SE TE 1

2nd Semester 2023 – 2024

LABORATORY NO. 7

Designing an IP Subnetting Scheme for Growth

Submitted by:

Rafael III J. Prudente

Submitted to:

Mr. Junem Albert Repollo

Instructor

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I. Objectives

a. Analyze the subnetting requirements for a small company with multiple networks.
b. Design a subnetting scheme that allows for 20% growth in the number of subnets and the number of hosts per subnet.
c. Develop an IP addressing plan to apply addresses to networking devices and host computers.

II. Tasks

Task 1: Analyze the Network Topology for Subnetting Requirements

Step 1: Examine the network topology to determine the number of segments.

a. How many Ethernet networks currently exist?
   - There are **4 Ethernet networks**.
b. How many WAN links currently exist?
   - There **is 1 WAN link.**
c. How many total networks?
   - There are **5 networks in total**
d. How many subnets?
   - There are 4 subnets.
e. How many subnets with 20% growth?
   - There **are 5 subnets with 20% growth**

Step 2: Document the current number of hosts on each network segment.

a. Enter the network segment names in the table. Enter the number of hosts on each subnet, and then calculate the number of hosts the subnet must support if the number grows by 20%.

Segment name	Current number of hosts	Number of hosts after 20% growth
LAN A	**20**	**24 (20 + 20% of 20)**
LAN B	**25**	**30 (25 + 20% of 25)**
LAN C	**10**	**12 (10 + 20% of 10)**
LAN D	**15**	**18 (15 + 20% of 15)**
WAN LINK	**2**	**2 (2 + 20% of 2)**

b. Which subnet must support the largest number of hosts?
   - The subnet that must support the largest number of hosts after a 20% growth is **LAN B,** which will have **30 hosts.**

Task 2: Develop the Subnet Scheme

Step 1: Determine the number of subnets and hosts.

The customer has been assigned IP address block 172.20.99.0 /24 by their ISP. This provides 8 bits for hosts.

a. How many total addresses do they have to work with before subnetting?
   - The customer has been assigned an IP address block of 172.20.99.0/24 by their ISP. This provides a total of **2^8 = 256 addresses** to work with before subnetting.

b. What is the decimal subnet mask for a /24 mask?
   - The decimal subnet mask for a /24 mask is **255.255.255.0.**

c. What is the minimum number of subnets required for the network design to allow for 20% growth?
   - To allow for 20% growth, we need to calculate the total number of subnets required. Since we have 4 subnets currently, and we need to account for 20% growth, the total number of subnets required would be 4+(20% of 4)=4+0.8=4.84+(20% of 4)=4+0.8=4.8. We round this up to the nearest whole number, **so the minimum number of subnets required is 5.**

d. How many bits must be borrowed from the host portion of the IP address to allow for that number of subnets, and how many total subnets can be created?
   - To determine the number of bits needed to borrow from the host portion of the IP address to create 5 subnets, we can use the formula: n = $\log_2$. (number of subnets). Thus, n = $\log_2(5)$ – 2.32. Since we can't borrow a fraction of a bit, we round up to the nearest whole number, so n= 3. **With 3 bits borrowed, we can create n^3=8 subnets.**

e. How many hosts (including the 20% growth) must the largest subnet support?
   - The largest subnet must support 30 hosts after 20% growth, as determined in Task 1. **So, it must support 30 hosts.**

f. To support that many hosts, the number of host bits required is 5. Does this subnet scheme allow for the number of subnets and hosts per subnet needed?
   - Yes, this subnet scheme allows for the required number of subnets and hosts per subnet needed as determined in the analysis. We have 8 subnets available with 5 bits borrowed and each subnet can support at least 30 hosts, satisfying the requirements.

Step 2: Calculate the custom subnet mask.

a. The address block assigned by the ISP is a /24 or 255.255.255.0. What is the custom subnet mask? _____._____._____._____, or /_____
   - Since we need to borrow 3 bits to create 8 subnets (2^3), the custom subnet mask will have 27 bits for the network portion (24 original bits + 3 borrowed bits), resulting in a subnet mask of **255.255.255.224, or in CIDR notation, /27.**

b. To which devices and interfaces is this mask assigned?
   - This custom subnet mask of 255.255.255.224 or /27 will be assigned to **all the devices and interfaces within the network**, including routers, switches, and hosts. It will be used to segment the IP address space into smaller subnets to accommodate the network design requirements.

Step 3: Identify the subnet and host IP addresses.

a. Now that the subnet mask is identified, the network addressing scheme can be created. The addressing scheme includes the subnet numbers, the subnet broadcast address, and the range of IP addresses assignable to hosts.

b. Complete the table showing all possible subnets for the 172.20.99.0 network. In the last column, enter the name of the network segment to which you are assigning the subnet.

