B. N. N. COLLEGE OF ARTS, SCIENCE & COMMERCE, BHIWANDI.

Padmashri Annasaheb Jadhav Bharatiya Samaj Unnati Mandal's

(Self-Funded Courses)

(Department of Computer Science)

CERTIFICATE

This is to certify that Mr. / Miss. **Tehmina Abdul Latif Hamdule**

Class **MSC. C.S (Part-I)** Exam Seat No. **1290093** has Satisfactorily completed the Practical in **Software Defined Networking**

As laid down in the regulation of University of Mumbai for the purpose of **Practical**

_____Examination 2023 – 2024.

Date:_____

Place:____BHIWANDI____

In- Charge Professor **Signature of External Exa**

Signature of HOD **Signature of Principal**

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Practical No 1

Aim:Implement IP SLA (IP Service Level Agreement)

Introduction:

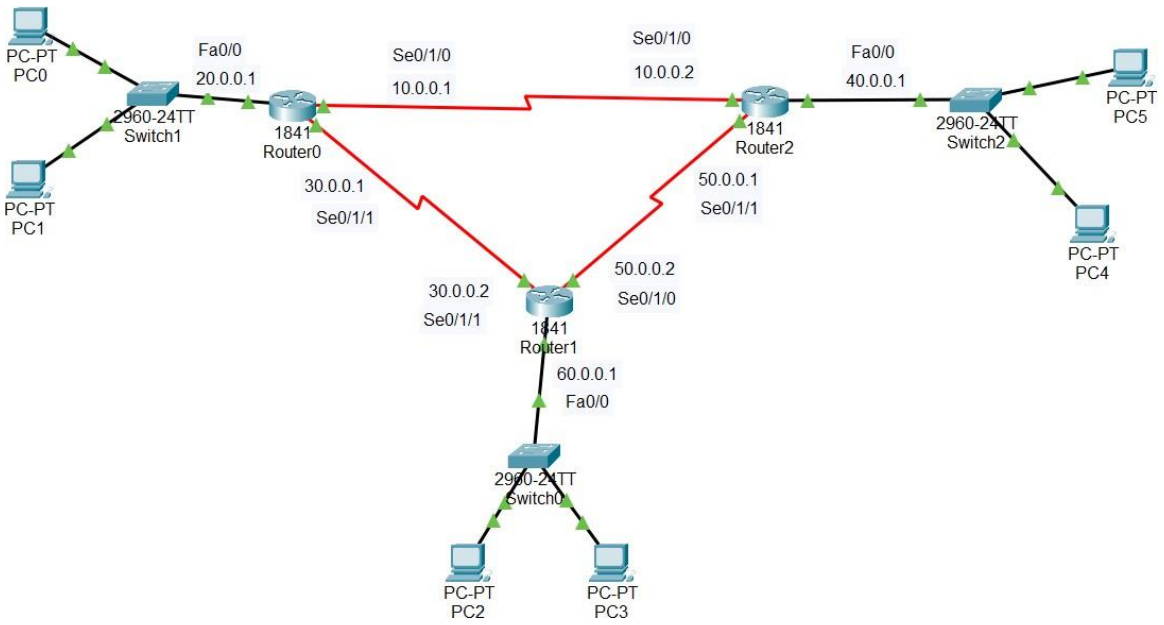
IP Service Level Agreement (IP SLA) is a feature that helps administrators collect information about network performance in real time. With increasing pressure on maintaining agreed-upon Service Level Agreements on Enterprises and ISPs alike, the IP SLA serves as a useful tool.

Any IP SLA test involves a source node and a destination node. For all discussions in this document, the source will always be an HP switch with IP SLA support. A destination can, in most cases, be any IP-enabled device. For some SLA types that expect a nonstandard response to a test packet, an “SLA responder” must be configured. An “SLA responder” is nothing but an HP switch with IP SLA configurations on it that enable it to respond to the test packet.

The IP SLA feature provides:

- Application-aware monitoring that simulates actual protocol packets.
- Predictable measures that aid in ease of deployment and help with assessment of existing network performance.
- Accurate measures of delay and packet loss for time-sensitive applications.
- End-to-end measurements to represent actual user experience.

Topology:


PC-PT
PC0
Fa0/0
20.0.0.1
2960-24TT
Switch1
1841
Router0
Se0/1/0
10.0.0.1
Se0/1/0
10.0.0.2
1841
Router2
Fa0/0
40.0.0.1
2960-24TT
Switch2
PC-PT
PC5
PC-PT
PC1
30.0.0.1
Se0/1/1
50.0.0.1
Se0/1/1
PC-PT
PC4
30.0.0.2
Se0/1/1
50.0.0.2
Se0/1/0
1841
Router1
60.0.0.1
Fa0/0
2960-24TT
Switch0
PC-PT
PC2
PC-PT
PC3

Command

s:Router

```
exit
0:conf t
router ospf 1
network 10.0.0.0 0.255.255.255 area 0
network 20.0.0.0 0.255.255.255 area 0
network 30.0.0.0 0.255.255.255 area 0
exit
```

```
Router(config-if)#exit
Router(config)#conf t
%Invalid hex value
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20.0.0.0 0.255.255.255 area 0
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
```

Router 1:

```
en
conf t
router ospf 1
network 30.0.0.0 0.255.255.255 area 0
network 50.0.0.0 0.255.255.255 area 0
network 60.0.0.0 0.255.255.255 area 0
exit
```

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
00:15:43: %OSPF-5-ADJCHG: Process 1, Nbr 30.0.0.1 on Serial0/1/
Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Router(config-router)#network 50.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
```

Router 2:

```
en
conf t
router ospf 1
network 10.0.0.0 0.255.255.255 area 0
network 40.0.0.0 0.255.255.255 area 0
network 50.0.0.0 0.255.255.255 area 0
exit
```

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#
00:20:09: %OSPF-5-ADJCHG: Process 1, Nbr 30.0.0.1 on Serial0/1/0 from LOADING to FULL, Loading
Done

Router(config-router)#network 50.0.0.0 0.255.255.255 area 0
Router(config-router)#
00:20:27: %OSPF-5-ADJCHG: Process 1, Nbr 50.0.0.1 on Serial0/1/1 from LOADING to FULL, Loading
Done

Router(config-router)#network 60.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
```

