Static Routing with Least-Cost Path Selection in Triangular Network Topology

1. Introduction

This report documents the configuration of a triangular network topology with three routers (R1, R2, R3), where link costs are:

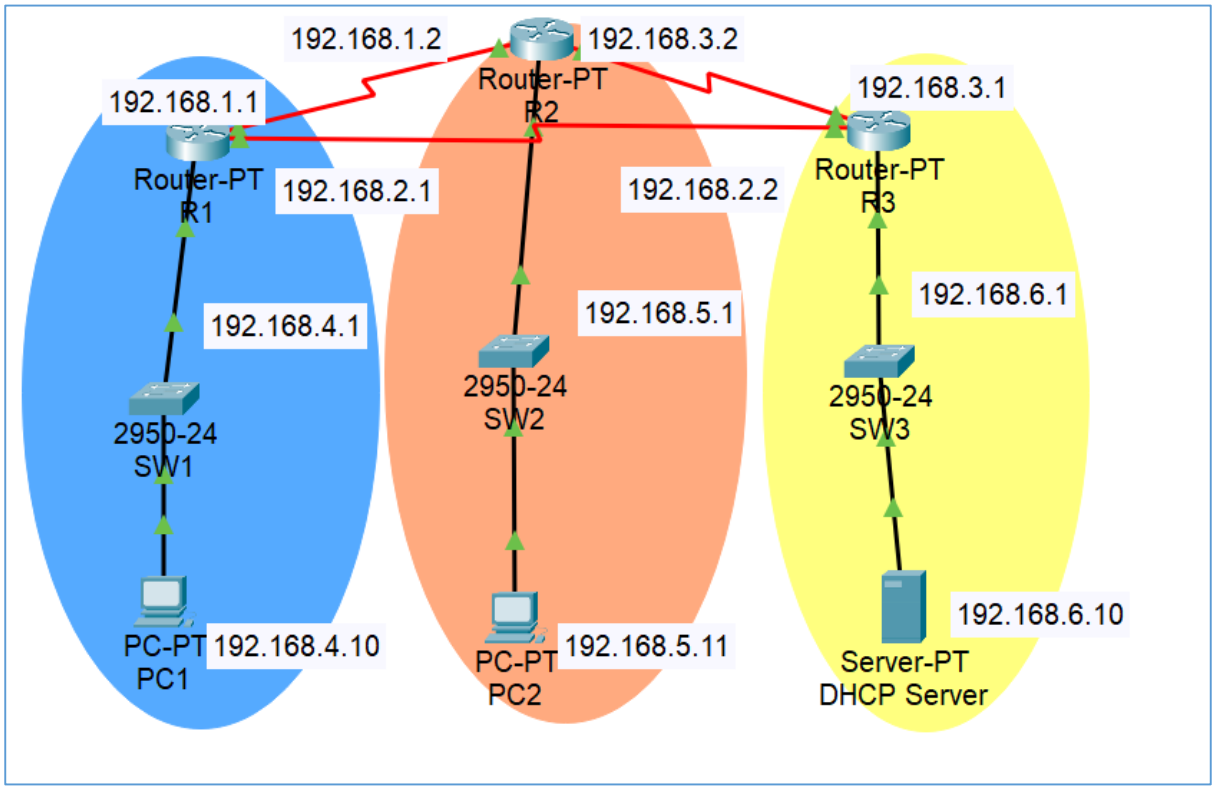
R1–R2 = 3

R1–R3 = 1

R2–R3 = 1

PC1 is connected under R1 via SW1, PC2 under R2 via SW2, and a single DHCP server is connected under R3 via SW3. Static routing tables are configured to ensure traffic follows the least cost path with respect to R1. A successful ping between PC1 and PC2 verifies end-to-end connectivity.

2. Network Topology



Blue Zone: R1 LAN (192.168.4.0/24) — PC1 connected via SW1

Orange Zone: R2 LAN (192.168.5.0/24) — PC2 connected via SW2

Yellow Zone: R3 LAN (192.168.6.0/24) — DHCP Server connected via SW3

All router-to-router links use Gigabit Ethernet

Link Costs:

R1–R2: 3 (Red line)

R1–R3: 1 (Black line)

R2–R3: 1 (Black line)

3. IP Addressing Scheme

Device / Link	IP Address	Subnet Mask	Purpose
R1–R2	192.168.1.1/24	255.255.255.0	Inter-router link
	192.168.1.2/24		
R1–R3	192.168.2.1/24	255.255.255.0	Inter-router link
	192.168.2.2/24		
R2–R3	192.168.3.2/24	255.255.255.0	Inter-router link
	192.168.3.1/24		
R1 LAN (PC1)	192.168.4.1/24	255.255.255.0	Gateway for PC1
PC1	192.168.4.10	255.255.255.0	Assigned by DHCP
R2 LAN (PC2)	192.168.5.1/24	255.255.255.0	Gateway for PC2
PC2	192.168.5.10	255.255.255.0	Assigned by DHCP
R3 LAN (DHCP)	192.168.6.1/24	255.255.255.0	Gateway for DHCP Server
DHCP Server	192.168.6.10	255.255.255.0	Static IP

