

Lab 2-1: Configuring Layer 2 Switching

Complete this lab activity to practice what you have learned in the related module.

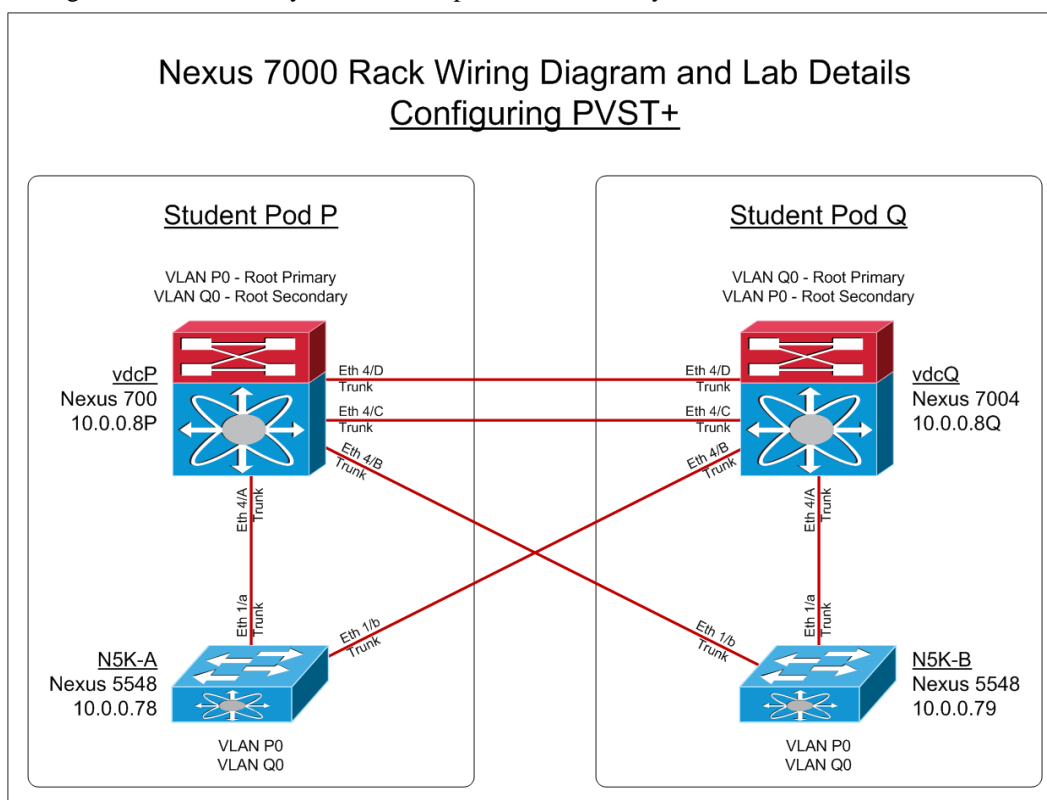
Activity Objective

In this activity, you will implement Layer 2 switching features on the Cisco Nexus 7000 Series and 5500 Platform switches. After completing this activity, you will be able to meet these objectives:

- Configure Layer 2 interfaces and implement and verify Rapid PVRST+
- Implement and verify spanning-tree enhancements in order to optimize and protect spanning-tree operation

Visual Objective

The figure illustrates what you will accomplish in this activity.



Command List

The following table describes the Cisco NX-OS commands that are used in this activity.

Command	Description
show interface brief	Displays a summary of the interfaces
show interface transceiver	Displays detailed information about installed small formfactor pluggables (SFPs)
rate-mode dedicated	Sets the first port in a port group to dedicated mode
switchport	Configures an interface as a Layer 2 switch port

