NST21022 - Practical for Network Switching and Routing

Department of Information and Communication Technology

Faculty of Technology

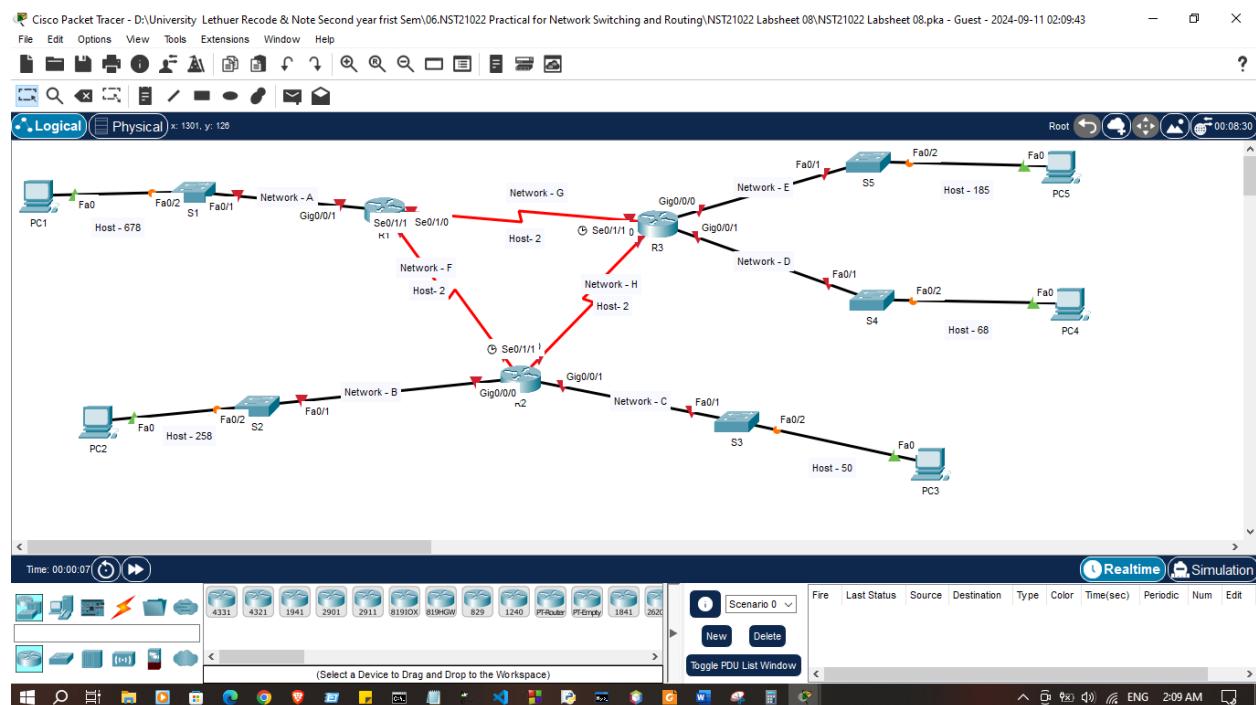**Title:** IPv4 VLSM (Variable Length Subnet Mask)

Aim:

- VLSM IP addressing scheme
- Configure devices with IPv4 after subnetting

Task:

- Design an IP scheme
- Subnet the IPv4 address
- Assign IP address to Network devices and verify connectivity

Use "NST21022 Labsheet 08.pka" file Activities

Exercise 01: Subnet the 172.16.0.0/16 network into the appropriate subnets.

1. Based on the topology, how many subnets were needed?

   - 8 subnets

2. How many hosts need for each subnet?

   - Subnet A:-678
   - Subnet B:-258
   - Subnet C:-50
   - Subnet D:-68
   - Subnet E:-185
   - Subnet F :-2
   - Subnet G:-2
   - Subnet H:-2

3. How many hosts provide by each subnet?

   - Subnet 1:-1024
   - Subnet 2:-512
   - Subnet 3:-64
   - Subnet 4:-256
   - Subnet 5:-128
   - Subnet 6 :-4
   - Subnet 7:-4
   - Subnet 8:-4

Exercise 02: Fill the subnet table.