Subnet	Subnet Address	Host IP Address Range	Broadcast Address	Network Segment
0	172.20.99.0	172.20.99.1 - 172.20.99.30	172.20.99.31	LAN A
1	172.20.99.32	172.20.99.33 - 172.20.99.62	172.20.99.63	LAN B
2	172.20.99.64	172.20.99.65 - 172.20.99.94	172.20.99.95	LAN C
3	172.20.99.96	172.20.99.97 - 172.20.99.126	172.20.99.127	LAN D
4	172.20.99.128	172.20.99.129 - 172.20.99.158	172.20.99.159	WAN Link
5	172.20.99.160	172.20.99.161 - 172.20.99.190	172.20.99.191	-
6	172.20.99.192	172.20.99.193 - 172.20.99.222	172.20.99.223	-
7	172.20.99.224	172.20.99.225 - 172.20.99.254	172.20.99.255	-

Task 3: Document network device and host interfaces.

Step 1: Document the network device interface IP addresses.

Fill in the following table with the IP addresses and subnet masks for the router interfaces.

Network Device Interface Addresses

Device	Network Segment	Interface	IP Address	Subnet Mask
R1	LAN A	FastEthernet 0/0	172.20.99.1	255.255.255.224
R1	LAN B	FastEthernet 0/1	172.20.99.33	255.255.255.224
R1	WAN	Serial0/0	203.0.113.1	255.255.255.252 (/30)
R2	LAN C	FastEthernet 0/0	172.20.99.65	255.255.255.224
R2	LAN D	FastEthernet 0/1	172.20.99.97	255.255.255.224
R2	WAN	Serial0/0	203.0.113.2	255.255.255.252 (/30)

Step 2: Document the host IP addresses.

Fill in the following table with the IP addresses and subnet masks for the first host on each LAN. Assign the next available address to the first host computer on the LAN.

Host Computer Interface Addresses

Device	Network Segment	Interface	IP Address	Subnet Mask	Default Gateway
Host 1	LAN A	NIC	172.20.99.2	255.255.255.224	172.20.99.1
Host 1	LAN B	NIC	172.20.99.34	255.255.255.224	172.20.99.33
Host 1	LAN C	NIC	172.20.99.66	255.255.255.224	172.20.99.65
Host 1	LAN D	NIC	172.20.99.98	255.255.255.224	172.20.99.97

