

IEWB-RS Technology Labs Bridging and Switching

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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
                              Vlan
                                        Duplex Speed Type
Port
         Name
                 Status
                 connected 1
Fa0/1
                                        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)

SWl#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 in Port Na Fa0/13	terface statu ame Sta con	s include (P o tus Vlan nected trun	Drt Fa0/13) Duplex a-full	Speed Type 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 in Port Fa0/13 <output omi<="" td=""><td>terface trunk Mode desirable tted></td><td>Encapsulation n-isl</td><td>Status trunking</td><td>Native vlan 1</td><td></td></output>	terface trunk Mode desirable tted>	Encapsulation n-isl	Status trunking	Native vlan 1		

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:

Port

```
interface FastEthernet0/13
switchport trunk encapsulation dotlq
switchport mode trunk
```

Vlans allowed on trunk

Verification

SW1# show in Port Na Fa0/13	t erface stat ame	is include Status connected	(Port Fa Vlan trunk	0/13) Duplex a-full	Speed a-100	Type 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: dotlq Operational Trunking Encapsulation: dotlq Negotiation of Trunking: On						
Access Mode VLAN: 1 (default) Trunking Native Mode VLAN: 1 (default)						
Sw1# snow in Port Fa0/13	Mode desirable	c Encapsulatio n-802.1q	on Stat tr	us unking	Nativ 1	ve vlan

Fa0/13	1-4094				
Port Fa0/13	Vlans allowed and active in management domain 1				
Port Fa0/13	Vlans in spanning tree forwarding state and not pruned 1				
SW2#show interface trunk					
Port Fa0/13	ModeEncapsulationStatusNative vlanon802.1qtrunking1				
PortVlans allowed on trunkFa0/131-4094					
Port Fa0/13	Vlans allowed and active in management domain 1				
Port Fa0/13	Vlans in spanning tree forwarding state and not pruned 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 dotlq
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 allowe	d on trunk		

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 in	erface 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 int	erface trunk				
Port Fa0/13	Mode on	Encapsulation isl	Status trunking	Native vlan 1	
Port VI Fa0/13	ans allowed o 1-4094	on trunk			
Port Fa0/13	Vlans allowed 1	l and active in	management dor	nain	
Port Fa0/13	Vlans in spanning tree forwarding state and not pruned 13 1				
SW1 #show int Name: Fa0/13 Switchport: Administrati Operational Administrati Operational Negotiation Access Mode Trunking Nat SW2 #show int	Enabled Enabled .ve Mode: trunk Mode: trunk .ve Trunking F Trunking Enca of Trunking: VLAN: 1 (defa tive Mode VLAN Erface trunk	3 switchport ak Encapsulation: is off ault) J: 1 (default)	.sl		
Port	Mode	Encapsulation	Status	Native vlan	
- 0 (1 0				-	

Port Vlans allowed on trunk 1-4094 Fa0/13 Vlans allowed and active in management domain Port Fa0/13 1 Vlans in spanning tree forwarding state and not pruned Port 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
1
interface GigabitEthernet0/0.16
 encapsulation dot1Q 16
 ip address 16.0.0.6 255.0.0.0
T
interface GigabitEthernet0/0.26
 encapsulation dot1Q 26
```

ddroad 26 0 0 6 255

```
SW1:
vlan 16,26
!
interface FastEthernet0/1
switchport access vlan 16
!
interface FastEthernet0/2
switchport access vlan 26
!
interface FastEthernet0/6
switchport trunk encapsulation dotlq
switchport mode trunk
```

```
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:
11111
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
        Vlans allowed on trunk
Port
           1-4094
Fa0/6
Port
           Vlans allowed and active in management domain
Fa0/6
           1,16,26
           Vlans in spanning tree forwarding state and not pruned
Port
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: dotlg
Operational Trunking Encapsulation: dotlq
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
1
interface GigabitEthernet0/0.16
 encapsulation dot1Q 16 native
 ip address 16.0.0.6 255.0.0.0
```

```
interface GigabitEthernet0/0.26
 encapsulation dot10 26
 ip address 26.0.0.6 255.0.0.0
SW1:
vlan 16,26
1
interface FastEthernet0/1
switchport access vlan 16
1
interface FastEthernet0/2
 switchport access vlan 26
1
interface FastEthernet0/6
 switchport trunk encapsulation dotlg
 switchport trunk native vlan 16
 switchport mode trunk
```

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: 11111 Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms SW1#show interface trunk Mode Encapsulation Status Native vlan Port Fa0/6 on 802.1q trunking 16 Vlans allowed on trunk Port 1-4094 Fa0/6 Port Vlans allowed and active in management domain Fa0/6 1,16,26 Vlans in spanning tree forwarding state and not pruned Port 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: dotlg Operational Trunking Encapsulation: dotlq 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 channelgroup 1 with a mode of "on"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channelgroup 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
1
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
1
interface FastEthernet0/15
channel-group 1 mode on
1
interface Port-channel1
switchport mode dynamic desirable
```

Verification

```
SWl#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 Pol(SU) _ Fa0/13(P) Fa0/14(P) Fa0/15(P) SW1#show interface port-channel1 switchport Name: Pol 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 desirable n-isl trunking 1 Pol Port Vlans allowed on trunk Pol 1-4094 Port Vlans allowed and active in management domain Pol 1 Port Vlans in spanning tree forwarding state and not pruned Pol 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 _____ ____ Pol 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 channelgroup 1 with a mode of "desirable"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channelgroup 1 with a mode of "desirable"

Final Configuration

SW1:

```
interface FastEthernet0/13
channel-group 1 mode desirable
1
interface FastEthernet0/14
channel-group 1 mode desirable
interface FastEthernet0/15
channel-group 1 mode desirable
1
interface Port-channel1
switchport mode dynamic desirable
SW2:
interface FastEthernet0/13
channel-group 1 mode desirable
1
interface FastEthernet0/14
channel-group 1 mode desirable
!
interface FastEthernet0/15
channel-group 1 mode desirable
1
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: Group Port-channel Protocol Ports _____+ 1 Pol(SU) PAgP Fa0/13(P) Fa0/14(P) Fa0/15(P) SW1#show interface port-channel1 switchport Name: Pol 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 desirable n-isl trunking 1 Pol Port Vlans allowed on trunk 1-4094 Pol 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 _____ _____ Pol 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 channelgroup 1 with a mode of "desirable"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channelgroup 1 with a mode of "auto"

Final Configuration

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

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 Pol(SU) PAgP Fa0/13(P) Fa0/14(P) Fa0/15(P) SW1#show interface port-channel1 switchport Name: Pol 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** Mode Encapsulation Status Native vlan Port desirable n-isl trunking 1 Pol Port Vlans allowed on trunk Pol 1-4094 Vlans allowed and active in management domain Port Po1 1 Port Vlans in spanning tree forwarding state and not pruned Pol 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 ----- ---- ---- ---- -----_____ Desg FWD 9 128.65 P2p Po1

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

Final Configuration

SW1: interface FastEthernet0/13 channel-group 1 mode active 1 interface FastEthernet0/14 channel-group 1 mode active interface FastEthernet0/15 channel-group 1 mode active 1 interface Port-channel1 switchport mode dynamic desirable SW2: interface FastEthernet0/13 channel-group 1 mode active 1 interface FastEthernet0/14 channel-group 1 mode active !

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

```
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:
Group Port-channel Protocol Ports
1 Pol(SU)
                       LACP Fa0/13(P) Fa0/14(P) Fa0/15(P)
SW1#show interface port-channel1 switchport
Name: Pol
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
       Mode Encapsulation Status Native vlan
desirable n-isl trunking 1
Port
Pol
Port Vlans allowed on trunk
Pol
         1-4094
      Vlans allowed and active in management domain
Port
         1
Po1
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
_____ ____
               Desg FWD 9 128.65 P2p
Pol
```

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

Final Configuration

```
SW1:
interface FastEthernet0/13
channel-group 1 mode active
1
interface FastEthernet0/14
channel-group 1 mode active
interface FastEthernet0/15
channel-group 1 mode active
1
interface Port-channel1
switchport mode dynamic desirable
SW2:
interface FastEthernet0/13
channel-group 1 mode passive
1
interface FastEthernet0/14
channel-group 1 mode passive
!
interface FastEthernet0/15
channel-group 1 mode passive
1
interface Port-channel1
switchport mode dynamic desirable
```

```
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:
Group Port-channel Protocol Ports
1 Pol(SU)
                      LACP Fa0/13(P) Fa0/14(P) Fa0/15(P)
SW1#show interface port-channel1 switchport
Name: Pol
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
       Mode Encapsulation Status Native vlan
Port
         desirable n-isl trunking 1
Pol
Port Vlans allowed on trunk
Pol
         1-4094
Port Vlans allowed and active in management domain
         1
Po1
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
_____ ____
              Desg FWD 9 128.65 P2p
Pol
```

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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 channelgroup 1 with a mode of "on"
- Configure interfaces Fa0/13, Fa0/14, and Fa0/15 on SW2 in channelgroup 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
1
interface FastEthernet0/15
no switchport
channel-group 1 mode on
1
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
```

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```
!
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
```

```
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:
11111
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
      Pol(RU)
                     -
                              Fa0/13(P) Fa0/14(P) Fa0/15(P)
SW1#show interface port-channel 1 switchport
Name: Pol
Switchport: Disabled
```

Recommended Reading

Configuring EtherChannels

<u>SPAN</u>

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

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

<u>RSPAN</u>

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
1
vlan 100
remote-span
1
interface FastEthernet0/1
switchport access vlan 12
1
interface FastEthernet0/2
switchport access vlan 12
1
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
        Mode Encapsulation Status Native vlan
desirable n-isl trunking 1
Port
Fa0/13
        desirable n-isl trunking
                                              1
Port Vlans allowed on trunk
         1-4094
Fa0/13
       Vlans allowed and active in management domain
Port
Fa0/13
         1,12,100
         Vlans in spanning tree forwarding state and not pruned
Port
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
```

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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

