Lab 06

Phase 1 — Enterprise Foundation

Lab 06 — Enterprise STP, RSTP & MST Architecture

Section A — Enterprise Build Scenario

Lab Type

Enterprise Foundation Build Lab

Difficulty

Intermediate → Advanced

Estimated Time

150–180 Minutes

Lab Objective

In this lab, you will deploy enterprise Spanning Tree architectures using:

- STP,
- Rapid Spanning Tree Protocol (RSTP),
- and Multiple Spanning Tree (MST).

You will learn how to:

- prevent Layer 2 loops,

- control root bridge placement,
- optimize Layer 2 convergence,
- configure MST regions,
- validate spanning-tree topology behavior,
- troubleshoot STP inconsistencies,
- and deploy enterprise Layer 2 resiliency.

Why This Lab Matters

Enterprise Layer 2 networks contain redundant physical links to improve availability.

Without Spanning Tree:

- switching loops form,
- broadcast storms occur,
- MAC tables become unstable,
- and enterprise networks collapse rapidly.

Modern enterprise infrastructures rely heavily on:

- Rapid convergence,
- predictable Layer 2 forwarding,
- root bridge engineering,
- and scalable STP design.

Understanding STP operations is critical for:

- enterprise campus networks,
- data center access layers,
- and large-scale switching environments.

Enterprise Scenario

Your organization is deploying a resilient enterprise campus network with redundant switching paths.

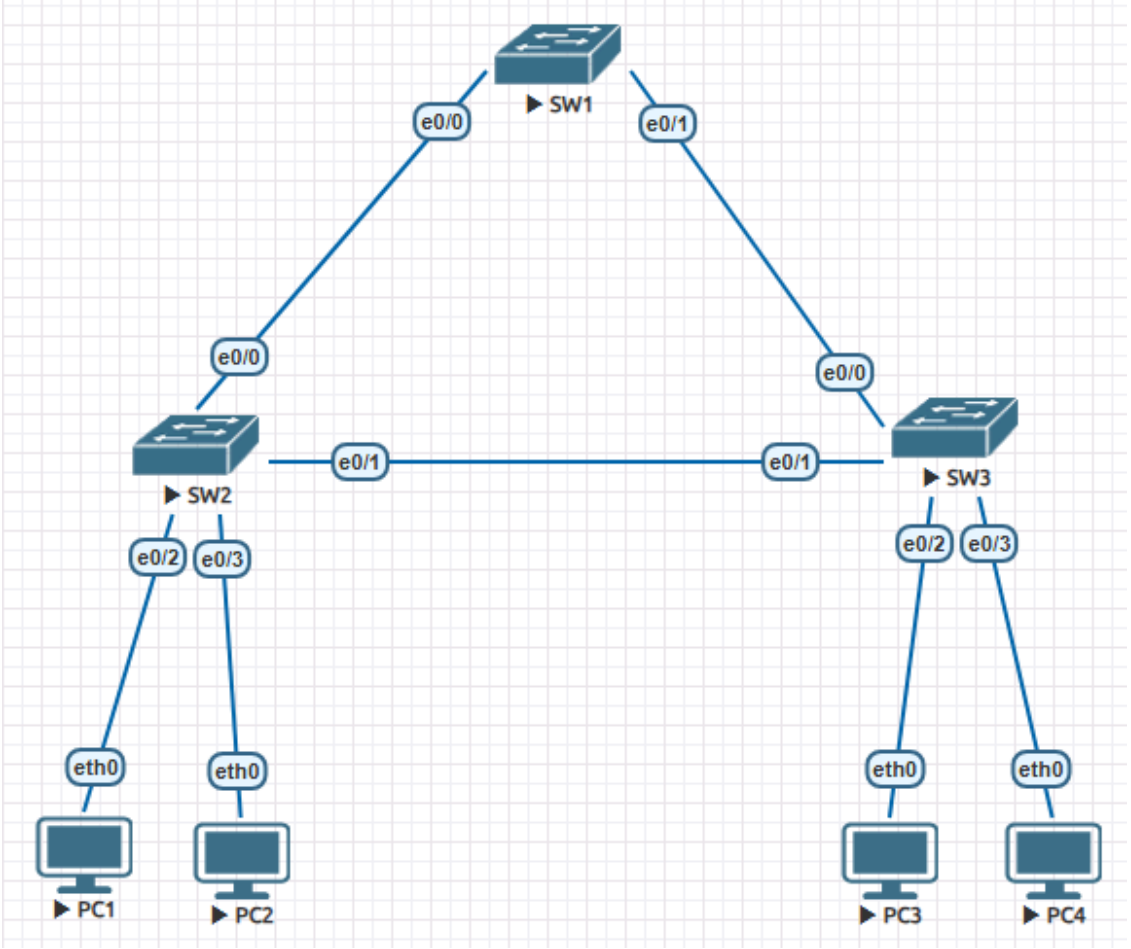
Management requires:

- loop prevention,
- rapid failover,
- optimized forwarding paths,
- and scalable Layer 2 architecture.

