version 4


# IEWB-RS Technology Labs
# Bridging and Switching

**Brian Dennis, CCIE # 2210 (R&S / ISP Dial / Security / Service Provider)**
**Brian McGahan, CCIE# 8583 (R&S / Service Provider)**

## *Copyright Information*



## *Disclaimer*

The following publication, ***CCIE Routing and Switching Lab Workbook***, is designed to assist candidates in the preparation for Cisco Systems' CCIE Routing & Switching Lab exam. While every effort has been made to ensure that all material is as complete and accurate as possible, the enclosed material is presented on an "as is" basis. Neither the authors nor Internetwork Expert, Inc. assume any liability or responsibility to any person or entity with respect to loss or damages incurred from the information contained in this workbook.

This workbook was developed by Internetwork Expert, Inc. and is an original work of the aforementioned authors. Any similarities between material presented in this workbook and actual CCIE™ lab material is completely coincidental.

# Understanding Layer 2 Access Switchports

**Objective:** Configure layer 2 connectivity between R1 and R2 through the Catalyst 3550/3560


## Directions

- Configure R1's Ethernet interface with the IP address 10.0.0.1/8
- Configure R2's Ethernet interface with the IP address 10.0.0.2/8
- Configure the interface attached to R1 as a dynamic desirable port on the 3550/3560
- Configure the interface attached to R2 as a static access port on the 3550/3560
- Use the default VLAN for this connection

## Final Configuration

```
R1:
interface FastEthernet0/0
 ip address 10.0.0.1 255.0.0.0

R2:
interface FastEthernet0/0
 ip address 10.0.0.2 255.0.0.0

SW1:
interface FastEthernet0/1
 switchport mode dynamic desirable
!
interface FastEthernet0/2
 switchport mode access
```

## Verification

```
R1#ping 10.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/3/4 ms

SW1#show interface status

Port      Name      Status       Vlan       Duplex  Speed Type
Fa0/1               connected    1          a-half   a-10 10/100BaseTX
Fa0/2               connected    1          a-half   a-10 10/100BaseTX

SW1#show interface fa0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: static access
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
```

```
Trunking Native Mode VLAN: 1 (default)

SW1#show interface fa0/2 switchport
Name: Fa0/2
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
```

## 🕮 Recommended Reading

Configuring Interface Characteristics

# Understanding ISL Trunk Ports

**Objective:** Configure an ISL trunk link between SW1 and SW2


## Directions

- Configure an ISL trunk between SW1's interface Fa0/13 and SW2's interface Fa0/13
- The link should be auto-negotiated via DTP

## Final Configuration

```
SW1:
interface FastEthernet0/13
 switchport mode dynamic desirable

SW2:
interface FastEthernet0/13
 switchport mode dynamic desirable
```

## Verification

```
SW1#show interface status | include (Port|Fa0/13)
Port      Name       Status       Vlan       Duplex  Speed Type
Fa0/13               connected    trunk      a-full  a-100 10/100BaseTX

SW1#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      desirable    n-isl          trunking      1

<output omitted>
```

## 🕮 Recommended Reading

Configuring VLANs: Configuring VLAN Trunks

# Understanding 802.1q Trunk Ports

**Objective:** Configure an 802.1q trunk link between SW1 and SW2


## Directions

- Configure an 802.1q trunk between SW1's interface Fa0/13 and SW2's interface Fa0/13
- The trunk link should be auto-negotiated via DTP on SW1
- The trunk link should be manually defined on SW2

## Final Configuration

**SW1:**
```
interface FastEthernet0/13
 switchport mode dynamic desirable
```

**SW2:**
```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

## Verification

```
SW1#show interface status | include (Port|Fa0/13)
Port      Name          Status       Vlan    Duplex  Speed Type
Fa0/13                  connected    trunk   a-full  a-100 10/100BaseTX

SW1#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW2#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On

Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      desirable      n-802.1q       trunking      1

Port      Vlans allowed on trunk
```

```
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1

SW2#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on             802.1q         trunking      1

Port      Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1
```

## 🕮 Recommended Reading

Configuring VLANs: Configuring VLAN Trunks

# Understanding 802.1q Trunk Ports and the Native VLAN

**Objective:** Configure an 802.1q trunk link between SW1 and SW2 with VLAN 10 as the native VLAN


**Directions**

- Configure an 802.1q trunk between SW1's interface Fa0/13 and SW2's interface Fa0/13
- The trunk link should be manually defined on both SW1 and SW2
- Configure the Native VLAN for the trunk to be VLAN 10

## Final Configuration

**SW1:**

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 10
 switchport mode trunk
```

**SW2:**

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 10
 switchport mode trunk
```

## Verification

```
SW1#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 10 (Inactive)

SW2#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 10 (Inactive)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on             802.1q         trunking      10

Port        Vlans allowed on trunk
Fa0/13      1-4094
```

```
Port        Vlans allowed and active in management domain
Fa0/13      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1

SW2#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on             802.1q         trunking      10

Port        Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1
```

## 📖 Recommended Reading

Configuring VLANs: Configuring the Native VLAN for Untagged Traffic

# Configuring Trunk Ports without DTP

**Objective:** Configure an ISL trunk link between SW1 and SW2 without using DTP (Dynamic Trunking Protocol)


## Directions

- Disable DTP negotiation on SW1's interface Fa0/13 and SW2's interface Fa0/13
- Configure an ISL trunk between SW1's interface Fa0/13 and SW2's interface Fa0/13

## Final Configuration

**SW1:**
```
interface FastEthernet0/13
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
```

**SW2:**
```
interface FastEthernet0/13
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
```

## Verification

```
SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           isl            trunking      1

Port      Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1

SW1#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: isl
Operational Trunking Encapsulation: isl
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW2#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
```

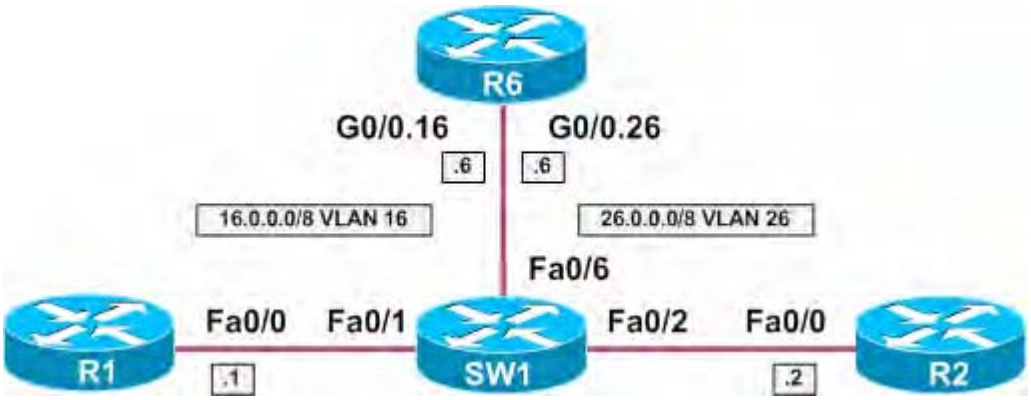
```
Port      Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1

SW2#show interface fa0/13 switchport
Name: Fa0/13
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: isl
Operational Trunking Encapsulation: isl
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
```

## 🕮 Recommended Reading

Configuring VLANs

# Router-on-a-Stick

**Objective:** Configure R6 to route traffic between VLAN 16 and VLAN 26 using 802.1q encapsulation




## Directions

- Configure R1's Ethernet interface with the IP address 16.0.0.1/8
- Configure R2's Ethernet interface with the IP address 26.0.0.2/8
- Configure VLAN 16 and VLAN 26 on SW1
- Assign VLAN 16 to interface Fa0/1 on SW1
- Assign VLAN 26 to interface Fa0/2 on SW1
- Configure interface Fa0/6 as an 802.1q trunk on SW1
- Configure subinterface G0/0.16 on R6
- Encapsulate VLAN 16 on this subinterface using 802.1q
- Configure subinterface G0/0.26 on R6
- Encapsulate VLAN 26 on this subinterface using 802.1q
- Configure R1 with a static route to reach VLAN 26 via R6
- Configure R2 with a static route to reach VLAN 16 via R6

## Final Configuration

**R1:**
```
interface FastEthernet0/0
 ip address 16.0.0.1 255.0.0.0
!
ip route 26.0.0.0 255.0.0.0 16.0.0.6
```

**R2:**
```
interface FastEthernet0/0
 ip address 26.0.0.2 255.0.0.0
!
ip route 16.0.0.0 255.0.0.0 26.0.0.6
```

**R6:**
```
interface GigabitEthernet0/0
 no ip address
!
interface GigabitEthernet0/0.16
 encapsulation dot1Q 16
 ip address 16.0.0.6 255.0.0.0
!
interface GigabitEthernet0/0.26
 encapsulation dot1Q 26
 ip address 26.0.0.6 255.0.0.0
```

**SW1:**

```
vlan 16,26
!
interface FastEthernet0/1
 switchport access vlan 16
!
interface FastEthernet0/2
 switchport access vlan 26
!
interface FastEthernet0/6
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

## Verification

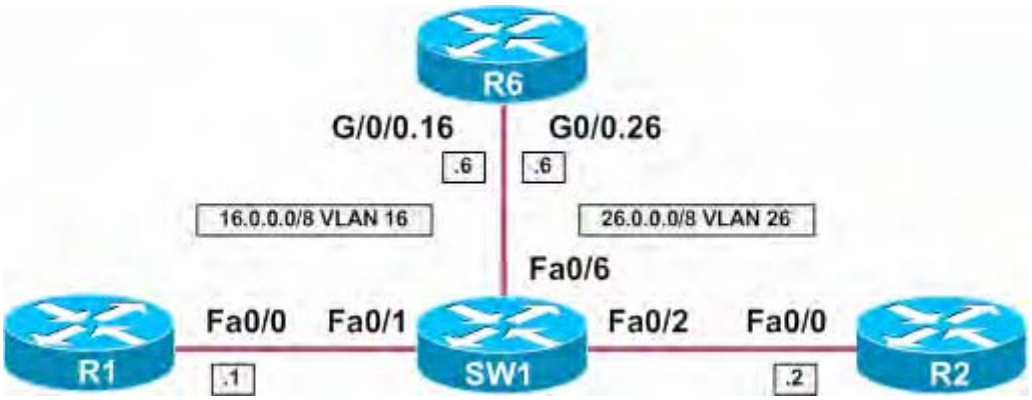
```
R1#ping 26.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 26.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/6       on           802.1q         trunking      1

Port      Vlans allowed on trunk
Fa0/6       1-4094

Port        Vlans allowed and active in management domain
Fa0/6       1,16,26

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/6       1,16,26

SW1#show interface fa0/6 switchport
Name: Fa0/6
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
```

## 🕮 Recommended Reading

Configuring Routing Between VLANs with IEEE 802.1Q Encapsulation

# Router-on-a-Stick and the Native VLAN

**Objective:** Configure R6 to route traffic between VLAN 16 and VLAN 26. VLAN 16 should be the 802.1q Native VLAN




## Directions

- Configure R1's Ethernet interface with the IP address 16.0.0.1/8
- Configure R2's Ethernet interface with the IP address 26.0.0.2/8
- Configure VLAN 16 and VLAN 26 on SW1
- Assign VLAN 16 to interface Fa0/1 on SW1
- Assign VLAN 26 to interface Fa0/2 on SW1
- Configure interface Fa0/6 as an 802.1q trunk on SW1
- Configure VLAN 16 as the Native VLAN on this trunk link.
- Configure subinterface G0/0.16 on R6
- Encapsulate VLAN 16 as the 802.1q Native VLAN on this subinterface
- Configure subinterface G0/0.26 on R6
- Encapsulate VLAN 26 on this subinterface using 802.1q
- Configure R1 with a static route to reach VLAN 26 via R6
- Configure R2 with a static route to reach VLAN 16 via R6

## Final Configuration

**R1:**
```
interface FastEthernet0/0
 ip address 16.0.0.1 255.0.0.0
!
ip route 26.0.0.0 255.0.0.0 16.0.0.6
```

**R2:**
```
interface FastEthernet0/0
 ip address 26.0.0.2 255.0.0.0
!
ip route 16.0.0.0 255.0.0.0 26.0.0.6
```

**R6:**
```
interface GigabitEthernet0/0
 no ip address
!
interface GigabitEthernet0/0.16
 encapsulation dot1Q 16 native
 ip address 16.0.0.6 255.0.0.0
!
```

```
interface GigabitEthernet0/0.26
 encapsulation dot1Q 26
 ip address 26.0.0.6 255.0.0.0
```

**SW1:**

```
vlan 16,26
!
interface FastEthernet0/1
 switchport access vlan 16
!
interface FastEthernet0/2
 switchport access vlan 26
!
interface FastEthernet0/6
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 16
 switchport mode trunk
```

## Verification

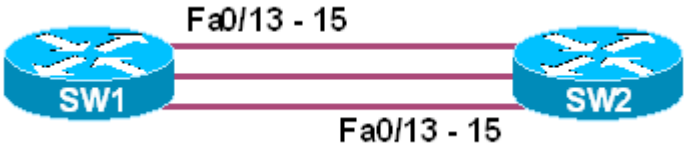
```
R1#ping 26.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 26.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/6       on           802.1q         trunking      16

Port      Vlans allowed on trunk
Fa0/6       1-4094

Port        Vlans allowed and active in management domain
Fa0/6       1,16,26

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/6       1,16,26

SW1#show interface fa0/6 switchport
Name: Fa0/6
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 16 (VLAN0016)
```

## 🕮 Recommended Reading

Configuring Routing Between VLANs with IEEE 802.1Q Encapsulation

## EtherChannel

**Objective:** Configure an EtherChannel between SW1 and SW2 on interfaces Fa0/13, Fa0/14, and Fa0/15 without using negotiation protocols




**Directions**

- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 in channel-group 1 with a mode of "on"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channel-group 1 with a mode of "on"

### Final Configuration

```
SW1:
interface FastEthernet0/13
 channel-group 1 mode on
!
interface FastEthernet0/14
 channel-group 1 mode on
!
interface FastEthernet0/15
 channel-group 1 mode on
!
interface Port-channel1
 switchport mode dynamic desirable

SW2:
interface FastEthernet0/13
 channel-group 1 mode on
!
interface FastEthernet0/14
 channel-group 1 mode on
!
interface FastEthernet0/15
 channel-group 1 mode on
!
interface Port-channel1
 switchport mode dynamic desirable
```

### Verification

```
SW1#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 - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
```

```
        d - default port

Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1       Po1(SU)           -          Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

SW1#show interface port-channel1 switchport
Name: Po1
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1          desirable      n-isl            trunking       1

Port      Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1

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

SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000a.f411.0e00
             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     000a.f411.0e00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po1              Desg FWD 9         128.65   P2p
```

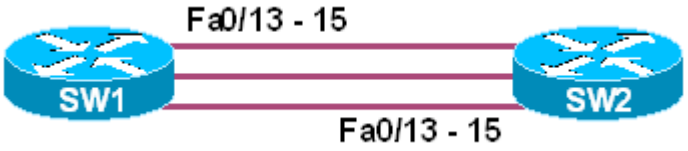
## 🕮 Recommended Reading

Configuring EtherChannels

## EtherChannel - PAgP

**Objective:** Configure an EtherChannel between SW1 and SW2 on interfaces Fa0/13, Fa0/14, and Fa0/15. Both SW1 and SW2 should initiate negotiation via PAgP




### Directions

- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 in channel-group 1 with a mode of "desirable"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channel-group 1 with a mode of "desirable"

### Final Configuration

**SW1:**
```
interface FastEthernet0/13
 channel-group 1 mode desirable
!
interface FastEthernet0/14
 channel-group 1 mode desirable
!
interface FastEthernet0/15
 channel-group 1 mode desirable
!
interface Port-channel1
 switchport mode dynamic desirable
```

**SW2:**
```
interface FastEthernet0/13
 channel-group 1 mode desirable
!
interface FastEthernet0/14
 channel-group 1 mode desirable
!
interface FastEthernet0/15
 channel-group 1 mode desirable
!
interface Port-channel1
 switchport mode dynamic desirable
```

### Verification

```
SW1#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 - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port

Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-------------------------------------
1      Po1(SU)         PAgP      Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

SW1#show interface port-channel1 switchport
Name: Po1
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1           desirable     n-isl             trunking      1

Port      Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1

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

SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000a.f411.0e00
             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     000a.f411.0e00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po1                Desg FWD 9          128.65     P2p
```

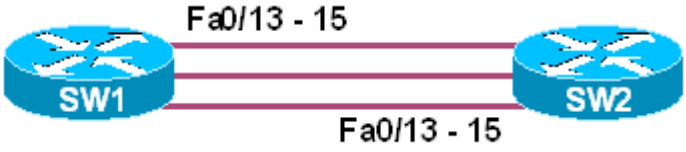
 

## 🕮 Recommended Reading

Configuring EtherChannels

**EtherChannel - PagP Auto**

**Objective:** Configure an EtherChannel between SW1 and SW2 on interfaces Fa0/13, Fa0/14, and Fa0/15. SW1 should initiate negotiation via PAgP, while SW2 should respond




**Directions**

- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 in channel-group 1 with a mode of "desirable"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channel-group 1 with a mode of "auto"

### Final Configuration

```
SW1:
interface FastEthernet0/13
 channel-group 1 mode desirable
!
interface FastEthernet0/14
 channel-group 1 mode desirable
!
interface FastEthernet0/15
 channel-group 1 mode desirable
!
interface Port-channel1
 switchport mode dynamic desirable

SW2:
interface FastEthernet0/13
 channel-group 1 mode auto
!
interface FastEthernet0/14
 channel-group 1 mode auto
!
interface FastEthernet0/15
 channel-group 1 mode auto
!
interface Port-channel1
 switchport mode dynamic desirable
```

## Verification

```
SW1#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 - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port

Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1       Po1(SU)           PAgP       Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

SW1#show interface port-channel1 switchport
Name: Po1
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1          desirable      n-isl            trunking       1

Port      Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1

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

SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000a.f411.0e00
             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     000a.f411.0e00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po1                Desg FWD 9           128.65    P2p
```

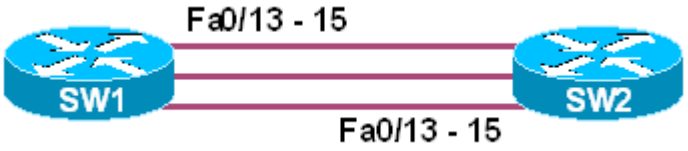
## 🕮 Recommended Reading

Configuring EtherChannels

## EtherChannel - LACP

**Objective:** Configure an EtherChannel between SW1 and SW2 on interfaces Fa0/13, Fa0/14, and Fa0/15. Both SW1 and SW2 should initiate negotiation via LACP




### Directions

- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 in channel-group 1 with a mode of "active"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channel-group 1 with a mode of "active"

### Final Configuration

**SW1:**

```
interface FastEthernet0/13
 channel-group 1 mode active
!
interface FastEthernet0/14
 channel-group 1 mode active
!
interface FastEthernet0/15
 channel-group 1 mode active
!
interface Port-channel1
 switchport mode dynamic desirable
```

**SW2:**

```
interface FastEthernet0/13
 channel-group 1 mode active
!
interface FastEthernet0/14
 channel-group 1 mode active
!
interface FastEthernet0/15
 channel-group 1 mode active
!
interface Port-channel1
 switchport mode dynamic desirable
```

## Verification

```
SW1#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 - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port

Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1       Po1(SU)           LACP       Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

SW1#show interface port-channel1 switchport
Name: Po1
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         desirable    n-isl          trunking      1

Port      Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1

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

SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000a.f411.0e00
             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     000a.f411.0e00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po1                Desg FWD 9           128.65    P2p
```

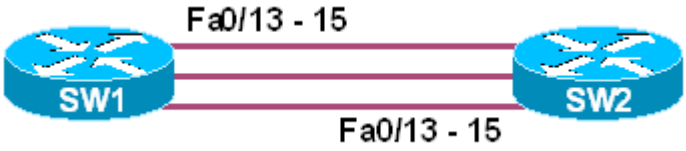
## 🕮 Recommended Reading

Configuring EtherChannels

## EtherChannel - LACP Passive

**Objective:** Configure an EtherChannel between SW1 and SW2 on interfaces Fa0/13, Fa0/14, and Fa0/15. SW1 should initiate negotiation via LACP, while SW2 should respond




### Directions

- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 in channel-group 1 with a mode of "active"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channel-group 1 with a mode of "passive"

### Final Configuration

**SW1:**

```
interface FastEthernet0/13
 channel-group 1 mode active
!
interface FastEthernet0/14
 channel-group 1 mode active
!
interface FastEthernet0/15
 channel-group 1 mode active
!
interface Port-channel1
 switchport mode dynamic desirable
```

**SW2:**

```
interface FastEthernet0/13
 channel-group 1 mode passive
!
interface FastEthernet0/14
 channel-group 1 mode passive
!
interface FastEthernet0/15
 channel-group 1 mode passive
!
interface Port-channel1
 switchport mode dynamic desirable
```

## Verification

```
SW1#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 - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port

Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1       Po1(SU)           LACP       Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

SW1#show interface port-channel1 switchport
Name: Po1
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: isl
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

SW1#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1          desirable      n-isl            trunking       1

Port      Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1

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

SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000a.f411.0e00
             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     000a.f411.0e00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Po1                Desg FWD 9           128.65     P2p
```

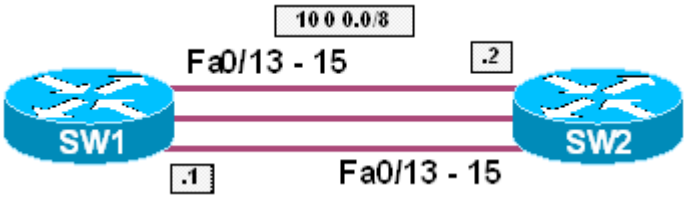
## 🕮 Recommended Reading

Configuring EtherChannels

# EtherChannel - Layer 3

**Objective:** Configure a layer 3 EtherChannel between SW1 and SW2 on interfaces Fa0/13, Fa0/14, and Fa0/15 without negotiation




## Directions

- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 as layer 3 interfaces
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 as layer 3 interfaces
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW1 in channel-group 1 with a mode of "on"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channel-group 1 with a mode of "on"
- Configure the port-channel 1 interface on SW1 and SW2 with the IP addresses 10.0.0.1/8 and 10.0.0.2/8 respectively

## Final Configuration

```
SW1:
interface FastEthernet0/13
 no switchport
 channel-group 1 mode on
!
interface FastEthernet0/14
 no switchport
 channel-group 1 mode on
!
interface FastEthernet0/15
 no switchport
 channel-group 1 mode on
!
interface Port-channel1
 no switchport
 ip address 10.0.0.1 255.0.0.0

SW2:
interface FastEthernet0/13
 no switchport
 channel-group 1 mode on
!
interface FastEthernet0/14
 no switchport
 channel-group 1 mode on
```

```
!
interface FastEthernet0/15
 no switchport
 channel-group 1 mode on
!
interface Port-channel1
 no switchport
 ip address 10.0.0.2 255.0.0.0
```

## Verification

```
SW1#ping 10.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms

SW1#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 - unsuitable for bundling
        U - in use      f - failed to allocate aggregator
        d - default port

Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1       Po1(RU)            -         Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

SW1#show interface port-channel 1 switchport
Name: Po1
Switchport: Disabled
```

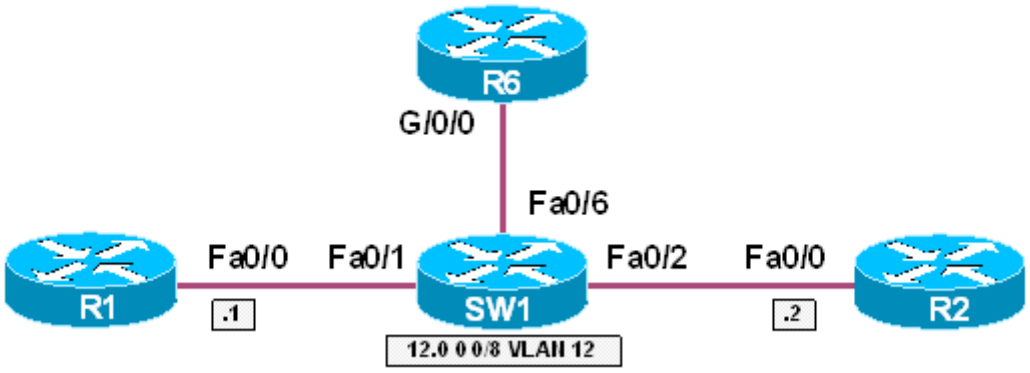
## 🕮 Recommended Reading

Configuring EtherChannels

## SPAN

**Objective:** Configure SPAN on SW1 to redirect all traffic from VLAN 12 to R6




### Directions

- Configure R1's Ethernet interface with the IP address 12.0.0.1/8
- Configure R2's Ethernet interface with the IP address 12.0.0.2/8
- Configure VLAN 12 on SW1
- Assign VLAN 12 to interfaces Fa0/1 and Fa0/2 on SW1
- Configure SW1 to redirect all traffic from VLAN 12 to port Fa0/6

### Final Configuration

**R1:**
```
interface FastEthernet0/0
 ip address 12.0.0.1 255.0.0.0
```

**R2:**
```
interface FastEthernet0/0
 ip address 12.0.0.2 255.0.0.0
```

**SW1:**
```
vlan 12
!
interface FastEthernet0/1
 switchport access vlan 12
!
interface FastEthernet0/2
 switchport access vlan 12
!
monitor session 1 source vlan 12 rx
monitor session 1 destination interface Fa0/6
```