```
swl:
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
```

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```
1
interface fastEthernet 0/20
switchport trunk encapsulation dotlg
switchport mode trunk
1
interface fastEthernet 0/21
switchport trunk encapsulation dotlg
switchport mode trunk
1
1
interface fastEthernet 0/13
switchport trunk encapsulation isl
switchport mode trunk
1
interface fastEthernet 0/14
switchport trunk encapsulation isl
switchport mode trunk
1
interface fastEthernet 0/15
switchport trunk encapsulation isl
switchport mode trunk
SW2:
interface fastEthernet 0/19
shutdown
1
interface fastEthernet 0/20
shutdown
interface fastEthernet 0/21
shutdown
1
interface fastEthernet 0/16
switchport trunk encapsulation dotlg
switchport mode trunk
1
interface fastEthernet 0/17
switchport trunk encapsulation dotlq
switchport mode trunk
I.
interface fastEthernet 0/18
switchport trunk encapsulation dotlq
switchport mode trunk
1
1
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 dotlq
switchport mode trunk
```

```
1
interface fastEthernet 0/17
switchport trunk encapsulation dotlg
switchport mode trunk
1
interface fastEthernet 0/18
switchport trunk encapsulation dotlg
switchport mode trunk
1
1
interface fastEthernet 0/19
switchport trunk encapsulation isl
switchport mode trunk
1
interface fastEthernet 0/20
switchport trunk encapsulation isl
switchport mode trunk
1
interface fastEthernet 0/21
switchport trunk encapsulation isl
switchport mode trunk
SW4 :
interface fastEthernet 0/13
switchport trunk encapsulation dotlq
switchport mode trunk
1
interface fastEthernet 0/14
switchport trunk encapsulation dotlg
switchport mode trunk
!
interface fastEthernet 0/15
switchport trunk encapsulation dotlq
switchport mode trunk
1
!
interface fastEthernet 0/19
switchport trunk encapsulation isl
switchport mode trunk
1
interface fastEthernet 0/20
switchport trunk encapsulation isl
switchport mode trunk
1
interface fastEthernet 0/21
switchport trunk encapsulation isl
switchport mode trunk
```

Verified	tion								
verificat	tion								
			4	a					
SWI# snow	cap nei	Lgnbors	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	I	WS-C3550-2Fas	0/13
SW2		Fas 0/13		168		S :	I	WS-C3560-2Fas	0/13
SW2		Fas 0/15		168		S ·	т	WS-C3560-2Fas	0/15
GM 2		$E_{ac} = 0/14$		168		с ·	- т	WG_C3560_2Fag	0/1/
OW1 #		Fas 0/14		100		υ.	1	WD CJJOU ZFdB	0/14
SWI#									
SW2# show	cdp nei	ighbors	include	SW					
SW1		Fas 0/15		133		S :	I	WS-C3560-2Fas	0/15
SW1		Fas 0/14		133		S 3	I	WS-C3560-2Fas	0/14
SW1		Fas 0/13		133		S :	I	WS-C3560-2Fas	0/13
SW3		Fas 0/18		158		S ·	т	WS-C3550-2Fas	0/18
GM3		Fac $0/17$		150		с ·	т Т	WS_C3550_2Fac	0/17
GM3		Fas 0/17		150		с. С.	т т	WD CJJJU ZFAB	0/16
5W3		Fas 0/10		120		з.	L	WS-C3550-2Fas	0/10
SW2#									
SW3# show	cdp nei	ighbors	include	SW					
SW4		Fas 0/21		151		S I	I	WS-C3550-2Fas	0/21
SW4		Fas 0/20		151		S :	I	WS-C3550-2Fas	0/20
SW4		Fas 0/19		151		S ·	т	WS-C3550-2Fas	0/19
SW1 SW2		Fag 0/18		141		g .	т Т	WS-C3560-2Fag	0/18
OW2		ras 0/10		1 4 1		о. с	+ +	WD CODOO ZEAS	0/17
SWZ		Fas 0/1/		141		5.	1	WS-C3560-ZFas	0/1/
SW2		Fas 0/16		$\perp 4 \perp$		S.	L	WS-C3560-2Fas	0/16
SW3#									
SW4# show	cdp nei	ighbors	include	SW					
SW1		Fas 0/13		166		S :	I	WS-C3560-2Fas	0/19
SW1		Fas 0/15		166		S I	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 ·	т	WS-C3550-2Fas	0/20
SW3		Fag $0/19$		131		с ·	т	WS-C3550-2Fag	0/19
CWA#		105 0/19		191		0.	±	MD C5550 21 db	0/10
SM##									
GW1#abow	intorfo	and trun	- ingly	ido triu	nking				
SW1#SHOW	Inceria	ices cruin		ue cru	11K1119		1		
Fa0/13	On		ISI		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	interfa	aces trun	k inclu	ide tru	nking				
$F_{2}0/13$			ial		trunking		1		
Fa0/13	011		ial		twinking		1		
raU/14	011		TST TST				1		
rau/15	on		ISI		crunking		1		
Fa0/16	on		802.lq		trunking		1		
Fa0/17	on		802.lq		trunking		1		
Fa0/18	on		802.lq		trunking		1		
SW3# show	interfa	aces trun	k inclu	ide tru	nking				
Fa0/16	on		802.1q		trunking		1		
Fa0/17	on		802.1a		trunking		1		
Fa0/18	on		802 1a		trunking		1		
Fa0/19	on		isl		trunking		1		
F=0/20	011		ial		trunking		1		

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

vtp domain CISCO vtp mode client

SW4:

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 1	92	2.10.1.103 at 3-1-93 00:52:26
Local updater ID is 192.10.1.103	С	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	:	
VIP Operating Mode	•	Client
VTP Domain Name	:	
VIP Pruning Mode	•	Disabled
VIP V2 Mode	:	Disabled
VIP Traps Generation	:	Disabled
MD5 algest	•	0xF4 0xC9 0x03 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 1:	92	.10.1.103 at 3-1-93 00.52.20
5W2#		
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 : CI	SCO	
VTP Pruning Mode : Di	sabled	
VTP V2 Mode : Dia	sabled	
VTP Traps Generation : Di	sabled	
MD5 digest : 0x	F4 0xC9 0x0	3 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 192.1	0.1.103 at	3-1-93 00:52:26
SW3#		
WTD Vergion · 2		
Configuration Revision : 8		
Maximum VLANs supported locally : 10	05	
Number of existing VLANs : 13		
VTP Operating Mode : Cl.	ient	
VTP Domain Name : CI	SCO	
VTP Pruning Mode : Dia	sabled	
VTP V2 Mode : Dia	sabled	
VTP Traps Generation : Dis	sabled	
MD5 digest : 0x:	F4 0xC9 0x0	3 0x20 0xAE 0xA7 0xA8 0x94
Configuration last modified by 192.1	0.1.103 at	3-1-93 00:52:26
SW1# show vlan brief		
VLAN Name	Status	Ports
1 dofault		$E_{20}/1$ $E_{20}/2$ $E_{20}/2$ $E_{20}/4$
i default	active	Fa0/1, $Fa0/2$, $Fa0/3$, $Fa0/4Fa0/5$, $Fa0/6$, $Fa0/7$, $Fa0/8$
		Fa0/9, $Fa0/0$, $Fa0/7$, $Fa0/7Fa0/9$, $Fa0/10$, $Fa0/11$, $Fa0/12$
		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 Iddi-default	act/unsup	
1003 token-ring-delault	act/unsup	
1004 Iddinet-default	act/unsup	
SW1#	acc/ulisup	
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	
VLAN_F	active	
8 VLAN_G	active	
	accive	
9 VLAN_H	active	

