SIES (NERUL) COLLEGE OF ARTS, SCIENCE AND COMMERCE NERUL, NAVI MUMBAI-400706

DEPARTMENT OF COMPUTER SCIENCE

MSc(CS) PART-1 SEMESTER I

Practical

Journal in

Software Defined Networking

Submitted by

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SIES (Nerul) College of Arts, Science and Commerce NAAC Re-Accredited 'A' Grade

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CERTIFICATE

This is to certify that **Anuj Jambhale** of **Part-1(Sem-1) Masters in Science (Computer Science)** has completed the practical work in the subject **Software Defined Networking** as per the requirement of University of Mumbai in part fulfillment for the completion of PG Degree of Masters of Science (Computer Science) during the academic year 2023-2024.

Roll Number: 06   Date of Submission:

Subject: **Software Defined Networking**

Prof. Flosia Simon   Date: _____

(Subject Teacher)

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Practical 1:

A. Implement SPAN Technologies (Switch Port Analyzer)
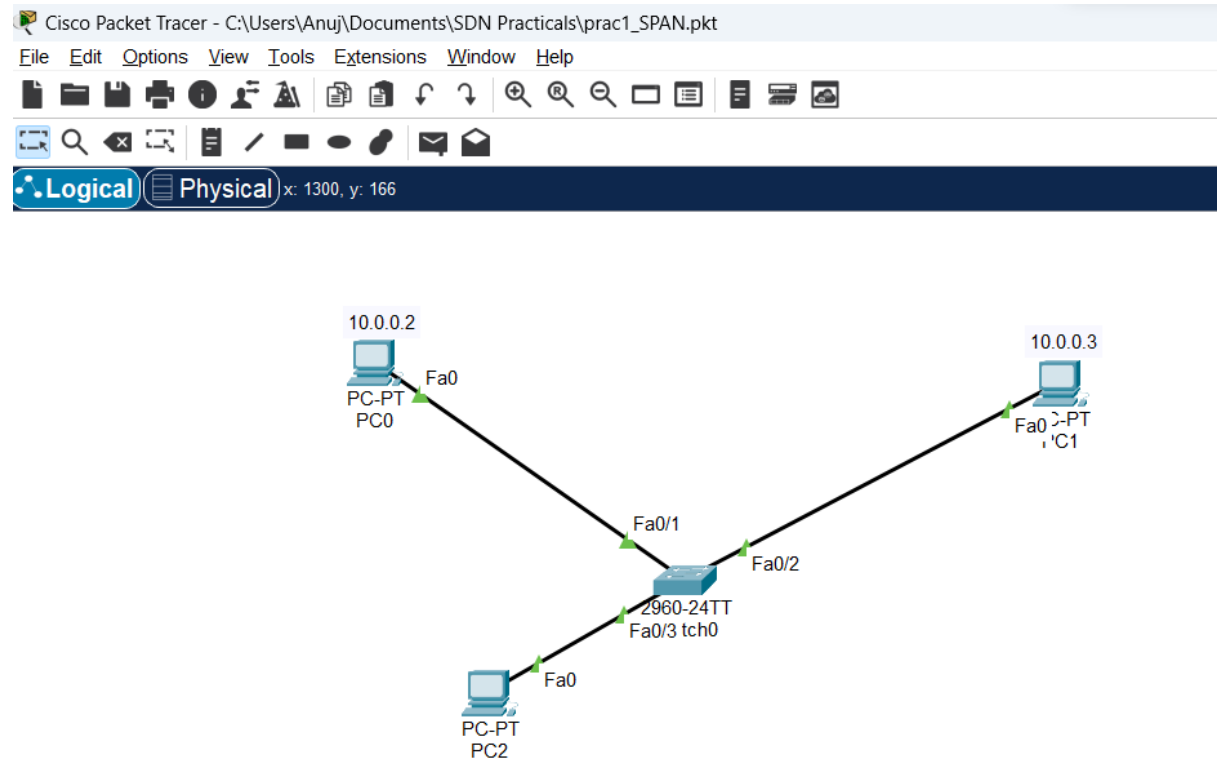
CLI COMMANDS:

Switch>en

Switch#conf t

Switch(config)#monitor session 1 source int fa0/1

Switch(config)#monitor session 1 destination int fa0/2

Switch(config)#exit

Switch#show monitor session 1

Switch#show monitor detail

Switch#monitor session 2 source int

Switch#monitor session 2 source int fa0/1

Switch#conf t

Switch(config)#monitor session 2 source int fa0/1

Switch(config)#monitor session 2 destination int fa0/3

Switch(config)#exit

Switch#show monitor detail

Switch#show monitor session 2

Switch#show monitor session 1

Switch>en

Switch#show monitor details

Switch#show monitor details

Switch#show monitor detail

Switch#show monitor session 1

Switch#show monitor session 2

OUTPUT:

```
Switch#show monitor 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


Session 2
---------
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       : Fa0/3
    Encapsulation       : Native
         Ingress        : Disabled
Filter VLANs            : None
Dest RSPAN VLAN         : None
```

```
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 2
Session 2
---------
Type                    : Local Session
Description             : -
Source Ports            :
    Both                : Fa0/1
Destination Ports       : Fa0/3
    Encapsulation       : Native
          Ingress       : Disabled
```

B. Implement SNMP and Syslog
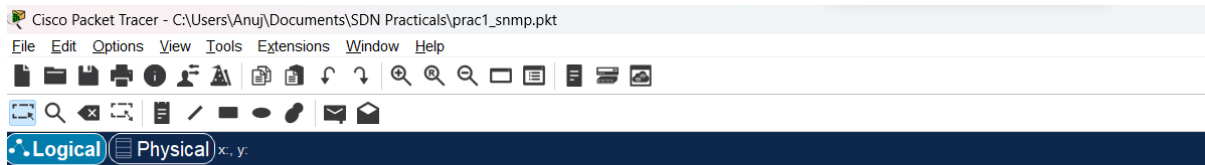
CLI COMMANDS:

Router>enable

Router#configure terminal

Router0   Router(config)#interface FastEthernet0/0

Router0   Router(config-if)#ip address 172.168.1.1 255.255.0.0

Router0   Router(config-if)#ip address 172.168.1.1 255.255.0.0

Router0   Router(config-if)#no shutdown

Router1   Router>enable

Router1   Router#configure terminal

Router1   Router(config)#interface FastEthernet0/0

Router1   Router(config-if)#ip address 172.168.2.1 255.255.0.0

Router1   Router(config-if)#ip address 172.168.2.1 255.255.0.0

Router1   Router(config-if)#no shutdown

Router1   Router(config-if)#exit

Router1   Router(config)#interface FastEthernet0/0

Router0   Router(config-if)#exit

Router0   Router(config)#snmp server community read ro
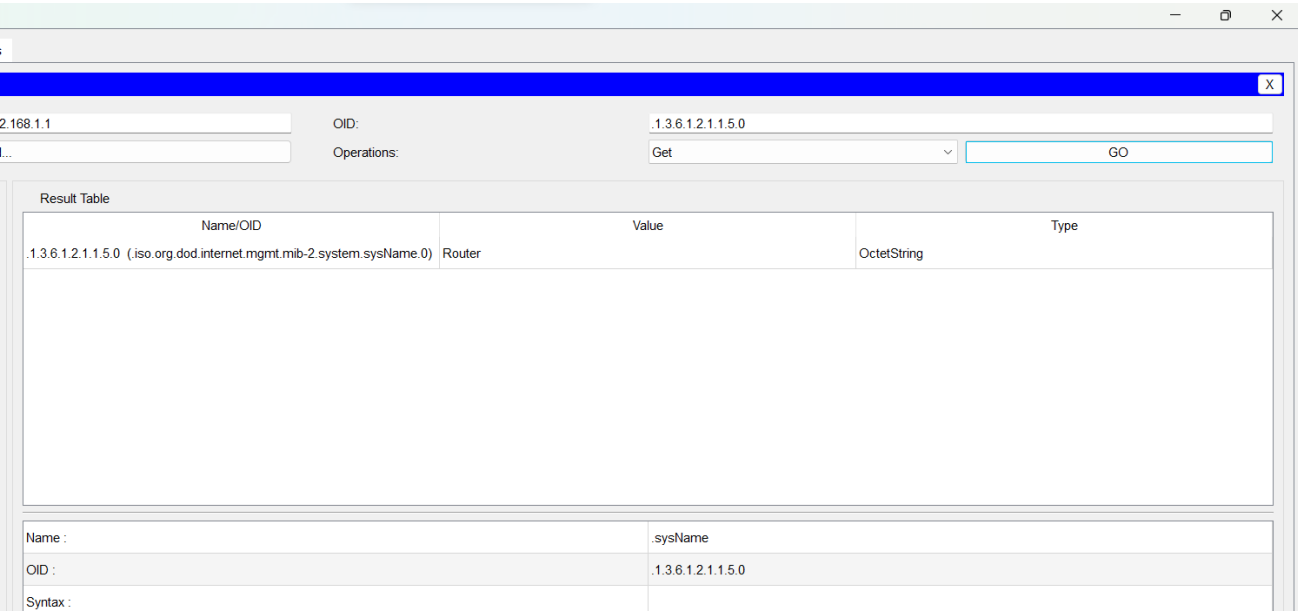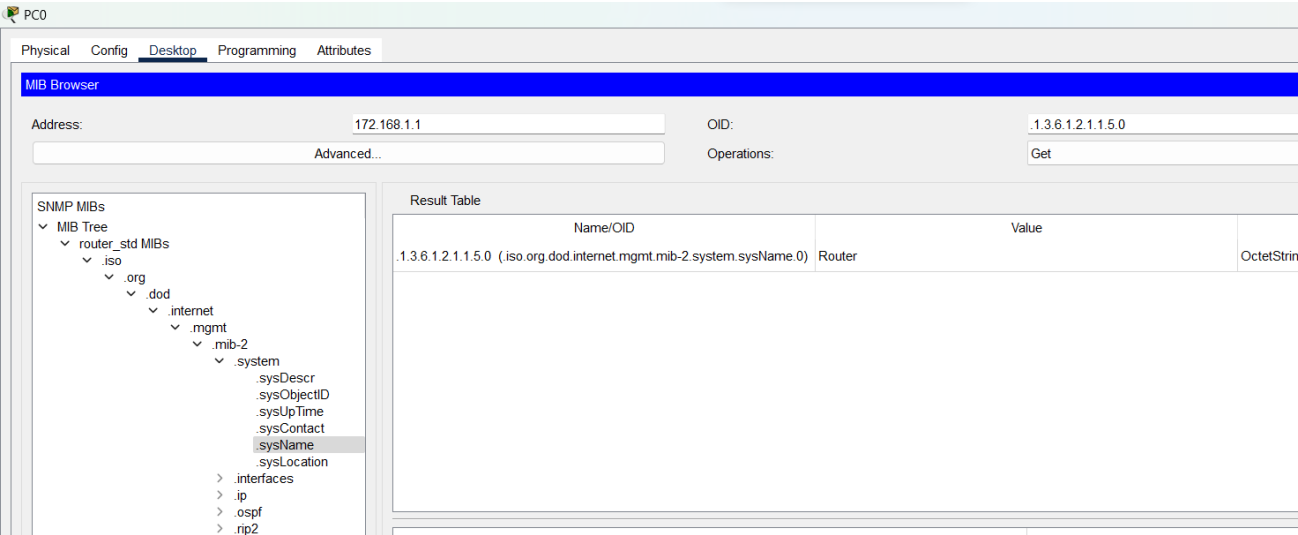
Router0   Router(config)#snmp-server community read ro

Router0   Router(config)#snmp-server community write wr

Router0   Router(config)#snmp-server community write rw

Router0   Router(config)#exit

OUTPUT:

SNMP MIBs

- ∨ MIB Tree
  - ∨ router_std MIBs
    - ∨ .iso
      - ∨ .org
        - ∨ .dod
          - ∨ .internet
            - ∨ .mgmt
              - ∨ .mib-2
                - ∨ .system
                  - .sysDescr
                  - .sysObjectID
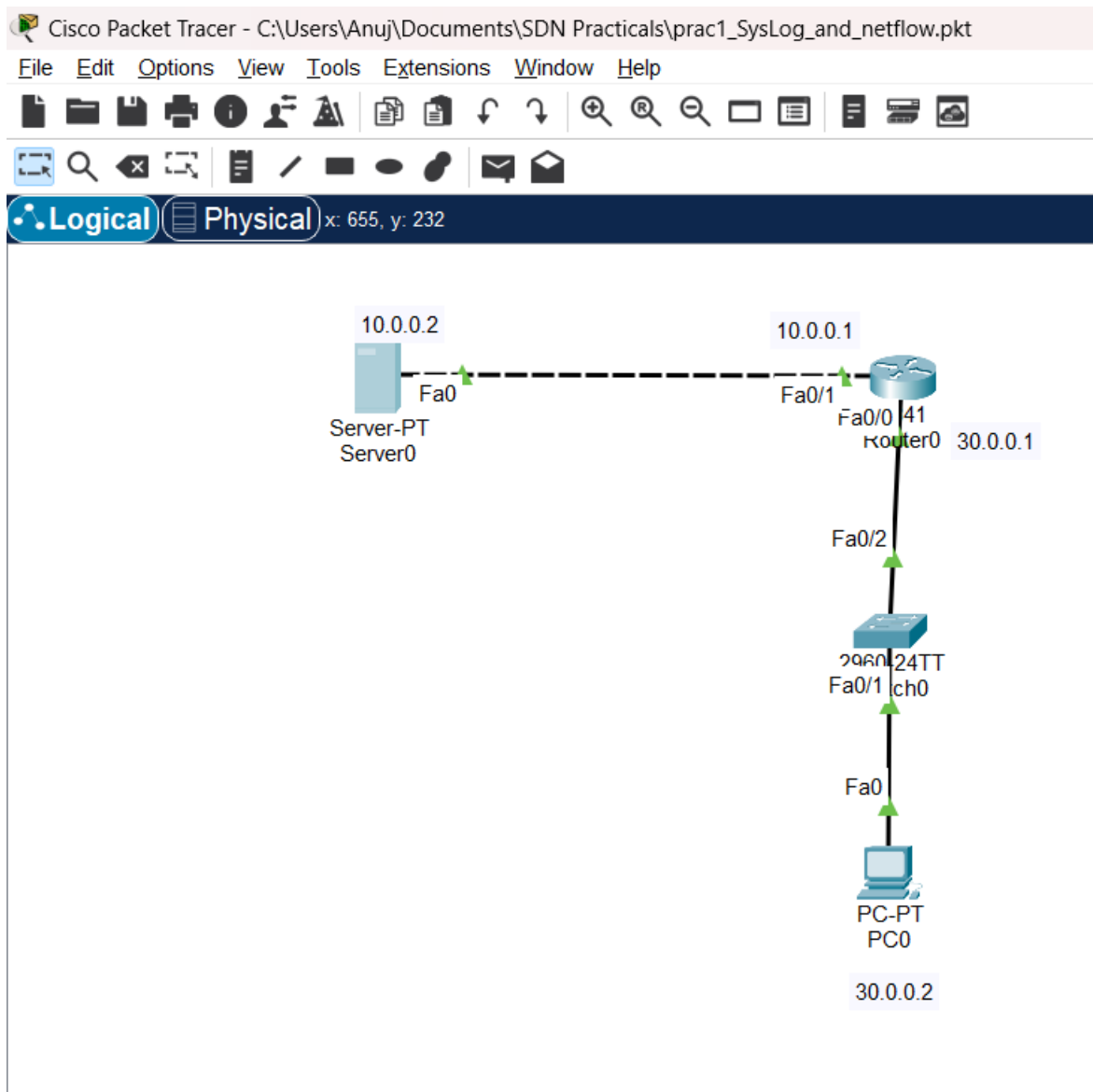   - .sysUpTime
                  - .sysContact
                  - .sysName
                  - .sysLocation