Subnet Number	Network Address	First Usable Host Address	Last Usable Host Address	Broadcast Address
A	172.16.0.0	172.16.0.1	172.16.0.0	172.16.3.255
B	172.16.4.0	172.16.4.1	172.16.0.0	172.16.5.255
C	172.16.7.128	172.16.7.129	172.16.0.0	172.16.7.191
D	172.16.7.0	172.16.7.1	172.16.0.0	172.16.7.121
E	172.16.6.0	172.16.6.1	172.16.0.0	172.16.6.255
F	172.16.7.192	172.16.7.193	172.16.7.194	172.16.7.195
G	172.16.7.196	172.16.7.197	172.16.7.198	172.16.7.199
H	172.16.7.200	172.16.7.201	172.16.7.202	172.16.7.203

Exercise 03: Configure IP address according to following criteria.
1. Fill the addressing table using following guidelines:
   a. Assign the first usable IP addresses in each subnet to R1, R2, R3 for the LAN links.
   b. Assign the first usable IP addresses in each subnet for the WAN links as follows;

>   **R1 – S0/1/0**
>
>   **R1 – S0/1/1**
>
>   **R2 – S0/1/1**

   c. Assign the last usable IP addresses in each subnet for the WAN links as follows.

>   **R2 – S0/1/0**
>
>   **R3 – S0/1/0**
>
>   **R3 – S0/1/1**

```
R2                                                                    —   □   ✕

  Physical    Config    CLI    Attributes

                          IOS Command Line Interface

  %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up

  Router(config-if)#interface g0/0/1
  Router(config-if)#ip address 172.16.7.129 255.255.255.192
  Router(config-if)#no shutdown

  Router(config-if)#
  %LINK-5-CHANGED: Interface GigabitEthernet0/0/1, changed state to up

  %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up

  Router(config-if)#interface s0/1/0
  Router(config-if)#ip address 172.16.7.194 255.255.255.252
  Router(config-if)#no shutdown

  Router(config-if)#
  %LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

  Router(config-if)#interface s0/1/1
  Router(config-if)#ip address 172.16.7.201 255.255.255.252
