MAJOR PROJECT

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The American University of Afghanistan

Fundamentals of Networking and Telecom - SPRING 2022 - SECTION 001

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Abstract

Purpose: This project aims to create a working 3-tier network topology. The requirements for the design and infrastructure of are stated in the introduction, which you will read in the following pages. These requirements are given to find out whether we can create a 3-tier topology for an enterprise or not.

The goal of this project is also to find out if we can implement this topology using concepts like ip routing or vlan and to learn more about the general aspects of computer networks. For example, nodes, ports, the physical or logical aspects of a computer network, and network topologies.

Method: We were given a set of requirements in the correct order for us to implement and execute our project:

- Naming our switches, routers and devices.

- Implementation of the console

- Implementation of Telnet

- Creating vlans over our routers

- Running dhcp, intervlans, ip routing and NAT.

- And finally, debugging to see if our topology is actually working or not

Although debugging was the final step in creating the topology, it was not the final step. The final step in completing this project was to document everything, i.e. all the above stages and screenshots of our progress to prove that our model works.

Findings: The results show that it is indeed possible to build a topology for a small domain by implementing the requirements set up for this project. And whether the model should be used or implemented in real cases.

Implication for research: through this project, we can better understand how the Cisco Packet Tracer works, how it is easy to use, and how the technology can help students learn faster. We also have a better understanding of the concepts used to create a working network topology. Perhaps this project will facilitate the learning of such concepts.

Conclusion: if you consider the points mentioned in the requirements and follow all the steps in this project, you can create a working network model.

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Introduction

This project is to design and implement a 3-tier networking infrastructure for an organization with the following requirements:

- Subnet an IP address from Class C in a way to have exactly 4 networks and at least 60 usable host IP addresses per network.
- In Cisco packet tracer, use 6 Switches and 3 routers, rename switches to your first name followed by a number (e.g. 1, 2, 3, or 4). Rename routers with your last name followed with some numbers. Now, configure console line, and telnet on each of them
- Create 4 VLANS on each switch, and to each VLAN connect at least 5 host devices.
- The Host devices should receive IP addresses via DHCP.
- configure inter VLAN routing, also make sure that on a same switch a host on one VLAN is able to interact to the host on another VLAN.
- For creating VLANs the use of VTP is preferred.
- A dynamic, static, or a combination of both must be used as a routing mechanism.
- The network design has to be debugged and tested for each service that has been implemented, the screenshot of the test result is required in the report.
- The users must have internet service from a single ISP or multiple ISPs, use NAT services.

IP Subnetting

1. Subnet an IP address from Class C in a way to have exactly 4 networks and at least 60 usable host IP addresses per network.

Answer: 220.100.100.0/26

Step 1 Binary: 11111111.11111111.11111111.11000000

Step 2 Decimal: 255.255.255.192

Step 3 Number of subnets: $2^2 = 4$

Step 4 Number of hosts per subnet: $2^6 - 2 = 62$

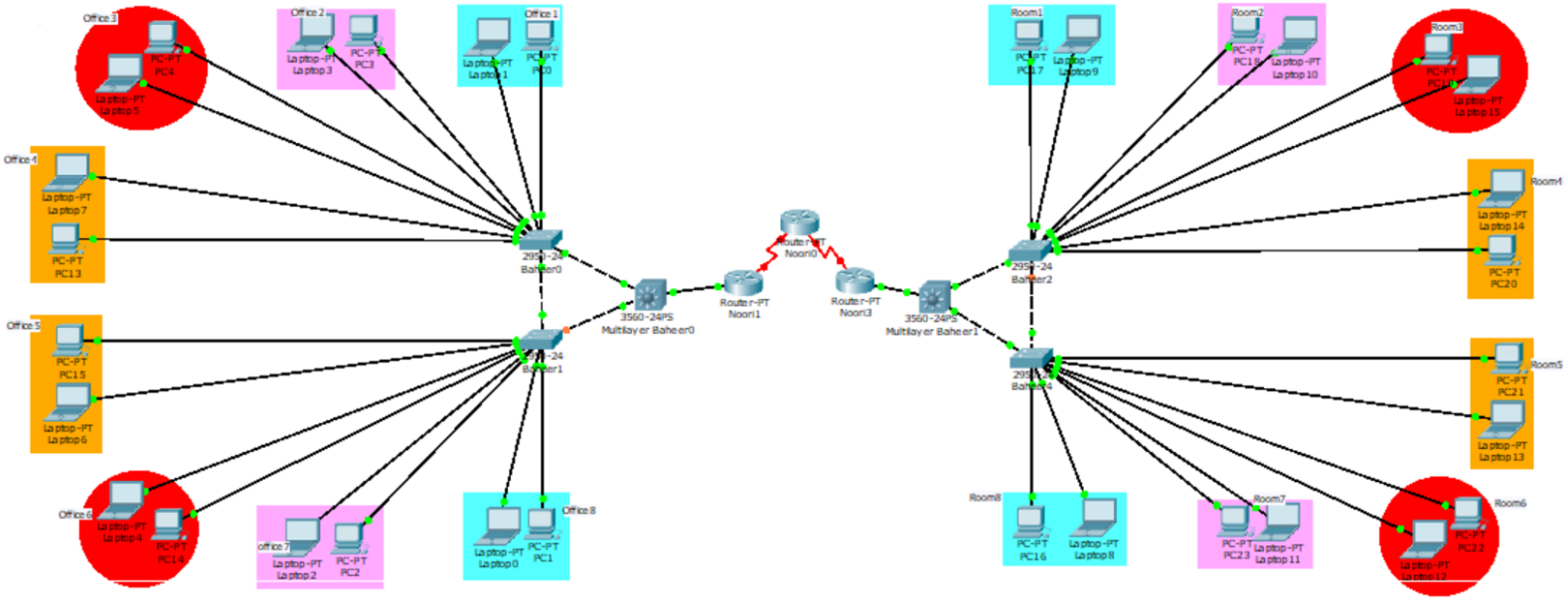
Step 5 Block size: 256 – 192 = 64

Step 6:

No.	NID	Start IP	End IP	Broadcast IP
1	220.100.100.0	220.100.100.1	220.100.100.62	220.100.100.63
2	220.100.100.64	220.100.100.65	220.100.100.126	220.100.100.127
3	220.100.100.128	220.100.100.129	220.100.100.190	220.100.100.191
Last Subnet	220.100.100.192	220.100.100.193	220.100.100.254	220.100.100.255

Networking topology

2. In Cisco packet tracer, use 6 Switches and 3 routers, rename switches to your first name followed by a number (e.g. 1, 2, 3, or 4). Rename routers with your last name followed with some numbers. Now, configure console line, and telnet on each of them.



Vlans

3. Create 4 VLANS on each switch, and to each VLAN connect at least 5 host devices.

Yes, I have created four vlans on either side.