## Verification

*Enable IP on R6's interface for debugging purposes:*

```
R6#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R6(config)#int g0/0
R6(config-if)#ip address 1.2.3.4 255.0.0.0
R6(config-if)#no shut
R6(config-if)#do debug ip packet
IP packet debugging is on
R6(config-if)#end
R6#

R1#ping 255.255.255.255

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 255.255.255.255, timeout is 2 seconds:

Rack1AS>6
[Resuming connection 6 to r6 ... ]
R6#
IP: s=12.0.0.1 (GigabitEthernet0/0), d=255.255.255.255, len 100, rcvd 2
    ICMP type=8, code=0
```

*R6 receives packets sent from R1 even though they're not in the same VLAN*

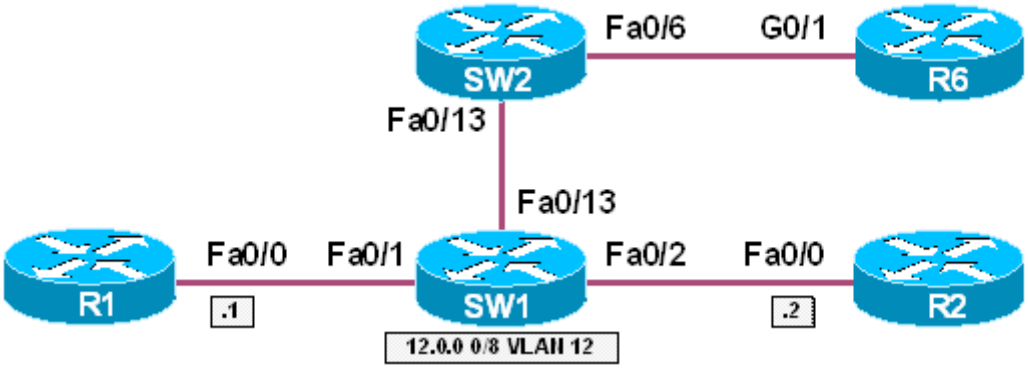
## 🕮 Recommended Reading

Configuring SPAN and RSPAN

# RSPAN

**Objective:** Configure RSPAN on SW1 and SW2 to redirect all traffic from VLAN 12 to R6. Use VLAN 100 as the RSPAN VLAN




## Directions

- Configure R1's Ethernet interface with the IP address 12.0.0.1/8
- Configure R2's Ethernet interface with the IP address 12.0.0.2/8
- Configure VLANs 12 on SW1
- Assign VLAN 12 to interfaces Fa0/1 and Fa0/2 on SW1
- Configure VLAN 100 on SW1 and SW2 as an RSPAN VLAN
- Configure SW1 to redirect all traffic from VLAN 12 the RSPAN VLAN 100
- Configure SW2 to redirect all traffic from the RSPAN VLAN 100 to R6

## Final Configuration

**R1:**
```
interface FastEthernet0/0
 ip address 12.0.0.1 255.0.0.0
```

**R2:**
```
interface FastEthernet0/0
 ip address 12.0.0.2 255.0.0.0
```

**SW1:**
```
vlan 12
!
vlan 100
 remote-span
!
interface FastEthernet0/1
 switchport access vlan 12
!
interface FastEthernet0/2
 switchport access vlan 12
!
monitor session 1 source vlan 12 rx
monitor session 1 destination remote vlan 100 reflector-port Gi0/1
```

```
SW2:
vlan 100
 remote-span
!
monitor session 1 destination interface Fa0/6
monitor session 1 source remote vlan 100
```

## Verification

```
SW1#show vlan  | begin SPAN
Remote SPAN VLANs
------------------------------------------------------------------------------
100

SW2#show vlan  | begin SPAN
Remote SPAN VLANs
------------------------------------------------------------------------------
100

SW1#show interface fa0/13 trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      desirable    n-isl          trunking      1

Port      Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1,12,100

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1,12,100
```

*Enable IP on R6's interface for debugging purposes:*

```
R6#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R6(config)#int g0/1
R6(config-if)#ip address 1.2.3.4 255.0.0.0
R6(config-if)#no shut
R6(config-if)#do debug ip packet
IP packet debugging is on
R6(config-if)#end

R1#ping 255.255.255.255

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 255.255.255.255, timeout is 2 seconds:

Rack1AS>6
[Resuming connection 6 to r6 ... ]

R6#
IP: s=12.0.0.1 (GigabitEthernet0/1), d=255.255.255.255, len 100, rcvd 2
IP: s=1.2.3.4 (local), d=12.0.0.1, len 100, unroutable
R6#
IP: s=12.0.0.1 (GigabitEthernet0/1), d=255.255.255.255, len 100, rcvd 2
IP: s=1.2.3.4 (local), d=12.0.0.1, len 100, unroutable
```

```
R6 receives packets sent from R1 even though they are not in the same VLAN
```

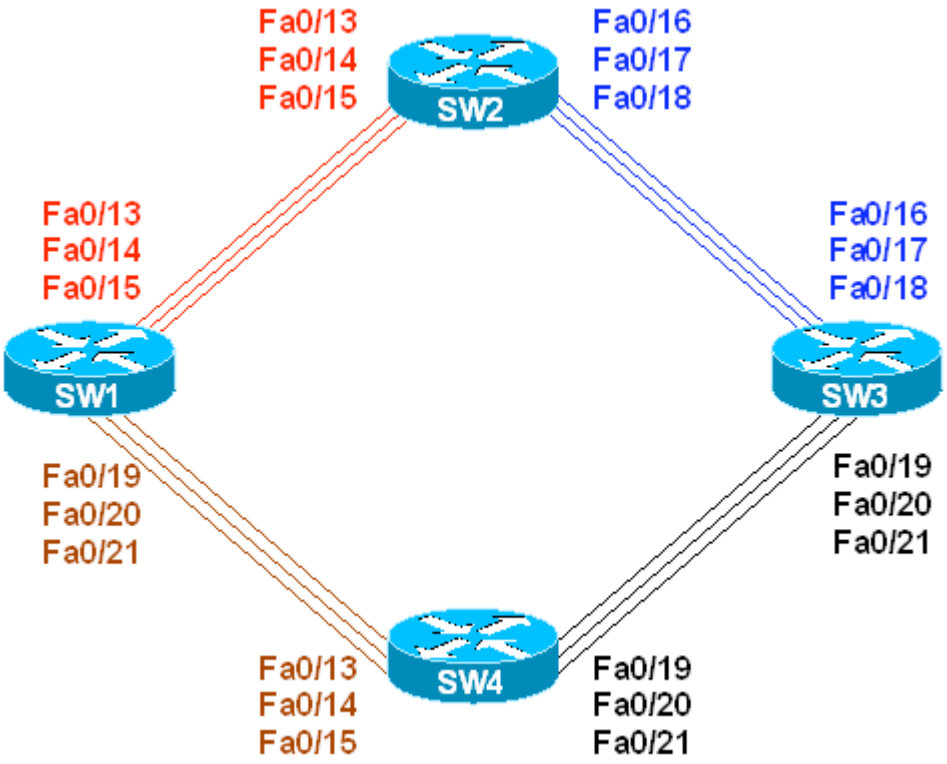
## Recommended Reading

Configuring SPAN and RSPAN

## Common Configuration for Ring Topology

**Objective:** Configure SW1-SW4 to form a ring topology




### Directions

- Shutdown ports Fa 0/16 – 18 on SW1
- Shutdown ports Fa 0/19 – 21 on SW2
- Configure trunk ports Fa 0/19 – 21 on SW1 to use 802.1q Encapsulation
- Configure trunk ports Fa 0/16 – 18 on SW2 to use 802.1q Encapsulation
- Configure all other trunk links to use ISL

### Final Configuration

```
SW1:
interface fastEthernet 0/16
 shutdown
!
interface fastEthernet 0/17
 shutdown
!
interface fastEthernet 0/18
 shutdown
!
!
interface fastEthernet 0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

```
!
interface fastEthernet 0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface fastEthernet 0/21
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
!
interface fastEthernet 0/13
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/14
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/15
 switchport trunk encapsulation isl
 switchport mode trunk
```

**SW2:**

```
interface fastEthernet 0/19
 shutdown
!
interface fastEthernet 0/20
 shutdown
!
interface fastEthernet 0/21
 shutdown
!
!
interface fastEthernet 0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface fastEthernet 0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface fastEthernet 0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
!
interface fastEthernet 0/13
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/14
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/15
 switchport trunk encapsulation isl
 switchport mode trunk
```

**SW3:**

```
interface fastEthernet 0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

```
!
interface fastEthernet 0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface fastEthernet 0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
!
interface fastEthernet 0/19
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/20
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/21
 switchport trunk encapsulation isl
 switchport mode trunk
```

**SW4:**

```
interface fastEthernet 0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface fastEthernet 0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface fastEthernet 0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
!
interface fastEthernet 0/19
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/20
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fastEthernet 0/21
 switchport trunk encapsulation isl
 switchport mode trunk
```

## Verification

```
SW1#show cdp neighbors | include SW
SW4              Fas 0/21          178              S I      WS-C3550-2Fas 0/15
SW4              Fas 0/20          178              S I      WS-C3550-2Fas 0/14
SW4              Fas 0/19          178              S I      WS-C3550-2Fas 0/13
SW2              Fas 0/13          168              S I      WS-C3560-2Fas 0/13
SW2              Fas 0/15          168              S I      WS-C3560-2Fas 0/15
SW2              Fas 0/14          168              S I      WS-C3560-2Fas 0/14
SW1#

SW2#show cdp neighbors | include SW
SW1              Fas 0/15          133              S I      WS-C3560-2Fas 0/15
SW1              Fas 0/14          133              S I      WS-C3560-2Fas 0/14
SW1              Fas 0/13          133              S I      WS-C3560-2Fas 0/13
SW3              Fas 0/18          158              S I      WS-C3550-2Fas 0/18
SW3              Fas 0/17          158              S I      WS-C3550-2Fas 0/17
SW3              Fas 0/16          158              S I      WS-C3550-2Fas 0/16
SW2#

SW3#show cdp neighbors | include SW
SW4              Fas 0/21          151              S I      WS-C3550-2Fas 0/21
SW4              Fas 0/20          151              S I      WS-C3550-2Fas 0/20
SW4              Fas 0/19          151              S I      WS-C3550-2Fas 0/19
SW2              Fas 0/18          141              S I      WS-C3560-2Fas 0/18
SW2              Fas 0/17          141              S I      WS-C3560-2Fas 0/17
SW2              Fas 0/16          141              S I      WS-C3560-2Fas 0/16
SW3#

SW4#show cdp neighbors | include SW
SW1              Fas 0/13          166              S I      WS-C3560-2Fas 0/19
SW1              Fas 0/15          166              S I      WS-C3560-2Fas 0/21
SW1              Fas 0/14          166              S I      WS-C3560-2Fas 0/20
SW3              Fas 0/21          131              S I      WS-C3550-2Fas 0/21
SW3              Fas 0/20          131              S I      WS-C3550-2Fas 0/20
SW3              Fas 0/19          131              S I      WS-C3550-2Fas 0/19
SW4#

SW1#show interfaces trunk | include trunking
Fa0/13      on           isl            trunking      1
Fa0/14      on           isl            trunking      1
Fa0/15      on           isl            trunking      1
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1
Fa0/21      on           802.1q         trunking      1

SW2#show interfaces trunk | include trunking
Fa0/13      on           isl            trunking      1
Fa0/14      on           isl            trunking      1
Fa0/15      on           isl            trunking      1
Fa0/16      on           802.1q         trunking      1
Fa0/17      on           802.1q         trunking      1
Fa0/18      on           802.1q         trunking      1

SW3#show interfaces trunk | include trunking
Fa0/16      on           802.1q         trunking      1
Fa0/17      on           802.1q         trunking      1
Fa0/18      on           802.1q         trunking      1
Fa0/19      on           isl            trunking      1
Fa0/20      on           isl            trunking      1
```

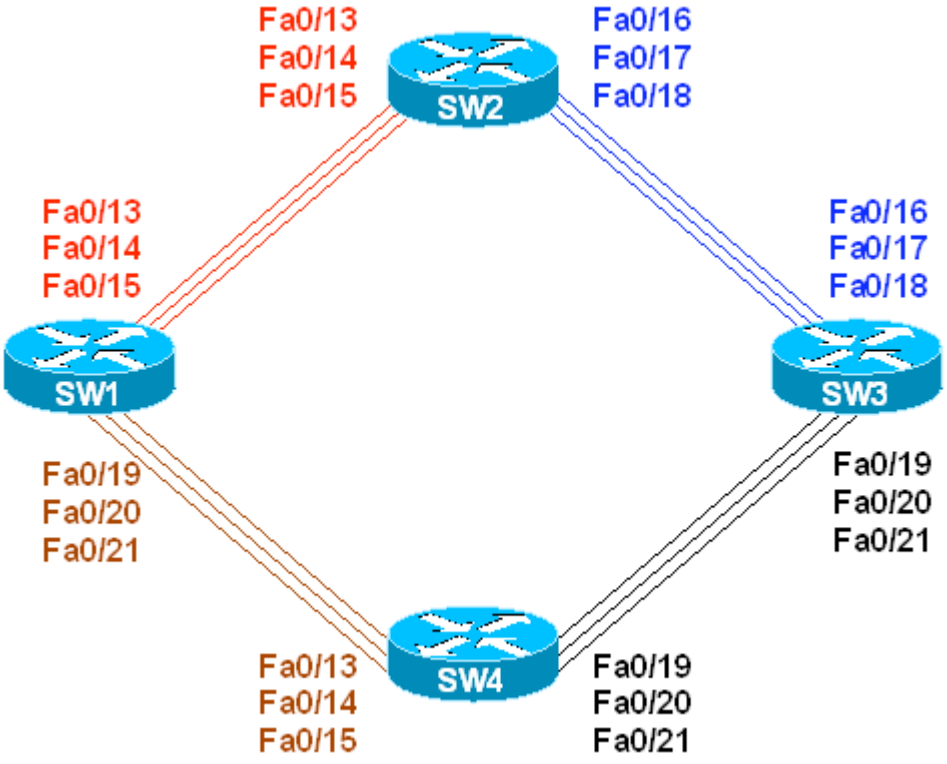
 

```
Fa0/21      on           isl            trunking      1
SW3#

SW4#show interfaces trunk | include trunking
Fa0/13      on           802.1q         trunking      1
Fa0/14      on           802.1q         trunking      1
Fa0/15      on           802.1q         trunking      1
Fa0/19      on           isl            trunking      1
Fa0/20      on           isl            trunking      1
Fa0/21      on           isl            trunking      1
```

## Using VTP to Propagate VLAN Information

**Objective:** Configure VTP and propagate VLAN information to all switches




### Directions

- Configure switches as per the 3550/3560 scenario "Common Configuration for Ring Topology"
- Configure all switches in the VTP domain CISCO
- Configure SW1 as VTP server, and SW2, SW3, SW4 as VTP clients
- Create VLANS 2-9 on SW1 and name them: VLAN_A, VLAN_B,… , VLAN_H

### Final Configuration

```
SW1:
vtp domain CISCO
vtp mode server

SW2:
vtp domain CISCO
vtp mode client

SW3:
vtp domain CISCO
vtp mode client
```

```
SW4:
vtp domain CISCO
vtp mode client

SW1:
vlan 2
 name VLAN_A
vlan 3
 name VLAN_B
vlan 4
 name VLAN_C
vlan 5
 name VLAN_D
vlan 6
 name VLAN_E
vlan 7
 name VLAN_F
vlan 8
 name VLAN_G
vlan 9
 name VLAN_H
```

## Verification

```
SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xF4 0xC9 0x03 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 192.10.1.103 at 3-1-93 00:52:26
Local updater ID is 192.10.1.103 on interface Vl1 (lowest numbered VLAN
interface found)
SW1#

SW2#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Client
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xF4 0xC9 0x03 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 192.10.1.103 at 3-1-93 00:52:26
SW2#

SW3#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Client
```

```
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xF4 0xC9 0x03 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 192.10.1.103 at 3-1-93 00:52:26
SW3#

SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Client
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xF4 0xC9 0x03 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 192.10.1.103 at 3-1-93 00:52:26

SW1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
2    VLAN_A                           active
3    VLAN_B                           active
4    VLAN_C                           active
5    VLAN_D                           active
6    VLAN_E                           active
7    VLAN_F                           active
8    VLAN_G                           active
9    VLAN_H                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
SW1#

SW2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
2    VLAN_A                           active
3    VLAN_B                           active
4    VLAN_C                           active
5    VLAN_D                           active
6    VLAN_E                           active
7    VLAN_F                           active
8    VLAN_G                           active
9    VLAN_H                           active
1002 fddi-default                     act/unsup
```

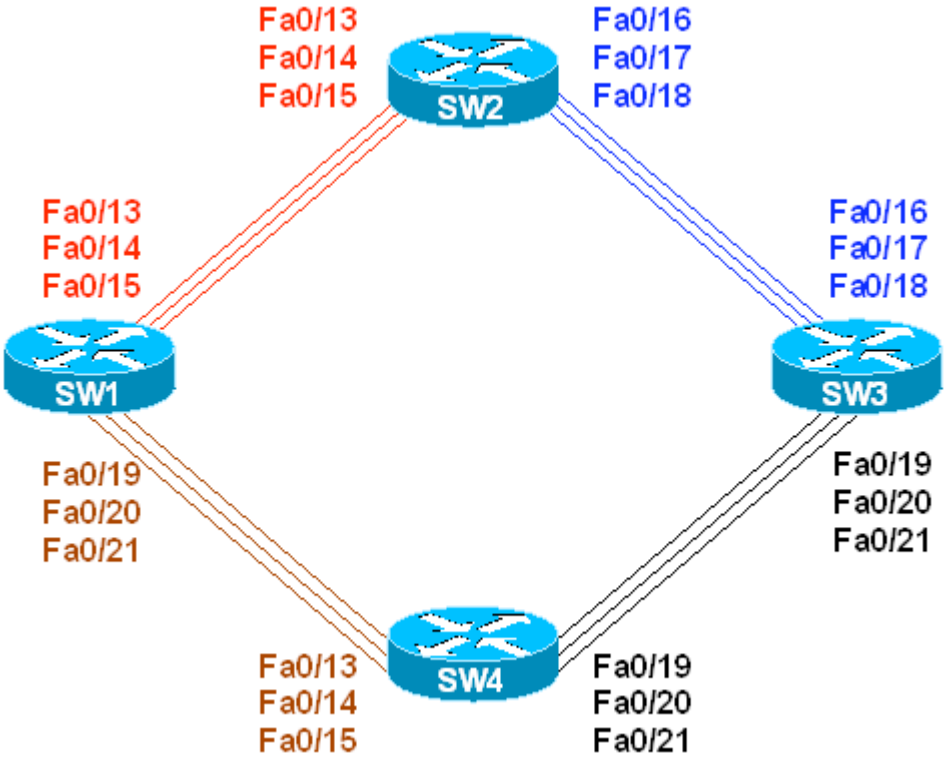
 

```
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
SW2#

SW3#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
2    VLAN_A                           active
3    VLAN_B                           active
4    VLAN_C                           active
5    VLAN_D                           active
6    VLAN_E                           active
7    VLAN_F                           active
8    VLAN_G                           active
9    VLAN_H                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
SW3#

SW4#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
2    VLAN_A                           active
3    VLAN_B                           active
4    VLAN_C                           active
5    VLAN_D                           active
6    VLAN_E                           active
7    VLAN_F                           active
8    VLAN_G                           active
9    VLAN_H                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

## Mixing VTP Modes in Single Topology

**Objective:** Configure switches to transparently relay VTP information




### Directions

- Configure devices as per the 3550/3560 scenario "Common Configuration for Ring Topology"
- Configure SW1 as VTP server and SW3 as VTP client in VTP domain CISCO
- Configure SW2 and SW4 in VTP transparent mode and VTP domain CISCO
- Create VLANs 2-9 on SW1 and name them VLAN_A,…,VLAN_H

### Final Configuration

```
SW1:
vtp mode server
vtp domain CISCO

SW3:
vtp mode client
vtp domain CISCO

SW2 & SW4:
vtp mode transparent
vtp domain CISCO
```

**SW1:**

```
vlan 2
 name VLAN_A
vlan 3
 name VLAN_B
vlan 4
 name VLAN_C
vlan 5
 name VLAN_D
vlan 6
 name VLAN_E
vlan 7
 name VLAN_F
vlan 8
 name VLAN_G
vlan 9
 name VLAN_H
```

## Verification

```
SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xC5 0xE6 0x11 0x9A 0xEE 0x01 0x52 0xC2
Configuration last modified by 192.10.1.114 at 3-1-93 00:21:20
Local updater ID is 192.10.1.114 on interface Vl1 (lowest numbered VLAN
interface found)

SW1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
2    VLAN_A                           active
3    VLAN_B                           active
4    VLAN_C                           active
5    VLAN_D                           active
6    VLAN_E                           active
7    VLAN_F                           active
8    VLAN_G                           active
9    VLAN_H                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

```
SW3#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Client
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xC5 0xE6 0x11 0x9A 0xEE 0x01 0x52 0xC2
Configuration last modified by 192.10.1.114 at 3-1-93 00:21:20

SW3#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
2    VLAN_A                           active
3    VLAN_B                           active
4    VLAN_C                           active
5    VLAN_D                           active
6    VLAN_E                           active
7    VLAN_F                           active
8    VLAN_G                           active
9    VLAN_H                           active
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup

SW2#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 5
VTP Operating Mode              : Transparent
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x57 0xCD 0x40 0x65 0x63 0x59 0x47 0xBD
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

SW2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

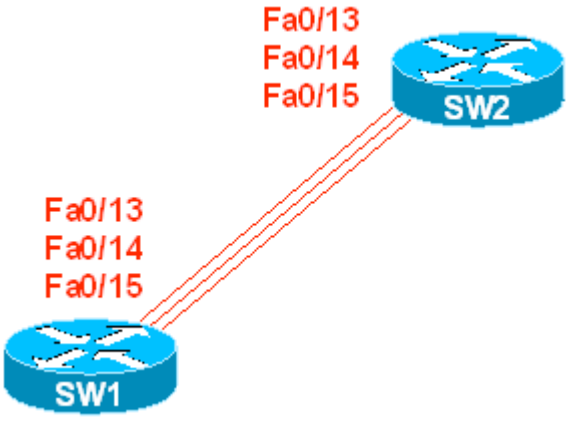
 

```
SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 5
VTP Operating Mode              : Transparent
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x57 0xCD 0x40 0x65 0x63 0x59 0x47 0xBD
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

SW4#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

## VTP Domain Name and DTP Operations

**Objective:** Configure DTP on a trunk link with VTP in transparent mode




### Directions

- Configure SW1 and SW2 in VTP transparent mode
- Configure interfaces Fa 0/13 – 15 on SW1 and SW2 in DTP desirable mode
- Configure VTP domain-name CISCO1 on SW1 and VTP domain-name CISCO2 on SW2

### Final Configuration

```
SW1:
vtp mode transparent
vtp domain CISCO1

interface Fa 0/13
switchport mode dynamic desirable
!
interface Fa 0/14
switchport mode dynamic desirable
!
interface Fa 0/15
switchport mode dynamic desirable

SW2:
vtp mode transparent
vtp domain CISCO2

interface Fa 0/13
switchport mode dynamic desirable
!
interface Fa 0/14
switchport mode dynamic desirable
!
interface Fa 0/15
switchport mode dynamic desirable
```

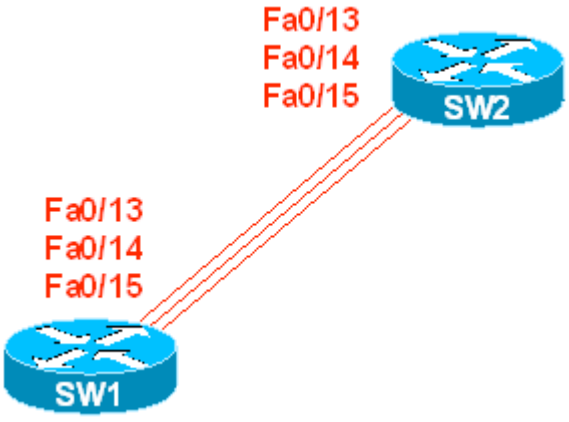
## Verification

```
SW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.

SW1(config)#int range fastEthernet 0/13 - 15
SW1(config-if-range)#shutdown
SW1(config-if-range)#

%LINK-5-CHANGED: Interface FastEthernet0/13, changed state to administratively
down
%LINK-5-CHANGED: Interface FastEthernet0/14, changed state to administratively
down
%LINK-5-CHANGED: Interface FastEthernet0/15, changed state to administratively
down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/13, changed state
to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/14, changed state
to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/15, changed state
to down

SW1(config-if-range)#no shutdown
SW1(config-if-range)#

%DTP-5-DOMAINMISMATCH: Unable to perform trunk negotiation on port Fa0/13
because of VTP domain mismatch.
%DTP-5-DOMAINMISMATCH: Unable to perform trunk negotiation on port Fa0/14
because of VTP domain mismatch.
%DTP-5-DOMAINMISMATCH: Unable to perform trunk negotiation on port Fa0/15
because of VTP domain mismatch.

SW1(config-if-range)#
%LINK-3-UPDOWN: Interface FastEthernet0/13, changed state to up
%LINK-3-UPDOWN: Interface FastEthernet0/14, changed state to up
%LINK-3-UPDOWN: Interface FastEthernet0/15, changed state to up

SW1(config-if-range)#do show interface fa0/13 switching
Name: Fa0/13
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: static access
Administrative Trunking Encapsulation: isl
Operational Trunking Encapsulation: native
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)

<output omitted>
```

## VLAN Load-Balancing using the allowed VLAN list

**Objective:** Assign groups of VLANs to different trunk links




### Directions

- Configure switches as per the 3550/3560 scenario “Using VTP to propagate VLAN information”
- Configure SW1 and SW2 to permit even VLANs in range 2-9 only on Fa 0/13 ports.
- Configure SW1 and SW2 to permit odd VLANs in range 2-9 only on Fa 0/14 ports.
- Use port Fa 0/15 on both SW1 and SW2 for VLAN 1 only