  Router(config-if)#no shutdown

  Router(config-if)#
  %LINK-5-CHANGED: Interface Serial0/1/1, changed state to up

  Router(config-if)#
  Router(config-if)#
  %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

  00:01:58: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.0.1 on Serial0/1/0 from LOADING to FULL,
  Loading Done

  %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up

  00:02:04: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.6.1 on Serial0/1/1 from LOADING to FULL,
  Loading Done

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R1                                                              —   □   ✕

  Physical    Config    CLI    Attributes

                          IOS Command Line Interface

   Router>Enable
   Router#Configure Terminal
   Enter configuration commands, one per line.  End with CNTL/Z.
   Router(config)#
   Router(config)#interface g0/0/0
   Router(config-if)#ip address 172.16.0.1 255.255.252.0
   Router(config-if)#no shutdown

   Router(config-if)#
   %LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up

   Router(config-if)#interface s0/1/0
   Router(config-if)#ip address 172.16.7.193 255.255.255.252
   Router(config-if)#no shutdown

   %LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
   Router(config-if)#
   Router(config-if)#interface s0/1/1
   Router(config-if)#ip address 172.16.7.197 255.255.255.252
   Router(config-if)#no shutdown

   Router(config-if)#
   %LINK-5-CHANGED: Interface Serial0/1/1, changed state to up

   Router(config-if)#
   %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up

   00:01:32: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.6.1 on Serial0/1/1 from LOADING to FULL,
   Loading Done

   %LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

   %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

