

SDN journal

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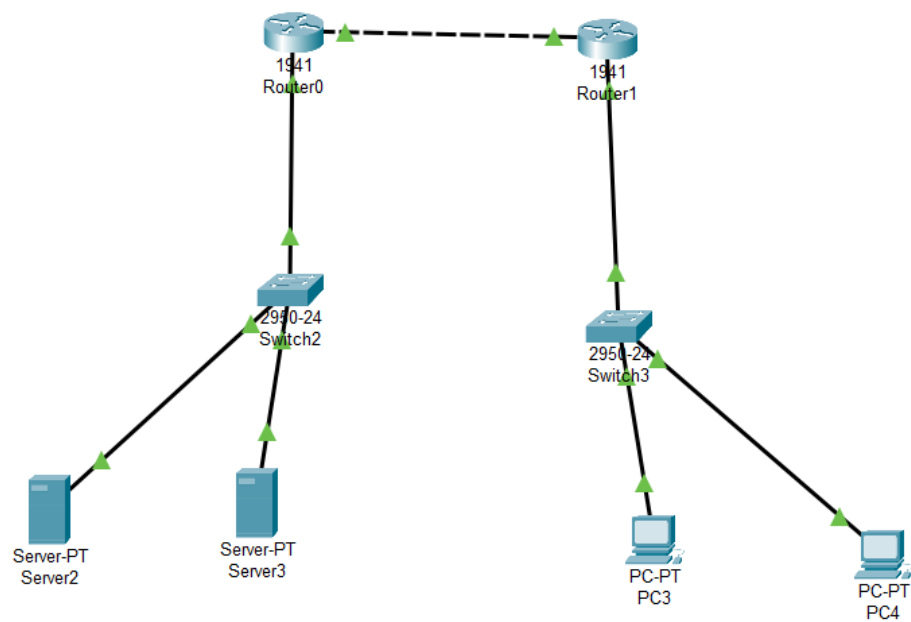
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3	Implement Inter-VLAN Routing.	
4	Observe STP Topology Changes and Implement RSTP	
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Practical -1

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

☐ Top

```
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

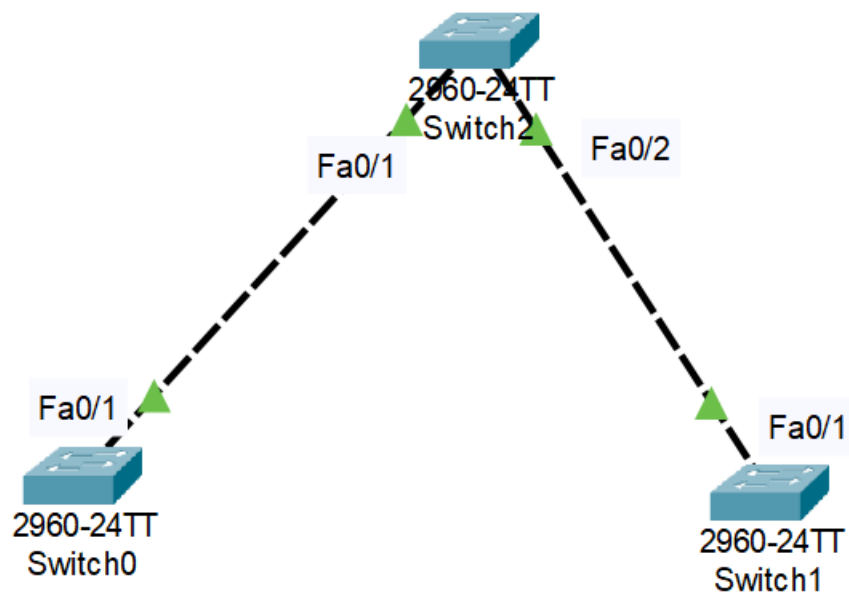
Paste

Practical- 2

Aim: Implement VTP

Requirement: 3 switches

Topology:



Steps:

Configure Switch0

```
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 2
Switch(config-vlan)#name compsci
Switch(config-vlan)#vlan 3
Switch(config-vlan)#name IT
Switch(config-vlan)#vlan 4
Switch(config-vlan)#name Biotech
Switch(config-vlan)#vlan 5
Switch(config-vlan)#name electronics
Switch(config-vlan)#
Switch(config-vlan)#
Switch(config-vlan)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#show vlan brief
```

VLAN Name Status Ports

```
-----
1 default active Fa0/1, Fa0/2, Fa0/3, Fa0/4
Fa0/5, Fa0/6, Fa0/7, Fa0/8
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
Gig0/1, Gig0/2
2 compsci active
3 IT active
4 Biotech active
5 electronics active
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch#
```

```
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vtp domain msc.com
Changing VTP domain name from NULL to msc.com
Switch(config)#vtp mode SERVER
Device mode already VTP SERVER.
Switch(config)#vtp password abc123
Setting device VLAN database password to abc123
Switch(config)#vtp version 2
Switch(config)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface fastEthernet0/
/
Switch(config)#interface fastEthernet0/1
Switch(config-if)#switchport mode trunk
```

```
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/1, changed state to down
```

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/1, changed state to up
```

Configure Switch2

```
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#show vlan brief
```

```
VLAN Name Status Ports
```

```
-----
1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5
```

```
Fa0/6, Fa0/7, Fa0/8, 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, Gig0/1
Gig0/2
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch#show vlan brief
```

VLAN Name Status Ports

```
-----
1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5
Fa0/6, Fa0/7, Fa0/8, 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, Gig0/1
Gig0/2
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch#en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vtp domain msc.com
Domain name already set to msc.com.
Switch(config)#vtp mode client
Setting device to VTP CLIENT mode.
Switch(config)#vtp password abc123
Setting device VLAN database password to abc123
Switch(config)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#show vlan brief
```

VLAN Name Status Ports

1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5
Fa0/6, Fa0/7, Fa0/8, 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, Gig0/1
Gig0/2

2 compsci active

3 IT active

4 Biotech active

5 electronics active

1002 fddi-default active

1003 token-ring-default active

1004 fddinet-default active

1005 trnet-default active

Switch#

Switch#conf t

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

Switch(config)#interface fastEthernet 0/2

Switch(config-if)#switchport mode trunk

Switch(config-if)#

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/2, changed state to up

Configure Switch1

Switch>en

Switch#conf t

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

Switch(config)#vtp domain msc.com

Changing VTP domain name from NULL to msc.com

Switch(config)#vtp password abc123

Setting device VLAN database password to abc123

Switch(config)#vtp mode client

Setting device to VTP CLIENT mode.


```
Switch(config)#^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#show vlan brief
```

```
VLAN Name Status Ports
```

```
-----
1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5
Fa0/6, Fa0/7, Fa0/8, 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, Gig0/1
Gig0/2
2 compsci active
3 IT active
4 Biotech active
5 electronics active
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch#
```

Output:

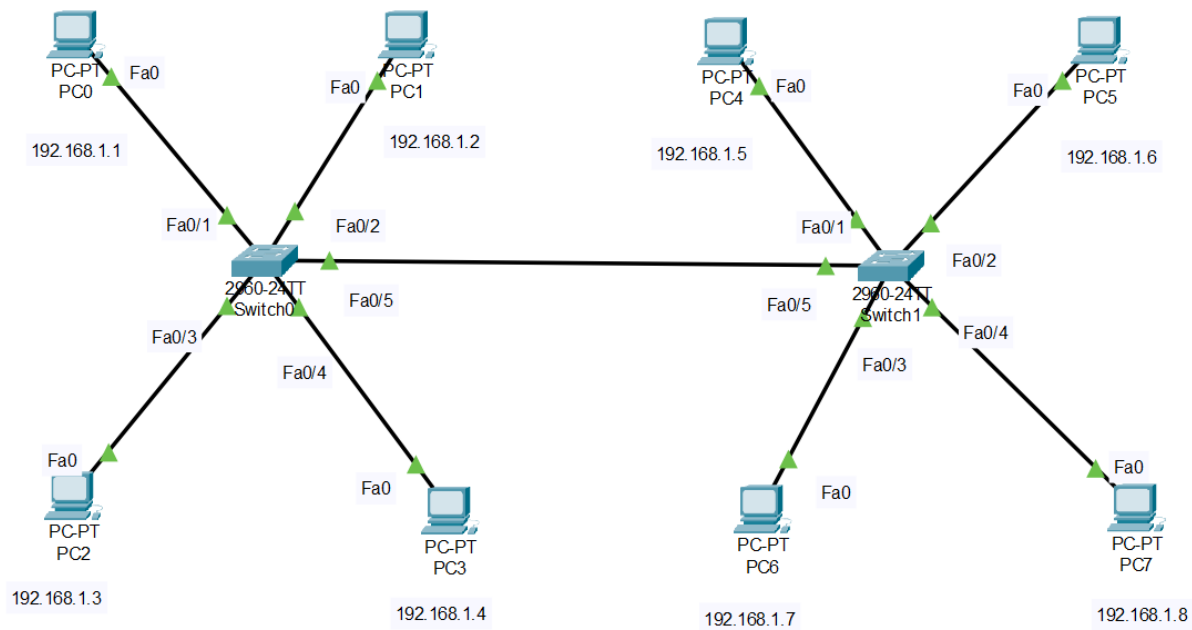
In this practical we are not sending any packets. The practical only shows how to configure VTP on switches.