3.1 On PC1

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::230:A3FF:FE28:91C1
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.4.10
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.4.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: ::
   IPv6 Address.....: ::
   IPv4 Address.....: 0.0.0.0
   Subnet Mask.....: 0.0.0.0
   Default Gateway.....: ::
                                 0.0.0.0
```

```
C:\>ping 192.168.5.11

Pinging 192.168.5.11 with 32 bytes of data:

Request timed out.
Reply from 192.168.5.11: bytes=32 time=2ms TTL=125
Reply from 192.168.5.11: bytes=32 time=2ms TTL=125
Reply from 192.168.5.11: bytes=32 time=2ms TTL=125

Ping statistics for 192.168.5.11:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 2ms, Average = 2ms

C:\>ping 192.168.5.11

Pinging 192.168.5.11 with 32 bytes of data:

Reply from 192.168.5.11: bytes=32 time=2ms TTL=125
Reply from 192.168.5.11: bytes=32 time=2ms TTL=125
Reply from 192.168.5.11: bytes=32 time=2ms TTL=125
Reply from 192.168.5.11: bytes=32 time=2ms TTL=125

Ping statistics for 192.168.5.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 2ms, Average = 2ms
```

```
C:\>ping 192.168.6.10

Pinging 192.168.6.10 with 32 bytes of data:

Reply from 192.168.6.10: bytes=32 time=1ms TTL=126
Reply from 192.168.6.10: bytes=32 time=1ms TTL=126
Reply from 192.168.6.10: bytes=32 time=1ms TTL=126
Reply from 192.168.6.10: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.6.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

3.2 On PC2

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::201:96FF:FE28:5B8A
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.5.11
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.5.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: ::
   IPv6 Address.....: ::
   IPv4 Address.....: 0.0.0.0
   Subnet Mask.....: 0.0.0.0
   Default Gateway.....: ::
                                 0.0.0.0
```

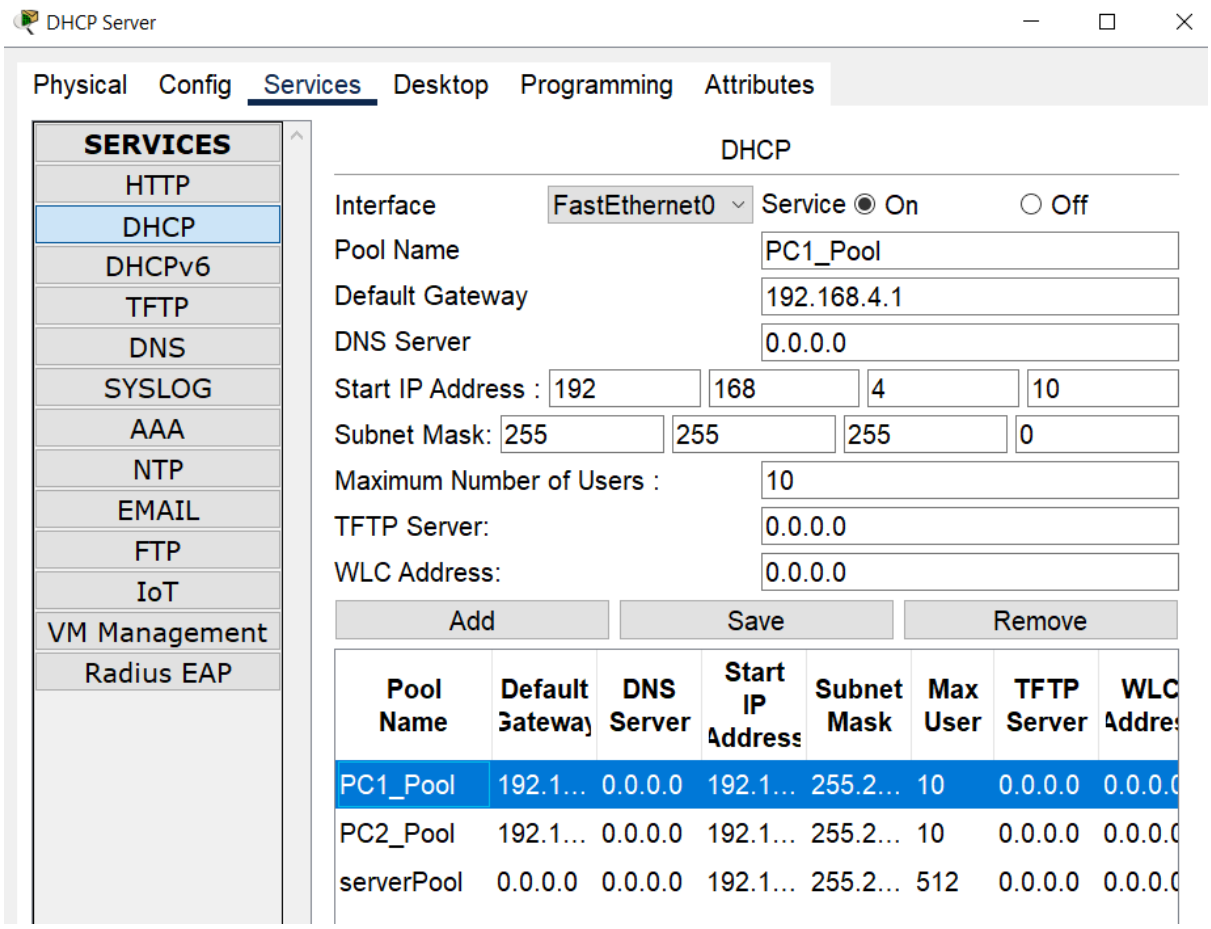
```
C:\>ping 192.168.4.10

