STP **Configuration Lab-1**

Open the Packet Tracer Scenario: STP Configuration Lab-1.pkt. Before proceeding, save as STP Configuration Lab-1-working.pkt.

Spanning Tree Protocol Overview:

The Spanning Tree Protocol (STP) is designed to prevent layer 2 loops. In a bridge or switch topology (for purposes of STP, bridges and switches are identical in operation), it is desirable to physically cable redundant paths to provide fault tolerance. This creates a layer 2 loop, however, and causes undesirable effects. Normally, when a broadcast frame is received by a bridge, it is forwarded out all other ports. Each bridge in the loop forwards the broadcast and a broadcast storm results. If a loop were allowed to exist, then, the first broadcast frame would essentially shut down the network.

The solution is STP. STP operation will result in one port in each loop being blocked. STP monitors the environment as well, so that a blocked port can be re-opened if a failure occurs in the working path. STP accomplishes these functions by exchanging STP information in frames called Bridge Protocol Data Units (BPDUs). A switch compares the values in BPDUs received with the values in BPDUs being sent - lower values are preferred over higher values.

In order to fully understand BPDUs and how they work, it is first necessary to understand certain aspects of the STP environment. First, every bridge has a Bridge Identifier (BID) that consists of the bridge STP priority and the MAC address assigned to the bridge itself. The default STP priority is 32768. (Cisco switches use Per VLAN Spanning Tree (PVST), a variation of the original version of STP. With PVST, an instance of STP is run for each configured VLAN. The VLAN number is added to the default priority for each instance. For VLAN 1, then, the default priority is 32769). Second, links are assigned a cost based on their speed. A 100 Mb link has a STP cost of 19, a 1 Gb link has a STP cost of 4. Finally, each port has a port ID and priority. These parameters are used by STP to ultimately determine which port to block in the loop. Again, when using these parameters, lower values are considered better than higher values. Below is an example of a BPDU sent out port Fa0/3 by a switch with the default priority for VLAN 1 of 32769, a MAC address of 000B.1111.1111 and a cost to root of 19. The root switch has been determined to be 000A.1111.1111. The row descriptions are above the fields.

Root ID (RID)		Cost to root	Bridge ID (BID)		Port ID (PID)	
Root priority	Root MAC		Bridge priority	Bridge MAC	Port priority	Port number
32769	000A.1111.1111	19	32769	000B.1111.1111	128	3

← Direction of BPDU

STP goes through a three step process to establish the role of each bridge (Root Bridge or non-root bridge) as well as the role and status of each operational port on each switch. A port's role can be either a root port, designated port or alternate port. Root ports and designated ports have a forwarding status while an alternate port has a blocking status.

The three STP steps are-

1. Determine the root bridge

2. Determine the root port on each non-root bridge

3. Determine the designated port for each segment.

Determining the root bridge

Spanning Tree elects the root bridge by determining the bridge with the lowest bridge ID. First, each bridge compares its STP priority. The bridge with the lowest priority will become the root bridge. If all bridges have the same bridge priority, the bridge with lowest MAC address becomes the root bridge.

All ports on the root bridge are automatically designated ports. Designated ports are put in a forwarding state so all root bridge ports are forwarding.

Determining the root port on each non-root bridge

Each non-root bridge will determine the port through which its cost to the root bridge is lowest. The cost to root for each port is determined by adding the cost-to-root value advertised in BPDUs received on the port to the cost assigned to the port. The port with the lowest total value will be made the root port. Root ports are put in a forwarding state.

Determining the designated port for each segment.

To determine the designated port for a segment, the bridges on the segment compare information in exchanged BPDUs. The bridge closest to root will have its port become the designated port for the segment. If two or more bridges have the same lowest cost to root, the bridge with the lowest BID will have its port become the designated port for the segment. Designated ports are put in a forwarding state.

Once a switch has determined its root port and any designated ports, all other ports are put in a blocking state. No traffic is sent out blocked ports nor is any traffic received on a blocked port forwarded out any other port.

Lab steps

1. You will look start by looking at the spanning tree behavior in the network. Wait at least 30 seconds and then issue the **show spanning-tree** command on all switches.

From the output, you can see that SwitchA is the spanning-tree root bridge. Since all the switches have the same default bridge priority number of 32769, the switch with lowest MAC address became the root bridge. Notice that on the root bridge all interfaces are designated forwarding ports.

