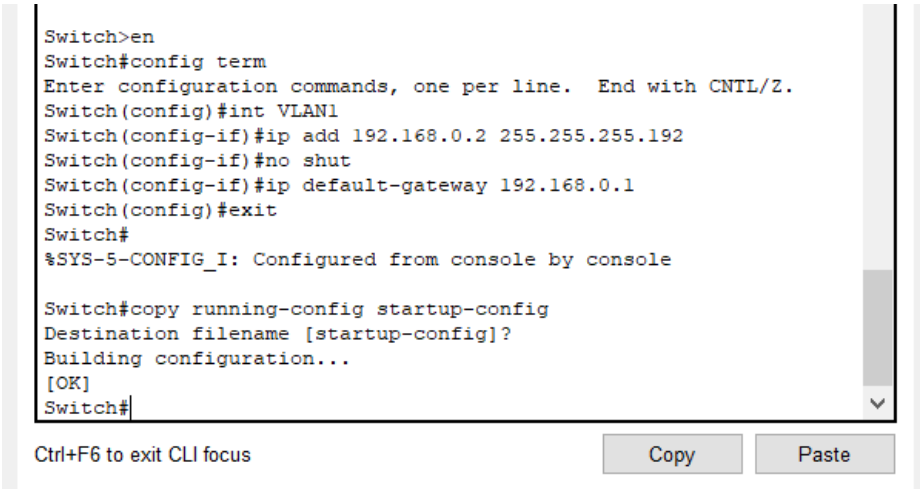
```
router(config) #host CustomerRouter
CustomerRouter(config) #enable secret Class123
CustomerRouter(config) #line con 0
CustomerRouter(config-line) #password Cisco123
CustomerRouter(config-line) #login
```



3. The router was configured for all three networking interfaces with the IP address and masks found in the table. The interfaces were enabled and then the config file was saved to the startup configuration file.

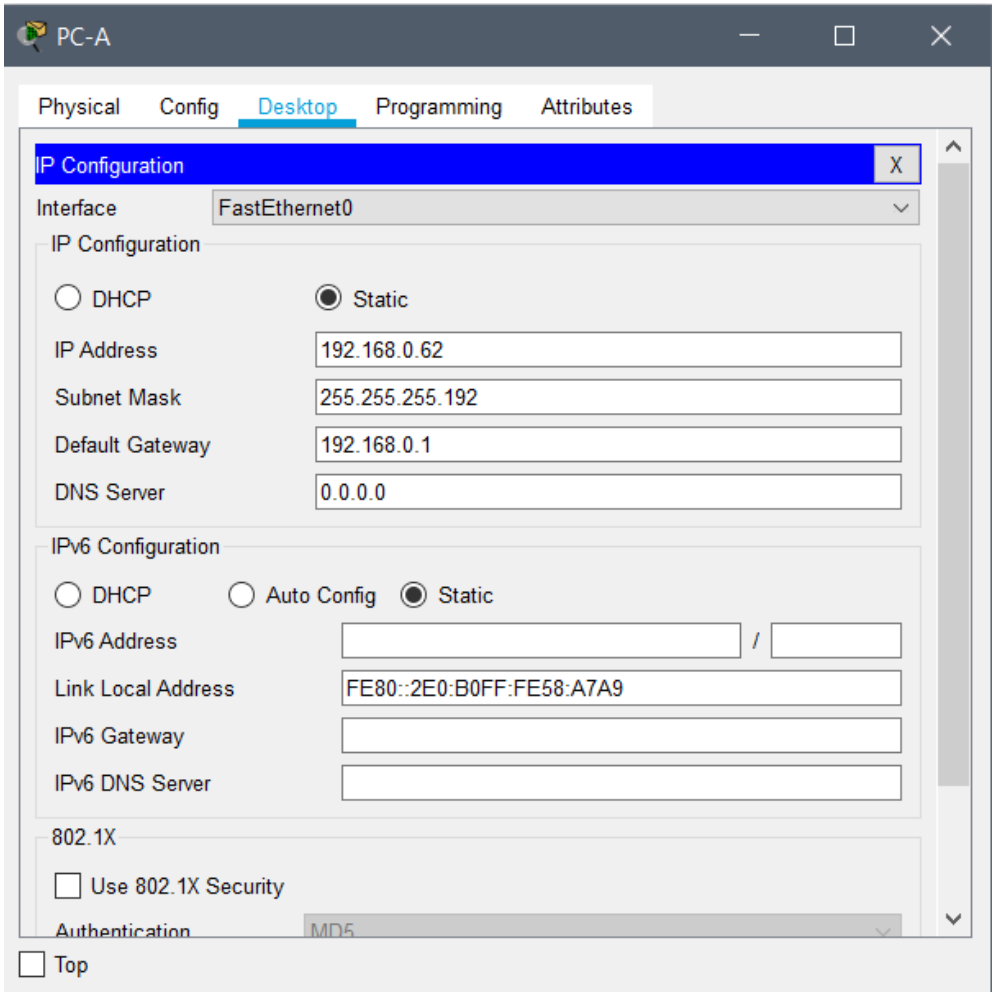
```
CustomerRouter(config-line) #interface GigabitEthernet 0/0
CustomerRouter(config-if)#ip address 192.168.0.1 255.255.255.192
CustomerRouter(config-if)#no shutdown
CustomerRouter(config-if)#exit
CustomerRouter(config-line) #interface GigabitEthernet0/1
CustomerRouter(config-if)#ip address 192.168.0.65 255.255.255.192
CustomerRouter(config-if)#no shutdown
CustomerRouter(config-if)#exit
CustomerRouter(config-line) #exit
CustomerRouter(config) #exit
CustomerRouter #copy running-config startup-config
```