Command	Description
switchport mode trunk	Configures an interface as a trunk port
show spanning-tree	Displays information related to the Spanning Tree Protocol (STP)
show vlan internal usage	Displays the list of VLANs that are reserved for internal use
vlan <vlan-list>	Creates one or more VLANs
name <vlan-name>	Configures the VLAN name
show spanning-tree summary	Displays a summarized view of the spanning-tree operational status
spanning-tree vlan <vlanlist> root primary	Changes the priority of the switch in order to make it the root of the spanning tree for the listed VLANs
spanning-tree vlan <vlanlist> root secondary	Lowers the spanning-tree priority of the switch below the default value in order to make the switch the backup spanning-tree root for the listed VLANs
spanning-tree guard root	Enables root guard on an interface
spanning-tree port type edge	Configures an interface as a spanning-tree edge port
feature uddl	Enables UniDirectional Link Detection (UDLD) on a switch
uddl aggressive	Enables UDLD aggressive mode
show uddl neighbors	Displays the list of current UDLD neighbors
spanning-tree port type network	Enables Bridge Assurance on an interface
show spanning-tree inconsistentports	Displays the switch ports that are in the spanning-tree inconsistent state
spanning-tree mst configuration	Enters configuration mode for Multiple Spanning Tree (MST)
name <mst-region-name>	Configures the MST region name
revision <mst-revision-nr>	Configures the MST revision number
spanning-tree mode mst	Changes the spanning-tree protocol to MST
instance <nr> vlan <vlanlist>	Maps a list of VLANs to an MST instance
spanning-tree mst <nr> root primary	Changes the priority of the switch in order to make it the root of the spanning tree for the MST instance

Task 0: Lab Preparation

In this task, you will perform the steps necessary to get ready for performing the Tasks in this lab.

Activity Procedure

Complete these steps:

Step 1 Before you can perform this lab you will need a Student Server and a Pod Number assigned to you. Your instructor should provide to you the following information:

- Student Server Name or IP Address
- Student Server Username
- Student Server Password
- Pod Number
- Peer Pod Number

Step 2 From your personal/work computer use the Remote Desktop Connection (RDC) application to log in to your assigned Student Server. Refer to *Accessing the NterOne Lab Equipment* for detailed instructions regarding how to use RDC to connect to your Student Server.

Step 3 From your Student Server desktop use the PuTTY application to open SSH sessions to each of the devices in the following table.

Device Name	Device Description	IP Address	Username	Password
N7K	Nexus 7004 Default VDC	10.0.0.80	admin	Nterone179
vdcP*	Your Pod Nexus 7004 VDC	10.0.0.8P*	admin	Nterone179
N5K-A	Nexus 5548UP Switch	10.0.0.78	admin	Nterone179
N5K-B	Nexus 5548UP Switch	10.0.0.79	admin	Nterone179

*Note Replace "P" with your Pod Number for this lab

Activity Verification

You have completed this activity when you have achieved these goals:

- You have made a successful connection to your Student Server.
- You have successfully used PuTTY to connect to the devices in the table above.

Task 1: Layer 2 Interfaces and Rapid PVST+

In this task you will configure basic Layer 2 parameters, such as VLAN and trunk settings. You will also configure Rapid per VLAN Spanning Tree Plus (Rapid PVRST+) and verify proper spanning-tree operation both within your pod and between your pod and your peer pod.

Activity Procedure

Note The sample command output in this document is to help you determine what you should see after performing a lab step. The actual output that you see may appear similar but not exactly the same as the command output in this document.

Complete these steps:

Step 4 Before you configure spanning tree and other features in your network you should verify the layer 1 and 2 connectivity between the network devices.

Step 5 In your Nexus 7000 VDC, check the interface state of your assigned interfaces by entering the **show interface brief** command. All four of the interfaces should be in the "up" state.

vdcP# **show interface brief**

```
-----
Port      VRF      Status IP Address      Speed      MTU
-----
mgmt0    --        up      10.0.0.8P      1000      1500
-----
```

```
-----
Ethernet  VLAN    Type Mode   Status Reason      Speed      Port
Interface
-----
Eth4/A    --      eth  routed up     none      10G (D)    --
Eth4/B    --      eth  routed up     none      10G (D)    --
Eth4/C    --      eth  routed up     none      1000 (D)   --
Eth4/D    --      eth  routed up     none      1000 (D)   --
-----
```