### Final Configuration

```
SW1 & SW2:
interface Fa 0/13
 switchport trunk allowed vlan 2,4,6,8
!
interface Fa 0/14
 switchport trunk allowed vlan 3,5,7,9
!
interface Fa 0/15
 switchport trunk allowed vlan 1
```

### Verification

```
SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           isl            trunking      1
Fa0/14      on           isl            trunking      1
Fa0/15      on           isl            trunking      1
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1
Fa0/21      on           802.1q         trunking      1

Port        Vlans allowed on trunk
```

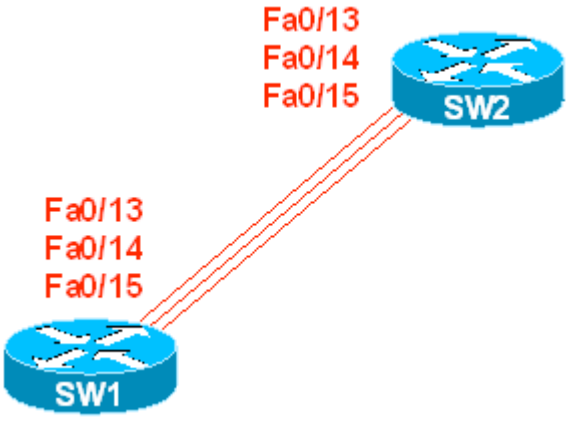
 

```
Fa0/13      2,4,6,8
Fa0/14      3,5,7,9
Fa0/15      1
Fa0/19      1-4094
Fa0/20      1-4094
Fa0/21      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      2,4,6,8
Fa0/14      3,5,7,9
Fa0/15      1
Fa0/19      1-9
Fa0/20      1-9

Port        Vlans allowed and active in management domain
Fa0/21      1-9

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      2,4,6,8
Fa0/14      3,5,7,9
Fa0/15      1
Fa0/19      1-9
Fa0/20      none
Fa0/21      none
SW1#

SW2#show inter trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           isl            trunking      1
Fa0/14      on           isl            trunking      1
Fa0/15      on           isl            trunking      1
Fa0/16      on           802.1q         trunking      1
Fa0/17      on           802.1q         trunking      1
Fa0/18      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/13      2,4,6,8
Fa0/14      3,5,7,9
Fa0/15      1
Fa0/16      1-4094
Fa0/17      1-4094
Fa0/18      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      2,4,6,8
Fa0/14      3,5,7,9
Fa0/15      1
Fa0/16      1-9
Fa0/17      1-9

Port        Vlans allowed and active in management domain
Fa0/18      1-9

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      none
Fa0/14      none
Fa0/15      none
Fa0/16      1-9
Fa0/17      none
Fa0/18      none
```

## Basic STP Features: Tuning Timers

**Objective:** Configure STP to minimize port-delay in while in the listening/learning states




### Directions

- Configure SW1 to be STP Root for VLAN 1 (you may effectively change timers only on STP Root Bridge)
- Change Forward-Delay timer to minimum value

### Final Configuration

**SW1:**

```
spanning-tree vlan 1 root primary
spanning-tree vlan 1 forward-time 4
```

### Verification

```
SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    24577
              Address     0016.4639.d580
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay  4 sec

  Bridge ID   Priority    24577  (priority 24576 sys-id-ext 1)
              Address     0016.4639.d580
              Hello Time   2 sec  Max Age 20 sec  Forward Delay  4 sec
              Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.4    P2p
Fa0/3            Desg FWD 100       128.5    Shr
Fa0/4            Desg FWD 100       128.6    Shr
Fa0/5            Desg FWD 100       128.7    Shr
```

```
Fa0/6            Desg FWD 19        128.8    P2p
Fa0/13           Desg FWD 19        128.15   P2p
Fa0/14           Desg FWD 19        128.16   P2p
Fa0/15           Desg FWD 19        128.17   P2p

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

Fa0/24           Desg FWD 100       128.26   Shr

SW2#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0016.4639.d580
             Cost        19
             Port        15 (FastEthernet0/13)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay  4 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/3            Desg FWD 100       128.5    Shr
Fa0/4            Desg FWD 100       128.6    Shr
Fa0/5            Desg FWD 100       128.7    Shr
Fa0/6            Desg FWD 19        128.8    P2p
Fa0/12           Desg FWD 19        128.14   P2p
Fa0/13           Root FWD 19        128.15   P2p
Fa0/14           Altn BLK 19        128.16   P2p

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

Fa0/15           Altn BLK 19        128.17   P2p

SW2#debug spanning-tree events
Spanning Tree event debugging is on
SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#int fa 0/3
SW2(config-if)#shut
01:00:02: STP: VLAN0001 sent Topology Change Notice on Fa0/13
01:00:04: %LINK-5-CHANGED: Interface FastEthernet0/3, changed state to
administratively down
01:00:05: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3,
changed state to down
SW2(config-if)#no shut
01:00:10: %LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to down
01:00:10: set portid: VLAN0001 Fa0/3: new port id 8005
01:00:10: STP: VLAN0001 Fa0/3 -> listening
01:00:12: %LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to up
01:00:13: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3,
changed state to up
01:00:14: STP: VLAN0001 Fa0/3 -> learning
01:00:18: STP: VLAN0001 sent Topology Change Notice on Fa0/13
01:00:18: STP: VLAN0001 Fa0/3 -> forwarding
```

## Basic STP Features: PortFast

**Objective:** Enable access-ports to bypass STP learning/listening states

### Directions

- Configure Fa 0/1 – Fa 0/6 on SW1 to operate in STP portfast mode

### Final Configuration

**SW1:**

```
interface range Fa 0/1 – 6
 spanning-tree portfast
```

### Verification

```
SW1#show spanning-tree interface fa0/1 detail
 Port 3 (FastEthernet0/1) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.3.
   Designated root has priority 32769, address 000e.83b2.9480
   Designated bridge has priority 32769, address 0016.4639.d580
   Designated port id is 128.3, designated path cost 19
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   The port is in the portfast mode
   Link type is point-to-point by default
   BPDU: sent 2517, received 0

Note that BPDUs are still sent on PortFast Link:

SW1#show spanning-tree interface fa0/1 detail
 Port 3 (FastEthernet0/1) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.3.
   Designated root has priority 32769, address 000e.83b2.9480
   Designated bridge has priority 32769, address 0016.4639.d580
   Designated port id is 128.3, designated path cost 19
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   The port is in the portfast mode
   Link type is point-to-point by default
   BPDU: sent 2553, received 0

SW1#debug spanning-tree events
Spanning Tree event debugging is on

SW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW1(config)#interface fa0/1
SW1(config-if)#shutdown

01:44:09: %LINK-5-CHANGED: Interface FastEthernet0/1, changed state to
administratively down
01:44:10: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
```

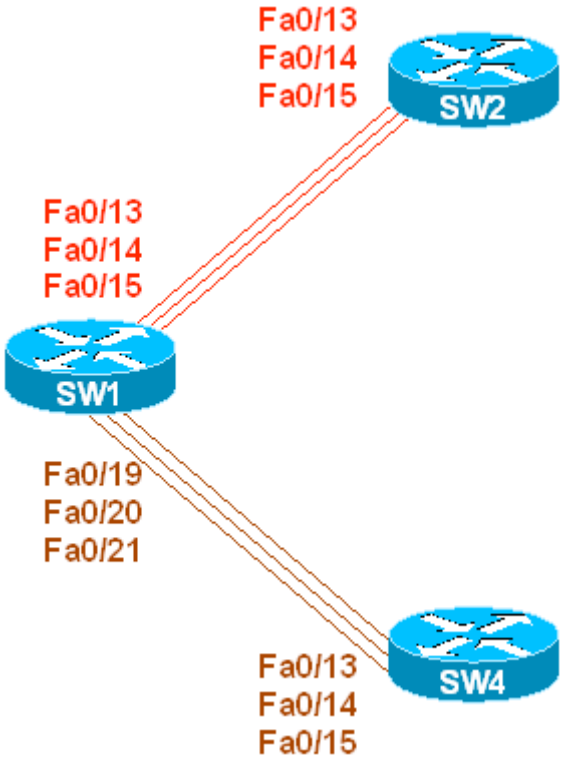
 

```
SW1(config-if)#no shutdown
SW1(config-if)#
01:44:22: set portid: VLAN0001 Fa0/1: new port id 8003
01:44:22: STP: VLAN0001 Fa0/1 ->jump to forwarding from blocking

01:44:22: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
01:44:23: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up

SW1(config-if)#shut
SW1(config-if)#
01:45:10: %LINK-5-CHANGED: Interface FastEthernet0/1, changed state to
administratively down
01:45:11: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down

SW1(config-if)#no spanning-tree portf
SW1(config-if)#no shutdown

01:45:27: set portid: VLAN0001 Fa0/1: new port id 8003
01:45:27: STP: VLAN0001 Fa0/1 -> listening
01:45:27: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
01:45:28: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up

01:45:42: STP: VLAN0001 Fa0/1 -> learning
01:45:57: STP: VLAN0001 sent Topology Change Notice on Fa0/19
01:45:57: STP: VLAN0001 Fa0/1 -> forwarding
```

## Basic STP Features: UplinkFast

**Objective:** Configure SW1 to quickly switch it's root port in the event of an uplink failure




### Directions

- Configure devices as per the 3550/3560 scenario "Common Configuration for Ring Topology"
- Shutdown ports Fa 0/14 – 15 and Fa 0/20 – 21 on SW1
- Enable spanning-tree uplinkfast feature on SW1

### Final Configuration

```
SW1:
interface Fa 0/14
 shutdown
!
interface Fa 0/15
 shutdown
!
interface Fa 0/20
 shutdown
!
interface Fa 0/21
 shutdown
!
spanning-tree uplinkfast
```

## Verification

```
SW1#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000e.83b2.9480
             Cost        3019
             Port        21 (FastEthernet0/19)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    49153  (priority 49152 sys-id-ext 1)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300
  Uplinkfast enabled

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 3019      128.3    P2p
Fa0/2            Desg FWD 3019      128.4    P2p
Fa0/3            Desg FWD 3100      128.5    Shr
Fa0/4            Desg FWD 3100      128.6    Shr
Fa0/5            Desg FWD 3100      128.7    Shr
Fa0/6            Desg FWD 3019      128.8    P2p

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

Fa0/13           Altn BLK 3019      128.15   P2p
Fa0/19           Root FWD 3019      128.21   P2p
Fa0/24           Desg FWD 3100      128.26   Shr

SW1#debug spanning-tree uplinkfast
Spanning Tree uplinkfast debugging is on

SW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW1(config)#int fa 0/19
SW1(config-if)#shut
SW1(config-if)#

00:13:29: STP FAST: UPLINKFAST: make_forwarding on VLAN0001 FastEthernet0/13
root port id new: 128.15 prev: 128.21

00:13:29: %SPANTREE_FAST-7-PORT_FWD_UPLINK: VLAN0001 FastEthernet0/13 moved to
Forwarding (UplinkFast).
00:13:29: STP FAST: make_forwarding: via UPLINKFAST: NOT: port FastEthernet0/1
VLAN0001 is: uplink enabled new root FastEthernet0/13 (not me)prev root
exists(8015/FastEthernet0/19) cur state forwarding role uplink

00:13:29: STP FAST: make_forwarding: via UPLINKFAST: NOT: port FastEthernet0/2
VLAN0001 is: uplink enabled new root FastEthernet0/13 (not me)prev root
exists(8015/FastEthernet0/19) cur state forwarding role uplink

<output omitted>

00:13:31: %LINK-5-CHANGED: Interface FastEthernet0/19, changed state to
administratively down
```

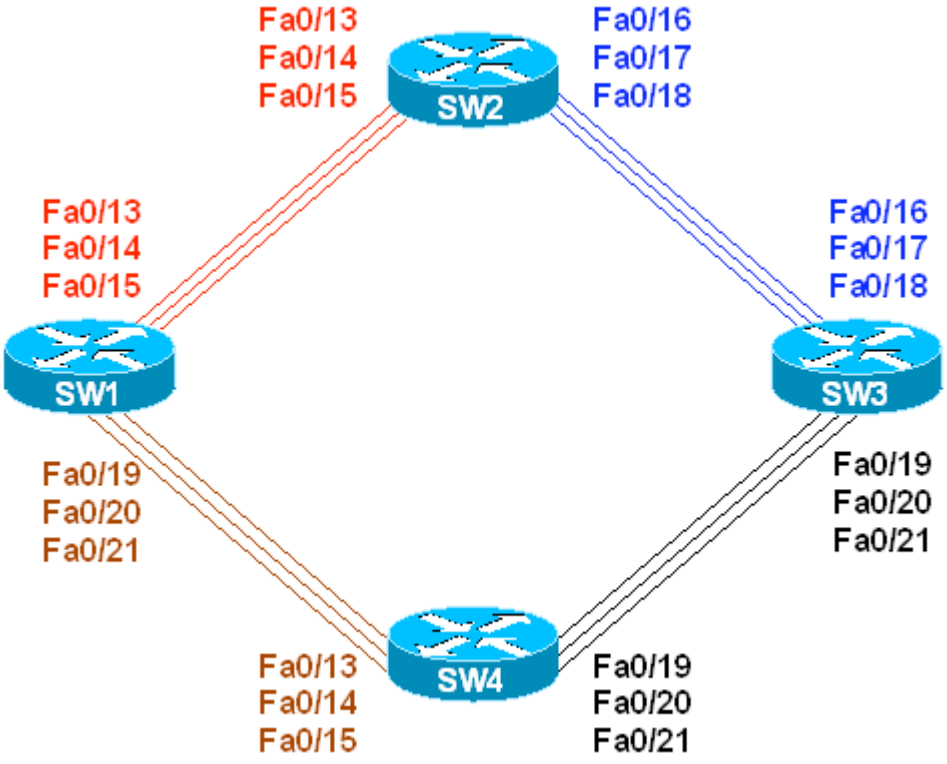
 

```
00:13:32: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/19,
changed state to down

SW1(config-if)#^Z

SW1#show spanning vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     000e.83b2.9480
             Cost        3057
             Port        15 (FastEthernet0/13)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    49153  (priority 49152 sys-id-ext 1)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15
  Uplinkfast enabled

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 3019      128.3    P2p
Fa0/2            Desg FWD 3019      128.4    P2p
Fa0/3            Desg FWD 3100      128.5    Shr
Fa0/4            Desg FWD 3100      128.6    Shr
Fa0/5            Desg FWD 3100      128.7    Shr
Fa0/6            Desg FWD 3019      128.8    P2p

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

Fa0/13           Root FWD 3019      128.15   P2p
Fa0/24           Desg FWD 3100      128.26   Shr
```

## Basic STP Features: BackboneFast

**Objective:** Configure the switches to accelerate the indirect link failure discovery




### Directions

- Configure switches as per the 3550/3560 scenario "Common Configuration for Ring Topology"
- Shutdown ports Fa 0/14 – 15 on SW1
- Shutdown ports Fa 0/20 – 21 on SW1
- Shutdown ports Fa 0/20 – 21 on SW3
- Shutdown ports Fa 0/17 – 18 on SW3
- Configure SW1 to be the root for VLAN 1
- Enable the backbonefast feature on all switches

### Final Configuration

```
SW1:
spanning-tree backbonefast
spanning-tree vlan 1 root primary
!
interface Fa 0/14
 shutdown
!
interface Fa 0/15
 shutdown
!
interface Fa 0/20
```

```
 shutdown
!
interface Fa 0/21
 shutdown

SW3:
interface Fa 0/17
 shutdown
!
interface Fa 0/18
 shutdown
!
interface Fa 0/20
 shutdown
!
interface Fa 0/21
 shutdown

SW2, SW3 & SW4:
spanning-tree backbonefast
```

## Verification

*Before the link failure:*

```
SW3#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0016.4639.d580
             Cost        38
             Port        19 (FastEthernet0/19)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0015.63c8.8800
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Altn BLK 19        128.16   P2p
Fa0/19           Root FWD 19        128.19   P2p
```

*After:*

```
SW3#debug spanning-tree events
Spanning Tree event debugging is on
SW3#debug spanning-tree backbonefast detail
Spanning Tree backbonefast detail debugging is on

SW1(config)#interface fastEthernet 0/19
SW1(config-if)#shutdown

SW3#
17:10:02: STP: VLAN0001 heard root 32769-000e.83b2.9480 on Fa0/19
17:10:02: STP FAST: received inferior BPDU on VLAN0001 FastEthernet0/19.
17:10:02: STP FAST: sending RLQ request PDU on VLAN0001(1) Fa0/16 Vlan1
17:10:02: STP FAST: Received RLQ response PDU on VLAN0001 FastEthernet0/16.
```

```
17:10:02: STP FAST: received RLQ response PDU was expected on VLAN0001

FastEthernet0/16 - resp root id 24577-0016.4639.d580 .
17:10:02: STP FAST: received_rlq_bpdu on VLAN0001 FastEthernet0/19 - making
FastEthernet0/19 a designated port

17:10:02: STP: VLAN0001 new root port Fa0/16, cost 38
17:10:02: STP: VLAN0001 Fa0/16 -> listening
17:10:03: STP: VLAN0001 Topology Change rcvd on Fa0/19
17:10:03: STP: VLAN0001 sent Topology Change Notice on Fa0/16
17:10:17: STP: VLAN0001 Fa0/16 -> learning
17:10:32: STP: VLAN0001 sent Topology Change Notice on Fa0/16
17:10:32: STP: VLAN0001 Fa0/16 -> forwarding

SW3#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0016.4639.d580
             Cost        38
             Port        16 (FastEthernet0/16)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0015.63c8.8800
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Root FWD 19        128.16   P2p
Fa0/19           Desg FWD 19        128.19   P2p
```

## Basic STP Features: BPDU Guard

**Objective:** Block an access-port if a BPDU is received

### Directions

- Enable BPDU guard on port Fa 0/1 of SW1

### Final Configuration

**SW1:**
```
interface fa 0/1
 spanning-tree bpduguard enable
```

### Verification

```
SW1#show spanning-tree interface fa0/1 detail
 Port 3 (FastEthernet0/1) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.3.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 24577, address 0016.4639.d580
   Designated port id is 128.3, 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 guard is enabled
   BPDU: sent 2176, received 0

BPDUs are still sent to this port:

SW1#show spanning-tree interface fa0/1 detail
 Port 3 (FastEthernet0/1) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.3.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 24577, address 0016.4639.d580
   Designated port id is 128.3, 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 guard is enabled
   BPDU: sent 2180, received 0

Configure R1 to produce BPDUs:

SW1#debug spanning-tree events

R1:
interface Fa 0/0
 no shutdown
 no ip address
 bridge-group 1
 exit
!
bridge 1 protocol ieee
bridge 1 priority 4096
```

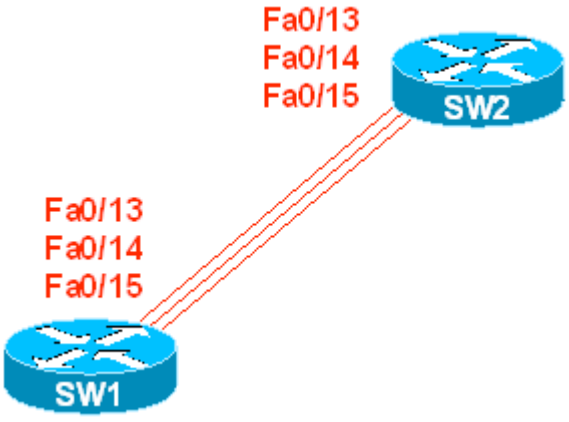
 

```
SW1#
%SPANTREE-2-BLOCK_BPDUGUARD: Received BPDU on port FastEthernet0/1 with BPDU
Guard enabled. Disabling port.
%PM-4-ERR_DISABLE: bpduguard error detected on Fa0/1, putting Fa0/1 in err-
disable state
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state
to down
%LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down

SW1#show interfaces fa0/1
FastEthernet0/1 is down, line protocol is down (err-disabled)
  Hardware is Fast Ethernet, address is 0016.4639.d583 (bia 0016.4639.d583)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed, media type is 10/100BaseTX
  input flow-control is off, output flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:03:06, output 00:03:07, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 453000 bits/sec, 151 packets/sec
     560 packets input, 63434 bytes, 0 no buffer
     Received 88 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 87 multicast, 0 pause input
     0 input packets with dribble condition detected
     17931976 packets output, 1847207828 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
```

## Basic STP Features: Root Guard

**Objective:** Configure SW1 to protect itself from another switch from becoming the STP root




### Directions

- Configure devices as per the 3550/3560 scenario “Common Configuration for Ring Topology”
- Configure SW1 to be root for VLAN1
- Configure root guard feature on SW1 interfaces Fa 0/13 – 15

### Final Configuration

```
SW1:
spanning-tree vlan 1 root primary
!
interface Fa 0/13
 no shut
 spanning-tree guard root
!
interface Fa 0/14
 no shut
 spanning-tree guard root
!
interface Fa 0/15
 no shut
 spanning-tree guard root
```

## Verification

```
SW1#show spanning-tree interface fa0/13 detail
 Port 15 (FastEthernet0/13) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.15.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 24577, address 0016.4639.d580
   Designated port id is 128.15, designated path cost 0
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 2
   Link type is point-to-point by default
   Root guard is enabled on the port
   BPDU: sent 2353, received 483

SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#spanning-tree vlan 1 priority 4096

SW1#show spanning-tree interface fa0/13 detail
 Port 15 (FastEthernet0/13) of VLAN0001 is broken  (Root Inconsistent)
   Port path cost 19, Port priority 128, Port Identifier 128.15.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 24577, address 0016.4639.d580
   Designated port id is 128.15, designated path cost 0
   Timers: message age 2, forward delay 0, hold 0
   Number of transitions to forwarding state: 2
   Link type is point-to-point by default
   Root guard is enabled on the port
   BPDU: sent 2413, received 502

SW1#show spanning-tree inconsistentports

Name                 Interface              Inconsistency
-------------------- ---------------------- ------------------
VLAN0001             FastEthernet0/13       Root Inconsistent
VLAN0001             FastEthernet0/14       Root Inconsistent
VLAN0001             FastEthernet0/15       Root Inconsistent

Number of inconsistent ports (segments) in the system : 3
```

## Basic STP Features: BPDU Filter

**Objective:** Configure the switch to stop BPDU exchanges on access ports

### Directions

- Configure SW1 as per the 3550/3560 scenario “Basic STP Features: PortFast”
- Enable BPDU filter on interface Fa 0/1 of SW1

### Final Configuration

```
SW1:
interface Fa 0/1
 spanning-tree bpdufilter enable
```

### Verification

```
SW1#clear spanning-tree counters interface fa0/1

Configure R1 to produce BPDUs:

R1:
interface Fa 0/0
 no shutdown
 no ip address
 bridge-group 1
 exit
!
bridge 1 protocol ieee
bridge 1 priority 4096

SW1#show spanning-tree interface fa0/1 detail
 Port 3 (FastEthernet0/1) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.3.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 24577, address 0016.4639.d580
   Designated port id is 128.3, designated path cost 0
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   The port is in the portfast mode
   Link type is point-to-point by default
   Bpdu filter is enabled
   BPDU: sent 0, received 0

Disable BPDU Filter on Fa 0/1:

SW1#debug spanning-tree events

SW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW1(config)#interface fa0/1
SW1(config-if)#no spanning-tree bpdufilter

STP: VLAN0001 heard root  4096-0004.27b5.2f60 on Fa0/1
     supersedes 24577-0016.4639.d580
```

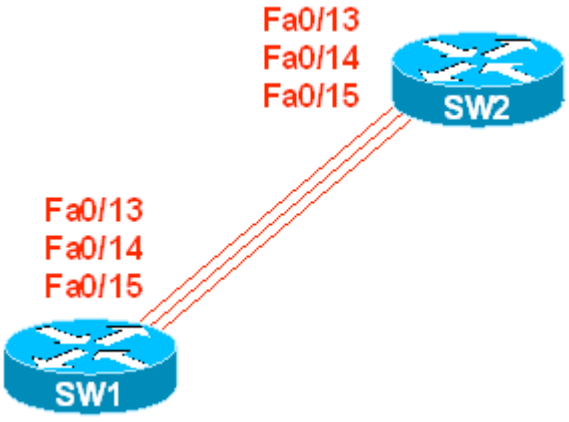
 

```
STP: VLAN0001 new root is 4096, 0004.27b5.2f60 on port Fa0/1, cost 19
STP: VLAN0001 sent Topology Change Notice on Fa0/1

SW1(config-if)#^Z
SW1#

Port is no longer in port-fast state:

SW1#show spanning-tree interface fa0/1 detail
 Port 3 (FastEthernet0/1) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.3.
   Designated root has priority 4096, address 0004.27b5.2f60
   Designated bridge has priority 4096, address 0004.27b5.2f60
   Designated port id is 128.3, designated path cost 0
   Timers: message age 2, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   Link type is point-to-point by default
   BPDU: sent 2, received 14
```

## Basic STP Features: Loopguard

**Objective:** Configure the switch to protect against sudden loss of BPDUs




### Directions

- Configure Fa 0/13 – 15 interfaces on SW1 & SW2 to be ISL trunks
- Configure SW1 to be the root of the spanning-tree for VLAN 1
- Enable loopguard on interfaces Fa 0/13 – 15 of SW1 (root & alternate ports)

### Final Configuration

**SW1 & SW2:**

```
interface fa 0/13
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fa 0/14
 switchport trunk encapsulation isl
 switchport mode trunk
!
interface fa 0/15
 switchport trunk encapsulation isl
 switchport mode trunk
```