Result Table

Name/OID	Value
.1.3.6.1.2.1.1.3.0 (.iso.org.dod.internet.mgmt.mib-2.system.sysUpTime.0)	0 hours 17 minutes 11 seconds

3. **Implement Flexible NetFlow**

CLI COMMANDS:

Router0   Router>enable

Router0   Router#configure terminal

Router0   Router(config)#interface FastEthernet0/0

Router0   Router(config-if)#ip address 30.0.0.1 255.0.0.0

Router0   Router(config-if)#ip address 30.0.0.1 255.0.0.0

Router0	Router(config-if)#no shutdown
Router0	Router(config-if)#exit
Router0	Router(config)#interface FastEthernet0/1
Router0	Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router0	Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router0	Router(config-if)#no shutdown
Router0	Router(config-if)#exit
Router0	Router(config)#service timestamps log datetime msec
Router0	Router(config)#int fa0/0/1
Router0	Router(config)#int fa0/0.1
Router0	Router(config-subif)#logging host ?
Router0	Router(config-subif)#logging ?
Router0	Router(config-subif)#logging host server 10.0.0.1
Router0	Router(config-subif)#exit
Router0	Router(config)#logging?
Router0	Router(config)#logging host ?
Router0	Router(config)#logging host server ?
Router0	Router(config)#logging host 10.0.0.1
Router0	Router(config)#logging host 10.0.0.2
Router0	Router(config)#exit
Router0	Router#configure terminal
Router0	Router(config)#service timestamps log datetime msec
Router0	Router(config)#int fa0/0.1
Router0	Router(config-subif)#exit
Router0	Router(config)#logging host 10.0.0.2
Router0	Router(config)#exit
Router0	Router#configure terminal
Router0	Router(config)#int fa0/0
Router0	Router(config-if)#ip flow ingress
Router0	Router(config-if)#ip flow egress
Router0	Router(config-if)#ip flow-export destination 10.0.0.2 99

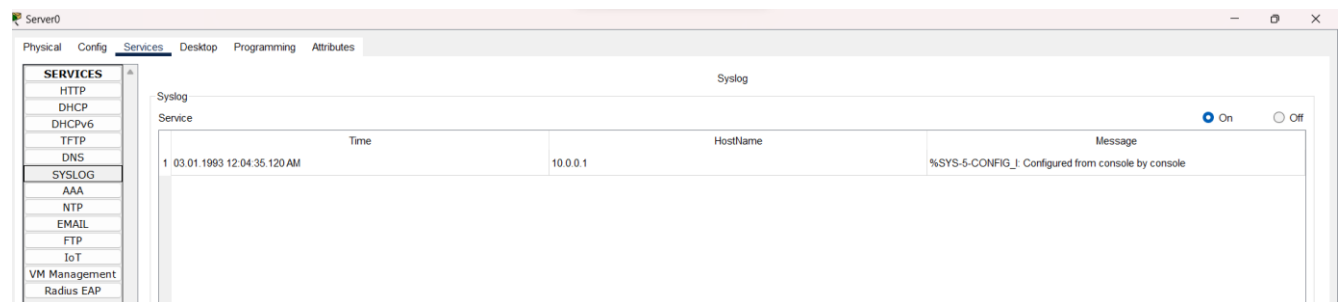Router0   Router(config)#ip flow-export source fa0/0

Router0   Router(config)#end

Router0   Router#show ip cache flow
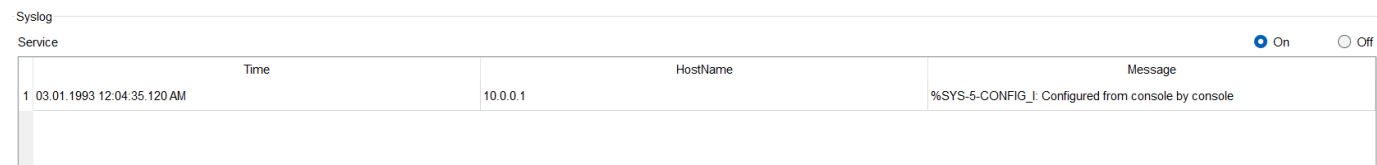
Router0   Router#show ip cache flow

OUTPUT:
SYSLOG:

NETFLOW:

```
Router#show ip cache flow
IP packet size distribution (0 total packets):
   1-32    64    96   128   160   192   224   256   288   320   352   384   416   448   480
   .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000

    512   544   576  1024  1536  2048  2560  3072  3584  4096  4608
   .000  .000  .000  .000  .000  .000  .000  .000  .000  .000  .000

IP Flow Switching Cache, 278544 bytes
  0 active, 4096 inactive, 0 added
  3 ager polls, 0 flow alloc failures
  Active flows timeout in 30 minutes
  Inactive flows timeout in 15 seconds
IP Sub Flow Cache, 34056 bytes
  0 active, 1024 inactive, 0 added, 0 added to flow
  0 alloc failures, 0 force free
  1 chunk, 1 chunk added
  last clearing of statistics never
Protocol         Total    Flows   Packets Bytes  Packets Active(Sec) Idle(Sec)
--------         Flows    /Sec    /Flow  /Pkt    /Sec    /Flow     /Flow
Total:               0     0.0       0      0     0.0     0.0       0.0

SrcIf        SrcIPaddress    DstIf        DstIPaddress   Pr SrcP DstP  Pkts
Router#
```
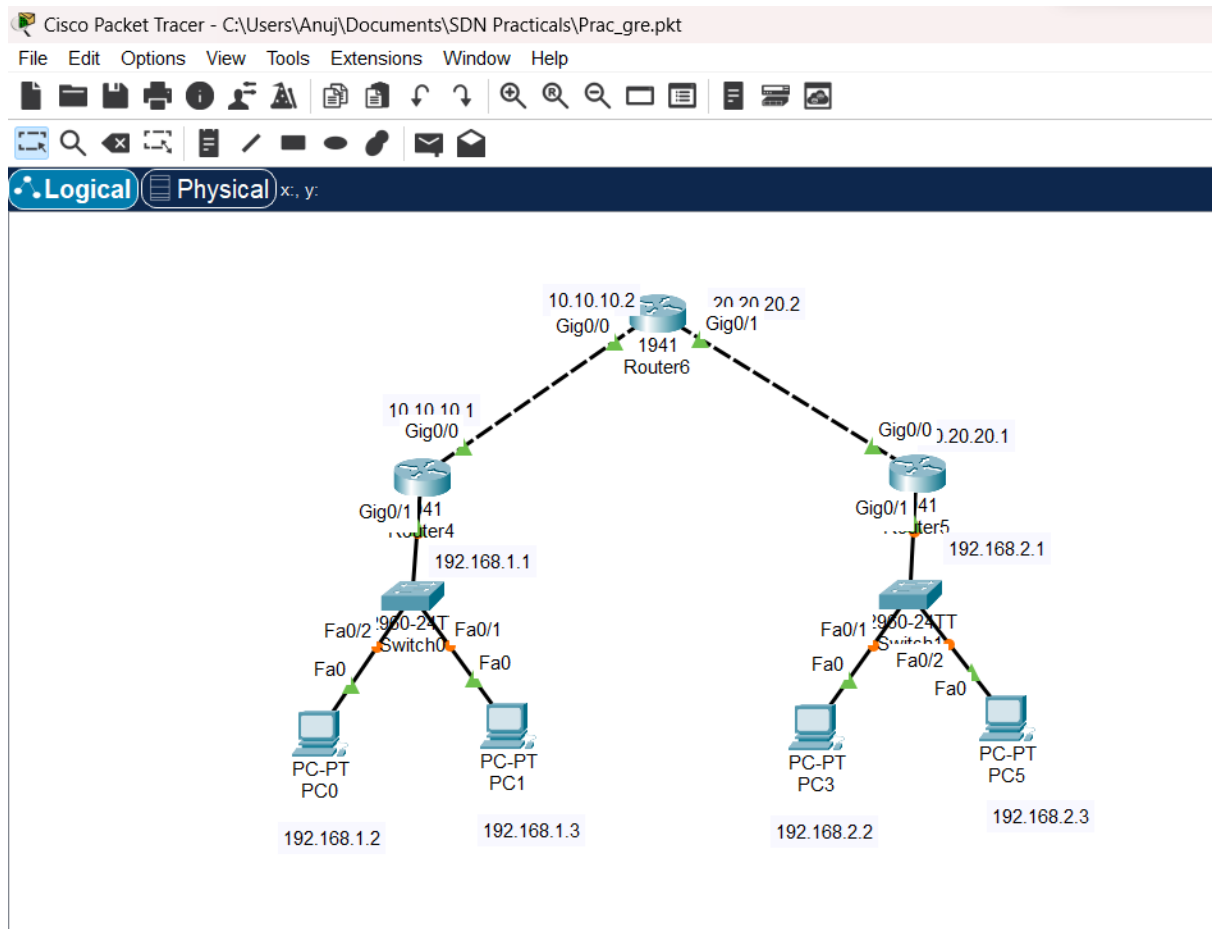
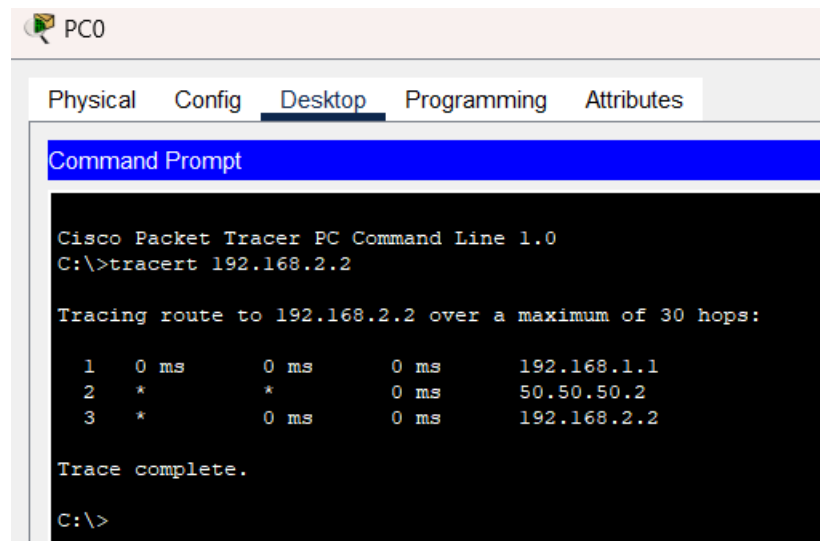# PRACTICAL 2:

A. Implement a GRE Tunnel

CLI COMMANDS:

Tue Sep 12 10:25:42 2023	Router4	Router(config)#int tunnel ?
Tue Sep 12 10:25:49 2023	Router4	Router(config)#int tunnel 0
Tue Sep 12 10:27:34 2023	Router4	Router(config-if)#ip address 50.50.50.1 255.255.255.0
Tue Sep 12 10:27:50 2023	Router4	Router(config-if)#no shutdown
Tue Sep 12 10:32:13 2023	Router4	Router(config-if)#tunnel source g0/0
Tue Sep 12 10:32:30 2023	Router4	Router(config-if)#tunnel destination 20.20.20.1
Tue Sep 12 10:33:07 2023	Router4	Router(config-if)#tunnel mode gre ip
Tue Sep 12 10:33:23 2023	Router5	Router>en
Tue Sep 12 10:33:26 2023	Router5	Router#conf t
Tue Sep 12 10:33:40 2023	Router5	Router(config)#int tunnel 0
Tue Sep 12 10:34:04 2023	Router5	Router(config-if)#ip address 50.50.50.2 255.255.255.0
Tue Sep 12 10:34:20 2023	Router5	Router(config-if)#tunnel source g0/0
Tue Sep 12 10:34:33 2023	Router5	Router(config-if)#tunnel destination 10.10.10.1
Tue Sep 12 10:34:38 2023	Router5	Router(config-if)#no shutdown