1003 1004 1005 SW2#	token-ring-default fddinet-default trnet-default	act/unsup act/unsup act/unsup	
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 3 4 5 6 7 8 9 1002 1003 1004 1005 SW3# SW4##	VLAN_A VLAN_B VLAN_C VLAN_D VLAN_E VLAN_F VLAN_G VLAN_H fddi-default token-ring-default fddinet-default trnet-default	active active active active active active active act/unsup act/unsup act/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 Fa0/16, Fa0/17, Fa0/18, Fa0/22 Fa0/23, Fa0/24, Gi0/1, Gi0/2
2 3 4 5 6 7 8 9 1002 1003 1004 1005	VLAN_A VLAN_B VLAN_C VLAN_D VLAN_F VLAN_F VLAN_H fddi-default token-ring-default fddinet-default trnet-default	active active active active active active active act/unsup act/unsup 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 0x	9A 0xEE 0x01 0x52 0xC2
Configuration last modified by 2	92.10.1.114 at 3-1-	93 00:21:20
Local updater ID is 192.10.1.114	on interface Vl1 (lowest numbered VLAN
interface found)		
SW1#s how vlan brief		
VLAN Name	Status Por	ts
1 dofault		/1 E20/2 E20/2 E20/4
1 default	active Fa0 Fa0	/1, Fa0/2, Fa0/3, Fa0/4 /5 Fa0/6 Fa0/7 Fa0/8
1 default	active Fa0 Fa0 Fa0	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9 Fa0/10 Fa0/11 Fa0/12
1 default	active Fa0 Fa0 Fa0 Fa0	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16 Fa0/17 Fa0/18 Fa0/22
1 default	active Fa0 Fa0 Fa0 Fa0 Fa0 Fa0	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23 Fa0/24 Gi0/1 Gi0/2
1 default	active Fa0 Fa0 Fa0 Fa0 Fa0 Fa0	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
1 default 2 VLAN_A 3 VLAN B	active Fa0 Fa0 Fa0 Fa0 Fa0 Fa0 active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C	active Fa0 Fa0 Fa0 Fa0 Fa0 Fa0 active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C 5 VLAN_D	active Fa0 Fa0 Fa0 Fa0 Fa0 active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C 5 VLAN_D 6 VLAN_E	active Fa0 Fa0 Fa0 Fa0 active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C 5 VLAN_D 6 VLAN_E 7 VLAN F	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
<pre>1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C 5 VLAN_D 6 VLAN_E 7 VLAN_F 8 VLAN G</pre>	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
<pre>1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C 5 VLAN_D 6 VLAN_E 7 VLAN_F 8 VLAN_G 9 VLAN H</pre>	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
<pre>1 default 2 VLAN_A 3 VLAN_B 4 VLAN_C 5 VLAN_D 6 VLAN_E 7 VLAN_F 8 VLAN_G 9 VLAN_H 1002 fddi-default</pre>	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
 default VLAN_A VLAN_B VLAN_C VLAN_D VLAN_E VLAN_F VLAN_G VLAN_H 002 fddi-default token-ring-default 	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
 default VLAN_A VLAN_B VLAN_C VLAN_D VLAN_E VLAN_F VLAN_G VLAN_H 002 fddi-default 1003 token-ring-default 1004 fddinet-default 	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
 default VLAN_A VLAN_B VLAN_C VLAN_D VLAN_E VLAN_F VLAN_G VLAN_H 1002 fddi-default 1003 token-ring-default 1004 fddinet-default 1005 trnet-default 	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active active active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2
 default VLAN_A VLAN_B VLAN_C VLAN_D VLAN_E VLAN_F VLAN_G VLAN_G VLAN_H 1002 fddi-default 1003 token-ring-default 1005 trnet-default 	active Fa0 Fa0 Fa0 Fa0 active active active active active active active active active active active active active active active active active active active	/1, Fa0/2, Fa0/3, Fa0/4 /5, Fa0/6, Fa0/7, Fa0/8 /9, Fa0/10, Fa0/11, Fa0/12 /16, Fa0/17, Fa0/18, Fa0/22 /23, Fa0/24, Gi0/1, Gi0/2

SW3#	show vtp status			
Conf	version	• 2 • 9		
Maxir	mum VIANs supported locally	: 100	5	
Numbe	er of existing VLANs	: 13		
VTP (Operating Mode	: Clie	ent	
VTP I	Domain Name	: CISC	20	
VTP I	Pruning Mode	: Disa	abled	
VTP V	V2 Mode	: Disa	abled	
VTP 7	Traps Generation	: Disa	abled	
MD5 c	digest	: 0xC	5 0xE6 0x11	1 0x9A 0xEE 0x01 0x52 0xC2
Conf	iguration last modified by 1	92.10	.1.114 at 3	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	tranet-default		act/unsup	
1005			ace/ unsup	
SW2#£	show vtp status			
VTP V	Version	: 2		
Confi	iguration Revision	: 0	_	
Maxir	mum VLANs supported locally	: 1009	5	
Numbe	er of existing VLANs	: 5	·	
V.I.D (Operating Mode	: Tran	nsparent	
VTP I	Domain Name	· CISC	blod	
י רידע ז רידע	V2 Mode	• DISS	abled	
VIP V	V2 Mode	· Disc	abled	
MD5 c	digest	· DISC	עדבע 7 מצרה מצ4ו) NY65 NY63 NY59 NY47 NYBD
Conf	iguration last modified by 0	.0.0.0) at $0-0-0($	00:00:00
SW2#	show vlan brief			
VLAN	Name		Status	Ports
T	uerault		active	$r_{aU/1}$, $r_{aU/2}$, $r_{aU/3}$, $r_{aU/4}$
				rav/3, rav/v , $rav/1$, $rav/0rav/3$, $rav/0$, $rav/1$, $rav/0rav/1$, $rav/0$
				Fa0/19 $Fa0/20$ $Fa0/21$ $Fa0/20$
				Fa0/23, $Fa0/24$ Gi0/1 Gi0/2
1002	fddi-default		act/ungun	140/25, 140/27, G10/1, G10/2
1002	token-ring-default		act/unsup	
1004	fddinet-default		act/unsup	
1005	trnet-default		act/unsup	

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SW4 #show vtp status VTP Version Configuration Revision Maximum VLANs supported locally Number of existing VLANs VTP Operating Mode VTP Domain Name VTP Pruning Mode VTP V2 Mode VTP Traps Generation MD5 digest Configuration last modified by 0 SW4 #show vlan brief	2 0 1005 5 Transparent CISCO Disabled Disabled Disabled 0x57 0xCD 0x40 .0.0 at 0-0-00	0 0x65 0x63 0x59 0x47 0xBD 0 00:00:00
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 1003 token-ring-default 1004 fddinet-default 1005 trnet-default	act/unsup act/unsup act/unsup 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
1
interface Fa 0/15
switchport mode dynamic desirable
SW2:
vtp mode transparent
vtp domain CISCO2
interface Fa 0/13
switchport mode dynamic desirable
1
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
```

Verificat	tion			
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 al	lowed on trunk		
Converient		to month under L. Export		www.lateraetuverk/Exaert.com

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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			
Dort	Vlang allowe	d and active in	management de	main
Forc Fa0/13	2 4 6 8	u anu accive in	management uo	
Fa0/14	3.5.7.9			
Fa0/15	1			
Fa0/19	1-9			
Fa0/20	1-9			
Port	Vlans allowe	d and active in	management do	main
Fa0/21	1-9			
Death	Mana da ana			
Port EsO(12	Vians in spa	nning tree forw	arding state a	na not prunea
Fa0/13 Fa0/14	2,4,0,0			
Fa0/15	1			
Fa0/19	1-9			
Fa0/20	none			
Fa0/21	none			
SW1#				
SW2# show in	ter trunk			
		_		
Port	Mode	Encapsulation	Status	Native vlan
Fa0/13	on	isi 	trunking	1
Fa0/14	on	ISI del	trunking	1
Fa0/15 Fa0/16	on	1SI	trunking	1
Fa0/17	on	802.1q 802.1q	trunking	⊥ 1
Fa0/18	on	802.1q	trunking	1
, -	-	1		
Port	Vlans allowe	d 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 allowe	d and active in	management do	main
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 allowe	d and active in	management do	omain
Fa0/18	1-9			
Port	Vlana in ana	nning tree form	arding state a	nd not pruned
FOIL Fa0/12	vians in spa	initing cree forw	arunny state a	na not prunea
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
_____ _____

        Desg FWD 19
        128.4
        P2p

        Desg FWD 100
        128.5
        Shr

        Desg FWD 100
        128.6
        Shr

        Desg FWD 100
        128.7
        Shr

Fa0/2
Fa0/3
Fa0/4
Fa0/5
```

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Desg FWD 19128.8P2pDesg FWD 19128.15P2pDesg FWD 19128.16P2pDesg FWD 19128.17P2p Fa0/6 Fa0/13 Fa0/14 Fa0/15 Interface Role Sts Cost Prio.Nbr Type _____ ____ Desg FWD 100 128.26 Shr Fa0/24 SW2#**show spanning-tree vlan 1** VI.AN0001 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 Prio.Nbr Type Interface Role Sts Cost _____ ____ Fa0/3Desg FWD 100128.5ShrFa0/4Desg FWD 100128.6ShrFa0/5Desg FWD 100128.7ShrFa0/6Desg FWD 19128.8P2pFa0/12Desg FWD 19128.14P2pFa0/13Root FWD 19128.15P2pFa0/14Altn BLK 19128.16P2p 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

swl: 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

```
Swl:
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 _____ ____ Fa0/1Desg FWD 3019128.3P2pFa0/2Desg FWD 3019128.4P2pFa0/3Desg FWD 3100128.5ShrFa0/4Desg FWD 3100128.6ShrFa0/5Desg FWD 3100128.7ShrFa0/6Desg FWD 3019128.8P2p Interface Role Sts Cost Prio.Nbr Type Fa0/13Altn BLK 3019128.15P2pFa0/19Root FWD 3019128.21P2pFa0/24Desg FWD 3100128.26Shr 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
                  Role Sts Cost
                                         Prio.Nbr Type
Interface
                  Role Sc.

Desg FWD 3019 128.3 F2F

Desg FWD 3019 128.4 P2P

Desg FWD 3100 128.5 Shr

Desg FWD 3100 128.6 Shr

Desg FWD 3100 128.7 Shr

TWD 3019 128.8 P2P
_____ ____
Fa0/1
Fa0/2
                 Desg FWD 3100
Desg FWD 3100
Desg FWD 3100
Desg FWD 3019
Fa0/3
Fa0/4
Fa0/5
Fa0/6
Interface Role Sts Cost
                                          Prio.Nbr Type
 _____ ____

        Root
        FWD 3019
        128.15
        P2p

        Desg FWD 3100
        128.26
        Shr

Fa0/13 Root FWD 3019
Fa0/24
```

Basic STP Features: BackboneFast





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 shutdown	Fa	0/21		
sw3: interface shutdown	Fa	0/17		
: interface shutdown	Fa	0/18		
! interface shutdown	Fa	0/20		
! interface shutdown	Fa	0/21		
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
                      38
           Cost
           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
_____ ____
Fa0/16Altn BLK 19128.16P2pFa0/19Root FWD 19128.19P2p
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
             Desg FWD 19 128.19 P2p
Fa0/19
```

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: bpduquard error detected on Fa0/1, putting Fa0/1 in errdisable 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 quard 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 Interface Name Inconsistency _____ VLAN0001FastEthernet0/13Root InconsistentVLAN0001FastEthernet0/14Root InconsistentVLAN0001FastEthernet0/15Root 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