On the left: Vlans 10 - 40 are assigned to:

- Baheer0 (switch) Office 1 - 4
- Baheer1 (switch) Office 5 - 8

On the left: Vlans 50 - 80 are assigned to:

- Baheer2 (switch) Room 1 - 4
- Baheer4 (switch) Room 5 - 8

Baheer0

Physical Config CLI

IOS Command Line Interface

```
Baheer(config)#int range fa0/7-8
Baheer(config-if-range)#switchport mode access
Baheer(config-if-range)#switchport access vlan 40
% Access VLAN does not exist. Creating vlan 40
Baheer(config-if-range)#exit
Baheer(config)#vlan 10
Baheer(config-vlan)#Office1
                    ^
% Invalid input detected at '^' marker.

Baheer(config-vlan)#name Office1
Baheer(config-vlan)#vlan 20
Baheer(config-vlan)#name Office2
Baheer(config-vlan)#vlan 30
Baheer(config-vlan)#name Office3
Baheer(config-vlan)#vlan 40
Baheer(config-vlan)#name Office4
Baheer(config-vlan)#exit
Baheer(config)#do show vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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
10   Office1                           active    Fa0/1, Fa0/2
20   Office2                           active    Fa0/3, Fa0/4
30   Office3                           active    Fa0/5, Fa0/6
40   Office4                           active    Fa0/7, Fa0/8
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Baheer(config)#
```

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Baheer1

Physical Config CLI

IOS Command Line Interface

```
Baheer(config-if-range)#switchport mode access
Baheer(config-if-range)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
Baheer(config-if-range)#exit
Baheer(config)#int range fa0/7-8
Baheer(config-if-range)#switchport mode access
Baheer(config-if-range)#switchport access vlan 40
% Access VLAN does not exist. Creating vlan 40
Baheer(config-if-range)#exit
Baheer(config)#vlan 10
Baheer(config-vlan)#name Office5
Baheer(config-vlan)#vlan 20
Baheer(config-vlan)#name Office6
Baheer(config-vlan)#vlan 30
Baheer(config-vlan)#name Office7
Baheer(config-vlan)#vlan 40
Baheer(config-vlan)#name Office8
Baheer(config-vlan)#exit
Baheer(config)#do show vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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
10   Office5                           active    Fa0/1, Fa0/2
20   Office6                           active    Fa0/3, Fa0/4
30   Office7                           active    Fa0/5, Fa0/6
40   Office8                           active    Fa0/7, Fa0/8
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Baheer(config)#
```

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Baheer2

Physical Config CLI

IOS Command Line Interface

```
Baheer(config-if-range)#no switchport access vlan 40
Baheer(config-if-range)#switchport access vlan 80
Baheer(config-if-range)#exit
Baheer(config)#int range fa0/5-6
Baheer(config-if-range)#switchport access vlan 70
Baheer(config-if-range)#exit
Baheer(config)#do show vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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
50   Room1                             active    Fa0/1, Fa0/2
60   Room2                             active    Fa0/3, Fa0/4
70   Room3                             active    Fa0/5, Fa0/6
80   Room4                             active    Fa0/7, Fa0/8
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Baheer(config)#exit
```

Baheer4

Physical Config CLI

IOS Command Line Interface

```
% Access VLAN does not exist. Creating vlan 10
Baheer(config-if-range)#exit
Baheer(config)#int range fa0/3-4
Baheer(config-if-range)#switchport access vlan 20
% Access VLAN does not exist. Creating vlan 20
Baheer(config-if-range)#exit
Baheer(config)#int range fa0/5-6
Baheer(config-if-range)#switchport access vlan 30
% Access VLAN does not exist. Creating vlan 30
Baheer(config-if-range)#exit
Baheer(config)#int range fa0/7-8
Baheer(config-if-range)#switchport access vlan 40
% Access VLAN does not exist. Creating vlan 40
Baheer(config-if-range)#exit
Baheer(config)#vlan 10
Baheer(config-vlan)#name Room5
Baheer(config-vlan)#vlan 20
Baheer(config-vlan)#name Room6
Baheer(config-vlan)#vlan 30
Baheer(config-vlan)#name Room7
Baheer(config-vlan)#vlan 40
Baheer(config-vlan)#name Room8
Baheer(config-vlan)#exit
Baheer(config)#do show vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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
10   Room5                             active    Fa0/1, Fa0/2
20   Room6                             active    Fa0/3, Fa0/4
```

Assigned IPs to vlans:

Vlan 10: 220.100.100.0

Vlan 20: 220.100.100.64

Vlan 30: 220.100.100.128

Vlan 40: 220.100.100.192

Vlan 50: 200.100.90.0

Vlan 60: 200.100.90.64

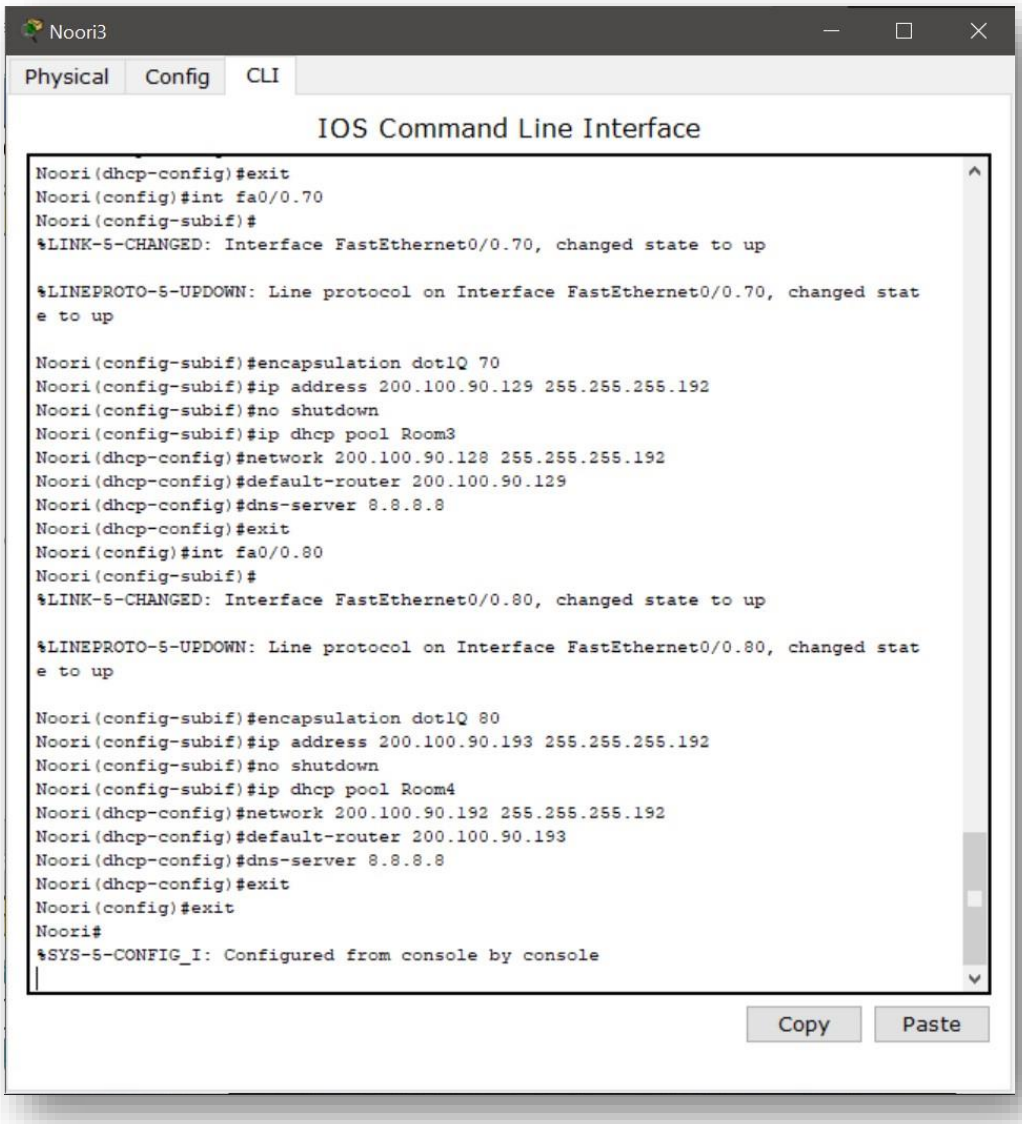
Vlan 70: 200.100.90.128

Vlan 80: 200.100.90.192

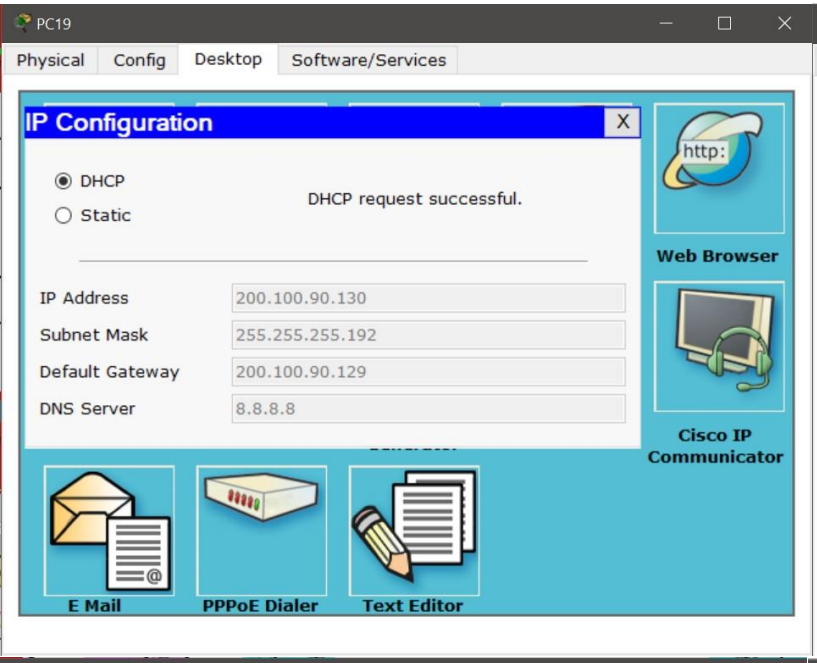
DHCP (dynamic host configuration protocol)

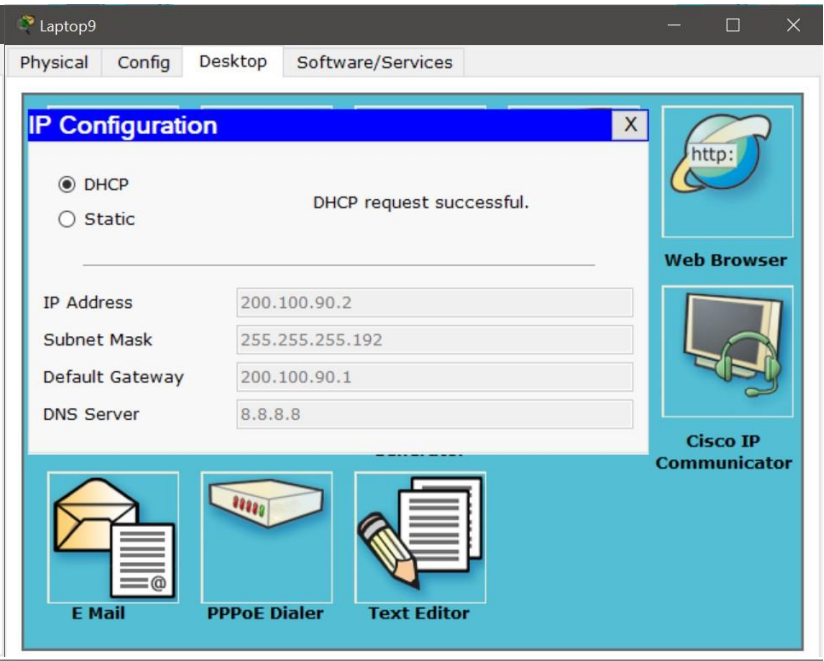
4. The Host devices should receive IP addresses via DHCP.

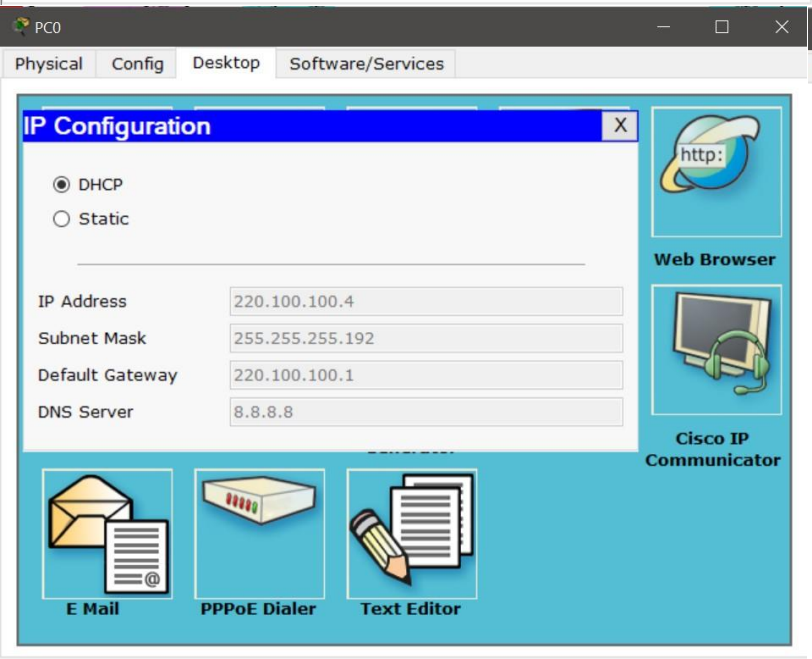
Assigning the default gateway address, domain name server address, subnet mask and other configuration parameters dynamically. The following code and DHCP was configured on Noori1 router too.