Tue Sep 12 10:34:49 2023   Router5   Router(config-if)#tunnel mode gre ip
Tue Sep 12 10:35:22 2023   Router5   Router(config-if)#exit
Tue Sep 12 10:35:29 2023   Router4   Router(config-if)#exit
Tue Sep 12 10:36:38 2023   Router5   Router(config)#int tunnel 0
Tue Sep 12 10:36:41 2023   Router5   Router(config-if)#no shutdown
Tue Sep 12 10:36:46 2023   Router5   Router(config-if)#ip address 50.50.50.2 255.255.255.0
Tue Sep 12 10:36:54 2023   Router5   Router(config-if)#tunnel source g0/0
Tue Sep 12 10:36:58 2023   Router5   Router(config-if)#tunnel destination 10.10.10.1
Tue Sep 12 10:37:09 2023   Router5   Router(config-if)#tunnel mode gre ip
Tue Sep 12 10:37:13 2023   Router5   Router(config-if)#exit
Tue Sep 12 10:41:59 2023   Router4   Router(config)#ip route 192.168.2.0 50.50.50.2
Tue Sep 12 10:42:43 2023   Router4   Router(config)#ip route 192.168.2.0 255.255.255.0
50.50.50.2
Tue Sep 12 10:43:17 2023   Router5   Router(config)#ip route 192.168.1.0 255.255.255.0
50.50.50.1

OUTPUT:

B. Implement VTP

CLI COMMANDS:

Tue Sep 26 10:29:41 2023   Router0   Router#NA?
Tue Sep 26 10:29:43 2023   Router0   Router#NAT?
Tue Sep 26 10:29:47 2023   Router0   Router#conf t
Tue Sep 26 10:29:52 2023   Router0   Router(config)#nat ?
Tue Sep 26 10:31:09 2023   Router0   Router(config)#int fa0/0 ?
Tue Sep 26 10:31:13 2023   Router0   Router(config)#int fa0/0
Tue Sep 26 10:31:25 2023   Router0   Router(config-if)#ip nat inside ?
Tue Sep 26 10:31:28 2023   Router0   Router(config-if)#ip nat inside
Tue Sep 26 10:32:16 2023   Router0   Router(config-if)#int fa1/0
Tue Sep 26 10:32:29 2023   Router0   Router(config-if)#ip nat inside
Tue Sep 26 10:32:56 2023   Router0   Router(config-if)#int se2/0
Tue Sep 26 10:33:02 2023   Router0   Router(config-if)#ip nat outside
Tue Sep 26 10:33:10 2023   Router0   Router(config-if)#exit
Tue Sep 26 10:33:50 2023   Router0   Router(config)#ip ?
Tue Sep 26 10:34:04 2023   Router0   Router(config)#ip nat ?
Tue Sep 26 10:34:30 2023   Router0   Router(config)#ip nat inside ?
Tue Sep 26 10:34:41 2023   Router0   Router(config)#ip nat inside source ?
Tue Sep 26 10:34:51 2023   Router0   Router(config)#ip nat inside source static ?

Tue Sep 26 10:35:45 2023	Router0	Router(config)#ip nat inside source static 10.10.10.2 50.50.50.2
Tue Sep 26 10:35:59 2023	Router0	Router(config)#ip nat inside source static 10.10.10.3 50.50.50.3
Tue Sep 26 10:36:04 2023	Router0	Router(config)#exit
Tue Sep 26 10:38:29 2023	Router1	Router>en
Tue Sep 26 10:38:30 2023	Router1	Router#conf t
Tue Sep 26 10:38:38 2023	Router1	Router(config)#int fa0/0
Tue Sep 26 10:38:46 2023	Router1	Router(config-if)#ip nat inside
Tue Sep 26 10:38:52 2023	Router1	Router(config-if)#int fa1/0
Tue Sep 26 10:38:57 2023	Router1	Router(config-if)#ip nat inside
Tue Sep 26 10:39:26 2023	Router1	Router(config-if)#int se2/0
Tue Sep 26 10:39:31 2023	Router1	Router(config-if)#ip nat outside
Tue Sep 26 10:39:37 2023	Router1	Router(config-if)#exit
Tue Sep 26 10:39:40 2023	Router1	Router(config)#ip nat ?
Tue Sep 26 10:39:51 2023	Router1	Router(config)#ip nat inside source static ?
Tue Sep 26 10:40:03 2023	Router1	Router(config)#ip nat inside source static 20.20.20.2 60.60.60.2
Tue Sep 26 10:40:09 2023	Router1	Router(config)#exit
Tue Sep 26 10:41:11 2023	Router1	Router#conf t
Tue Sep 26 10:42:32 2023	Router1	Router(config)#ip route ?
Tue Sep 26 10:44:24 2023	Router1	Router(config)#ip route 60.60.60.2 255.255.255.0 192.168.10.2
Tue Sep 26 10:44:33 2023	Router1	Router(config)#ip route 60.60.60.2 255.0.0.0 192.168.10.2
Tue Sep 26 10:44:41 2023	Router1	Router(config)#ip route ?
Tue Sep 26 10:44:51 2023	Router1	Router(config)#ip route 60.60.60.2 ?
Tue Sep 26 10:45:05 2023	Router1	Router(config)#ip route 60.60.60.2 255.255.255.0 ?
Tue Sep 26 10:45:19 2023	Router1	Router(config)#ip route 60.60.60.2 255.255.255.0 192.168.10.2
Tue Sep 26 10:45:36 2023	Router1	Router(config)#ip route 60.60.60.2 255.255.255.255 192.168.10.2
Tue Sep 26 10:46:03 2023	Router1	Router(config)#ip route 60.60.60.2 255.255.255.255 192.168.10.2
Tue Sep 26 10:46:37 2023	Router0	Router#conf t
Tue Sep 26 10:46:40 2023	Router0	Router(config)#ip route 60.60.60.2 255.255.255.255 192.168.10.2
Tue Sep 26 10:46:59 2023	Router0	Router(config)#exit
Tue Sep 26 10:52:29 2023	Router0	Router>conf t
Tue Sep 26 10:52:32 2023	Router0	Router>en
Tue Sep 26 10:52:34 2023	Router0	Router#conf t
Tue Sep 26 10:52:55 2023	Router0	Router(config)#ip route 60.60.60.2 255.255.255.255 192.168.10.2
Tue Sep 26 10:53:13 2023	Router1	Router>en
Tue Sep 26 10:53:16 2023	Router1	Router#conf t
Tue Sep 26 10:55:07 2023	Router1	Router(config)#ip route 50.50.50.2 255.255.255.255 192.168.10.1

Tue Sep 26 10:55:14 2023   Router1   Router(config)#ip route 50.50.50.3 255.255.255.255 192.168.10.1
Tue Sep 26 11:23:53 2023   Switch1   Switch>en
Tue Sep 26 11:23:55 2023   Switch1   Switch#conf t
Tue Sep 26 11:23:59 2023   Switch1   Switch(config)#vtp ?
Tue Sep 26 11:24:05 2023   Switch1   Switch(config)#vtp mode ?
Tue Sep 26 11:24:11 2023   Switch1   Switch(config)#mode ?
Tue Sep 26 11:24:22 2023   Switch1   Switch(config)#int fa0/1
Tue Sep 26 11:24:31 2023   Switch1   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:24:39 2023   Switch1   Switch(config-if)#int fa0/2
Tue Sep 26 11:24:43 2023   Switch1   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:25:09 2023   Switch0   Switch>en
Tue Sep 26 11:25:12 2023   Switch0   Switch#conf t
Tue Sep 26 11:25:15 2023   Switch0   Switch(config)#int fa0/1
Tue Sep 26 11:25:25 2023   Switch0   Switch(config-if)#switchport ?
Tue Sep 26 11:25:29 2023   Switch0   Switch(config-if)#switchport mode ?
Tue Sep 26 11:25:31 2023   Switch0   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:25:48 2023   Switch2   Switch>rn
Tue Sep 26 11:26:21 2023   Switch3   Switch>en
Tue Sep 26 11:26:23 2023   Switch3   Switch#conf t
Tue Sep 26 11:26:30 2023   Switch3   Switch(config)#int fa0/3
Tue Sep 26 11:26:33 2023   Switch3   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:27:17 2023   Switch4   Switch>en
Tue Sep 26 11:27:19 2023   Switch4   Switch#conf t
Tue Sep 26 11:27:26 2023   Switch4   Switch(config)#int fa0/2
Tue Sep 26 11:27:29 2023   Switch4   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:27:34 2023   Switch4   Switch(config-if)#int fa0/3
Tue Sep 26 11:27:36 2023   Switch4   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:27:52 2023   Switch1   Switch(config-if)#int fa0/2
Tue Sep 26 11:27:54 2023   Switch1   Switch(config-if)#switchport mode trunk
Tue Sep 26 11:30:57 2023   Switch1   Switch(config-if)#exit
Tue Sep 26 11:31:25 2023   Switch1   Switch(config)#vtp mode server
Tue Sep 26 11:31:41 2023   Switch0   Switch(config-if)#exit
Tue Sep 26 11:31:45 2023   Switch0   Switch(config)#vtp mode client
Tue Sep 26 11:31:56 2023   Switch1   Switch(config)#vtp domain ?
Tue Sep 26 11:32:08 2023   Switch1   Switch(config)#vtp domain vtpServer
Tue Sep 26 11:33:20 2023   Switch1   Switch(config)#end
Tue Sep 26 11:33:41 2023   Switch1   Switch#show vtp status
Tue Sep 26 11:34:41 2023   Switch0   Switch(config)#end
Tue Sep 26 11:34:46 2023   Switch0   Switch#show vtp status
Tue Sep 26 11:35:09 2023   Switch4   Switch(config-if)#vtp mode ?
Tue Sep 26 11:35:13 2023   Switch4   Switch(config-if)#exit
Tue Sep 26 11:35:18 2023   Switch4   Switch(config)#vtp mode ?
Tue Sep 26 11:35:23 2023   Switch4   Switch(config)#vtp mode transparent
Tue Sep 26 11:35:28 2023   Switch4   Switch(config)#end
Tue Sep 26 11:35:33 2023   Switch4   Switch#show vtp status
Tue Sep 26 11:35:42 2023   Switch3   Switch(config-if)#exit
Tue Sep 26 11:35:47 2023   Switch3   Switch(config)#vtp mode client

Tue Sep 26 11:35:54 2023   Switch3   Switch(config)#end
Tue Sep 26 11:35:58 2023   Switch3   Switch#show vtp status
Tue Sep 26 11:38:03 2023   Switch1   Switch#show vtp status
Tue Sep 26 11:38:20 2023   Switch1   Switch#configure terminal
Tue Sep 26 11:38:38 2023   Switch1   Switch(config)#vlan 10
Tue Sep 26 11:38:50 2023   Switch1   Switch(config-vlan)#name production
Tue Sep 26 11:38:52 2023   Switch1   Switch(config-vlan)#exit
Tue Sep 26 11:39:03 2023   Switch1   Switch(config)#end
Tue Sep 26 11:39:09 2023   Switch1   Switch#show vtp status
Tue Sep 26 11:39:37 2023   Switch0   Switch#show vtp status
Tue Sep 26 11:40:05 2023   Switch4   Switch#show vtp status
Tue Sep 26 11:40:15 2023   Switch3   Switch#show vtp status
Tue Sep 26 11:41:22 2023   Switch1   Switch#conf t
Tue Sep 26 11:41:26 2023   Switch1   Switch(config)#vlan 20
Tue Sep 26 11:41:31 2023   Switch1   Switch(config-vlan)#name marketing
Tue Sep 26 11:41:33 2023   Switch1   Switch(config-vlan)#exit
Tue Sep 26 11:41:36 2023   Switch1   Switch(config)#vlan 30
Tue Sep 26 11:41:41 2023   Switch1   Switch(config-vlan)#name advertising
Tue Sep 26 11:41:43 2023   Switch1   Switch(config-vlan)#exit
Tue Sep 26 11:41:44 2023   Switch1   Switch(config)#end
Tue Sep 26 11:41:46 2023   Switch1   Switch#show vtp status