   00:01:58: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.4.1 on Serial0/1/0 from LOADING to FULL,
   Loading Done

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R3                                                          —  ☐  ✕

Physical    Config    CLI    Attributes

                        IOS Command Line Interface

Router(config-if)#ip address 172.16.7.1 255.255.255.128
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up

Router(config-if)#
Router(config-if)#interface s0/1/0
Router(config-if)#ip address 172.16.7.202 255.255.255.252
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
Router(config-if)#
Router(config-if)#
Router(config-if)#interface s0/1/1
Router(config-if)#ip address 172.16.7.198 255.255.255.252
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1/1, changed state to down
Router(config-if)#
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to up

00:01:32: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.0.1 on Serial0/1/1 from LOADING to FULL,
Loading Done

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

00:02:04: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.4.1 on Serial0/1/0 from LOADING to FULL,
Loading Done

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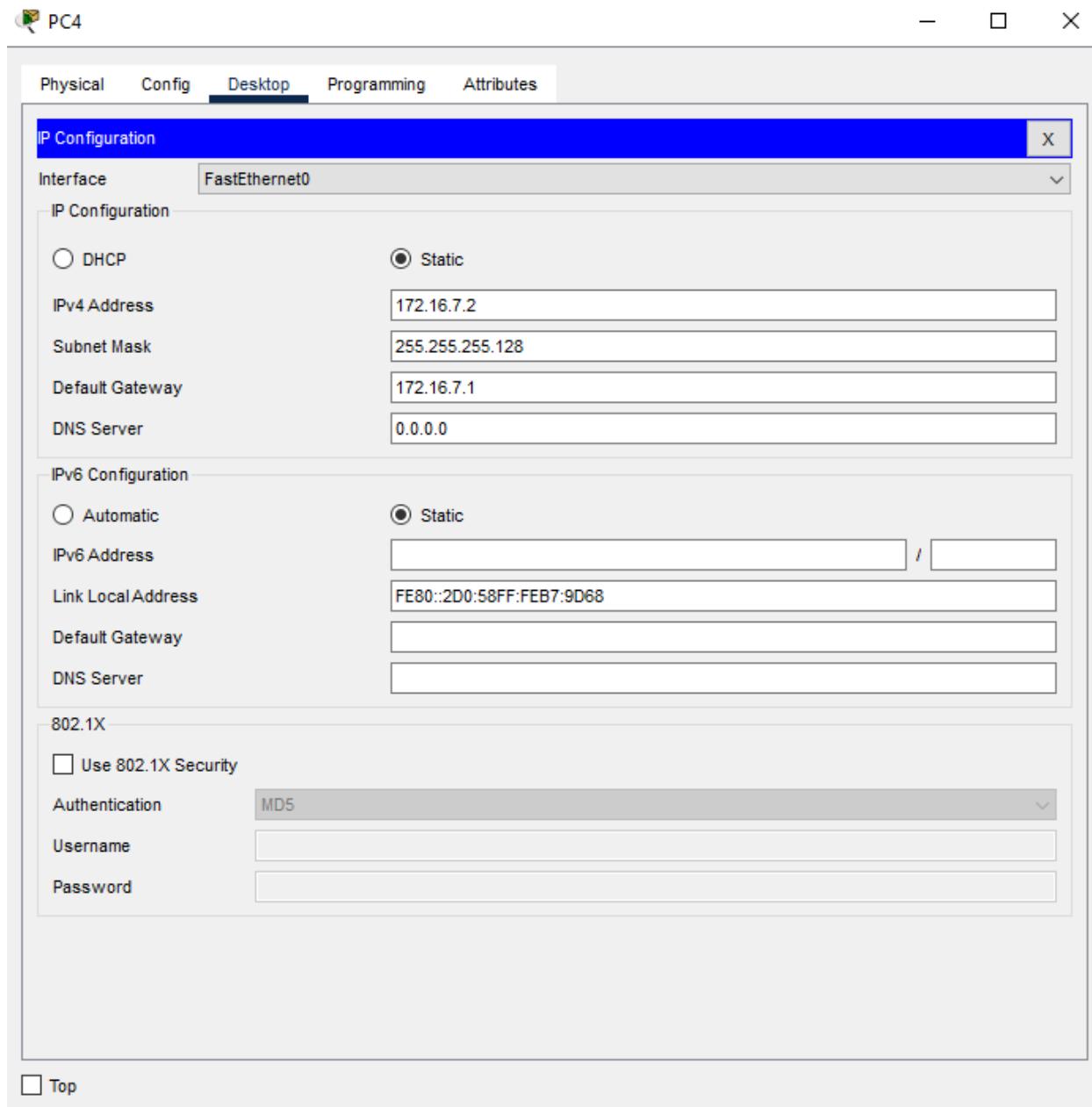
d. Assign the second usable IP address to the PCs in each subnet

PC4   —   □   ✕

Physical   Config   Desktop   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0   ⌄
IP Configuration

  ○ DHCP   ◉ Static

  IPv4 Address   172.16.7.2

  Subnet Mask   255.255.255.128

  Default Gateway   172.16.7.1

  DNS Server   0.0.0.0

IPv6 Configuration

  ○ Automatic   ◉ Static

  IPv6 Address   /

  Link Local Address   FE80::2D0:58FF:FEB7:9D68

  Default Gateway

  DNS Server

802.1X

  ☐ Use 802.1X Security

  Authentication   MD5   ⌄

  Username

  Password

☐ Top

PC3

— □ ✕