Pinging 192.168.4.10 with 32 bytes of data:

Reply from 192.168.4.10: bytes=32 time=10ms TTL=125
Reply from 192.168.4.10: bytes=32 time=2ms TTL=125
Reply from 192.168.4.10: bytes=32 time=2ms TTL=125
Reply from 192.168.4.10: bytes=32 time=2ms TTL=125

Ping statistics for 192.168.4.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 10ms, Average = 4ms

C:\>ping 192.168.6.10

Pinging 192.168.6.10 with 32 bytes of data:

Reply from 192.168.6.10: bytes=32 time=1ms TTL=126
Reply from 192.168.6.10: bytes=32 time=1ms TTL=126
Reply from 192.168.6.10: bytes=32 time=1ms TTL=126
Reply from 192.168.6.10: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.6.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

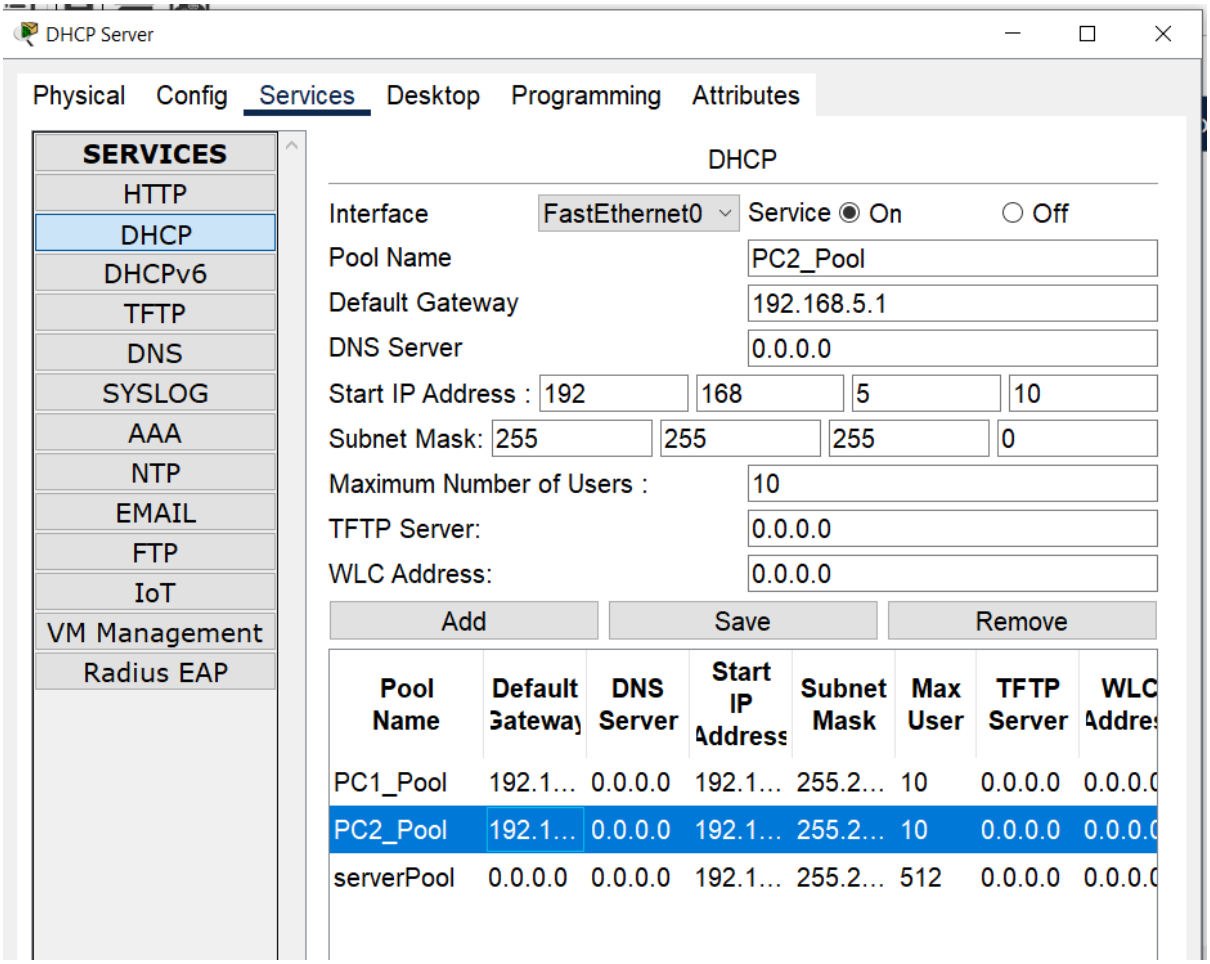
3.3 On PC3

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::20A:41FF:FECD:493B
   IPv6 Address.....: ::
   IPv4 Address.....: 192.168.6.10
   Subnet Mask.....: 255.255.255.0
   Default Gateway.....: ::
                                 192.168.6.1

C:\>ping 192.168.4.10

Pinging 192.168.4.10 with 32 bytes of data:

Reply from 192.168.4.10: bytes=32 time=1ms TTL=126
Reply from 192.168.4.10: bytes=32 time=1ms TTL=126
Reply from 192.168.4.10: bytes=32 time=1ms TTL=126
Reply from 192.168.4.10: bytes=32 time=10ms TTL=126

Ping statistics for 192.168.4.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 3ms
```

```
C:\>ping 192.168.5.11

Pinging 192.168.5.11 with 32 bytes of data:

Reply from 192.168.5.11: bytes=32 time=1ms TTL=126
Reply from 192.168.5.11: bytes=32 time=1ms TTL=126
Reply from 192.168.5.11: bytes=32 time=1ms TTL=126
Reply from 192.168.5.11: bytes=32 time=1ms TTL=126

Ping statistics for 192.168.5.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