OUTPUT:

```
Switch>en
Switch#show vtp status
VTP Version capable             : 1 to 2
VTP version running             : 1
VTP Domain Name                 : vtpServer
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 0060.4740.B800
Configuration last modified by 0.0.0.0 at 3-1-93 00:21:17
Local updater ID is 0.0.0.0 (no valid interface found)

Feature VLAN :
--------------
VTP Operating Mode              : Server
Maximum VLANs supported locally : 255
Number of existing VLANs        : 8
Configuration Revision          : 6
MD5 digest                      : 0xE9 0xB9 0xD0 0x1C 0xC5 0x26 0xDB 0x53
                                  0x2C 0xB6 0xA4 0xD8 0x70 0x26 0x18 0xA6
Switch#
```

```
Switch>en
Switch#show vtp status
VTP Version capable             : 1 to 2
VTP version running             : 1
VTP Domain Name                 : vtpServer
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 00E0.F9A4.B200
Configuration last modified by 0.0.0.0 at 3-1-93 00:21:17

Feature VLAN :
--------------
VTP Operating Mode              : Client
Maximum VLANs supported locally : 255
Number of existing VLANs        : 8
Configuration Revision          : 6
MD5 digest                      : 0xE9 0xB9 0xD0 0x1C 0xC5 0x26 0xDB 0x53
                                  0x2C 0xB6 0xA4 0xD8 0x70 0x26 0x18 0xA6
Switch#
```

```
Switch>en
Switch#show vtp status
VTP Version capable             : 1 to 2
VTP version running             : 1
VTP Domain Name                 : vtpServer
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 0090.21EB.7C00
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Feature VLAN :
--------------
VTP Operating Mode              : Transparent
Maximum VLANs supported locally : 255
Number of existing VLANs        : 5
Configuration Revision          : 0
MD5 digest                      : 0x4E 0x68 0x17 0x4C 0xC9 0x99 0x85 0x69
                                  0x50 0xB0 0x29 0x1D 0x21 0x1B 0xE4 0x9F
Switch#
```
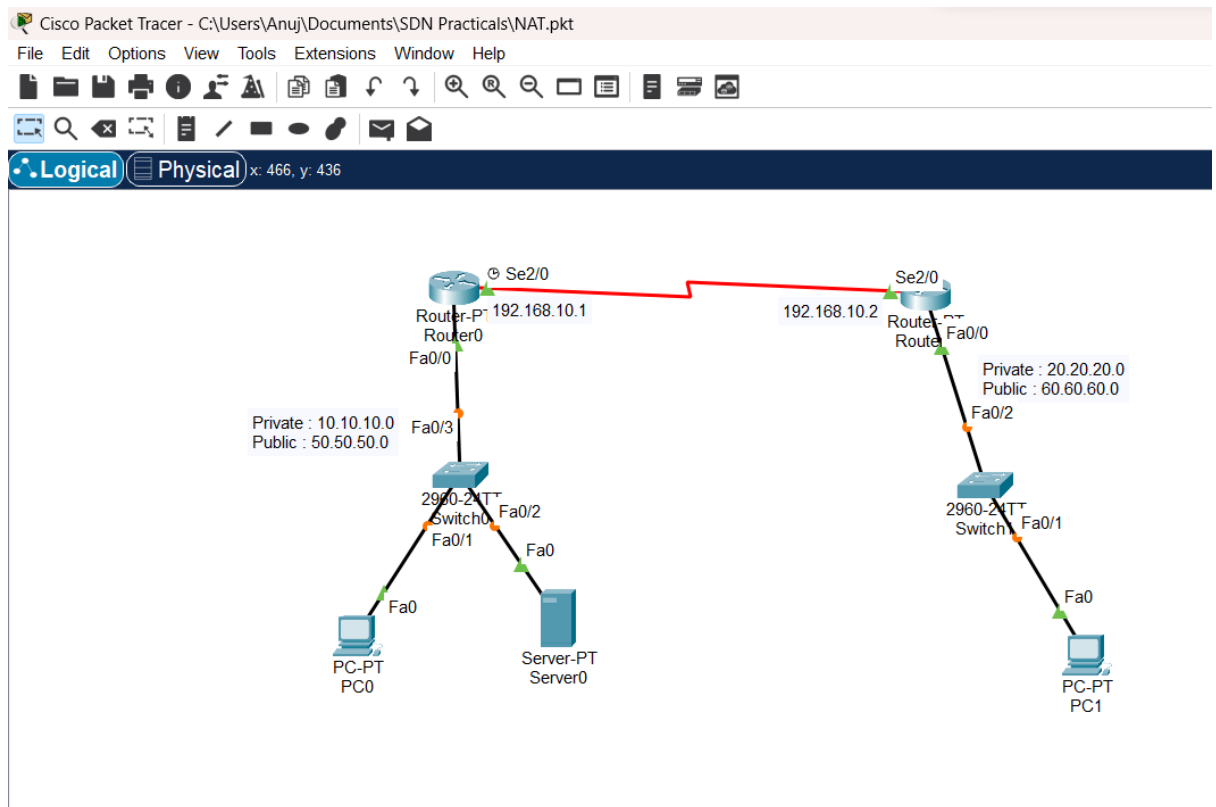
```
Switch>en
Switch#show vtp status
VTP Version capable             : 1 to 2
VTP version running             : 1
VTP Domain Name                 : vtpServer
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 0030.A3D2.1200
Configuration last modified by 0.0.0.0 at 3-1-93 00:21:17

Feature VLAN :
--------------
VTP Operating Mode              : Client
Maximum VLANs supported locally : 255
Number of existing VLANs        : 8
Configuration Revision          : 6
MD5 digest                      : 0xE9 0xB9 0xD0 0x1C 0xC5 0x26 0xDB 0x53
                                  0x2C 0xB6 0xA4 0xD8 0x70 0x26 0x18 0xA6
Switch#
```

C. Implement NAT

CLI COMMANDS:

Tue Sep 26 10:29:47 2023 Router0 Router#conf t
Tue Sep 26 10:29:52 2023 Router0 Router(config)#nat ?
Tue Sep 26 10:31:09 2023 Router0 Router(config)#int fa0/0 ?
Tue Sep 26 10:31:13 2023 Router0 Router(config)#int fa0/0
Tue Sep 26 10:31:25 2023 Router0 Router(config-if)#ip nat inside ?
Tue Sep 26 10:31:28 2023 Router0 Router(config-if)#ip nat inside
Tue Sep 26 10:32:16 2023 Router0 Router(config-if)#int fa1/0
Tue Sep 26 10:32:29 2023 Router0 Router(config-if)#ip nat inside
Tue Sep 26 10:32:56 2023 Router0 Router(config-if)#int se2/0
Tue Sep 26 10:33:02 2023 Router0 Router(config-if)#ip nat outside
Tue Sep 26 10:33:10 2023 Router0 Router(config-if)#exit
Tue Sep 26 10:35:45 2023 Router0 Router(config)#ip nat inside source static 10.10.10.2
50.50.50.2
Tue Sep 26 10:35:59 2023 Router0 Router(config)#ip nat inside source static 10.10.10.3
50.50.50.3
Tue Sep 26 10:36:04 2023 Router0 Router(config)#exit
Tue Sep 26 10:38:29 2023 Router1 Router>en
Tue Sep 26 10:38:30 2023 Router1 Router#conf t
Tue Sep 26 10:38:38 2023 Router1 Router(config)#int fa0/0
Tue Sep 26 10:38:46 2023 Router1 Router(config-if)#ip nat inside
Tue Sep 26 10:38:52 2023 Router1 Router(config-if)#int fa1/0
Tue Sep 26 10:38:57 2023 Router1 Router(config-if)#ip nat inside
Tue Sep 26 10:39:26 2023 Router1 Router(config-if)#int se2/0

Tue Sep 26 10:39:31 2023 Router1 Router(config-if)#ip nat outside
Tue Sep 26 10:39:37 2023 Router1 Router(config-if)#exit
Tue Sep 26 10:40:03 2023 Router1 Router(config)#ip nat inside source static 20.20.20.2
60.60.60.2
Tue Sep 26 10:40:09 2023 Router1 Router(config)#exit
Tue Sep 26 10:41:11 2023 Router1 Router#conf t
Tue Sep 26 10:44:24 2023 Router1 Router(config)#ip route 60.60.60.2 255.255.255.0
192.168.10.2
Tue Sep 26 10:44:33 2023 Router1 Router(config)#ip route 60.60.60.2 255.0.0.0
192.168.10.2
Tue Sep 26 10:45:19 2023 Router1 Router(config)#ip route 60.60.60.2 255.255.255.0
192.168.10.2
Tue Sep 26 10:45:36 2023 Router1 Router(config)#ip route 60.60.60.2 255.255.255.255
192.168.10.2
Tue Sep 26 10:46:03 2023 Router1 Router(config)#ip route 60.60.60.2 255.255.255.255
192.168.10.2
Tue Sep 26 10:46:37 2023 Router0 Router#conf t
Tue Sep 26 10:46:40 2023 Router0 Router(config)#ip route 60.60.60.2 255.255.255.255
192.168.10.2
Tue Sep 26 10:46:59 2023 Router0 Router(config)#exit
Tue Sep 26 10:52:29 2023 Router0 Router>conf t
Tue Sep 26 10:52:32 2023 Router0 Router>en
Tue Sep 26 10:52:34 2023 Router0 Router#conf t
Tue Sep 26 10:52:55 2023 Router0 Router(config)#ip route 60.60.60.2 255.255.255.255
192.168.10.2
Tue Sep 26 10:53:13 2023 Router1 Router>en
Tue Sep 26 10:53:16 2023 Router1 Router#conf t
Tue Sep 26 10:55:07 2023 Router1 Router(config)#ip route 50.50.50.2 255.255.255.255
192.168.10.1
Tue Sep 26 10:55:14 2023 Router1 Router(config)#ip route 50.50.50.3 255.255.255.255
192.168.10.1
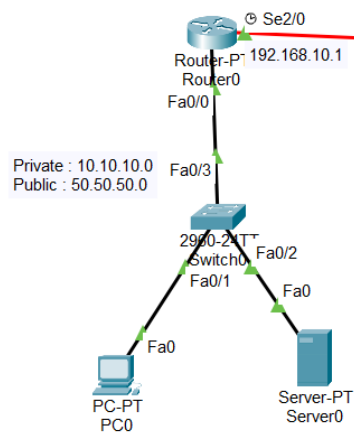
OUTPUT:


```
C:\>ping 60.60.60.2

Pinging 60.60.60.2 with 32 bytes of data:

Reply from 60.60.60.2: bytes=32 time=9ms TTL=126
Reply from 60.60.60.2: bytes=32 time=1ms TTL=126
Reply from 60.60.60.2: bytes=32 time=1ms TTL=126
Reply from 60.60.60.2: bytes=32 time=11ms TTL=126

Ping statistics for 60.60.60.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 11ms, Average = 5ms

C:\>
```

Se2/0

Router-P 192.168.10.1
Router0

Fa0/0

Private : 10.10.10.0
Public : 50.50.50.0

Fa0/3

2900-2 TT
Switch0   Fa0/2

Fa0/1   Fa0

Fa0

PC-PT   Server-PT
PC0   Server0

PC1

Physical   Config   Desktop   Programming   Attributes

Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 50.50.50.2

Pinging 50.50.50.2 with 32 bytes of data:

Reply from 50.50.50.2: bytes=32 time=15ms TTL=126
Reply from 50.50.50.2: bytes=32 time=7ms TTL=126
Reply from 50.50.50.2: bytes=32 time=7ms TTL=126
Reply from 50.50.50.2: bytes=32 time=8ms TTL=126

Ping statistics for 50.50.50.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 15ms, Average = 9ms

C:\>

3. Implement Inter-VLAN Routing
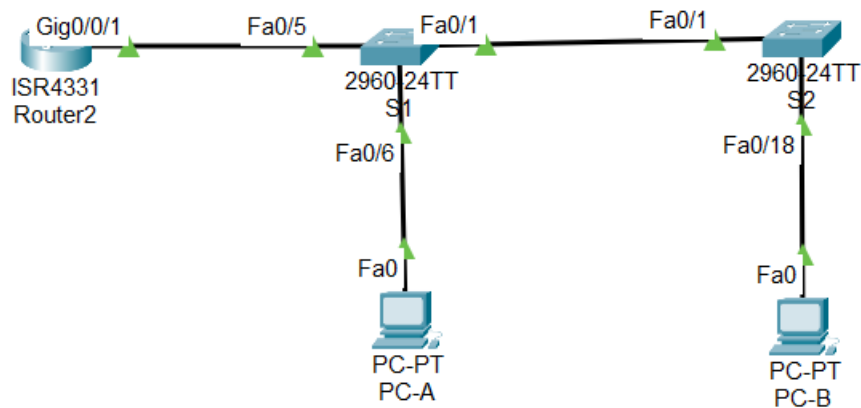
CLI:

Router 2

Sat Nov 11 11:09:54 2023   Router2   Router>enable
Sat Nov 11 11:09:54 2023   Router2   Router#configure terminal
Sat Nov 11 11:09:54 2023   Router2   Router(config)#interface GigabitEthernet0/0/1
Sat Nov 11 11:10:25 2023   Router2   Router(config-if)#exit
Sat Nov 11 11:10:35 2023   Router2   Router(config)#hostname R1
Sat Nov 11 11:10:50 2023   Router2   R1(config)#no ip domain-lookup
Sat Nov 11 11:10:58 2023   Router2   R1(config)#enable secret class
Sat Nov 11 11:11:04 2023   Router2   R1(config)#line console 0
Sat Nov 11 11:11:11 2023   Router2   R1(config-line)#password cisco
Sat Nov 11 11:11:14 2023   Router2   R1(config-line)#login
Sat Nov 11 11:11:25 2023   Router2   R1(config-line)#line vty 0 4
Sat Nov 11 11:11:30 2023   Router2   R1(config-line)#password cisco
Sat Nov 11 11:11:33 2023   Router2   R1(config-line)#login
Sat Nov 11 11:11:44 2023   Router2   R1(config-line)#service password-encryption
Sat Nov 11 11:12:27 2023   Router2   R1(config)#banner motd $ Authorized users only $
Sat Nov 11 11:17:14 2023   Router2   R1(config)#exit
Sat Nov 11 11:17:27 2023   Router2   R1#copy running-config startup-config
Sat Nov 11 11:17:41 2023   Router2   R1#copy running-config startup-config
Sat Nov 11 11:18:12 2023   Router2   R1#clock set 11:17:00 11 November 2023

Switch S1

Sat Nov 11 11:18:26 2023   S1   Switch>en
Sat Nov 11 11:18:28 2023   S1   Switch#conf t
Sat Nov 11 11:18:35 2023   S1   Switch(config)#hostname S1

Sat Nov 11 11:18:50 2023 S1 S1(config)#no ip domain-lookup
Sat Nov 11 11:18:57 2023 S1 S1(config)#enable secret class
Sat Nov 11 11:19:04 2023 S1 S1(config)#line console 0
Sat Nov 11 11:19:08 2023 S1 S1(config-line)#password cisco
Sat Nov 11 11:19:11 2023 S1 S1(config-line)#login
Sat Nov 11 11:19:17 2023 S1 S1(config-line)#line vty 0 4
Sat Nov 11 11:19:23 2023 S1 S1(config-line)#password cisco
Sat Nov 11 11:19:36 2023 S1 S1(config-line)#login
Sat Nov 11 11:19:48 2023 S1 S1(config-line)#service passwo?
Sat Nov 11 11:20:46 2023 S1 S1(config-line)#service password-encryption
Sat Nov 11 11:21:13 2023 S1 S1(config)#banner motd $ Authorized users only $
Sat Nov 11 11:21:15 2023 S1 S1(config)#exit
Sat Nov 11 11:21:36 2023 S1 S1#clock set 11:21:00 11 November 2023
Sat Nov 11 11:21:48 2023 S1 S1#copy running-config startup-config