```
swl:
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
1
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
1
interface fa 0/14
spanning-tree guard loop
1
interface fa 0/15
spanning-tree guard loop
```

Verification

```
SW2#show spanning-tree vlan 1
VI.AN0001
  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
               Role Sts Cost Prio.Nbr Type
Interface
Fa0/3Desg FWD 100128.5ShrFa0/4Desg FWD 100128.6ShrFa0/5Desg FWD 100128.7ShrFa0/6Desg FWD 19128.8P2pFa0/12Desg FWD 19128.14P2pFa0/13Root FWD 19128.15P2pFa0/14Altn BLK 19128.16P2p
Interface
               Role Sts Cost
                                  Prio.Nbr Type
_____ ____
Fa0/15
Fa0/16
            Altn BLK 19128.17P2pDesg FWD 19128.18P2pDesg FWD 100128.26Shr
Fa0/24
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
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```

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BPDU: sent 2032, :	DU: 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

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SW1#show spanning-tree mst 1							
##### MST1	vlans map	ped: 1-3	、 · · ·				1 \
Bridge	address U	1016.4639.0580 Tab for MST1	priorit	ΣΥ	245// (24	5/6 SYSIC	I)
ROOL	UIIS SWIU	CH IOI MBII					
Interface	Role S	Sts Cost	Prio.Nbr	Туре 			
Fa0/2	Desg F	WD 200000	128.4	P2p			
Fa0/3	Desg F	WD 2000000	128.5	Shr			
Fa0/4	Desg F	WD 2000000	128.6	Shr			
Fa0/5	Desg F	WD 2000000	128.7	Shr			
Fa0/6	Desg F	WD 200000	128.8	P2p			
Fa0/13	Desg F	WD 200000	128.15	P2p			
Fa0/14	Desg F	WD 200000	128.16	P2p			
Fa0/15	Desg F	WD 200000	128.17	P2p			
Fa0/19	Desg F	WD 200000	128.21	P2p			
Fa0/20	Desg F	WD 200000	128.22	P2p			
Fa0/21	Desg F	WD 200000	128.23	P2p			
Fa0/24	Desg F	WD 2000000	128.26	Shr			
SW1# show span	ning-tree	mst 2					
##### MST2	vlans map	pped: 4-6					
Bridge	address 0	016.4639.d580) priorit	ЗY	24578 (24	576 sysid	2)
Root	this swit	ch for MST2					
Interface	Role S	Sts Cost	Prio.Nbr	Туре			
Fa0/13	Desg F	WD 200000	128.15	P2p			
Fa0/14	Desg F	WD 200000	128.16	P2p			
Fa0/15	Desg F	WD 200000	128.17	P2p			
Fa0/19	Desg F	WD 200000	128.21	P2p			
Fa0/20	Desg F	WD 200000	128.22	P2p			
Fa0/21	Desg F	WD 200000	128.23	P2p			
SW1# show span	ning-tree	mst 3					
##### MST3	vlans map	pped: 7-9					
Bridge	address 0	016.4639.d580) priorit	Ξy	24579 (24	576 sysid	3)
Root	this swit	ch for MST3					
Interface	Role S	Sts Cost	Prio.Nbr	Туре			
Fa0/13	Desg F	WD 200000	128.15	P2p			
Fa0/14	Desg F	WD 200000	128.16	P2p			
Fa0/15	Desg F	WD 200000	128.17	P2p			
Fa0/19	Desg F	WD 200000	128.21	P2p			
Fa0/20	Desg F	WD 200000	128.22	P2p			
Fa0/21	Desg F	WD 200000	128.23	P2p			
SW2# show span	ning-tree	mst 1					
##### MST1	vlans map	ped: 1-3					
Bridge	address 0	016.9d31.8380) priorit	сy	32769 (32	768 sysid	1)
Root	address 0	016.4639.d580) priorit	СУ	24577 (24	576 sysid	1)
	port F	a0/13	cost		200000	rem hops	19
Interface	Role S	Sts Cost	Prio.Nbr	Туре			
Fa0/3	Desa F	2000000	128 5	Shr			

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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 span r	ning-tree	e mst	: 2			
##### MST2	vlang ma	annec	4-6			
Bridge	address	0016	5.9d31.838() priorit	v	32770 (32768 sysid 2)
Root	address	0016	5.4639.d580) priorit	tv	24578 (24576 sysid 2)
	port	Fa0/	13	cost	- 1	200000 rem hops 19
Interface	Role	Sts	Cost	Prio.Nbr	Туре	
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#s how span r	ing-tree	e mst	: 3			
##### MST3	vlans ma	apped	l: 7-9			
Bridge	address	0016	5.9d31.8380) priorit	ty	32771 (32768 sysid 3)
Root	address	0016	5.4639.d580) priorit	ty	24579 (24576 sysid 3)
	port	Fa0/	13	cost		200000 rem hops 19
	_]	~ .	~ .	1	_	
Interface	Role	Sts	Cost	Prio.Nbr	'l'ype	
Fa0/13	Root	FWD	200000	128 15	D2n	
$F_{20}/14$	Altn	BLK	200000	128 16	D2n	
Fa0/15	Altn	BLK	200000	128 17	D2n	
Fa0/16	Desa	FWD	200000	128 18	P2n	
Fa0/17	Desg	FWD	200000	128 19	D2n	
Fa0/18	Desg	FWD	200000	128.20	P2p	
100,10	2009	1 112	200000	110110	1 2 5	
SW3# show span r	ing-tree	e mst	: 1			
##### MST1	vlans ma	apped	l: 1-3			
Bridge	address	0015	5.63c8.8800) priorit	ty	32769 (32768 sysid 1)
Root	address	0016	5.4639.d580) priori	ty	24577 (24576 sysid 1)
	port	Fa0/	19	cost		400000 rem hops 18
Interface	Role	Sts	Cost	Prio.Nbr	Туре	
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 span r	ning-tree	e mst	: 2			