Packet Delivery after implementing OSPF:-

PDU List Window

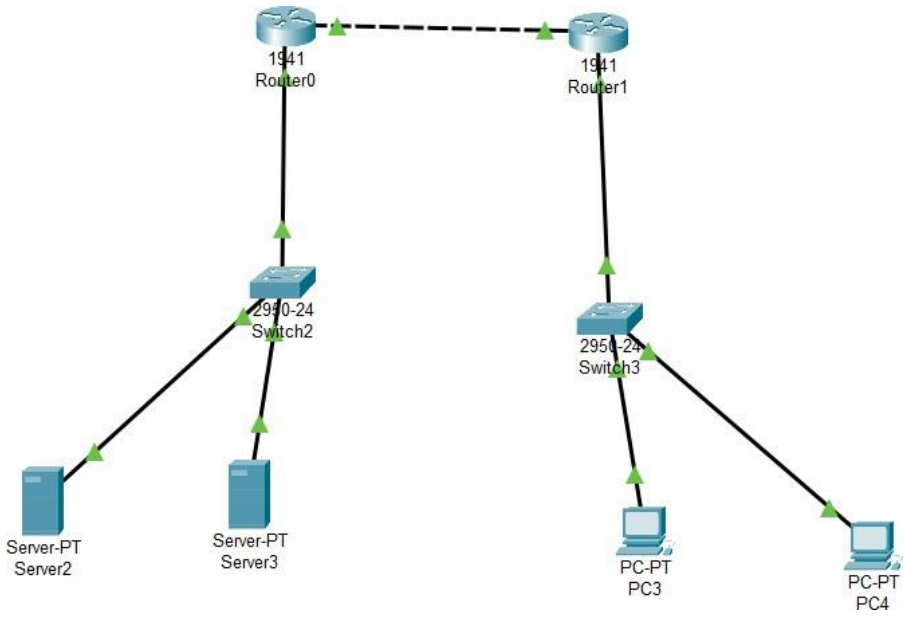
Fire	Last Status	Source	Destination	Type	Color	Time(sec	Periodic	Num	Edit	Delete
	Successful	PC0	PC3	ICMP		0.000	N	0	(edit)	
	Successful	PC0	PC4	ICMP		0.000	N	1	(edit)	
	Successful	PC5	PC1	ICMP		0.000	N	2	(edit)	
	Successful	PC5	PC2	ICMP		0.000	N	3	(edit)	

Practical No 2

Aim: Access control list

Requirement: 2 switches, 2 routers, 2 servers, 2pc

Topology:



```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip access-list extended abc
Router(config-ext-nacl)#permit tcp host 192.168.3.2 host
192.168.1.3 eq www
Router(config-ext-nacl)#permit tcp host 192.168.3.2 host
192.168.1.3 eq www
Router(config-ext-nacl)#deny tcp host 192.168.3.3 host
192.168.1.3 eq www
Router(config-ext-nacl)#exit
Router(config)#
```

Ctrl+F6 to exit CLI focus | Copy | Paste

Top

```
Router(config-ext-nacl)#exit
Router(config)#int gig0/1
Router(config-if)#ip access-group abc
% Incomplete command.
Router(config-if)#ip access-group abc out
Router(config-if)#
```

Ctrl+F6 to exit CLI focus | Copy | Paste

```
Router(config-if)#do sh access-lists
Extended IP access list abc
    10 permit tcp host 192.168.3.2 host 192.168.1.3 eq www
    20 deny tcp host 192.168.3.3 host 192.168.1.3 eq www

Router(config-if)#
```

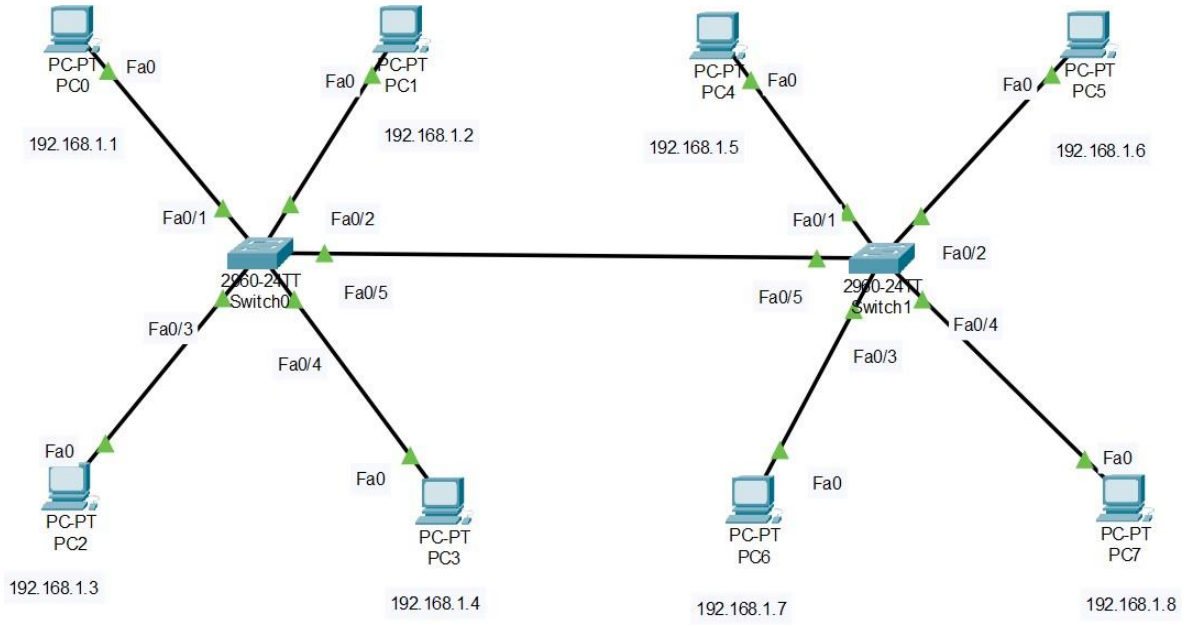
Ctrl+F6 to exit CLI focus | Copy | Paste