4. Then the two switches were configured by going to the switch's CLI, then console terminal and assigning IP addresses and default-gateway to the VLAN1 according to the table.



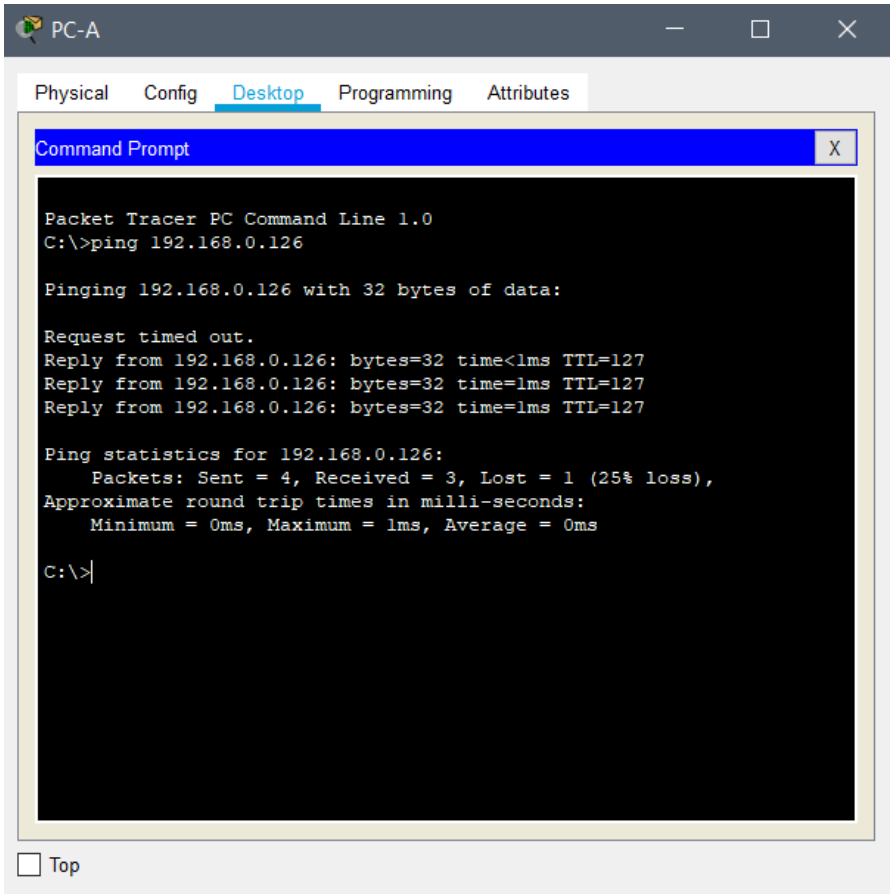
```
Switch (config) #interface Vlan1
Switch (config-if) #ip address 192.168.0.2 255.255.255.192
Switch (config-if) #no shutdown
Switch (config-if) #ip default-gateway 192.168.0.1
Switch (config-if) #exit
```

5. Finally the IP addresses, subnet masks, and default gateways for the PCs are set by double clicking on PC and then clicking on the Desktop tab, then clicking on IP configuration.