Switch S2

Sat Nov 11 11:22:02 2023 S2 Switch>en
Sat Nov 11 11:22:04 2023 S2 Switch#conf t
Sat Nov 11 11:22:18 2023 S2 Switch(config)#hostname S2
Sat Nov 11 11:22:31 2023 S2 S2(config)#no ip domain-lookup
Sat Nov 11 11:22:48 2023 S2 S2(config)#enable secret class
Sat Nov 11 11:22:56 2023 S2 S2(config)#line console 0
Sat Nov 11 11:23:01 2023 S2 S2(config-line)#password cisco
Sat Nov 11 11:23:04 2023 S2 S2(config-line)#login
Sat Nov 11 11:23:21 2023 S2 S2(config-line)#line vty 0 4
Sat Nov 11 11:23:26 2023 S2 S2(config-line)#password cisco
Sat Nov 11 11:23:28 2023 S2 S2(config-line)#login
Sat Nov 11 11:23:43 2023 S2 S2(config-line)#service password-encryption
Sat Nov 11 11:24:00 2023 S2 S2(config)#banner motd $ Authorized Users only ! $
Sat Nov 11 11:24:04 2023 S2 S2(config)#exit
Sat Nov 11 11:24:22 2023 S2 S2#clock set 11:24:00 11 November 2023
Sat Nov 11 11:24:46 2023 S2 S2#copy running-config startup-config

Switch S1

Sat Nov 11 11:25:44 2023 S1 S1#vlan 10
Sat Nov 11 11:25:48 2023 S1 S1#conf t
Sat Nov 11 11:25:59 2023 S1 S1(config)#vlan 10
Sat Nov 11 11:26:06 2023 S1 S1(config-vlan)#name management
Sat Nov 11 11:26:10 2023 S1 S1(config-vlan)#vlan 20
Sat Nov 11 11:26:14 2023 S1 S1(config-vlan)#name Sales
Sat Nov 11 11:26:19 2023 S1 S1(config-vlan)#vlan 30
Sat Nov 11 11:26:25 2023 S1 S1(config-vlan)#name Operations
Sat Nov 11 11:26:28 2023 S1 S1(config-vlan)#vlan 999
Sat Nov 11 11:26:37 2023 S1 S1(config-vlan)#name Parking_lot
Sat Nov 11 11:26:46 2023 S1 S1(config-vlan)#vlan 1000
Sat Nov 11 11:26:55 2023 S1 S1(config-vlan)#name Native

Sat Nov 11 11:26:57 2023   S1   S1(config-vlan)#exit

Switch S2

Sat Nov 11 11:27:05 2023   S2   S2#conf t
Sat Nov 11 11:27:10 2023   S2   S2(config)#vlan 10
Sat Nov 11 11:27:18 2023   S2   S2(config-vlan)#name Management
Sat Nov 11 11:27:21 2023   S2   S2(config-vlan)#vlan 20
Sat Nov 11 11:27:27 2023   S2   S2(config-vlan)#name Sales
Sat Nov 11 11:27:30 2023   S2   S2(config-vlan)#vlan 30
Sat Nov 11 11:27:39 2023   S2   S2(config-vlan)#name Operations
Sat Nov 11 11:27:44 2023   S2   S2(config-vlan)#vlan 999
Sat Nov 11 11:27:50 2023   S2   S2(config-vlan)#name Parking_lot
Sat Nov 11 11:28:02 2023   S2   S2(config-vlan)#vlan 1000
Sat Nov 11 11:28:06 2023   S2   S2(config-vlan)#name Native
Sat Nov 11 11:28:08 2023   S2   S2(config-vlan)#exit

Switch S1

Sat Nov 11 11:28:27 2023   S1   S1(config)#interface vlan 10
Sat Nov 11 11:29:28 2023   S1   S1(config-if)#ip address 192.168.10.11 255.255.255.0
Sat Nov 11 11:29:34 2023   S1   S1(config-if)#no shutdown
Sat Nov 11 11:29:36 2023   S1   S1(config-if)#exit
Sat Nov 11 11:29:52 2023   S1   S1(config)#ip default-gateway 192.168.10.1

Switch S2

Sat Nov 11 11:30:07 2023   S2   S2(config)#interface vlan 10
Sat Nov 11 11:30:34 2023   S2   S2(config-if)#ip address 192.168.10.12 255.255.255.0
Sat Nov 11 11:30:38 2023   S2   S2(config-if)#no shutdown
Sat Nov 11 11:30:41 2023   S2   S2(config-if)#exit
Sat Nov 11 11:30:55 2023   S2   S2(config)#ip default-gateway 192.168.10.1
Sat Nov 11 11:32:10 2023   S1   S1(config)#interface range f0/2 - 4 , f0/7 - 24, g0/1 - 2
Sat Nov 11 11:32:24 2023   S1   S1(config-if-range)#switchport mode access
Sat Nov 11 11:32:41 2023   S1   S1(config-if-range)#switchport access vlan 999
Sat Nov 11 11:33:14 2023   S1   S1(config-if-range)#shutdown

Switch S2

Sat Nov 11 11:34:08 2023   S2   S2(config)#interface range f0/2 - 4 , f0/7 - 24, g0/1 - 2
Sat Nov 11 11:34:30 2023   S2   S2(config-if-range)#exit
Sat Nov 11 11:35:07 2023   S2   S2(config)#interface range f0/2 - 17 , f0/19 - 24, g0/1 - 2
Sat Nov 11 11:35:18 2023   S2   S2(config-if-range)#switchport mode access
Sat Nov 11 11:35:34 2023   S2   S2(config-if-range)#switchport access vlan 999
Sat Nov 11 11:35:38 2023   S2   S2(config-if-range)#shutdown

Switch S1

Sat Nov 11 11:35:56 2023   S1   S1(config-if-range)#exit
Sat Nov 11 11:36:07 2023   S1   S1(config)#interface f0/6
Sat Nov 11 11:36:15 2023   S1   S1(config-if)#switchport mode access

Sat Nov 11 11:36:25 2023 S1 S1(config-if)#switchport access vlan 20
Sat Nov 11 11:36:34 2023 S1 S1(config-if)#exit
Sat Nov 11 11:36:35 2023 S1 S1(config)#end
Sat Nov 11 11:36:42 2023 S1 S1#show vlan brief

Switch S2
Sat Nov 11 11:37:08 2023 S2 S2(config-if-range)#exit
Sat Nov 11 11:37:21 2023 S2 S2(config)#interface f0/18
Sat Nov 11 11:37:29 2023 S2 S2(config-if)#switchport mode access
Sat Nov 11 11:37:40 2023 S2 S2(config-if)#switchport access vlan 30
Sat Nov 11 11:38:03 2023 S2 S2(config-if)#show vlan brief
Sat Nov 11 11:38:06 2023 S2 S2(config-if)#exit
Sat Nov 11 11:38:07 2023 S2 S2(config)#end
Sat Nov 11 11:38:13 2023 S2 S2#show vlan brief

Switch S1
Sat Nov 11 11:38:50 2023 S1 S1#conf t
Sat Nov 11 11:39:06 2023 S1 S1(config)#interface f0/1
Sat Nov 11 11:39:13 2023 S1 S1(config-if)#switchport mode trunk
Sat Nov 11 11:39:38 2023 S1 S1(config-if)#switchport trunk native vlan 1000
Sat Nov 11 11:39:46 2023 S1 S1(config-if)#sw
Sat Nov 11 11:40:12 2023 S1 S1(config-if)#switchport trunk allowed vlan 10,20,30,1000
Sat Nov 11 11:40:24 2023 S1 S1(config-if)#show interfaces trunk
Sat Nov 11 11:40:27 2023 S1 S1(config-if)#exit
Sat Nov 11 11:40:28 2023 S1 S1(config)#end
Sat Nov 11 11:40:35 2023 S1 S1#show interfaces trunk

Switch S2
Sat Nov 11 11:40:47 2023 S2 S2#conf t
Sat Nov 11 11:40:56 2023 S2 S2(config)#interface f0/1
Sat Nov 11 11:41:02 2023 S2 S2(config-if)#switchport mode trunk
Sat Nov 11 11:41:59 2023 S2 S2(config-if)#switchport trunk native vlan 1000
Sat Nov 11 11:42:41 2023 S2 S2(config-if)#switchport trunk allowed vlan 10,20,30,1000
Sat Nov 11 11:42:55 2023 S2 S2(config-if)#exit
Sat Nov 11 11:42:56 2023 S2 S2(config)#end
Sat Nov 11 11:43:03 2023 S2 S2#show vlan brief
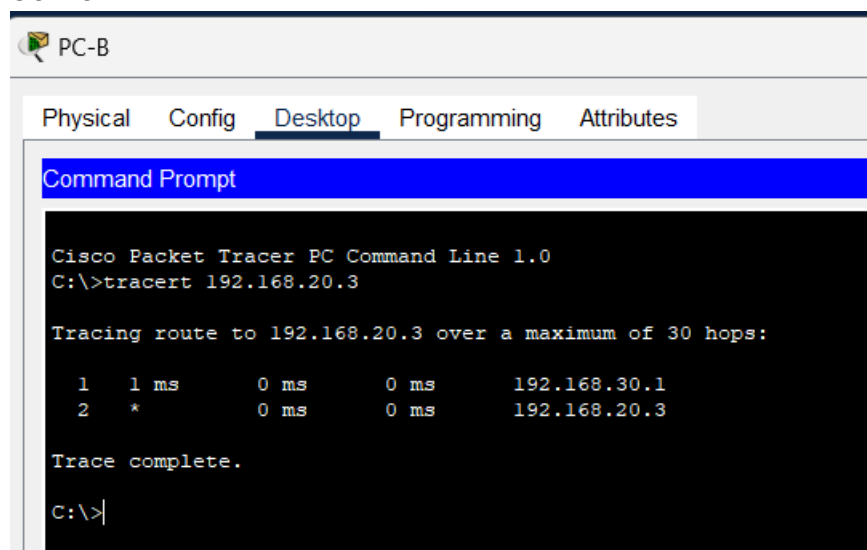Sat Nov 11 11:43:30 2023 S2 S2#show interfaces trunk

Switch S1
Sat Nov 11 11:43:59 2023 S1 S1#conf t
Sat Nov 11 11:44:06 2023 S1 S1(config)#int fa 0/5
Sat Nov 11 11:44:13 2023 S1 S1(config-if)#switchport mode trunk
Sat Nov 11 11:44:26 2023 S1 S1(config-if)#switchport trunk native vlan 1000
Sat Nov 11 11:45:03 2023 S1 S1(config-if)#switchport trunk allowed vlan remove 1
Sat Nov 11 11:45:08 2023 S1 S1(config-if)#switchport trunk allowed vlan remove 999
Sat Nov 11 11:45:11 2023 S1 S1(config-if)#end
Sat Nov 11 11:45:30 2023 S1 S1#copy running-config startup-config

Sat Nov 11 11:45:48 2023   S2   S2#copy running-config startup-config

Router 2
Sat Nov 11 11:46:21 2023   Router2   R1>en
Sat Nov 11 11:46:31 2023   Router2   R1#conf t
Sat Nov 11 11:46:40 2023   Router2   R1(config)#interface g0/0/1
Sat Nov 11 11:46:44 2023   Router2   R1(config-if)#no shutdown
Sat Nov 11 11:46:49 2023   Router2   R1(config-if)#exit
Sat Nov 11 11:47:02 2023   Router2   R1(config)#interface g0/0/1.10
Sat Nov 11 11:47:20 2023   Router2   R1(config-subif)#description Management Network
Sat Nov 11 11:47:42 2023   Router2   R1(config-subif)#encapsulation dot1q 10
Sat Nov 11 11:48:05 2023   Router2   R1(config-subif)#ip address 192.168.10.1 255.255.255.0
Sat Nov 11 11:48:13 2023   Router2   R1(config-subif)#interface g0/0/1.20
Sat Nov 11 11:48:20 2023   Router2   R1(config-subif)#encapsulation dot1q 20
Sat Nov 11 11:48:33 2023   Router2   R1(config-subif)#description Sales Network
Sat Nov 11 11:48:52 2023   Router2   R1(config-subif)#ip address 192.168.20.1 255.255.255.0
Sat Nov 11 11:48:59 2023   Router2   R1(config-subif)#interface g0/0/1.30
Sat Nov 11 11:49:08 2023   Router2   R1(config-subif)#encapsulation dot1q 30
Sat Nov 11 11:49:31 2023   Router2   R1(config-subif)#description Operations Network
Sat Nov 11 11:49:53 2023   Router2   R1(config-subif)#ip address 192.168.30.1 255.255.255.0
Sat Nov 11 11:50:03 2023   Router2   R1(config-subif)#interface g0/0/1.1000
Sat Nov 11 11:50:22 2023   Router2   R1(config-subif)#encapsulation dot1q 1000 native
Sat Nov 11 11:50:37 2023   Router2   R1(config-subif)#description Native VLAN
Sat Nov 11 11:50:42 2023   Router2   R1(config-subif)#exit
Sat Nov 11 11:50:43 2023   Router2   R1(config)#end
Sat Nov 11 11:50:54 2023   Router2   R1#show ip address brief
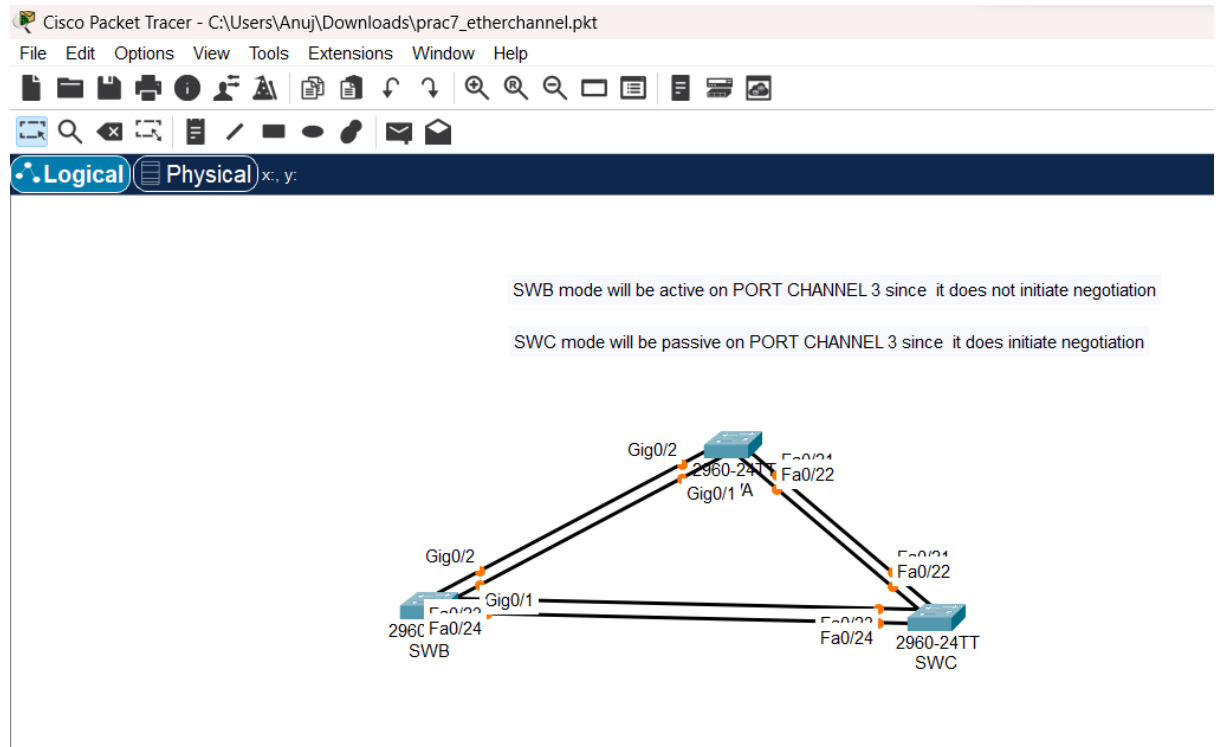Sat Nov 11 11:51:02 2023   Router2   R1#show ip interface brief