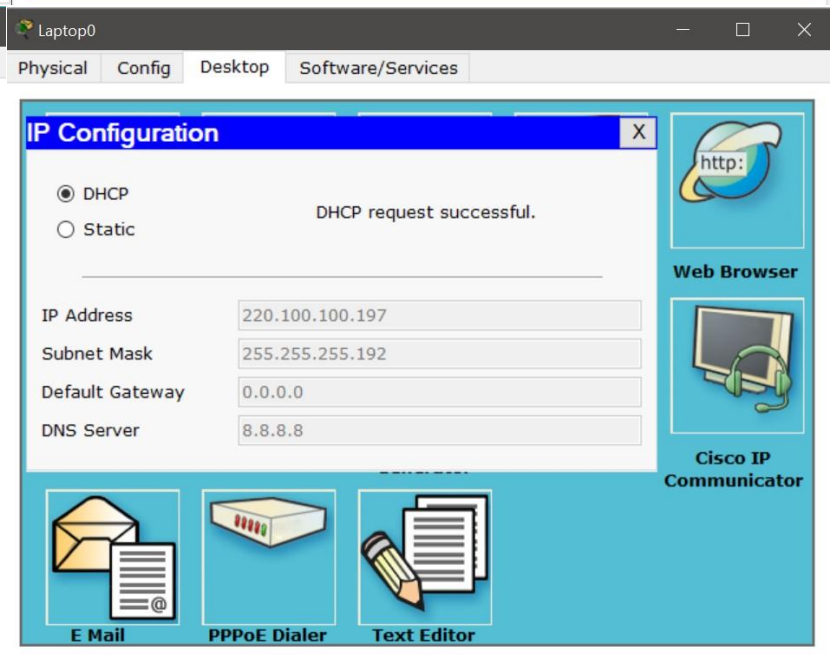


Here are some of the dhcp configuration done on the devices as prove:

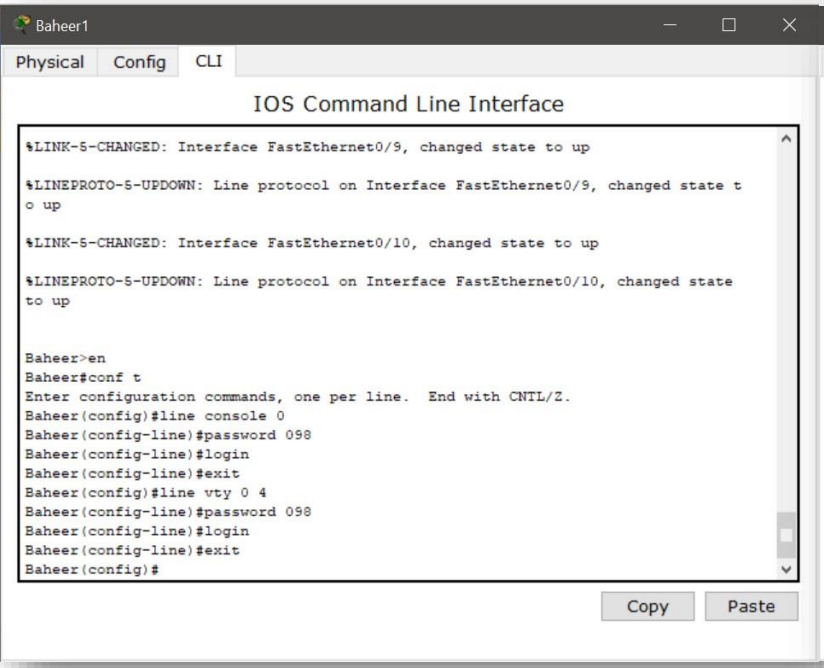


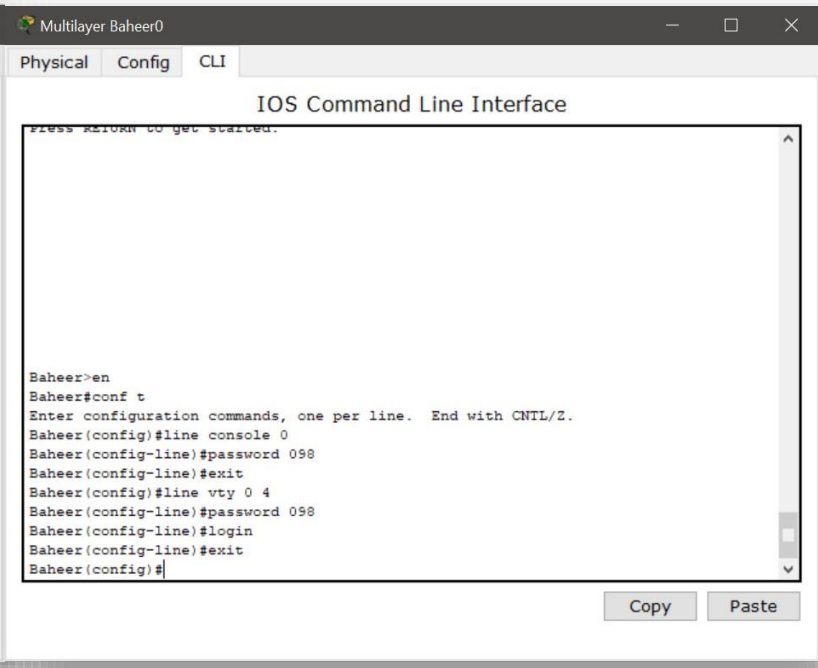




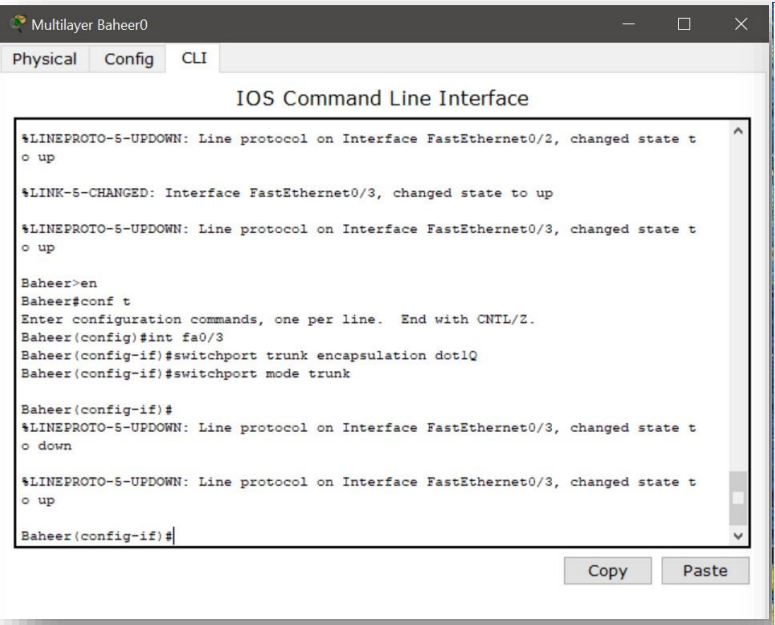


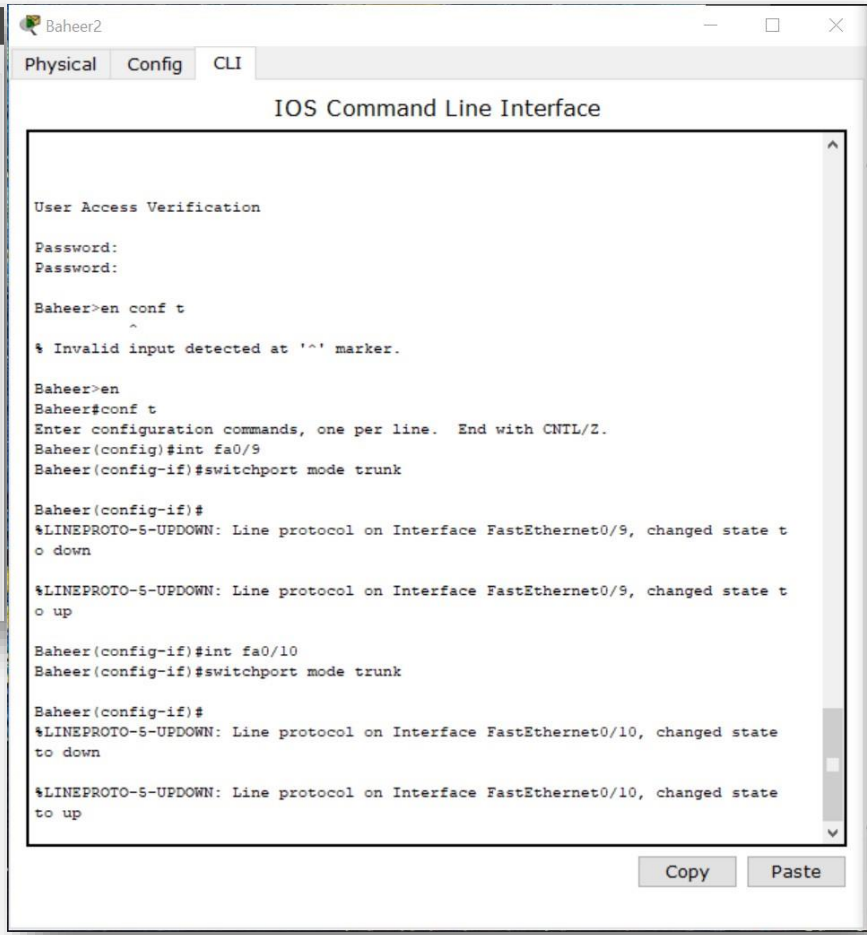
Telnet and console configurations





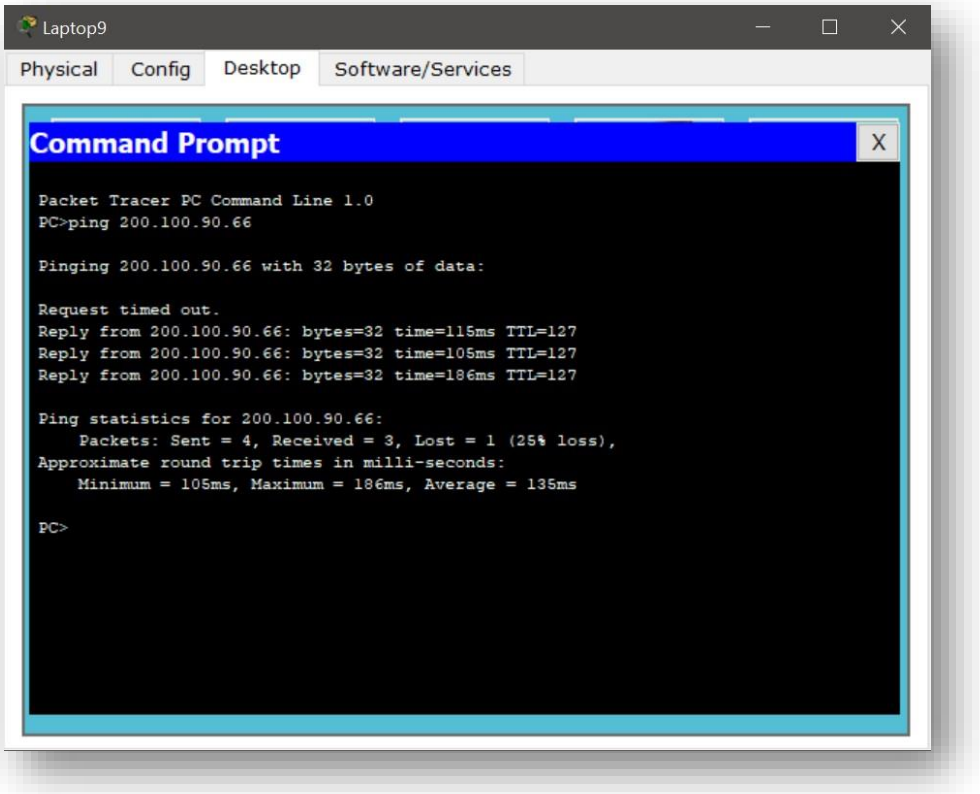
Multilayer trunk configuration





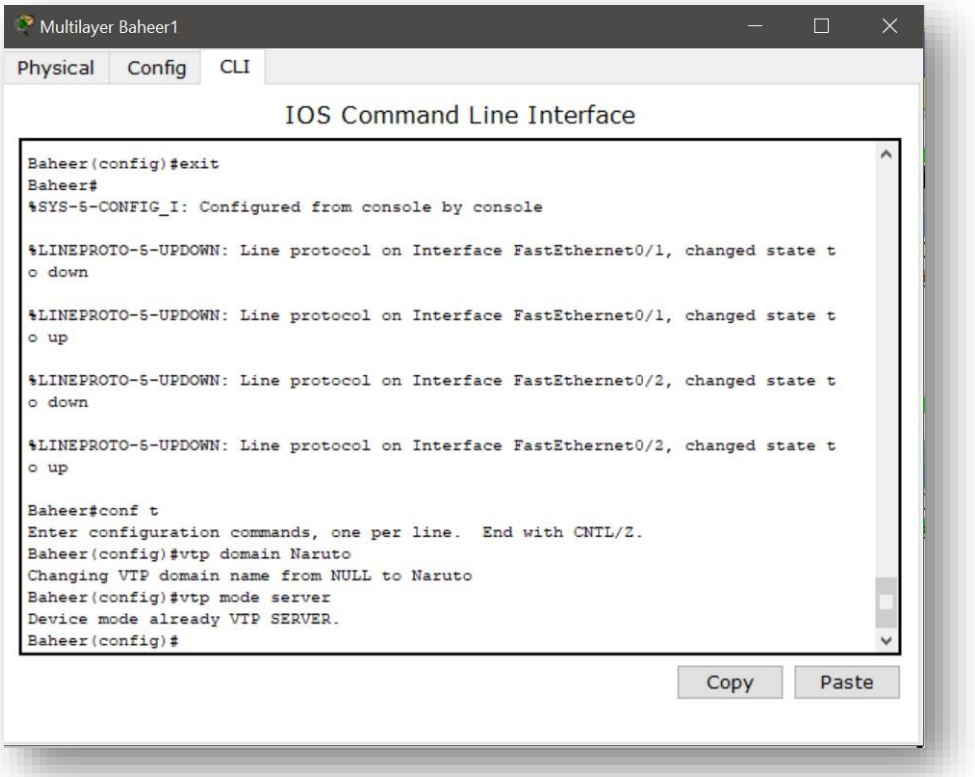
Inter Vlan routing

5. configure inter VLAN routing, also make sure that on a same switch a host on one VLAN is able to interact to the host on another VLAN.