Practical No 3

Aim: Implement Inter – VLAN Routing

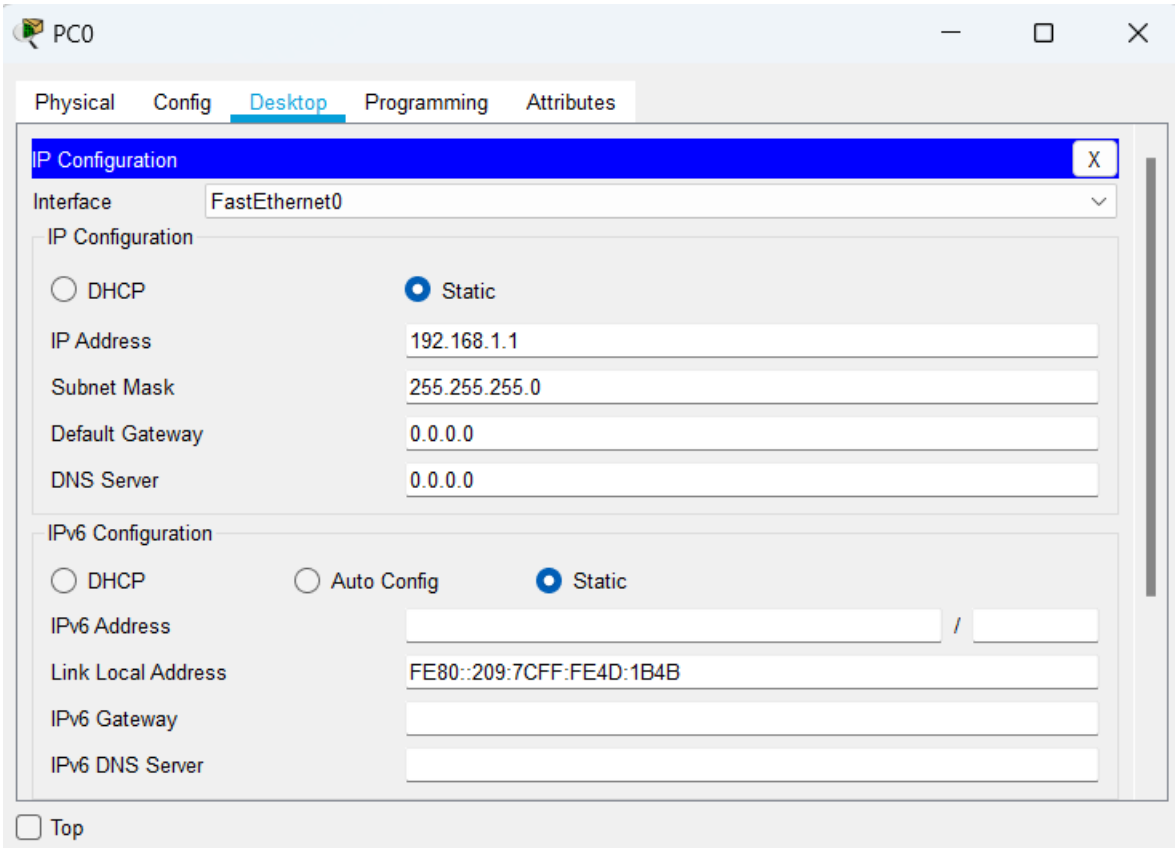
Requirement: 2 Switches and 8 End points

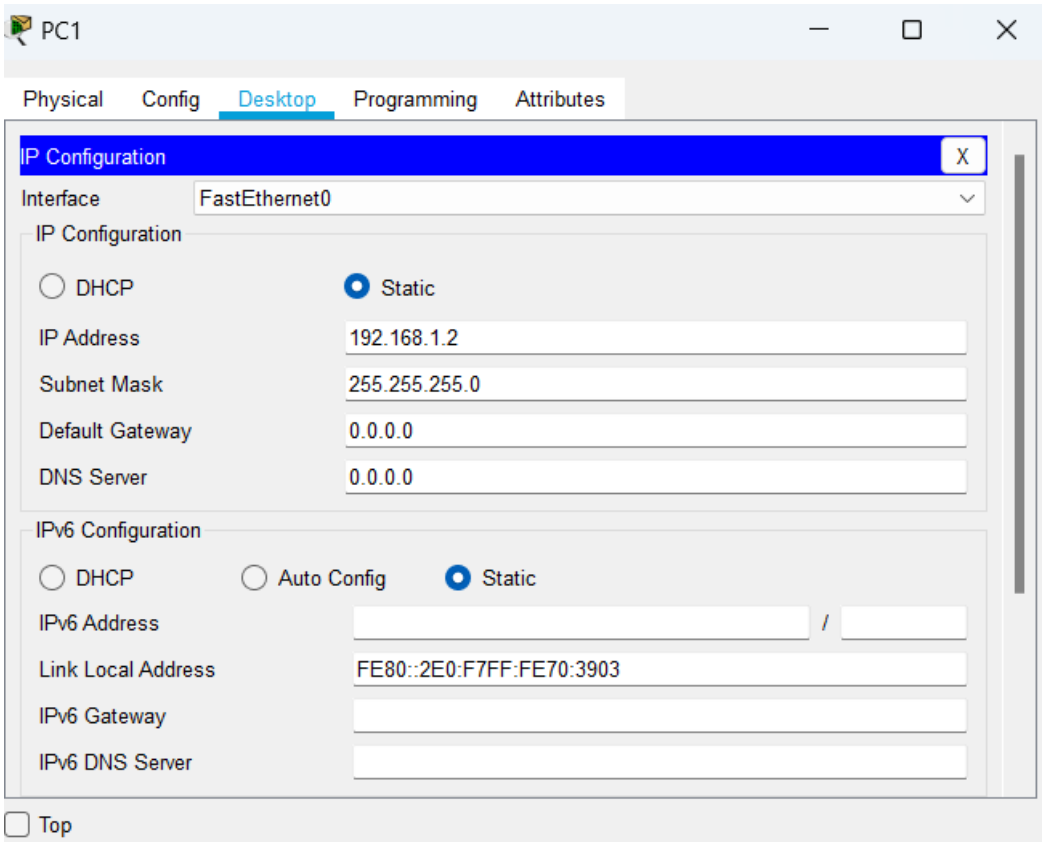
Topology:



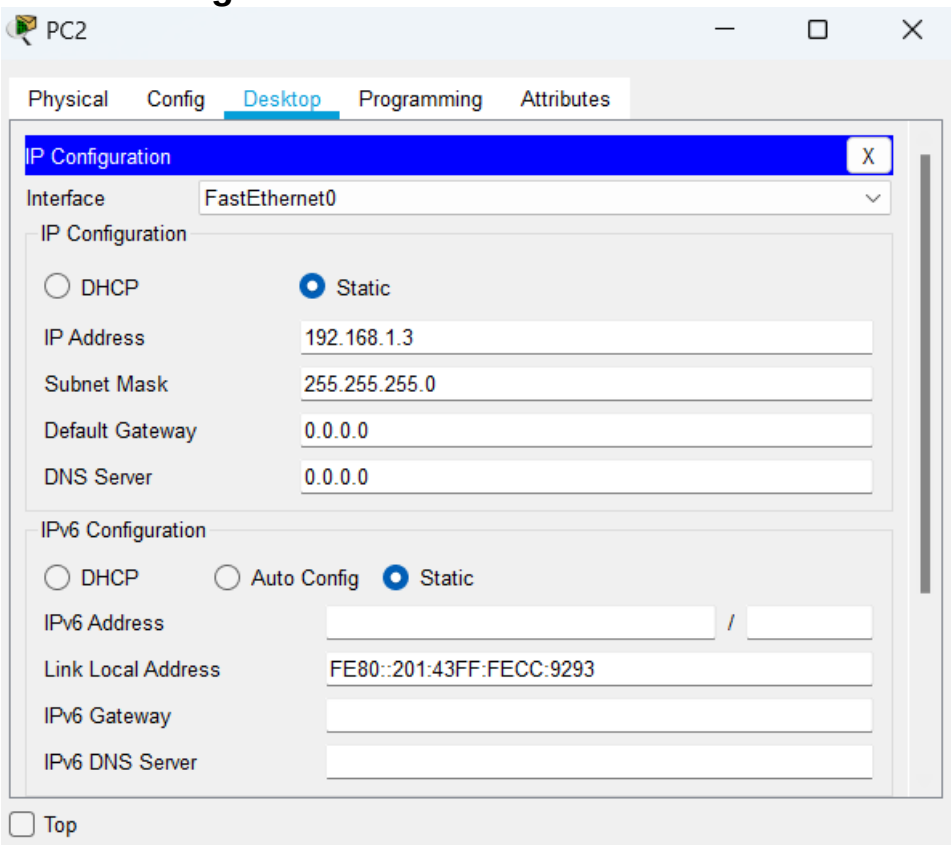
Step-1:

Configure PC0

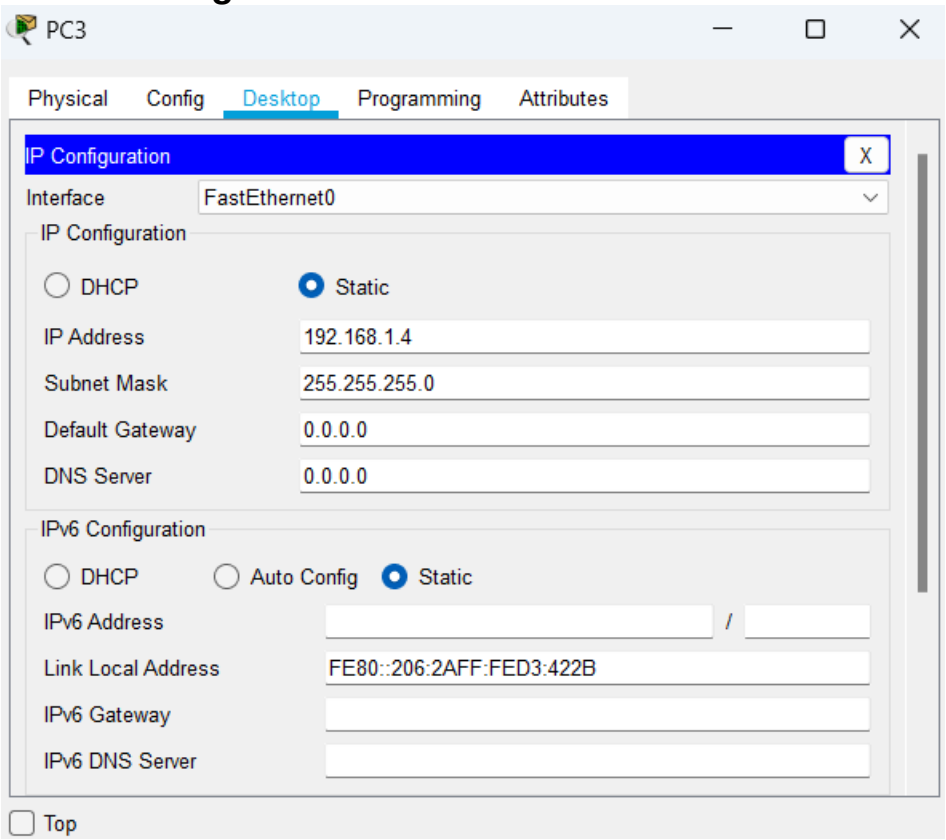



PC1
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IP Address
192.168.1.2
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::2E0:F7FF:FE70:3903
IPv6 Gateway
IPv6 DNS Server
Top