6. Finally, we check if the PCs can communicate by going to the PC, then Desktop tab and then Command Prompt. We check the pings from each PC to their respective default gateways and from one PC to the other.

```
ping 192.168.0.126
```



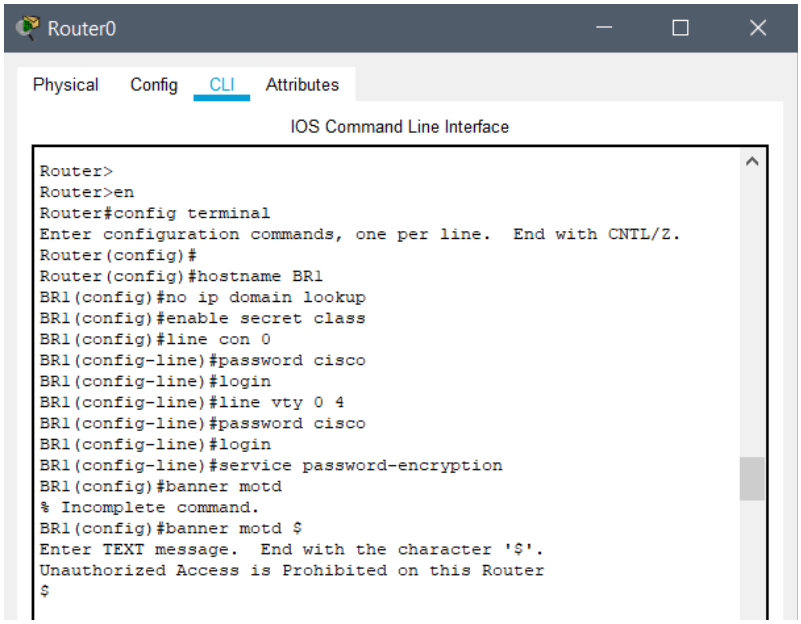
TASK #02:

1. First we create the given topology by selecting the given routers and switches, and connecting them according to the given topology.
2. Then we change the hostname of the routers, disable DNS lookup, assign password to the router's login and console for both of the routers.

```
router(config) # hostname BR1
BR1(config)# no ip domain lookup
BR1(config)# enable secret class
BR1(config)# line con 0
BR1(config-line)# password cisco
BR1(config)# login
```

3. Then we assign a VTY password and encrypt the plaintext passwords.

```
BR1(config)# line vty 0 4
BR1(config-line)# password cisco
BR1(config-line)# login
BR1(config-line)# exit
BR1(config)# service password-encryption
```