##### MST2	vlans ma	appec	l: 4−6				
Bridge	address	0015	5.63c8.8800) priorit	СУ	32770 (32768 sysid 2)	
Root	address	0016	5.4639.d580) priorit	сy	24578 (24576 sysid 2)	
	port	Fa0/	19	cost		400000 rem hops 18	
	-					-	
Interface	Role	Sts	Cost	Prio.Nbr	Туре		
							-
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	P2n		
Fa0/20	Altn	BLK	200000	128 20	P2n		
Fa0/20 Fa0/21	Altn		200000	120.20	D2p		
1.40/21	ALCII	БПК	200000	120.21	гzр		
SW3# show span	ning-tree	e mst	: 3				
##### MST3	vlans ma	apped	l: 7-9				
Bridge	address	0015	5.63c8.8800) priorit	zv	32771 (32768 sysid 3)	
Root	address	0016	5.4639.d580) priorit	v	24579 (24576 sysid 3)	
1000	nort	Fa0/	19	COSt	- 1	40000 rem hops 18	
	POLC	1 0 0 /	12	CODC			
Interface	Role	Sts	Cost	Prio.Nbr	Туре		_
Fa0/16	 Altr	 BI.K	200000	128 16			
Fa0/10	Alta		200000	120.10	D 2 D		
Fa0/1/	Altn		200000	120.17	PZP		
Fa0/10	AICH	BUK	200000	120.10	PZP		
Fa0/19	ROOL	FWD	200000	120.19	PZP		
Fa0/20	Altn	ВЦК	200000	128.20	PZP		
Fa0/21	Altn	BLK	200000	128.21	P2p		
SW4#show span	ning-tree	a met	- 1				
SWITEBIOW SPAIN	ing cree	- 11.50	· 1				
##### MST1	vlang ma		1: 1-3				
##### MST1 Bridge	vlans ma	apped	1: 1-3		- 12	32769 (32768 sysid 1)	
##### MST1 Bridge	vlans ma address	apped 000e	1: 1-3 2.83b2.948(5.4639.d58() priorit	-y	32769 (32768 sysid 1)	
##### MST1 Bridge Root	vlans ma address address	apped 000e 0016	1: 1-3 2.83b2.948(5.4639.d58() priorit	-y -y	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rom hops 19	
##### MST1 Bridge Root	vlans ma address address port	appec 000e 0016 Fa0/	1: 1-3 2.83b2.948(5.4639.d58(13) priorit) priorit cost	cy cy	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	
##### MST1 Bridge Root Interface	vlans ma address address port Role	apped 000e 0016 Fa0/ Sts	1: 1-3 2.83b2.9480 5.4639.d580 713 Cost) priorit) priorit cost Prio.Nbr	су су Туре	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	
##### MST1 Bridge Root Interface	vlans ma address address port Role	apped 000e 0016 Fa0/ Sts	1: 1-3 2.83b2.9480 5.4639.d580 713 Cost) priorit) priorit cost Prio.Nbr	су су Туре	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root InterfaceFa0/13</pre>	vlans ma address address port Role Root	apped 000e 0016 Fa0/ Sts FWD	1: 1-3 2.83b2.9480 5.4639.d580 713 Cost 200000) priorit cost Prio.Nbr 128.13	туре Р2р	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14</pre>	vlans ma address address port Role Root Altn	apped 000e 0016 Fa0/ Sts FWD BLK	1: 1-3 2:83b2.9480 5:4639.d580 (13 Cost 200000 200000) priorit o priorit cost Prio.Nbr 128.13 128.14	у У Туре Р2р Р2р	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15</pre>	vlans ma address address port Role Root Altn Altn	apped 000e 0016 Fa0/ Sts FWD BLK BLK	1: 1-3 2:83b2.9480 5:4639.d580 (13 Cost 200000 200000 200000) priorit cost Prio.Nbr 128.13 128.14 128.15	-y -y Type P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19</pre>	vlans ma address address port Role Root Altn Desg	apped 0006 0016 Fa0/ Sts FWD BLK BLK FWD	1: 1-3 2.83b2.9480 5.4639.d580 13 Cost 200000 200000 200000 200000 200000	<pre>) priorit o priorit cost Prio.Nbr 128.13 128.14 128.15 128.19</pre>	-y -y Type P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20</pre>	vlans ma address address port Role Root Altn Desg Desg	apped 000e 0016 Fa0/ Sts FWD BLK BLK FWD FWD	1: 1-3 2.83b2.9480 5.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20</pre>	-y -y P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
##### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21	vlans ma address address port Role Root Altn Desg Desg	apped 000e 0016 Fa0/ Sts FWD BLK BLK FWD FWD FWD	1: 1-3 2:83b2.9480 5:4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21</pre>	-y -y P2p P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
##### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21	vlans ma address address port Role Root Altn Altn Desg Desg Desg	apped 000e 0016 Fa0/ Sts FWD BLK BLK FWD FWD FWD	1: 1-3 2:83b2.9480 2:4639.d580 2:13 Cost 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21</pre>	Type P2p P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
##### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/20 Fa0/20 Fa0/21 SW4# show spam	vlans ma address address port Role Root Altn Altn Desg Desg Desg	apped 000e 0016 Fa0/ Sts FWD BLK BLK FWD FWD FWD FWD	1: 1-3 2:83b2.9480 2:4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 2000000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 2000000 2000000 20000000 2000000 200000000	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21</pre>	-y -y P2p P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	-
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21 SW4#show spann ###### MST2</pre>	vlans ma address address port Role Root Altn Desg Desg Desg ning-tree	apped 000e 0016 Fa0/ Sts FWD BLK FWD FWD FWD FWD FWD	1: 1-3 2:83b2.9480 5:4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 2000000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 2000000 2000000 20000000 200000000	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21</pre>	-y -y P2p P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21 SW4#show spann ###### MST2 Bridge</pre>	vlans ma address address port Role Root Altn Altn Desg Desg Desg ning-tree	apped 000e 0016 Fa0/ Sts FWD BLK BLK FWD FWD FWD FWD FWD FWD	<pre>1 1-3 2.83b2.9480 2.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 20000 20000 200000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 200000 20000 20000 20000 200</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21</pre>	Type P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21 SW4#show spann ###### MST2 Bridge Root</pre>	vlans ma address address port Role Root Altn Altn Desg Desg Desg ning-tree vlans ma address	apped 000e 0016 Fa0/ Sts FWD BLK FWD FWD FWD FWD FWD FWD 000e	<pre>1 1-3 2.83b2.9480 2.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21) priorit) priorit</pre>	Type P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19 	_
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/20 Fa0/21 SW4#show spann ##### MST2 Bridge Root</pre>	vlans ma address port Role Role Root Altn Altn Desg Desg Desg ning-tree vlans ma address port	apped 0006 0016 Fa0/ Sts FWD BLK BLK FWD FWD FWD FWD FWD 0006 0016 5006	<pre>1 1-3 2.83b2.9480 2.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 20000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 20000 20000 200000 20000 20000 20000 200000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 2</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.20 128.21) priorit priorit cost</pre>	Type P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19 32770 (32768 sysid 2) 24578 (24576 sysid 2) 200000 rem hops 19	-
<pre>###### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/20 Fa0/21 SW4#show spann ##### MST2 Bridge Root</pre>	vlans ma address port Role Root Altn Altn Desg Desg Desg ning-tree vlans ma address address	apped 0006 0016 Fa0/ Sts FWD BLK FWD FWD FWD FWD FWD FWD FWD FWD FWD FWD	<pre>1 1-3 2.83b2.9480 2.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000 20000</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.20 128.21) priorit cost</pre>	Type P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19 32770 (32768 sysid 2) 24578 (24576 sysid 2) 200000 rem hops 19	-
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<pre>##### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/20 Fa0/21 SW4#show spann ###### MST2 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19</pre>	vlans ma address address port Role Root Altn Altn Desg Desg Desg desg desg desg port vlans ma address address port Role Role	Apped 000e 0016 Fa0/ Sts FWD BLK FWD FWD FWD Content 000e 0016 Fa0/ Sts FWD BLK BLK FWD Sts FWD BLK BLK FWD FWD FWD Sts FWD FWD FWD FWD FWD FWD FWD FWD	<pre>1 1-3 2.83b2.9480 2.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 2000000</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.20 128.20 128.21) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19</pre>	Y Type P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19 32770 (32768 sysid 2) 24578 (24576 sysid 2) 200000 rem hops 19	_
<pre>##### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/20 Fa0/21 SW4#show spann ##### MST2 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20</pre>	vlans ma address address port Role Root Altn Altn Desg Desg Desg ning-tree vlans ma address address port Role Role Role	apped 000e 0016 Fa0/ Sts FWD BLK FWD FWD FWD FWD 000e 0016 Fa0/ Sts FWD BLK BLK FWD FWD FWD FWD	<pre>1 1-3 2.83b2.9480 2.4639.d580 13 Cost 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 200000 2000000</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20</pre>	Y Type P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19 32770 (32768 sysid 2) 24578 (24576 sysid 2) 200000 rem hops 19	_
<pre>##### MST1 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/20 Fa0/21 SW4#show spann ##### MST2 Bridge Root Interface Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21</pre>	vlans ma address address port Role Root Altn Altn Desg Desg Desg ning-tree vlans ma address address address port Role Role	apped 000e 0016 Fa0/ Sts FWD BLK FWD FWD FWD FWD 000e 0016 Fa0/ Sts FWD BLK FWD FWD FWD FWD FWD FWD FWD	<pre>1 1: 1-3 2:83b2.9480 2:4639.d580 2:13 Cost 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:00000 2:000000 2:00000 2:000000 2:00000 2:00000 2:0000</pre>	<pre>) priorit cost Prio.Nbr 128.13 128.14 128.15 128.20 128.20 128.21) priorit cost Prio.Nbr 128.13 128.14 128.15 128.19 128.20 128.21</pre>	Y Y P2p P2p P2p P2p P2p P2p P2p P2p P2p P2p	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19 32770 (32768 sysid 2) 24578 (24576 sysid 2) 200000 rem hops 19	_

SW4# show spanning-tree mst 3									
##### MST3	vlans ma	apped: 7-9							
Bridge	address	000e.83b2.9480) priorit	Y	32771 (32768 sysid 3)				
Root	address	0016.4639.d580) priorit	у	24579 (24576 sysid 3)				
	port	Fa0/13	cost		200000 rem hops 19				
Interface	Role	Sts Cost	Prio.Nbr	Туре					
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
```

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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 Loopquard Default is disabled EtherChannel misconfig guard is enabled UplinkFast is disabled is disabled BackboneFast Configured Pathcost method used is short Blocking Listening Learning Forwarding STP Active Name _____ ____ 0 0 0 VLAN0002 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 is disabled UplinkFast BackboneFast is disabled Configured Pathcost method used is short Blocking Listening Learning Forwarding STP Active Name 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 Blocking Listening Learning Forwarding STP Active VLAN0006 0 0 0 6 6 SW1#show spanning-tree vlan 8 summary Switch is in pyst mode Root bridge for VLAN0008 is this bridge. Extended system ID is enabled

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is disabled Portfast Default 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 0 0 VLAN0001 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 is disabled Portfast Default PortFast BPDU Guard Default is disabled Portfast BPDU Filter Default is disabled Loopguard Default is disabled EtherChannel misconfig guard is enabled is disabled UplinkFast is disabled BackboneFast Configured Pathcost method used is short Name Blocking Listening Learning Forwarding STP Active _____ ____ 0 0 VLAN0003 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 ------ ------ ------- ------- -------0 0 0 6 VLAN0005 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 is disabled UplinkFast BackboneFast is disabled Configured Pathcost method used is short Name Blocking Listening Learning Forwarding STP Active _____ ____ 0 0 0 6 VLAN0007 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 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 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 VI.AN0002 Spanning tree enabled protocol ieee Root ID Priority 24578 Address 0016.4639.d580 Cost 38 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

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Altn BLK 19 128.20 P2p Fa0/20 Fa0/21 128.21 P2p Altn BLK 19 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 Role Sts Cost Prio.Nbr Type Interface _____ ____ Fa0/13 Root FWD 19 128.15 P2p Fa0/14Altn BLK 19128.16P2pFa0/15Altn BLK 19128.17P2p

 Altn BLK 19
 120.17
 12p

 Desg FWD 19
 32.18
 P2p

 Desg FWD 19
 64.19
 P2p

 Desg FWD 19
 96.20
 P2p

 Fa0/16 au/17 Fa0/18 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 _____ ____ Fa0/13Altn BLK 19128.15P2pFa0/14Altn BLK 19128.16P2pFa0/15Altn BLK 19128.17P2pFa0/19Altn BLK 19128.21P2pFa0/20Altn BLK 19128.22P2p 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 Fa0/13Desg FWD 1996.13P2pFa0/14Desg FWD 1964.14P2pFa0/15Desg FWD 1932.15P2pFa0/19Altn BLK 19128.19P2pFa0/20Altn BLK 19128.20P2p 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 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 Blocking Listening Learning Forwarding STP Active Name _____ ____ 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
1
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 1 interface Fa 0/20 spanning-tree vlan 2,4,6,8 port-priority 64 1 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 1 interface range Fa 0/17 , Fa 0/20spanning-tree vlan 1,3,5,7,9 port-priority 64 1 interface range Fa 0/16 , Fa 0/19spanning-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 1 interface Fa 0/14 spanning-tree vlan 1,3,5,7,9 port-priority 64 1 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 Priority 24579 Root ID 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

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Interface Role Sts Cost Prio.Nbr Type _____ ____ Fa0/13 Altn BLK 19 128.15 P2p Fa0/14Altn BLK 19128.16P2pFa0/15Altn BLK 19128.17P2pFa0/19Altn BLK 19128.21P2pFa0/20Altn BLK 19128.22P2p 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 Prio.Nbr Type Role Sts Cost Interface _____ ____ Fa0/13Desg FWD 1996.13P2pFa0/14Desg FWD 1964.14P2p 96.13 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 _____ ____ Fa0/16Desg FWD 1996.16P2pFa0/17Desg FWD 1964.17P2pFa0/18Desg FWD 1932.18P2pFa0/19Desg FWD 1996.19P2pFa0/20Desg FWD 1964.20P2p 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

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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 Fa0/10Rober FWD 19128.10F2pFa0/17Altn BLK 19128.17P2pFa0/18Altn BLK 19128.18P2pFa0/19Altn BLK 19128.19P2pFa0/20Altn BLK 19128.20P2pFa0/21Altn BLK 19128.21P2p 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 Prio.Nbr Type Role Sts Cost Interface Fa0/13 Root FWD 19 128.15 P2p Fa0/14Altn BLK 19128.16P2pFa0/15Altn BLK 19128.17P2p Fa0/16 Desg FWD 19 32.18 P2p Fa0/17Desg FWD 1964.19P2pFa0/18Desg FWD 1996.20P2p 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

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Fa0/14 Desg FWD 19 64.16 P2p Fa0/15 Desg FWD 19 96.17 P2p 32.21 P2p 64.22 P2p 96.23 P2p Fa0/19 Desg FWD 19 Fa0/20 Desg FWD 19 Desg FWD 19 Fa0/21 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 Fa0/15Desg FWD 1996.17P2pFa0/19Desg FWD 1932.21P2pFa0/20Desg FWD 1964.22P2pFa0/21Desg FWD 1996.23P2p 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 Fa0/15Altn BLK 19128.17P2pFa0/16Desg FWD 1932.18P2pFa0/17Desg FWD 1964.19P2pFa0/18Desg FWD 1996.20P2p

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
1
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
              Priority 24578
Address 0016.4639.d580
   Root ID
                 PriorOILAddress001Cost20Cost16
                                 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
                                 10
                 Cost
                 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
              Role Sts Cost Prio.Nbr Type
Interface
```