OUTPUT:

Practical 5:
1. Implement EtherChannel
2. Tune and Optimize EtherChannel Operations

CLI COMMANDS:

Tue Oct 3 10:28:07 2023   SWB   Switch>en
Tue Oct 3 10:28:10 2023   SWB   Switch#conf t
Tue Oct 3 10:28:52 2023   SWB   Switch(config)#int range g0/1-2
Tue Oct 3 10:29:07 2023   SWB   Switch(config-if-range)#switchport mode trunk
Tue Oct 3 10:34:42 2023   SWB   Switch(config-if-range)#shut
Tue Oct 3 10:35:23 2023   SWB   Switch(config-if-range)#channel-group 1 mode desirable
Tue Oct 3 10:35:48 2023   SWB   Switch(config-if-range)#no shut
Tue Oct 3 10:35:53 2023   SWB   Switch(config-if-range)#int ?
Tue Oct 3 10:38:04 2023   SWB   Switch(config-if-range)#int port-channel 1
Tue Oct 3 10:38:11 2023   SWB   Switch(config-if)#switchport mode trunk
Tue Oct 3 10:38:13 2023   SWB   Switch(config-if)#exit
Tue Oct 3 10:39:30 2023   SWA   Switch>en
Tue Oct 3 10:40:00 2023   SWA   Switch#conf t
Tue Oct 3 10:41:31 2023   SWB   Switch(config)#show etherchannel summary

```
Tue Oct 3 10:41:35 2023   SWB   Switch(config)#end
Tue Oct 3 10:41:47 2023   SWB   Switch#show etherchannel summary
Tue Oct 3 10:44:58 2023   SWB   Switch#show int trunk
Tue Oct 3 10:45:10 2023   SWB   Switch#show interface trunk
Tue Oct 3 10:45:19 2023   SWB   Switch#show interface trunk
Tue Oct 3 10:46:26 2023   SWA   Switch(config)#int range g0/1-2
Tue Oct 3 10:46:36 2023   SWA   Switch(config-if-range)#switchport mode trunk
Tue Oct 3 10:46:42 2023   SWA   Switch(config-if-range)#shut
Tue Oct 3 10:47:54 2023   SWA   Switch(config-if-range)#channel-group 1 mode desirable
Tue Oct 3 10:49:30 2023   SWA   Switch(config-if-range)#no shut
Tue Oct 3 10:50:11 2023   SWA   Switch(config-if-range)#int port-channel 1
Tue Oct 3 10:50:20 2023   SWA   Switch(config-if)#switchport mode trunk
Tue Oct 3 10:50:23 2023   SWA   Switch(config-if)#exit
Tue Oct 3 10:50:24 2023   SWA   Switch(config)#end
Tue Oct 3 10:50:31 2023   SWA   Switch#show etherchannel summary
Tue Oct 3 10:50:40 2023   SWA   Switch#show int trunk
Tue Oct 3 10:51:56 2023   SWA   Switch#en
Tue Oct 3 10:51:59 2023   SWA   Switch#conf t
Tue Oct 3 10:52:26 2023   SWA   Switch(config)#int range f0/21-22
Tue Oct 3 10:52:49 2023   SWA   Switch(config-if-range)#switchport mode trunk
Tue Oct 3 10:53:18 2023   SWA   Switch(config-if-range)#shut
Tue Oct 3 10:53:53 2023   SWA   Switch(config-if-range)#channel-group 2 mode active
Tue Oct 3 10:54:25 2023   SWA   Switch(config-if-range)#no shut
Tue Oct 3 10:54:58 2023   SWA   Switch(config-if-range)#int port-channel 2
Tue Oct 3 10:55:06 2023   SWA   Switch(config-if)#switchport mode trunk
Tue Oct 3 10:55:07 2023   SWA   Switch(config-if)#exit
Tue Oct 3 10:55:08 2023   SWA   Switch(config)#end
Tue Oct 3 10:55:17 2023   SWA   Switch#show etherchannel summary
Tue Oct 3 10:56:45 2023   SWC   Switch>en
Tue Oct 3 10:57:41 2023   SWC   Switch#conf t
Tue Oct 3 10:58:18 2023   SWC   Switch(config)#int range f0/21-22
Tue Oct 3 10:58:24 2023   SWC   Switch(config-if-range)#switchport mode trunk
Tue Oct 3 10:58:35 2023   SWC   Switch(config-if-range)#shut
Tue Oct 3 10:58:52 2023   SWC   Switch(config-if-range)#channel-group 2 mode active
Tue Oct 3 10:58:56 2023   SWC   Switch(config-if-range)#no shut
Tue Oct 3 10:59:09 2023   SWC   Switch(config-if-range)#int port-channel 2
Tue Oct 3 10:59:19 2023   SWC   Switch(config-if)#switchport mode trunk
Tue Oct 3 10:59:20 2023   SWC   Switch(config-if)#exit
Tue Oct 3 10:59:23 2023   SWC   Switch(config)#end
Tue Oct 3 10:59:31 2023   SWC   Switch#show etherchannel summary
Tue Oct 3 10:59:39 2023   SWC   Switch#show int trunk
Tue Oct 3 11:00:00 2023   SWA   Switch#show int trunk
Tue Oct 3 11:03:47 2023   SWB   Switch>en
Tue Oct 3 11:03:49 2023   SWB   Switch#conf t
Tue Oct 3 11:04:26 2023   SWB   Switch(config)#int range f0/23-24
Tue Oct 3 11:04:34 2023   SWB   Switch(config-if-range)#switchport mode trunk
Tue Oct 3 11:04:38 2023   SWB   Switch(config-if-range)#shut
Tue Oct 3 11:05:01 2023   SWB   Switch(config-if-range)#channel-group 3 mode active
```

Tue Oct 3 11:05:06 2023 SWB Switch(config-if-range)#no shut
Tue Oct 3 11:05:23 2023 SWB Switch(config-if-range)#int port-channel 3
Tue Oct 3 11:05:29 2023 SWB Switch(config-if)#switchport mode trunk
Tue Oct 3 11:05:30 2023 SWB Switch(config-if)#exit
Tue Oct 3 11:05:32 2023 SWB Switch(config)#end
Tue Oct 3 11:05:43 2023 SWB Switch#show etherchannel summary
Tue Oct 3 11:05:51 2023 SWC Switch#conf t
Tue Oct 3 11:06:07 2023 SWC Switch(config)#int range f0/23-24
Tue Oct 3 11:06:11 2023 SWC Switch(config-if-range)#switchport mode trunk
Tue Oct 3 11:06:15 2023 SWC Switch(config-if-range)#shut
Tue Oct 3 11:08:32 2023 SWC Switch(config-if-range)#channel-group 3 mode passive
Tue Oct 3 11:08:39 2023 SWC Switch(config-if-range)#no shut
Tue Oct 3 11:08:55 2023 SWC Switch(config-if-range)#int port-channel 3
Tue Oct 3 11:09:00 2023 SWC Switch(config-if)#switchport mode trunk
Tue Oct 3 11:09:01 2023 SWC Switch(config-if)#exit
Tue Oct 3 11:09:04 2023 SWC Switch(config)#end
Tue Oct 3 11:09:32 2023 SWC Switch#show etherchannel summary
Tue Oct 3 11:09:35 2023 SWC Switch#show int trunk

OUTPUT:

SWA:

```
Switch>en
Switch#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3       S - Layer2
        U - in use       f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:          2

Group  Port-channel  Protocol    Ports
------+------------+-----------+-----------------------------------------------

1      Po1(SU)           PAgP    Gig0/1(P) Gig0/2(P)
2      Po2(SU)           LACP    Fa0/21(P) Fa0/22(P)
Switch#
```

```
Switch#show int trunk
Port            Mode            Encapsulation   Status          Native vlan
Po1             on              802.1q          trunking        1
Po2             on              802.1q          trunking        1

Port            Vlans allowed on trunk
Po1             1-1005
Po2             1-1005

Port            Vlans allowed and active in management domain
Po1             1
Po2             1

Port            Vlans in spanning tree forwarding state and not pruned
Po1             1
Po2             1
```

SWB:

```
Switch>en
Switch#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3       S - Layer2
        U - in use       f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+----------+---------------------------------

1      Po1(SU)           PAgP   Gig0/1(P)  Gig0/2(P)
3      Po3(SU)           LACP   Fa0/23(P)  Fa0/24(P)
Switch#
```

```
Switch#show int trunk
Port            Mode            Encapsulation   Status          Native vlan
Po1             on              802.1q          trunking        1
Po3             on              802.1q          trunking        1

Port            Vlans allowed on trunk
Po1             1-1005
Po3             1-1005

Port            Vlans allowed and active in management domain
Po1             1
Po3             1

Port            Vlans in spanning tree forwarding state and not pruned
Po1             1
Po3             1
```

SWC:

```
Switch>en
Switch#show etherchannel summary
Flags:  D - down         P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3       S - Layer2
        U - in use       f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+------------+-----------+-----------------------------

2      Po2(SU)           LACP    Fa0/21(P) Fa0/22(P)
3      Po3(SU)           LACP    Fa0/23(P) Fa0/24(P)
Switch#
```

```
Switch#show int trunk
Port          Mode          Encapsulation  Status       Native vlan
Po2           on            802.1q         trunking     1
Po3           on            802.1q         trunking     1

Port          Vlans allowed on trunk
Po2           1-1005
Po3           1-1005

Port          Vlans allowed and active in management domain
Po2           1
Po3           1

Port          Vlans in spanning tree forwarding state and not pruned
Po2           none
Po3           1

Switch#
```

6. OSPF Implementation
1. Implement Single-Area OSPFv2
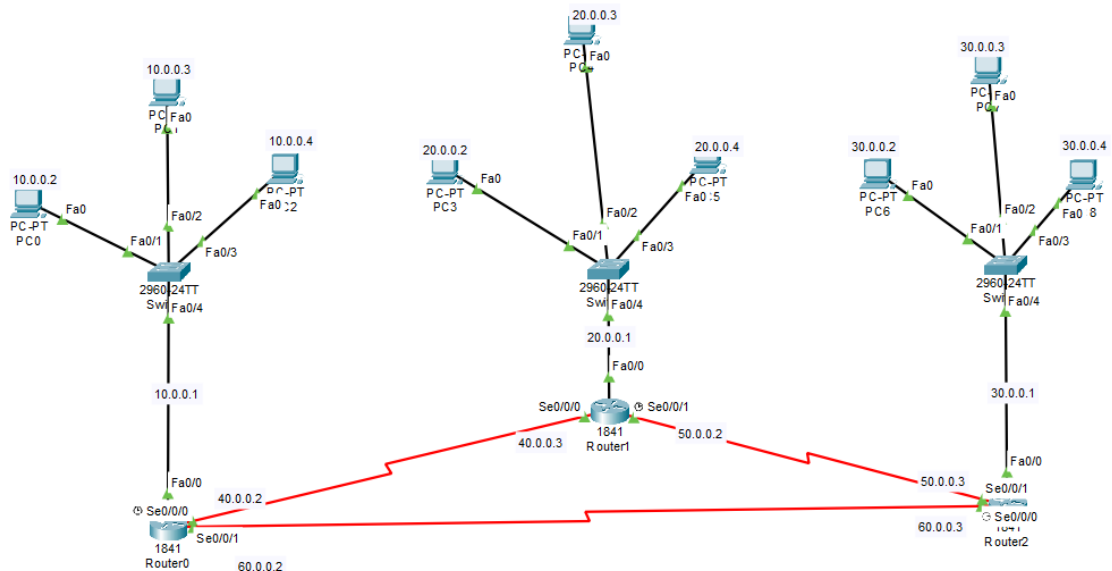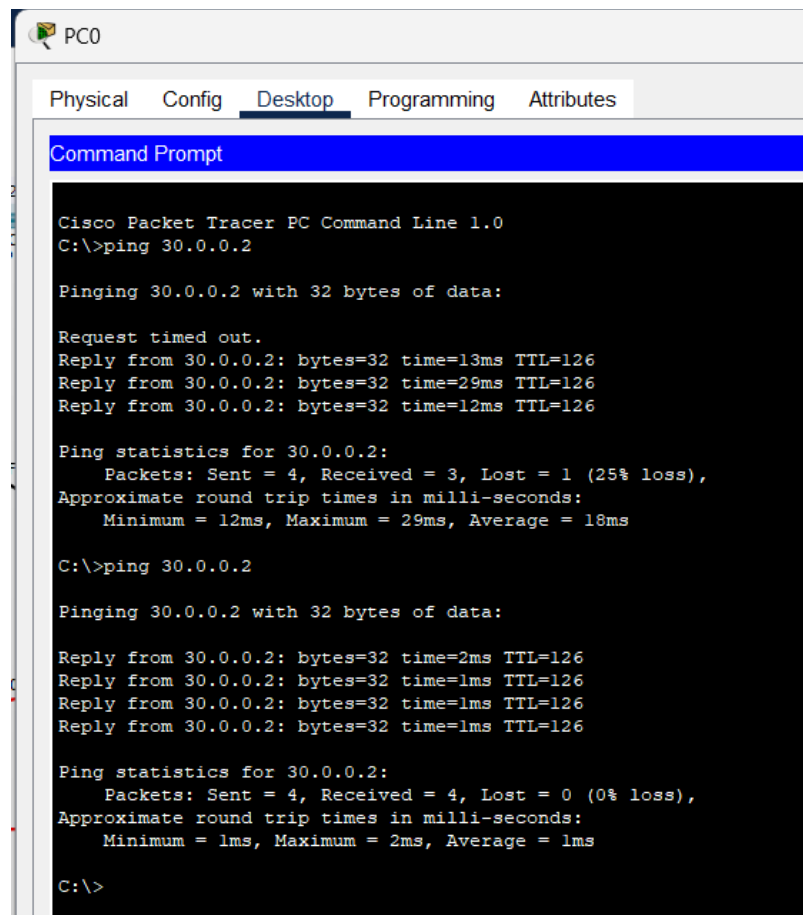