Optimizing the Spanning Tree environment

STP has successfully closed off the layer 2 loops without any configuration changes being made. This is its strength – leave it alone and it works! However, it does not necessarily optimize the environment. Administrator intervention is needed to accomplish that task.

Note that a server is connected to SwitchC. Because the links between SwitchB and SwitchC are blocked, data destined for the server from hosts connected to SwitchB must pass through SwitchA. This isn't optimal for two reasons – it induces propagation delay and burdens the link between SwitchA and SwitchC. If SwitchC were the root switch, however, the link between SwitchB and SwitchC would be forwarding – this would eliminate both issues.

You will now make SwitchC the root with the command, **spanning-tree vlan 1 root primary.** This command lowers the default priority on the switch thus making it the root bridge.

SwitchC#**config t**
SwitchC(config)#**spanning-tree vlan 1 root primary**

You will now confirm that the link between SwitchB and SwitchC is in a forwarding state.

SwitchB#**show spanning-tree**

In the topology with which you are working SwitchA is also at the distribution layer. Accordingly, it generally considered a good practice to make such a switch the secondary root switch.

SwitchA#**config t**
SwitchA(config)#**spanning-tree vlan 1 root secondary**
SwitchA(config)#**exit**
SwitchA#

The command, **spanning-tree vlan 1 root secondary** sets a switch's priority number higher than the primary root bridge's priority number but lower than the default setting. This causes the switch to become the secondary root bridge.

5. On SwitchC and SwitchA issue the **show run** command to display the primary and secondary root bridge priority numbers.

SwitchC#**show run**
!
spanning-tree vlan 1 priority 24576
!
SwitchA#**show run**
!
spanning-tree vlan 1 priority 28672
!

The command you entered was **spanning-tree vlan 1 root primary**. However, in the running configuration, the real command is **spanning-tree vlan 1 priority 24576**. You could have also used this command to manually configure root bridges as well. The priority number must be in increments of 4096.

Please Note: The following configuration in this step is only an example. Do not use the command **spanning-tree vlan 1 priority 4096** in this lab.

SwitchB#**config t**
SwitchB(config)#**spanning-tree vlan 1 priority 4096**
SwitchB(config)#**exit**
SwitchB#

6. Now that you have made SwitchC the primary root and SwitchA the secondary root, view the spanning tree environment by issuing the **show spanning-tree** command on all switches.

Now, all the switches see SwitchC as the root bridge. Look at the MAC address under the Root ID for each switch. The MAC address for the Root ID belongs to SwitchC.

Host port optimization

Normally, when a switch port is brought up it takes the port approximately 30 seconds for spanning-tree to go through an initialization process. The purpose of this process is to make sure that any bridging loop is closed before packets are forwarded. Accordingly, during this time the switch port is in a blocking state and does not forward packets. Where a host (server, workstation, printer, router, iphone or other non-switch device) is connected to the port, no bridging loop can actually occur so it is not necessary to have STP go through this initialization process. In fact, it is often undesirable to have the port effectively shut down during the initial 30 seconds as it can be during this time that a network device is seeking an address through DHCP.

To remedy this, the “portfast” command can be entered on a port directly connected to a host. Configuring portfast allows the switch port to immediately transition to a forwarding state and skip the spanning-tree initialization process. Portfast does entirely disable STP, however. Should a switch be connected to the port and a BPDU is received, the port will immediately transition to a blocking state and go through the STP initialization process.

Lab steps-

In the following steps you will configure portfast on the appropriate port on each switch.

SwitchB#**config t**
SwitchB(config)#**interface fastethernet 0/8**
SwitchB(config-if)#**spanning-tree portfast**
SwitchB(config-if)#**exit**
SwitchB(config)#**exit**
SwitchB#

SwitchA#**config t**
SwitchA(config)#**interface fastethernet 0/8**
SwitchA(config-if)#**spanning-tree portfast**
SwitchA(config-if)#**exit**
SwitchA(config)#**exit**
SwitchA#

SwitchC#**config t**
SwitchC(config)#**interface fastethernet 0/8**
SwitchC(config-if)#**spanning-tree portfast**
SwitchC(config-if)#**exit**
SwitchC(config)#**exit**
SwitchC#

Confirm the configuration with the “show run” command on each switch.