VTP

6. For creating VLANs the use of VTP is preferred.



IP routing

7. A dynamic, static, or a combination of both must be used as a routing mechanism.

RIP routing

Noori1

Physical Config CLI

IOS Command Line Interface

```
     220.100.100.0/26 is subnetted, 4 subnets
C       220.100.100.0 is directly connected, FastEthernet0/0.10
C       220.100.100.64 is directly connected, FastEthernet0/0.20
C       220.100.100.128 is directly connected, FastEthernet0/0.30
C       220.100.100.192 is directly connected, FastEthernet0/0.40
C    221.100.100.0/24 is directly connected, Serial2/0
Noori(config)#router rip
Noori(config-router)#version 2
Noori(config-router)#no auto-summary
Noori(config-router)#network 220.100.100.100.0
                             ^
% Invalid input detected at '^' marker.

Noori(config-router)#network 220.100.100.0
Noori(config-router)#network 220.100.100.64
Noori(config-router)#network 220.100.100.128
Noori(config-router)#network 220.100.100.192
Noori(config-router)#network 221.100.100.0
Noori(config-router)#exit
Noori(config)#do show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
```

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Noori3

Physical Config CLI

IOS Command Line Interface

```
       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

     200.100.90.0/26 is subnetted, 4 subnets
C       200.100.90.0 is directly connected, FastEthernet0/0.50
C       200.100.90.64 is directly connected, FastEthernet0/0.60
C       200.100.90.128 is directly connected, FastEthernet0/0.70
C       200.100.90.192 is directly connected, FastEthernet0/0.80
C    222.100.100.0/24 is directly connected, Serial2/0
Noori(config)#router rip
Noori(config-router)#version 2
Noori(config-router)#no auto-summary
Noori(config-router)#network 200.100.90.0
Noori(config-router)#network 200.100.90.64
Noori(config-router)#network 200.100.90.128
Noori(config-router)#network 200.100.90.192
Noori(config-router)#network 222.100.90.0
Noori(config-router)#
```

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Routing table

Noori0

Physical Config CLI

IOS Command Line Interface

```
R       220.100.100.128 [120/1] via 221.100.100.1, 00:00:04, Serial2/0
R       220.100.100.192 [120/1] via 221.100.100.1, 00:00:04, Serial2/0
C    221.100.100.0/24 is directly connected, Serial2/0
C    222.100.100.0/24 is directly connected, Serial3/0
Noori(config-router)#exit
Noori(config)#do show ip route
Codes: C - connected, S - static, I - IGRP, 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

     200.100.90.0/26 is subnetted, 4 subnets
R       200.100.90.0 [120/1] via 222.100.100.1, 00:00:26, Serial3/0
R       200.100.90.64 [120/1] via 222.100.100.1, 00:00:26, Serial3/0
R       200.100.90.128 [120/1] via 222.100.100.1, 00:00:26, Serial3/0
R       200.100.90.192 [120/1] via 222.100.100.1, 00:00:26, Serial3/0
     220.100.100.0/26 is subnetted, 4 subnets
R       220.100.100.0 [120/1] via 221.100.100.1, 00:00:05, Serial2/0
R       220.100.100.64 [120/1] via 221.100.100.1, 00:00:05, Serial2/0
R       220.100.100.128 [120/1] via 221.100.100.1, 00:00:05, Serial2/0
R       220.100.100.192 [120/1] via 221.100.100.1, 00:00:05, Serial2/0
C    221.100.100.0/24 is directly connected, Serial2/0
C    222.100.100.0/24 is directly connected, Serial3/0
Noori(config)#
```

