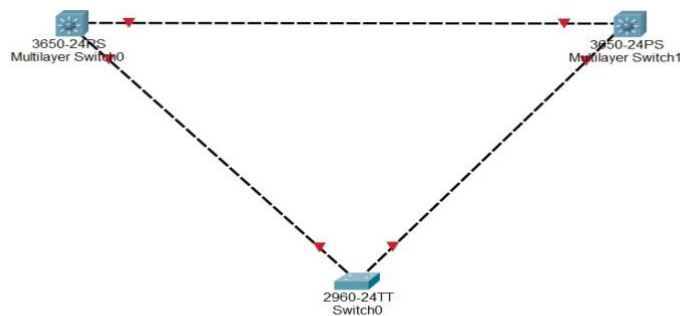
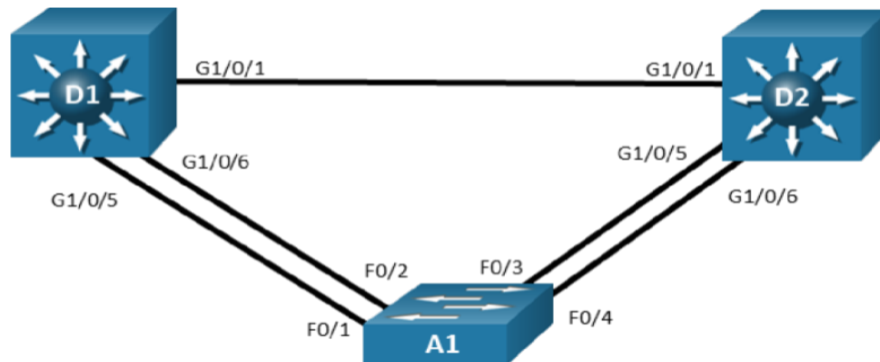


## Practical 6

Aim : Observe STP topology changes and implement RSTP



### Addressing Table

| Device | Interface | IPv4 Address |
|--------|-----------|--------------|
| D1     | VLAN1     | 10.0.0.1/8   |
| D2     | VLAN1     | 10.0.0.2/8   |
| A1     | VLAN1     | 10.0.0.3/8   |

### Objectives:-

**Part 1: Build the Network and Configure Basic Device Settings**

**Part 2: Observe STP Convergence and Topology Change Part 3: Configure and**

### Required Resources

- 2 Switches (Cisco 3650 with Cisco IOS XE release 16.9.4 universal image or comparable)