You are assigned to:

- deploy enterprise STP operations,
- optimize root bridge placement,
- validate RSTP convergence,
- and implement MST region architecture for scalable VLAN management.

Topology for EVE-NG & GNS3



Connection Table

Device	Interface	Connected To	Interface
SW1	Ethernet0/0	SW2	Ethernet0/0
SW1	Ethernet0/1	SW3	Ethernet0/0
SW2	Ethernet0/1	SW3	Ethernet0/1
SW2	Ethernet0/2	PC1	eth0
SW2	Ethernet0/3	PC2	eth0
SW3	Ethernet0/2	PC3	eth0
SW3	Ethernet0/3	PC4	eth0

VLAN Design Table

VLAN ID	VLAN Name
10	SALES
20	ENGINEERING
99	MANAGEMENT

IP Addressing Table

Device	Interface	IP Address	VLAN
PC1	eth0	10.10.10.10/24	VLAN 10
PC2	eth0	10.20.20.10/24	VLAN 20
PC3	eth0	10.10.10.20/24	VLAN 10
PC4	eth0	10.20.20.20/24	VLAN 20

Enterprise Naming Standards

Device Type	Naming Convention
Distribution Switch	SW1
Access Switch	SW2
Access Switch	SW3

Device Type	Naming Convention
Endpoint	PC1–PC4

Required Images

Device	Purpose
Cisco IOL L2	Enterprise switching
VPCS	Endpoint validation

Step 1 — Deploy Nodes in EVE-NG

Goal

Deploy the enterprise redundant Layer 2 topology.

Add The Following Nodes

Node	Quantity
IOL L2 Switch	3
VPCS Host	4

Step 2 — Connect The Enterprise Topology

Goal

Deploy redundant enterprise switching paths.

Use the Connection Table above.

Step 3 — Configure VPCS Hosts

PC1

```
ip 10.10.10.10/24
set pcname PC1
save
```

PC2

```
ip 10.20.20.10/24
set pcname PC2
save
```

PC3

```
ip 10.10.10.20/24
set pcname PC3
save
```

PC4

```
ip 10.20.20.20/24
set pcname PC4
save
```

```
VPCS> ip 10.20.20.10/24
Checking for duplicate address...
VPCS : 10.20.20.10 255.255.255.0

VPCS> set pcname PC2

PC2> save
```

```
Saving startup configuration to startup.vpc
.  done
```

Verification

```
PC2> show ip

NAME        : PC2[1]
IP/MASK     : 10.20.20.10/24
GATEWAY     : 0.0.0.0
DNS         :
MAC         : 00:50:79:66:68:02
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500
```

Expected Result

All endpoints should display operational addressing.

Step 4 — Configure SW1

Goal

Deploy enterprise root bridge architecture.

Commands

```
enable
conf t

hostname SW1

spanning-tree mode rapid-pvst

vlan 10
 name SALES
```

```
vlan 20
 name ENGINEERING

vlan 99
 name MANAGEMENT

spanning-tree vlan 10,20,99 priority 4096

interface range Ethernet0/0 - 1
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk native vlan 99
 switchport trunk allowed vlan 10,20,99
 no shutdown

end
write memory
```

Verification

```
SW1#show spanning-tree root
                                        Root    Hello Max F
wd
Vlan                 Root ID            Cost    Time  Age D
ly  Root Port
---------------- -------------------- --------- ----- --- -
--  ------------
VLAN0001         32769 aabb.cc00.5000         0    2   20
15
VLAN0010          4106 aabb.cc00.5000         0    2   20
15
VLAN0020          4116 aabb.cc00.5000         0    2   20
15
VLAN0099          4195 aabb.cc00.5000         0    2   20
15
```

```
SW1#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: VLAN0001, VLAN0010, VLAN0020, VLAN0099
EtherChannel misconfig guard            is enabled
Extended system ID                      is enabled
```

```
Portfast Default                          is disabled
PortFast BPDU Guard Default              is disabled
Portfast BPDU Filter Default             is disabled
Loopguard Default                        is disabled
UplinkFast                                is disabled
BackboneFast                              is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwardi
ng STP Active
---------------------- -------- --------- -------- --------
-- ----------
VLAN0001                     0         0        0
2          2
VLAN0010                     0         0        2
0          2
VLAN0020                     0         0        2
0          2
VLAN0099                     2         0        0
0          2
---------------------- -------- --------- -------- --------
-- ----------
4 vlans                      2         0        4
2          8
```