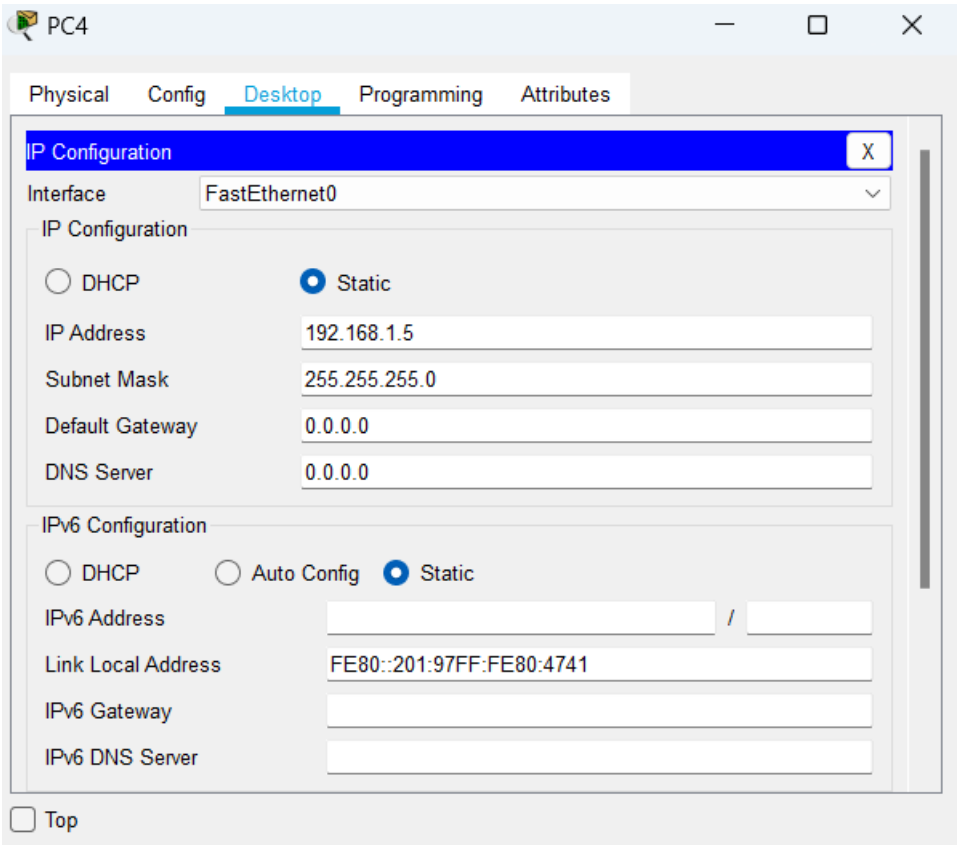
Configure PC2



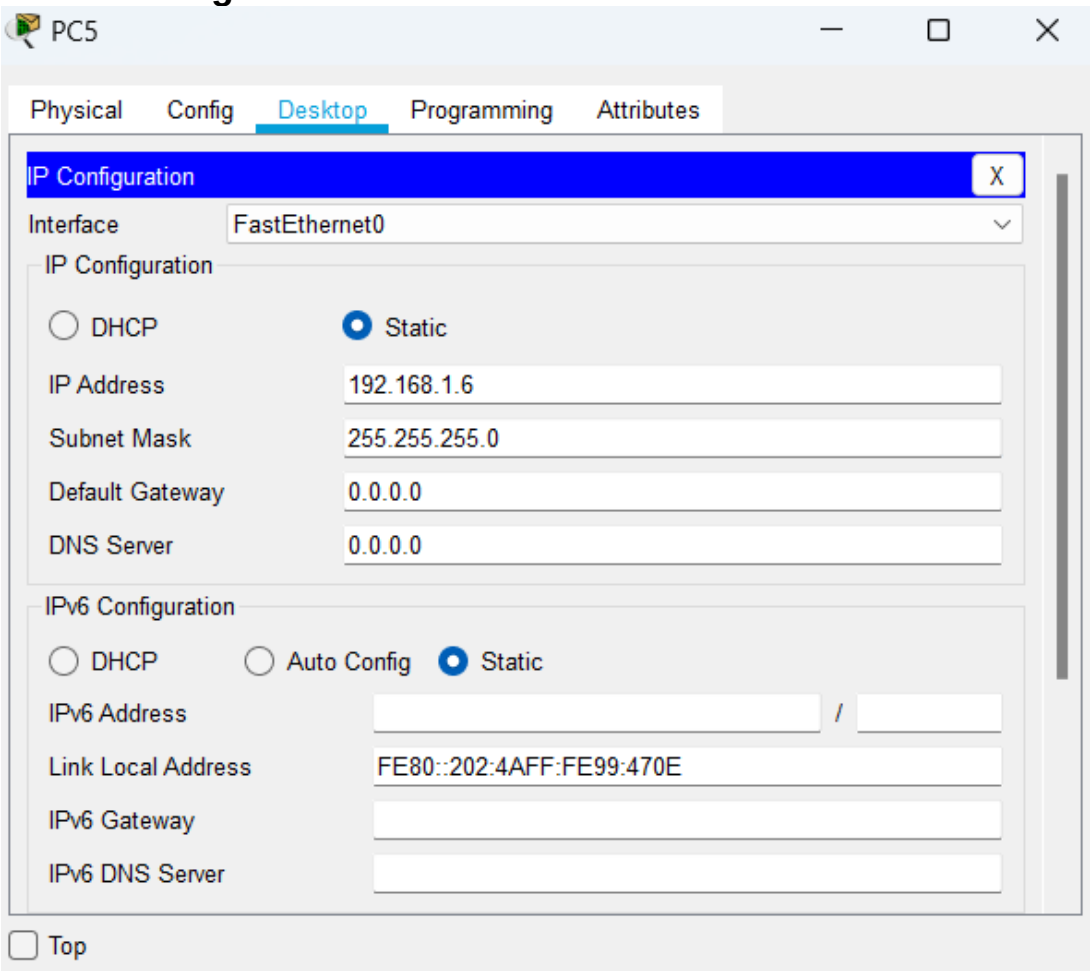
Configure PC3

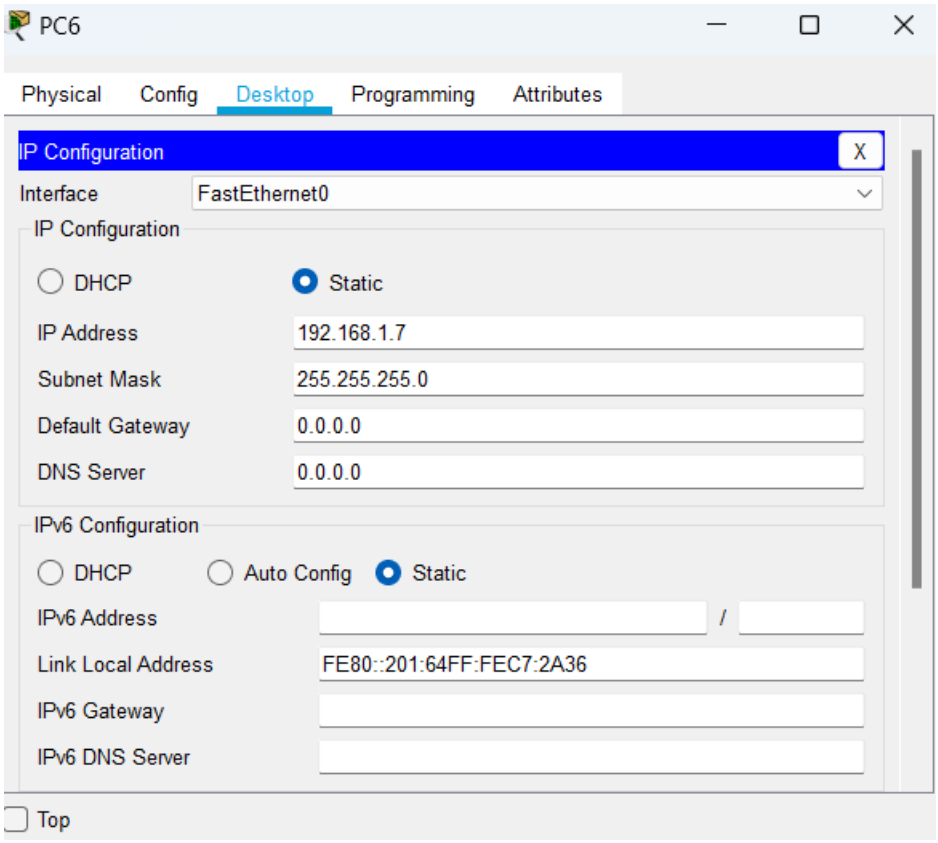


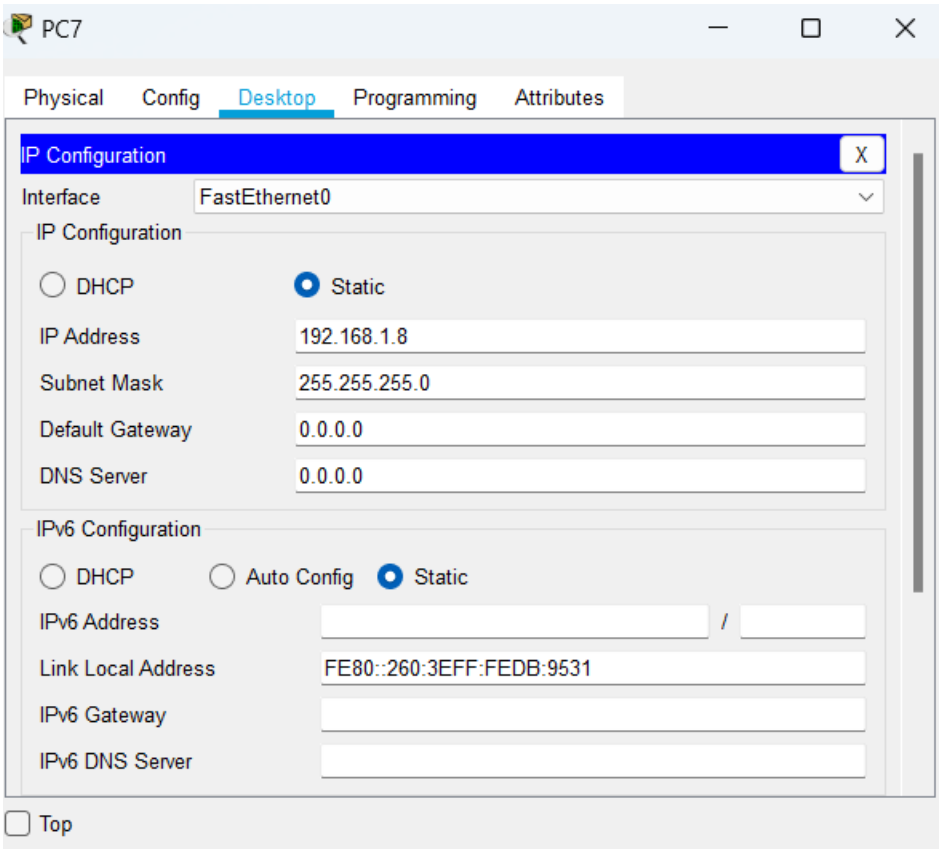
Configure PC4


PC4
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IP Address
192.168.1.5
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::201:97FF:FE80:4741
IPv6 Gateway
IPv6 DNS Server
Top

Configure PC5




PC6
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IP Address
192.168.1.7
Subnet Mask
255.255.255.0
Default Gateway
0.0.0.0
DNS Server
0.0.0.0
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
/
Link Local Address
FE80::201:64FF:FEC7:2A36
IPv6 Gateway
IPv6 DNS Server
Top



Step-2:

Create VLAN on Switch0

Switch>en Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name up
Switch(config-vlan)#vlan 20 Switch(config-
vlan)#name down Switch(config-vlan)#do
sh vlan br

VLAN Name Status Ports
---

1 default active Fa0/1, Fa0/2, Fa0/3, Fa0/4Fa0/5,
Fa0/6, Fa0/7, Fa0/8
Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13,
Fa0/14, Fa0/15, Fa0/16Fa0/17, Fa0/18,
Fa0/19, Fa0/20

Fa0/21, Fa0/22, Fa0/23, Fa0/24