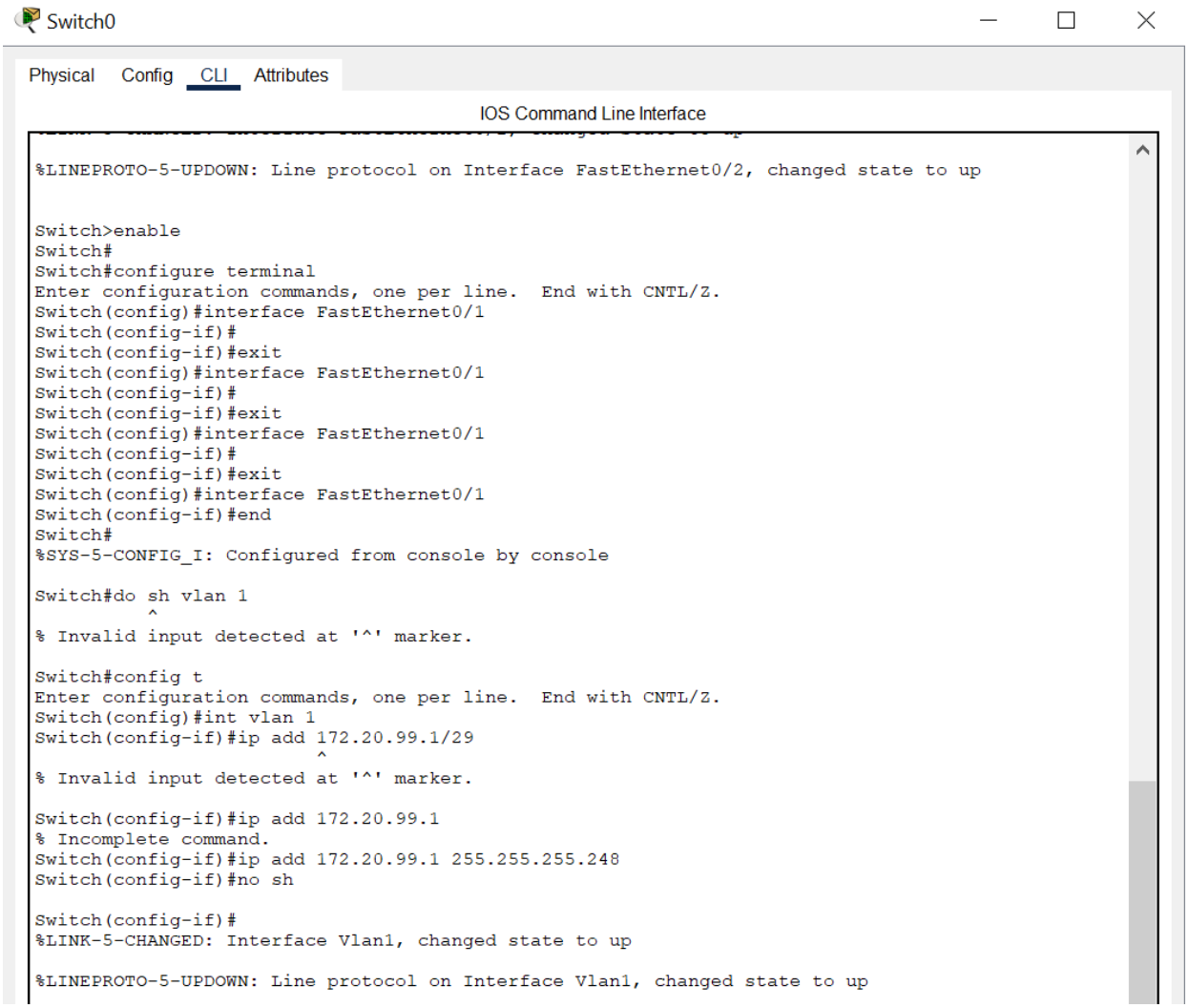
Task 4: Reflection

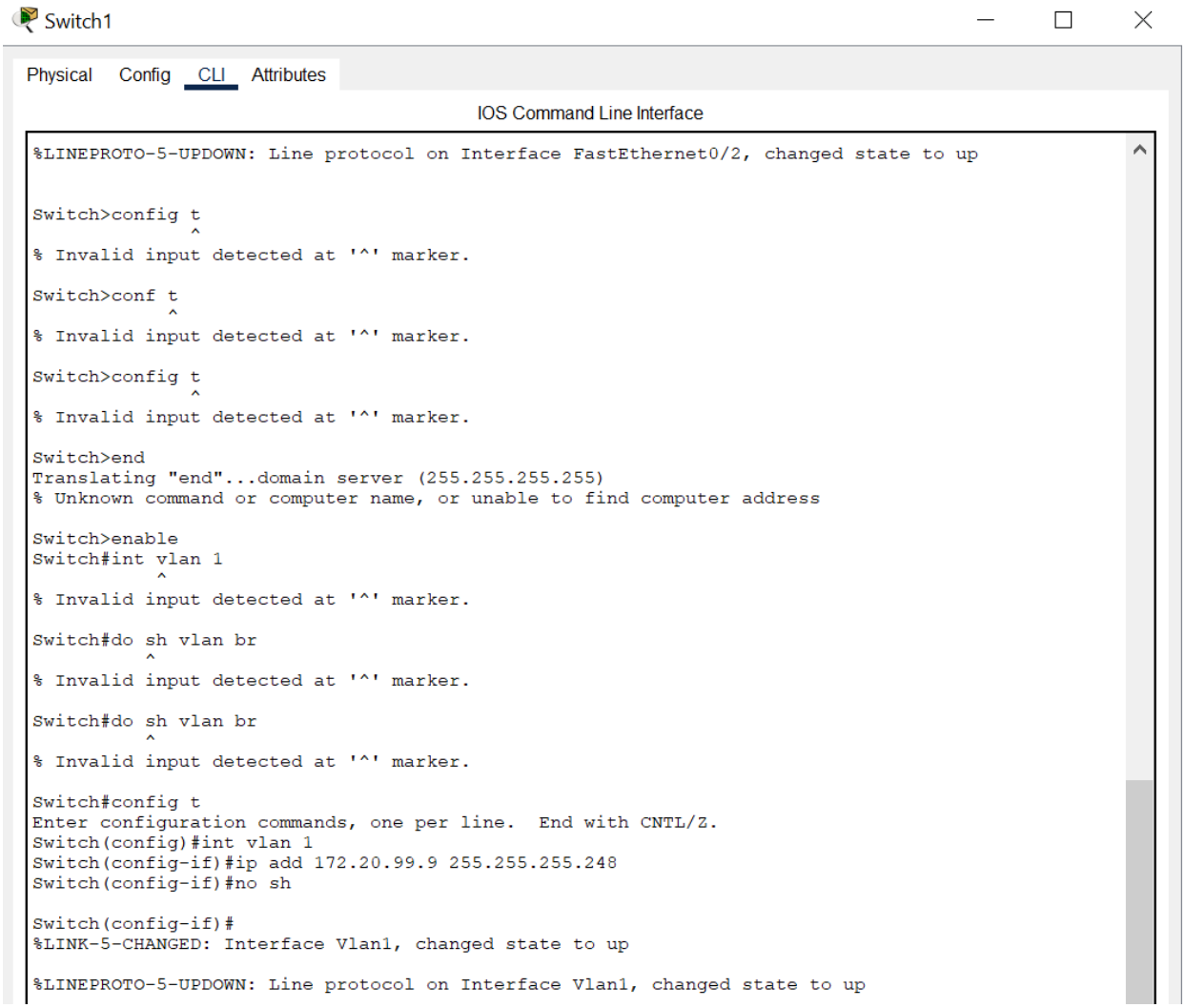
a. With the initial block of addresses assigned by the ISP, and the requirements for future growth, is there any other subnetting scheme that could have worked?
   - Yes, given the initial IP block from the ISP and future growth needs, an alternative subnetting scheme like Variable Length Subnet Mask (VLSM) could have been more efficient. VLSM allows for dividing an IP address space into subnets of varying sizes, optimizing the use of IP addresses by allocating smaller subnets to networks with fewer hosts and larger subnets to those with more hosts.