**SW1:**

```
spanning-tree vlan 1 root primary
```

**SW2:**

```
interface fa 0/13
 spanning-tree guard loop
!
interface fa 0/14
 spanning-tree guard loop
!
interface fa 0/15
 spanning-tree guard loop
```

## Verification

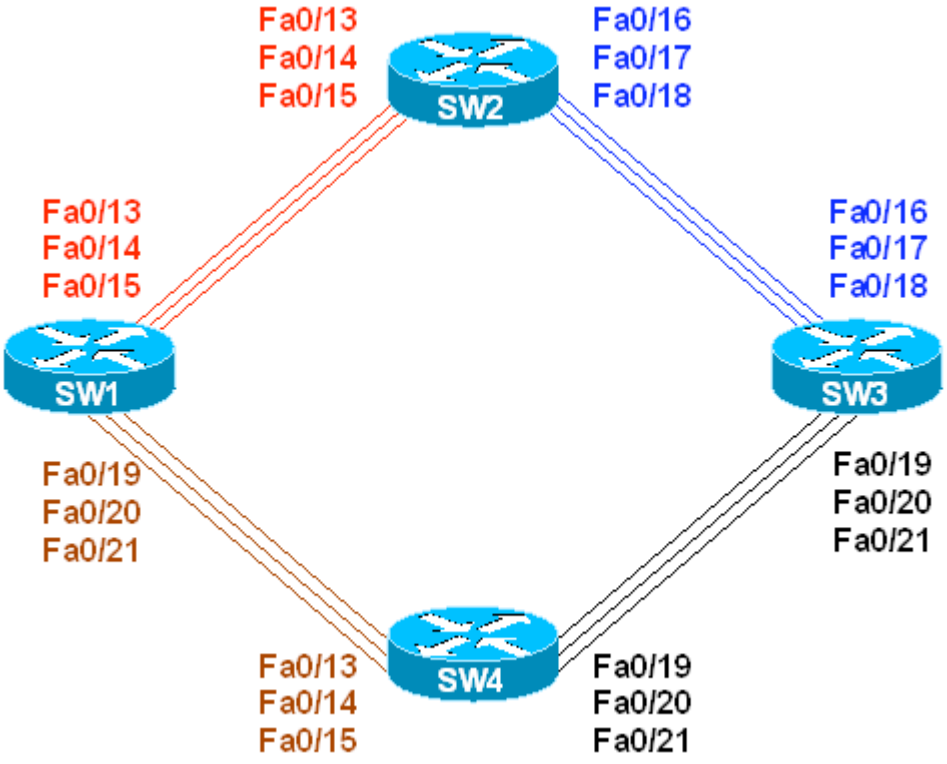
```
SW2#show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0016.4639.d580
             Cost        19
             Port        15 (FastEthernet0/13)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- -------------------------
Fa0/3            Desg FWD 100       128.5    Shr
Fa0/4            Desg FWD 100       128.6    Shr
Fa0/5            Desg FWD 100       128.7    Shr
Fa0/6            Desg FWD 19        128.8    P2p
Fa0/12           Desg FWD 19        128.14   P2p
Fa0/13           Root FWD 19        128.15   P2p
Fa0/14           Altn BLK 19        128.16   P2p

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

Fa0/15           Altn BLK 19        128.17   P2p
Fa0/16           Desg FWD 19        128.18   P2p
Fa0/24           Desg FWD 100       128.26   Shr

SW2#show spanning-tree interface fa0/13 detail
 Port 15 (FastEthernet0/13) of VLAN0001 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.15.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 24577, address 0016.4639.d580
   Designated port id is 128.15, designated path cost 0
   Timers: message age 1, forward delay 0, hold 0
   Number of transitions to forwarding state: 2
   Link type is point-to-point by default
   Loop guard is enabled on the port
   BPDU: sent 2031, received 3027

Filter BPDUs on port fa0/13 of SW1:

SW1(config)#interface fa0/13
SW1(config-if)#spanning-tree bpdufilter enable

SW2#show spanning-tree interface fa0/13 detail
 Port 15 (FastEthernet0/13) of VLAN0001 is broken  (Loop Inconsistent)
   Port path cost 19, Port priority 128, Port Identifier 128.15.
   Designated root has priority 24577, address 0016.4639.d580
   Designated bridge has priority 32769, address 0016.9d31.8380
   Designated port id is 128.15, designated path cost 19
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 2
   Link type is point-to-point by default
   Loop guard is enabled on the port
```

```
   BPDU: sent 2032, received 3059

SW2#show spanning-tree inconsistentports

Name                 Interface              Inconsistency
-------------------- ---------------------- ------------------
VLAN0001             FastEthernet0/13       Loop Inconsistent
```

## Configuring MSTP

**Objective:** Configure three MSTP instances in a single MSTP region




### Directions

- Configure devices as per the 3550/3560 scenario "Using VTP to Propagate VLAN Information"
- Configure instance "1" and map VLANs 1-3 to it
- Configure instance "2" and map VLANs 4-6 to it
- Configure instance "3" and map VLANs 7-9 to it
- Make SW1 the STP root for instances 1-3

### Final Configuration

**SW1 – SW4:**

```
spanning-tree mode mst
!
spanning-tree mst configuration
 instance 1 vlan 1-3
 instance 2 vlan 4-6
 instance 3 vlan 7-9
```

**SW1:**

```
spanning-tree mst 1-3 root primary
```

### Verification

```
SW1#show spanning-tree mst 1

##### MST1    vlans mapped:   1-3
Bridge        address 0016.4639.d580  priority      24577 (24576 sysid 1)
Root          this switch for MST1

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 200000    128.4    P2p
Fa0/3            Desg FWD 2000000   128.5    Shr
Fa0/4            Desg FWD 2000000   128.6    Shr
Fa0/5            Desg FWD 2000000   128.7    Shr
Fa0/6            Desg FWD 200000    128.8    P2p
Fa0/13           Desg FWD 200000    128.15   P2p
Fa0/14           Desg FWD 200000    128.16   P2p
Fa0/15           Desg FWD 200000    128.17   P2p
Fa0/19           Desg FWD 200000    128.21   P2p
Fa0/20           Desg FWD 200000    128.22   P2p
Fa0/21           Desg FWD 200000    128.23   P2p
Fa0/24           Desg FWD 2000000   128.26   Shr

SW1#show spanning-tree mst 2

##### MST2    vlans mapped:   4-6
Bridge        address 0016.4639.d580  priority      24578 (24576 sysid 2)
Root          this switch for MST2

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Desg FWD 200000    128.15   P2p
Fa0/14           Desg FWD 200000    128.16   P2p
Fa0/15           Desg FWD 200000    128.17   P2p
Fa0/19           Desg FWD 200000    128.21   P2p
Fa0/20           Desg FWD 200000    128.22   P2p
Fa0/21           Desg FWD 200000    128.23   P2p

SW1#show spanning-tree mst 3

##### MST3    vlans mapped:   7-9
Bridge        address 0016.4639.d580  priority      24579 (24576 sysid 3)
Root          this switch for MST3

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Desg FWD 200000    128.15   P2p
Fa0/14           Desg FWD 200000    128.16   P2p
Fa0/15           Desg FWD 200000    128.17   P2p
Fa0/19           Desg FWD 200000    128.21   P2p
Fa0/20           Desg FWD 200000    128.22   P2p
Fa0/21           Desg FWD 200000    128.23   P2p

SW2#show spanning-tree mst 1

##### MST1    vlans mapped:   1-3
Bridge        address 0016.9d31.8380  priority      32769 (32768 sysid 1)
Root          address 0016.4639.d580  priority      24577 (24576 sysid 1)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/3            Desg FWD 2000000   128.5    Shr
```

```
Fa0/4            Desg FWD 2000000   128.6    Shr
Fa0/5            Desg FWD 2000000   128.7    Shr
Fa0/6            Desg FWD 200000    128.8    P2p
Fa0/12           Desg FWD 200000    128.14   P2p
Fa0/13           Root FWD 200000    128.15   P2p
Fa0/14           Altn BLK 200000    128.16   P2p
Fa0/15           Altn BLK 200000    128.17   P2p
Fa0/16           Desg FWD 200000    128.18   P2p
Fa0/17           Desg FWD 200000    128.19   P2p
Fa0/18           Desg FWD 200000    128.20   P2p
Fa0/24           Desg FWD 2000000   128.26   Shr

SW2#show spanning-tree mst 2

##### MST2    vlans mapped:   4-6
Bridge        address 0016.9d31.8380  priority      32770 (32768 sysid 2)
Root          address 0016.4639.d580  priority      24578 (24576 sysid 2)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.15   P2p
Fa0/14           Altn BLK 200000    128.16   P2p
Fa0/15           Altn BLK 200000    128.17   P2p
Fa0/16           Desg FWD 200000    128.18   P2p
Fa0/17           Desg FWD 200000    128.19   P2p
Fa0/18           Desg FWD 200000    128.20   P2p

SW2#show spanning-tree mst 3

##### MST3    vlans mapped:   7-9
Bridge        address 0016.9d31.8380  priority      32771 (32768 sysid 3)
Root          address 0016.4639.d580  priority      24579 (24576 sysid 3)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.15   P2p
Fa0/14           Altn BLK 200000    128.16   P2p
Fa0/15           Altn BLK 200000    128.17   P2p
Fa0/16           Desg FWD 200000    128.18   P2p
Fa0/17           Desg FWD 200000    128.19   P2p
Fa0/18           Desg FWD 200000    128.20   P2p

SW3#show spanning-tree mst 1

##### MST1    vlans mapped:   1-3
Bridge        address 0015.63c8.8800  priority      32769 (32768 sysid 1)
Root          address 0016.4639.d580  priority      24577 (24576 sysid 1)
              port    Fa0/19          cost          400000    rem hops 18

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Altn BLK 200000    128.16   P2p
Fa0/17           Altn BLK 200000    128.17   P2p
Fa0/18           Altn BLK 200000    128.18   P2p
Fa0/19           Root FWD 200000    128.19   P2p
Fa0/20           Altn BLK 200000    128.20   P2p
Fa0/21           Altn BLK 200000    128.21   P2p

SW3#show spanning-tree mst 2
```

```
##### MST2    vlans mapped:   4-6
Bridge        address 0015.63c8.8800  priority      32770 (32768 sysid 2)
Root          address 0016.4639.d580  priority      24578 (24576 sysid 2)
              port    Fa0/19          cost          400000    rem hops 18

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Altn BLK 200000    128.16   P2p
Fa0/17           Altn BLK 200000    128.17   P2p
Fa0/18           Altn BLK 200000    128.18   P2p
Fa0/19           Root FWD 200000    128.19   P2p
Fa0/20           Altn BLK 200000    128.20   P2p
Fa0/21           Altn BLK 200000    128.21   P2p

SW3#show spanning-tree mst 3

##### MST3    vlans mapped:   7-9
Bridge        address 0015.63c8.8800  priority      32771 (32768 sysid 3)
Root          address 0016.4639.d580  priority      24579 (24576 sysid 3)
              port    Fa0/19          cost          400000    rem hops 18

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Altn BLK 200000    128.16   P2p
Fa0/17           Altn BLK 200000    128.17   P2p
Fa0/18           Altn BLK 200000    128.18   P2p
Fa0/19           Root FWD 200000    128.19   P2p
Fa0/20           Altn BLK 200000    128.20   P2p
Fa0/21           Altn BLK 200000    128.21   P2p

SW4#show spanning-tree mst 1

##### MST1    vlans mapped:   1-3
Bridge        address 000e.83b2.9480  priority      32769 (32768 sysid 1)
Root          address 0016.4639.d580  priority      24577 (24576 sysid 1)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.13   P2p
Fa0/14           Altn BLK 200000    128.14   P2p
Fa0/15           Altn BLK 200000    128.15   P2p
Fa0/19           Desg FWD 200000    128.19   P2p
Fa0/20           Desg FWD 200000    128.20   P2p
Fa0/21           Desg FWD 200000    128.21   P2p

SW4#show spanning-tree mst 2

##### MST2    vlans mapped:   4-6
Bridge        address 000e.83b2.9480  priority      32770 (32768 sysid 2)
Root          address 0016.4639.d580  priority      24578 (24576 sysid 2)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.13   P2p
Fa0/14           Altn BLK 200000    128.14   P2p
Fa0/15           Altn BLK 200000    128.15   P2p
Fa0/19           Desg FWD 200000    128.19   P2p
Fa0/20           Desg FWD 200000    128.20   P2p
Fa0/21           Desg FWD 200000    128.21   P2p
```

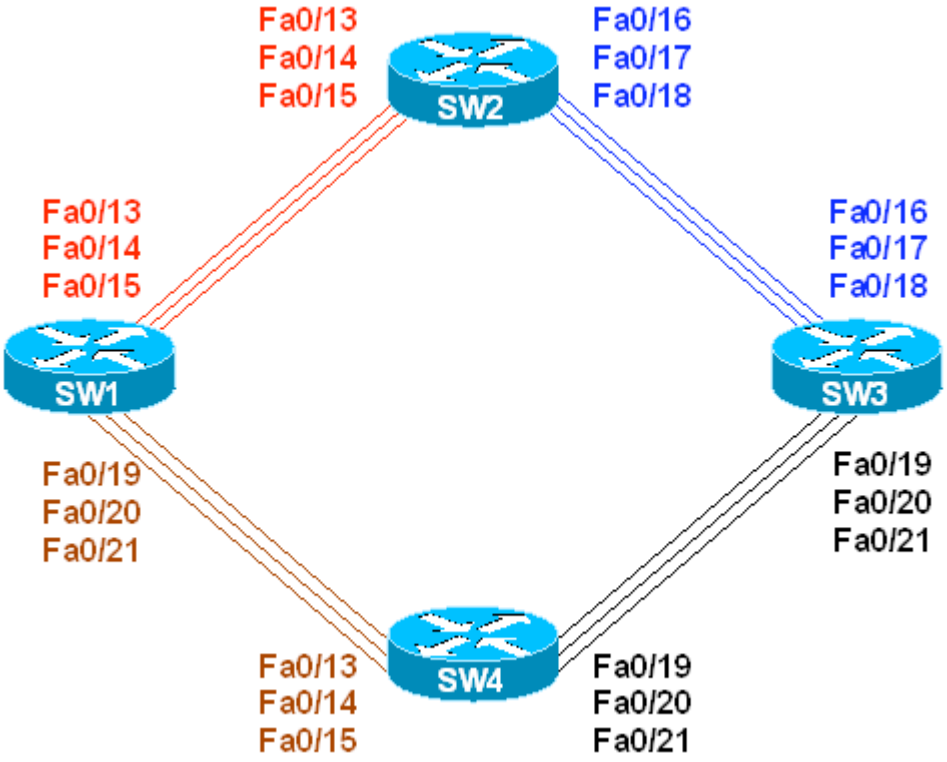
 

```
SW4#show spanning-tree mst 3

##### MST3    vlans mapped:   7-9
Bridge        address 000e.83b2.9480  priority      32771 (32768 sysid 3)
Root          address 0016.4639.d580  priority      24579 (24576 sysid 3)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.13   P2p
Fa0/14           Altn BLK 200000    128.14   P2p
Fa0/15           Altn BLK 200000    128.15   P2p
Fa0/19           Desg FWD 200000    128.19   P2p
Fa0/20           Desg FWD 200000    128.20   P2p
Fa0/21           Desg FWD 200000    128.21   P2p
```

## Load-Balancing with STP Root Bridge Placement

**Objective:** Configure different STP roots for VLAN groups to allow for shared traffic load




### Directions

- Configure devices per the 3550/3560 scenario: "Using VTP to Propagate VLAN Information"
- Configure SW1 to be STP root for even-numbered VLANs (first group) SW2 should backup SW1
- Configure SW3 to be STP root for odd-numbered VLANs (second group) SW4 should backup SW3

### Final Configuration

**SW1:**
```
spanning-tree vlan 2,4,6,8 root primary
```

**SW2:**
```
spanning-tree vlan 2,4,6,8 root secondary
```

**SW3:**
```
spanning-tree vlan 1,3,5,7,9 root primary
```

**SW4:**
```
spanning-tree vlan 1,3,5,7,9 root secondary
```

## Verification

*Confirm that SW1 is root for even-numbered VLANs:*

```
SW1#show spanning-tree vlan 2 summary
Switch is in pvst mode
Root bridge for VLAN0002 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0002                     0         0        0          6          6

SW1#show spanning-tree vlan 4 summary
Switch is in pvst mode
Root bridge for VLAN0004 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0004                     0         0        0          6          6

SW1#show spanning-tree vlan 6 summary
Switch is in pvst mode
Root bridge for VLAN0006 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0006                     0         0        0          6          6

SW1#show spanning-tree vlan 8 summary
Switch is in pvst mode
Root bridge for VLAN0008 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0008                     0         0        0          6          6
```

*Confirm that SW3 is root for odd-numbered VLANs:*

```
SW3#show spanning-tree vlan 1 summary
Switch is in pvst mode
Root bridge for VLAN0001 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0001                     0         0        0          6          6

SW3#show spanning-tree vlan 3 summary
Switch is in pvst mode
Root bridge for VLAN0003 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0003                     0         0        0          6          6

SW3#show spanning-tree vlan 5 summary
Switch is in pvst mode
Root bridge for VLAN0005 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short
```

```
Name                 Blocking Listening Learning Forwarding STP Active
-------------------- -------- --------- -------- ---------- ----------
VLAN0005                    0         0        0          6          6

SW3#show spanning-tree vlan 7 summary
Switch is in pvst mode
Root bridge for VLAN0007 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                 Blocking Listening Learning Forwarding STP Active
-------------------- -------- --------- -------- ---------- ----------
VLAN0007                    0         0        0          6          6

SW3#show spanning-tree vlan 9 summary
Switch is in pvst mode
Root bridge for VLAN0009 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                 Blocking Listening Learning Forwarding STP Active
-------------------- -------- --------- -------- ---------- ----------
VLAN0009                    0         0        0          6          6
```

*Confirm, that due to secondary root-switch placement, even-numbered VLANs now travel over SW1-SW2-SW3 half of the ring. For instance, with VLAN2:*

```
SW3#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        38
             Port        16 (FastEthernet0/16)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32770  (priority 32768 sys-id-ext 2)
             Address     0015.63c8.8800
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Root FWD 19        128.16   P2p
Fa0/17           Altn BLK 19        128.17   P2p
Fa0/18           Altn BLK 19        128.18   P2p
Fa0/19           Altn BLK 19        128.19   P2p
```

```
Fa0/20           Altn BLK 19        128.20   P2p
Fa0/21           Altn BLK 19        128.21   P2p


SW2#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        19
             Port        15 (FastEthernet0/13)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28674  (priority 28672 sys-id-ext 2)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 19        128.15   P2p
Fa0/14           Altn BLK 19        128.16   P2p
Fa0/15           Altn BLK 19        128.17   P2p
Fa0/16           Desg FWD 19         32.18   P2p
Fa0/17           Desg FWD 19         64.19   P2p
Fa0/18           Desg FWD 19         96.20   P2p

Confirm, that due to secondary root placement, odd-numbered VLANs now travel
over SW1-SW4-SW3 half of the ring. For instance, with VLAN3:

SW1#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             Cost        38
             Port        23 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32771  (priority 32768 sys-id-ext 3)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Altn BLK 19        128.15   P2p
Fa0/14           Altn BLK 19        128.16   P2p
Fa0/15           Altn BLK 19        128.17   P2p
Fa0/19           Altn BLK 19        128.21   P2p
Fa0/20           Altn BLK 19        128.22   P2p
Fa0/21           Root FWD 19        128.23   P2p

SW4#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             Cost        19
```

```
             Port        21 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28675  (priority 28672 sys-id-ext 3)
             Address     000e.83b2.9480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Desg FWD 19         96.13   P2p
Fa0/14           Desg FWD 19         64.14   P2p
Fa0/15           Desg FWD 19         32.15   P2p
Fa0/19           Altn BLK 19        128.19   P2p
Fa0/20           Altn BLK 19        128.20   P2p
Fa0/21           Root FWD 19        128.21   P2p
```

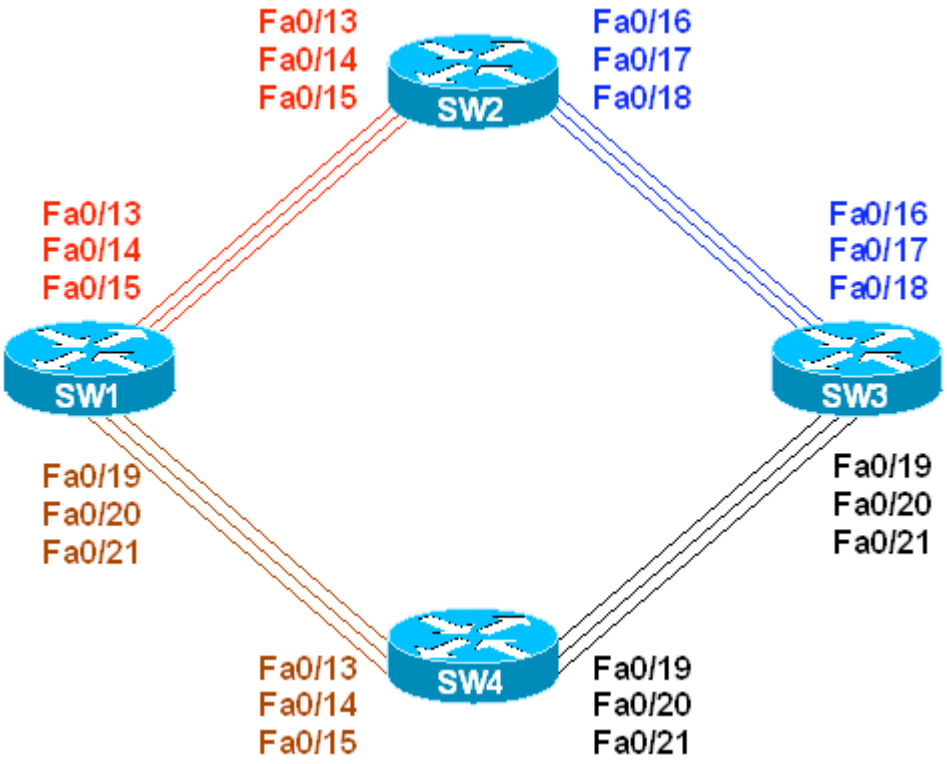
*Verify STP backup for SW1:*

```
SW3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.

SW1(config)#interface range fa 0/13 - 15 , fa 0/19 - 21
SW1(config-if-range)#shut

SW2#show spanning-tree vlan 2 summary
Switch is in pvst mode
Root bridge for VLAN0002 is this bridge.
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
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                   Blocking Listening Learning Forwarding STP Active
---------------------- -------- --------- -------- ---------- ----------
VLAN0002                    0         0        0          3          3
```

## VLAN Load-Balancing using STP Port-Priority

**Objective:** Assign VLANs to different trunks by manipulating STP port-priority




**Directions**

- Configure devices per the 3550/3560 scenario “Load-Balancing with STP Root Bridge Placement”
- To share the load across the ring we’ll need to configure the switches to utilize the redundant inter-switch links
- We’ll assign port-priorities so that the even-numbered VLANs will use numerically lower port numbers, and odd-numbered VLANs will use numerically higher port numbers
- Assigning VLANs to trunks by using port priorities also provides for redundancy
- The idea is to move downstream from STP root for a given VLAN group (even or odd), and adjust STP priority on designated ports
- Remember you always adjust port-priorities on designated ports, i.e. on switches that are closer to STP Root
- Configure SW1 to adjust priority to low numerical value (e.g. 32) for VLANs 2,4,6,8 on ports Fa 0/13 and Fa 0/19
- Configure SW1 to adjust priority to medium numerical value (e.g. 64) for VLANs 2,4,6,8 on Ports Fa 0/14 and Fa 0/20

- Configure SW1 to adjust priority to high numerical value (e.g. 96) for VLANs 2,4,6,8 on Ports FA 0/15 and Fa 0/21
- Therefore, Fa 0/13 and Fa 0/19 are the primary group; Fa 0/14, Fa0/20 is backup group and Fa 0/15, Fa 0/21 – secondary backup group
- Configure SW2 to adjust priority to low numerical value (e.g. 32) for VLANs 2,4,6,8 on port Fa 0/16; to medium value (e.g. 64) on port Fa 0/17; to high value on port Fa 0/18
- Configure SW4 to adjust priority to low numerical value (e.g. 32) for VLANs 2,4,6,8 on port Fa 0/19; to medium value (e.g. 64) on port Fa 0/20; to high value on port Fa 0/21
- Configure SW3 to adjust priority to low numerical value (e.g. 32) for VLANs 1,3,5,7,9 on ports Fa 0/18 and Fa 0/21
- Configure SW3 to adjust priority to medium numerical value (e.g. 64) for VLANs 1,3,5,7,9 on Ports Fa 0/17 and Fa 0/20
- Configure SW3 to adjust priority to high numerical value (e.g. 96) for VLANs 1,3,5,7,9 on Ports Fa 0/16 and Fa 0/19
- Configure SW2 to adjust priority to low numerical value (e.g. 32) for VLANs 1,3,5,7,9 on port Fa 0/15; to medium value (e.g. 64) on port Fa 0/14; to high value on port Fa 0/13
- Configure SW4 to adjust priority to low numerical value (e.g. 32) for VLANs 1,3,5,7,9 on port Fa 0/15; to medium value (e.g. 64) on port Fa 0/14; to high value on port Fa 0/13
- In essence, a load distribution has been achieved, with a good level of redundancy
- With such complex scenarios it's a good practice to type all the configuration in a text editor and then copy-paste them to appropriate devices