Gig0/1, Gig0/210 up
active
20 down active
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch(config-vlan)#int f0/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#int f0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#int f0/3
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#int f0/4
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#

Create VLAN on Switch1

Switch>en Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.Switch(config)#vlan 10
Switch(config-vlan)#name up Switch(config-
vlan)#vlan 20 Switch(config-vlan)#name down
Switch(config-vlan)#int f0/1 Switch(config-
if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#int f0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#int f0/3
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#int f0/4

```
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#
```

Connecting two switches to allow data from 2 VLANs

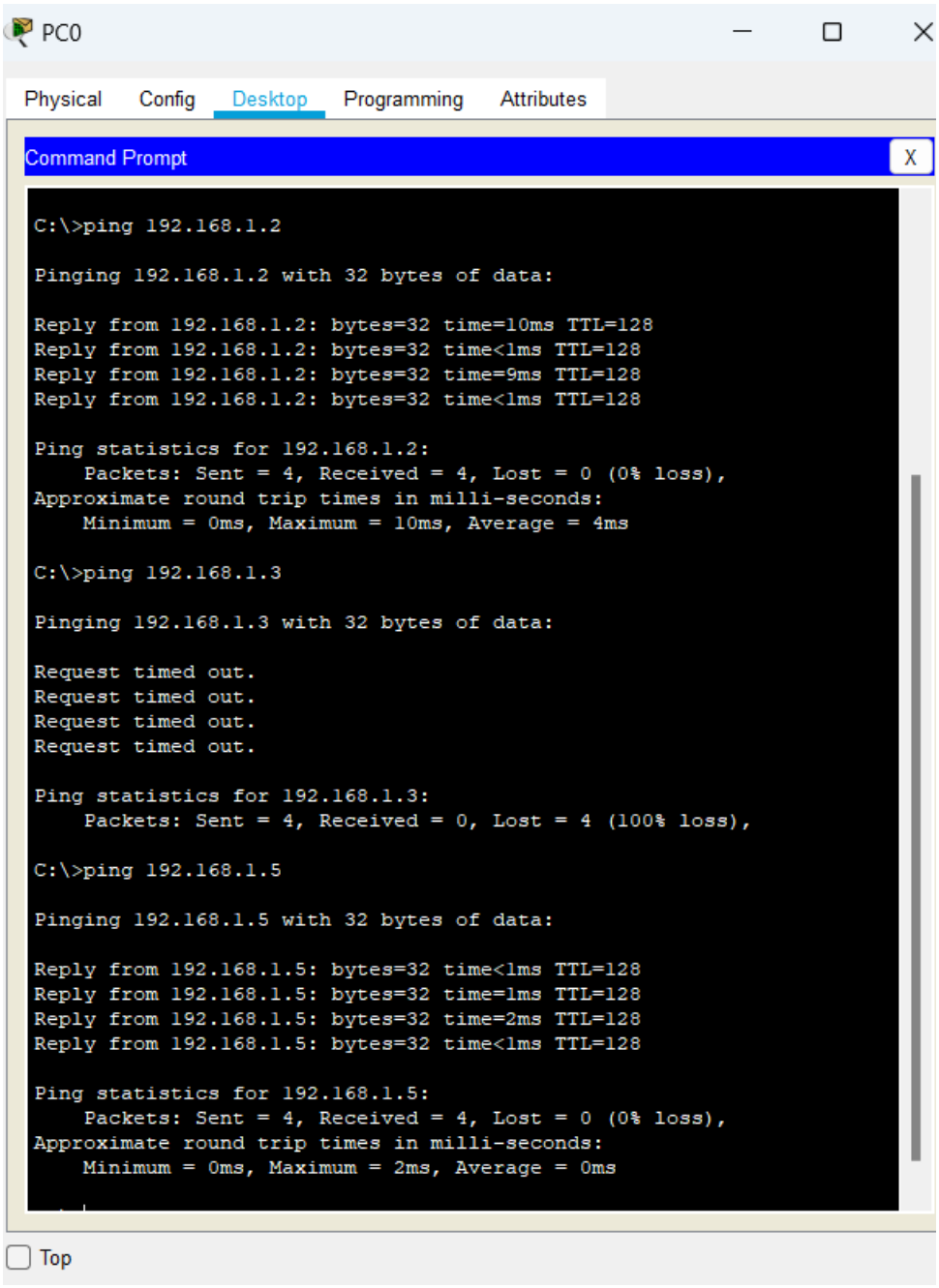
On switch0

```
Switch(config-if)#int f0/5
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/5, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/5, changed state to up
```