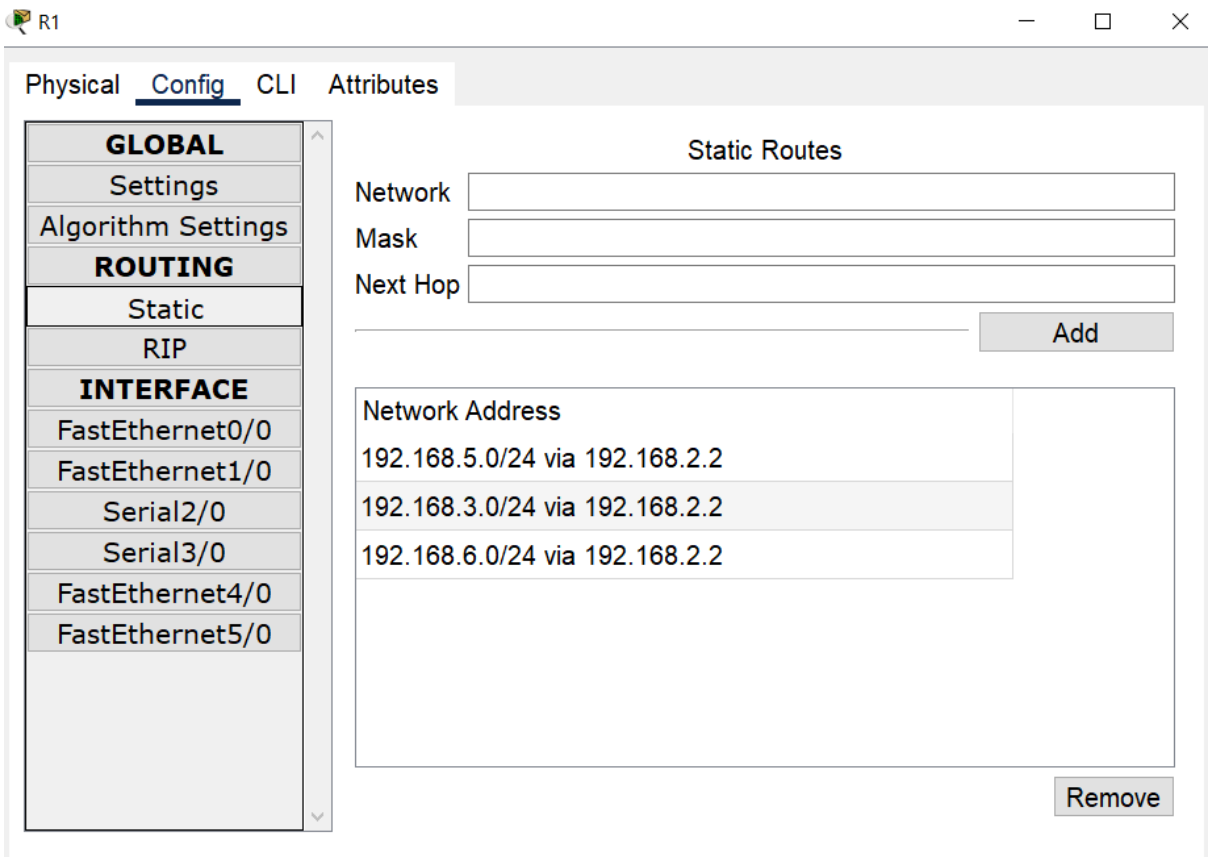
4. **DHCP**


DHCP Server
Physical
Config
Services
Desktop
Programming
Attributes
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
IoT
VM Management
Radius EAP
DHCP
Interface
FastEthernet0
Service
On
Off
Pool Name
PC1_Pool
Default Gateway
192.168.4.1
DNS Server
0.0.0.0
Start IP Address :
192
168
4
10
Subnet Mask:
255
255
255
0
Maximum Number of Users :
10
TFTP Server:
0.0.0.0
WLC Address:
0.0.0.0
Add
Save
Remove
Pool Name
Default Gateway
DNS Server
Start IP Address
Subnet Mask
Max User
TFTP Server
WLC Addres
PC1_Pool
192.1...
0.0.0.0
192.1...
255.2...
10
0.0.0.0
0.0.0.0