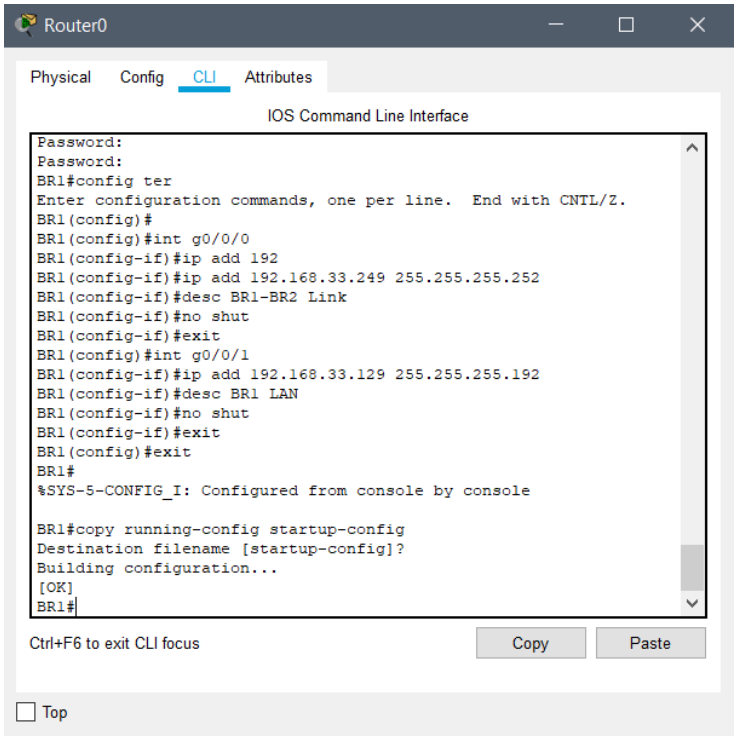


4. Then we create a banner that warns others of unauthorized access.

```
BR1(config)# banner motd $
Unauthorized Access is Prohibited on this Router
$
```

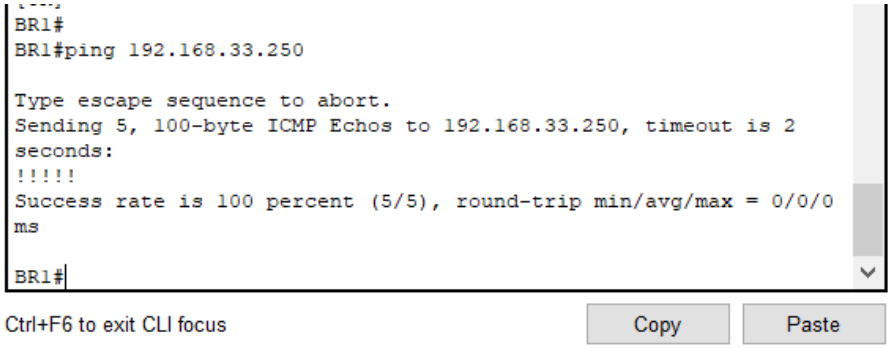
5. Then we configure the interfaces on each router and save them using the following commands:

```
BR1(config)# interface g0/0/0
BR1(config-if)# ip address 192.168.33.249 255.255.255.252
BR1(config-if)# description BR1-BR2 Link
BR1(config-if)# no shutdown
BR1(config-if)# exit
BR1(config)# interface g0/0/1
BR1(config-if)# ip address 192.168.33.129 255.255.255.192
BR1(config-if)# description BR1 LAN
BR1(config-if)# no shutdown
BR1(config-if)# exit
BR1(config)# exit
BR1# copy running-config startup-config
```

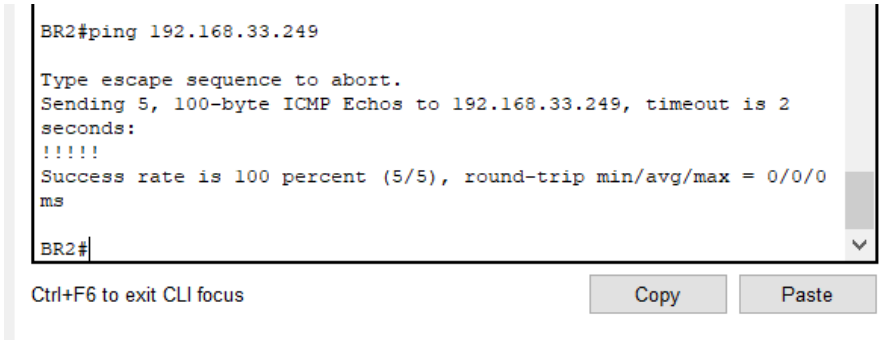


6. Then we test the connectivity by pinging from BR1 to BR2's G0/0/0 interface and,from BR2 to BR1's G0/0/0 interface.

BR1 to BR2's G0/0/0 interface:



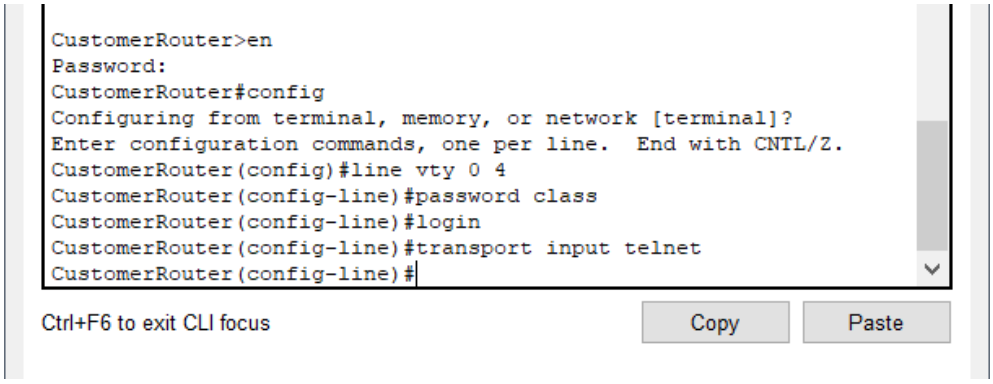
BR2 to BR1's G0/0/0 interface:



TASK #03:

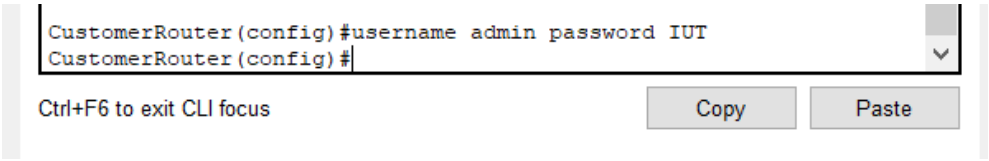
1. First, the .pka file from Task1 was copied and renamed to Task3_120.pka
2. Double clicking on the customer router and going on the CLI tab, I configured the VTY line using the commands:

```
CustomerRouter(config)# line VTY 0 4
CustomerRouter(config-line)# password class
CustomerRouter(config-line)# login
CustomerRouter(config-line)# transport input telnet
```



3. Then username and password were created

```
CustomerRouter(config)# username admin password IUT
```



4. Then the domain name was changed to 120.com where 120 indicates the last 3 digits of my student ID

```
CustomerRouter(config)# ip domain-name 120.com
```

5. Then we generate an RSA key and set the modulus to 1024

```
CustomerRouter(config)# crypto key generate rsa
How many bits in modulas [512]: 1024
```

```
CustomerRouter(config)#ip domain-name 120.com
CustomerRouter(config)#crupto key generate rsa
                       ^
% Invalid input detected at '^' marker.

CustomerRouter(config)#crypto key generate rsa
The name for the keys will be: CustomerRouter.120.com
Choose the size of the key modulus in the range of 360 to 2048 for your
  General Purpose Keys. Choosing a key modulus greater than 512 may take
  a few minutes.

How many bits in the modulus [512]: 1024
% Generating 1024 bit RSA keys, keys will be non-exportable...[OK]

CustomerRouter(config)#
```

Ctrl+F6 to exit CLI focus

6. Now, we authenticate all incoming virtual terminal sessions via the local username database i.e., users created using the username admin password IUT command in global configuration mode

```
CustomerRouter(config)# line VTY 0 4
CustomerRouter(config-line)# login local
```

```
CustomerRouter(config)#line vty 0 4
*Mar 2 11:14:48.476: %SSH-5-ENABLED: SSH 1.99 has been enabled
CustomerRouter(config-line)#login local
CustomerRouter(config-line)#
```

Ctrl+F6 to exit CLI focus

7. We double click on a PC, and go to the desktop tab. Then we click on the command prompt, and try accessing the router using

```
> telnet 192.168.11.1
```

Or,

```
> ssh -l admin 192.168.11.1
```

```
C:\>
C:\>
C:\>telnet 192.168.0.1
Trying 192.168.0.1 ...Open


User Access Verification

Username: admin
Password:
CustomerRouter>
```

Top

Fill in the missing IP address in the addressing table (Task #01):

Now fill in the addressing table with missing IP Address following the steps in **Step 2 of Part 1:**