On Switch1

```
Switch(config-if)#int f0/5
Switch(config-if)#switchport mode trunk
Switch(config-if)#
```

Output:


PC0
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
C:\>ping 192.168.1.2
Pinging 192.168.1.2 with 32 bytes of data:
Reply from 192.168.1.2: bytes=32 time=10ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time=9ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.1.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 10ms, Average = 4ms
C:\>ping 192.168.1.3
Pinging 192.168.1.3 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 192.168.1.3:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\>ping 192.168.1.5
Pinging 192.168.1.5 with 32 bytes of data:
Reply from 192.168.1.5: bytes=32 time<1ms TTL=128
Reply from 192.168.1.5: bytes=32 time=1ms TTL=128
Reply from 192.168.1.5: bytes=32 time=2ms TTL=128
Reply from 192.168.1.5: bytes=32 time<1ms TTL=128
Ping statistics for 192.168.1.5:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 2ms, Average = 0ms
Top

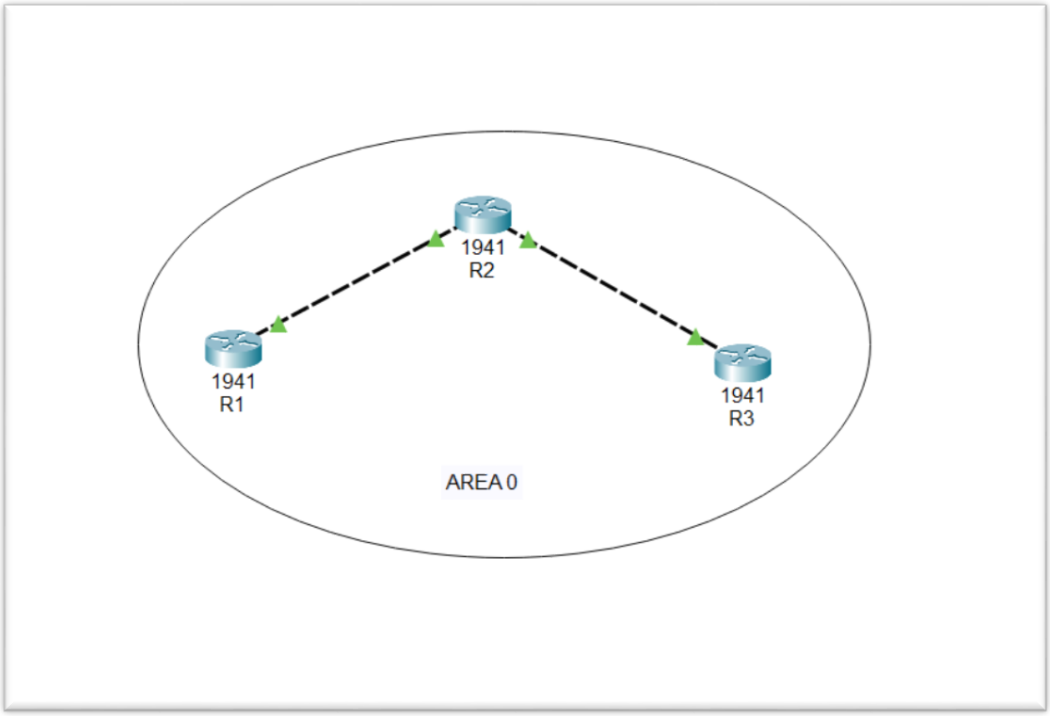
Practical -4

Aim:OSPF Implementation 1.Implement Single Area OSPFv22.Implement Multi Area OSPFv2

SOLUTION:

1. Implement Single Area OSPFv2

TOPOLOGY 1:



Steps:

Configuration table:

Devices	Interface	IP-address	Subnet mask
R1	Gig0/0	10.10.10.1	255.255.255.0
R2	Gig0/0	10.10.10.2	255.255.255.0
	Gig0/1	20.20.20.2	255.255.255.0
R3	Gig0/0	20.20.20.1	255.255.255.0

On router R1 perform the following commands

Router#en

Router#conf t

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#router ospf 1

Router(config-router)#network 10.10.10.0 0.0.0.255 area 0

Router(config-router)#

00:11:39: %OSPF-5-ADJCHG: Process 1, Nbr 20.20.20.2 on GigabitEthernet0/0 from LOADING to FULL, Loading Done

On router R2 perform the following commands Router(config-router)#network 10.10.10.0 0.0.0.255 area 0

Router(config-router)#network 20.20.20.0 0.0.0.255 area 0

Router(config-router)#

00:12:57: %OSPF-5-ADJCHG: Process 1, Nbr 20.20.20.1 on GigabitEthernet0/1 from LOADING to FULL, Loading Done

On router R3 perform the following commandsospf 1

Router(config-router)#network 20.20.20.0 0.0.0.255 area 0

Router(config-router)#

00:12:54: %OSPF-5-ADJCHG: Process 1, Nbr 20.20.20.2 on GigabitEthernet0/0 from LOADING to FULL, Loading Done

Now let's ping from router R1 to R2 and R3

Router(config)#do ping 10.10.10.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.10.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

Router(config)#do ping 20.20.20.1

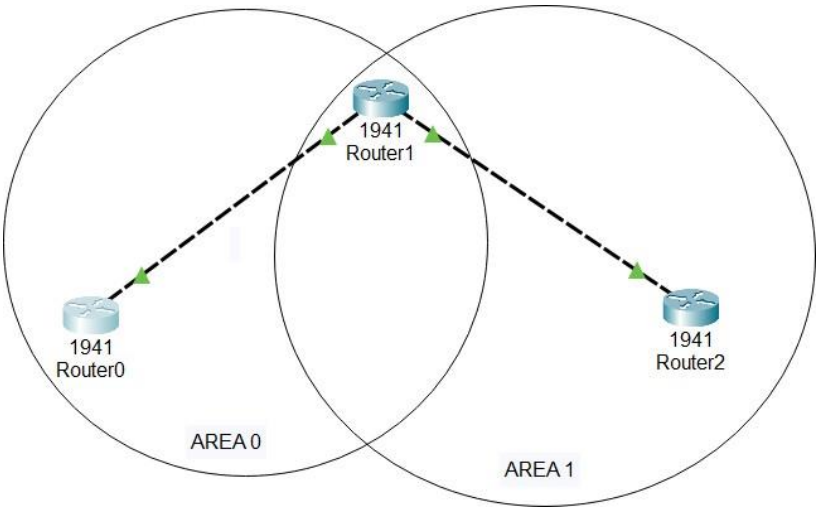
Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 20.20.20.1, timeout is 2 seconds:

!!!!!