Expected Result

SW1 should become root bridge for VLANs 10, 20, and 99.

```
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovere
d on Ethernet0/0 (99), with Switch Ethernet0/0 (1).
```

Step 5 — Configure SW2

Goal

Deploy enterprise access switching with RSTP.

Note: It is common to see this warning while the other switch is not yet configured.

Commands

```
enable
conf t

hostname SW2

spanning-tree mode rapid-pvst

vlan 10
 name SALES

vlan 20
 name ENGINEERING

vlan 99
 name MANAGEMENT

interface Ethernet0/0
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk native vlan 99
 switchport trunk allowed vlan 10,20,99
 no shutdown

interface Ethernet0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk native vlan 99
 switchport trunk allowed vlan 10,20,99
 no shutdown

interface Ethernet0/2
 switchport mode access
 switchport access vlan 10
 spanning-tree portfast
 no shutdown

interface Ethernet0/3
 switchport mode access
 switchport access vlan 20
 spanning-tree portfast
 no shutdown
```

```
end
write memory
```

Verification

```
SW2#show spanning-tree

VLAN0010
  Spanning tree enabled protocol rstp
  Root ID     Priority    4106
              Address     aabb.cc00.5000
              Cost        100
              Port        1 (Ethernet0/0)
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec

  Bridge ID  Priority    32778  (priority 32768 sys-id-ext
10)
              Address     aabb.cc00.6000
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- ------------
--------------------
Et0/0               Root FWD 100       128.1    P2p
Et0/1               Desg FWD 100       128.2    P2p
Et0/2               Desg FWD 100       128.3    P2p Edge



VLAN0020
  Spanning tree enabled protocol rstp
  Root ID     Priority    4116
              Address     aabb.cc00.5000
              Cost        100
```

```
              Port        1 (Ethernet0/0)
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec

  Bridge ID  Priority    32788  (priority 32768 sys-id-ext
20)
              Address     aabb.cc00.6000
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- ------------
----------------------
Et0/0               Root FWD 100       128.1    P2p
Et0/1               Desg FWD 100       128.2    P2p
Et0/3               Desg FWD 100       128.4    P2p Edge



VLAN0099
  Spanning tree enabled protocol rstp
  Root ID    Priority    4195
              Address     aabb.cc00.5000
              Cost        100
              Port        1 (Ethernet0/0)
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec

  Bridge ID  Priority    32867  (priority 32768 sys-id-ext
99)
              Address     aabb.cc00.6000
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- ------------
```

```
----------------------
Et0/0               Root FWD 100       128.1    P2p
Et0/1               Desg BKN*100       128.2    P2p *PVID_I
nc
```

```
SW2#show spanning-tree blockedports

Name                 Blocked Interfaces List
-------------------- ------------------------------------
VLAN0099             Et0/1

Number of blocked ports (segments) in the system : 1
```

Expected Result

One redundant path should transition into blocking/discarding state.

Step 6 — Configure SW3

Goal

Deploy additional enterprise RSTP operations.

Commands

```
enable
conf t

hostname SW3

spanning-tree mode rapid-pvst

vlan 10
 name SALES

vlan 20
 name ENGINEERING
```

```
vlan 99
 name MANAGEMENT

interface Ethernet0/0
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk native vlan 99
 switchport trunk allowed vlan 10,20,99
 no shutdown

interface Ethernet0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport trunk native vlan 99
 switchport trunk allowed vlan 10,20,99
 no shutdown

interface Ethernet0/2
 switchport mode access
 switchport access vlan 10
 spanning-tree portfast
 no shutdown

interface Ethernet0/3
 switchport mode access
 switchport access vlan 20
 spanning-tree portfast
 no shutdown

end
write memory
```