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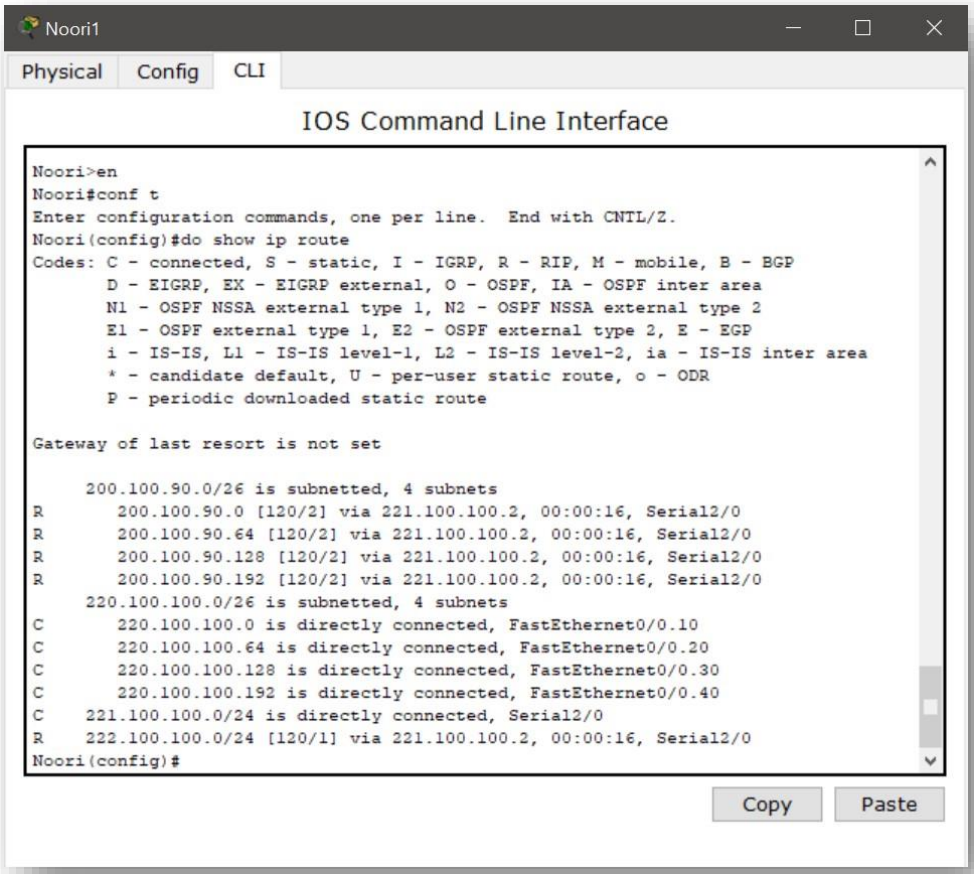
Noori1
Physical
Config
CLI
IOS Command Line Interface
Noori>en
Noori#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Noori(config)#do show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
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
200.100.90.0/26 is subnetted, 4 subnets
R 200.100.90.0 [120/2] via 221.100.100.2, 00:00:16, Serial2/0
R 200.100.90.64 [120/2] via 221.100.100.2, 00:00:16, Serial2/0
R 200.100.90.128 [120/2] via 221.100.100.2, 00:00:16, Serial2/0
R 200.100.90.192 [120/2] via 221.100.100.2, 00:00:16, Serial2/0
220.100.100.0/26 is subnetted, 4 subnets
C 220.100.100.0 is directly connected, FastEthernet0/0.10
C 220.100.100.64 is directly connected, FastEthernet0/0.20
C 220.100.100.128 is directly connected, FastEthernet0/0.30
C 220.100.100.192 is directly connected, FastEthernet0/0.40
C 221.100.100.0/24 is directly connected, Serial2/0
R 222.100.100.0/24 [120/1] via 221.100.100.2, 00:00:16, Serial2/0
Noori(config)#
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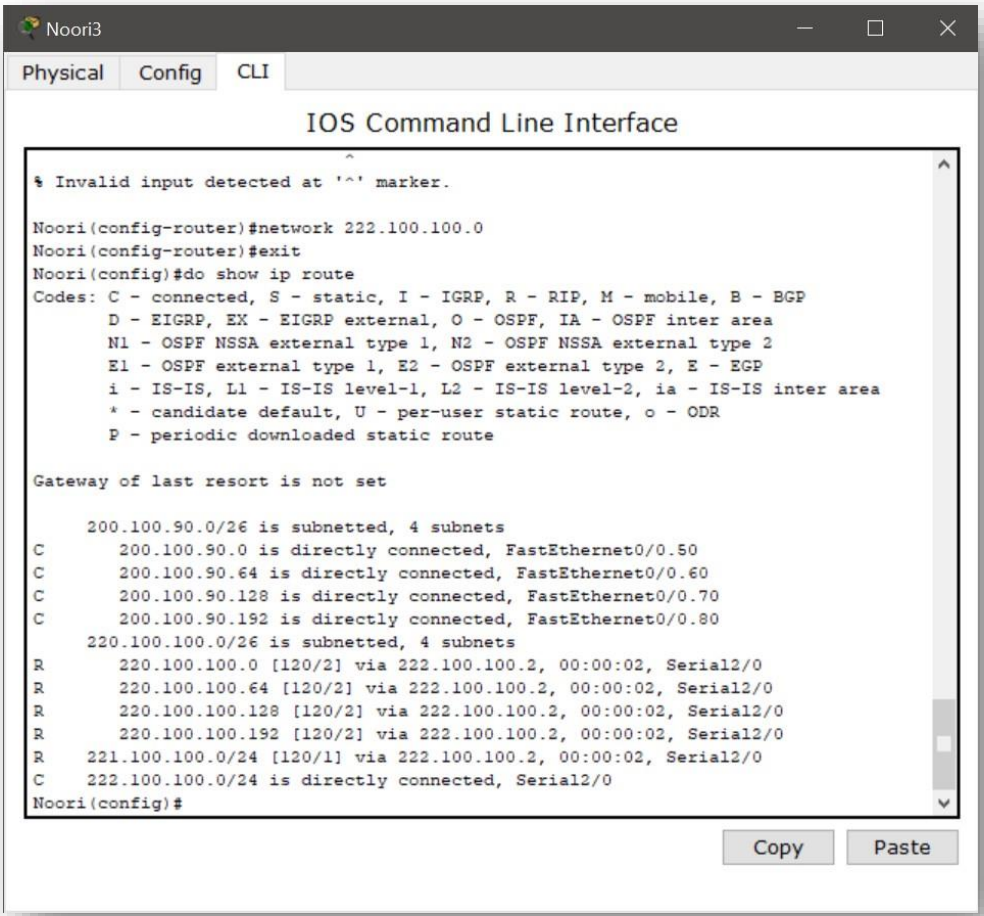
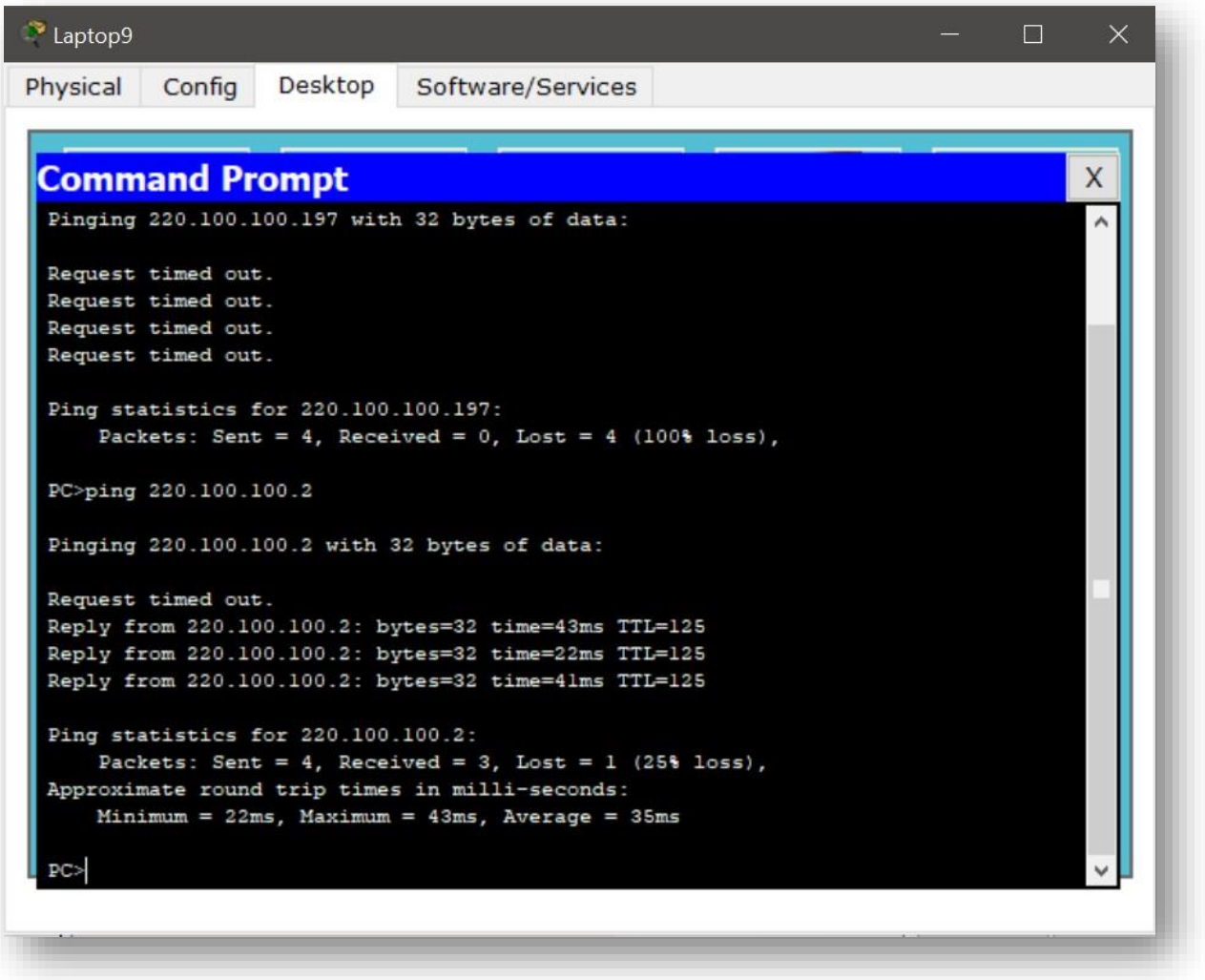
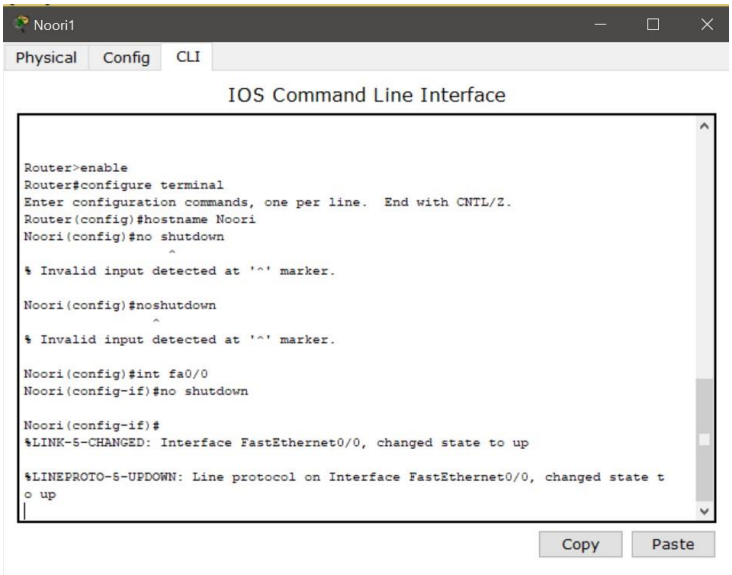