Implement Multi Area OSPFv2

TOPOLOGY 2:



Steps:

Configuration table:

Devices	Interface	IP-address	Subnet mask
R1	Gig0/0	10.10.10.1	255.255.255.0
R2	Gig0/0	10.10.10.2	255.255.255.0

	Gig0/1	20.20.20.2	255.255.255.0
R3	Gig0/0	20.20.20.1	255.255.255.0

On router R1 perform the following commands:Router#en

Router#conf t

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#router ospf 1

Router(config-router)#network 10.10.10.0 0.0.0.255 area 0

Router(config-router)#

00:09:44: %OSPF-5-ADJCHG: Process 1, Nbr 20.20.20.2 on GigabitEthernet0/0 from LOADING to FULL, Loading Done

On router R2 perform the following commands:Router(config)#router ospf 1

Router(config-router)#network 10.10.10.0 0.0.0.255 area 0

Router(config-router)#

00:09:42: %OSPF-5-ADJCHG: Process 1, Nbr 10.10.10.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done

Router(config-router)#network 20.20.20.0 0.0.0.255 area 1

Router(config-router)#

00:11:20: %OSPF-5-ADJCHG: Process 1, Nbr 20.20.20.1 on GigabitEthernet0/1 from LOADING to FULL, Loading Done

On router R3 perform the following commands:

Router(config)#router ospf 1

Router(config-router)#network 20.20.20.0 0.0.0.255 area 1

Router(config-router)#

00:11:17: %OSPF-5-ADJCHG: Process 1, Nbr 20.20.20.2 on GigabitEthernet0/0 from LOADING to FULL, Loading DoneNow let's

ping from router R1 to R2 and R3 Router(config)#do ping 10.10.10.2

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 10.10.10.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

Router(config)#do ping 20.20.20.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 20.20.20.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

Practical No 5

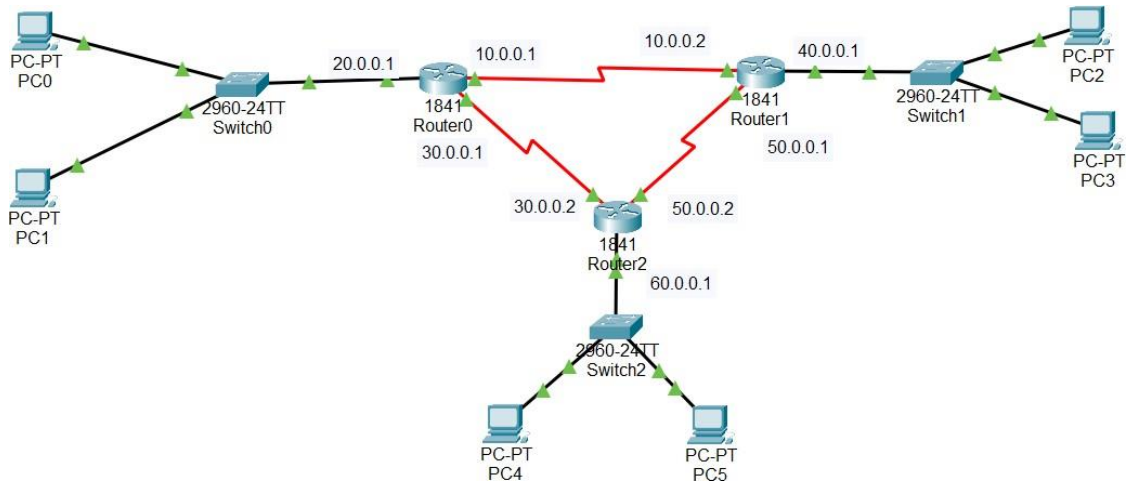
Aim: Implement BGP Communities

Introduction:

Border Gateway Protocol (BGP) refers to a gateway protocol that enables the internet to exchange routing information between autonomous systems (AS). As networks interact with each other, they need a way to communicate. This is accomplished through peering. BGP makes peering possible. Without it, networks would not be able to send and receive information with each other.

When you have a network router that connects to other networks, it does not know which network is the best one to send its data to. BGP takes into consideration all the different peering options a router has and chooses the one that is closest to where the router is.

Topology:



Command

s:Router 0

```
router bgp 1000
network 10.0.0.0
network 20.0.0.0
network 30.0.0.0
neighbor 10.0.0.2 remote-as 2000
neighbor 30.0.0.2 remote-as 3000
exit
```

```
Router(config)#router bgp 1000
Router(config-router)#network 10.0.0.0
Router(config-router)#network 20.0.0.0
Router(config-router)#network 30.0.0.0
Router(config-router)#neighbor 10.0.0.2 remote-as 2000
Router(config-router)#neighbor 30.0.0.2 remote-as 3000
Router(config-router)#exit
```

Router 1

```
router bgp 2000
network 10.0.0.0
network 40.0.0.0
network 50.0.0.0
neighbor 10.0.0.1 remote-as 1000
neighbor 50.0.0.2 remote-as 3000
exit
```

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router bgp 2000
Router(config-router)#network 10.0.0.0
Router(config-router)#network 40.0.0.0
Router(config-router)#network 50.0.0.0
Router(config-router)#neighbor 10.0.0.1 remote-as 1000
Router(config-router)#%BGP-5-ADJCHANGE: neighbor 10.0.0.1 Up
neighbor 50.0.0.2 remote-as 3000
Router(config-router)#exit
```

Router 2

```
router bgp 3000
network 30.0.0.0
network 50.0.0.0
network 60.0.0.0
neighbor 30.0.0.1 remote-as 1000
neighbor 50.0.0.1 remote-as 2000
exit
```

```
Router(config)#router bgp 3000
Router(config-router)#network 30.0.0.0
Router(config-router)#network 50.0.0.0
Router(config-router)#network 60.0.0.0
Router(config-router)#neighbor 30.0.0.1 remote-as 1000
Router(config-router)#%BGP-5-ADJCHANGE: neighbor 30.0.0.1 Up
neighbor 50.0.0.1 remote-as 2000
Router(config-router)#%BGP-5-ADJCHANGE: neighbor 50.0.0.1 Up
exit
```

PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec	Periodic	Num	Edit	Delete
	Successful	PC0	PC3	ICMP		0.000	N	0	(edit)	
	Successful	PC0	PC4	ICMP		0.000	N	1	(edit)	
	Successful	PC3	PC0	ICMP		0.000	N	2	(edit)	
	Successful	PC5	PC0	ICMP		0.000	N	3	(edit)	
	Successful	PC3	PC0	ICMP		0.000	N	4	(edit)	