Verification

```
SW3#show spanning-tree

VLAN0010
  Spanning tree enabled protocol rstp
  Root ID    Priority    4106
             Address     aabb.cc00.5000
             Cost        100
             Port        1 (Ethernet0/0)
             Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec

  Bridge ID  Priority    32778  (priority 32768 sys-id-ext
```

```
10)
              Address     aabb.cc00.7000
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- ------------
---------------------
Et0/0               Root FWD 100       128.1    P2p
Et0/1               Altn BLK 100       128.2    P2p
Et0/2               Desg FWD 100       128.3    P2p Edge



VLAN0020
  Spanning tree enabled protocol rstp
  Root ID     Priority    4116
              Address     aabb.cc00.5000
              Cost        100
              Port        1 (Ethernet0/0)
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec

  Bridge ID   Priority    32788  (priority 32768 sys-id-ext
20)
              Address     aabb.cc00.7000
              Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- ------------
---------------------
Et0/0               Root FWD 100       128.1    P2p
Et0/1               Altn BLK 100       128.2    P2p
Et0/3               Desg FWD 100       128.4    P2p Edge
```

```
VLAN0099
  Spanning tree enabled protocol rstp
  Root ID    Priority    4195
             Address     aabb.cc00.5000
             Cost        100
             Port        1 (Ethernet0/0)
             Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec

  Bridge ID  Priority    32867  (priority 32768 sys-id-ext
99)
             Address     aabb.cc00.7000
             Hello Time   2 sec  Max Age 20 sec  Forward De
lay 15 sec
             Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- ---------- -------- ------------
----------------------
Et0/0               Root FWD 100       128.1    P2p
Et0/1               Altn BLK 100       128.2    P2p
```

```
SW3#show spanning-tree root

                                        Root    Hello Max F
wd
Vlan                Root ID             Cost    Time  Age D
ly  Root Port
----------------- -------------------- --------- ----- --- -
--  ------------
VLAN0010          4106 aabb.cc00.5000       100    2   20
15  Et0/0
VLAN0020          4116 aabb.cc00.5000       100    2   20
15  Et0/0
```

```
VLAN0099           4195 aabb.cc00.5000       100    2   20
15  Et0/0
```

Expected Result

RSTP topology should converge successfully with loop-free forwarding.

Step 7 — Validate STP Operations

Goal

Validate enterprise loop prevention behavior.

Verification Commands

```
SW1#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: VLAN0001, VLAN0010, VLAN0020, VLAN0099
EtherChannel misconfig guard            is enabled
Extended system ID                      is enabled
Portfast Default                        is disabled
PortFast BPDU Guard Default             is disabled
Portfast BPDU Filter Default            is disabled
Loopguard Default                       is disabled
UplinkFast                              is disabled
BackboneFast                            is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0001                    0         0        0          2          2
VLAN0010                    0         0        0          2          2
VLAN0020                    0         0        0          2          2
VLAN0099                    0         0        0          2          2
---------------------- -------- --------- -------- ---------- ----------
4 vlans                     0         0        0          8          8
```

```
SW1#show spanning-tree interface Ethernet0/1 detail
 Port 2 (Ethernet0/1) of VLAN0010 is designated forwarding
   Port path cost 100, Port priority 128, Port Identifier 128.2.
   Designated root has priority 4106, address aabb.cc00.5000
```

```
  Designated bridge has priority 4106, address aabb.cc00.5000
  Designated port id is 128.2, designated path cost 0
  Timers: message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default
  BPDU: sent 863, received 5

Port 2 (Ethernet0/1) of VLAN0020 is designated forwarding
  Port path cost 100, Port priority 128, Port Identifier 128.2.
  Designated root has priority 4116, address aabb.cc00.5000
  Designated bridge has priority 4116, address aabb.cc00.5000
  Designated port id is 128.2, designated path cost 0
  Timers: message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default
  BPDU: sent 863, received 5

Port 2 (Ethernet0/1) of VLAN0099 is designated forwarding
  Port path cost 100, Port priority 128, Port Identifier 128.2.
  Designated root has priority 4195, address aabb.cc00.5000
  Designated bridge has priority 4195, address aabb.cc00.5000
  Designated port id is 128.2, designated path cost 0
  Timers: message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default
  BPDU: sent 863, received 12
```

Expected Result

- Root bridge identified correctly
- One redundant path blocked
- No Layer 2 loops present
- RSTP operational

Step 8 — Configure MST Architecture

Goal

Deploy enterprise MST region design.