PC2_Pool
192.1...
0.0.0.0
192.1...
255.2...
10
0.0.0.0
0.0.0.0
serverPool
0.0.0.0
0.0.0.0
192.1...
255.2...
512
0.0.0.0
0.0.0.0

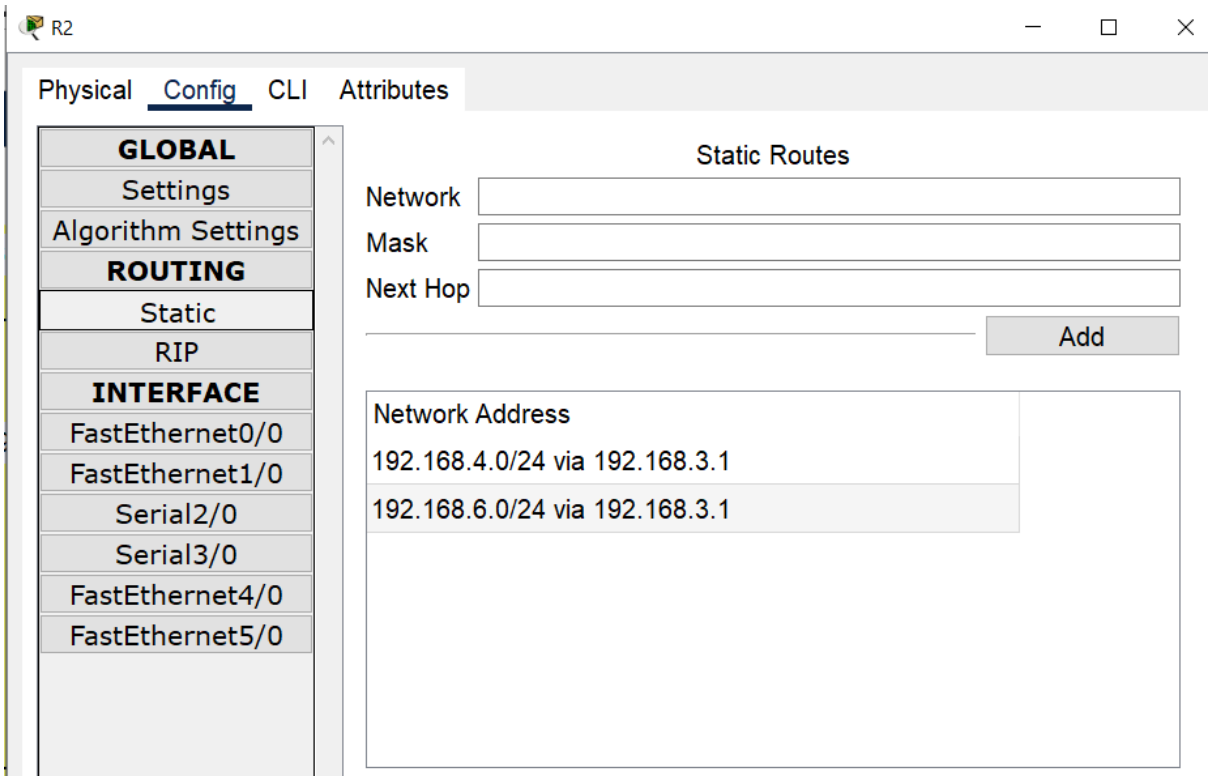


4.1 R1

```
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        192.168.4.1     YES manual up
up
FastEthernet1/0        unassigned      YES unset
administratively down down
Serial2/0              192.168.1.1     YES manual up
up
Serial3/0              192.168.2.1     YES manual up
up
FastEthernet4/0        unassigned      YES unset
administratively down down
FastEthernet5/0        unassigned      YES unset
administratively down down
```