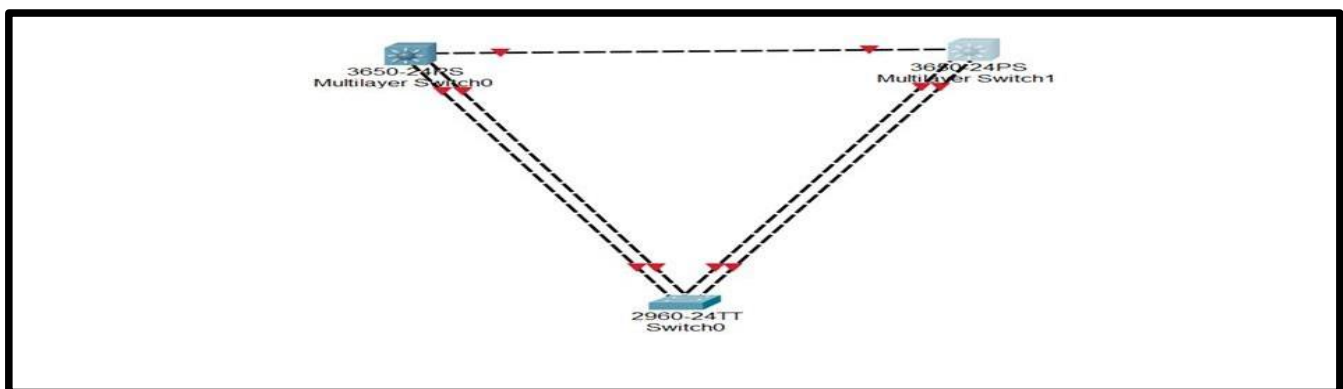
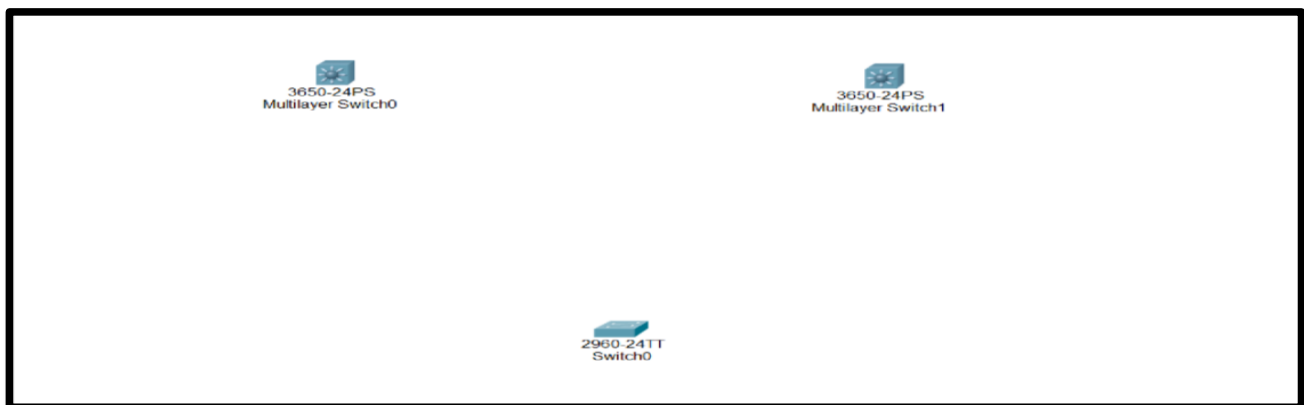
- ☐ 1 Switch (Cisco 2960+ with Cisco IOS release 15.2 lanbase image or comparable)
- ☐ 1 PC (Windows with a terminal emulation program, such as Tera Term)
- ☐ Console cables to configure the Cisco IOS devices via the console ports
- ☐ Ethernet cables as shown in the topology

### What is STP?

- Spanning Tree Protocol (STP) is a Layer 2 network protocol used to prevent looping within a network topology.
- STP was created to avoid the problems that arise when computers exchange data on a local area network (LAN) that contains redundant paths.
- If the flow of traffic is not carefully monitored and controlled, the data can be caught in a loop that circles around network segments, affecting performance and bringing traffic to a near halt. Networks are often configured with redundant paths when connecting network segments.
- STP can help prevent bridge looping on LANs that include redundant links.
- STP monitors all network links, identifies redundant connections, and disables the ports that can lead to looping.

### Part 1: Build the Network and Configure Basic Device Settings and Interface Addressing

#### Step 1: Cable the network as shown in the topology.



#### Step 2: Configure basic settings for each switch.

a. Console into each switch, enter global configuration mode, and apply the basic settings and interface addressing. The start-up configuration is provided below for each switch in the topology.