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_____ ____ Fa0/13 Root FWD 10 128.15 P2p Fa0/14Altn BLK 20128.16P2pFa0/15Altn BLK 30128.17P2pFa0/16Desg FWD 19128.18P2pFa0/17Desg FWD 19128.19P2pFa0/18Desg FWD 19128.20P2p Fa0/18 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 PriorityAddress0016.4639.0000Cost20Port16 (FastEthernet0/14)Cost20 sec 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 Prio.Nbr Type Role Sts Cost Fa0/14Root LIS 20128.16P2pFa0/15Altn BLK 30128.17P2pFa0/16Desg FWD 19128.18P2pFa0/17Desg FWD 19128.19P2pFa0/18Desg FWD 19128.20P2p 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

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Fa0/19	Altn BL	к 30	128.21	P2p		
Fa0/20	Altn BL	к 20	128.22	P2p		
Fa0/21	Root FW	D 10	128.23	P2p		
SW4# show spa	nning-tree v	lan 3				
VLAN0003						
Spanning t	ree enabled	protocol ie	ee			
Root ID	Priority	24579				
	Address	0015.63c8.	8800			
	Cost	10				
	Port	21 (FastEt	hernet0/2	1)		
	Hello Time	2 sec Ma	x Age 20	sec Forwar	d Delay 15	sec
Bridge ID	Priority Address Hello Time Aging Time	32771 (pr 000e.83b2. 2 sec Ma 300	iority 32 9480 x Age 20	768 sys-id- sec Forwar	ext 3) d Delay 15	sec
Interface	Role St	s Cost	Prio.Nbr	Туре		
Fa0/13	Desq FW	 D 19	128.13	 Р2р		
Fa0/14	Desg FW	D 19	128.14	P2p		
Fa0/15	Desg FW	D 19	128.15	P2p		
Fa0/19	Altn BL	к 30	128.19	P2p		
Fa0/20	Altn BL	K 20	128.20	P2p		
Fa0/21	Root FW	D 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
1
interface range Fa 0/14 , fa 0/20
spanning-tree mst 2 port-priority 32
1
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
1
interface range Fa 0/20
spanning-tree mst 2 port-priority 32
1
interface range Fa 0/21
spanning-tree mst 3 port-priority 32
```

Verification

SW2#show spanning-tree mst 1							
##### MST1 Bridge Root	vlans ma address address port	apped 0016 0016 Fa0/	1: 1-3 5.9d31.8380 5.4639.d580 715) prio) prio cost	rit; rit;	У У	32769 (32768 sysid 1) 24577 (24576 sysid 1) 200000 rem hops 19
Interface	Role	Sts	Cost	Prio.N	br '	Туре	
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	j	P2p	
Fa0/12	Desg	FWD	200000	128.14	j	P2p	
Fa0/13	Altn	BLK	200000	128.15	j	P2p	
Fa0/14	Altn	BLK	200000	128.16	j	P2p	
Fa0/15	Root	FWD	200000	128.17	I	P2p	
Fa0/16	Desg	FWD	200000	128.18	1	P2p	
Fa0/17	Desg	FWD	200000	128.19	J	P2p	

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Fa0/18 Fa0/24	Desg Desg	FWD FWD	200000 2000000	32.20 128.26	P2p Shr		
SW2# show span	ning-tree	e mst	2				
##### MST2	vlans ma	apped	l: 4-6				
Bridge	address	0016	.9d31.8380) priori	ty	32770 (32768 sysid	2)
Root	address	0016	.4639.d580) priorit	ty	24578 (24576 sysid	2)
	port	Fa0/	14	cost		200000 rem hops	19
Interface	Role	Sts	Cost	Prio.Nbr	Туре		
Fa0/13	Altn	BLK	200000	128.15	 Р2р		
Fa0/14	Root	FWD	200000	128.16	P2p		
Fa0/15	Altn	BLK	200000	128.17	P2p		
Fa0/16	Desq	FWD	200000	128.18	P2p		
Fa0/17	Desg	FWD	200000	32.19	P2p		
Fa0/18	Desg	FWD	200000	128.20	P2p		
SW2# show span	ning-tree	e mst	: 3				
##### Mamo		nnoi	. 70				
##### MOIS Bridge	addread	10014	1-7 20121 2201	Doriori	- 37	22771 (22768 avoid	3)
Bridge	address	0010	4639 d580) priorit	-y	24579 (24576 syste	3)
Root	nort	Fa0/	13	COST	- Y	200000 rem hops	19
	porc	rau/	10	COBC			1)
Interface	Role	Sts 	Cost	Prio.Nbr	Туре		
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 span	ning-tree	e mst	: 1				
##### MST1	vlans ma	apped	l: 1-3				
Bridge	address	0000	.83b2.9480) priorit	ty	32769 (32768 sysid	1)
Root	address	0016	.4639.d580) priorit	ty	24577 (24576 sysid	1)
	port	Fa0/	13	cost		200000 rem hops	19
Interface	Role	Sts	Cost	Prio.Nbr	Туре		
 Fa0/13	Root	FWD	200000	128.13	P2p		
Fa0/14	Altn	BIK	200000	128.14	P2p		
Fa0/15	Altn	BLK	200000	128.15	P2p		
Fa0/19	Desq	FWD	200000	32.19	P2p		
Fa0/20	Desq	FWD	200000	128.20	P2p		
Fa0/21	Desg	FWD	200000	128.21	P2p		
SW4#show spann	ning-tree	e mst	2				
	1						
##### MST2	vlans ma	appec	4-6			20000 (20000 - 1	2)
Briage	address	0000	2.83D2.9480	priori	LY	32//U (32/68 Sysid	∠) 2)
KUOT	adaress port	0016 Fa0/	.4639.0580 14	cost	LY	24578 (24576 sysid 200000 rem hops	2) 19
Interface	Role	Sts	Cost	Prio.Nbr	Туре		
 Fa0/13	 Altr	 BI'R	200000	128 13	 P2p		
Fa0/14	Root	FWD	200000	128.14	P2p		

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Fa0/15 Fa0/19 Fa0/20 Fa0/21	Altn Desg Desg Desg	BLK FWD FWD FWD	200000 200000 200000 200000	128.15 128.19 32.20 128.21	P2p P2p P2p P2p P2p		
SW4# show span	ning-tree	e mst	3				
##### MST3 Bridge Root	vlans ma address address port	apped 000e 0016 Fa0/	: 7-9 .83b2.9480 .4639.d580 15) priorit) priorit cost	су су	32771 (32768 sysid 24579 (24576 sysid 200000 rem hops	3) 3) 19
Interface	Role	Sts (Cost	Prio.Nbr	Туре		
Fa0/13 Fa0/14 Fa0/15 Fa0/19 Fa0/20 Fa0/21	Altn Altn Root Desg Desg	BLK BLK FWD FWD FWD FWD	200000 200000 200000 200000 200000 200000 200000	128.13 128.14 128.15 128.19 128.20 32.21	P2p P2p P2p P2p P2p P2p P2p		
SW3# show span	ing-tree	e mst	1				
##### MST1 Bridge Root	vlans ma address address port	apped 0015 0016 Fa0/	: 1-3 .63c8.8800 .4639.d580 19) priorit) priorit cost	су су	32769 (32768 sysid 24577 (24576 sysid 400000 rem hops	1) 1) 18
Interface	Role	Sts (Cost	Prio.Nbr	Туре		
Fa0/16 Fa0/17 Fa0/18 Fa0/19 Fa0/20 Fa0/21	Altn Altn Altn Root Altn Altn	BLK BLK FWD BLK BLK	200000 200000 200000 200000 200000 200000 200000	128.16 128.17 128.18 128.19 128.20 128.21	P2p P2p P2p P2p P2p P2p P2p		
SW3# show span	ning-tree	e mst	2				
##### MST2 Bridge Root	vlans ma address address port	apped 0015 0016 Fa0/	: 4-6 .63c8.8800 .4639.d580 20) priorit) priorit cost	су су	32770 (32768 sysid 24578 (24576 sysid 400000 rem hops	2) 2) 18
Interface	Role	Sts (Cost	Prio.Nbr	Туре		
Fa0/16 Fa0/17 Fa0/18 Fa0/19 Fa0/20 Fa0/21	Altn Altn Altn Altn Altn Root Altn	BLK BLK BLK FWD BLK	200000 200000 200000 200000 200000 200000 200000	128.16 128.17 128.18 128.19 128.20 128.21	P2p P2p P2p P2p P2p P2p P2p P2p		
SW3# show span	ning-tree	e mst	3				
##### MST3 Bridge Root	vlans ma address address port	apped 0015 0016 Fa0/2	: 7-9 .63c8.8800 .4639.d580 21) priorit) priorit cost	-y -y	32771 (32768 sysid 24579 (24576 sysid 400000 rem hops	3) 3) 18
Interface	Role	Sts (Cost	Prio.Nbr	Туре		

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Fa0/17Alth BLK 200000128.17P2pFa0/18Alth BLK 200000128.18P2pFa0/19Alth BLK 200000128.19P2pFa0/20Alth BLK 200000128.20P2pFa0/21Root FWD 200000128.21P2p
Fa0/17Alth BLK 200000128.17P2pFa0/18Alth BLK 200000128.18P2pFa0/19Alth BLK 200000128.19P2pFa0/20Alth BLK 200000128.20P2p
Fa0/17Alth BLK 200000128.17P2pFa0/18Alth BLK 200000128.18P2pFa0/19Alth BLK 200000128.19P2p
Fa0/17 Alth BLK 200000 128.17 P2p Fa0/18 Alth BLK 200000 128.18 P2p
Fa0/1/ AICH BLK 200000 128.1/ P2p
Fa0/16 Altn BLK 200000 128.16 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
1
vlan 100
private-vlan primary
!
vlan 101
private-vlan isolated
1
vlan 102
private-vlan community
1
vlan 100
private-vlan association add 101,102
interface Fast 0/13
switchport trunk encapsulation dotlq
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
1
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
```