Step 6 Determine the SFP+ transceiver type(s) installed in your interfaces by entering the **show interface transceiver** command.

```

vdcP# show interface transceiver
Ethernet4/A
  transceiver is present
  type is SFP-H10GB-CU5M
  name is CISCO-MOLEX
  part number is 74752-9521
  revision is 09
  serial number is MOC16310A4Q
  nominal bitrate is 10300 MBit/sec
  Link length supported for copper is 5 m
  cisco id is --
  cisco extended id number is 4

Ethernet4/B
  transceiver is present
  type is SFP-H10GB-CU5M
  name is CISCO-MOLEX
  part number is 74752-9521
  revision is 09
  serial number is MOC16310A4W
  nominal bitrate is 10300 MBit/sec
  Link length supported for copper is 5 m
  cisco id is --
  cisco extended id number is 4

Ethernet4/C
  transceiver is present
  type is 1000base-T
  name is CISCO-METHODE
  part number is SP7041
  revision is F
  serial number is 00000MTC143108Y9
  nominal bitrate is 1300 MBit/sec
  Link length supported for copper is 100 m
  cisco id is --
  cisco extended id number is 4

Ethernet4/D
  transceiver is present
  type is 1000base-T
  name is CISCO-AVAGO
  part number is ABCU-5710RZ-CS2
  revision is
  serial number is AGM1224204G
  nominal bitrate is 1300 MBit/sec
  Link length supported for copper is 100 m
  cisco id is --
  cisco extended id number is 4

```

Step 7 Enter configuration mode and change all of the interfaces to Layer 2 switch ports by using the **switchport** command.

```

vdcP# config
Enter configuration commands, one per line. End with CNTL/Z.
vdcP(config)# interface ethernet 4/A-D
vdcP(config-if-range)# switchport

```

Step 8 Change all of the ports to trunking mode by entering the **switchport mode trunk** command.

```

vdcP(config-if-range)# switchport mode trunk

```

Step 9 Verify that the interfaces have been enabled, changed to Layer 2 switch ports, and are in trunking mode.

```
vdcP(config-if-range) # show interface brief
```

```
-----  
Port      VRF          Status IP Address          Speed    MTU  
-----  
mgmt0    --           up      10.0.0.8P           1000    1500  
-----  
Ethernet  VLAN      Type Mode   Status Reason           Speed    Port  
Interface  
-----  
Eth4/A    1         eth  trunk up     none           10G(D)  --  
Eth4/B    1         eth  trunk up     none           10G(D)  --  
Eth4/C    1         eth  trunk up     none          1000(D)  --  
Eth4/D    1         eth  trunk up     none          1000(D)  --
```

Step 10 Switch to the PuTTY SSH session that you have opened to Nexus 5548 switch in your Pod, N5K-X.

Note During this class the Nexus 5548 switch in your Pod will be referred to as N5K-X, and the Nexus 5548 switch in your Peer Pod will be referred to as N5K-Y. Refer to the *Resource Guide* for this class for more specific details.

Step 11 Check the state of the interfaces connected to your Pod VDC and your Peer Pod VDC by entering the **show interface interface 1/a-b brief** command, where “a” and “b” are your Pod and Peer Pod numbers. Both interfaces should be in the “up” state.

```
N5K-X# show interface ethernet 1/a-b brief
```

```
-----  
Ethernet  VLAN      Type Mode   Status Reason           Speed    Port  
Interface  
-----  
Eth1/a    1         eth  access up     none           10G(D)  --  
Eth1/b    1         eth  access up     none           10G(D)  --
```

Step 12 Enter configuration mode and change all of the ports to trunking mode by entering the **switchport mode trunk** command.

```
N5K-X# config
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
N5K-X(config)# interface ethernet 1/a-b
```

```
N5K-X(config-if-range)# switchport mode trunk
```

Step 13 Verify that the interfaces have been enabled, changed to Layer 2 switch ports, and are in trunking mode.

```
N5K-X(config-if-range) # show interface ethernet 1/a-b brief
```

```
-----  
Ethernet  VLAN      Type Mode   Status Reason           Speed    Port  
Interface  
-----  
Eth1/a    1         eth  trunk up     none           10G(D)  --  
Eth1/b    1         eth  trunk up     none           10G(D)  --
```

Step 14 Return to your PuTTY session to your Pod VDC.