Noori3
Physical
Config
CLI
IOS Command Line Interface
% Invalid input detected at '^' marker.
Noori(config-router)#network 222.100.100.0
Noori(config-router)#exit
Noori(config)#do show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - 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
200.100.90.0/26 is subnetted, 4 subnets
C 200.100.90.0 is directly connected, FastEthernet0/0.50
C 200.100.90.64 is directly connected, FastEthernet0/0.60
C 200.100.90.128 is directly connected, FastEthernet0/0.70
C 200.100.90.192 is directly connected, FastEthernet0/0.80
220.100.100.0/26 is subnetted, 4 subnets
R 220.100.100.0 [120/2] via 222.100.100.2, 00:00:02, Serial2/0
R 220.100.100.64 [120/2] via 222.100.100.2, 00:00:02, Serial2/0
R 220.100.100.128 [120/2] via 222.100.100.2, 00:00:02, Serial2/0
R 220.100.100.192 [120/2] via 222.100.100.2, 00:00:02, Serial2/0
R 221.100.100.0/24 [120/1] via 222.100.100.2, 00:00:02, Serial2/0
C 222.100.100.0/24 is directly connected, Serial2/0
Noori(config)#
Copy
Paste

IP routing testing

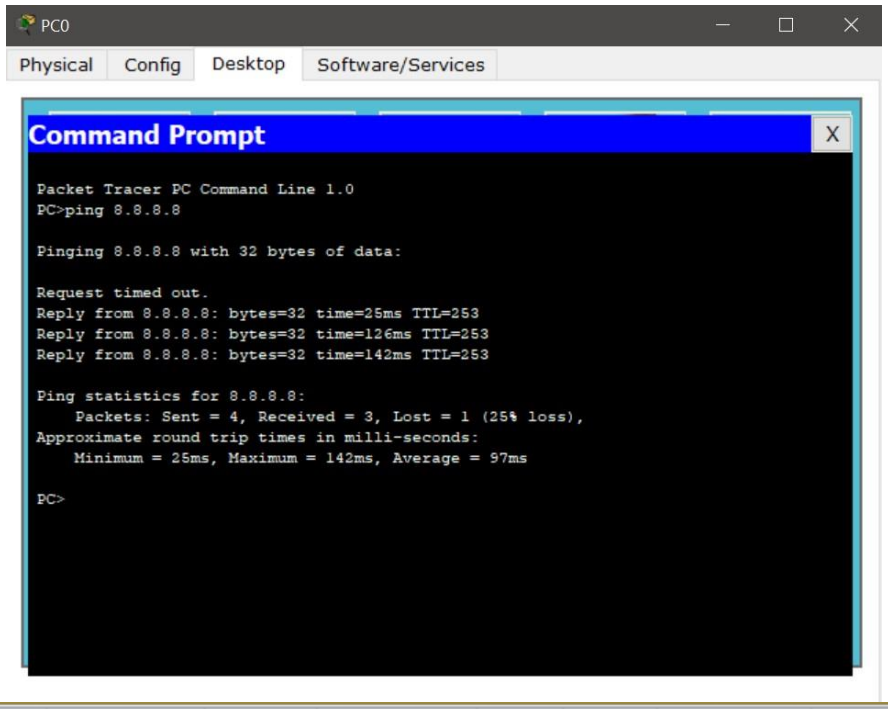


Configuring router

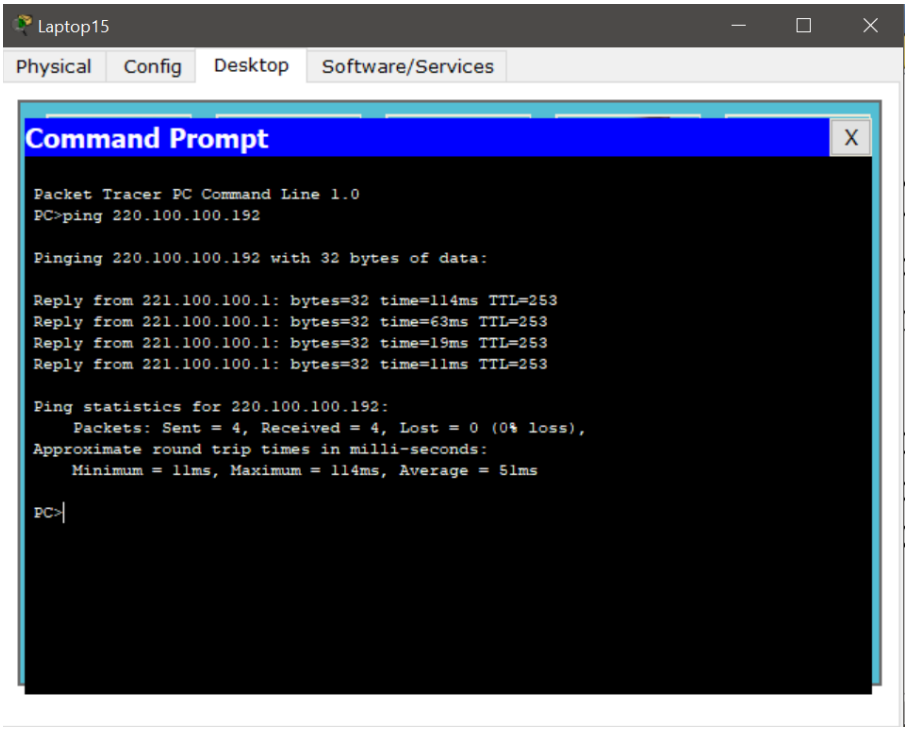


8. The network design has to be debugged and tested for each service that has been implemented, the screenshot of the test result is required in the report.

Here are samples



Fire	Last Status	Source	Destination	Type	Color	Time (sec)	Periodic
	Failed	PC18	PC13	ICMP		0.000	N
	Successful	PC18	PC13	ICMP		0.000	N



Nat

9. The users must have internet service from a single ISP or multiple ISPs, use NAT services.