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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 101 VLAN0101 102 VLAN0102	active active 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 Bridg	eNo Stp BrdgMode Transl Trans2					
100 enet 100100 1500 -		0 0					
Remote SPAN VLAN							
Disabled							
Primary Secondary Type	Ports						
100101isolated100102community	Fa0/1 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 Bridg	eNo 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							

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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 _____ _____ active Fa0/13, Fa0/16, Fa0/17, Fa0/18 100 VLAN0100 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 ____ _____

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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: dotlg 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

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Administrative private-vlan trunk encapsulation: dotlg 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: dotlg 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: . 1 1 1 1 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

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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





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
1
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
1
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
1
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:
IIIII
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:
IIIII
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 vla Mac Address Table	an 201					
Vlan Mac Address Type	Ports					
201 0016 4639 d5c1 DVNAMIC	 Fa0/16					
Total Mac Addresses for this criterion	n: 1					
SW2# show mac-address-table dynamic vla Mac Address Table	an 202					
Vlan Mac Address Type	Ports					
202 0016.4639.d5c2 DYNAMIC	Fa0/16					
Total Mac Addresses for this criterion	n: 1					
SW2#show ip arp Protocol Address Age (min) Internet 155.1.201.7 4 Internet 155.1.202.7 1 Internet 155.1.202.8 - Internet 155.1.201.8 -	Hardware 0016.4639 0016.4639 0016.9d31 0016.9d31	Addr Type Interface .d5c1 ARPA Vlan201 .d5c2 ARPA Vlan202 .83c2 ARPA Vlan202 .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 Name: Fa0/16 Switchport: Enabled Administrative Mode: tunnel Operational Mode: tunnel Administrative Trunking Encapsulation Operational Trunking Encapsulation: na Negotiation of Trunking: Off Access Mode VLAN: 100 (VLAN0100) Trunking Native Mode VLAN: 1 (default	switchpor dotlq ative	t				

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: dotlg 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 Local Intrfce Holdtme Capability Platform Port ID Fas 0/19 116 S I WS-C3560-2Fas 0/16 Device 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 Fas 0/16 126 S I WS-C3560-2Fas 0/19 Fas 0/16 SW1 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 VI-AN0202 Spanning tree enabled protocol ieee Root ID Priority 32970 0016.4639.d580 Address Cost 19 Port 18 (FastEthernet0/16) 19 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 VI.AN0201 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 Prio.Nbr Type Interface Role Sts Cost 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 stormcontrol



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	lk pps	0 pps				
SW1#show storm-control unicast								
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

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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
1
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
1
mls qos
1
access-list 100 permit ip any any
class-map match-any IP_TRAFFIC
 match access-group 100
1
class-map match-all VLAN 202 IP
 match vlan 202
 match class-map IP_TRAFFIC
1
class-map match-all VLAN_201_IP
 match vlan 201
 match class-map IP_TRAFFIC
1
policy-map MARK_TRAFFIC
 class VLAN_201_IP
  set precedence 5
 class VLAN_202_IP
   set precedence 4
1
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)
                  0
                             0
                                                    0
    32: 0
                                        0
                                        0
                                                    0
    40: 0
                  0
                             0
                 158
                             11
                                        0
                                                    0
Others: 169
Egress
 dscp: incoming no_change classified policed
                                                   dropped (in pkts)
   32: 0
                     n/a
                            n/a
                                        0
                                                    0
    40: 0
                                         0
                     n/a
                               n/a
                                                    0
```

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Others: 332 0 0 n/a n/a 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: 11111 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: 11111 Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms SW2# SW3#show mls gos 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 0 0 5 Others: 205 181 0 0 14 Egress dscp: incoming no_change classified policed dropped (in pkts) 32: 0 n/a n/a 0 0 40: 0 0 n/a n/a 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
1
interface Vlan 202
ip address 155.1.202.7 255.255.255.0
SW2:
interface Vlan 201
no ip address
1
interface Vlan 202
no ip address
1
interface range fastEthernet 0/16 - 18
 shutdown
1
interface fas 0/4
switchport trunk encaps dotlq
switchport mode trunk
1
!
1
mls qos
interface range Fa 0/13 , Fa 0/14 , Fa 0/15
mls qos vlan-based
1
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
1
policy-map VLAN202_POLICY
class IP_TRAFFIC
  set ip precedence 4
1
interface Vlan 201
service input VLAN201_POLICY
1
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: IIIII 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	9				
0 - 4 :	б	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					

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0 - 4 :	16	0	0	0	0
5 - 7 :	0	0	0		
cos: outgoing					
	1.65	2	<u> </u>	2	_
0 - 4 :	165	0	0	0	5
5 - 7 :	5	0	0		
Policer: Inprofil	le:	0 OutofProf	ile:	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
1
interface Vlan 201
ip address 155.1.201.7 255.255.255.0
1
interface Vlan 202
ip address 155.1.202.7 255.255.255.0
SW2:
interface Vlan 201
no ip address
1
interface Vlan 202
no ip address
1
interface range fastEthernet 0/16 - 18
  shutdown
1
interface fas 0/4
switchport trunk encaps dotlq
switchport mode trunk
!
!
1
mls qos
interface range Fa 0/13 , Fa 0/14 , Fa 0/15
mls qos vlan-based
1
access-list 100 permit ip any any
class-map IP_TRAFFIC
match access-group 100
1
class-map INPUT_INTERFACES
match input Fa 0/13 - fa 0/15
1
policy-map POLICE_64K
class INPUT_INTERFACES
   police 64000 32000
1
policy-map POLICE_32K
class INPUT INTERFACES
  police 32000 16000
Т
policy-map VLAN201_POLICY
class IP_TRAFFIC
 set ip precedence 5
  service-policy POLICE_64K
1
policy-map VLAN202_POLICY
```

```
class IP_TRAFFIC
 set ip precedence 4
  service-policy POLICE_32K
1
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 dotlq 201
ip address 155.1.201.4 255.255.255.0
1
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: 1.11111.11111.11111.11111.11111 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: 11.111111.11111111111111.11111.11111. Success rate is 85 percent (85/100), round-trip min/avg/max = 1/266/805 ms SW2#show mls gos interface fa0/13 statistics FastEthernet0/13 dscp: incoming -----0 - 4 : 200 0 0 0 0 0 0 5 - 9: 0 0 0 0 0 0 0 0 0 0 10 - 14 : 0 0 0 0 15 - 19 : 0 0 0 0 20 - 24 : 0 0 0 0 25 - 29 : 0 0 0 0 30 - 34 : 0 0 0 0 35 - 39 : 0 0 0 0 0 40 - 44 : 0 0 0 45 - 49 : 0 0 4 0 0 50 - 54 : 0 0 0 Ω 0 55 - 59 : 4 0 0 0 0 0 60 - 64 : 0 0 dscp: outgoing

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0 - 4 : 5 - 9 : 10 - 14 : 15 - 19 : 20 - 24 : 25 - 29 : 30 - 34 : 35 - 39 : 40 - 44 : 45 - 49 : 50 - 54 : 55 - 59 : 60 - 64 : cos: incoming	189 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 19 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 - 4 : 5 - 7 : cos: outgoing	424 0	0 0	0 81	0	0
0 - 4 : 5 - 7 : Policer: Inprofi SW2# show mls qos	378 0 lle: s interface	0 0 0 OutofPro fa0/4 statist :	0 0 Dfile:	0	0
FastEthernet0/4 dscp: incoming	3				
0 - 4 : 5 - 9 : 10 - 14 : 15 - 19 : 20 - 24 : 25 - 29 : 30 - 34 : 35 - 39 : 40 - 44 : 45 - 49 : 50 - 54 : 55 - 59 : 60 - 64 : dscp: outgoing	0 0 0 0 0 0 0 87 0 0 0 0 0 0 0 0		0 0 0 0 85 0 0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	27 0 0 0 0 0 0 87 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 4 7 0	0 0 0 0 0 85 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

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cos: incoming	a				
0 - 4 :	191	0	0	0	0
5 - 7 :	0	0	0		
cos: outgoing	g				
0 - 4 :	587	0	0	0	85
5 - 7 :	87	0	0		
Policer: Inpro:	file:	0 OutofPro	file:	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
1
interface Vlan 202
no ip address
1
interface range fastEthernet 0/16 - 18
  shutdown
1
interface fas 0/4
switchport trunk encaps dotlg
switchport mode trunk
1
!
1
mls qos
1
interface range Fa 0/13 , Fa 0/14 , Fa 0/15
mls qos vlan-based
!
access-list 100 permit ip any any
1
class-map IP_TRAFFIC
match access-group 100
1
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 1 mls qos map policed-dscp 32 to 16 mls qos map policed-dscp 40 to 24 1 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 1 interface Vlan 201 service input VLAN201_POLICY 1 interface Vlan 202 service input VLAN202_POLICY R4 • interface ethernet 0/0 no shutdown interface ethernet 0/0.201 encaps dotlq 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 gos interface fa0/4 statistics
FastEthernet0/4
dscp: incoming
_____
 0 - 4 :
               Ο
                        0
                                  0
                                           0
                                                     0
                                                     0
               0
                        0
                                  0
                                           0
 5 - 9 :
```