**Final Configuration**

```
---------------- Even-Numbered VLANs

SW1:
interface range Fa 0/13 , Fa 0/19
  spanning-tree vlan 2,4,6,8 port-priority 32
!
interface range Fa 0/14 , Fa 0/20
  spanning-tree vlan 2,4,6,8 port-priority 64
!
interface range Fa 0/15 , Fa 0/21
 spanning-tree vlan 2,4,6,8 port-priority 96

SW2:
interface Fa 0/16
  spanning-tree vlan 2,4,6,8 port-priority 32
!
interface Fa 0/17
  spanning-tree vlan 2,4,6,8 port-priority 64
!
interface Fa 0/18
  spanning-tree vlan 2,4,6,8 port-priority 96
```

```
SW4:
interface Fa 0/19
  spanning-tree vlan 2,4,6,8 port-priority 32
!
interface Fa 0/20
  spanning-tree vlan 2,4,6,8 port-priority 64
!
interface Fa 0/21
  spanning-tree vlan 2,4,6,8 port-priority 96

---------------- Odd-Numbered VLANs

SW3:
interface range Fa 0/18 , Fa 0/21
  spanning-tree vlan 1,3,5,7,9 port-priority 32
!
interface range Fa 0/17 , Fa 0/20
  spanning-tree vlan 1,3,5,7,9 port-priority 64
!
interface range Fa 0/16 , Fa 0/19
 spanning-tree vlan 1,3,5,7,9 port-priority 96

SW2:
interface Fa 0/15
  spanning-tree vlan 1,3,5,7,9 port-priority 32
!
interface Fa 0/14
  spanning-tree vlan 1,3,5,7,9 port-priority 64
!
interface Fa 0/13
  spanning-tree vlan 1,3,5,7,9 port-priority 96

SW4:
interface Fa 0/15
  spanning-tree vlan 1,3,5,7,9 port-priority 32
!
interface Fa 0/14
  spanning-tree vlan 1,3,5,7,9 port-priority 64
!
interface Fa 0/13
  spanning-tree vlan 1,3,5,7,9 port-priority 96
```

## Verification

*Verify configuration for Odd-numbered VLANs. For instance with VLAN 3:*

```
SW1#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             Cost        38
             Port        23 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32771  (priority 32768 sys-id-ext 3)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300
```

```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Altn BLK 19        128.15   P2p
Fa0/14           Altn BLK 19        128.16   P2p
Fa0/15           Altn BLK 19        128.17   P2p
Fa0/19           Altn BLK 19        128.21   P2p
Fa0/20           Altn BLK 19        128.22   P2p
Fa0/21           Root FWD 19        128.23   P2p

SW4#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             Cost        19
             Port        21 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28675  (priority 28672 sys-id-ext 3)
             Address     000e.83b2.9480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Desg FWD 19         96.13   P2p
Fa0/14           Desg FWD 19         64.14   P2p
Fa0/15           Desg FWD 19         32.15   P2p
Fa0/19           Altn BLK 19        128.19   P2p
Fa0/20           Altn BLK 19        128.20   P2p
Fa0/21           Root FWD 19        128.21   P2p

SW3#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24579  (priority 24576 sys-id-ext 3)
             Address     0015.63c8.8800
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Desg FWD 19         96.16   P2p
Fa0/17           Desg FWD 19         64.17   P2p
Fa0/18           Desg FWD 19         32.18   P2p
Fa0/19           Desg FWD 19         96.19   P2p
Fa0/20           Desg FWD 19         64.20   P2p
Fa0/21           Desg FWD 19         32.21   P2p

Verify configuration for Even-numbered VLANs. For instance with VLAN 2:

SW3#show spanning-tree vlan 2

VLAN0002
```

```
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        38
             Port        16 (FastEthernet0/16)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32770  (priority 32768 sys-id-ext 2)
             Address     0015.63c8.8800
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Root FWD 19        128.16   P2p
Fa0/17           Altn BLK 19        128.17   P2p
Fa0/18           Altn BLK 19        128.18   P2p
Fa0/19           Altn BLK 19        128.19   P2p
Fa0/20           Altn BLK 19        128.20   P2p
Fa0/21           Altn BLK 19        128.21   P2p

SW2#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        19
             Port        15 (FastEthernet0/13)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28674  (priority 28672 sys-id-ext 2)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 19        128.15   P2p
Fa0/14           Altn BLK 19        128.16   P2p
Fa0/15           Altn BLK 19        128.17   P2p
Fa0/16           Desg FWD 19         32.18   P2p
Fa0/17           Desg FWD 19         64.19   P2p
Fa0/18           Desg FWD 19         96.20   P2p

SW1#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24578  (priority 24576 sys-id-ext 2)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Desg FWD 19         32.15   P2p
```

```
Fa0/14           Desg FWD 19         64.16   P2p
Fa0/15           Desg FWD 19         96.17   P2p
Fa0/19           Desg FWD 19         32.21   P2p
Fa0/20           Desg FWD 19         64.22   P2p
Fa0/21           Desg FWD 19         96.23   P2p
```

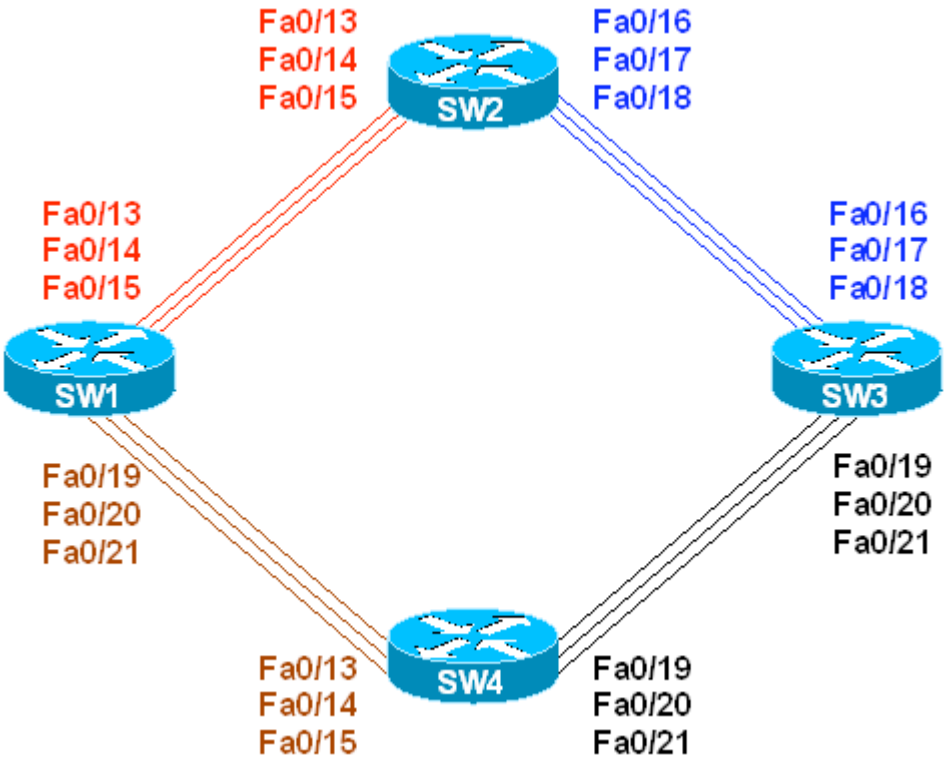
*Verify that higher-priority trunks backup lower-priority. For instance with VLAN2:*

```
SW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW1(config)#interface fastEthernet 0/13
SW1(config-if)#shutdown

SW1#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24578  (priority 24576 sys-id-ext 2)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/14           Desg FWD 19          64.16   P2p
Fa0/15           Desg FWD 19          96.17   P2p
Fa0/19           Desg FWD 19          32.21   P2p
Fa0/20           Desg FWD 19          64.22   P2p
Fa0/21           Desg FWD 19          96.23   P2p

SW2#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        19
             Port        16 (FastEthernet0/14)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28674  (priority 28672 sys-id-ext 2)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/14           Root FWD 19        128.16   P2p
Fa0/15           Altn BLK 19        128.17   P2p
Fa0/16           Desg FWD 19         32.18   P2p
Fa0/17           Desg FWD 19         64.19   P2p
Fa0/18           Desg FWD 19         96.20   P2p
```

## VLAN Load-Balancing using STP Port-Cost

**Objective:** Assign VLANs to different trunks by manipulating STP Port-Cost




**Directions**

- Configure devices as per the 3550/3560 scenario "Load-Balancing with STP Root Bridge Placement"
- To share the load across the ring we'll need to configure the switches to utilize the redundant inter-switch links
- We'll change the port-costs so that even-numbered VLANs will use numerically lower port numbers, and odd-numbered VLANs will use numerically higher port numbers
- Assigning VLANs to trunks by manipulating port-costs also provides for redundancy
- The idea is to move upstream towards the STP root for a given VLAN group (even or odd), and adjust STP port-costs on root and alternative (Blocked) ports
- Configure SW3 to assign port-cost of 10 (lowest) to interfaces Fa 0/16, 19; port-cost of 20 (middle) to interfaces Fa 0/17, 20 and port-cost of 30 (highest) to interfaces Fa 0/18, 21 for VLANs 2,4,6,8 (Even-numbered)
- Configure SW2 and SW4 to assign port-cost of 10 (lowest) to interface Fa 0/13; port-cost of 20 (middle) to interfaces Fa 0/14 and port-cost of 30 (highest) to interface Fa 0/15 for VLANs 2,4,6,8 (Even-numbered)

- Configure SW1 to assign port-cost of 10 (lowest) to interfaces Fa 0/21, 15; port-cost of 20 (middle) to interfaces Fa 0/20, 14 and port-cost of 30 (highest) to interfaces Fa 0/19, 13 for VLANs 1,3,5,7,9 (Odd-numbered).
- Configure SW2 to assign port-cost of 10 (lowest) to interfaces Fa 0/18; port-cost of 20 (middle) to interfaces Fa 0/17 and port-cost of 30 (highest) to interfaces Fa 0/16 for VLANs 1,3,5,7,9 (Odd-numbered)
- Configure SW4 to assign port-cost of 10 (lowest) to interfaces Fa 0/21; port-cost of 20 (middle) to interfaces Fa 0/20 and port-cost of 30 (highest) to interfaces Fa 0/19 for VLANs 1,3,5,7,9 (Odd-numbered)
- In essence, a load distribution has been achieved with a good level of backup
- With such complex scenarios it's a good practice to type all the configuration in a text editor and then copy-paste them to appropriate devices

## Final Configuration

```
---------------- Even-Numbered VLANs

SW3:
interface range Fa 0/16 , Fa 0/19
 spanning-tree vlan 2,4,6,8 cost 10
!
interface range Fa 0/17 , Fa 0/20
 spanning-tree vlan 2,4,6,8 cost 20
!
interface range Fa 0/18 , Fa 0/21
 spanning-tree vlan 2,4,6,8 cost 30
!
SW2 & SW4:
interface Fa 0/13
 spanning-tree vlan 2,4,6,8 cost 10
!
interface Fa 0/14
 spanning-tree vlan 2,4,6,8 cost 20
!
interface Fa 0/15
 spanning-tree vlan 2,4,6,8 cost 30

---------------- Odd-Numbered VLANs

SW1:
interface range Fa 0/21 , Fa 0/15
 spanning-tree vlan 1,3,5,7,9 cost 10
!
interface range Fa 0/20 , Fa 0/14
 spanning-tree vlan 1,3,5,7,9 cost 20
!
interface range Fa 0/19 , Fa 0/13
 spanning-tree vlan 1,3,5,7,9 cost 30
!
SW2:
interface Fa 0/18
 spanning-tree vlan 1,3,5,7,9 cost 10
!
```

```
interface Fa 0/17
 spanning-tree vlan 1,3,5,7,9 cost 20
!
interface Fa 0/16
 spanning-tree vlan 1,3,5,7,9 cost 30

SW4:
interface Fa 0/21
 spanning-tree vlan 1,3,5,7,9 cost 10
!
interface Fa 0/20
 spanning-tree vlan 1,3,5,7,9 cost 20
!
interface Fa 0/19
 spanning-tree vlan 1,3,5,7,9 cost 30
```

## Verification

*Verify the Even-Numbered VLANs Root Ports:*

```
SW3#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        20
             Port        16 (FastEthernet0/16)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32770  (priority 32768 sys-id-ext 2)
             Address     0015.63c8.8800
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Root FWD 10        128.16   P2p
Fa0/17           Altn BLK 20        128.17   P2p
Fa0/18           Altn BLK 30        128.18   P2p
Fa0/19           Altn BLK 10        128.19   P2p
Fa0/20           Altn BLK 20        128.20   P2p
Fa0/21           Altn BLK 30        128.21   P2p

SW2#show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        10
             Port        15 (FastEthernet0/13)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28674  (priority 28672 sys-id-ext 2)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
```

```
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 10        128.15   P2p
Fa0/14           Altn BLK 20        128.16   P2p
Fa0/15           Altn BLK 30        128.17   P2p
Fa0/16           Desg FWD 19        128.18   P2p
Fa0/17           Desg FWD 19        128.19   P2p
Fa0/18           Desg FWD 19        128.20   P2p

SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#interface fa0/13
SW2(config-if)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/13, changed state to administratively
down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/13, changed state
to down

SW2(config-if)#do show spanning-tree vlan 2

VLAN0002
  Spanning tree enabled protocol ieee
  Root ID    Priority    24578
             Address     0016.4639.d580
             Cost        20
             Port        16 (FastEthernet0/14)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    28674  (priority 28672 sys-id-ext 2)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/14           Root LIS 20        128.16   P2p
Fa0/15           Altn BLK 30        128.17   P2p
Fa0/16           Desg FWD 19        128.18   P2p
Fa0/17           Desg FWD 19        128.19   P2p
Fa0/18           Desg FWD 19        128.20   P2p
```

*Verify the Odd-Numbered VLANs Root Ports:*

```
SW1#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             Cost        20
             Port        23 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32771  (priority 32768 sys-id-ext 3)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/14           Altn BLK 20        128.16   P2p
Fa0/15           Altn BLK 10        128.17   P2p
```

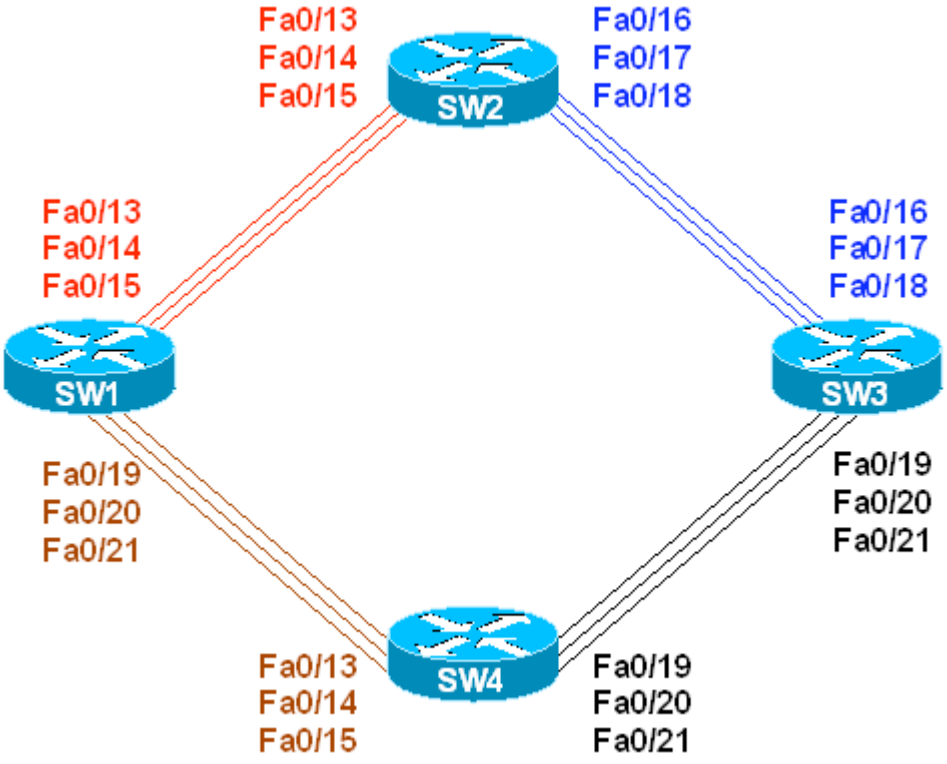
 

```
Fa0/19           Altn BLK 30        128.21   P2p
Fa0/20           Altn BLK 20        128.22   P2p
Fa0/21           Root FWD 10        128.23   P2p

SW4#show spanning-tree vlan 3

VLAN0003
  Spanning tree enabled protocol ieee
  Root ID    Priority    24579
             Address     0015.63c8.8800
             Cost        10
             Port        21 (FastEthernet0/21)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32771  (priority 32768 sys-id-ext 3)
             Address     000e.83b2.9480
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Desg FWD 19        128.13   P2p
Fa0/14           Desg FWD 19        128.14   P2p
Fa0/15           Desg FWD 19        128.15   P2p
Fa0/19           Altn BLK 30        128.19   P2p
Fa0/20           Altn BLK 20        128.20   P2p
Fa0/21           Root FWD 10        128.21   P2p
```

## VLAN Load-Balancing using MSTP

**Objective:** Distribute load evenly across all physical links using MSTP




**Directions**

- Configure devices as per the 3550/3560 scenario “Configuring MSTP in Ring Topology”
- Our goal is to utilize all the “rings” formed by inter-switch links.
- We are going to assign VLANs 1-3 to inner ring (closest to the center of topology), VLANs 4-6 to middle ring, and VLANs 7-9 to outer ring.
- To achieve our goal we may use either port-priority or port-cost assignment
- In this particular task we are going to manipulate port-priorities.
- Moving downstream from the regional MSTP root, assign port-priorities to designated ports
- On SW1 configure the low priority (e.g. 32) for instance “1” on ports Fa 0/15 , 19 (they form inner ring); configure low priority for instance “2” on ports Fa 0/14, 20 (middle ring) and configure low priority for instance “3” on ports Fa 0/13, 21
- On SW2 configure the low priority (e.g. 32) for instance “1” on port Fa 0/18; configure low priority for instance “2” on port Fa0/17 and configure low priority for instance “3” on port Fa 0/16

- On SW4 configure the low priority (e.g. 32) for instance “1” on port Fa 0/19; configure low priority for instance “2” on port Fa0/20 and configure low priority for instance “3” on port Fa 0/21

## Final Configuration

**SW1:**

```
interface range Fa 0/15 , fa 0/19
 spanning-tree mst 1 port-priority 32
!
interface range Fa 0/14 , fa 0/20
 spanning-tree mst 2 port-priority 32
!
interface range Fa 0/13 , fa 0/21
 spanning-tree mst 3 port-priority 32
```

**SW2:**

```
interface range Fa 0/18
 spanning-tree mst 1 port-priority 32
!
interface range Fa 0/17
 spanning-tree mst 2 port-priority 32
!
interface range Fa 0/16
 spanning-tree mst 3 port-priority 32
```

**SW4:**

```
interface range Fa 0/19
 spanning-tree mst 1 port-priority 32
!
interface range Fa 0/20
 spanning-tree mst 2 port-priority 32
!
interface range Fa 0/21
 spanning-tree mst 3 port-priority 32
```

## Verification

```
SW2#show spanning-tree mst 1

##### MST1    vlans mapped:   1-3
Bridge        address 0016.9d31.8380  priority      32769 (32768 sysid 1)
Root          address 0016.4639.d580  priority      24577 (24576 sysid 1)
              port    Fa0/15          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/3            Desg FWD 2000000   128.5    Shr
Fa0/4            Desg FWD 2000000   128.6    Shr
Fa0/5            Desg FWD 2000000   128.7    Shr
Fa0/6            Desg FWD 200000    128.8    P2p
Fa0/12           Desg FWD 200000    128.14   P2p
Fa0/13           Altn BLK 200000    128.15   P2p
Fa0/14           Altn BLK 200000    128.16   P2p
Fa0/15           Root FWD 200000    128.17   P2p
Fa0/16           Desg FWD 200000    128.18   P2p
Fa0/17           Desg FWD 200000    128.19   P2p
```

```
Fa0/18           Desg FWD 200000     32.20   P2p
Fa0/24           Desg FWD 2000000   128.26   Shr

SW2#show spanning-tree mst 2

##### MST2    vlans mapped:   4-6
Bridge        address 0016.9d31.8380  priority      32770 (32768 sysid 2)
Root          address 0016.4639.d580  priority      24578 (24576 sysid 2)
              port    Fa0/14          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Altn BLK 200000    128.15   P2p
Fa0/14           Root FWD 200000    128.16   P2p
Fa0/15           Altn BLK 200000    128.17   P2p
Fa0/16           Desg FWD 200000    128.18   P2p
Fa0/17           Desg FWD 200000     32.19   P2p
Fa0/18           Desg FWD 200000    128.20   P2p

SW2#show spanning-tree mst 3

##### MST3    vlans mapped:   7-9
Bridge        address 0016.9d31.8380  priority      32771 (32768 sysid 3)
Root          address 0016.4639.d580  priority      24579 (24576 sysid 3)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.15   P2p
Fa0/14           Altn BLK 200000    128.16   P2p
Fa0/15           Altn BLK 200000    128.17   P2p
Fa0/16           Desg FWD 200000     32.18   P2p
Fa0/17           Desg FWD 200000    128.19   P2p
Fa0/18           Desg FWD 200000    128.20   P2p

SW4#show spanning-tree mst 1

##### MST1    vlans mapped:   1-3
Bridge        address 000e.83b2.9480  priority      32769 (32768 sysid 1)
Root          address 0016.4639.d580  priority      24577 (24576 sysid 1)
              port    Fa0/13          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Root FWD 200000    128.13   P2p
Fa0/14           Altn BLK 200000    128.14   P2p
Fa0/15           Altn BLK 200000    128.15   P2p
Fa0/19           Desg FWD 200000     32.19   P2p
Fa0/20           Desg FWD 200000    128.20   P2p
Fa0/21           Desg FWD 200000    128.21   P2p

SW4#show spanning-tree mst 2

##### MST2    vlans mapped:   4-6
Bridge        address 000e.83b2.9480  priority      32770 (32768 sysid 2)
Root          address 0016.4639.d580  priority      24578 (24576 sysid 2)
              port    Fa0/14          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Altn BLK 200000    128.13   P2p
Fa0/14           Root FWD 200000    128.14   P2p
```

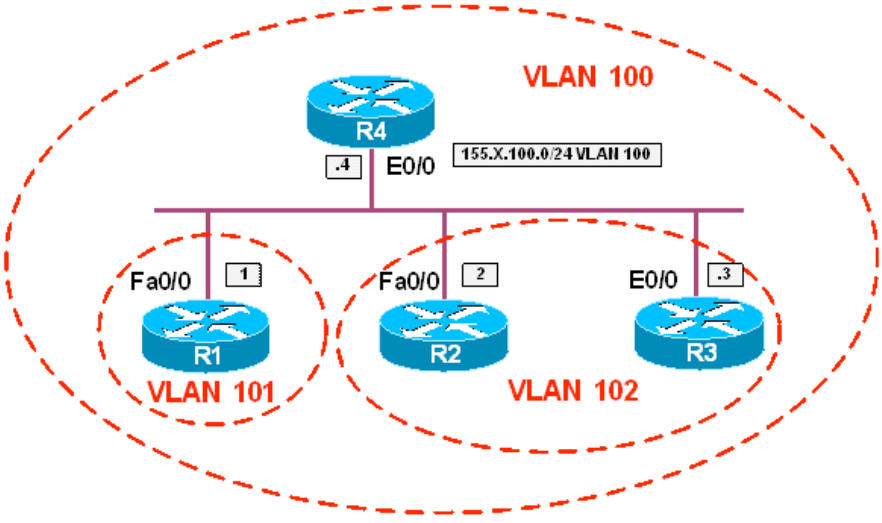
 

```
Fa0/15           Altn BLK 200000    128.15   P2p
Fa0/19           Desg FWD 200000    128.19   P2p
Fa0/20           Desg FWD 200000     32.20   P2p
Fa0/21           Desg FWD 200000    128.21   P2p

SW4#show spanning-tree mst 3

##### MST3     vlans mapped:   7-9
Bridge         address 000e.83b2.9480  priority      32771 (32768 sysid 3)
Root           address 0016.4639.d580  priority      24579 (24576 sysid 3)
               port    Fa0/15          cost          200000    rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/13           Altn BLK 200000    128.13   P2p
Fa0/14           Altn BLK 200000    128.14   P2p
Fa0/15           Root FWD 200000    128.15   P2p
Fa0/19           Desg FWD 200000    128.19   P2p
Fa0/20           Desg FWD 200000    128.20   P2p
Fa0/21           Desg FWD 200000     32.21   P2p

SW3#show spanning-tree mst 1

##### MST1     vlans mapped:   1-3
Bridge         address 0015.63c8.8800  priority      32769 (32768 sysid 1)
Root           address 0016.4639.d580  priority      24577 (24576 sysid 1)
               port    Fa0/19          cost          400000    rem hops 18

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Altn BLK 200000    128.16   P2p
Fa0/17           Altn BLK 200000    128.17   P2p
Fa0/18           Altn BLK 200000    128.18   P2p
Fa0/19           Root FWD 200000    128.19   P2p
Fa0/20           Altn BLK 200000    128.20   P2p
Fa0/21           Altn BLK 200000    128.21   P2p

SW3#show spanning-tree mst 2

##### MST2     vlans mapped:   4-6
Bridge         address 0015.63c8.8800  priority      32770 (32768 sysid 2)
Root           address 0016.4639.d580  priority      24578 (24576 sysid 2)
               port    Fa0/20          cost          400000    rem hops 18

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Altn BLK 200000    128.16   P2p
Fa0/17           Altn BLK 200000    128.17   P2p
Fa0/18           Altn BLK 200000    128.18   P2p
Fa0/19           Altn BLK 200000    128.19   P2p
Fa0/20           Root FWD 200000    128.20   P2p
Fa0/21           Altn BLK 200000    128.21   P2p

SW3#show spanning-tree mst 3

##### MST3     vlans mapped:   7-9
Bridge         address 0015.63c8.8800  priority      32771 (32768 sysid 3)
Root           address 0016.4639.d580  priority      24579 (24576 sysid 3)
               port    Fa0/21          cost          400000    rem hops 18

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