### Switch D1 hostname D1 spanning-tree mode

pvst

interface range g1/0/1-24, g1/1/1-4, g0/0

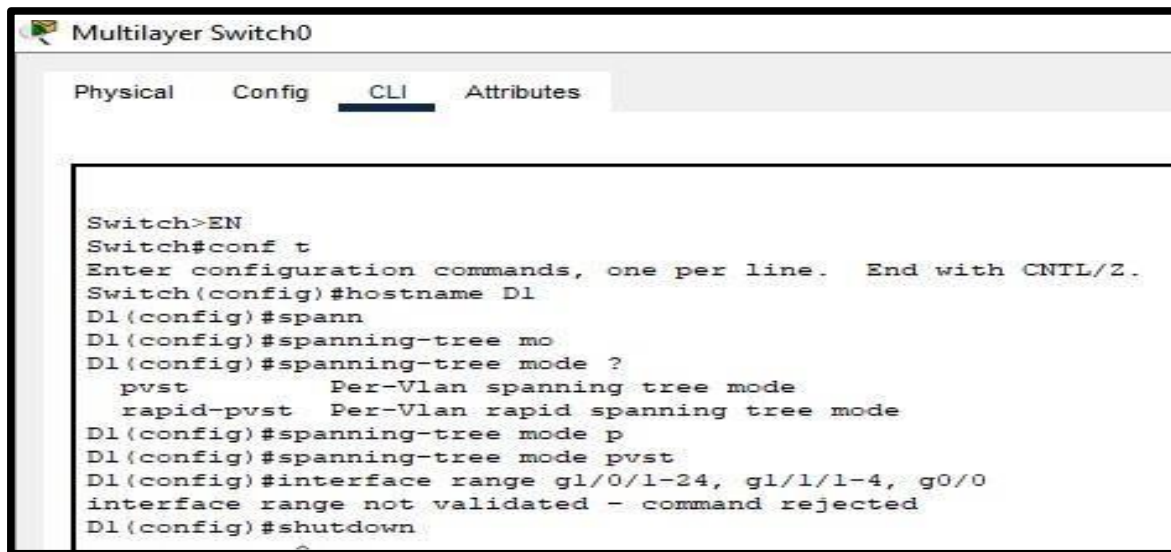
shutdown

exit

interface range g1/0/1, g1/0/5-6 switchport mode  
trunk no shutdown exit vlan 2

name SecondVLAN

exit interface vlan 1 ip address 10.0.0.1 255.0.0.0  
no shut exit



Multilayer Switch0

Physical Config CLI Attributes

```
Switch>EN
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname D1
D1(config)#spann
D1(config)#spanning-tree mo
D1(config)#spanning-tree mode ?
    pvst          Per-Vlan spanning tree mode
    rapid-pvst    Per-Vlan rapid spanning tree mode
D1(config)#spanning-tree mode p
D1(config)#spanning-tree mode pvst
D1(config)#interface range g1/0/1-24, g1/1/1-4, g0/0
interface range not validated - command rejected
D1(config)#shutdown
```



Multilayer Switch0

Physical Config CLI Attributes

IOS Command Line Interface

```
D1(config)#interface range g1/0/1-24, g1/1/1-4, g0/0
interface range not validated - command rejected
D1(config)#interface range g1/0/1-24
D1(config-if-range)#shutdown

%LINK-S-CHANGED: Interface GigabitEthernet1/0/2, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/3, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/4, changed state to administratively down

%LINK-S-CHANGED: Interface GigabitEthernet1/0/7, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/8, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/9, changed state to administratively down
```

```
Multilayer Switch0
Physical Config CLI Attributes
IOS Command Line Interface

%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/6, changed state to down
D1(config-if-range)#interface range g1/1/1-4
D1(config-if-range)#shutdown

%LINK-S-CHANGED: Interface GigabitEthernet1/1/1, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/1/2, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/1/3, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/1/4, changed state to administratively down
D1(config-if-range)#exit
D1(config)#interface range g1/0/1, g1/0/5-6
D1(config-if-range)#sw
D1(config-if-range)#switchport mo
D1(config-if-range)#switchport mode tr
D1(config-if-range)#switchport mode trunk
D1(config-if-range)#no sh
D1(config-if-range)#no shutdown

D1(config-if-range)#
%LINK-S-CHANGED: Interface GigabitEthernet1/0/1, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to up
%LINK-S-CHANGED: Interface GigabitEthernet1/0/5, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/5, changed state to up
%LINK-S-CHANGED: Interface GigabitEthernet1/0/6, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/6, changed state to up
D1(config-if-range)#exit
D1(config)#vlan 2
```

```
Multilayer Switch0
Physical Config CLI Attributes
IOS Command Line Interface

D1(config)#interface range g1/0/1, g1/0/5-6
D1(config-if-range)#sw
D1(config-if-range)#switchport mo
D1(config-if-range)#switchport mode tr
D1(config-if-range)#switchport mode trunk
D1(config-if-range)#no sh
D1(config-if-range)#no shutdown

D1(config-if-range)#
%LINK-S-CHANGED: Interface GigabitEthernet1/0/1, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to up
%LINK-S-CHANGED: Interface GigabitEthernet1/0/5, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/5, changed state to up
%LINK-S-CHANGED: Interface GigabitEthernet1/0/6, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/6, changed state to up
D1(config-if-range)#exit
D1(config)#vlan 2
D1(config-vlan)#name SecondVLAN
D1(config-vlan)#exit
D1(config)#interface vlan 1
D1(config-if)#ip address 10.0.0.1 255.0.0.0
D1(config-if)#no shut

D1(config-if)#
%LINK-S-CHANGED: Interface Vlan1, changed state to up
%LINEPROTO-S-UPDOWN: Line protocol on Interface Vlan1, changed state to up
D1(config-if)#exit
D1(config)#
```

