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Internetworking

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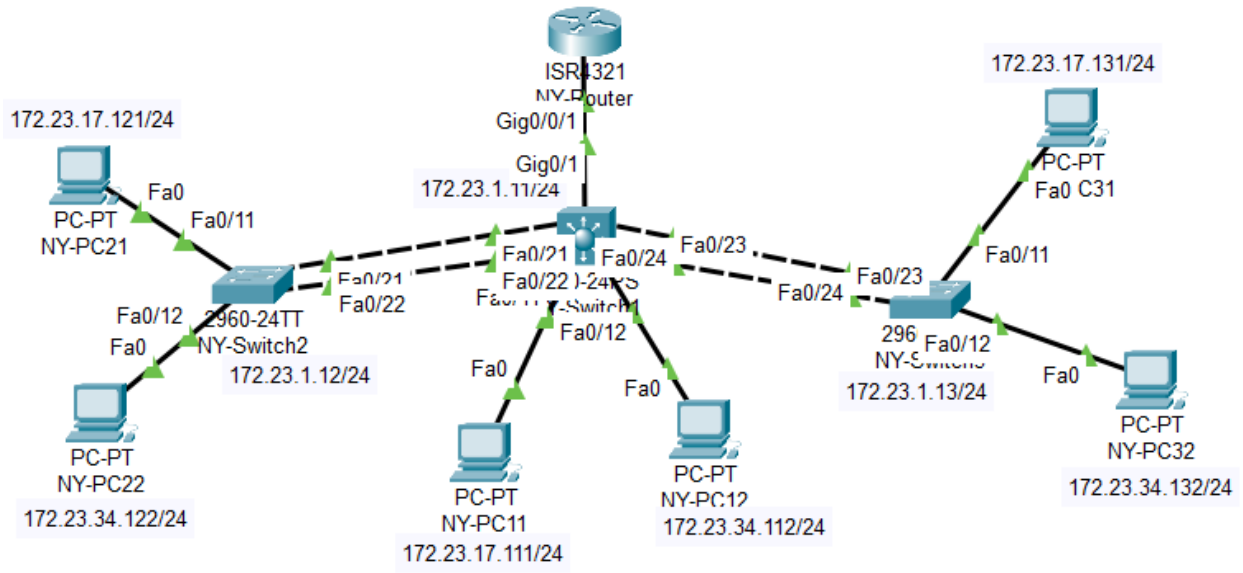
Lab 3

Description: In this lab, I created a router-on-a-stick topology in order to implement routing between separate VLANs. The main skill I learned from this lab was basic router configuration.

Topology/Diagram:



Syntax:

CLI	Command	Description	Mode
Cisco IOS	no ip domain lookup	Prevents the device from looking up invalid commands using DNS.	Global Config
Cisco IOS	ip default-gateway <ip>	Sets the default gateway	Global Config
Cisco IOS	channel-group mode <x> active	Creates an etherchannel from the selected interfaces	Interface Config
Cisco IOS	int port-channel <x>	Enters config for an etherchannel	Global Config
Cisco IOS	show etherchannel summary	Shows a summary of the configurated etherchannels	User Exec Mode
Cisco IOS	vtp mode server	Makes the device a VTP server that can distribute VLAN info	Global Config
Cisco IOS	vtp mode client	Makes the device a VTP client to receive VLAN info from a server	Global Config
Cisco IOS	shutdown	Disables an interface	Interface Config
Cisco IOS	no ip address	Removes any IP from the interface	Interface Config
Cisco IOS	int g0/0/1.xx	Creates a subinterface	Interface Config
Cisco IOS	encapsulation dot1q xx	Sets encapsulation type for subinterface	Subinterface Config
Cisco IOS	show ip route	Shows the device's routing table	User Exec Mode
Cisco IOS	spanning-tree mode rapid-pvst	Implements rapid spanning tree protocol on the device	Global Config

Verification:

Display NY-Switch1's VLANs:

```
NY-Switch1#show vlan

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, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/20, Gig0/2
17   BLUE                             active    Fa0/11
34   GREEN                            active    Fa0/12
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
17   enet  100017     1500  -      -      -        -    -        0      0
34   enet  100034     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
```

Display NY-Switch1's Trunk Interfaces:

```
NY-Switch1#sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1
Po3         on           802.1q         trunking      1
Gig0/1      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005
Po3         1-1005
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Po2         1,17,34
Po3         1,17,34
Gig0/1      1,17,34

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1,17,34
Po3         1,17,34
Gig0/1      1,17,34

NY-Switch1#
```

Display NY-Switch1's EtherChannels in a summarized format:

```
NY-Switch1#sh 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)
NY-Switch1#
```

Display NY-Switch2's VLANs:

```
NY-Switch2#show vlan

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, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/20, Fa0/23, Fa0/24
                                                Gig0/1, Gig0/2
17   BLUE                             active    Fa0/11
34   GREEN                            active    Fa0/12
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
17   enet  100017     1500  -      -      -        -    -        0      0
34   enet  100034     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
```

Display NY-Switch2's Trunk Interfaces:

```
NY-Switch2#sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Po2         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po2         1-1005

Port        Vlans allowed and active in management domain
Po2         1,17,34

Port        Vlans in spanning tree forwarding state and not pruned
Po2         1,17,34

NY-Switch2#
```

Display NY-Switch2's EtherChannel in a summarized format:

```
NY-Switch2#sh 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: 1
Number of aggregators:           1

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

2      Po2(SU)           LACP   Fa0/21(P) Fa0/22(P)
NY-Switch2#
```

Display NY-Switch3's VLANs:

```
NY-Switch3#sh vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Po3, Fa0/1, Fa0/2, Fa0/3
                                                Fa0/4, Fa0/5, Fa0/6, Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10, Fa0/13
                                                Fa0/14, Fa0/15, Fa0/16, Fa0/17
                                                Fa0/18, Fa0/19, Fa0/20, Fa0/21
                                                Fa0/22, Gig0/1, Gig0/2
17   BLUE                             active    Fa0/11
34   GREEN                            active    Fa0/12
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
17   enet  100017     1500  -      -      -        -    -        0      0
34   enet  100034     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
NY-Switch3#
```

Display NY-Switch3's Trunk Interfaces (NY-Switch1's are shown at the top of verification):

```
NY-Switch3#sh int trunk
Port        Mode         Encapsulation  Status        Native vlan
Po3         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Po3         1-1005

Port        Vlans allowed and active in management domain
Po3         1,17,34

Port        Vlans in spanning tree forwarding state and not pruned
Po3         1,17,34

NY-Switch3#
```

Display NY-Switch3's EtherChannel in a summarized format (NY-Switch1's at the top):

```
NY-Switch3#sh 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: 1
Number of aggregators:           1

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

3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)
NY-Switch3#
```

Verify NY-PC11 is able to reach NY-PC21 and NY-PC31:

```
C:\>ping 172.23.17.121

Pinging 172.23.17.121 with 32 bytes of data:

Reply from 172.23.17.121: bytes=32 time<1ms TTL=128
Reply from 172.23.17.121: bytes=32 time=1ms TTL=128
Reply from 172.23.17.121: bytes=32 time=1ms TTL=128
Reply from 172.23.17.121: bytes=32 time<1ms TTL=128

Ping statistics for 172.23.17.121:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
C:\>ping 172.23.17.131

Pinging 172.23.17.131 with 32 bytes of data:

Reply from 172.23.17.131: bytes=32 time<1ms TTL=128
Reply from 172.23.17.131: bytes=32 time=1ms TTL=128
Reply from 172.23.17.131: bytes=32 time=1ms TTL=128
Reply from 172.23.17.131: bytes=32 time=1ms TTL=128

Ping statistics for 172.23.17.131:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Verify NY-PC12 is able to reach NY-PC22 and NY-PC32:

```
C:\>ping 172.23.34.122

Pinging 172.23.34.122 with 32 bytes of data:

Reply from 172.23.34.122: bytes=32 time<1ms TTL=128
Reply from 172.23.34.122: bytes=32 time=1ms TTL=128
Reply from 172.23.34.122: bytes=32 time<1ms TTL=128
Reply from 172.23.34.122: bytes=32 time=1ms TTL=128

Ping statistics for 172.23.34.122:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
C:\>ping 172.23.34.132

Pinging 172.23.34.132 with 32 bytes of data:

Reply from 172.23.34.132: bytes=32 time<1ms TTL=128
Reply from 172.23.34.132: bytes=32 time=1ms TTL=128
Reply from 172.23.34.132: bytes=32 time<1ms TTL=128
Reply from 172.23.34.132: bytes=32 time=1ms TTL=128

Ping statistics for 172.23.34.132:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Display NY-Router's in-use interfaces in a brief format:

```
NY-Router#sh ip int brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   unassigned      YES NVRAM  administratively down down
GigabitEthernet0/0/1   unassigned      YES NVRAM  up                    up
GigabitEthernet0/0/1.1 172.23.1.1      YES manual up                    up
GigabitEthernet0/0/1.17172.23.17.1     YES manual up                    up
GigabitEthernet0/0/1.34172.23.34.1     YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
NY-Router#
```

Display NY-Router's routing table:

```
NY-Router#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.23.0.0/16 is variably subnetted, 6 subnets, 2 masks
C       172.23.1.0/24 is directly connected, GigabitEthernet0/0/1.1
L       172.23.1.1/32 is directly connected, GigabitEthernet0/0/1.1
C       172.23.17.0/24 is directly connected, GigabitEthernet0/0/1.17
L       172.23.17.1/32 is directly connected, GigabitEthernet0/0/1.17
C       172.23.34.0/24 is directly connected, GigabitEthernet0/0/1.34
L       172.23.34.1/32 is directly connected, GigabitEthernet0/0/1.34

NY-Router#
```

(NY-Switch1's trunking interfaces are shown at the top of verification)
Verify all PCs are able to reach their own default gateway.
From PC11, PC21, PC31 - VLAN 17:

```
C:\>ping 172.23.17.1

Pinging 172.23.17.1 with 32 bytes of data:

Reply from 172.23.17.1: bytes=32 time<1ms TTL=255
Reply from 172.23.17.1: bytes=32 time<1ms TTL=255
Reply from 172.23.17.1: bytes=32 time<1ms TTL=255
Reply from 172.23.17.1: bytes=32 time=1ms TTL=255

Ping statistics for 172.23.17.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

From PC12, PC22, PC32 - VLAN 34:

```
C:\>ping 172.23.34.1

Pinging 172.23.34.1 with 32 bytes of data:

Reply from 172.23.34.1: bytes=32 time<1ms TTL=255
Reply from 172.23.34.1: bytes=32 time=1ms TTL=255
Reply from 172.23.34.1: bytes=32 time=1ms TTL=255
Reply from 172.23.34.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.23.34.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Verify NY-PC11 is able to reach NY-PC12, NY-PC22, and NY-PC32 (VLAN 17 to 34):

```
C:\>ping 172.23.34.112

Pinging 172.23.34.112 with 32 bytes of data:

Reply from 172.23.34.112: bytes=32 time<1ms TTL=127
Reply from 172.23.34.112: bytes=32 time<1ms TTL=127
Reply from 172.23.34.112: bytes=32 time=1ms TTL=127
Reply from 172.23.34.112: bytes=32 time<1ms TTL=127

Ping statistics for 172.23.34.112:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.23.34.122

Pinging 172.23.34.122 with 32 bytes of data:

Reply from 172.23.34.122: bytes=32 time=6ms TTL=127
Reply from 172.23.34.122: bytes=32 time<1ms TTL=127
Reply from 172.23.34.122: bytes=32 time=10ms TTL=127
Reply from 172.23.34.122: bytes=32 time=1ms TTL=127

Ping statistics for 172.23.34.122:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 4ms
```

```
C:\>ping 172.23.34.132

Pinging 172.23.34.132 with 32 bytes of data:

Reply from 172.23.34.132: bytes=32 time<1ms TTL=127
Reply from 172.23.34.132: bytes=32 time=1ms TTL=127
Reply from 172.23.34.132: bytes=32 time<1ms TTL=127
Reply from 172.23.34.132: bytes=32 time=10ms TTL=127

Ping statistics for 172.23.34.132:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms

C:\>
```