Configure SW1

```
enable
conf t

spanning-tree mode mst

spanning-tree mst configuration
 name ENTERPRISE
 revision 1
 instance 1 vlan 10
 instance 2 vlan 20
 exit

end
write memory
```

Configure SW2

```
enable
conf t

spanning-tree mode mst

spanning-tree mst configuration
 name ENTERPRISE
 revision 1
 instance 1 vlan 10
 instance 2 vlan 20
 exit

end
write memory
```

Configure SW3

```
enable
conf t

spanning-tree mode mst

spanning-tree mst configuration
 name ENTERPRISE
 revision 1
 instance 1 vlan 10
 instance 2 vlan 20
```

```
 exit

end
write memory
```

⚠️ **Note:** After applying configuration changes on all three switches, SW1 may temporarily display this message while Spanning Tree recalculates the topology and synchronizes BPDUs.

```
%SPANTREE-2-PVSTSIM_FAIL: Blocking designated port Et0/1: I
nconsitent superior PVST BPDU received on VLAN 10, claiming
root 4106:aabb.cc00.5000
SW1#
%SPANTREE-2-PVSTSIM_OK: PVST Simulation inconsistency clear
ed on port Ethernet0/1.
```

Verification

```
SW2#show spanning-tree mst

##### MST0    vlans mapped:   1-9,11-19,21-4094
Bridge        address aabb.cc00.6000  priority      32768 (32768 sysid 0)
Root          address aabb.cc00.5000  priority      32768 (32768 sysid 0)
              port    Et0/0           path cost     0
Regional Root address aabb.cc00.5000  priority      32768 (32768 sysid 0)
                                      internal cost 2000000   rem hops 19
Operational   hello time 2 , forward delay 15, max age 20, txholdcount 6
Configured    hello time 2 , forward delay 15, max age 20, max hops    20

Interface                       Role Sts Cost      Prio.Nbr Type
----------------                ---- --- --------- -------- --------------------------
-------
Et0/0                           Root FWD 2000000   128.1    P2p
Et0/1                           Desg FWD 2000000   128.2    P2p
Et0/2                           Desg FWD 2000000   128.3    P2p Edge
Et0/3                           Desg FWD 2000000   128.4    P2p Edge

##### MST1    vlans mapped:   10
Bridge        address aabb.cc00.6000  priority      32769 (32768 sysid 1)
Root          address aabb.cc00.5000  priority      32769 (32768 sysid 1)
              port    Et0/0           cost          2000000   rem hops 19

Interface                       Role Sts Cost      Prio.Nbr Type
----------------                ---- --- --------- -------- --------------------------
-------
Et0/0                           Root FWD 2000000   128.1    P2p
```

```
Et0/1                            Desg FWD 2000000   128.2    P2p
Et0/2                            Desg FWD 2000000   128.3    P2p Edge

##### MST2    vlans mapped:   20
Bridge       address aabb.cc00.6000  priority      32770 (32768 sysid 2)
Root         address aabb.cc00.5000  priority      32770 (32768 sysid 2)
             port    Et0/0           cost          2000000   rem hops 19

Interface                        Role Sts Cost      Prio.Nbr Type
---------------                  ---- --- --------- -------- --------------------------
-------
Et0/0                            Root FWD 2000000   128.1    P2p
Et0/1                            Desg FWD 2000000   128.2    P2p
Et0/3                            Desg FWD 2000000   128.4    P2p Edge
```

```
SW2#show spanning-tree mst configuration
Name      [ENTERPRISE]
Revision  1     Instances configured 3

Instance  Vlans mapped
--------  ----------------------------------------------------
----------------------
0         1-9,11-19,21-4094
1         10
2         20
```

Expected Result

- All switches should join same MST region
- MST instances should appear operational
- VLAN mappings should match across all switches

Step 9 — Validate MST Region Consistency

Goal

Validate enterprise MST operational consistency.

Verification Commands

```
SW1#show spanning-tree mst configuration digest
Name      [ENTERPRISE]
Revision  1     Instances configured 3
Digest          0x9357EBB7A8D74DD5FEF4F2BAB50531AA
Pre-std Digest  0x3B25D71AE88BA09B591621DB58F62F5
```

Expected Result

All switches should display identical MST digests.

Step 10 — Validate Enterprise Connectivity

Goal

Validate enterprise Layer 2 communication.

From PC1

```
PC1> ping 10.10.10.20

84 bytes from 10.10.10.20 icmp_seq=1 ttl=64 time=0.852 ms
84 bytes from 10.10.10.20 icmp_seq=2 ttl=64 time=1.712 ms
84 bytes from 10.10.10.20 icmp_seq=3 ttl=64 time=1.920 ms
```

Expected Result

PC3 should respond successfully.