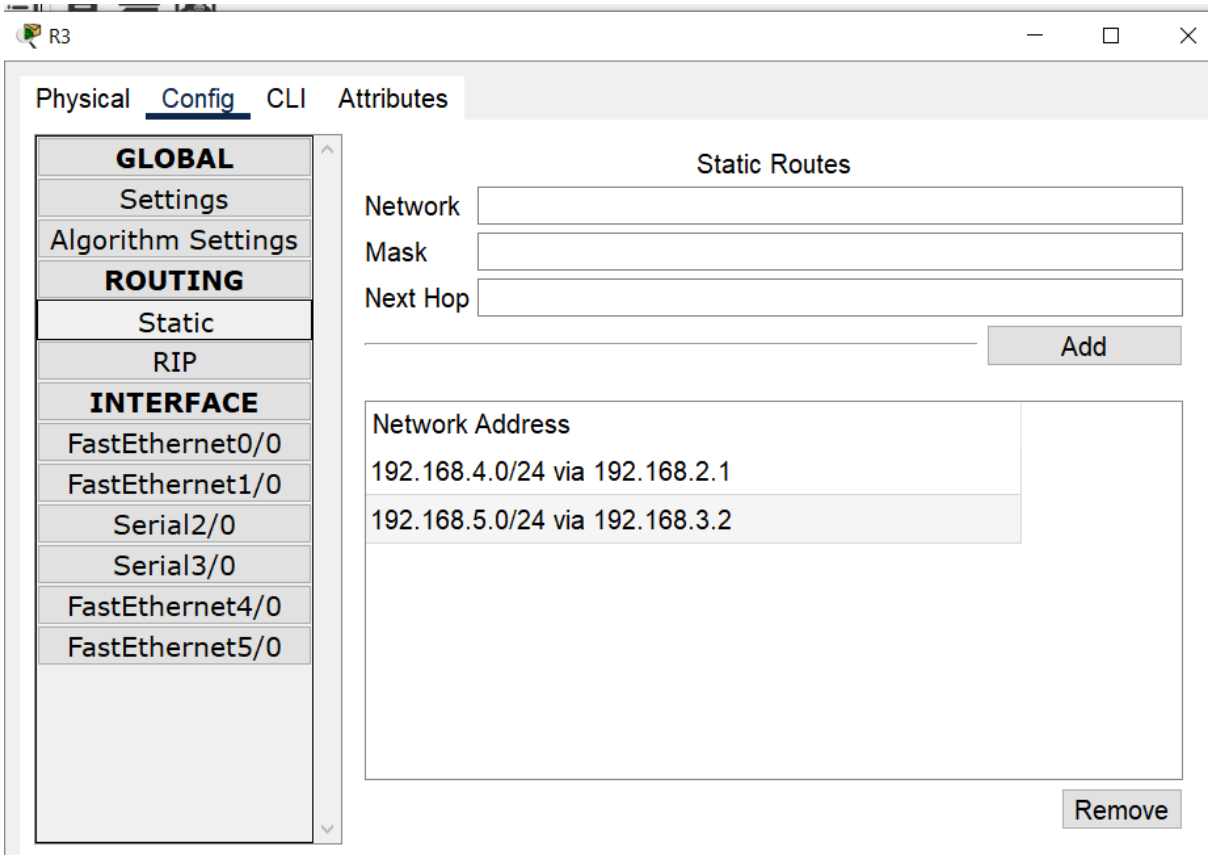

R1
Physical
Config
CLI
Attributes
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
Static Routes
Network
Mask
Next Hop
Add
Network Address
192.168.5.0/24 via 192.168.2.2
192.168.3.0/24 via 192.168.2.2
192.168.6.0/24 via 192.168.2.2
Remove