Practical – 3

Aim: Implement Inter – VLAN Routing

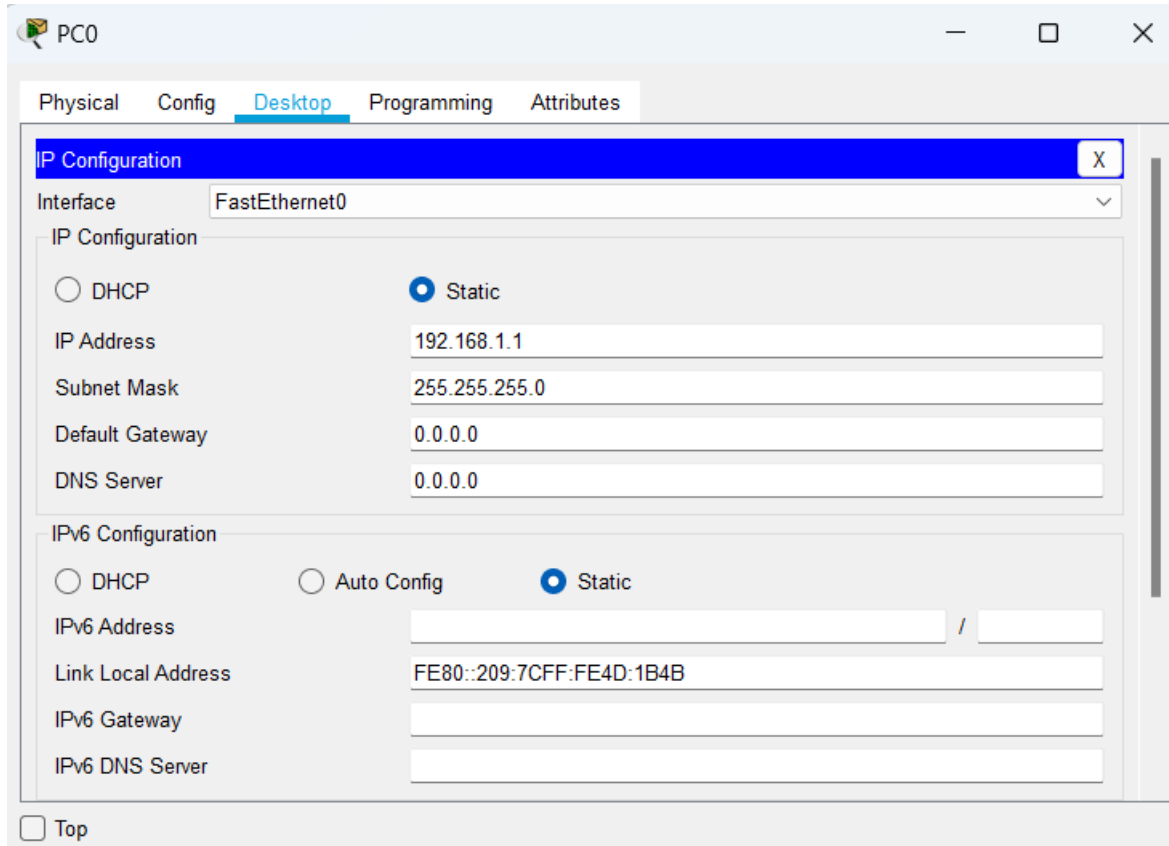
Requirement: 2 Switches and 8 End points

Topology:



Step-1:

Configure PC0



The screenshot shows a window titled "PC0" with a standard Windows-style title bar (minimize, maximize, close buttons). Inside the window, there are four tabs: "Physical", "Config", "Desktop" (which is selected and highlighted in blue), and "Attributes". Below the tabs, there is a section titled "IP Configuration" with a close button "X" in the top right corner. This section contains a dropdown menu for "Interface" set to "FastEthernet0". Below this, there are two radio buttons: "DHCP" (unselected) and "Static" (selected). Under the "Static" option, there are five text input fields: "IP Address" (192.168.1.1), "Subnet Mask" (255.255.255.0), "Default Gateway" (0.0.0.0), and "DNS Server" (0.0.0.0). Below these fields is another section titled "IPv6 Configuration". It also has two radio buttons: "DHCP" (unselected), "Auto Config" (unselected), and "Static" (selected). Under the "Static" option, there are four text input fields: "IPv6 Address" (empty), "Link Local Address" (FE80::209:7CFF:FE4D:1B4B), "IPv6 Gateway" (empty), and "IPv6 DNS Server" (empty). At the bottom left of the window, there is a checkbox labeled "Top" which is currently unchecked.

IP Configuration	
Interface	FastEthernet0
IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IP Address	192.168.1.1
Subnet Mask	255.255.255.0
Default Gateway	0.0.0.0
DNS Server	0.0.0.0
IPv6 Configuration	
<input type="radio"/> DHCP	<input type="radio"/> Auto Config
	<input checked="" type="radio"/> Static
IPv6 Address	/
Link Local Address	FE80::209:7CFF:FE4D:1B4B
IPv6 Gateway	
IPv6 DNS Server	

☐ Top

Configure PC1

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

PC2

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IP Address 192.168.1.3

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::201:43FF:FECC:9293

IPv6 Gateway

IPv6 DNS Server

☐ Top

Configure PC3

PC3

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IP Address 192.168.1.4

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::206:2AFF:FED3:422B

IPv6 Gateway

IPv6 DNS Server

☐ Top

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

PC5

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IP Address 192.168.1.6

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::202:4AFF:FE99:470E

IPv6 Gateway

IPv6 DNS Server

☐ Top

Configure PC6

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 /

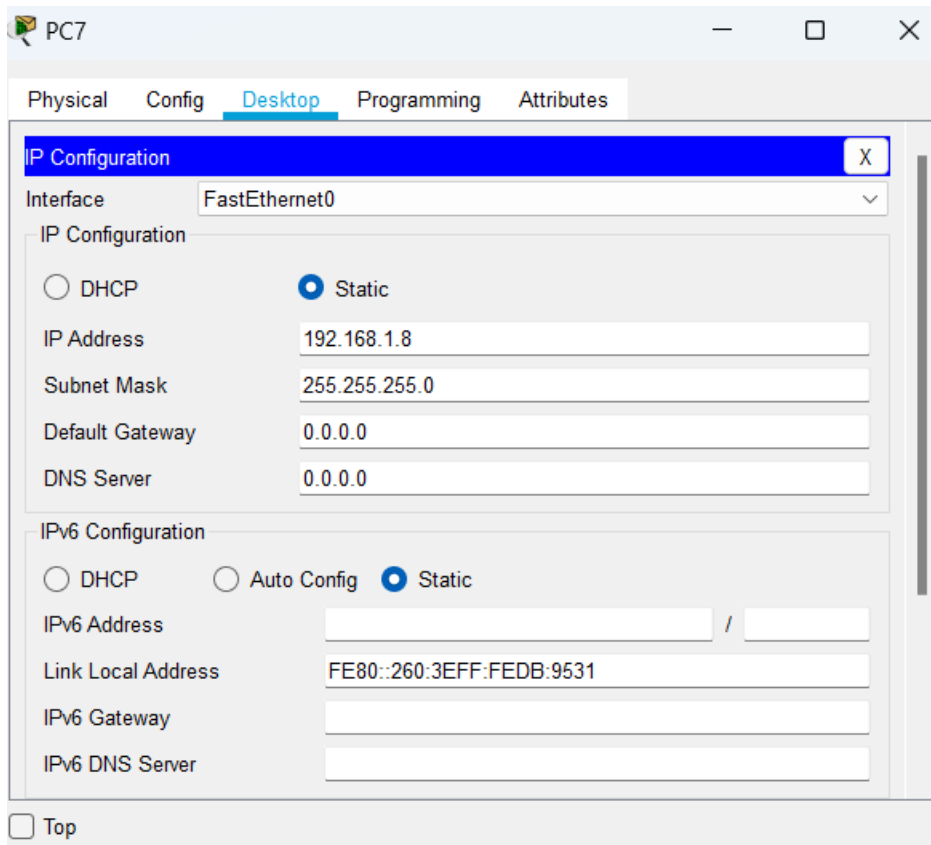
Link Local Address FE80::201:64FF:FEC7:2A36