Step 15 Verify the connections between your Pod VDC and the other devices in your Pod Pair by entering the **show cdp neighbors** command.

```
vdcP(config-if-range)# show cdp neighbors
Capability Codes: R - Router, T - Trans-Bridge, B - Source-Route-Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater,
                  V - VoIP-Phone, D - Remotely-Managed-Device,
                  s - Supports-STP-Dispute

Device-ID          Local Intrfce  Hldtme Capability  Platform      Port ID
B1-Sw1.ad.lab      mgmt0         164    R S I        WS-C3560G-48T Gig0/8
N5K-X(SSI16420TRQ) Eth4/A         171    R S I s      N5K-C5548UP   Eth1/a
N5K-Y(SSI164900XF) Eth4/B         126    R S I s      N5K-C5548UP   Eth1/a
vdcQ(JAF1651AMRJ) Eth4/C         165    R S I s      N7K-C7004     Eth4/C
vdcQ(JAF1651AMRJ) Eth4/D         165    R S I s      N7K-C7004     Eth4/D
```

STOP! Wait until your Peer Pod has completed all steps up to this point before proceeding.

Step 16 Switch back to your Nexus 7000 VDC and examine the spanning-tree operation for VLAN 1 by using the **show spanning-tree vlan 1** command.

```
vdcP(config-if-range)# show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    32768
            Address    002a.6a0f.7181
            Cost        2
            Port        514 (Ethernet4/B)
            Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
            Address    8478.ac57.9642
            Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec

Interface    Role Sts Cost          Prio.Nbr Type
-----
Eth4/A       Desg FWD 2           128.513 P2p
Eth4/B       Root FWD 2           128.514 P2p
Eth4/C       Desg FWD 4           128.515 P2p
Eth4/D       Desg FWD 4           128.516 P2p
```

Step 17 Determine which PVRST+ path cost method is being used by using the **show spanning-tree pathcost method** command.

```
vdcP(config-if-range)# show spanning-tree pathcost method
Spanning tree default pathcost method used is short
```

Step 18 Determine which switch or VDC is the root bridge for VLAN 1 by using the **show spanning-tree root** command.

```
vdcP(config-if-range)# show spanning-tree root

Vlan          Root ID          Root Cost  Hello Time  Max Age  Fwd Dly  Root Port
-----

```

```
VLAN0001          32768 002a.6a0f.7181      2    2    20 15      Ethernet4/B
```

Step 19 Examine which VLANs are available for you to use and which are used internally by using the **show vlan internal usage** command.

```
vdcP(config-if-range) # show vlan internal usage
```

```
VLANS                DESCRIPTION
-----
3968-4031            Multicast
4032-4035,4048-4059 Online Diagnostic
4036-4039,4060-4087 ERSPAN
4042                 Satellite
3968-4095            Current
```

Step 20 Create VLANs P0 (where “P” is your Pod Number) and Q0 (where “Q” is your Peer Pod Number) on your Nexus 7000 VDC.

```
vdcP(config) # vlan P0,Q0
vdcP(config-vlan) # exit
```

Step 21 Create VLANs P0 (where “P” is your Pod Number) and Q0 (where “Q” is your Peer Pod Number) on your Nexus 5548 switch.

```
N5K-X(config) # vlan P0,Q0
N5K-X(config-vlan) # exit
```

Step 22 Configure your VDC to be the spanning-tree primary root bridge for your VLAN P0 and a secondary root for your Peer Pod’s VLAN Q0.

```
vdcP(config) # spanning-tree vlan P0 root primary
vdcP(config) # spanning-tree vlan Q0 root secondary
```