b. If the maximum number of hosts per network segment was only 14, could you have used another scheme? ____ Why?
   - Yes, if the maximum number of hosts per network segment was 14, a /28 subnet mask could have been used. This mask supports up to 14 usable host addresses per subnet, making it suitable for the scenario described. The choice of a /28 subnet mask is practical for networks that require a maximum of 14 hosts, ensuring efficient use of IP addresses without wasting them.

c. Although it works for the scenario in item b above, would it be a good idea to use 4 bits for subnets and 4 bits for hosts? _____ Why?
   - No, using 4 bits for subnets and 4 bits for hosts might not be practical. With 4 bits for subnets, you would have 16 subnets, and with 4 bits for hosts, you would have 16 hosts per subnet. This setup would not meet the network's requirements for a maximum of 14 hosts per network segment, as it would allow for 16 hosts, not 14. Therefore, this approach would not be efficient for the given scenario.

III. Schematics





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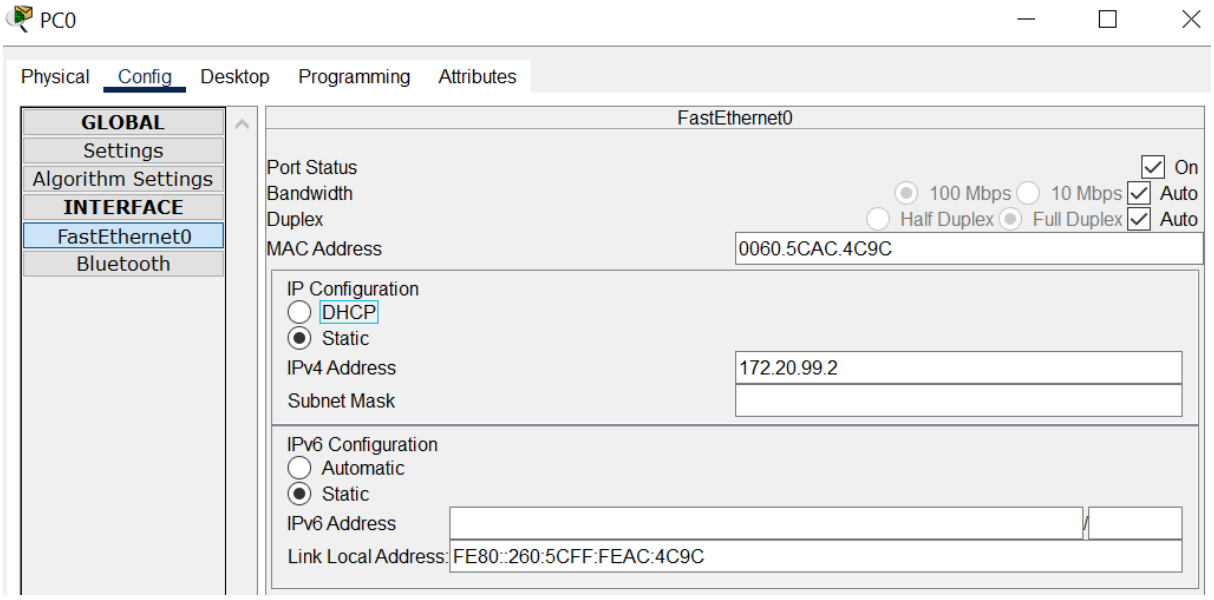

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