Device	Interface	IP Address	Subnet Mask	Default Gateway
CustomerRouter	G0/0	192.168.0.1	255.255.255.192	N/A
	G0/1	192.168.0.65	255.255.255.192	
	S0/1/0	209.165.201.2	255.255.255.252	
Lan-A Switch	VLAN1	192.168.0.2	255.255.255.192	192.168.0.1
Lan-B Switch	VLAN1	192.168.0.66	255.255.255.192	192.168.0.65
PC-A	NIC	192.168.0.62	255.255.255.192	192.168.0.1
PC-B	NIC	192.168.0.126	255.255.255.192	192.168.0.65
ISPRouter	G0/0	209.165.200.225	255.255.255.224	N/A
	S0/1/0	209.165.201.1	255.255.255.252	
ISP Switch	VLAN1	209.165.200.226	255.255.255.224	209.165.200.225
ISP Workstation	NIC	209.165.200.235	255.255.255.224	209.165.200.225
ISP Server	NIC	209.165.200.240	255.255.255.224	209.165.200.225

Table: Addressing Table

Design the VLSM Address Scheme (Task 2):

Calculate 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	192.168.33.128/25	192.168.33.129	192.168.33.191
BR2 LAN	25	192.168.33.192/27	192.168.33.193	192.168.33.223
BR2 IoT LAN	5	192.168.33.224/29	192.168.33.225	192.168.33.231
BR2 CCTV LAN	4	192.168.33.232/29	192.168.33.233	192.168.33.239
BR2 HVAC C2LAN	4	192.168.33.240/29	192.168.33.241	192.168.33.247
BR1-BR2 Link	2	192.168.33.248/30	192.168.33.249	192.168.33.251

Questions (Answer to the point):

TASK #01 - Part 1 – Step 1:

1. How many host addresses are needed in the largest required subnet?
   Ans: 50
2. What is the minimum number of subnets required?
   Ans: 4 (2 subnets for the LANs and 2 unused subnets for future expansion)
3. The network that you are tasked to subnet is 192.168.0.0/24. What is the /24 subnet mask in binary?
   Ans: 1111111.11111111.11111111.00000000
4. The subnet mask is made up of two portions, the network portion, and the host portion. This is represented in the binary by the ones and the zeros in the subnet mask.
   a. In the network mask, what do the ones represent?
      Ans: Network Portion
   b. In the network mask, what do the zeros represent?
      Ans: Host Portion
5. Given each of the possible subnet masks depicted in the following binary format, how many subnets and how many hosts are created in each example?
   a. (/25) 11111111.11111111.11111111.10000000 Dotted decimal subnet mask equivalent:
      Ans: 255.255.255.128
      Number of subnets?
      Ans: 2^1 = 2
      Number of hosts?
      Ans: 2^7 - 2 = 126
   b. (/26) 11111111.11111111.11111111.11000000 Dotted decimal subnet mask equivalent:
      Ans: 255.255.255.192
      Number of subnets?
      Ans: 2^2 = 4
      Number of hosts?
      Ans: 2^6 - 2 = 62
   c. (/27) 11111111.11111111.11111111.11100000 Dotted decimal subnet mask equivalent:
      Ans: 255.255.255.224
      Number of subnets?
      Ans: 2^3 = 8
      Number of hosts?
      Ans: 2^5 - 2 = 30
   d. (/28) 11111111.11111111.11111111.11110000 Dotted decimal subnet mask equivalent:

Ans: 255.255.255.240
Number of subnets?
Ans: 2^4 = 16
Number of hosts?
Ans:**:** 2^4 - 2 = 14

e. (/29) 11111111.11111111.11111111.11111000 Dotted decimal subnet mask equivalent:
Ans: 255.255.255.248
Number of subnets?
Ans:: 2^5 = 32
Number of hosts?
Ans: 2^3 - 2 = 6

f. (/30) 11111111.11111111.11111111.11111100 Dotted decimal subnet mask equivalent:
Ans: 255.255.255.252
Number of subnets?
Ans: 2^6 = 64
Number of hosts?
Ans: 2^2 - 2 = 2

6. Considering your answers above, which subnet masks meet the required number of minimum host addresses?
Ans: Each of these subnets can allocate 50 or more hosts
/25 255.255.255.128
/26 255.255.255.192
7. Considering your answers above, which subnet masks meet the minimum number of subnets required?
Ans: Each of these subnets gives us 4 or more subnets
/26 255.255.255.128
/27 255.255.255.192
/28 255.255.255.224
/29 255.255.255.240
/30 255.255.255.248
8. Considering your answers above, which subnet mask meets both the required minimum number of hosts and the minimum number of subnets required?
Ans: Only this subnet can give us 4 or more subnets and allocate 50 or more hosts
/26 255.255.255.128

When you have determined **(Step 1 of Part 1)** which subnet mask meets all of the stated network requirements, derive each of the subnets. List the subnets from the fast to last in the table. Remember that the first subnet is 192.168.0.0 with the chosen subnet mask.