IPv6 Gateway

IPv6 DNS Server

Top

Configure PC7



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, Fa0/4

Fa0/5, Fa0/6, Fa0/7, Fa0/8

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
Gig0/1, Gig0/2
10 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
```

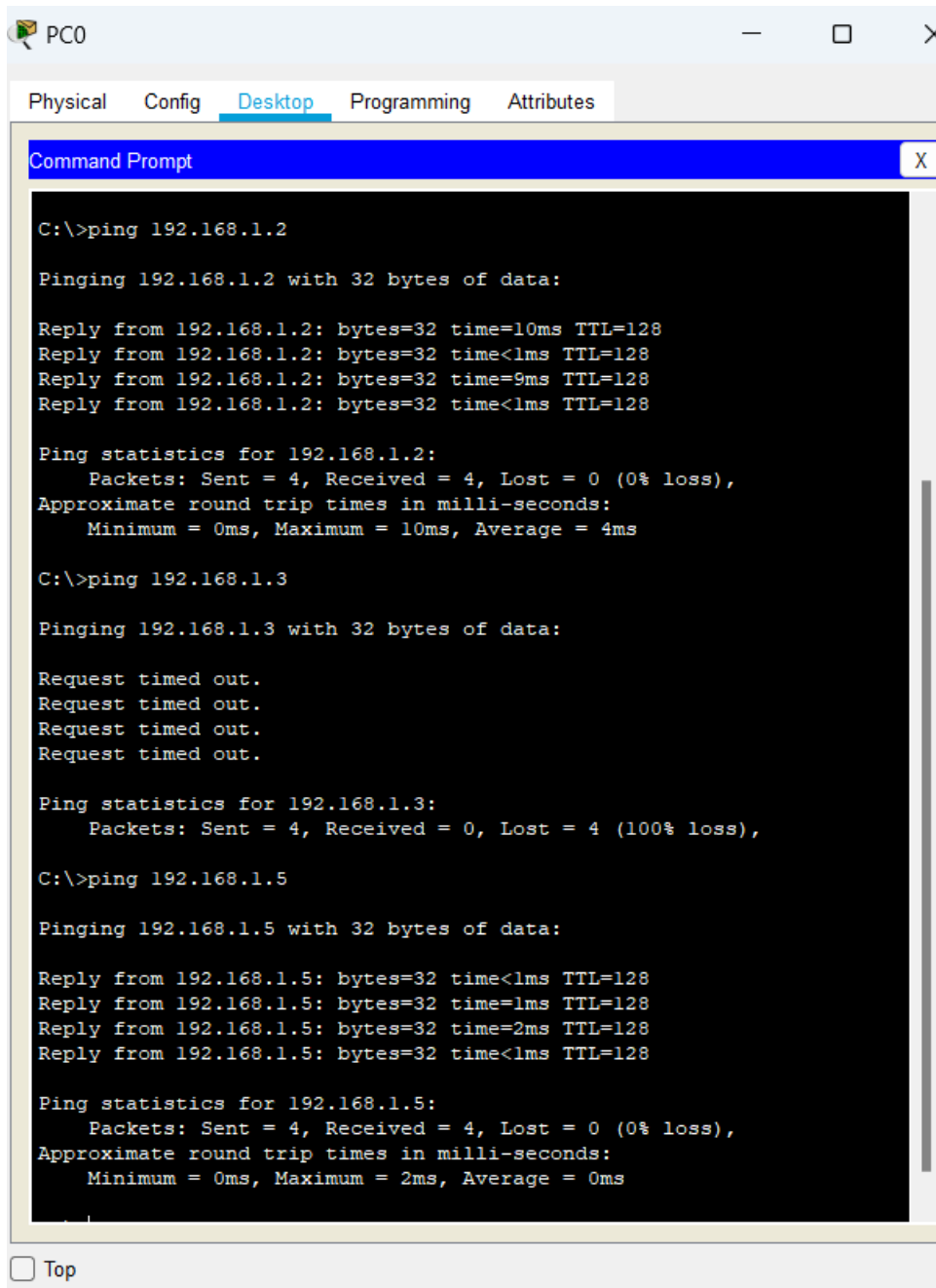
```
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/5, changed state to down
```

```
%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:



The screenshot shows a desktop environment for a PC named 'PC0'. The 'Desktop' tab is selected in the top navigation bar. A 'Command Prompt' window is open, displaying the results of three ping commands. The first command, 'ping 192.168.1.2', shows successful results with 0% loss and an average round trip time of 4ms. The second command, 'ping 192.168.1.3', shows a 100% loss with 'Request timed out' for all four attempts. The third command, 'ping 192.168.1.5', shows successful results with 0% loss and an average round trip time of 0ms. A 'Top' button is visible at the bottom left of the window.

```
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
```

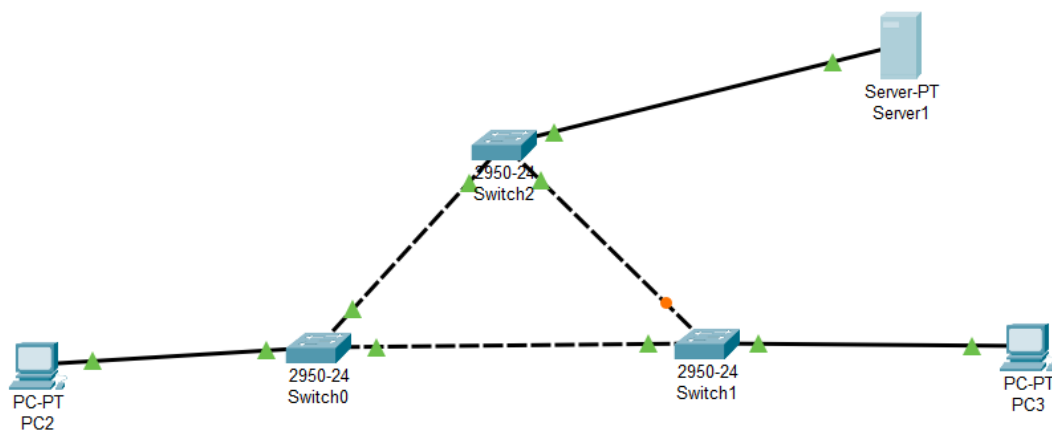
☐ Top

Practical -4

Aim: - Observe STP Topology Changes and Implement RSTP

Requirements: 1 Server, 3 Switches, 2 End devices

Topology:



Steps :

1-Create topology as shown in the figure

2-Give IP address to server as 192.168.1.1

Default gateway 192.168.1.1

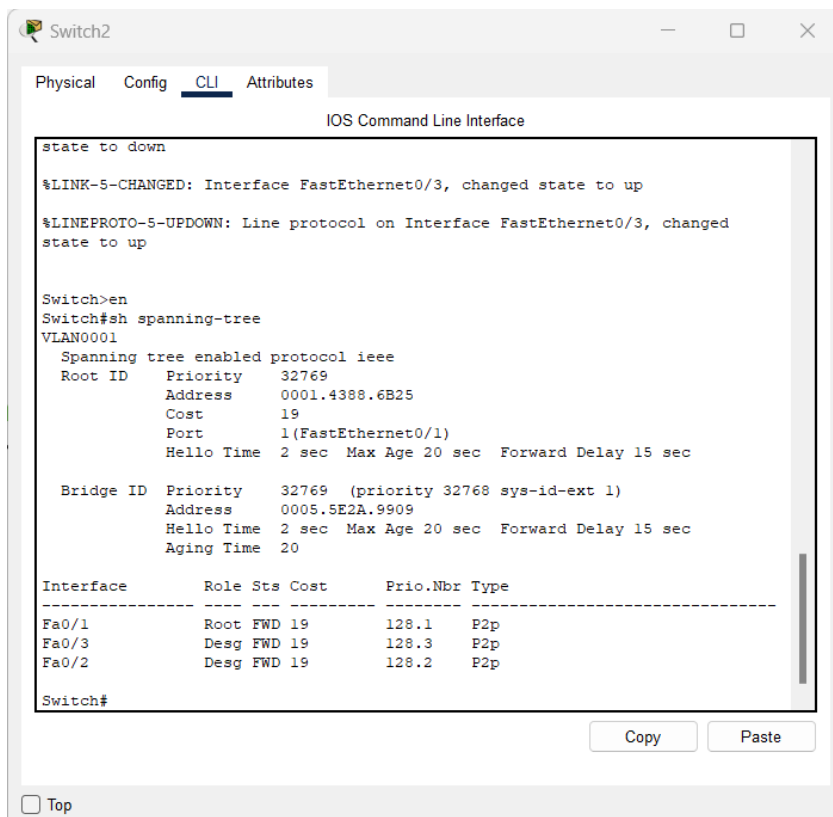
Give same series IP to other 2 end devices

3- Open CLI of switch 2 and type the following

Switch>en

Switch#sh spanning tree

We will get following result



The screenshot shows a window titled 'Switch2' with tabs for 'Physical', 'Config', 'CLI', and 'Attributes'. The 'CLI' tab is active, displaying the 'IOS Command Line Interface'. The terminal output shows the switch entering enable mode and running the 'sh spanning-tree' command. The output displays spanning tree information for VLAN0001, including the root ID, priority, address, cost, port, and hello time. It also shows the bridge ID, priority, address, hello time, and aging time. Finally, it displays a table of interfaces and their roles in the spanning tree.

```
state to down
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed
state to up

Switch>en
Switch#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
            Address     0001.4388.6B25
            Cost        19
            Port        1(FastEthernet0/1)
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
            Address     0005.5E2A.9909
            Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time  20

Interface    Role Sts Cost      Prio.Nbr Type
-----
Fa0/1        Root FWD 19        128.1   P2p
Fa0/3        Desg FWD 19        128.3   P2p
Fa0/2        Desg FWD 19        128.2   P2p

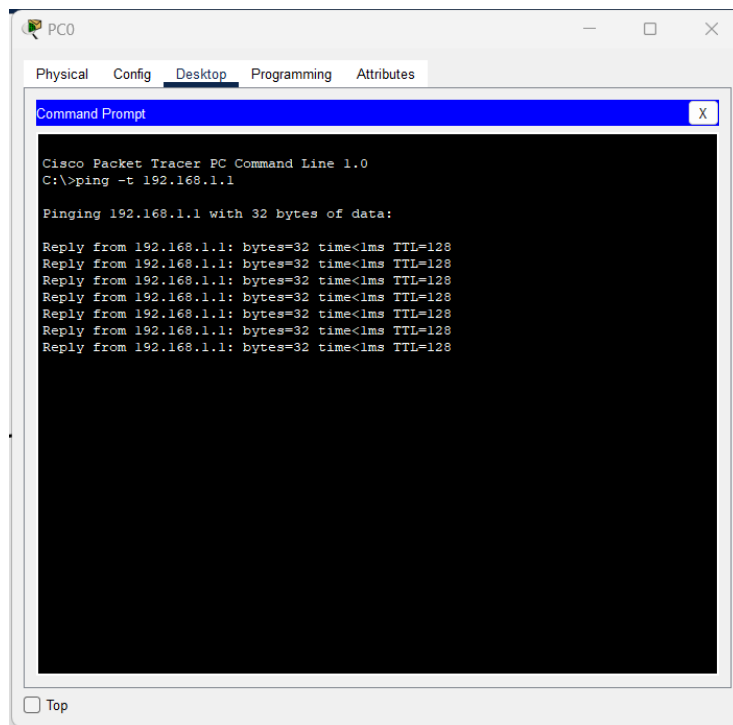
Switch#
```

4- Do the same for other 2 switches.