```
Fa0/16           Altn BLK 200000    128.16   P2p
Fa0/17           Altn BLK 200000    128.17   P2p
Fa0/18           Altn BLK 200000    128.18   P2p
Fa0/19           Altn BLK 200000    128.19   P2p
Fa0/20           Altn BLK 200000    128.20   P2p
Fa0/21           Root FWD 200000    128.21   P2p
```

## Configuring Private VLANs

**Objective:** Configure Private VLANs on SW1 and SW2




### Directions

- Configure VTP transparent mode on SW1 and SW2. The following VLAN configuration steps should be applied to both switches
- Create VLAN 100 and configure it as Private-VLAN primary
- Create VLAN 101 and configure it as Private-VLAN isolated
- Create VLAN 102 and configure it as Private-VLAN community
- Associate Primary VLAN 100 with secondary VLAN 101 and 102
- Configure interfaces Fa 0/13 on SW1 and SW2 as 802.1q trunks
- Configure port Fa 0/1 on SW1 as private-vlan host, and associate it with primary vlan 100 and secondary 101
- Configure port Fa 0/2 on SW2 as private-vlan host, and associate it with primary vlan 100 and secondary 102
- Configure port Fa 0/3 on SW1 as private-vlan host, and associate it with primary vlan 100 and secondary 102
- Configure port Fa 0/4 on SW2 as private-vlan promiscuous, and associate it with primary vlan 100 adding secondaries 101 and 102
- Configure IP addressing on R1, R2, R3, R4 as per diagram

## Final Configuration

**SW1 & SW2:**

```
vtp mode transparent
!
vlan 100
private-vlan primary
!
vlan 101
 private-vlan isolated
!
vlan 102
 private-vlan community
!
vlan 100
 private-vlan association add 101,102
!
interface Fast 0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
```

**SW1:**

```
interface fa 0/1
 switchport mode private-vlan host
 switchport private-vlan host-assoc 100 101
!
interface fa 0/3
 switchport mode private-vlan host
 switchport private-vlan host-assoc 100 102
```

**SW2:**

```
interface fa 0/2
 switchport mode private-vlan host
 switchport private-vlan host-assoc 100 102
!
interface fa 0/4
 switchport mode private-vlan promisc
 switchport private-vlan mapping 100 add 101,102
```

**R1:**

```
interface Fa 0/0
 no shut
 ip add 155.1.100.1 255.255.255.0
```

**R2:**

```
interface Fa 0/0
 no shut
 ip add 155.1.100.2 255.255.255.0
```

**R3:**

```
interface Eth 0/0
 no shut
 ip add 155.1.100.3 255.255.255.0
```

**R4:**

```
interface Eth 0/0
```

```
 no shut
 ip add 155.1.100.4 255.255.255.0
```

## Verification

```
SW1#show vlan brief | ex unsupp

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/22, Fa0/23, Fa0/24, Gi0/1
                                                Gi0/2
100  VLAN0100                         active
101  VLAN0101                         active
102  VLAN0102                         active

SW1#show vlan id 100

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
100  VLAN0100                         active    Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
100  enet  100100     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
100     101       isolated          Fa0/1
100     102       community         Fa0/3

SW1#show vlan id 101

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
101  VLAN0101                         active    Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
101  enet  100101     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
100     101       isolated          Fa0/1

SW1#show vlan id 102
```

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
102  VLAN0102                          active    Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                 Fa0/21

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
102  enet  100102     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
100     102       community         Fa0/3

SW2#show vlan id 100

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
100  VLAN0100                          active    Fa0/13, Fa0/16, Fa0/17, Fa0/18
                                                 Fa0/19, Fa0/21

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
100  enet  100100     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
100     101       isolated          Fa0/4
100     102       community         Fa0/2, Fa0/4

Rack1SW2#show vlan id 101

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
101  VLAN0101                          active    Fa0/13, Fa0/16, Fa0/17, Fa0/18
                                                 Fa0/19, Fa0/21

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
101  enet  100101     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
100     101       isolated          Fa0/4

Rack1SW2#show vlan id 102

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
```

```
102  VLAN0102                         active    Fa0/13, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/21

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
102  enet  100102     1500  -      -      -        -    -        0      0

Remote SPAN VLAN
----------------
Disabled

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
100     102       community         Fa0/2, Fa0/4

SW1#show interfaces fa0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: private-vlan host
Operational Mode: private-vlan host
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: 100 (VLAN0100) 101 (VLAN0101)
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan:
  100 (VLAN0100) 101 (VLAN0101)
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

SW2#show interfaces fa0/2 switchport
Name: Fa0/2
Switchport: Enabled
Administrative Mode: private-vlan host
Operational Mode: private-vlan host
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: 100 (VLAN0100) 102 (VLAN0102)
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
```

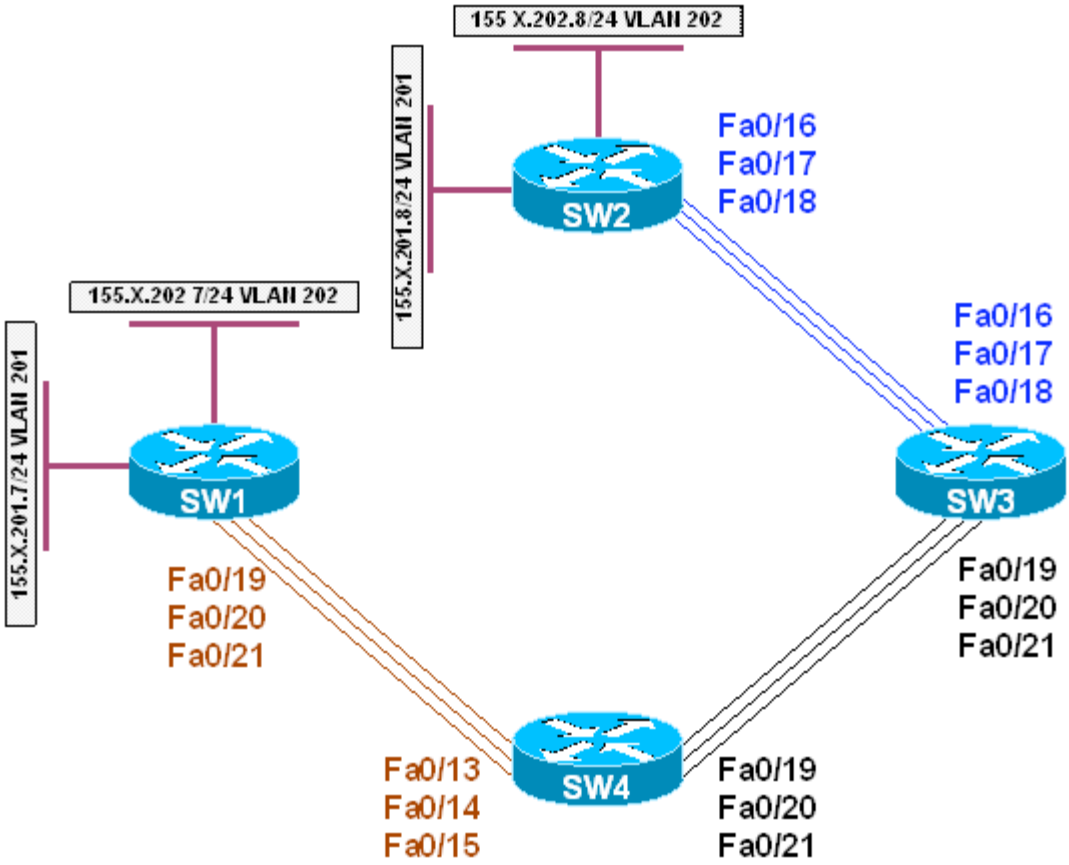
```
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan:
  100 (VLAN0100) 102 (VLAN0102)
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

SW2#show interfaces fa0/4 switchport
Name: Fa0/4
Switchport: Enabled
Administrative Mode: private-vlan promiscuous
Operational Mode: private-vlan promiscuous
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: 100 (VLAN0100) 101 (VLAN0101) 102
(VLAN0102)
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan:
  100 (VLAN0100) 101 (VLAN0101) 102 (VLAN0102)
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

R1#ping 155.1.100.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.100.4, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/4 ms

R1#ping 155.1.100.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.100.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

R1#ping 155.1.100.3
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.100.3, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)



R2#ping 155.1.100.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.100.4, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/4 ms

R2#ping 155.1.100.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.100.3, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/4 ms

R2#ping 155.1.100.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.100.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

## Using QinQ for Transparent Tunneling

**Objective:** Configure the switches for 802.1q tunneling




**Directions**

- Configure devices as per the 3550/3560 scenario “Common Configuration for Ring Topology”
- Configure SW1 and SW2 in VTP transparent mode and create VLANs 201 and 202 on both switches
- Shutdown interface Fa 0/13 – 15 on SW1 and SW2
- Create SVI interfaces and configure IP addresses on SW1 and SW2 as per diagram
- Configure SW3 and SW4 in VTP transparent mode and create VLAN 100 on both switches
- Set system MTU to 1504 and reload both switches for the MTU to take effect
- Configure ports Fa 0/16 on SW3 and Fa 0/13 on SW2 as 802.1q Tunnels, and assign them to VLAN100
- Shutdown redundant ports Fa 0/17, Fa 0/18 on SW3 and Fa 0/14, Fa 0/15 on SW4

## Final Configuration

**SW1 & SW2:**
```
vtp mode transparent
vlan 201,202
!
interface range fastEthernet 0/13 , fa 0/14 , fa 0/15
 shutdown
!
```
**SW1:**
```
interface Vlan 201
 ip address 155.1.201.7 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.7 255.255.255.0
```

**SW2:**
```
interface Vlan 201
 ip address 155.1.201.8 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.8 255.255.255.0
```

**SW3 & SW4:**
```
vtp mode transparent
vlan 100
system mtu 1504
```

**SW3:**
```
interface fa 0/16
 switchport mode dot1q-tunnel
 switchport access vlan 100
!
interface range fa 0/17 , fa 0/18
 shutdown
```

**SW4:**
```
interface fa 0/13
 switchport mode dot1q-tunnel
 switchport access vlan 100
!
interface fa 0/14 , fa 0/15
 shutdown
```

## Verification

```
SW2#ping 155.1.201.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.201.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms

SW2#ping 155.1.202.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.202.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

```
SW2#show vlan brief | ex unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/17
                                                Fa0/18, Fa0/19, Fa0/20, Fa0/21
                                                Fa0/22, Fa0/23, Fa0/24, Gi0/1
                                                Gi0/2
201  VLAN0201                         active
202  VLAN0202                         active


SW2#show mac-address-table dynamic vlan 201
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
 201    0016.4639.d5c1    DYNAMIC     Fa0/16
Total Mac Addresses for this criterion: 1

SW2#show mac-address-table dynamic vlan 202
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
 202    0016.4639.d5c2    DYNAMIC     Fa0/16
Total Mac Addresses for this criterion: 1

SW2#show ip arp
Protocol  Address          Age (min)  Hardware Addr   Type   Interface
Internet  155.1.201.7              4   0016.4639.d5c1  ARPA   Vlan201
Internet  155.1.202.7              1   0016.4639.d5c2  ARPA   Vlan202
Internet  155.1.202.8              -   0016.9d31.83c2  ARPA   Vlan202
Internet  155.1.201.8              -   0016.9d31.83c1  ARPA   Vlan201

SW3#show vlan brief | ex unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1, Gi0/2
100  VLAN0100                         active    Fa0/16, Fa0/17, Fa0/18

SW3#show interfaces fastEthernet 0/16 switchport
Name: Fa0/16
Switchport: Enabled
Administrative Mode: tunnel
Operational Mode: tunnel
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 100 (VLAN0100)
Trunking Native Mode VLAN: 1 (default)
```

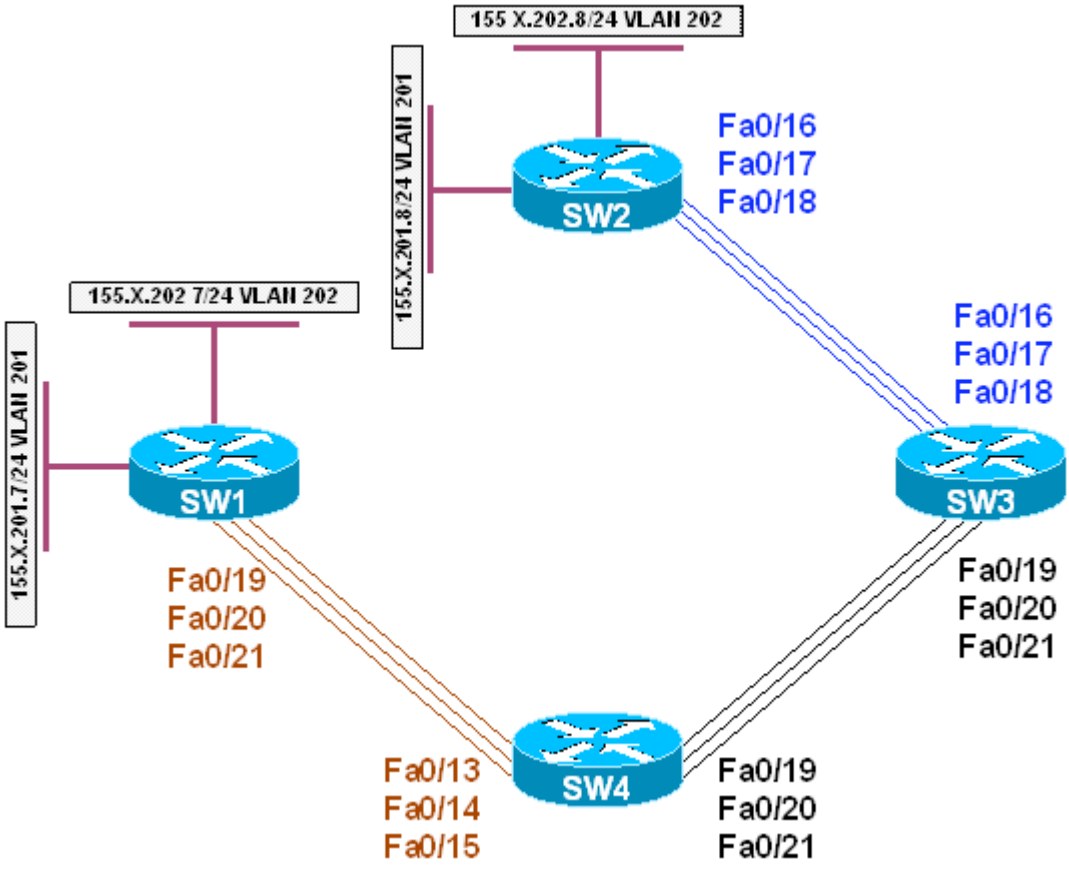
 

```
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none

SW3#show spanning-tree interface fastEthernet 0/16 detail
 Port 16 (FastEthernet0/16) of VLAN0100 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.16.
   Designated root has priority 32868, address 000e.83b2.9480
   Designated bridge has priority 32868, address 0015.63c8.8800
   Designated port id is 128.16, designated path cost 19
   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 filter is enabled internally
   BPDU: sent 0, received 0
```

## QinQ and Layer 2 Protocol Forwarding

**Objective:** Configure “metro” switches to forward customer’s CDP/STP frames transparently




### Directions

- Configure devices as per the 3550/3560 scenario “Using 802.1q Tunnels”
- Enable L2 Protcol forwarding on ports Fa 0/16 of SW3 and Fa 0/13 of SW4

### Final Configuration

```
SW3:
interface Fast 0/16
 l2protocol-tunnel cdp
 l2protocol-tunnel stp

SW4:
interface Fa 0/13
 l2protocol-tunnel cdp
 l2protocol-tunnel stp
```

## Verification

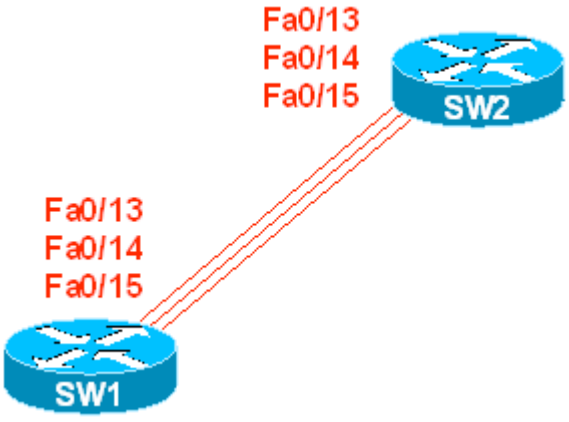
```
SW1#show cdp neighbors fa0/19
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

Device ID            Local Intrfce   Holdtme   Capability    Platform   Port ID
SW2                 Fas 0/19         116            S I      WS-C3560-2Fas 0/16

SW2#show cdp neighbors fa0/16
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

Device ID            Local Intrfce   Holdtme   Capability    Platform   Port ID
SW1                 Fas 0/16         126            S I      WS-C3560-2Fas 0/19

SW2#show spanning-tree vlan 201

VLAN0201
  Spanning tree enabled protocol ieee
  Root ID    Priority    32969
             Address     0016.4639.d580
             Cost        19
             Port        18 (FastEthernet0/16)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32969  (priority 32768 sys-id-ext 201)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Root FWD 19        128.18   P2p

SW2#show spanning-tree vlan 202

VLAN0202
  Spanning tree enabled protocol ieee
  Root ID    Priority    32970
             Address     0016.4639.d580
             Cost        19
             Port        18 (FastEthernet0/16)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32970  (priority 32768 sys-id-ext 202)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/16           Root FWD 19        128.18   P2p

SW1#show spanning-tree vlan 201

VLAN0201
  Spanning tree enabled protocol ieee
  Root ID    Priority    32969
             Address     0016.4639.d580
```

```
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32969  (priority 32768 sys-id-ext 201)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/19           Desg FWD 19        128.21   P2p

SW1#show spanning-tree vlan 202

VLAN0202
  Spanning tree enabled protocol ieee
  Root ID    Priority    32970
             Address     0016.4639.d580
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32970  (priority 32768 sys-id-ext 202)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/19           Desg FWD 19        128.21   P2p
```

## Controlling Traffic-Rate with Storm-Control

**Objective:** Configure the switch to limit the incoming traffic rate using storm-control




### Directions

- Configure SW1 to limit broadcasts on Fa 0/13 to 15% of link's capacity
- Configure SW1 to limit broadcasts on Fa 0/14 to 1000 packets per second
- Configure SW1 to limit unicast traffic on Fa 0/15 to 10Mbps

### Final Configuration

**SW1:**

```
interface Fa 0/13
 storm-control broadcast level 15
!
interface Fa 0/14
 storm-control broadcast level pps 1000
!
interface Fa 0/15
 storm-control unicast level bps 10m
```

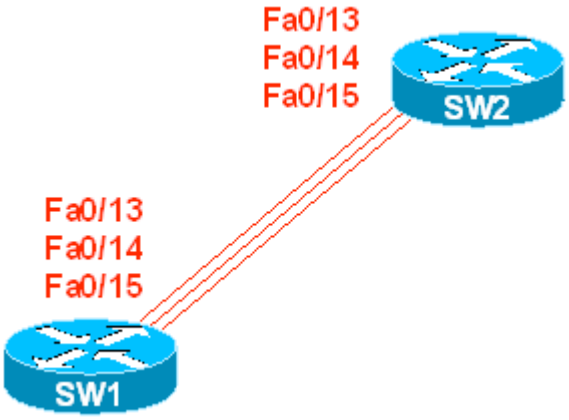
### Verification

```
SW1#show storm-control broadcast
Interface  Filter State   Upper         Lower         Current
---------  -------------  -----------   -----------   ----------
Fa0/13     Forwarding      15.00%        15.00%         0.00%
Fa0/14     Forwarding      1k pps        1k pps         0 pps

SW1#show storm-control unicast
Interface  Filter State   Upper         Lower         Current
---------  -------------  -----------   -----------   ----------
Fa0/15     Forwarding        10m bps       10m bps        0 bps
```

## Configuring Redundancy with Flex Links

**Objective:** Configure inter-switch links redundancy without using STP




### Directions

- Shutdown port Fa0/15 on SW1 and SW2
- Configure Flex Pair on SW1: Fa0/13 and Fa0/14. Port Fa0/13 should be primary
- Configure SW1 to send and SW2 respectively to receive MAC address table move updates

### Final Configuration

**SW1:**

```
interface Fa 0/15
 shutdown
!
interface fa 0/13
 switchport backup interface fastEthernet 0/14
!
mac address-table move update transmit
```

**SW2:**

```
mac address-table move update receive
```

### Verification

```
SW1#show interfaces switchport backup detail

Switch Backup Interface Pairs:

Active Interface        Backup Interface        State
------------------------------------------------------------------------
FastEthernet0/13        FastEthernet0/14        Active Up/Backup Standby


Interface Pair   : Fa0/13, Fa0/14
Preemption Mode  : off
```

```
Bandwidth : 100000 Kbit (Fa0/13), 100000 Kbit (Fa0/14)
Mac Address Move Update Vlan : auto

SW1#show mac address-table move update
Switch-ID : 0116.4639.d580
Dst mac-address : 0180.c200.0010
Vlans/Macs supported : 1023/6272
Default/Current settings: Rcv Off/Off, Xmt Off/On
Max packets per min : Rcv 40, Xmt 60

Rcv packet count : 0
Rcv conforming packet count : 0
Rcv invalid packet count : 0
Rcv packet count this min : 0
Rcv threshold exceed count : 0
Rcv last sequence# this min : 0
Rcv last interface : None
Rcv last src-mac-address : 0000.0000.0000
Rcv last switch-ID : 0000.0000.0000

Xmt packet count : 0
Xmt packet count this min : 0
Xmt threshold exceed count : 0
Xmt pak buf unavail cnt : 0
Xmt last interface : None

SW2#show mac address-table move update
Switch-ID : 0116.9d31.8380
Dst mac-address : 0180.c200.0010
Vlans/Macs supported : 1023/6272
Default/Current settings: Rcv Off/On, Xmt Off/Off
Max packets per min : Rcv 40, Xmt 60

Rcv packet count : 0
Rcv conforming packet count : 0
Rcv invalid packet count : 0
Rcv packet count this min : 0
Rcv threshold exceed count : 0
Rcv last sequence# this min : 0
Rcv last interface : None
Rcv last src-mac-address : 0000.0000.0000
Rcv last switch-ID : 0000.0000.0000

Xmt packet count : 0
Xmt packet count this min : 0
Xmt threshold exceed count : 0
Xmt pak buf unavail cnt : 0
Xmt last interface : None

SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#interface fa0/13
SW2(config-if)#shutdown

SW1#show interfaces switchport backup

Switch Backup Interface Pairs:

Active Interface        Backup Interface        State
------------------------------------------------------------------------
FastEthernet0/13        FastEthernet0/14        Active Down/Backup Up
```

```
SW1#show mac address-table move update
Switch-ID : 0116.4639.d580
Dst mac-address : 0180.c200.0010
Vlans/Macs supported : 1023/6272
Default/Current settings: Rcv Off/Off, Xmt Off/On
Max packets per min : Rcv 40, Xmt 60

Rcv packet count : 0
Rcv conforming packet count : 0
Rcv invalid packet count : 0
Rcv packet count this min : 0
Rcv threshold exceed count : 0
Rcv last sequence# this min : 0
Rcv last interface : None
Rcv last src-mac-address : 0000.0000.0000
Rcv last switch-ID : 0000.0000.0000

Xmt packet count : 1
Xmt packet count this min : 0
Xmt threshold exceed count : 0
Xmt pak buf unavail cnt : 0
Xmt last interface : Fa0/14

SW2#show mac-address-table move update
Switch-ID : 0116.9d31.8380
Dst mac-address : 0180.c200.0010
Vlans/Macs supported : 1023/6272
Default/Current settings: Rcv Off/On, Xmt Off/Off
Max packets per min : Rcv 40, Xmt 60

Rcv packet count : 1
Rcv conforming packet count : 1
Rcv invalid packet count : 0
Rcv packet count this min : 0
Rcv threshold exceed count : 0
Rcv last sequence# this min : 0
Rcv last interface : Fa0/14
Rcv last src-mac-address : 0016.4639.d590
Rcv last switch-ID : 0116.4639.d580

Xmt packet count : 0
Xmt packet count this min : 0
Xmt threshold exceed count : 0
Xmt pak buf unavail cnt : 0
Xmt last interface : None
```

## Using Smartport Macros

**Objective:** Create a template to streamline interface configuration

### Directions

- Create a macro named “ACCESS”.
- This macro should put a port into access mode and assign a VLAN number VLANID to it (VLANID is the value of macro parameter)
- In addition macro should configure a port in spanning-tree portfast mode, filter BPDUs, and permit no more than MAXHOSTS mac-addresses on a port
- Configure VLANID and MAXHOSTS as macro keywords

### Final Configuration

**SW1:**

```
macro name ACCESS
switchport mode access
switchport access vlan VLANID
switchport port-security
switchport port-security maximum MAXHOSTS
spanning-tree portfast
spanning-tree bpdufilter enable
#macro keywords VLANID MAXHOSTS
@
```

### Verification

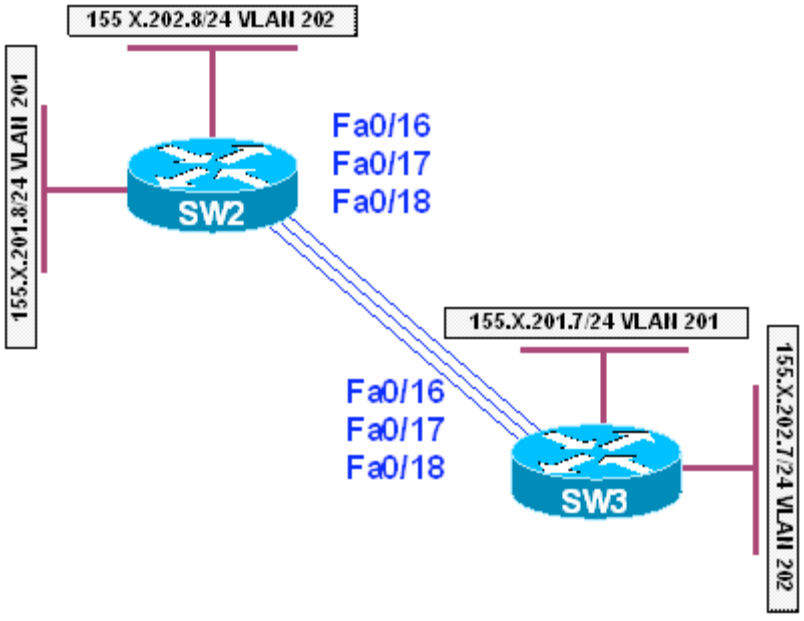
```
SW1(config-if)#do show version | include IOS
Cisco IOS Software, C3560 Software (C3560-ADVIPSERVICESK9-M), Version
12.2(25)SEE2, RELEASE SOFTWARE (fc1)

SW1(config)#macro name ACCESS
Enter macro commands one per line. End with the character '@'.
switchport mode access
switchport access vlan VLANID
switchport port-security
switchport port-security maximum MAXHOSTS
spanning-tree portfast
spanning-tree bpdufilter enable
#macro keywords VLANID MAXHOSTS
@
SW1(config)#interface fa0/1
SW1(config-if)#macro apply ACCESS VLANID 1 MAXHOSTS 10
SW1(config-if)#do show run int fa 0/1
Building configuration...

Current configuration : 221 bytes
!
interface FastEthernet0/1
 switchport mode access
 switchport port-security maximum 10
```

```
 switchport port-security
 macro description ACCESS
 spanning-tree portfast
 spanning-tree bpdufilter enable
end
```

## Per-Port Per-VLAN Classification on the 3550

**Objective:** Classify incoming IP traffic on per-port per-VLAN basis




### Directions

- In this task, SW2 will source IP traffic on two different VLANs and SW3 will classify and mark it with IP precedence.
- Configure SW2 and SW3 in VTP transparent mode and create VLANs 201 and 202 on all switches.
- Shutdown interface Fa 0/13 – 15 on SW1 and SW2
- Create SVI interfaces and configure IP addresses on SW1 and SW3 as per diagram.
- Shutdown redundant interfaces Fa0/17, Fa 0/18 on SW3.