4.2 R2

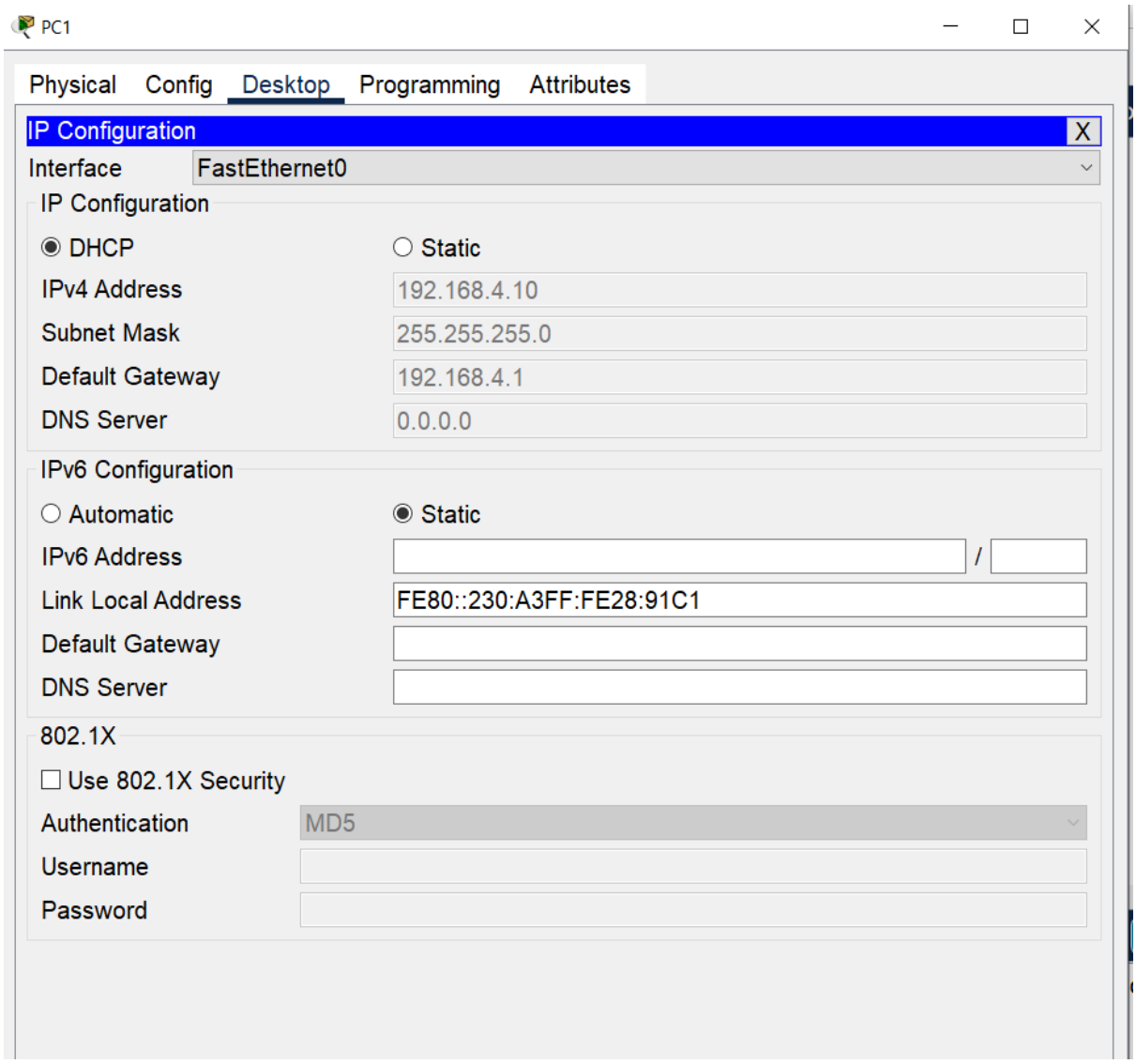

R2
Physical
Config
CLI
Attributes
GLOBAL
Settings
Algorithm Settings
ROUTING
Static
RIP
INTERFACE
FastEthernet0/0
FastEthernet1/0
Serial2/0
Serial3/0
FastEthernet4/0
FastEthernet5/0
Static Routes
Network
Mask
Next Hop
Add
Network Address
192.168.4.0/24 via 192.168.3.1
192.168.6.0/24 via 192.168.3.1