5-Now go to pc0 and in command prompt type following command

C:\>ping -t 192.168.1.1

We will be able to see the data packets are reaching the server



6- configuration in Switch0

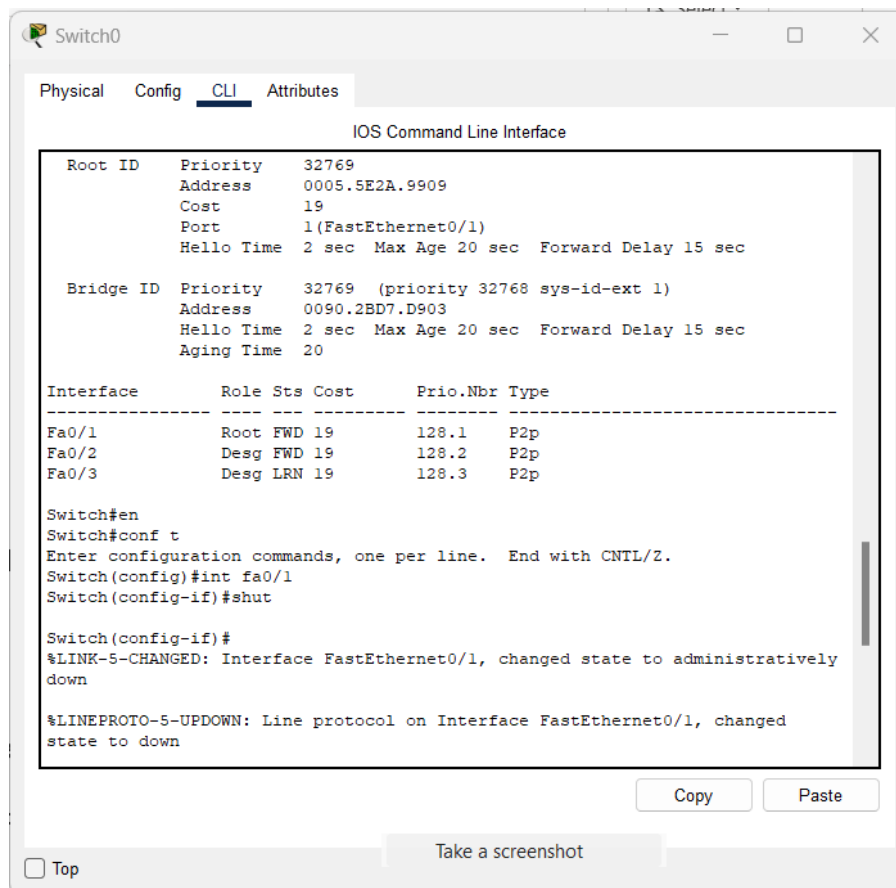
Now again in switch0 type following commands

Switch>en

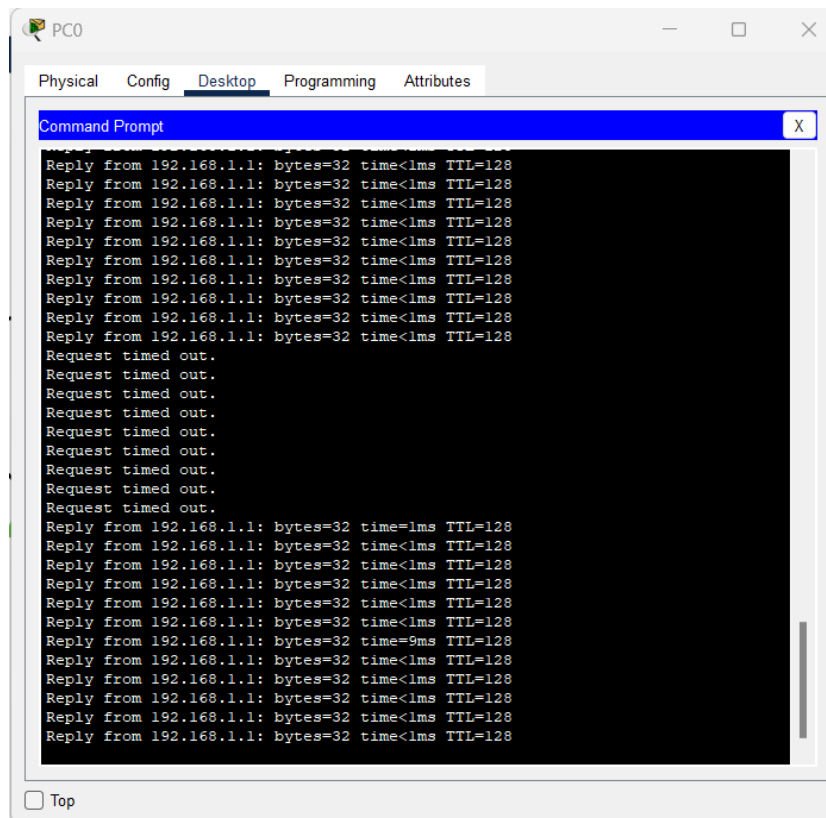
Switch#conf t

Switch(config)#int fa0/1

Switch(config-if)#shut



In following figure you can observe that at the beginning package was delivered successfully but as soon as we pass shutdown command in CLI of switch0. After some time, the switch will search for other available path and start sending the data packets. This is the demonstration of Spanning tree



2-Implementation of RSTP

For that we need to change our all switches to the RSTP

1-congifuration in switches

Open CLI of switch2

And type following commands

switch#en

switch#conf t

You will enter into Global conf

Switch(config)#spanning-tree mode ?

Switch(config)#spanning-tree mode rapid-pvst

Switch(config)# ^Z **(Note: press ctrl + z)**

Switch(config)#sh span

You can see that in figure the mode of spanning tree is change to RSTP

The screenshot shows a network switch CLI interface with the following commands and output:

```
Switch#
Switch#en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#spanning-tree mode ?
  pvst      Per-Vlan spanning tree mode
  rapid-pvst Per-Vlan rapid spanning tree mode
Switch(config)#spanning-tree mode rapid-pvst
Switch(config)#sh span
Switch(config)# ^Z
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#sh span
VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    32769
             Address     0005.5E2A.9909
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
             Address     0005.5E2A.9909
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface    Role Sts Cost      Prio.Nbr Type
-----
Fa0/1        Desg FWD 19       128.1    P2p
Fa0/3        Desg FWD 19       128.3    P2p
Fa0/2        Desg FWD 19       128.2    P2p

Switch#
```

At the bottom of the window, there are "Copy" and "Paste" buttons, and a "Top" button in the footer.

Apply this same process to all other switches

Practical -5

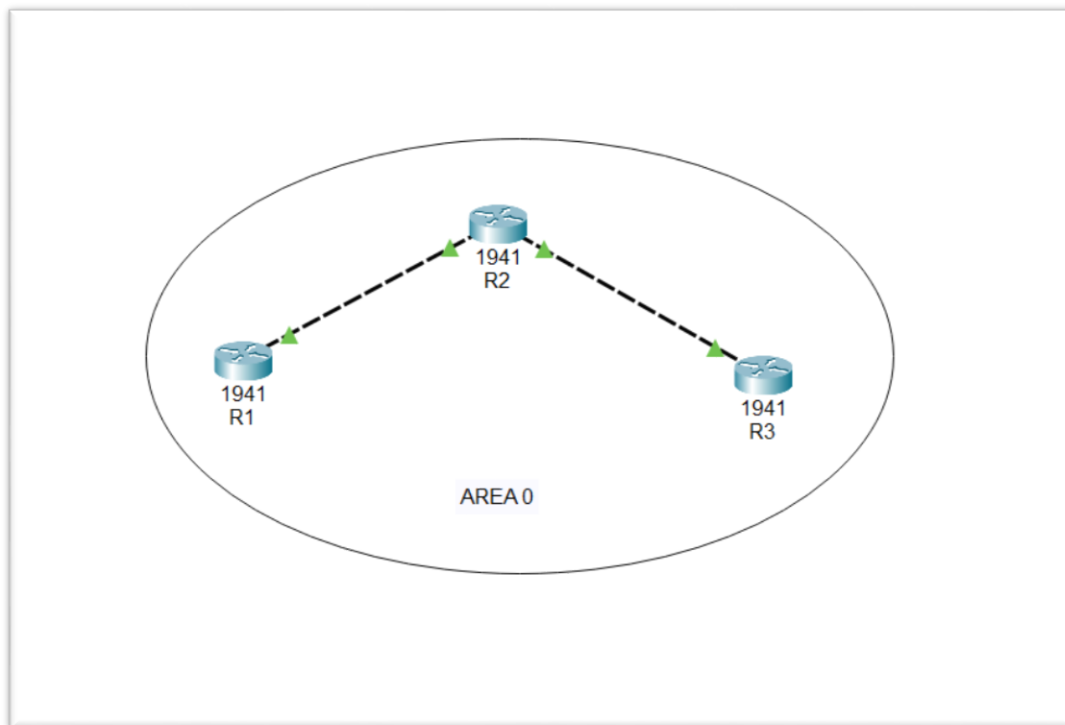
Aim: OSPF Implementation

1. Implement Single Area OSPFv2
2. 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 commands

```
ospf 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
```