Switch D2 hostname D2

banner motd # D2, STP Topology Change and RSTP Lab # spanning-tree mode pvst

interface range g1/0/1-24, g1/1/1-4, g0/0 shutdown

exit interface range g1/0/1, g1/0/5-6 switchport

mode trunk no shutdown exit vlan 2

name SecondVLAN

exit interface vlan 1 ip address 10.0.0.2

255.0.0.0 no shut

exit

```
Multilayer Switch1
Physical Config CLI Attributes
IOS Command Line

Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname D2
D2(config)#sp
D2(config)#spanning-tree mo
D2(config)#spanning-tree mode p
D2(config)#spanning-tree mode pvst
D2(config)#interface range g1/0/1-24, g1/1/1-4, g0/0
interface range not validated - command rejected
D2(config)#interface range g1/0/1-24
D2(config-if-range)#shutdown

%LINK-S-CHANGED: Interface GigabitEthernet1/0/2, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/3, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/4, changed state to administratively down

%LINK-S-CHANGED: Interface GigabitEthernet1/0/7, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/8, changed state to administratively down
```

```
Multilayer Switch1
Physical Config CLI Attributes
IOS Command Line Interface

%LINK-S-CHANGED: Interface GigabitEthernet1/0/24, changed state to administratively down
D2(config-if-range)#
%LINK-S-CHANGED: Interface GigabitEthernet1/0/1, changed state to administratively down
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/5, changed state to administratively down
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/5, changed state to down
%LINK-S-CHANGED: Interface GigabitEthernet1/0/6, changed state to administratively down
%LINEPROTO-S-UPDOWN: Line protocol on Interface GigabitEthernet1/0/6, changed state to down
D2(config-if-range)#interface range g1/1/1-4
D2(config-if-range)#shutdown

%LINK-S-CHANGED: Interface GigabitEthernet1/1/1, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/1/2, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/1/3, changed state to administratively down
%LINK-S-CHANGED: Interface GigabitEthernet1/1/4, changed state to administratively down
D2(config-if-range)#
D2(config-if-range)#exit
D2(config)#vlan 2
D2(config-vlan)#name SecondVLAN
D2(config-vlan)#exit
D2(config)#interface vlan 1
D2(config-if)#ip address 10.0.0.2 255.0.0.0
D2(config-if)#no shu
D2(config-if)#no shutdown

D2(config-if)#
%LINK-S-CHANGED: Interface Vlan1, changed state to up
exit
D2(config)#
```