Step 23 Examine the current status of spanning-tree on your Nexus 7000 VDC using the **show spanning-tree** command. Compare this output to the output of the **show spanning-tree summary** and **show spanning-tree root** commands.

```
vdcP(config) # show spanning-tree
```

```
VLAN0001
Spanning tree enabled protocol rstp
Root ID    Priority    32769
Address    002a.6a0f.7181
Cost       2
Port       514 (Ethernet4/B)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
Address    8478.ac57.9642
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
```

```
Interface      Role Sts Cost      Prio.Nbr Type
-----
Eth4/A         Desg FWD 2         128.513 P2p
Eth4/B         Root FWD 2         128.514 P2p
Eth4/C         Desg FWD 4         128.515 P2p
Eth4/D         Desg FWD 4         128.516 P2p
```

```
VLAN00P0
```

```

Spanning tree enabled protocol rstp
Root ID      Priority    24586
             Address    8478.ac57.9642
             This bridge is the root
             Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID    Priority    24586 (priority 24576 sys-id-ext 10)
             Address    8478.ac57.9642
             Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface      Role Sts Cost      Prio.Nbr Type
-----
Eth4/A         Desg FWD 2         128.513 P2p
Eth4/B         Desg FWD 2         128.514 P2p
Eth4/C         Desg FWD 4         128.515 P2p
Eth4/D         Desg FWD 4         128.516 P2p

VLAN00Q0
Spanning tree enabled protocol rstp
Root ID      Priority    24596
             Address    8478.ac57.9643
             Cost      4
             Port      515 (Ethernet4/C)
             Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID    Priority    28692 (priority 28672 sys-id-ext 20)
             Address    8478.ac57.9642
             Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface      Role Sts Cost      Prio.Nbr Type
-----
Eth4/A         Altn BLK 2         128.513 P2p
Eth4/B         Altn BLK 2         128.514 P2p
Eth4/C         Root FWD 4         128.515 P2p
Eth4/D         Altn BLK 4         128.516 P2p

vdcP(config)# show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: VLAN00P0
Port Type Default          is disable
Edge Port [PortFast] BPDU Guard Default is disabled
Edge Port [PortFast] BPDU Filter Default is disabled
Bridge Assurance           is enabled
Loopguard Default         is disabled
Pathcost method used      is short
STP-Lite                   is enabled

Name                    Blocking Listening Learning Forwarding STP Active
-----
VLAN0001                0           0           0           4           4
VLAN00P0                0           0           0           4           4
VLAN00Q0                3           0           0           1           4
-----
3 vlans                 3           0           0           9           12

vdcP(config)# show spanning-tree root

Vlan                    Root ID          Root Cost  Hello Time  Max Age  Fwd Dly  Root Port
-----
VLAN0001                32769 002a.6a0f.7181 2       2         20      15      Ethernet4/B
VLAN00P0                24586 8478.ac57.9642 0       2         20      15      This bridge is root

```

VLAN00Q0 24596 8478.ac57.9643 4 2 20 15 Ethernet4/C

Step 24 Verify that the spanning-tree for VLANs P0 and Q0 is behaving as expected.

Activity Verification

You have completed this task when you attain these results:

- You have verified basic interface operation and settings on your Nexus 7000 VDC and your Nexus 5548 switch.
- You have configured the links between the switches in your pod and your peer pod as 802.1Q trunks.
- You have created new VLANs.
- You have verified spanning-tree operation for selected VLANs.

Task 3: STP Enhancements

In this task, you will configure STP optimization and protection features and verify their operation.

Note In the previous task, the Cisco Nexus 7000 VDCs were configured as the root and backup root for VLANs P0 and Q0. Together they form the aggregation layer of the lab network. Now you will protect the spanning tree by preventing the access switches from becoming root bridges.

Activity Procedure

Complete these steps:

Step 25 In your Nexus 7000 VDC, configure root guard on the trunk links connecting to the Nexus 5548 switches in your pod as well as your Peer Pod.

```
vdcP(config)# interface ethernet 4/A, ethernet 4/B  
vdcP(config-if-range)# spanning-tree guard root
```

Note The configuration of root guard is on a per-port basis. Root guard does not allow the port to become an STP root port, so the port is always STP-designated. If a better BPDU arrives on this port, root guard does not take the BPDU into account and elect a new STP root. Instead, root guard puts the port into the root-inconsistent STP state. You must enable root guard on all ports where the root bridge should not appear.

Step 26 Enable UDLD in aggressive mode on the devices in your VDC and your Nexus 5548 switch in order to protect your switches against unidirectional link failures.

```
vdcP(config)# feature udld  
vdcP(config)# udld aggressive  
N5K-X(config)# feature udld  
N5K-X(config)# udld aggressive
```

Step 27 Verify UDLD operation by using the **show udld global** command.

```
vdcl(config-if-range)# show udld global  
  
UDLD global configuration mode: enabled-aggressive  
UDLD global message interval: 15
```

Step 28 Enable bridge assurance on the links between your VDC and the VDC in the Peer Pod.

```
vdcP(config)# interface ethernet 4/C-D
vdcP(config-if)# spanning-tree port type network
```

Note UDLD can protect against bridging loops caused by physical problems, but it cannot protect against software-caused spanning-tree failures. The bridge assurance feature can help protect against bridging loops caused by software failures.