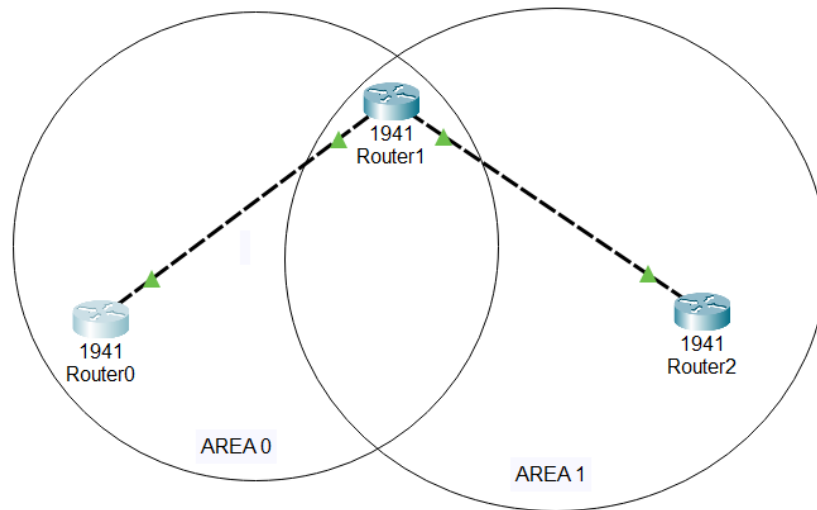
Type escape sequence to abort.

```
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 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 = 0/0/1 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:

!!!!

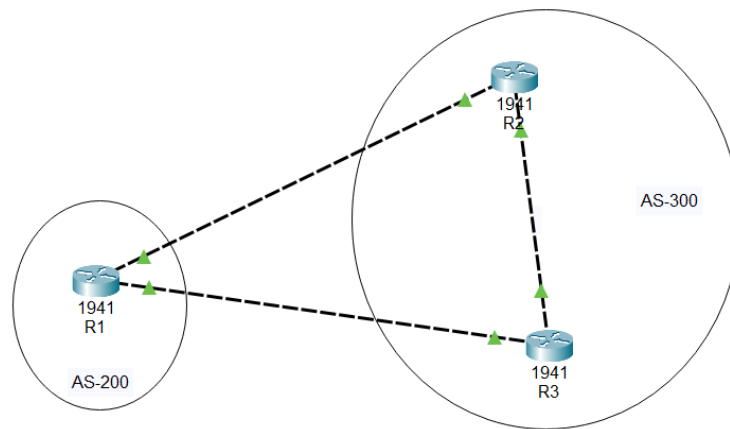
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

Practical -6

AIM: Implement BGP communities:

- 1.Implement EBGp
- 2.Implement IBGP

TOPOLOGY 1 :



Steps:

Configuration Table:

Devices	Interface	Ip-address	Subnet mask
R1	Gig0/0	192.168.1.1	255.255.255.0
	Gig0/1	192.168.2.1	255.255.255.0
R2	Gig0/0	192.168.1.2	255.255.255.0
	Gig0/1	192.168.3.2	255.255.255.0
R3	Gig0/0	192.168.3.1	255.255.255.0
	Gig0/0	192.168.2.2	255.255.255.0

On router R2 perform following commands:

```
Router(config)#router eigrp 1
```

```
Router(config-router)#network 192.168.3.0
```

```
Router(config-router)#
```

```
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.3.1  
(GigabitEthernet0/1) is up: new adjacency
```

On router R3 perform the following commands:

```
Router(config)#router eigrp 1
```

```
Router(config-router)#network 192.168.3.0
```

```
Router(config-router)#
```

```
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 192.168.3.2  
(GigabitEthernet0/0) is up: new adjacency
```

On router R1 perform the following the command:

```
Router(config)#router bgp 200
```

```
Router(config-router)#network 10.10.10.0
```

```
Router(config-router)#neighbor 192.168.1.2 remote-as 300
```

```
Router(config-router)#neighbor 192.168.2.2 remote-as 300
```

```
Router(config-router)#do show ip bgp summary
```

```
BGP router identifier 10.10.10.10, local AS number 200
```

```
BGP table version is 1, main routing table version 6
```

```
0 network entries using 0 bytes of memory
```

```
0 path entries using 0 bytes of memory
```

```
0/0 BGP path/bestpath attribute entries using 0 bytes of memory
```

```
0 BGP AS-PATH entries using 0 bytes of memory
```

```
0 BGP route-map cache entries using 0 bytes of memory
```

```
0 BGP filter-list cache entries using 0 bytes of memory
```

```
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
```

```
BGP using 32 total bytes of memory
```

```
BGP activity 0/0 prefixes, 0/0 paths, scan interval 60 secs
```

```
Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  
State/PfxRcd
```

```
192.168.1.2 4 300 0 0 1 0 0 00:22:07 4
```

192.168.2.2 4 300 0 0 1 0 0 00:22:07 4

On router R2 perform the following commands:

```
Router(config)#router bgp 300
```

```
Router(config-router)#network 20.20.20.0
```

```
Router(config-router)#neighbor 192.168.1.1 remote-as 200
```

```
Router(config-router)#%BGP-5-ADJCHANGE: neighbor 192.168.1.1 Up
```

```
Router(config-router)#network 192.168.3.0
```

```
Router(config-router)#exit
```

On router R3 perform the following commands:

```
Router(config)#router bgp 300
```

```
Router(config-router)#network 30.30.30.0
```

```
Router(config-router)#network 192.168.3.0
```

```
Router(config-router)#neighbor 192.168.2.1 remote-as 200
```

```
Router(config-router)#%BGP-5-ADJCHANGE: neighbor 192.168.2.1 Up
```

```
Router(config-router)#do show ip bgp summary
```

```
BGP router identifier 30.30.30.30, local AS number 300
```

```
BGP table version is 2, main routing table version 6
```

```
1 network entries using 132 bytes of memory
```

```
1 path entries using 52 bytes of memory
```

```
0/0 BGP path/bestpath attribute entries using 0 bytes of memory
```

1 BGP AS-PATH entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 240 total bytes of memory
BGP activity 1/0 prefixes, 1/0 paths, scan interval 60 secs

Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down
State/PfxRcd

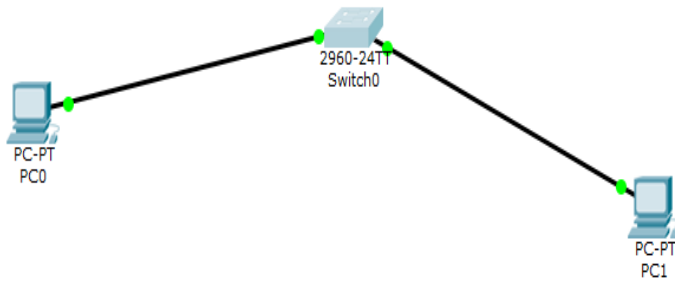
192.168.2.1 4 200 2 2 2 0 0 00:00:20 4

Practical -7

Aim: Implement SPAN Technologies (Switch Port Analyzer)

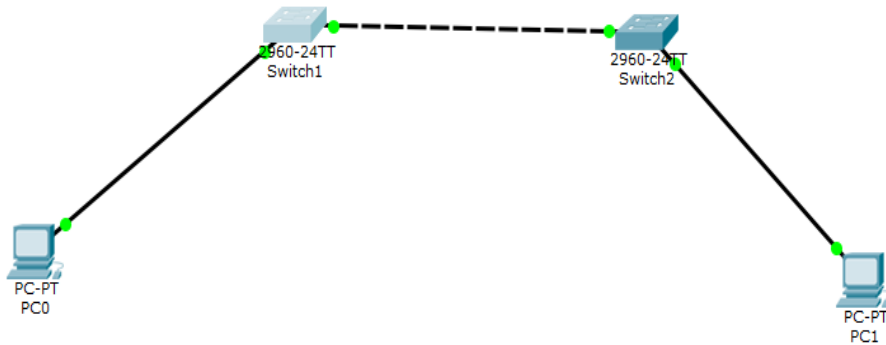
Topology:

Topology 1



Topology 2:

-Implement Remote SPAN configuration



Steps:

For topology 1:

Open CLI

Switch>en

Switch#config ter

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

Switch(config)#monitor session ?

<1-66>

Switch(config)#monitor session 1 source interface fastEthernet 0/1

Switch(config)#monitor session 1 destination interface fastEthernet 1/1

Switch(config)#^Z

Switch#

%SYS-5-CONFIG_I: Configured from console by console

Switch#show monitor ?

detail

session

| Output Modifiers

<cr>

Switch#show monitor session 1
Session 1

Type : Local Session
Description : -
Source Ports :
Both : Fa0/1
Destination Ports : Fa0/2
Encapsulation : Native
Ingress : Disabled

Switch#show monitor
Session 1

Type : Local Session
Description : -
Source Ports :
Both : Fa0/1
Destination Ports : Fa0/2
Encapsulation : Native
Ingress : Disabled

Switch#show monitor session 1 detail
Session 1

Type : Local Session
Description : -
Source Ports :
RX Only : None
TX Only : None
Both : Fa0/1
Source VLANs :
RX Only : None
TX Only : None
Both : None
Source RSPAN VLAN : None
Destination Ports : Fa0/2
Encapsulation : Native

Ingress : Disabled
Filter VLANs : None
Dest RSPAN VLAN : None

For topology 2:

Open CLI of Switch1