## Switch A1

hostname A1

banner motd # A1, STP Topology Change and RSTP Lab # spanning-tree mode

pvst line con 0 exec-timeout 0 0 logging synchronous exit

interface range f0/1-24, g0/1-2 shutdown

exit interface range f0/1-4 switchport

mode trunk no shutdown

exit vlan 2

name SecondVLAN

exit



```
Switch0
Physical Config CLI Attributes
IOS Command Line Interface

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to down

Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname Al
Al(config)#sp
Al(config)#spanning-tree m
Al(config)#spanning-tree mode p
Al(config)#spanning-tree mode pvst
Al(config)#interface range f0/1-24
Al(config-if-range)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/7, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/8, changed state to administratively down
%LINK-5-CHANGED: Interface FastEthernet0/9, changed state to administratively down
```

```
Switch0
Physical Config CLI Attributes
IOS Command Line Interface

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to administratively down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down
Al(config-if-range)#interface range g0/1-2
Al(config-if-range)#shutdown
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to administratively down
%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
Al(config-if-range)#exit
Al(config)#interface range f0/1-4
Al(config-if-range)#sw
Al(config-if-range)#switchport m
Al(config-if-range)#switchport mode tr
Al(config-if-range)#switchport mode trunk
Al(config-if-range)#no sh
Al(config-if-range)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to down
%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to down
Al(config-if-range)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up
exit
Al(config)#vlan 2
Al(config-vlan)#name SecondVLAN
Al(config-vlan)#exit
Al(config)#interface vlan 1
Al(config-if)#ip address 10.0.0.3 255.0.0.0
Al(config-if)#no sh
Al(config-if)#no shutdown
```

```
Switch0
Physical Config CLI Attributes
IOS Command Line Interface

%LINK-5-CHANGED: Interface GigabitEthernet0/2, changed state to administratively down
Al(config-if-range)#exit
Al(config)#interface range f0/1-4
Al(config-if-range)#sw
Al(config-if-range)#switchport m
Al(config-if-range)#switchport mode tr
Al(config-if-range)#switchport mode trunk
Al(config-if-range)#no sh
Al(config-if-range)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to down
%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to down
Al(config-if-range)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up
exit
Al(config)#vlan 2
Al(config-vlan)#name SecondVLAN
Al(config-vlan)#exit
Al(config)#interface vlan 1
Al(config-if)#ip address 10.0.0.3 255.0.0.0
Al(config-if)#no sh
Al(config-if)#no shutdown

Al(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up
exit
Al(config)#
```

b. Set the clock on each switch to UTC time.

c. Save the running configuration to startup-config.

## Part 2: Discover the Default Spanning Tree

Your switches have been configured and interfaces have been enabled, and the Spanning Tree Protocol, operational by default, has already converged onto a loop-free logical network. In this part of the lab, we will discover what that default spanning tree looks like and evaluate why it converged the way it did

# show spanning-tree Switch D1

```
Multilayer Switch0
Physical Config CLI Attributes
IOS Command Line Interface

D1(config)#show spanning-tree
% Invalid input detected at '^' marker.
D1(config)#exit
D1#
$SYS-S-CONFIG_I: Configured from console by console
D1#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     0003.E424.07A8
             Cost        19
             Port        5 (GigabitEthernet1/0/5)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
  Bridge ID   Priority    32768 (priority 32768 sys-id-ext 1)
             Address     0090.0C34.455B
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  20
Interface-----Role Sts Cost-----Prio.Nbr Type-----
Gi1/0/5-----Desg FWD 19-----128.1 P2p
Gi1/0/6-----Altn BLK 19-----128.6 P2p
VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    32770
             Address     0003.E424.07A8
             Cost        19
             Port        5 (GigabitEthernet1/0/5)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
  Bridge ID   Priority    32770 (priority 32768 sys-id-ext 2)
             Address     0030.F242.A5BA
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  20
--More--
```

Switch D2

```
Multilayer Switch4
Physical Config CLI Attributes
IOS Command Line Interface

D2(config-if)#exit
D2(config)#exit
D2#
$SYS-S-CONFIG_I: Configured from console by console
D2#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     0003.E424.07A8
             Cost        19
             Port        5 (GigabitEthernet1/0/5)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
  Bridge ID   Priority    32768 (priority 32768 sys-id-ext 1)
             Address     0030.F242.A5BA
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  20
Interface-----Role Sts Cost-----Prio.Nbr Type-----
Gi1/0/1-----Desg FWD 4-----128.1 P2p
Gi1/0/6-----Altn BLK 19-----128.6 P2p
Gi1/0/5-----Root FWD 19-----128.6 P2p
VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    32770
             Address     0003.E424.07A8
             Cost        19
             Port        5 (GigabitEthernet1/0/5)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
  Bridge ID   Priority    32770 (priority 32768 sys-id-ext 2)
             Address     0003.E424.07A8
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  20
--More--
```