Physical | Config | Desktop | Programming | Attributes

IP Configuration   X

| Interface | FastEthernet0 | ⌄ |

IP Configuration

○ DHCP   ⦿ Static

IPv4 Address	172.16.7.130
Subnet Mask	255.255.255.192
Default Gateway	172.16.7.129
DNS Server	0.0.0.0

IPv6 Configuration

○ Automatic   ⦿ Static

IPv6 Address		/
Link Local Address	FE80::210:11FF:FE5E:52E9
Default Gateway	
DNS Server	

802.1X

☐ Use 802.1X Security

Authentication	MD5	⌄
Username	
Password	

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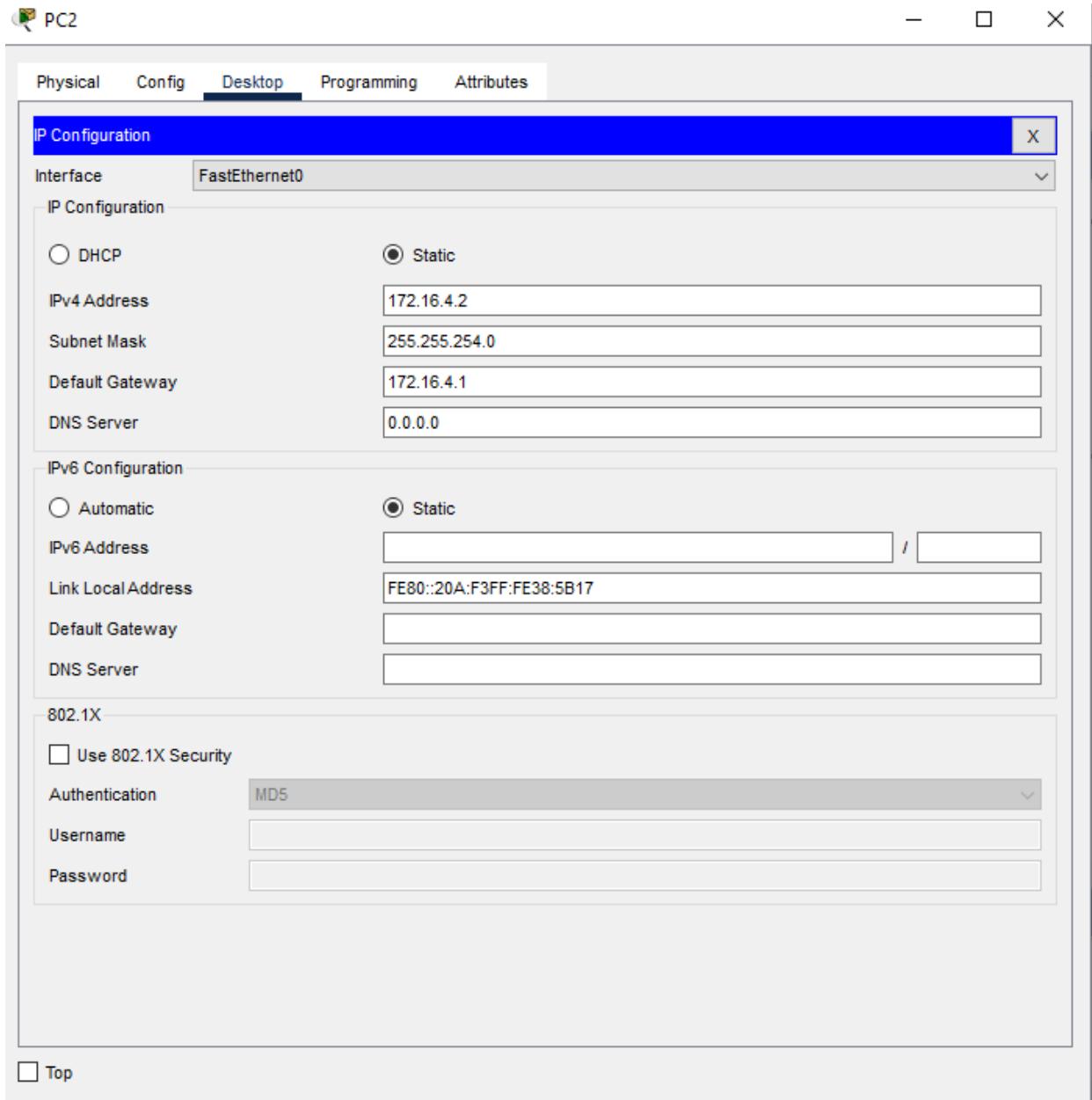PC2   — □ ✕
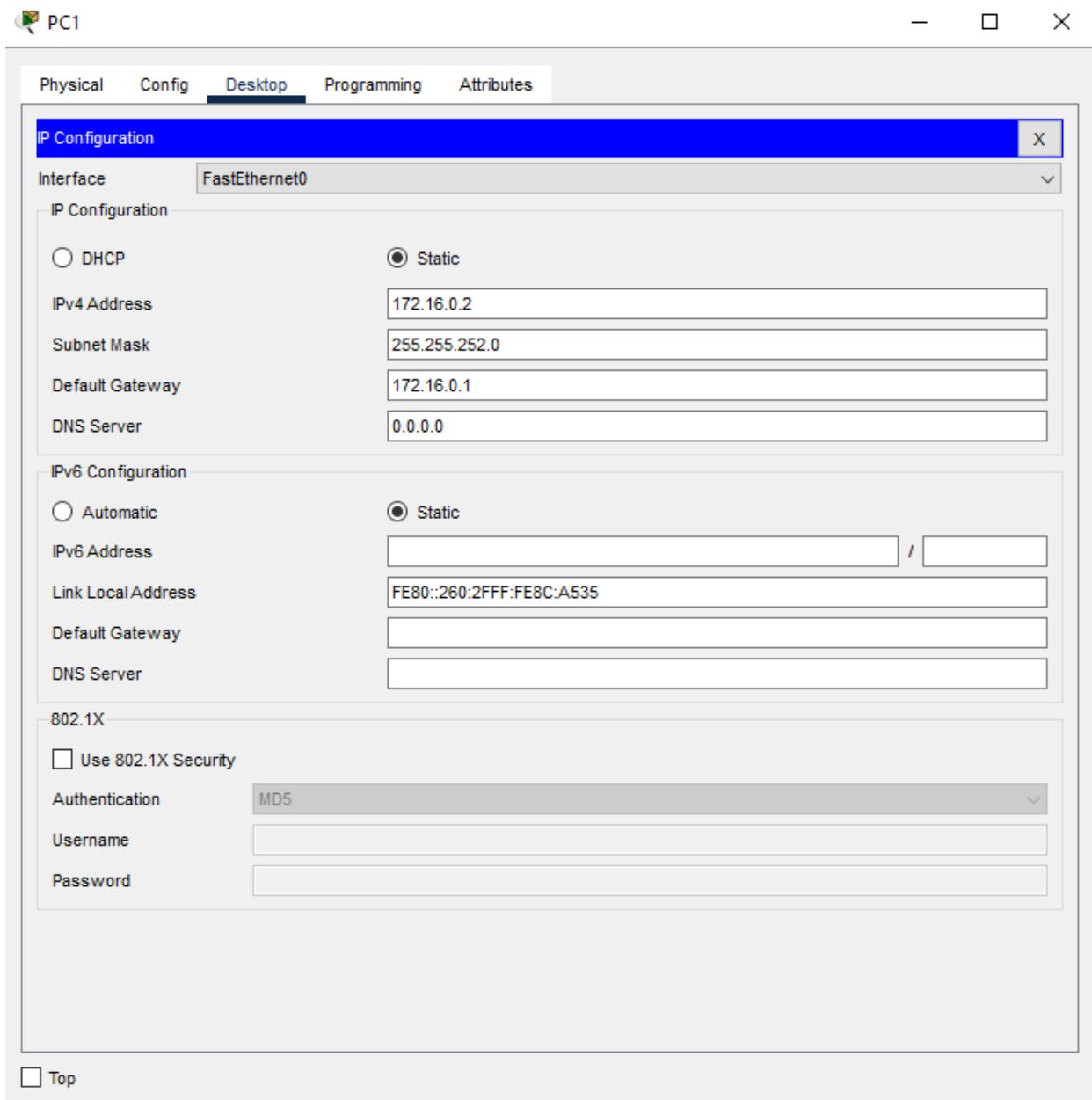
Physical   Config   Desktop   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0   ⌄

IP Configuration

⊙ DHCP   ⊙ Static

IPv4 Address   172.16.4.2

Subnet Mask   255.255.254.0

Default Gateway   172.16.4.1

DNS Server   0.0.0.0

IPv6 Configuration

○ Automatic   ⊙ Static

IPv6 Address   /

Link Local Address   FE80::20A:F3FF:FE38:5B17

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication   MD5   ⌄

Username

Password

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PC1

Physical   Config   **Desktop**   Programming   Attributes

IP Configuration   X

Interface   FastEthernet0

IP Configuration

○ DHCP   ● Static

IPv4 Address   172.16.0.2

Subnet Mask   255.255.252.0

Default Gateway   172.16.0.1

DNS Server   0.0.0.0

IPv6 Configuration

○ Automatic   ● Static

IPv6 Address   /

Link Local Address   FE80::260:2FFF:FE8C:A535

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security
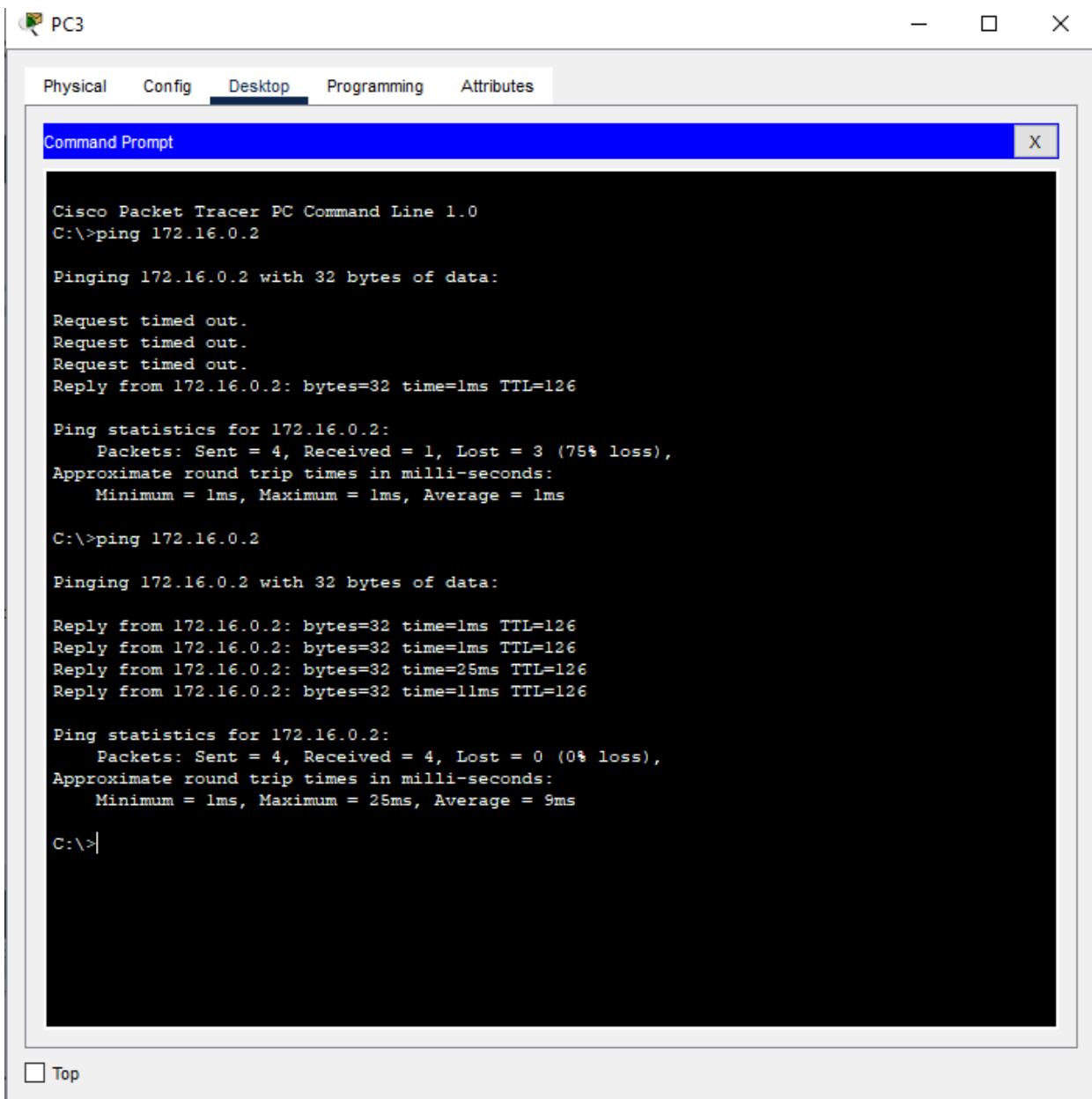
Authentication   MD5

Username

Password

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PC5 — □ ✕

Physical | Config | Desktop | Programming | Attributes

IP Configuration ✕

Interface   FastEthernet0   ⌄

IP Configuration

○ DHCP   ⦿ Static

IPv4 Address   172.16.6.2

Subnet Mask   255.255.255.0