From PC2

```
PC2> ping 10.20.20.20

84 bytes from 10.20.20.20 icmp_seq=1 ttl=64 time=0.924 ms
84 bytes from 10.20.20.20 icmp_seq=2 ttl=64 time=1.469 ms
84 bytes from 10.20.20.20 icmp_seq=3 ttl=64 time=2.864 ms
```

Expected Result

PC4 should respond successfully.

Step 11 — Enterprise Operational Verification

SW1 Verification

```
SW1#show spanning-tree

MST0
  Spanning tree enabled protocol mstp
  Root ID    Priority    32768
             Address     aabb.cc00.5000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32768  (priority 32768 sys-id-ext 0)
             Address     aabb.cc00.5000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Et0/0               Desg FWD 2000000   128.1    P2p
Et0/1               Desg FWD 2000000   128.2    P2p
Et0/2               Desg FWD 2000000   128.3    P2p
Et0/3               Desg FWD 2000000   128.4    P2p



MST1
  Spanning tree enabled protocol mstp
  Root ID    Priority    32769
             Address     aabb.cc00.5000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
```

```
  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     aabb.cc00.5000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Et0/0               Desg FWD 2000000   128.1    P2p
Et0/1               Desg FWD 2000000   128.2    P2p



MST2
  Spanning tree enabled protocol mstp
  Root ID    Priority    32770
             Address     aabb.cc00.5000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32770  (priority 32768 sys-id-ext 2)
             Address     aabb.cc00.5000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Et0/0               Desg FWD 2000000   128.1    P2p
Et0/1               Desg FWD 2000000   128.2    P2p
```

```
SW1# show spanning-tree mst

##### MST0    vlans mapped:   1-9,11-19,21-4094
Bridge        address aabb.cc00.5000  priority      32768
(32768 sysid 0)
Root          this switch for the CIST
Operational   hello time 2 , forward delay 15, max age 20,
txholdcount 6
Configured    hello time 2 , forward delay 15, max age 20,
max hops    20

Interface                       Role Sts Cost      Prio.Nb
r Type
----------------                ---- --- ---------- -------
- --------------------------------
Et0/0                           Desg FWD 2000000   128.1
P2p
Et0/1                           Desg FWD 2000000   128.2
```

```
P2p
Et0/2                            Desg FWD 2000000   128.3
P2p
Et0/3                            Desg FWD 2000000   128.4
P2p

##### MST1    vlans mapped:   10
Bridge       address aabb.cc00.5000  priority      32769
(32768 sysid 1)
Root         this switch for MST1

Interface                        Role Sts Cost      Prio.Nb
r Type
---------------                  ---- --- --------- -------
- --------------------------------
Et0/0                            Desg FWD 2000000   128.1
P2p
Et0/1                            Desg FWD 2000000   128.2
P2p

##### MST2    vlans mapped:   20
Bridge       address aabb.cc00.5000  priority      32770
(32768 sysid 2)
Root         this switch for MST2

Interface                        Role Sts Cost      Prio.Nb
r Type
---------------                  ---- --- --------- -------
- --------------------------------
Et0/0                            Desg FWD 2000000   128.1
P2p
Et0/1                            Desg FWD 2000000   128.2
P2p

SW1#
```

```
SW1#show spanning-tree root
```

```
                                          Root    Hello Max F
wd
MST Instance           Root ID          Cost    Time  Age D
ly  Root Port
---------------- --------------------- --------- ----- --- -
--  ------------
MST0             32768 aabb.cc00.5000         0    2   20
15
MST1             32769 aabb.cc00.5000         0    2   20
15
MST2             32770 aabb.cc00.5000         0    2   20
15
```

SW2 Verification

```
SW2#show spanning-tree blockedports

Name                 Blocked Interfaces List
-------------------- ------------------------------------

Number of blocked ports (segments) in the system : 0
```

```
SW2#show spanning-tree summary
Switch is in mst mode (IEEE Standard)
Root bridge for: none
EtherChannel misconfig guard            is enabled
Extended system ID                      is enabled
Portfast Default                        is disabled
PortFast BPDU Guard Default             is disabled
Portfast BPDU Filter Default            is disabled
Loopguard Default                       is disabled
UplinkFast                              is disabled
BackboneFast                            is disabled
Configured Pathcost method used is short (Operational value
is long)
```

```
Name                   Blocking Listening Learning Forwardi
ng STP Active
---------------------- -------- ---------- --------- --------
-- ----------
MST0                          0          0         0
4           4
MST1                          0          0         0
3           3
MST2                          0          0         0
3           3
---------------------- -------- ---------- --------- --------
-- ----------
3 msts                        0          0         0          1
0          10
```