Switch A1

```
Switch0
Physical Config CLI Attributes
IOS Command Line Interface

A1(config-if)#exit
A1(config)#exit
A1#
$SYS-S-CONFIG_I: Configured from console by console
A1#sh spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     0003.E424.07A8
             Cost        19
             Port        5 (GigabitEthernet1/0/5)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
  Bridge ID   Priority    32768 (priority 32768 sys-id-ext 1)
             Address     0003.E424.07A8
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  20
Interface-----Role Sts Cost-----Prio.Nbr Type-----
Fa0/2-----Desg FWD 19-----128.2 P2p
Fa0/1-----Desg FWD 19-----128.1 P2p
VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    32770
             Address     0003.E424.07A8
             Cost        19
             Port        5 (GigabitEthernet1/0/5)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
  Bridge ID   Priority    32770 (priority 32768 sys-id-ext 2)
             Address     0003.E424.07A8
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  20
--More--
```

### Part 3: Implement and Observe Rapid Spanning Tree Protocol

- a. On D2, issue the debug spanning-tree events command, and then issue the shutdown command for interface g1/0/1 and observe the output.

```
Multilayer Switch4
Physical Config CLI Attributes
IOS Command Line

%LINK-5-UPDOWN: Line protocol on interface GigabitEthernet1/0/1, changed state to up
D2>
D2>en
D2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
D2(config)#interface g1/0/1
D2(config-if)#shutdown

D2(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet1/0/1, changed state to administratively down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to down
D2(config-if)#
D2(config-if)#
D2(config-if)#
D2(config-if)#
D2(config-if)#
```

- b. On D2 and A1, change the spanning tree mode to rapid spanning tree

```
Multilayer Switch0
down

D1>
D1>
D1>en
D1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
D1(config)#sp
D1(config)#spanning-tree mo
D1(config)#spanning-tree mode r
D1(config)#spanning-tree mode rapid-pvst
D1(config)#
D1(config)#

Switch0
%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up

A1>
A1>en
A1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
A1(config)#sp
A1(config)#spanning-tree mo
A1(config)#spanning-tree mode r
A1(config)#spanning-tree mode rapid-pvst
A1(config)#
```

- c. On D1, issue the command show spanning-tree.

```
Multilayer Switch0
Physical Config CLI Attributes
IOS Command Line interface

show spanning-tree
D1#show spanning-tree
VLAN0001
Spanning tree enabled protocol STP
Root ID    Priority    32768
Address    0000.0000.0000
Cost       1
Hello Time  2 sec Hold time 10 sec Forward Delay 15 sec
Bridge ID  Priority    32768
Address    0000.0000.0000
Cost       1
Hello Time  2 sec Hold time 10 sec Forward Delay 15 sec

Interface    Role    Sts    Cost    Prio    P2p    Type
Gig1/0/26    DESI    STP    100     128    P2P    ET
Gig1/0/26    DESI    STP    100     128    P2P    ET
Gig1/0/26    DESI    STP    100     128    P2P    ET
VLAN0001
Spanning tree enabled protocol STP
Root ID    Priority    32768
Address    0000.0000.0000
Cost       1
Hello Time  2 sec Hold time 10 sec Forward Delay 15 sec
Bridge ID  Priority    32768
Address    0000.0000.0000
Cost       1
Hello Time  2 sec Hold time 10 sec Forward Delay 15 sec
```

A1 was the last switch that was configured for RSTP. As you can see, interface VLAN1 was only down for 0.048 seconds. This is the “rapid” in rapid spanning tree.