### Final Configuration

```
SW2, SW3:
vtp mode transparent
vlan 201,202

SW3:
interface Vlan 201
 ip address 155.1.201.9 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.9 255.255.255.0

SW2:
interface Vlan 201
 ip address 155.1.201.8 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.8 255.255.255.0
```

```
SW3:
interface range fa 0/17 , fa 0/18
 shutdown
!
mls qos
!
access-list 100 permit ip any any
!
class-map match-any IP_TRAFFIC
  match access-group 100
!
class-map match-all VLAN_202_IP
  match vlan  202
  match class-map IP_TRAFFIC
!
class-map match-all VLAN_201_IP
  match vlan  201
  match class-map IP_TRAFFIC
!
policy-map MARK_TRAFFIC
  class VLAN_201_IP
   set precedence 5
  class VLAN_202_IP
   set precedence 4
!
interface FastEthernet0/16
 service-policy input MARK_TRAFFIC
```

## Verification

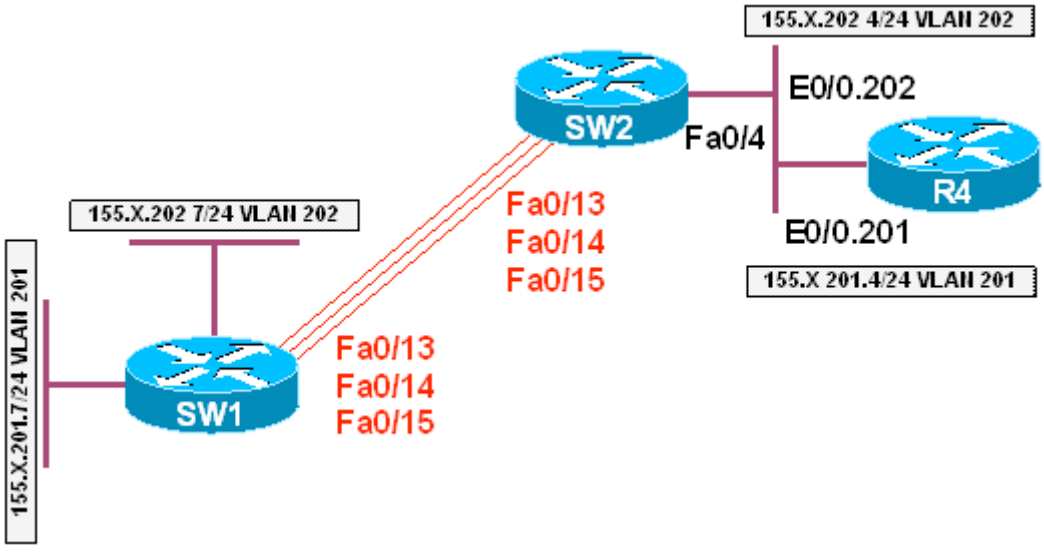
*Remember that IP precedence 5 = DSCP 40 and precedence 4 = DSCP 32. Configure MLS QoS monitoring:*

```
SW3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW3(config)#interface fa0/16
SW3(config-if)#mls qos monitor dscp 32 40
SW3(config-if)#mls qos monitor packets
QoS: This command is only applicable on a master port.
 On a 24 ports switch:
  -port 1 controls interface 1 to 12
  -port 13 controls interface 13 to 24
 On a 48 ports switch:
  -port 25 controls interface 25 to 36
  -port 37 controls interface 37 to 48
SW3(config-if)#exit
SW3(config)#interface fa0/13
SW3(config-if)#mls qos monitor packets

SW3#show mls qos interface fa0/16 statistics
Ingress
  dscp: incoming   no_change  classified policed    dropped (in pkts)
    32: 0          0          0          0          0
    40: 0          0          0          0          0
Others: 169        158        11         0          0
Egress
  dscp: incoming   no_change  classified policed    dropped (in pkts)
    32: 0             n/a        n/a      0          0
    40: 0             n/a        n/a      0          0
```

```
Others: 332           n/a       n/a      0          0

SW2#ping 155.1.201.9

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.201.9, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

SW2#ping 155.1.202.9

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.202.9, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
SW2#

SW3#show mls qos interface fa 0/16 statistics
FastEthernet0/16
Ingress
  dscp: incoming   no_change  classified policed    dropped (in pkts)
    32: 0          0          5          0          0
    40: 0          0          5          0          0
Others: 205        181        14         0          0
Egress
  dscp: incoming   no_change  classified policed    dropped (in pkts)
    32: 0             n/a       n/a      0          0
    40: 0             n/a       n/a      0          0
Others: 404           n/a       n/a      0          0
```

## Using Hierarchical Policy-Maps for QoS Classification on the 3560

**Objective:** Classify incoming IP traffic on per-VLAN basis




**Directions**

- In this task SW1 will source IP traffic and SW2 will classify it inbound
- The difference from per-port classification is that you configure policy-map on SVI, and it's applied to all physical interfaces, carrying the respective VLAN
- Configure SW1 and SW2 in VTP transparent mode and create VLANs 201 and 202 on both switches.
- Shutdown interface Fa 0/19 – 0/21 on SW1 and Fa 0/16 – 18 on SW2
- Create SVI interfaces and configure IP addresses on SW1 and R4 as per diagram
- Configure port Fa 0/4 of SW2 as an 802.1q trunk
- Create access-list 100 on SW2 to match IP traffic
- Create class-map IP_TRAFFIC to match access-group 100
- Create policy-map VLAN201_POLICY and set IP precedence for class IP_TRAFFIC to 5. Assign this policy map to VLAN 201
- Create policy-map VLAN202_POLICY and set IP precedence for class IP_TRAFFIC to 4. Assign this policy map to VLAN 202
- Enable vlan-based MLS QoS on interfaces Fa 0/13 – 0/15 of SW2

## Final Configuration

**SW1, SW2:**

```
vtp mode transparent
vlan 201,202
```

**SW1:**

```
interface range fastEthernet 0/19 – 21
 shutdown
!
interface Vlan 201
 ip address 155.1.201.7 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.7 255.255.255.0
```

**SW2:**

```
interface Vlan 201
 no ip address
!
interface Vlan 202
 no ip address
!
interface range fastEthernet 0/16 – 18
  shutdown
!
interface fas 0/4
 switchport trunk encaps dot1q
 switchport mode trunk
!
!
!
mls qos
!
interface range Fa 0/13 , Fa 0/14 , Fa 0/15
 mls qos vlan-based
!
access-list 100 permit ip any any
!
class-map IP_TRAFFIC
match access-group 100
!
policy-map VLAN201_POLICY
 class IP_TRAFFIC
  set ip precedence 5
!
policy-map VLAN202_POLICY
 class IP_TRAFFIC
   set ip precedence 4
!
interface Vlan 201
 service input VLAN201_POLICY
!
interface Vlan 202
 service input VLAN202_POLICY
```

**R4:**

```
interface ethernet 0/0
 no shutdown
!
interface ethernet 0/0.201
```

```
 encaps dot1q 201
 ip address 155.1.201.4 255.255.255.0
!
interface ethernet 0/0.202
 encaps dot1q 202
 ip address 155.1.202.4 255.255.255.0
```

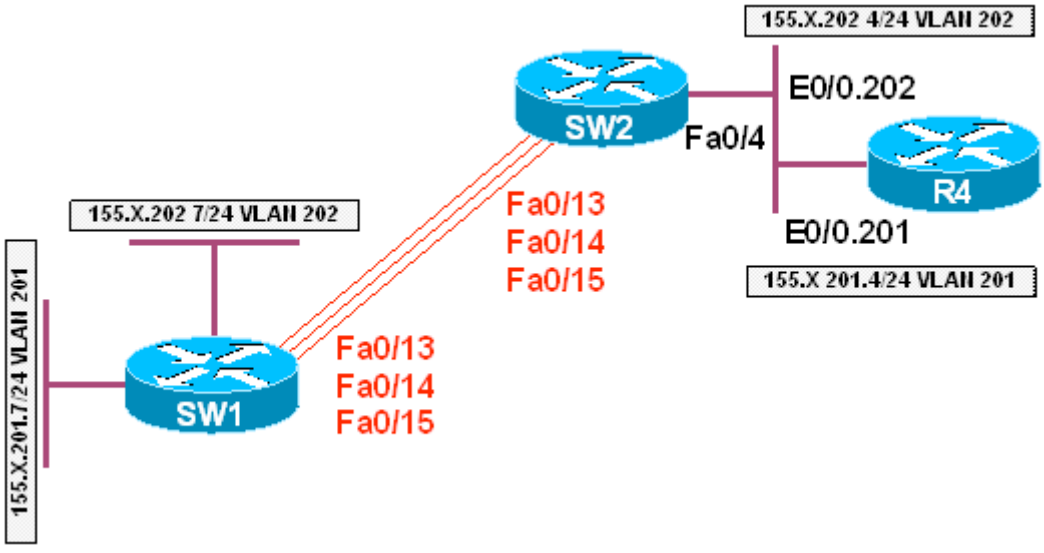
## Verification

```
SW1#ping 155.1.201.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.201.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/5/9 ms

SW1#ping 155.1.202.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.202.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/206/1007 ms
SW1#

SW2#show mls qos interface fa0/4 statistics
FastEthernet0/4

  dscp: incoming
-------------------------------

  0 -  4 :           0            0            0            0            0
  5 -  9 :           0            0            0            0            0
 10 - 14 :           0            0            0            0            0
 15 - 19 :           0            0            0            0            0
 20 - 24 :           0            0            0            0            0
 25 - 29 :           0            0            0            0            0
 30 - 34 :           0            0            5            0            0
 35 - 39 :           0            0            0            0            0
 40 - 44 :           5            0            0            0            0
 45 - 49 :           0            0            0            0            0
 50 - 54 :           0            0            0            0            0
 55 - 59 :           0            0            0            0            0
 60 - 64 :           0            0            0            0
  dscp: outgoing
-------------------------------

  0 -  4 :           6            0            0            0            0
  5 -  9 :           0            0            0            0            0
 10 - 14 :           0            0            0            0            0
 15 - 19 :           0            0            0            0            0
 20 - 24 :           0            0            0            0            0
 25 - 29 :           0            0            0            0            0
 30 - 34 :           0            0            5            0            0
 35 - 39 :           0            0            0            0            0
 40 - 44 :           5            0            0            0            0
 45 - 49 :           0            0            0            0            0
 50 - 54 :           0            0            0            0            0
 55 - 59 :           0            9            0            0            0
 60 - 64 :           0            0            0            0
  cos: incoming
-------------------------------
```

```
  0 -  4 :          16            0            0            0            0
  5 -  7 :           0            0            0
  cos: outgoing
-------------------------------

  0 -  4 :         165            0            0            0            5
  5 -  7 :           5            0            0
Policer: Inprofile:            0 OutofProfile:            0
```

## Using Hierarchical Policy-Maps for Traffic Policing on 3560

**Objective:** Classify and police inbound IP traffic on per-VLAN basis




**Directions**

- In this task SW1 will source IP traffic and SW2 will classify and police it inbound
- IP traffic from VLANs 201 and 202 will by classified, marked and policed differently
- Configure SW1 , SW2 in VTP transparent mode and create VLANs 201 and 202 on both switches
- Shutdown interface Fa 0/19 – 0/21 on SW1 and Fa 0/16 – 18 on SW2
- Create SVI interfaces and configure IP addresses on SW1 and R4 as per diagram
- Configure port Fa 0/4 of SW2 as an 802.1q trunk
- Create access-list 100 on SW2 to match IP traffic
- Create class-map IP_TRAFFIC to match access-group 100
- Create class-map INPUT_INTERFACES and match interface range Fa 0/13 – 15 with it
- Create policy-map POLICE_64K, and rate-limit class INPUT_INTERFACES to 64 Kbps within
- Create policy-map POLICE_32K and rate-limit class INPUT_INTERFACES to 32Kb within
- Create policy-map VLAN201_POLICY and set IP precedence for class IP_TRAFFIC to 5. Assign nested service-policy POLICE_64K to this class Attach this policy map to VLAN 201
- Create policy-map VLAN202_POLICY and set IP precedence for class IP_TRAFFIC to 4. Assign nested service-policy POLICE_32K to this class Attach this policy map to VLAN 202

- Enable VLAN-based MLS QoS on interfaces Fa 0/13 – 0/15 of SW2

## Final Configuration

**SW1, SW2:**

```
vtp mode transparent
vlan 201,202
```

**SW1:**

```
interface range fastEthernet 0/19 – 21
 shutdown
!
interface Vlan 201
 ip address 155.1.201.7 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.7 255.255.255.0
```

**SW2:**

```
interface Vlan 201
 no ip address
!
interface Vlan 202
 no ip address
!
interface range fastEthernet 0/16 – 18
  shutdown
!
interface fas 0/4
 switchport trunk encaps dot1q
 switchport mode trunk
!
!
!
mls qos
!
interface range Fa 0/13 , Fa 0/14 , Fa 0/15
 mls qos vlan-based
!
access-list 100 permit ip any any
!
class-map IP_TRAFFIC
match access-group 100
!
class-map INPUT_INTERFACES
 match input Fa 0/13 – fa 0/15
!
policy-map POLICE_64K
 class INPUT_INTERFACES
   police 64000 32000
!
policy-map POLICE_32K
 class INPUT_INTERFACES
   police 32000 16000
!
policy-map VLAN201_POLICY
 class IP_TRAFFIC
  set ip precedence 5
  service-policy POLICE_64K
!
policy-map VLAN202_POLICY
```

```
 class IP_TRAFFIC
   set ip precedence 4
   service-policy POLICE_32K
!
interface Vlan 201
 service input VLAN201_POLICY
!
interface Vlan 202
 service input VLAN202_POLICY

R4:
interface ethernet 0/0
 no shutdown
!
interface ethernet 0/0.201
 encaps dot1q 201
 ip address 155.1.201.4 255.255.255.0
!
interface ethernet 0/0.202
 encaps dot1q 202
 ip address 155.1.202.4 255.255.255.0
```

## Verification

```
SW1#ping 155.1.201.4 repeat 100 size 1490 timeout 1

Type escape sequence to abort.
Sending 100, 1490-byte ICMP Echos to 155.1.201.4, timeout is 1 seconds:
!!!!!!!!!!!!!!!!!!!!!!.!!!!!.!!!!!.!!!!!.!!!!!.!!!!!.!!!!!.!!!!
!.!!!!!.!!!!!.!!!!!.!!!!!.!!!!
Success rate is 87 percent (87/100), round-trip min/avg/max = 1/15/604 ms

SW1#ping 155.1.202.4 repeat 100 size 1490 timeout 1

Type escape sequence to abort.
Sending 100, 1490-byte ICMP Echos to 155.1.202.4, timeout is 1 seconds:
!!!!!!!!!!.!!.!!.!!.!!!.!!.!!.!!!!!!!!!!!!!!.!!!!!!.!!!.!!!!!!!!.!!!!!!
!!.!!!!!!.!!!!!!!!!!!!!!.!!!!!.
Success rate is 85 percent (85/100), round-trip min/avg/max = 1/266/805 ms

SW2#show mls qos interface fa0/13 statistics
FastEthernet0/13

  dscp: incoming
-------------------------------

  0 -  4 :         200           0           0           0           0
  5 -  9 :           0           0           0           0           0
 10 - 14 :           0           0           0           0           0
 15 - 19 :           0           0           0           0           0
 20 - 24 :           0           0           0           0           0
 25 - 29 :           0           0           0           0           0
 30 - 34 :           0           0           0           0           0
 35 - 39 :           0           0           0           0           0
 40 - 44 :           0           0           0           0           0
 45 - 49 :           0           0           0           4           0
 50 - 54 :           0           0           0           0           0
 55 - 59 :           0           4           0           0           0
 60 - 64 :           0           0           0           0
  dscp: outgoing
```

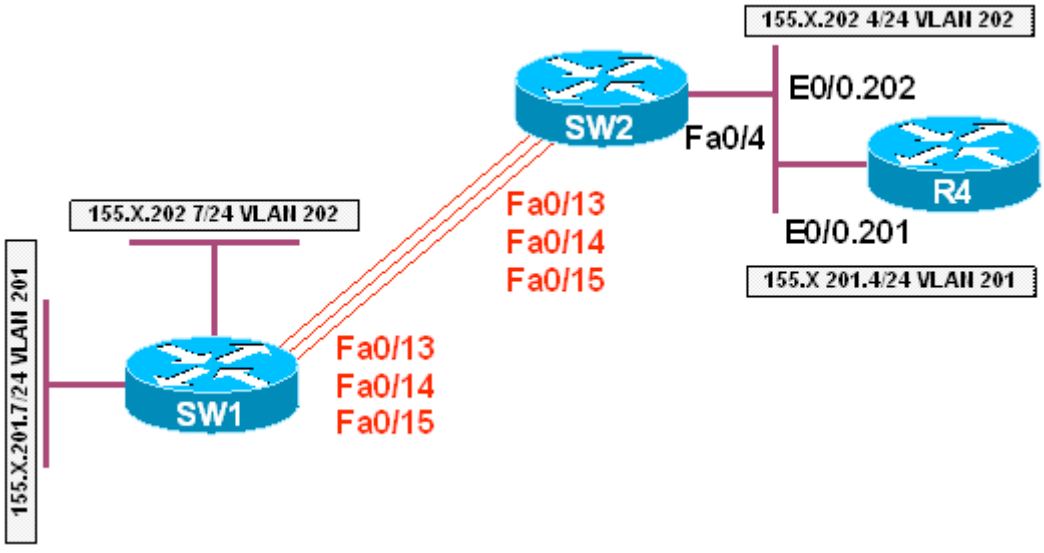
```
-------------------------------

  0 -  4 :          189             0             0             0             0
  5 -  9 :            0             0             0             0             0
 10 - 14 :            0             0             0             0             0
 15 - 19 :            0             0             0             0             0
 20 - 24 :            0             0             0             0             0
 25 - 29 :            0             0             0             0             0
 30 - 34 :            0             0             0             0             0
 35 - 39 :            0             0             0             0             0
 40 - 44 :            0             0             0             0             0
 45 - 49 :            0             0             0             0             0
 50 - 54 :            0             0             0             0             0
 55 - 59 :            0            19             0             0             0
 60 - 64 :            0             0             0             0
  cos: incoming
-------------------------------

  0 -  4 :          424             0             0             0             0
  5 -  7 :            0             0            81
  cos: outgoing
-------------------------------

  0 -  4 :          378             0             0             0             0
  5 -  7 :            0             0             0
Policer: Inprofile:            0 OutofProfile:             0

SW2#show mls qos interface fa0/4 statistics
FastEthernet0/4

  dscp: incoming
-------------------------------

  0 -  4 :            0             0             0             0             0
  5 -  9 :            0             0             0             0             0
 10 - 14 :            0             0             0             0             0
 15 - 19 :            0             0             0             0             0
 20 - 24 :            0             0             0             0             0
 25 - 29 :            0             0             0             0             0
 30 - 34 :            0             0            85             0             0
 35 - 39 :            0             0             0             0             0
 40 - 44 :           87             0             0             0             0
 45 - 49 :            0             0             0             0             0
 50 - 54 :            0             0             0             0             0
 55 - 59 :            0             0             0             0             0
 60 - 64 :            0             0             0             0
  dscp: outgoing
-------------------------------

  0 -  4 :           27             0             0             0             0
  5 -  9 :            0             0             0             0             0
 10 - 14 :            0             0             0             0             0
 15 - 19 :            0             0             0             0             0
 20 - 24 :            0             0             0             0             0
 25 - 29 :            0             0             0             0             0
 30 - 34 :            0             0            85             0             0
 35 - 39 :            0             0             0             0             0
 40 - 44 :           87             0             0             0             0
 45 - 49 :            0             0             0             0             0
 50 - 54 :            0             0             0             0             0
 55 - 59 :            0            47             0             0             0
 60 - 64 :            0             0             0             0
```

```
  cos: incoming
-------------------------------

  0 -  4 :         191            0            0            0            0
  5 -  7 :           0            0            0
  cos: outgoing
-------------------------------

  0 -  4 :         587            0            0            0           85
  5 -  7 :          87            0            0
Policer: Inprofile:            0 OutofProfile:            0
```

## Using Hierarchical Policy-Maps for Policing Markdown on 3560

**Objective:** Configure policing markdown for IP traffic on per-VLAN basis




### Directions

- In this task SW1 will source IP traffic and SW2 will classify and police it inbound
- IP traffic from VLANs 201 and 202 will by classified, marked and policed differently
- In case if traffic is out of profile, SW2 will not drop ip, but remark with lower DSCP value
- Configure SW1 , SW2 in VTP transparent mode and create VLANs 201 and 202 on both switches
- Shutdown interface Fa 0/19 – 0/21 on SW1 and Fa 0/16 – 18 on SW2
- Create SVI interfaces and configure IP addresses on SW1 and R4 as per diagram
- Configure port Fa 0/4 of SW2 as 802.1q trunk
- Create access-list 100 on SW2 to match IP traffic
- Create class-map IP_TRAFFIC to match access-group 100
- Create class-map INPUT_INTERFACES and match interface range Fa 0/13 – 15 with it
- Create policy-map POLICE_64K, and rate-limit class INPUT_INTERFACES to 64 Kbps within. Configure markdown as exceed action.
- Create policy-map POLICE_32K and rate-limit class INPUT_INTERFACES to 32Kb within. Configure markdown as exceed action.
- Configure policed DSCP markdown of DSCP value 40 to 32 and DSCP value 32 to 16

- Create policy-map VLAN201_POLICY and set IP precedence for class IP_TRAFFIC to 5. Assign nested service-policy POLICE_64K to this class Attach this policy map to VLAN 201.
- Create policy-map VLAN202_POLICY and set IP precedence for class IP_TRAFFIC to 4. Assign nested service-policy POLICE_32K to this class Attach this policy map to VLAN 202.
- Enable vlan-based MLS QoS on interfaces Fa 0/13 – 0/15 of SW2.