```
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 8
Switch(config-vlan)#remote-span
Switch(config-vlan)#
```

```
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#monitor session 1 source interface fastEthernet0/2

Switch(config)#monitor session 1 destination remote vlan 8 reflector-port
fastEthernet 0/5
```

```
Switch#en
Switch#show monitor session 1
Session 1
-----
Type : Remote Destination Session
Description : -
Source Ports :
Both : Fa0/2
Dest RSPAN VLAN : 8
```

Switch#show monitor session 1 detail

Session 1

Type : Remote Destination Session

Description : -

Source Ports :

RX Only : None

TX Only : None

Both : Fa0/2

Source VLANs :

RX Only : None

TX Only : None

Both : None

Source RSPAN VLAN : None

Destination Ports : None

Encapsulation : Native

Ingress : Disabled

Filter VLANs : None

Dest RSPAN VLAN : 8

Switch#

Switch 2

Open CLI of Switch2

Switch>en

Switch#conf t

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

Switch(config)#vlan 8

Switch(config-vlan)#remote-span

Switch(config-vlan)#

Switch>en

Switch#conf t

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

```
Switch(config)#monitor session 1 source remote vlan 8
```

```
Switch(config)#monitor session 1 destination interface fastEthernet 0/2
```

```
Switch(config)#
```

```
Switch#en
```

```
Switch#show monitor session 1
```

```
Session 1
```

```
Type : Remote Source Session
```

```
Description : -
```

```
Source RSPAN VLAN : 8
```

```
Destination Ports : Fa0/2
```

```
Encapsulation : Native
```

```
Ingress : Disabled
```

```
Switch#show monitor session 1 detail
```

```
Session 1
```

```
-----
```

```
Type : Remote Source Session
```

```
Description : -
```

```
Source Ports :
```

```
RX Only : None
```

```
TX Only : None
```

```
Both : None
```

```
Source VLANs :
```

RX Only : None

TX Only : None

Both : None

Source RSPAN VLAN : 8

Destination Ports : Fa0/2

Encapsulation : Native

Ingress : Disabled

Filter VLANs : None

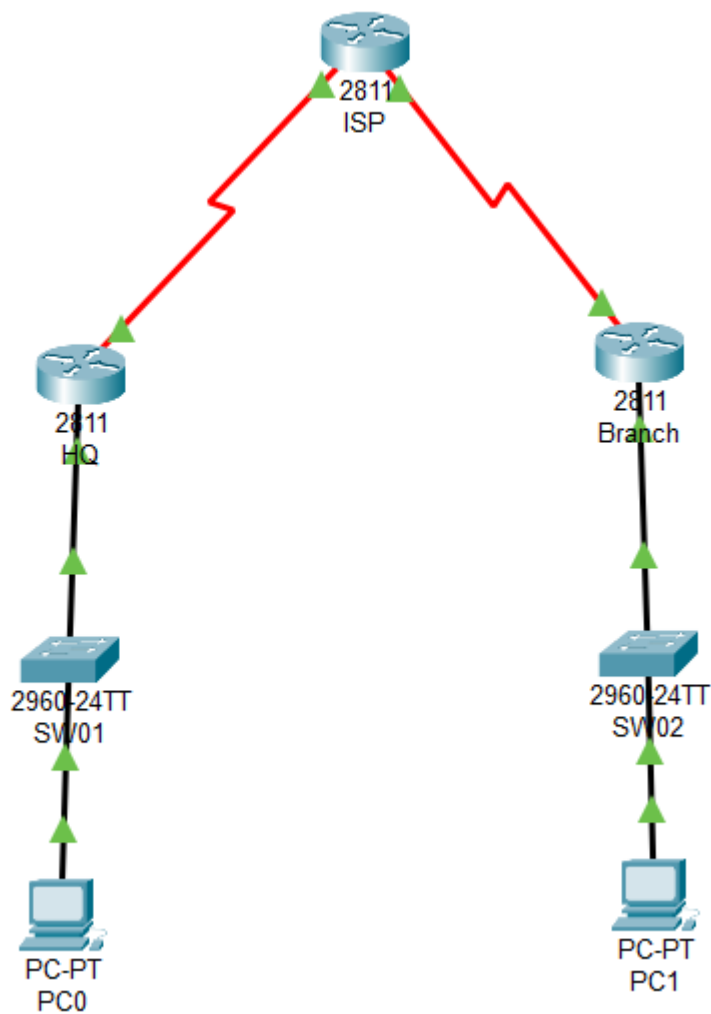
Dest RSPAN VLAN : None

Practical-8

Aim: Implement IPsec Site-to-Site VPNs connection using Cisco Packet Tracer.

Requirement: 3 routers, 2 switches, PCs

Topology:



Steps:

Configure PC0

PC0

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IP Address 172.16.1.10

Subnet Mask 255.255.255.0

Default Gateway 172.16.1.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ DHCP ☐ Auto Config ☒ Static

IPv6 Address /

Link Local Address FE80::230:A3FF:FE9C:381

IPv6 Gateway

IPv6 DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

☐ Top

Configure PC1

PC1

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IP Address 192.168.10.10

Subnet Mask 255.255.255.0

Default Gateway 192.168.10.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ DHCP ☐ Auto Config ☒ Static

IPv6 Address /

Link Local Address FE80::230:F2FF:FE7A:7363

IPv6 Gateway

IPv6 DNS Server


802.1X

☐ Use 802.1X Security

Authentication MD5

☐ Top

Configure Router HQ

 HQ

Physical

Config

CLI

Attributes

IOS Command Line Interface

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up

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

HQ>
HQ>en
HQ#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
HQ(config)#hostname HQ
HQ(config)#
HQ(config)#int f0/0
HQ(config-if)#ip address 172.16.1.1 255.255.255.0
HQ(config-if)#no shut
HQ(config-if)#
HQ(config-if)#int s/0/0/0
      ^
% Invalid input detected at '^' marker.


HQ(config-if)#int s0/0/0
HQ(config-if)#ip address 10.10.10.1 255.255.255.0
HQ(config-if)#no shut
HQ(config-if)#
```

Ctrl+F6 to exit CLI focus

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Configure Router Branch

 Branch

PhysicalConfigCLIAttributes

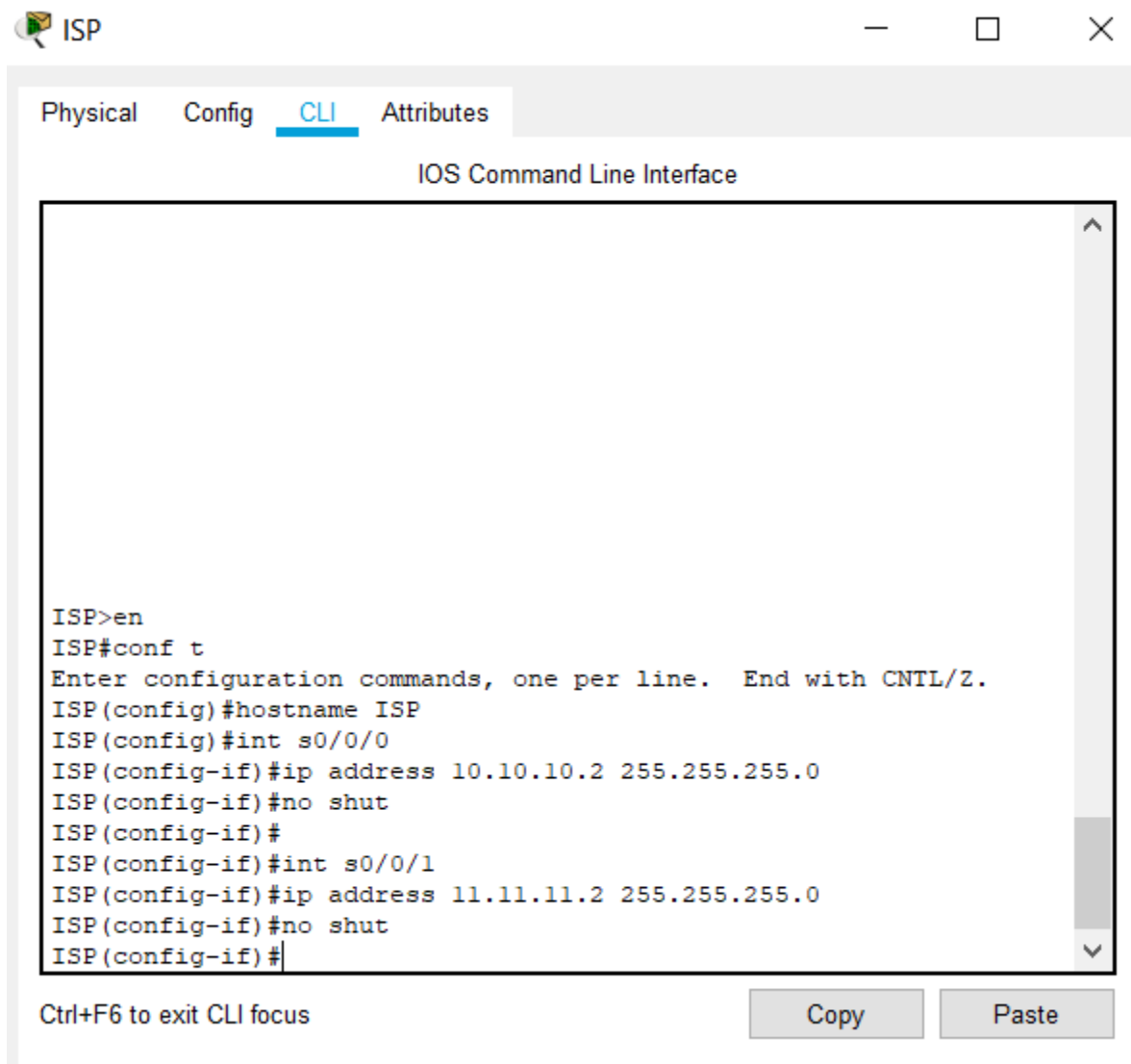
IOS Command Line Interface

```
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>
Branch>en
Branch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Branch(config)#hostname Branch
Branch(config)#int f0/0
Branch(config-if)#ip address 192.168.10.1 255.255.255.0
Branch(config-if)#no shut
Branch(config-if)#
Branch(config-if)#int s0/0/0
Branch(config-if)#ip address 11.11.11.1 255.255.255.0
Branch(config-if)#no shut
Branch(config-if)#
```