SW3 Verification

```
SW3#show spanning-tree mst configuration
Name      [ENTERPRISE]
Revision  1     Instances configured 3

Instance  Vlans mapped
--------  ---------------------------------------------------------------------
0         1-9,11-19,21-4094
1         10
2         20
---------------------------------------------------------------------------
```

```
SW3#show spanning-tree mst configuration
Name      [ENTERPRISE]
Revision  1     Instances configured 3

Instance  Vlans mapped
--------  ------------------------------------------------------------------
----------------------
0         1-9,11-19,21-4094
1         10
2         20
```

```
--------------------------------------------------------------------
--------------------


SW3#show spanning-tree mst detail

##### MST0    vlans mapped:   1-9,11-19,21-4094
Bridge        address aabb.cc00.7000  priority      32768
(32768 sysid 0)
Root          address aabb.cc00.5000  priority      32768
(32768 sysid 0)
              port    Et0/0           path cost     0
Regional Root address aabb.cc00.5000  priority      32768
(32768 sysid 0)
                                      internal cost 2000000
rem hops 19
Operational   hello time 2 , forward delay 15, max age 20,
txholdcount 6
Configured    hello time 2 , forward delay 15, max age 20,
max hops    20

Ethernet0/0 of MST0 is root forwarding
Port info             port id          128.1  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
68  cost           0
Design. regional root address aabb.cc00.5000  priority  327
68  cost           0
Designated bridge     address aabb.cc00.5000  priority  327
68  port id    128.2
Timers: message expires in 5 sec, forward delay 0, forward
transitions 1
Bpdus sent 9, received 329

Ethernet0/1 of MST0 is alternate blocking
Port info             port id          128.2  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
```

```
68  cost           0
Design. regional root address aabb.cc00.5000  priority  327
68  cost     2000000
Designated bridge     address aabb.cc00.6000  priority  327
68  port id    128.2
Timers: message expires in 4 sec, forward delay 0, forward
transitions 0
Bpdus sent 4, received 330

Ethernet0/2 of MST0 is designated forwarding
Port info             port id          128.3  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
68  cost           0
Design. regional root address aabb.cc00.5000  priority  327
68  cost     2000000
Designated bridge     address aabb.cc00.7000  priority  327
68  port id    128.3
Timers: message expires in 0 sec, forward delay 0, forward
transitions 1
Bpdus sent 325, received 0

Ethernet0/3 of MST0 is designated forwarding
Port info             port id          128.4  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
68  cost           0
Design. regional root address aabb.cc00.5000  priority  327
68  cost     2000000
Designated bridge     address aabb.cc00.7000  priority  327
68  port id    128.4
Timers: message expires in 0 sec, forward delay 0, forward
transitions 1
Bpdus sent 325, received 0

##### MST1    vlans mapped:   10
Bridge        address aabb.cc00.7000  priority      32769
(32768 sysid 1)
```

```
Root          address aabb.cc00.5000  priority      32769
(32768 sysid 1)
              port    Et0/0           cost          2000000
rem hops 19

Ethernet0/0 of MST1 is root forwarding
Port info             port id          128.1  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
69  cost           0
Designated bridge     address aabb.cc00.5000  priority  327
69  port id    128.2
Timers: message expires in 5 sec, forward delay 0, forward
transitions 1
Bpdus (MRecords) sent 9, received 329

Ethernet0/1 of MST1 is alternate blocking
Port info             port id          128.2  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
69  cost     2000000
Designated bridge     address aabb.cc00.6000  priority  327
69  port id    128.2
Timers: message expires in 4 sec, forward delay 0, forward
transitions 0
Bpdus (MRecords) sent 4, received 330

Ethernet0/2 of MST1 is designated forwarding
Port info             port id          128.3  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
69  cost     2000000
Designated bridge     address aabb.cc00.7000  priority  327
69  port id    128.3
Timers: message expires in 0 sec, forward delay 0, forward
transitions 1
Bpdus (MRecords) sent 325, received 0
```

```
##### MST2    vlans mapped:   20
Bridge        address aabb.cc00.7000  priority      32770
(32768 sysid 2)
Root          address aabb.cc00.5000  priority      32770
(32768 sysid 2)
              port    Et0/0           cost          2000000
rem hops 19

Ethernet0/0 of MST2 is root forwarding
Port info             port id          128.1  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
70  cost           0
Designated bridge     address aabb.cc00.5000  priority  327
70  port id    128.2
Timers: message expires in 5 sec, forward delay 0, forward
transitions 1
Bpdus (MRecords) sent 9, received 329

Ethernet0/1 of MST2 is alternate blocking
Port info             port id          128.2  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
70  cost     2000000
Designated bridge     address aabb.cc00.6000  priority  327
70  port id    128.2
Timers: message expires in 4 sec, forward delay 0, forward
transitions 0
Bpdus (MRecords) sent 4, received 330

Ethernet0/3 of MST2 is designated forwarding
Port info             port id          128.4  priority    1
28  cost     2000000
Designated root       address aabb.cc00.5000  priority  327
70  cost     2000000
Designated bridge     address aabb.cc00.7000  priority  327
70  port id    128.4
Timers: message expires in 0 sec, forward delay 0, forward
```

```
transitions 1
Bpdus (MRecords) sent 325, received 0

SW3#
```