Subnet Address	Prefix	Subnet Mask
192.168.0.0	**/26**	**255.255.255.192**
192.168.0.64	**/26**	**255.255.255.192**
192.168.0.128	**/26**	**255.255.255.192**
192.168.0.192	**/26**	**255.255.255.192**

TASK #01 - Part 3:

1. Determine if PC-A can communicate with its default gateway. Do you get a reply?
   Ans: Yes
2. Determine if PC-B can communicate with its default gateway. Do you get a reply?
   Ans: Yes
3. Determine if PC-A can communicate with PC-B. Do you get a reply?
   Ans: Yes

TASK #02 - Part 1 – Step 1:

1. How many host addresses are available in a /25 network?
   Ans: 2^7 - 2 = 126 host addresses
2. What is the total number of host addresses needed in the topology diagram?
   Ans: 40 + 2 + 25 + 5 + 4 + 4 = 80 hosts
3. How many subnets are needed in the network topology?
   Ans: 6

TASK #02 - Part 1 – Step 2: Determine the largest subnet.

1. What is the subnet description (e.g., BR1 LAN or BR1-BR2 link)?
   Ans: BR1 LAN
2. How many IP addresses are required in the largest subnet?
   Ans: 40
3. What subnet mask can support that many host addresses?
   Ans: 255.255.255.192/26
4. How many total host addresses can that subnet mask support?
   Ans: 2^6 - 2 = 62
5. Can you subnet the 192.168.33.128/25 network address to support this subnet?
   Ans: Yes
6. What are the network addresses that would result from this subnetting?
   Ans: 192.168.33.128/26
   192.168.33.192/26

TASK #02 - Part 1 – Step 3: Determine the second largest subnet.

1. What is the subnet description?
   Ans: BR2 LAN
2. How many IP addresses are required in the second largest subnet?
   Ans: 25
3. What subnet mask can support that many host addresses?
   Ans: 255.255.255.224/27
4. How many total host addresses can that subnet mask support?
   Ans: 2^5 - 2 = 30
5. Can you subnet the remaining subnet again and still support this subnet?
   Ans: Yes
6. What are the network addresses that would result from this subnetting?
   Ans: 192.168.33.192/27
   192.168.33.224/27

TASK #02 - Part 1 – Step 4: Determine the third largest subnet.

1. What is the subnet description?
   Ans: BR2 IoT LAN
2. How many IP addresses are required in the third largest subnet?
   Ans: 5
3. What subnet mask can support that many host addresses?
   Ans: 255.255.255.248/29
4. How many total host addresses can that subnet mask support?
   Ans: 2^3 - 2 = 6
5. Can you subnet the remaining subnet again and still support this subnet?
   Ans: Yes
6. What are the network addresses that would result from this subnetting?
   Ans: 192.168.33.224/29
   192.168.33.232/29
   192.168.33.240/29
   192.168.33.248/29

TASK #02 - Part 1 – Step 5: Determine the fourth largest subnet.

1. What is the subnet description?
   Ans: BR1-BR2 Link
2. How many IP addresses are required in the fourth largest subnet?
   Ans: 2
3. What subnet mask can support that many host addresses?
   Ans: 255.255.255.252/30
4. How many total host addresses can that subnet mask support?

Ans: 2^2 - 2 = 2

5. Can you subnet the remaining subnet again and still support this subnet?
   Ans: Yes
6. What are the network addresses that would result from this subnetting?
   Ans: 192.168.33.248/30
   192.168.33.252/30

TASK #02 – Reflection Question:

1. Can you think of a shortcut for calculating the network addresses of consecutive /30 subnets?
   Ans: For /30 addresses, the block-size is 4. So, by adding 4 to the previous network address, we can find the addresses of the consecutive subnets.

Challenges (if any):

- I faced no major challenges. The assignment was relatively lengthy but apart from that most of the stuff was already covered in the theoretical course.