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Configure Router ISP



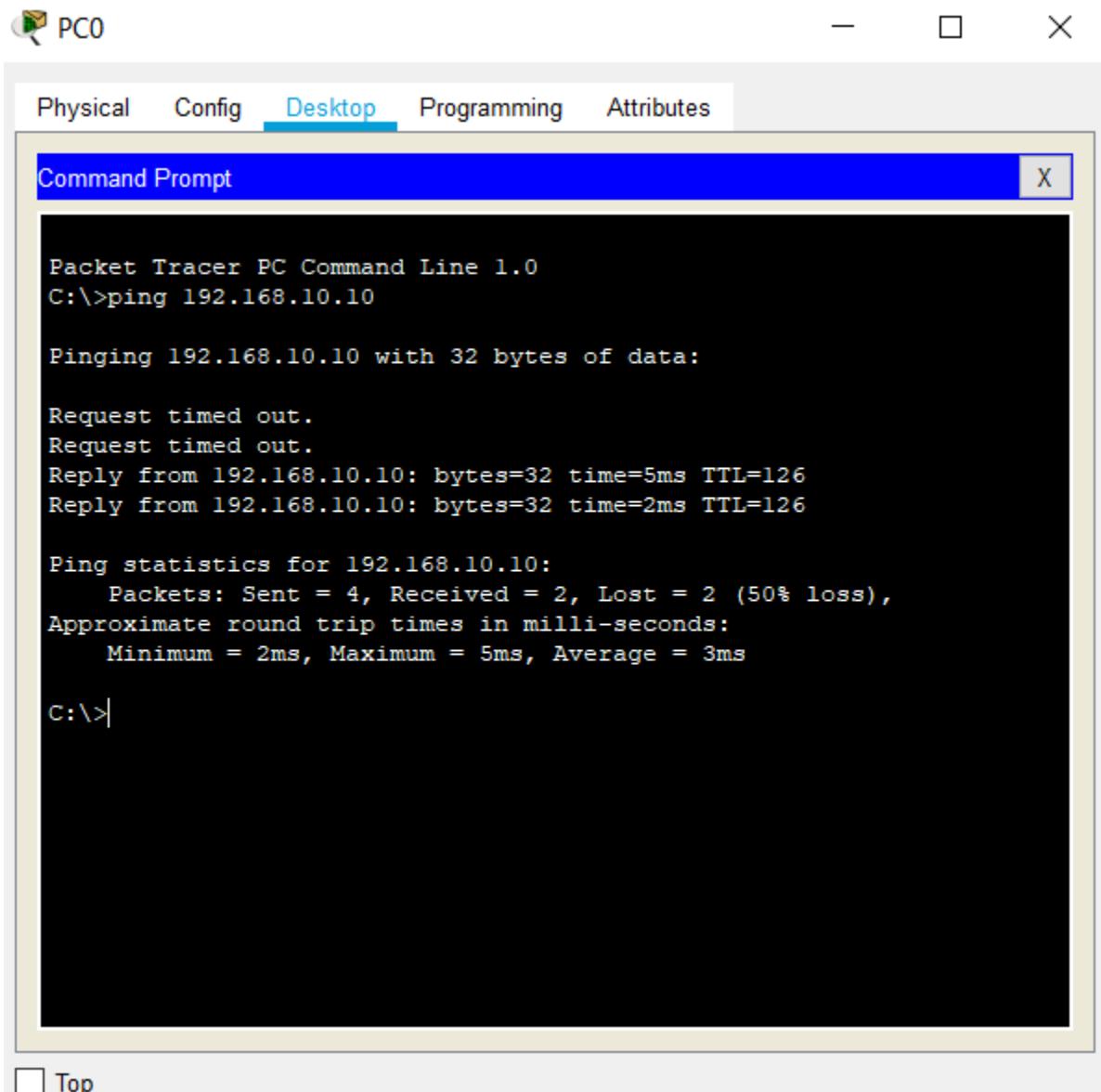
Configure Default Router on HQ, Branch, and Static Router from ISP

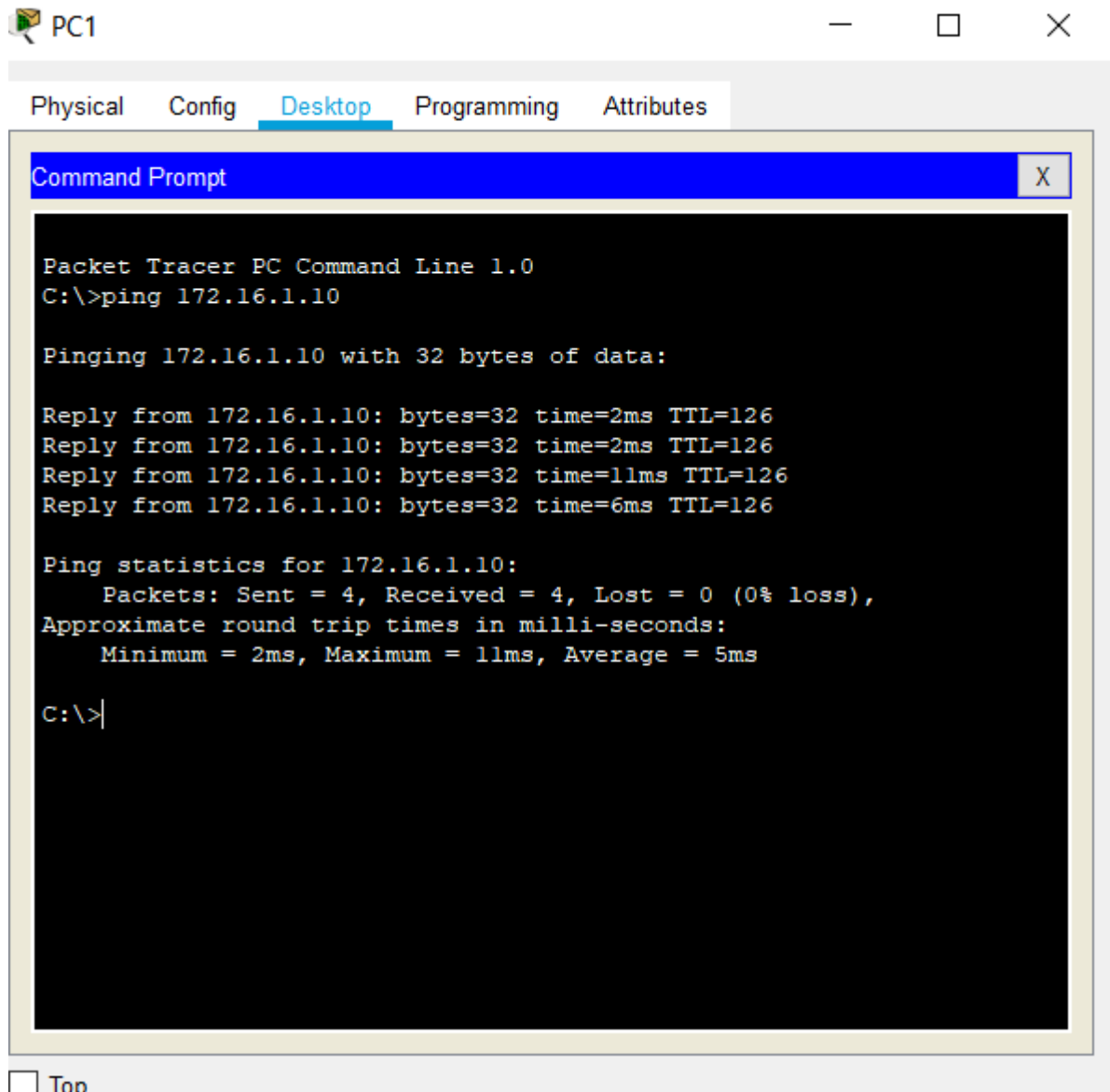
```
HQ(config)#ip route 0.0.0.0 0.0.0.0 10.10.10.2
HQ(config)#

Branch(config)#ip route 0.0.0.0 0.0.0.0 11.11.11.2
Branch(config)#

ISP(config)#ip route 172.16.1.0 255.255.255.0 10.10.10.1
ISP(config)#ip route 192.168.10.0 255.255.255.0 11.11.11.1
ISP(config)#
```