Common Mistakes

Problem	Cause
STP loops	STP disabled
MST inconsistency	Different VLAN mappings
Root bridge unexpected	Incorrect priorities
Topology instability	Native VLAN mismatch
Convergence delay	Legacy STP mode

Enterprise Engineering Notes

- RSTP converges significantly faster than traditional STP.
- MST improves scalability by reducing STP instances.
- Root bridge placement should always be engineered intentionally.
- MST digest mismatches occur because of VLAN mapping or region-name mismatches.
- Changing only MST revision numbers does not create region mismatch.

Step 12 — Save Configurations

SW1

```
write memory
```

SW2

```
write memory
```

SW3

```
write memory
```

Step 13 — Backup Enterprise STP Documentation

Goal

Document enterprise spanning-tree architecture.

Suggested Documentation

```
Root Bridge:
 SW1

MST Region:
 ENTERPRISE

Instance Mapping:
 MST1 -> VLAN 10
 MST2 -> VLAN 20
```

What You Learned

In this lab you learned:

- enterprise STP operations,
- RSTP convergence behavior,

- MST region deployment,
- root bridge engineering,
- Layer 2 loop prevention,
- spanning-tree troubleshooting,
- and enterprise resiliency operations.

Verification Score

Task	Status
STP configured	☐
RSTP operational	☐
Root bridge verified	☐
MST configured	☐
MST consistency validated	☐
Connectivity verified	☐
Configurations saved	☐

Section B — Enterprise Troubleshooting Scenario

Incident Scenario

Users report intermittent connectivity and spanning-tree instability after a switch replacement.

Your task:

- investigate the enterprise STP failure,
- identify the root cause,
- and restore Layer 2 stability.

Step 1 — Introduce Failure

On SW3

```
enable
conf t

spanning-tree mst configuration
 name ENTERPRISE
 revision 1
 instance 1 vlan 10
 instance 2 vlan 20,99
 exit

end
```

Step 2 — Verify Failure Symptoms

Verification Commands

```
show spanning-tree mst configuration digest
show spanning-tree inconsistentports
```

Expected Result

SW3 should display a different MST digest and may appear as MST boundary.

Step 3 — Begin Investigation

Verification Commands

```
show spanning-tree mst configuration
```

Expected Result

VLAN mappings should appear inconsistent compared to SW1 and SW2.

Root Cause Analysis

SW3 contains incorrect MST VLAN-to-instance mapping.

This creates:

- MST region inconsistency,
- boundary port behavior,
- topology instability,
- and unpredictable Layer 2 forwarding.

Step 4 — Restore Enterprise Stability

Commands

```
enable
conf t

spanning-tree mst configuration
 name ENTERPRISE
 revision 1
 instance 1 vlan 10
 instance 2 vlan 20
 exit

end
```

Step 5 — Validate Recovery

Verification Commands

```
show spanning-tree mst configuration digest
```

Expected Result

All switches should display identical MST digests again.

Final Enterprise Validation

SW1

```
show spanning-tree root
```

SW2

```
show spanning-tree blockedports
```

SW3

```
show spanning-tree mst
```

Final Engineering Note

Enterprise STP troubleshooting should always follow a structured workflow:

1. Verify physical connectivity
2. Verify trunk operations
3. Verify root bridge placement
4. Verify STP mode consistency
5. Verify MST region mappings
6. Restore Layer 2 consistency
7. Validate topology convergence

End of Lab 06 — Enterprise STP, RSTP & MST Architecture