Default Gateway   172.16.6.1

DNS Server   0.0.0.0

IPv6 Configuration

○ Automatic   ⦿ Static

IPv6 Address   [   ] / [   ]

Link Local Address   FE80::202:4AFF:FEB4:98E0

Default Gateway   [   ]

DNS Server   [   ]

802.1X

☐ Use 802.1X Security

Authentication   MD5   ⌄

Username   [   ]

Password   [   ]

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Addressing Table

Devices	Interfaces	IP Addresses	Subnet Mask	Default Gateway
R1	G0/0/0	172.16.0.1	255.255.252.0	
	S0/1/0	172.16.7.193	255.255.255.252	
	S0/1/1	172.16.7.197	255.255.255.252	
R2	G0/0/0	172.16.4.1	255.255.254.0	
	G0/0/1	172.16.7.129	255.255.255.192	
	S0/1/0	172.16.7.194	255.255.255.252	
	S0/1/1	172.16.7.201	255.255.255.252	
R3	G0/0/0	172.16.6.1	255.255.255.128	
	G0/0/1	172.16.7.1	255.255.255.0	
	S0/1/0	172.16.7.202	255.255.255.252	
	S0/1/1	172.16.7.198	255.255.255.252	
PC1	NIC	172.16.0.2	255.255.252.0	172.16.0.1
PC2	NIC	172.16.4.2	255.255.254.0	172.16.4.1
PC3	NIC	172.16.4.130	255.255.255.192	172.16.4.129
PC4	NIC	172.16.7.2	255.255.255.192	172.16.7.1
PC5	NIC	172.16.6.2	255.255.255.0	172.16.6.1

2. Assign IP addresses to network devices and verify connectivity

PC3

Physical   Config   Desktop   Programming   Attributes

Command Prompt   X

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.0.2

Pinging 172.16.0.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Reply from 172.16.0.2: bytes=32 time=1ms TTL=126

Ping statistics for 172.16.0.2:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\>ping 172.16.0.2

Pinging 172.16.0.2 with 32 bytes of data:

Reply from 172.16.0.2: bytes=32 time=1ms TTL=126
Reply from 172.16.0.2: bytes=32 time=1ms TTL=126
Reply from 172.16.0.2: bytes=32 time=25ms TTL=126
Reply from 172.16.0.2: bytes=32 time=11ms TTL=126

Ping statistics for 172.16.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 25ms, Average = 9ms

C:\>
```