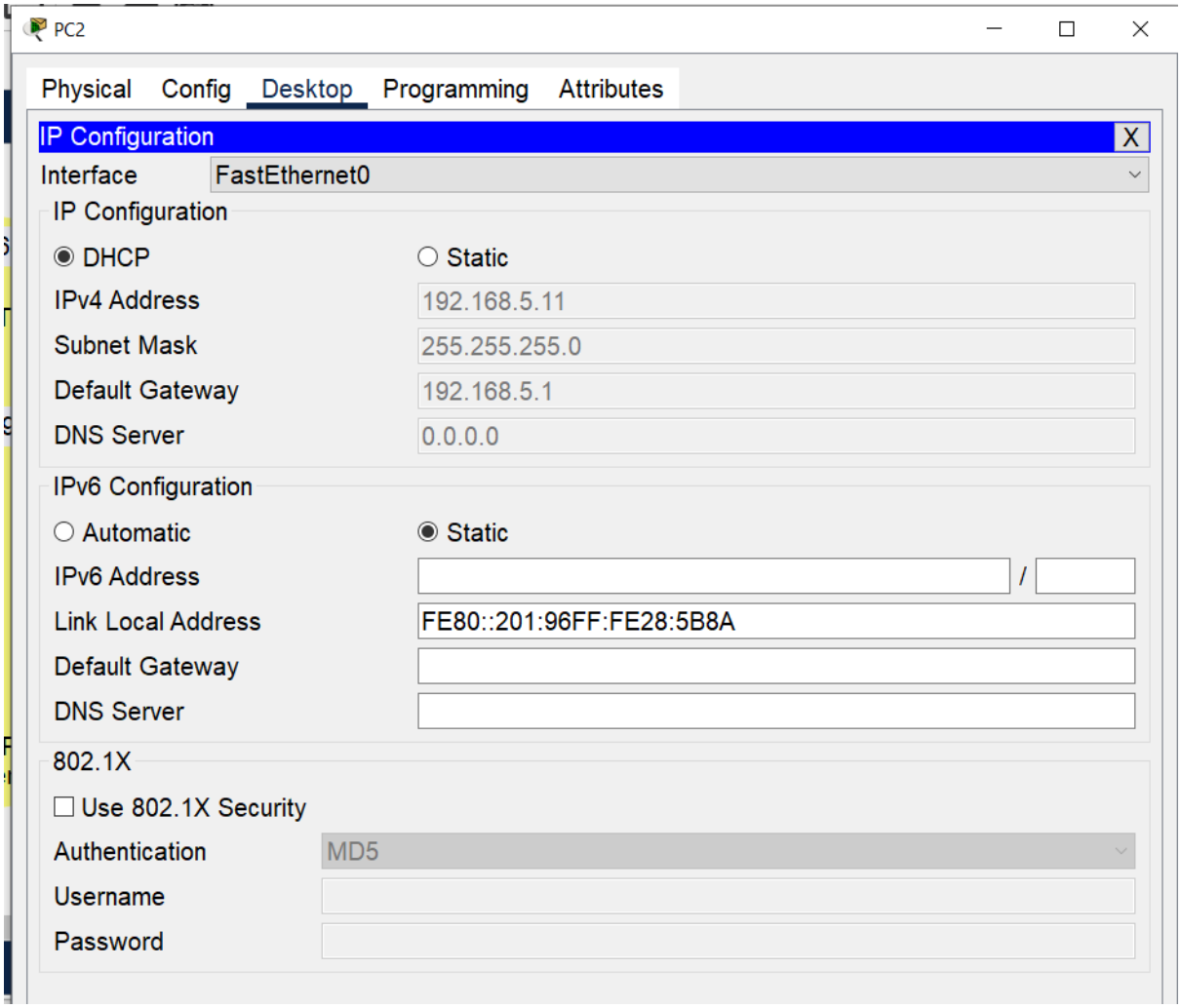
```
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        192.168.5.1     YES manual up
up
FastEthernet1/0        unassigned      YES unset
administratively down down
Serial2/0              192.168.1.2     YES manual up
up
Serial3/0              192.168.3.2     YES manual up
up
FastEthernet4/0        unassigned      YES unset
administratively down down
FastEthernet5/0        unassigned      YES unset
administratively down down
```

4.3 R3



```
Router#
%SYS-5-CONFIG_I: Configured from console by console
show ip interface brief
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        192.168.6.1     YES manual up
up
FastEthernet1/0        unassigned      YES unset
administratively down down
Serial2/0              192.168.3.1     YES manual up
up
Serial3/0              192.168.2.2     YES manual up
up
FastEthernet4/0        unassigned      YES unset
administratively down down
FastEthernet5/0        unassigned      YES unset
administratively down down
```





5. Inference

Inference 1: Even though R1 has a direct link to R2 (cost 3), the least cost path to reach PC2 is via R3 (total cost 2), proving that static routing can optimize paths logically.

Inference 2: DHCP server under R3 (connected via SW3) successfully assigns IPs to both subnets, demonstrating centralized IP management across multiple networks — while strictly following the requirement to use switches for all connections.

Inference 3: All routers have correct static routes ensuring optimal forwarding without dynamic protocols.

Inference 4: Successful ping confirms Layer 3 connectivity across multiple hops using calculated least cost paths — fulfilling the core requirement of the task.

6. Conclusion

The network was successfully configured with:

A single DHCP server under R3 serving both PCs,

Static routes enforcing the least cost path with respect to R1,

Full end-to-end connectivity verified by ping.

All requirements of the exam question have been met.