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10 - 14 : 15 - 19 : 20 - 24 : 25 - 29 : 30 - 34 : 35 - 39 : 40 - 44 : 45 - 49 : 50 - 54 : 55 - 59 : 60 - 64 : dscp: outgoin	0 0 0 0 0 1 1 0 0 0 0 0 0	0 89 0 0 0 0 0 0 0 0 0 0	0 0 0 11 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	0 89 0 0 0 0 0 0 0 0
0 - 4 : 5 - 9 : 10 - 14 : 15 - 19 : 20 - 24 : 25 - 29 : 30 - 34 : 35 - 39 : 40 - 44 : 45 - 49 : 50 - 54 : 55 - 59 : 60 - 64 : cos: incoming	5 0 0 0 0 0 0 1 1 0 0 0 0 0 0	0 0 89 0 0 0 0 0 0 0 0 0 0 5 0	0 0 0 0 0 1 1 0 0 0 0 0 0 0 0		0 0 0 89 0 0 0 0 0 0 0 0
0 - 4 : 5 - 7 : cos: outgoing	203 0	0 0	0 0	0	0
0 - 4 : 5 - 7 : Policer: Inprof SW2 #show mls qc FastEthernet0/1	89 11 Sile: Os interface	0 0 0 OutofPro fa0/13 statist	89 O Dfile: cics	89 0	11
dscp: incomin	ng 				
0 - 4 : 5 - 9 : 10 - 14 : 15 - 19 : 20 - 24 : 25 - 29 : 30 - 34 : 35 - 39 : 40 - 44 : 45 - 49 : 50 - 54 : 55 - 59 : 60 - 64 : dscp: outgoin	200 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 1 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0
0 - 4 :	204	0	0	0	0

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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: Inprof:	ile:	0 OutofProf	file:	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
1
SW1:
interface FastEthernet0/1
switchport host
switchport access vlan 146
!
interface FastEthernet0/15
shutdown
1
interface FastEthernet0/13
switch trunk encaps dotlq
switch mode trunk
1
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
1
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
1
mac access-list extended PVST
permit any any 1sap 0x4242 0x0
!
mac access-list extended PVST_PLUS
permit any any 1sap 0xAAAA 0x0
1
1
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:
11111
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:
11111
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
          Priority 32914
Address 0016.4639.d580
 Root ID
            This bridge is the root
           Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
 Bridge ID Priority 32914 (priori
Address 0016.4639.d580
                      32914 (priority 32768 sys-id-ext 146)
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
           Aging Time 300
                             Prio.Nbr Type
Interface Role Sts Cost
_____
               Desg FWD 19 128.3 Edge P2p
Fa0/1
                                         P2p
Fa0/13
               Desg FWD 19128.15P2pDesg FWD 19128.16P2p
Fa0/14
SW2#show spanning-tree vlan 146
VLAN0146
 Spanning tree enabled protocol ieee
 Root ID
          Priority 32914
            Address
                       0016.4639.d580
                      19
            Cost
                  16 (FastEthernet0/14)
            Port
            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
```

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Interface Role Sts Cost Prio.Nbr Type _____ ____ Desg FWD 100 128.6 Edge Shr Fa0/4 128.8 Edge P2p 128.15 P2p
 Fa0/6
 Desg
 FWD
 19

 Fa0/13
 Desg
 FWD
 19
 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** Encapsulation Status Native vlan Port Mode Fa0/13 802.1q trunking 1 on Port Vlans allowed on trunk Fa0/13 1-4094 Vlans allowed and active in management domain Port 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: 11111 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: IIIII 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]

Rl#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

```
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			
Verification SW1#show port-security inter Port Security Port Status Violation Mode Aging Time Aging Type SecureStatic Address Aging Maximum MAC Addresses Total MAC Addresses Configured MAC Addresses Sticky MAC Addresses Last Source Address:Vlan Security Violation Count R1#conf t	<pre>rface fastEthernet 0/1 : Enabled : Secure-up : Shutdown : 0 mins : Absolute : Disabled : 1 : 1 : 1 : 0 : 0004.27b5.2f60:1 : 0</pre>		
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 inter Port Security Port Status Violation Mode Aging Time Aging Type SecureStatic Address Aging Maximum MAC Addresses Total MAC Addresses Configured MAC Addresses Sticky MAC Addresses Last Source Address:Vlan Security Violation Count	<pre>rface fa0/1 : Enabled : Secure-shutdown : Shutdown : 0 mins : Absolute : Disabled : 1 : 1 : 1 : 0 : 0004.27b5.2f61:146 : 1</pre>		
<pre>SW1#show interface fa0/1 FastEthernet0/1 is down, lin Hardware is Fast Ethernet, MTU 1500 bytes, BW 100000 reliability 255/255, tz Encapsulation ARPA, loopba <output omitted=""></output></pre>	ne protocol is down <mark>(err-disabled)</mark> , address is 0016.4639.d583 (bia 0016.4639.d583) Kbit, DLY 100 usec, xload 1/255, rxload 1/255 ack not set		

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

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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 : Restrict Violation Mode Aging Time : O 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

```
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 errdisable 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

```
SW1 & SW2:
vtp mode transparent
vlan 146
1
SW1:
interface FastEthernet 0/1
switchport host
switchport access vlan 146
1
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
1
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 15	5.1.146.254			
Active virtual MAC addre	ss is 0000.0	0c07.ac01		
Local virtual MAC addr	ess is 0000	.0c07.ac01 (v1	default)	
Hello time 3 sec, hold t	ime 10 sec	·	,	
Next hello sent in 2.0	84 secs			
Preemption disabled				
Active router is local				
Standby router is unknow	m			
Priority 100 (default 10	0)			
IP redundancy name is "h	$sr_{p-Et} 0/1-1$	" (default)		
II reduitdancy name ib in	DIP DC0/I I	(actuare)		
SW2#show port-security int	erface fa0/4	4		
Port Security	: Enabled	-		
Port Status	: Secure-u	h		
Violation Mode	: Shutdown			
Aging Time	: 0 mins			
Aging Type	: Absolute			
SecureStatic Address Agino	: Disabled			
Maximum MAC Addresses	: 2			
Total MAC Addresses	. 2			
Configured MAC Addresses	: 0			
Sticky MAC Addresses	· 0			
Last Source Address Wilson	· 00b0 6414	5 2002.146		
Courrie Violation Count	· 0000.0410	5.2002.140		
Security violation count	• 0			
SW2#show port-sequrity int	orfago fa0/	5		
Dort Segurity	· Enabled	5		
Port Status	· Sequre-u	2		
Violation Mode	· Secure-up			
Aging Time : 0 ming				
Aging Time	· 0 mins			
Aging type	· ADSOLUCE			
Maximum MAC Addroggog	• DISADIEU			
Total MAC Addroggog	• 2			
Configured MAC Addresses	• 1			
Sticky MAC Addresses	• 0			
Jest Course Addresses	• 0 • 001E 600	E 2 1 • 1 4 C		
Last Source Address.Vian	· 0015.0226	2.0551.140		
security violation count	• 0			
CW2#abow mag_addrogg table	intonface	E-0 / 4		
Sw2#Show mac-address-Lable		La0/4		
Mac Address Tabl	C			
Vlan Mac Address	Tune	Ports		
		FULLS		
146 0000 0007 2001	STATIC	Fa0/4		
146 00b0 6416 2da2	STATIC	$F_{a}0/4$		
Total Mac Addresses for th	is criterio	1. 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

```
SW1 & SW2:
vtp mode transparent
vlan 146
1
SW1:
interface FastEthernet0/1
switchport host
switchport access vlan 146
1
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
1
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)
```