☐ Top

PC5

Physical   Config   Desktop   Programming   Attributes

Command Prompt   X

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.16.0.2

Pinging 172.16.0.2 with 32 bytes of data:

Reply from 172.16.6.1: Destination host unreachable.
Reply from 172.16.6.1: Destination host unreachable.
Reply from 172.16.6.1: Destination host unreachable.
Reply from 172.16.6.1: Destination host unreachable.

Ping statistics for 172.16.0.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 172.16.7.2

Pinging 172.16.7.2 with 32 bytes of data:

Request timed out.
Reply from 172.16.7.2: bytes=32 time=1ms TTL=127
Reply from 172.16.7.2: bytes=32 time<1ms TTL=127
Reply from 172.16.7.2: bytes=32 time<1ms TTL=127

Ping statistics for 172.16.7.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

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Discussion:

- In this lab session, we focused on implementing the Variable Length Subnet Mask (VLSM) to design an efficient IPv4 addressing scheme. The aim was to optimize the use of IP addresses by assigning subnet sizes according to the specific needs of each network segment. We began by designing an IP scheme that accounted for varying numbers of hosts in each subnet, allowing us to allocate IP addresses more effectively. After subnetting the IPv4 address using VLSM, we assigned IP addresses to the network devices such as routers, switches, and hosts. Finally, we tested the network by verifying connectivity between devices within each subnet and across different subnets. This session highlighted the benefits of VLSM in conserving IP address space and improving network scalability.