Step 29 Verify that bridge assurance is enabled on the link between the VDCs by using the **show spanning-tree vlan 1** command.

```
vdcP(config-if-range)# show spanning-tree vlan 1

VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    32769
            Address    002a.6a0f.7181
            Cost      2
            Port      514 (Ethernet4/B)
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

  Bridge ID  Priority    32769 (priority 32768 sys-id-ext 1)
            Address    8478.ac57.9642
            Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface      Role Sts Cost      Prio.Nbr Type
-----
Eth4/A         Desg FWD 2         128.513 P2p
Eth4/B         Root FWD 2         128.514 P2p
Eth4/C         Desg FWD 4         128.515 Network P2p
Eth4/D         Desg FWD 4         128.516 Network P2p
```

Step 30 Determine which keyword indicates that bridge assurance is enabled on the port.

Step 31 On your Nexus 7000 VDC, enable bridge assurance on the ports that are connected to the Nexus 5548 switches in your pod and the peer pod.

```
vdcP(config-if-range)# interface ethernet 4/A, ethernet 4/B
vdcP(config-if-range)# spanning-tree port type network
```

Step 32 Check the spanning-tree inconsistencies by using the **show spanning-tree inconsistentports** command and the **show spanning-tree vlan 1** command.

```
vdcP(config-if-range)# show spanning-tree inconsistentports

Name          Interface      Inconsistency
-----
VLAN0001      Eth4/A        Bridge Assurance Inconsistent
VLAN00P0      Eth4/A        Bridge Assurance Inconsistent
VLAN00P0      Eth4/B        Bridge Assurance Inconsistent
```

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

```
vdcP(config-if-range)# show spanning-tree vlan 1
```

```
VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    32769
            Address    002a.6a0f.7181
            Cost      2
```

```

Port          514 (Ethernet4/B)
Hello Time    2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority    32769 (priority 32768 sys-id-ext 1)
Address       8478.ac57.9642
Hello Time    2 sec Max Age 20 sec Forward Delay 15 sec

Interface      Role Sts Cost      Prio.Nbr Type
-----
Eth4/A         Desg BKN*2      128.513 Network P2p *BA_Inc
Eth4/B         Root FWD 2          128.514 Network P2p
Eth4/C         Desg FWD 4          128.515 Network P2p
Eth4/D         Desg FWD 4          128.516 Network P2p

```

Step 33 Repair the misconfiguration by enabling bridge assurance on your Nexus 5548 switch for the ports that connect to the Nexus 7000 VDCs.

```

N5K-X(config)# interface ethernet 1/a-b
N5K-X(config-if-range)# spanning-tree port type network

```

Step 34 Ensure that the problem has been resolved by verifying inconsistent ports on your VDC once again.

```

vdcP(config-if-range)# show spanning-tree inconsistentports
vdcP(config-if-range)# show spanning-tree vlan 1

VLAN0001
Spanning tree enabled protocol rstp
Root ID    Priority    32769
Address    002a.6a0f.7181
Cost       2
Port       514 (Ethernet4/B)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority    32769 (priority 32768 sys-id-ext 1)
Address       8478.ac57.9642
Hello Time    2 sec Max Age 20 sec Forward Delay 15 sec

Interface      Role Sts Cost      Prio.Nbr Type
-----
Eth4/A         Desg FWD 2          128.513 Network P2p
Eth4/B         Root FWD 2          128.514 Network P2p
Eth4/C         Desg FWD 4          128.515 Network P2p
Eth4/D         Desg FWD 4          128.516 Network P2p

```

Activity Verification

You have completed this task when you attain these results:

- You have enabled root guard on the VDC ports connecting to the Nexus 5548 switches in your pod and the peer pod.
- You have successfully enabled UDLD in aggressive mode between the switches in your pod and your peer pod.
- You have successfully enabled bridge assurance between the switches in your pod and your peer pod.
- You have observed the spanning-tree behavior when bridge assurance is only enabled on one side of a link.