Verify NY-PC12 is able to reach NY-PC11, NY-PC21, and NY-PC31 (VLAN 34 to 17).

```
C:\>ping 172.23.17.111

Pinging 172.23.17.111 with 32 bytes of data:

Reply from 172.23.17.111: bytes=32 time<1ms TTL=127
Reply from 172.23.17.111: bytes=32 time=1ms TTL=127
Reply from 172.23.17.111: bytes=32 time=1ms TTL=127
Reply from 172.23.17.111: bytes=32 time=2ms TTL=127

Ping statistics for 172.23.17.111:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms

C:\>ping 172.23.17.121

Pinging 172.23.17.121 with 32 bytes of data:

Reply from 172.23.17.121: bytes=32 time<1ms TTL=127
Reply from 172.23.17.121: bytes=32 time<1ms TTL=127
Reply from 172.23.17.121: bytes=32 time=10ms TTL=127
Reply from 172.23.17.121: bytes=32 time<1ms TTL=127

Ping statistics for 172.23.17.121:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

```
C:\>ping 172.23.17.131

Pinging 172.23.17.131 with 32 bytes of data:

Reply from 172.23.17.131: bytes=32 time<1ms TTL=127
Reply from 172.23.17.131: bytes=32 time<1ms TTL=127
Reply from 172.23.17.131: bytes=32 time=10ms TTL=127
Reply from 172.23.17.131: bytes=32 time<1ms TTL=127

Ping statistics for 172.23.17.131:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms

C:\>
```

Can the PCs reach ALL of the PCs and ALL of the Switches? Explain why.
Yes, each PC on the network can reach all of the other PCs and all of the switches. This is because we have a router to route traffic between VLANs. For example, a PC on VLAN 17 can reach other PCs on VLAN 17, and the router will route to the PCs on VLAN 34 and the switches on VLAN 1 if need be.

Implement Rapid Spanning-Tree Protocol on all of the switches. Display a screenshot demonstrating the protocol changed and is currently in use.
As we can see, the spanning tree enabled protocol is RSTP. This screenshot is from NY-Switch1.

```
NY-Switch1#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    24577
             Address     00D0.D390.7E1C
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
             Address     00D0.D390.7E1C
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Gi0/1            Desg FWD 4         128.25   P2p
Po2              Desg FWD 12        128.27   Shr
Po3              Desg FWD 12        128.28   Shr

VLAN0017
  Spanning tree enabled protocol rstp
  Root ID    Priority    24593
             Address     00D0.D390.7E1C
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24593  (priority 24576 sys-id-ext 17)
             Address     00D0.D390.7E1C
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Fa0/11           Desg FWD 19        128.11   P2p
Gi0/1            Desg FWD 4         128.25   P2p
Po2              Desg FWD 12        128.27   Shr
Po3              Desg BLK 12        128.28   Shr

VLAN0034
  Spanning tree enabled protocol rstp
  Root ID    Priority    24610
             Address     00D0.D390.7E1C
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24610  (priority 24576 sys-id-ext 34)
             Address     00D0.D390.7E1C
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Fa0/12           Desg FWD 19        128.12   P2p
Gi0/1            Desg FWD 4         128.25   P2p
Po2              Desg FWD 12        128.27   Shr
Po3              Desg BLK 12        128.28   Shr

NY-Switch1#
```

<u>Conclusion:</u> Everything went smoothly in this lab after Professor Cannistra explained the router setup in class. From this lab, I learned basic router configuration and inter-VLAN routing.