## Final Configuration

**SW1, SW2:**

```
vtp mode transparent
vlan 201,202
```

**SW1:**

```
interface range fastEthernet 0/19 – 21
 shutdown
!
interface Vlan 201
 ip address 155.1.201.7 255.255.255.0
!
interface Vlan 202
 ip address 155.1.202.7 255.255.255.0
```

**SW2:**

```
interface Vlan 201
 no ip address
!
interface Vlan 202
 no ip address
!
interface range fastEthernet 0/16 – 18
  shutdown
!
interface fas 0/4
 switchport trunk encaps dot1q
 switchport mode trunk
!
!
!
mls qos
!
interface range Fa 0/13 , Fa 0/14 , Fa 0/15
 mls qos vlan-based
!
access-list 100 permit ip any any
!
class-map IP_TRAFFIC
match access-group 100
!
class-map INPUT_INTERFACES
 match input Fa 0/13 – fa 0/15
!
policy-map POLICE_64K
 class INPUT_INTERFACES
   police 64000 32000 exceed policed
!
policy-map POLICE_32K
 class INPUT_INTERFACES
```

```
   police 32000 16000 exceed policed
!
mls qos map policed-dscp  32 to 16
mls qos map policed-dscp  40 to 24
!
policy-map VLAN201_POLICY
 class IP_TRAFFIC
  set ip precedence 5
  service-policy POLICE_64K
!
policy-map VLAN202_POLICY
 class IP_TRAFFIC
   set ip precedence 4
   service-policy POLICE_32K
!
interface Vlan 201
 service input VLAN201_POLICY
!
interface Vlan 202
 service input VLAN202_POLICY

R4:
interface ethernet 0/0
 no shutdown
!
interface ethernet 0/0.201
 encaps dot1q 201
 ip address 155.1.201.4 255.255.255.0
!
interface ethernet 0/0.202
 encaps dot1q 202
 ip address 155.1.202.4 255.255.255.0
```

## Verification

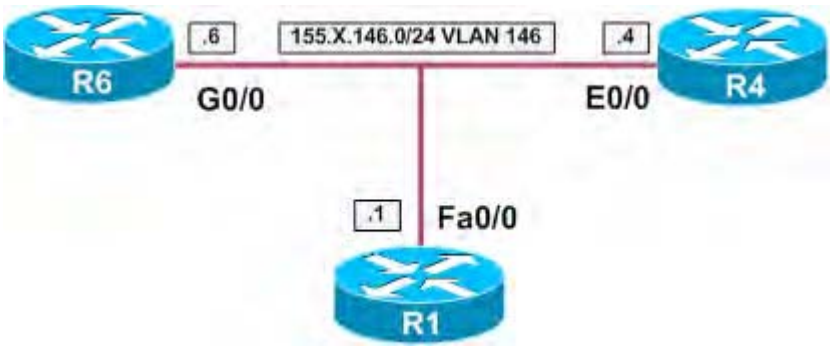
```
SW1#ping 155.1.201.4 repeat 100 size 1490 timeout 1

Type escape sequence to abort.
Sending 100, 1490-byte ICMP Echos to 155.1.201.4, timeout is 1 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (100/100), round-trip min/avg/max = 1/5/25 ms

SW1#ping 155.1.202.4 repeat 100 size 1490 timeout 1

Type escape sequence to abort.
Sending 100, 1490-byte ICMP Echos to 155.1.202.4, timeout is 1 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (100/100), round-trip min/avg/max = 1/5/9 ms
SW1#

SW2#show mls qos interface fa0/4 statistics
FastEthernet0/4

  dscp: incoming
--------------------------------

  0 -  4 :           0            0            0            0            0
  5 -  9 :           0            0            0            0            0
```

```
 10 - 14 :           0            0            0            0            0
 15 - 19 :           0           89            0            0            0
 20 - 24 :           0            0            0            0           89
 25 - 29 :           0            0            0            0            0
 30 - 34 :           0            0           11            0            0
 35 - 39 :           0            0            0            0            0
 40 - 44 :          11            0            0            0            0
 45 - 49 :           0            0            0            0            0
 50 - 54 :           0            0            0            0            0
 55 - 59 :           0            0            0            0            0
 60 - 64 :           0            0            0            0
  dscp: outgoing
-------------------------------

  0 -  4 :           5            0            0            0            0
  5 -  9 :           0            0            0            0            0
 10 - 14 :           0            0            0            0            0
 15 - 19 :           0           89            0            0            0
 20 - 24 :           0            0            0            0           89
 25 - 29 :           0            0            0            0            0
 30 - 34 :           0            0           11            0            0
 35 - 39 :           0            0            0            0            0
 40 - 44 :          11            0            0            0            0
 45 - 49 :           0            0            0            0            0
 50 - 54 :           0            0            0            0            0
 55 - 59 :           0            5            0            0            0
 60 - 64 :           0            0            0            0
  cos: incoming
-------------------------------

  0 -  4 :         203            0            0            0            0
  5 -  7 :           0            0            0
  cos: outgoing
-------------------------------

  0 -  4 :          89            0           89           89           11
  5 -  7 :          11            0            0
Policer: Inprofile:            0 OutofProfile:            0

SW2#show mls qos interface fa0/13 statistics
FastEthernet0/13

  dscp: incoming
-------------------------------

  0 -  4 :         200            0            0            0            0
  5 -  9 :           0            0            0            0            0
 10 - 14 :           0            0            0            0            0
 15 - 19 :           0            0            0            0            0
 20 - 24 :           0            0            0            0            0
 25 - 29 :           0            0            0            0            0
 30 - 34 :           0            0            0            0            0
 35 - 39 :           0            0            0            0            0
 40 - 44 :           0            0            0            0            0
 45 - 49 :           0            0            0            1            0
 50 - 54 :           0            0            0            0            0
 55 - 59 :           0            1            0            0            0
 60 - 64 :           0            0            0            0
  dscp: outgoing
-------------------------------

  0 -  4 :         204            0            0            0            0
```

```
  5 -  9 :           0            0            0            0            0
 10 - 14 :           0            0            0            0            0
 15 - 19 :           0            0            0            0            0
 20 - 24 :           0            0            0            0            0
 25 - 29 :           0            0            0            0            0
 30 - 34 :           0            0            0            0            0
 35 - 39 :           0            0            0            0            0
 40 - 44 :           0            0            0            0            0
 45 - 49 :           0            0            0            0            0
 50 - 54 :           0            0            0            0            0
 55 - 59 :           0            5            0            0            0
 60 - 64 :           0            0            0            0
  cos: incoming
------------------------------

  0 -  4 :         254            0            0            0            0
  5 -  7 :           0            0           23
  cos: outgoing
------------------------------

  0 -  4 :         249            0            0            0            0
  5 -  7 :           0            0            0
Policer: Inprofile:            0 OutofProfile:            0
```

## Using VLAN Access-Map for Non-IP Traffic Filtering

**Objective:** Configure switches to permit the minimum necessary non-IP traffic for an IP network




**Directions**

- Create VLAN 146 on SW1 and SW2, configure access-ports and IP addressing for routers as per the diagram
- Shutdown interface Fa 0/15 on SW1 and SW2. Configure interfaces Fa 0/13 as dot1q trunks, and Fa 0/14 as ISL trunks.
- In our task, necessary non-IP traffic includes STP and ARP frames
- We may distinguish ARP frames by Ethertype value of 0x806
- With STP situation is a bit more complex:
  - Cisco uses it's proprietary PVST protocol over ISL trunks. Switches send BPDUs encapsulated with VLAN tag header, using LLC frame format with LSAP (SSAP/DSAP) value of 0x42
  - With 802.1q Trunks, Cisco utilizes PVST+ protocols. In this implementation, STP BPDUs are sent over non-native VLAN with LLC SNAP encapsulation. This frame format uses LSAP value of 0xAA, and additional SNAP data to distinguish STP frames
- Note that the Catalyst switches do look farther into the SNAP frame for additional protocol information. Once SNAP frames are permitted, any L3 protocol that uses them is permitted as well
- Create MAC access-list PVST to match PVST BPDUs
- Create MAC access-list ARP to match ARP frames
- Create MAC access-list PVST_PLUS to match PVST+ BPDUs
- Create VLAN access-map VLAN146_FILTER and forward the mentioned traffic types with it
- Apply this VLAN filter to VLAN 146

## Final Configuration

**SW1 & SW2:**
```
vtp mode transparent
vlan 146
!
```

**SW1:**
```
interface FastEthernet0/1
 switchport host
 switchport access vlan 146
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/13
 switch trunk encaps dot1q
 switch mode trunk
!
interface FastEthernet0/14
 switch trunk encaps isl
 switch mode trunk
```

**SW2:**
```
interface range Fa 0/4 , Fa 0/6
 switchport host
 switchport access vlan 146
```

**R1:**
```
interface FastEthernet0/0
   no shut
   ip add 155.1.146.1 255.255.255.0
!
```
**R4:**
```
interface Ethernet0/0
   no shut
   ip add 155.1.146.4 255.255.255.0
!
```
**R6:**
```
interface GigabitEthernet0/0
   no shutdown
   ip address 155.1.146.6 255.255.255.0
```

**SW1 & SW2:**
```
mac access-list extended ARP
 permit any any 0x806
!
mac access-list extended PVST
 permit any any lsap 0x4242 0x0
!
mac access-list extended PVST_PLUS
 permit any any lsap 0xAAAA 0x0
!
!
vlan access-map VLAN146_FILTER 10
 action forward
 match mac address ARP
!
vlan access-map VLAN146_FILTER 20
 action forward
 match mac address PVST
```

```
!
vlan access-map VLAN146_FILTER 30
 action forward
 match mac address PVST_PLUS
!
vlan filter VLAN146_FILTER vlan-list 146
```

## Verification

```
R1#ping 155.1.146.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.146.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

R1#ping 155.1.146.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.146.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Verify STP. If a switch hears STP BPDUs, then a Root ports should be elected:

SW1#show spanning-tree vlan 146

VLAN0146
  Spanning tree enabled protocol ieee
  Root ID    Priority    32914
             Address     0016.4639.d580
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32914  (priority 32768 sys-id-ext 146)
             Address     0016.4639.d580
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.3    Edge P2p
Fa0/13           Desg FWD 19        128.15   P2p
Fa0/14           Desg FWD 19        128.16   P2p

SW2#show spanning-tree vlan 146

VLAN0146
  Spanning tree enabled protocol ieee
  Root ID    Priority    32914
             Address     0016.4639.d580
             Cost        19
             Port        16 (FastEthernet0/14)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32914  (priority 32768 sys-id-ext 146)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300
```

```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/4            Desg FWD 100       128.6    Edge Shr
Fa0/6            Desg FWD 19        128.8    Edge P2p
Fa0/13           Desg FWD 19        128.15   P2p
Fa0/14           Root FWD 19        128.16   P2p
```

*Shutdown the ISL trunk to verify if filtering is OK with 802.1q:*

```
SW2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
SW2(config)#int fa 0/14
SW2(config-if)#shut
SW2#

SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q            trunking      1

Port        Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1,146

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1,146

SW2#show spanning-tree vlan 146

VLAN0146
  Spanning tree enabled protocol ieee
  Root ID    Priority    32914
             Address     0016.4639.d580
             Cost        19
             Port        16 (FastEthernet0/14)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32914  (priority 32768 sys-id-ext 146)
             Address     0016.9d31.8380
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/3            Desg FWD 100       128.5    Shr
Fa0/4            Desg FWD 100       128.6    Edge Shr
Fa0/6            Desg FWD 19        128.8    Edge P2p
Fa0/13           Root FWD 19        128.16   P2p
```

*Confirm that other SNAP-encapsulated protocols may also traverse VLAN 146:*

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#ipx routing
R4(config)#interface e0/1
R4(config-if)#ipx network 146 encapsulation snap

R6(config)#ipx routing
R6(config)#interface g0/1
```

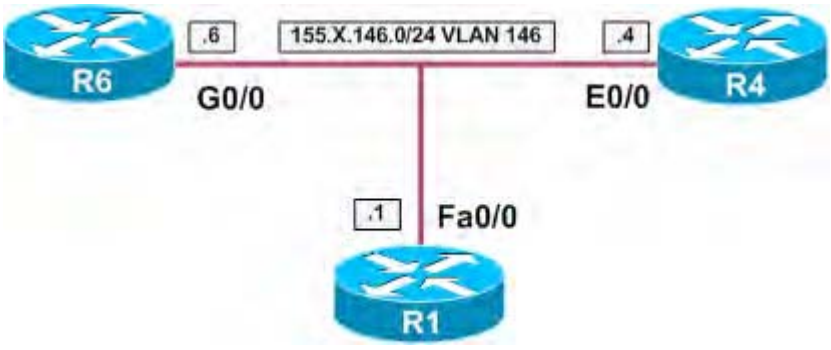
 

```
R6(config-if)#ipx network 146 encapsulation snap

R6#show ipx interface g0/1
GigabitEthernet0/1 is up, line protocol is up
  IPX address is 146.0015.622e.e531, SNAP [up]
  Delay of this IPX network, in ticks is 1
  IPXWAN processing not enabled on this interface.
  IPX SAP update interval is 60 seconds
  IPX type 20 propagation packet forwarding is disabled
  Incoming access list is not set
  Outgoing access list is not set
  IPX helper access list is not set
  SAP GGS output filter list is not set
  SAP GNS processing enabled, delay 0 ms, output filter list is not set
  SAP Input filter list is not set
  SAP Output filter list is not set
  SAP Router filter list is not set
  Input filter list is not set
  Output filter list is not set
  Router filter list is not set
  Netbios Input host access list is not set
  Netbios Input bytes access list is not set
  Netbios Output host access list is not set
  Netbios Output bytes access list is not set
  Updates each 60 seconds aging multiples RIP: 3 SAP: 3
  SAP interpacket delay is 55 ms, maximum size is 480 bytes

R4#ping ipx 146.0015.622e.e531

Type escape sequence to abort.
Sending 5, 100-byte IPX Novell Echoes to 146.0015.622e.e531, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
Rack1R4#
```

## Using VLAN Access-Map for IP Traffic Filtering

**Objective:** Configure the switches to permit only specified IP traffic




### Directions

- Configure devices as per the 3550/3560 scenario "Using VLAN Access-Map for Non-IP Traffic Filtering"
- Permit only ping and telnet traffic to pass through the VLAN
- In future, there may be OSPF configured between routers. Make sure you account for this.
- Create access-list 100 on both switches and match telnet and ping traffic plus additionally match OSPF
- Add an entry to access-map VLAN146_FILTER and re-apply it in on both switches

### Final Configuration

**SW1 & SW2:**

```
access-list 100 permit icmp any any echo
access-list 100 permit icmp any any echo-reply
access-list 100 permit tcp any any eq 23
access-list 100 permit tcp any eq 23 any
access-list 100 permit ospf any any
!
vlan access-map VLAN146_FILTER 40
 action forward
 match ip address 100
!
no vlan filter VLAN146_FILTER vlan-list 146
vlan filter VLAN146_FILTER vlan-list 146
```

## Verification

```
R1#ping 155.1.146.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 155.1.146.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms

R1#telnet 155.1.146.6
Trying 155.1.146.6 ... Open

Rack1R6#exit

[Connection to 155.1.146.6 closed by foreign host]

R1#telnet 155.1.146.6 80
Trying 155.1.146.6, 80 ...
% Connection timed out; remote host not responding

R1#trace 155.1.146.6

Type escape sequence to abort.
Tracing the route to 155.1.146.6

  1  *  *  *
  2  *
R1#
```

## Configuring Port-Security

**Objective:** Configure SW1 to permit only R1 to be connected to Fa 0/1

### Directions

- Find out R1 ethernet interface's MAC address
- Configure Fa 0/1 port of SW1 as static access-port
- Enable port-security on Fa0/1, and configure the static secure MAC address of R1

### Final Configuration

```
R1#show interfaces fastEthernet 0/0
FastEthernet0/0 is up, line protocol is up
  Hardware is AmdFE, address is 0004.27b5.2f60 (bia 0004.27b5.2f60)
  Internet address is 155.1.146.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:03, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/115118/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1814303 packets input, 1002127978 bytes
     Received 1761770 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     197131 packets output, 20724753 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out

SW1:
interface Fa 0/1
 switchport mode access
 switchport port-security
 switchport port-security mac-address 0004.27b5.2f60
```

## Verification

```
SW1#show port-security interface fastEthernet 0/1
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 1
Configured MAC Addresses   : 1
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0004.27b5.2f60:1
Security Violation Count   : 0

R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface fa0/0
R1(config-if)#mac-address 0004.27b5.2f61

SW1#show port-security interface fa0/1
Port Security              : Enabled
Port Status                : Secure-shutdown
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 1
Configured MAC Addresses   : 1
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0004.27b5.2f61:146
Security Violation Count   : 1

SW1#show interface fa0/1
FastEthernet0/1 is down, line protocol is down (err-disabled)
  Hardware is Fast Ethernet, address is 0016.4639.d583 (bia 0016.4639.d583)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set

<output omitted>
```

## Port-Security Violation Action

**Objective:** Configure the switch to block and report port-security violations

### Directions

- Determine R1 Ethernet interface's MAC address
- Configure Fa 0/1 port of SW1 as a static access-port
- Enable port-security on Fa0/1 and configure the static secure MAC address of R1
- Configure "restrict" as violation action

### Final Configuration

```
R1#show interfaces fa0/0
FastEthernet0/0 is up, line protocol is up
  Hardware is AmdFE, address is 0004.27b5.2f60 (bia 0004.27b5.2f60)
  Internet address is 155.1.146.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:03, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/115118/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1814303 packets input, 1002127978 bytes
     Received 1761770 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     197131 packets output, 20724753 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out

SW1:
interface Fa 0/1
 switchport mode access
 switchport port-security
 switchport port-security mac-address 0004.27b5.2f60
 switchport port-security violation restrict
```

### Verification

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface fa0/0
```

```
R1(config-if)#mac-address 0004.27b5.2f6

SW1#
%PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC
address 0004.27b5.2f61 on port FastEthernet0/1.

%PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC
address 0004.27b5.2f61 on port FastEthernet0/1.

%PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by MAC
address 0004.27b5.2f61 on port FastEthernet0/1.
SW1#

SW1#show interfaces fa0/1
FastEthernet0/1 is up, line protocol is up (connected)
  Hardware is Fast Ethernet, address is 0016.4639.d583 (bia 0016.4639.d583)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, media type is 10/100BaseTX
  input flow-control is off, output flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:57, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     9091 packets input, 993615 bytes, 0 no buffer
     Received 1303 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 1294 multicast, 0 pause input
     0 input packets with dribble condition detected
     451957711 packets output, 2305059375 bytes, 0 underruns
     0 output errors, 0 collisions, 3 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out

SW1#show port-security interface fastEthernet 0/1
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 1
Configured MAC Addresses   : 1
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0004.27b5.2f61:146
Security Violation Count   : 28
```

## Port-Security Violation Recovery

**Objective:** Configure the switch to restore the secure-down port in 1 minute

### Directions

- Determine R1 Ethernet interface's MAC address
- Configure Fa 0/1 port of SW1 as a static access-port
- Enable port-security on Fa0/1 and configure the static secure MAC address of R1
- Configure psecure-violation as errdisable recovery cause
- Configure the recovery interval of 1 minute

### Final Configuration

```
R1#show interfaces fa0/0
FastEthernet0/0 is up, line protocol is up
  Hardware is AmdFE, address is 0004.27b5.2f60 (bia 0004.27b5.2f60)
  Internet address is 155.1.146.1/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:03, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/115118/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     1814303 packets input, 1002127978 bytes
     Received 1761770 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     197131 packets output, 20724753 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out

SW1:
interface Fa 0/1
 switchport mode access
 switchport port-security
 switchport port-security mac-address 0004.27b5.2f60

!
errdisable recovery cause psecure
errdisable recovery interval 60
```

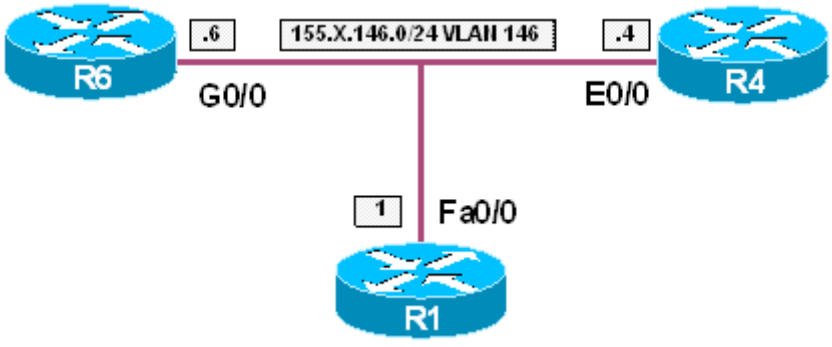
## Verification

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface fa0/0
R1(config-if)#mac-address 0004.27b5.2f6

SW1(config-if)#
23:40:49: %PM-4-ERR_DISABLE: psecure-violation error detected on Fa0/1, putting
Fa0/1 in err-disable state

23:40:49: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred,
caused by MAC address 0004.27b5.2f61 on port FastEthernet0/1.

23:40:50: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
23:40:51: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down

23:41:43: %PM-4-ERR_RECOVER: Attempting to recover from psecure-violation err-
disable state on Fa0/1

23:41:46: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
23:41:47: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up
```

## Port-Security and HSRP with Virtual MAC Address

**Objective:** Configure the switch to support HSRP with port-security




### Directions

- Create VLAN 146 on SW1 and SW2, configure the access-ports and IP addressing for routers as per diagram
- Configure HSRP group 1 on R4 and R6, use the virtual IP of 155.X.146.254
- Configure port-security on SW2 for ports Fa 0/4 and Fa 0/6
- Permit the HSRP virtual MAC address to be learned on these ports
- Do not configure static secure MAC addresses

### Final Configuration

```
SW1 & SW2:
vtp mode transparent
vlan 146
!
SW1:
interface FastEthernet 0/1
 switchport host
 switchport access vlan 146
!
SW2:
interface range Fa 0/4 , Fa 0/6
 switchport host
 switchport access vlan 146

R4:
interface Ethernet0/0
 no shutdown
 ip address 155.1.146.4 255.255.255.0
 standby 1 ip 155.1.146.254
!
R6:
interface GigabitEthernet0/0
 no shutdown
 ip address 155.1.146.6 255.255.255.0
 standby 1 ip 155.1.146.254
```

```
SW2:
interface range Fa 0/4 , Fa 0/6
  switchport port-security
  switchport port-security maximum 2
```

## Verification

```
Rack1R4#show standby
Ethernet0/1 - Group 1
  State is Active
    2 state changes, last state change 00:46:07
  Virtual IP address is 155.1.146.254
  Active virtual MAC address is 0000.0c07.ac01
    Local virtual MAC address is 0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.084 secs
  Preemption disabled
  Active router is local
  Standby router is unknown
  Priority 100 (default 100)
  IP redundancy name is "hsrp-Et0/1-1" (default)

SW2#show port-security interface fa0/4
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 2
Total MAC Addresses        : 2
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 00b0.6416.2dc2:146
Security Violation Count   : 0

SW2#show port-security interface fa0/6
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 2
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0015.622e.e531:146
Security Violation Count   : 0

SW2#show mac-address-table interface fa0/4
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
 146    0000.0c07.ac01    STATIC      Fa0/4
 146    00b0.6416.2dc2    STATIC      Fa0/4
Total Mac Addresses for this criterion: 2
```

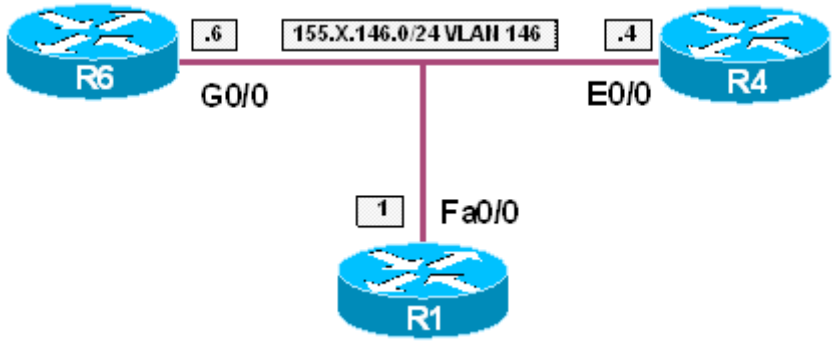
 

```
SW2#show mac-address-table interface fastEthernet 0/6
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
 146    0015.622e.e531    STATIC      Fa0/6
Total Mac Addresses for this criterion: 1
```

## Port-Security and HSRP with BIA MAC Address

**Objective:** Configure the switch to support HSRP with port-security




### Directions

- Create VLAN 146 on SW1 and SW2, configure access-ports and IP addressing for routers as per diagram
- Configure HSRP group 1 on R4 and R6, use virtual IP 155.X.146.254
- Configure HSRP to use the BIA MAC address instead of virtual MAC address
- Configure port-security on SW2 for ports Fa 0/4 and Fa 0/6
- Permit only one secure MAC address on these ports
- Do not configure static secure MAC addresses

### Final Configuration

```
SW1 & SW2:
vtp mode transparent
vlan 146
!
SW1:
interface FastEthernet0/1
 switchport host
 switchport access vlan 146
!
SW2:
interface range Fa 0/4 , Fa 0/6
 switchport host
 switchport access vlan 146

R4:
interface Ethernet0/0
  no shutdown
  ip address 155.1.146.4 255.255.255.0
  standby 1 ip 155.1.146.254
  standby use-bia
!
R6:
interface GigabitEthernet0/0
 no shutdown
 ip address 155.1.146.6 255.255.255.0
 standby 1 ip 155.1.146.254
```

```
 standby use-bia

SW2:
interface range Fa 0/4 , Fa 0/6
  switchport port-security
  switchport port-security maximum 1
```

## Verification

```
R4#show standby
Ethernet0/1 - Group 1
  State is Standby
    4 state changes, last state change 00:00:12
  Virtual IP address is 155.1.146.254
  Active virtual MAC address is 0015.622e.e531
    Local virtual MAC address is 00b0.6416.2dc2 (bia)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.000 secs
  Preemption disabled
  Active router is 155.1.146.6, priority 100 (expires in 8.996 sec)
  Standby router is local
  Priority 100 (default 100)
  IP redundancy name is "hsrp-Et0/1-1" (default)

R6#show standby
GigabitEthernet0/1 - Group 1
  State is Active
    2 state changes, last state change 00:01:07
  Virtual IP address is 155.1.146.254
  Active virtual MAC address is 0015.622e.e531
    Local virtual MAC address is 0015.622e.e531 (bia)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.708 secs
  Preemption disabled
  Active router is local
  Standby router is 155.1.146.4, priority 100 (expires in 7.716 sec)
  Priority 100 (default 100)
  IP redundancy name is "hsrp-Gi0/1-1" (default)
```