CLI:

Tue Aug 22 20:20:51 2023   Router0   Router(config-if)#exit
Tue Aug 22 20:20:57 2023   Router0   Router(config)#en
Tue Aug 22 20:21:04 2023   Router0   Router(config)#router ospf ?
Tue Aug 22 20:21:10 2023   Router0   Router(config)#router ospf 1
Tue Aug 22 20:21:50 2023   Router0   Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:22:02 2023   Router0   Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:22:09 2023   Router0   Router(config-router)#network 60.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:22:17 2023   Router0   Router(config-router)#exit

Tue Aug 22 20:22:29 2023   Router1   Router(config-if)#exit
Tue Aug 22 20:22:38 2023   Router1   Router(config)#router ospf 2
Tue Aug 22 20:23:20 2023   Router1   Router(config-router)#network 20.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:23:25 2023   Router1   Router(config-router)#network 40.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:23:36 2023   Router1   Router(config-router)#network 50.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:23:45 2023   Router1   Router(config-router)#exit
Tue Aug 22 20:23:55 2023   Router2   Router(config-if)#exit

Tue Aug 22 20:24:03 2023   Router2   Router(config)#router ospf 3
Tue Aug 22 20:24:28 2023   Router2   Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:24:36 2023   Router2   Router(config-router)#network 50.0.0.0 0.255.255.255 area 0
Tue Aug 22 20:24:45 2023   Router2   Router(config-router)#network 60.0.0.0 0.255.255.255 area 0

OUTPUT:

PC0

Physical   Config   Desktop   Programming   Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 30.0.0.2

Pinging 30.0.0.2 with 32 bytes of data:

Request timed out.
Reply from 30.0.0.2: bytes=32 time=13ms TTL=126
Reply from 30.0.0.2: bytes=32 time=29ms TTL=126
Reply from 30.0.0.2: bytes=32 time=12ms TTL=126

Ping statistics for 30.0.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 29ms, Average = 18ms

C:\>ping 30.0.0.2

Pinging 30.0.0.2 with 32 bytes of data:

Reply from 30.0.0.2: bytes=32 time=2ms TTL=126
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126

Ping statistics for 30.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>
```
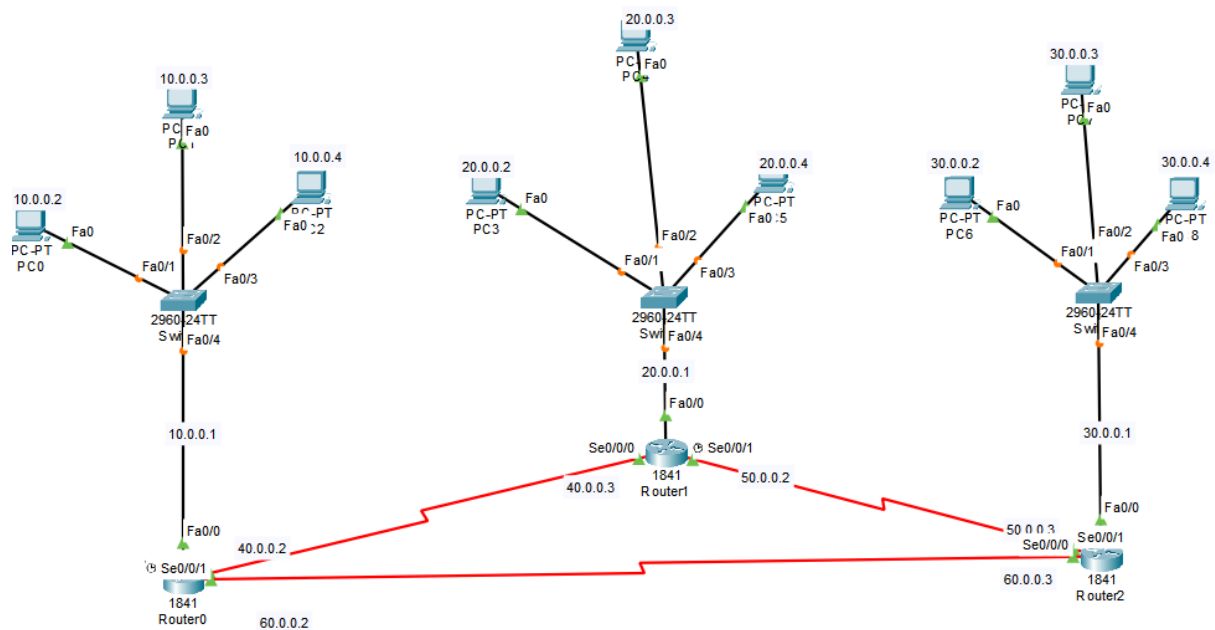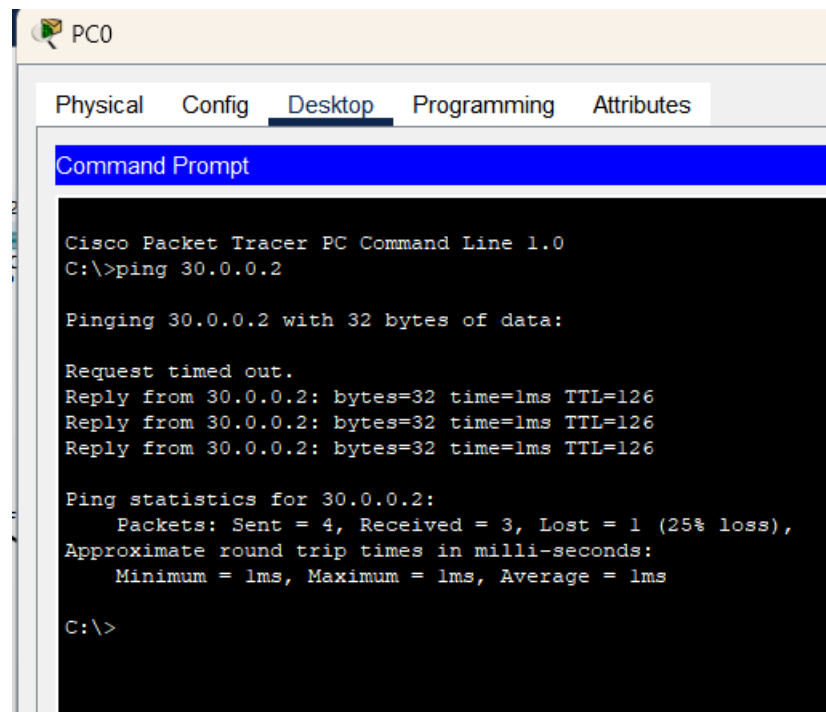
2. Implement Multi-Area OSPFv2

CLI commands:

Tue Aug 22 20:20:57 2023   Router0   Router(config)#en

Tue Aug 22 20:21:10 2023   Router0   Router(config)#router ospf 1

Tue Aug 22 20:21:50 2023   Router0   Router(config-router)#network 10.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:22:02 2023   Router0   Router(config-router)#network 40.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:22:09 2023   Router0   Router(config-router)#network 60.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:22:38 2023   Router1   Router(config)#router ospf 2

Tue Aug 22 20:23:20 2023   Router1   Router(config-router)#network 20.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:23:25 2023   Router1   Router(config-router)#network 40.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:23:36 2023   Router1   Router(config-router)#network 50.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:24:03 2023   Router2   Router(config)#router ospf 3

Tue Aug 22 20:24:28 2023   Router2   Router(config-router)#network 30.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:24:36 2023   Router2   Router(config-router)#network 50.0.0.0 0.255.255.255 area 0

Tue Aug 22 20:24:45 2023   Router2   Router(config-router)#network 60.0.0.0 0.255.255.255 area 0

Tue Sep 5 19:07:43 2023   Router0   Router>en

Tue Sep 5 19:07:47 2023   Router0   Router#conf t

Tue Sep 5 19:07:57 2023   Router0   Router(config)#router ospf 2

Tue Sep 5 19:08:13 2023   Router0   Router(config-router)#network 10.0.0.0 0.255.255.255 area 1

Tue Sep 5 19:10:45 2023   Router0   Router(config-router)#network 40.0.0.0 0.255.255.255 area 1

Tue Sep 5 19:10:55 2023   Router1   Router>en

Tue Sep 5 19:10:58 2023   Router1   Router#conf t

Tue Sep 5 19:11:03 2023   Router1   Router(config)#router ospf 3

Tue Sep 5 19:11:19 2023   Router1   Router(config-router)#network 40.0.0.0 0.255.255.255 area 1

Tue Sep 5 19:11:45 2023   Router1   Router(config-router)#network 50.0.0.0 0.255.255.255 area 2

Tue Sep 5 19:12:00 2023   Router2   Router>en

Tue Sep 5 19:12:03 2023   Router2   Router#conf t

Tue Sep 5 19:12:08 2023   Router2   Router(config)#router ospf 4

Tue Sep 5 19:12:23 2023   Router2   Router(config-router)#network 30.0.0.0 0.255.255.255 area 2

Tue Sep 5 19:12:28 2023   Router2   Router(config-router)#network 50.0.0.0 0.255.255.255 area 2

Tue Sep 5 19:14:29 2023   Router0   Router(config-router)#end

OUTPUT:


```
PC0

Physical   Config   Desktop   Programming   Attributes

Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 30.0.0.2

Pinging 30.0.0.2 with 32 bytes of data:

Request timed out.
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126

Ping statistics for 30.0.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\>
```
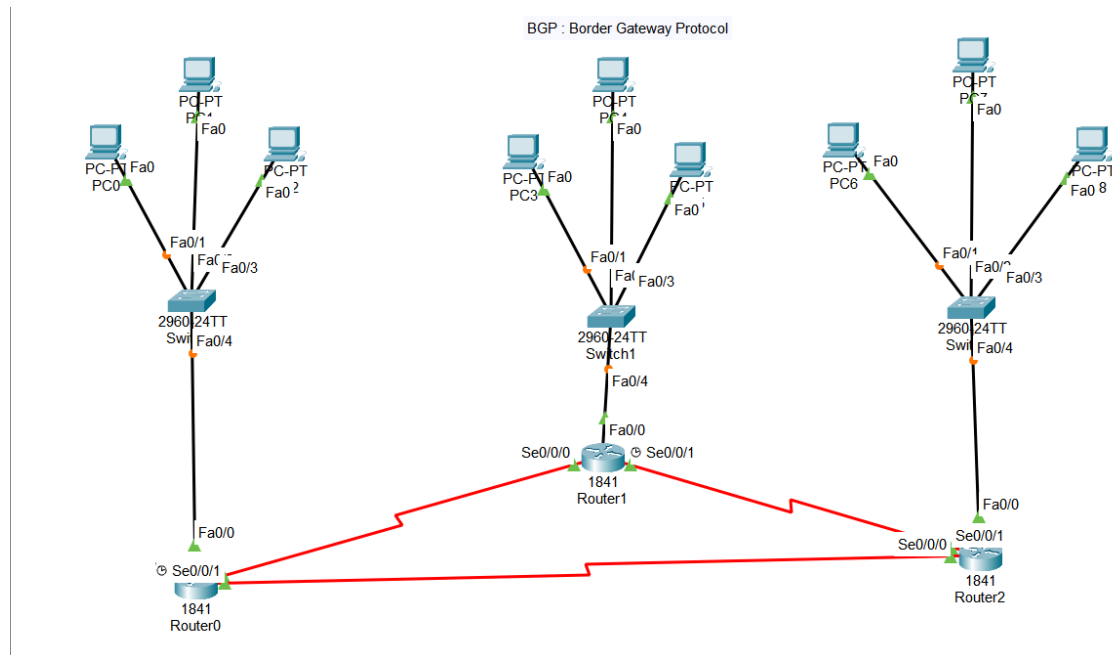
7. Implement BGP Communities.

CLI Commands:
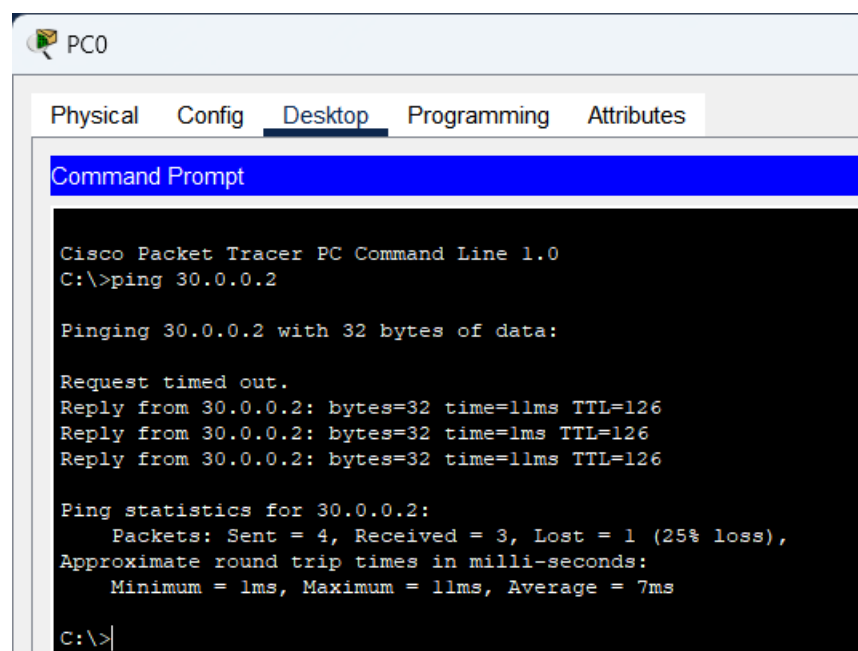
Sat Sep 9 08:07:18 2023   Router0   Router(config)#router bgp?

Sat Sep 9 08:07:20 2023   Router0   Router(config)#router bgp ?

Sat Sep 9 08:07:22 2023   Router0   Router(config)#router bgp 100

Sat Sep 9 08:07:39 2023   Router0   Router(config-router)#neigh?

Sat Sep 9 08:07:59 2023   Router0   Router(config-router)#neighbor 40

Sat Sep 9 08:08:15 2023   Router0   Router(config-router)#neighbor 40.0.0.2 ?

Sat Sep 9 08:08:33 2023   Router0   Router(config-router)#neighbor 40.0.0.2 remote-as ?

Sat Sep 9 08:08:57 2023   Router0   Router(config-router)#neighbor 40.0.0.2 remote-as 200 ?

Sat Sep 9 08:09:11 2023   Router0   Router(config-router)#neighbor 40.0.0.2 remote-as 200

Sat Sep 9 08:09:34 2023   Router1   Router>en

Sat Sep 9 08:09:36 2023   Router1   Router#conf t

Sat Sep 9 08:09:52 2023   Router1   Router(config)#router bgp ?

Sat Sep 9 08:09:54 2023   Router1   Router(config)#router bgp 200

Sat Sep 9 08:10:03 2023   Router2   Router>en

Sat Sep 9 08:10:07 2023   Router2   Router#conf t

Sat Sep 9 08:10:22 2023   Router2   Router(config)#router bgp 300

Sat Sep 9 08:10:29 2023   Router0   Router(config-router)#neighbor 40.0.0.2 remote-as 200

Sat Sep 9 08:10:39 2023   Router0   Router(config-router)#neighbor 40.0.0.3 remote-as 200

Sat Sep 9 08:10:48 2023   Router0   Router(config-router)#neighbor 60.0.0.3 remote-as 300

Sat Sep 9 08:11:03 2023   Router0   Router(config-router)#network 10.0.0.0 ?

Sat Sep 9 08:11:07 2023   Router0   Router(config-router)#network 10.0.0.0 mask ?

Sat Sep 9 08:11:16 2023   Router0   Router(config-router)#network 10.0.0.0 mask 255.0.0.0

Sat Sep 9 08:11:35 2023   Router1   Router(config-router)#neighbor 40.0.0.2 ?

Sat Sep 9 08:11:41 2023   Router1   Router(config-router)#neighbor 40.0.0.2 remote-as 100

Sat Sep 9 08:11:52 2023   Router1   Router(config-router)#neighbor 50.0.0.3 remote-as 300

Sat Sep 9 08:12:09 2023   Router1   Router(config-router)#network 20.0.0.0 mask 255.0.0.0

Sat Sep 9 08:12:27 2023   Router2   Router(config-router)#neighbor 50.0.0.2 rem?

Sat Sep 9 08:12:38 2023   Router2   Router(config-router)#neighbor 50.0.0.2 remote-as 200

Sat Sep 9 08:12:44 2023   Router2   Router(config-router)#neighbor 60.0.0.2 remote-as 100

Sat Sep 9 08:13:01 2023   Router2   Router(config-router)#network 30.0.0.0 mask 255.0.0.0

Output:


```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 30.0.0.2

Pinging 30.0.0.2 with 32 bytes of data:

Request timed out.
Reply from 30.0.0.2: bytes=32 time=11ms TTL=126
Reply from 30.0.0.2: bytes=32 time=1ms TTL=126
Reply from 30.0.0.2: bytes=32 time=11ms TTL=126

Ping statistics for 30.0.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 11ms, Average = 7ms

C:\>
```
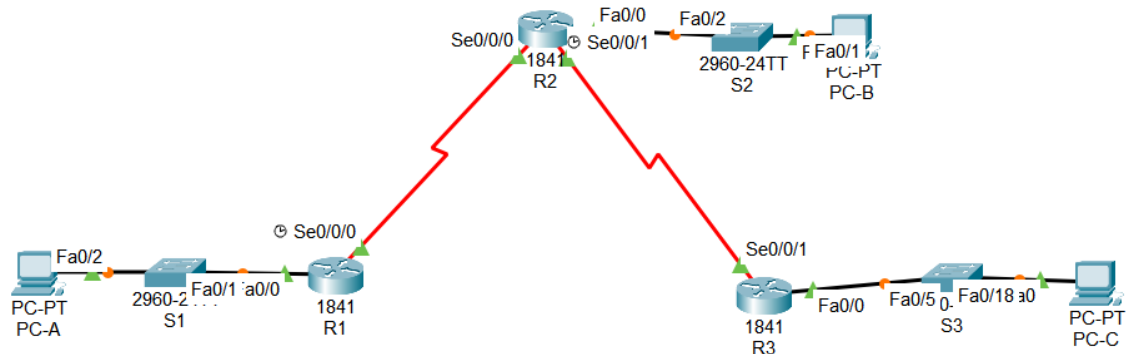
8. Implement IPsec Site-to-Site VPNs

CLI Commands:

Tue Nov 28 11:43:11 2023 R1 Router>en

Tue Nov 28 11:44:32 2023 R1 Router#conf t

Tue Nov 28 11:44:35 2023 R1 Router(config)#access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.0

Tue Nov 28 11:44:58 2023 R1 Router(config)#access-list 110 permit ip 192.168.1.0 0.0.0.255 192.168.3.0 0.0.0.255

Tue Nov 28 11:45:11 2023 R1 Router(config)#crypto isakmp policy 10

Tue Nov 28 11:45:24 2023 R1 Router(config-isakmp)#encryption aes 256

Tue Nov 28 11:45:39 2023 R1 Router(config-isakmp)#authentication pre-share

Tue Nov 28 11:45:46 2023 R1 Router(config-isakmp)#group 5

Tue Nov 28 11:45:48 2023 R1 Router(config-isakmp)#exit

Tue Nov 28 11:46:12 2023 R1 Router(config)#crypto isakmp vpnpa55 address 10.2.2.2

Tue Nov 28 11:46:19 2023 R1 Router(config)#crypto isakmp key vpnpa55 address 10.2.2.2

Tue Nov 28 11:47:21 2023 R1 Router(config)#crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac

Tue Nov 28 11:47:47 2023 R1 Router(config)#crypto map VPM-MAP 10 ipsec-isakmp

Tue Nov 28 11:48:11 2023 R1 Router(config-crypto-map)#description VPN connection to R3

Tue Nov 28 11:48:18 2023 R1 Router(config-crypto-map)#set peer 10.2.2.2

Tue Nov 28 11:48:30 2023 R1 Router(config-crypto-map)#set transform-set VPN-SET

Tue Nov 28 11:48:37 2023 R1 Router(config-crypto-map)#match address 110

Tue Nov 28 11:48:40 2023 R1 Router(config-crypto-map)#exit

Tue Nov 28 11:48:56 2023 R1 Router(config)#interface s0/0/0

Tue Nov 28 11:49:07 2023 R1 Router(config-if)#crypto map VPN-MAP

Tue Nov 28 11:50:05 2023 R1 Router(config-if)#crypto map VPN-MAP

Tue Nov 28 11:55:52 2023 R1 Router(config-if)#crypto map VPN-MAP

Tue Nov 28 11:56:01 2023 R1 Router(config-if)#crypto map VPM-MAP 10 ipsec-isakmp

Tue Nov 28 11:56:25 2023 R1 Router(config-crypto-map)#set peer 10.2.2.2

Tue Nov 28 11:56:29 2023 R1 Router(config-crypto-map)#exit

Tue Nov 28 11:56:33 2023 R1 Router(config)#interface s0/0/0

Tue Nov 28 11:56:38 2023 R1 Router(config-if)#crypto map VPN-MAP

Tue Nov 28 11:57:13 2023 R1 Router(config-if)#crypto map VPN-MAP 10 ipsec-isakmp

Tue Nov 28 11:57:28 2023 R1 Router(config-crypto-map)#description VPN connection to R3

Tue Nov 28 11:57:37 2023 R1 Router(config-crypto-map)#set peer 10.2.2.2

Tue Nov 28 11:57:42 2023 R1 Router(config-crypto-map)#set transform-set VPN-SET

Tue Nov 28 11:57:48 2023 R1 Router(config-crypto-map)#match address 110

Tue Nov 28 11:57:51 2023 R1 Router(config-crypto-map)#exit

Tue Nov 28 11:57:57 2023 R1 Router(config)#interface s0/0/0

Tue Nov 28 11:58:08 2023 R1 Router(config-if)#crypto map VPN-MAP

Tue Nov 28 11:58:35 2023 R3 Router>en

Tue Nov 28 11:58:37 2023 R3 Router#conf t

Tue Nov 28 11:58:50 2023 R3 Router(config)#access-list 110 permit ip 192.168.3.0 0.0.0.255
192.168.1.0

Tue Nov 28 11:59:07 2023 R3 Router(config)#access-list 110 permit ip 192.168.3.0 0.0.0.255
192.168.1.0 0.0.0.255

Tue Nov 28 11:59:14 2023 R3 Router(config)#crypto isakmp policy 10

Tue Nov 28 11:59:27 2023 R3 Router(config-isakmp)#encryption aes 256

Tue Nov 28 11:59:38 2023 R3 Router(config-isakmp)#authentication pre-share

Tue Nov 28 11:59:43 2023 R3 Router(config-isakmp)#group 5

Tue Nov 28 11:59:46 2023 R3 Router(config-isakmp)#exit

Tue Nov 28 11:59:57 2023 R3 Router(config)#crypto isakmp key vpnpa55 address 10.1.1.2

Tue Nov 28 12:00:06 2023 R3 Router(config)#crypto ipsec transform-set VPN-SET esp-aes esp-sha-hmac

Tue Nov 28 12:00:31 2023 R3 Router(config)#crypto map VPN-MAP 10 ipsec-isakmp

Tue Nov 28 12:00:39 2023 R3 Router(config-crypto-map)#description VPN connection to R1

Tue Nov 28 12:00:47 2023 R3 Router(config-crypto-map)#set peer 10.1.1.2

Tue Nov 28 12:00:57 2023 R3 Router(config-crypto-map)#set transform-set VPN-SET

Tue Nov 28 12:01:05 2023 R3 Router(config-crypto-map)#match address 110

Tue Nov 28 12:01:06 2023 R3 Router(config-crypto-map)#exit

Tue Nov 28 12:01:15 2023 R3 Router(config)#int s0/0/1

Tue Nov 28 12:01:23 2023 R3 Router(config-if)#crypto map VPN-MAP

Tue Nov 28 12:01:47 2023 R1 Router(config-if)#exit

Tue Nov 28 12:01:49 2023 R1 Router(config)#exit

Tue Nov 28 12:01:57 2023 R1 Router#show crypto ipsec sa

Tue Nov 28 12:02:29 2023 R1 Router#show crypto ipsec sa

Tue Nov 28 12:04:42 2023 R1 Router#show crypto ipsec sa

Output:

```
Router#show crypto ipsec sa

interface: Serial0/0/0
    Crypto map tag: VPN-MAP, local addr 10.1.1.2

   protected vrf: (none)
   local  ident (addr/mask/prot/port): (192.168.1.0/255.255.255.0/0/0)
   remote ident (addr/mask/prot/port): (192.168.3.0/255.255.255.0/0/0)
   current_peer 10.2.2.2 port 500
    PERMIT, flags={origin_is_acl,}
   #pkts encaps: 3, #pkts encrypt: 3, #pkts digest: 0
   #pkts decaps: 3, #pkts decrypt: 3, #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 1, #recv errors 0

     local crypto endpt.: 10.1.1.2, remote crypto endpt.:10.2.2.2
     path mtu 1500, ip mtu 1500, ip mtu idb Serial0/0/0
     current outbound spi: 0xC1B58423(3249898531)

     inbound esp sas:
      spi: 0xE352EF19(3813863193)
        transform: esp-aes esp-sha-hmac ,
        in use settings ={Tunnel, }
        conn id: 2001, flow_id: FPGA:1, crypto map: VPN-MAP
        sa timing: remaining key lifetime (k/sec): (4525504/3580)
        IV size: 16 bytes
        replay detection support: N
        Status: ACTIVE

     inbound ah sas:

     inbound pcp sas:

     outbound esp sas:
      spi: 0xC1B58423(3249898531)
        transform: esp-aes esp-sha-hmac ,
        in use settings ={Tunnel, }
 --More--
```