Ping both PCs





Configure VPN site-to-site HQ

Physical Config **CLI** Attributes

IOS Command Line Interface

```
HQ(config)#ip route 0.0.0.0 0.0.0.0 10.10.10.2
HQ(config)#crypto isakmp enable
HQ(config)#crypto isakmp policy 20
HQ(config-isakmp)#authentication pre-share
HQ(config-isakmp)#encryption 3des
HQ(config-isakmp)#hash md5
HQ(config-isakmp)#group 1
HQ(config-isakmp)#lifetime 3600
HQ(config-isakmp)#exit
HQ(config)#crypto isakmp key cisco123 address 11.11.11.1
A pre-shared key for address mask 11.11.11.1 255.255.255.255
already exists!
HQ(config)#crypto ipsec transform-set myset esp-3des esp-md5-hmac
HQ(config)#access-list 100 permit ip 172.16.1.0 0.0.0.255
192.168.10.0 0.0.0.255
HQ(config)#crypto map mymap 20 ipsec-isakmp
HQ(config-crypto-map)#set peer 11.11.11.1
HQ(config-crypto-map)#set transform-set myset
HQ(config-crypto-map)#match address 100
HQ(config-crypto-map)#exit
HQ(config)#int s0/0/0
HQ(config-if)#crypto map mymap
*Jan  3 07:16:26.785: %CRYPTO-6-ISA_KMP_ON_OFF: ISAKMP is ON
HQ(config-if)#
```

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Branch

```
Branch(config)#crypto isakmp enable
Branch(config)#crypto isakmp policy 20
Branch(config-isakmp)#authentication pre-share
Branch(config-isakmp)#encryption 3des
Branch(config-isakmp)#hash md5
Branch(config-isakmp)#group 1
Branch(config-isakmp)#lifetime 3600
Branch(config-isakmp)#exit
```

```
Branch(config)#crypto isakmp key cisco123 address 10.10.10.1
A pre-shared key for address mask 10.10.10.1 255.255.255.255
already exists!
Branch(config)#crypto ipsec transform-set myset esp-3des esp-md5-
hmac
Branch(config)#access-list 100 permit ip 192.168.10.0 0.0.0.255
172.16.1.0
% Incomplete command.
Branch(config)#access-list 100 permit ip 192.168.10.0 0.0.0.255
172.16.1.0 0.0.0.255
Branch(config)#crypto map mymap 20 ipsec-isakmp
Branch(config-crypto-map)#set peer 10.10.10.1
Branch(config-crypto-map)#set transform-set myset
Branch(config-crypto-map)#match address 100
Branch(config-crypto-map)#exit
Branch(config)#int s0/0/0
Branch(config-if)#crypto map mymap
*Jan  3 07:16:26.785: %CRYPTO-6-ISA_KMP_ON_OFF: ISAKMP is ON
Branch(config-if)#
```

Verify Command

IOS Command Line Interface

```

HQ>
HQ>en
HQ#show crypto isakmp sa
IPv4 Crypto ISAKMP SA
dst          src          state          conn-id slot
status

IPv6 Crypto ISAKMP SA

HQ#show crypto isakmp policy

Global IKE policy
Protection suite of priority 20
    encryption algorithm: Three key triple DES
    hash algorithm:      Message Digest 5
    authentication method: Pre-Shared Key
    Diffie-Hellman group: #1 (768 bit)
    lifetime:            3600 seconds, no volume limit
Default protection suite
    encryption algorithm: DES - Data Encryption Standard
(56 bit keys).
    hash algorithm:      Secure Hash Standard
    authentication method: Rivest-Shamir-Adleman Signature
    Diffie-Hellman group: #1 (768 bit)
  
```

Ctrl+F6 to exit CLI focus

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Physical Config CLI Attributes

IOS Command Line Interface

```
lifetime: 86400 seconds, no volume limit
HQ#show crypto map
Crypto Map mymap 20 ipsec-isakmp
  Peer = 11.11.11.1
  Extended IP access list 100
    access-list 100 permit ip 172.16.1.0 0.0.0.255
192.168.10.0 0.0.0.255
  Current peer: 11.11.11.1
  Security association lifetime: 4608000 kilobytes/3600
seconds
  PFS (Y/N): N
  Transform sets={
    myset,
  }
  Interfaces using crypto map mymap:
    Serial0/0/0

HQ#show crypto ipsec sa

interface: Serial0/0/0
  Crypto map tag: mymap, local addr 10.10.10.1

  protected vrf: (none)
  local ident (addr/mask/prot/port):
(172.16.1.0/255.255.255.0/0/0)
```

Ctrl+F6 to exit CLI focus

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Physical Config **CLI** Attributes

IOS Command Line Interface

```
HQ#show crypto ipsec sa

interface: Serial0/0/0
  Crypto map tag: mymap, local addr 10.10.10.1


  protected vrf: (none)
  local ident (addr/mask/prot/port):
(172.16.1.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port):
(192.168.10.0/255.255.255.0/0/0)
  current_peer 11.11.11.1 port 500
    PERMIT, flags={origin_is_acl,}
    #pkts encaps: 0, #pkts encrypt: 0, #pkts digest: 0
    #pkts decaps: 0, #pkts decrypt: 0, #pkts verify: 0
    #pkts compressed: 0, #pkts decompressed: 0
    #pkts not compressed: 0, #pkts compr. failed: 0
    #pkts not decompressed: 0, #pkts decompress failed: 0
    #send errors 0, #recv errors 0

    local crypto endpt.: 10.10.10.1, remote crypto endpt.:
11.11.11.1
    path mtu 1500, ip mtu 1500, ip mtu idb Serial0/0/0
    current outbound spi: 0x0(0)

  inbound esp sas:
```

Ctrl+F6 to exit CLI focus

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 Branch

PhysicalConfigCLIAttributes

IOS Command Line Interface

```
Branch>en
Branch#show crypto isakmp sa
IPv4 Crypto ISAKMP SA
dst          src          state          conn-id slot
status

IPv6 Crypto ISAKMP SA

Branch#show crypto isakmp policy

Global IKE policy
Protection suite of priority 20
  encryption algorithm: Three key triple DES
  hash algorithm:       Message Digest 5
  authentication method: Pre-Shared Key
  Diffie-Hellman group: #1 (768 bit)
  lifetime:             3600 seconds, no volume limit
Default protection suite
  encryption algorithm: DES - Data Encryption Standard
(56 bit keys).
  hash algorithm:       Secure Hash Standard
  authentication method: Rivest-Shamir-Adleman Signature
  Diffie-Hellman group: #1 (768 bit)
  lifetime:             86400 seconds, no volume limit
```

Ctrl+F6 to exit CLI focus

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Physical Config CLI Attributes

IOS Command Line Interface

```
Branch#show crypto map
Crypto Map mymap 20 ipsec-isakmp
  Peer = 10.10.10.1
  Extended IP access list 100
    access-list 100 permit ip 192.168.10.0 0.0.0.255
172.16.1.0 0.0.0.255
  Current peer: 10.10.10.1
  Security association lifetime: 4608000 kilobytes/3600
seconds
  PFS (Y/N): N
  Transform sets={
    myset,
  }
  Interfaces using crypto map mymap:
    Serial0/0/0

Branch#show crypto ipsec sa

interface: Serial0/0/0
  Crypto map tag: mymap, local addr 11.11.11.1

  protected vrf: (none)
  local ident (addr/mask/prot/port):
(192.168.10.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port):
```

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Physical Config CLI Attributes

IOS Command Line Interface

```
Branch#show crypto ipsec sa

interface: Serial0/0/0
  Crypto map tag: mymap, local addr 11.11.11.1

  protected vrf: (none)
  local ident (addr/mask/prot/port):
(192.168.10.0/255.255.255.0/0/0)
  remote ident (addr/mask/prot/port):
(172.16.1.0/255.255.255.0/0/0)
  current_peer 10.10.10.1 port 500
    PERMIT, flags={origin_is_acl,}
    #pkts encaps: 0, #pkts encrypt: 0, #pkts digest: 0
    #pkts decaps: 0, #pkts decrypt: 0, #pkts verify: 0
    #pkts compressed: 0, #pkts decompressed: 0
    #pkts not compressed: 0, #pkts compr. failed: 0
    #pkts not decompressed: 0, #pkts decompress failed: 0
    #send errors 0, #recv errors 0

    local crypto endpt.: 11.11.11.1, remote crypto endpt.:
10.10.10.1
    path mtu 1500, ip mtu 1500, ip mtu idb Serial0/0/0
    current outbound spi: 0x0(0)
```

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Ping Both PCs and Check Packets Encapsulated using show crypto ipsec sa command