CIS 83 LAB 4 - Spanning Tree Protocol
Rich Simms
October 3, 2006

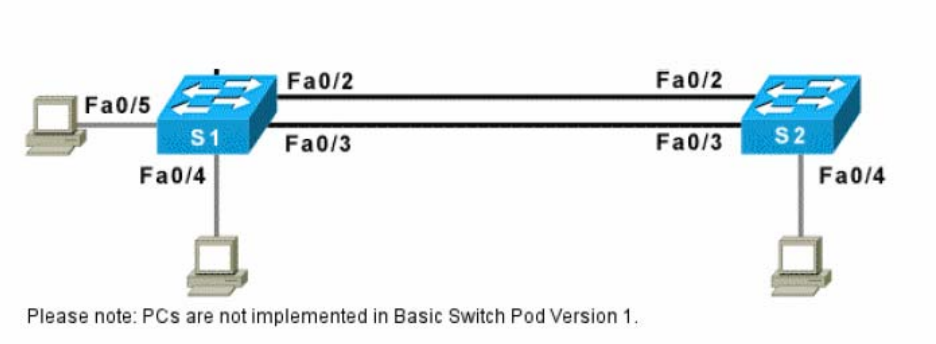
Objective

The objective of this lab is to become familiar with Cisco switches as well as the Spanning Tree Protocol.

Scenario

This lab was done using the basic router pod on NETLAB. NETLAB lets you remotely access a pod of Cisco switches. The two Cisco switches were configured as shown below.

Topology



Final Running Configurations

Switch-1	Switch-2
Switch-1#show run Building configuration... Current configuration : 1587 bytes ! version 12.1 no service pad service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname Switch-1 ! enable secret 5 1L605$lSxeclE/S2rF0DgEPn9jW. ! ip subnet-zero ! ! spanning-tree mode pvst	Switch-2#show run Building configuration... Current configuration : 1331 bytes ! version 12.1 no service pad service timestamps debug uptime service timestamps log uptime no service password-encryption ! hostname Switch-2 ! enable secret 5 1gNjy$cTGTCydIDboyqGquCqHlQ/ ! ip subnet-zero ! ! !

```
no spanning-tree optimize bpdu
transmission
spanning-tree extend system-id
!
!
interface FastEthernet0/1
 no ip address
!
interface FastEthernet0/2
 no ip address
!
interface FastEthernet0/3
 no ip address
!
interface FastEthernet0/4
 no ip address
!
interface FastEthernet0/5
 no ip address
!
interface FastEthernet0/6
 no ip address
!
interface FastEthernet0/7
 no ip address
!
interface FastEthernet0/8
 no ip address
!
interface FastEthernet0/9
 no ip address
!
interface FastEthernet0/10
 no ip address
!
interface FastEthernet0/11
 no ip address
!
interface FastEthernet0/12
 no ip address
!
interface FastEthernet0/13
 no ip address
!
interface FastEthernet0/14
 no ip address
!
interface FastEthernet0/15
 no ip address
!
interface FastEthernet0/16
 no ip address
!
interface FastEthernet0/17
 no ip address
!
interface FastEthernet0/18
 no ip address
!
interface FastEthernet0/19
 no ip address
!
interface FastEthernet0/20
 no ip address
!
interface FastEthernet0/21
 no ip address
!
interface FastEthernet0/22
 no ip address
!
```

```
spanning-tree mode pvst
no spanning-tree optimize bpdu
transmission
spanning-tree extend system-id
spanning-tree vlan 1 priority
24576
!
!
!
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 192.168.1.2
255.255.255.0
 no ip route-cache
!
ip http server
!
line con 0
 exec-timeout 0 0
```

```
interface FastEthernet0/23
 no ip address
!
interface FastEthernet0/24
 no ip address
!
interface Vlan1
 ip address 192.168.1.1
255.255.255.0
 no ip route-cache
!
ip http server
!
!
line con 0
 exec-timeout 0 0
 logging synchronous
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end

Switch-1#
```

```
 logging synchronous
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
!
end

Switch-2#
```

Final Spanning Tree Tables

Switch-1

```
Switch-1#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0013.6012.42c0
             Cost        19
             Port        2 (FastEthernet0/2)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0011.5cd1.bc00
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Root FWD 19        128.2    P2p
Fa0/3            Altn BLK 19        128.3    P2p
Fa0/4            Desg FWD 100       128.4    Shr

Switch-1#
```

Switch-2

```
Switch-2#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0013.6012.42c0
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
             Address     0013.6012.42c0
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/3            Desg LIS 19        128.3    P2p
Fa0/5            Desg FWD 100       128.5    Shr

Switch-2#
```

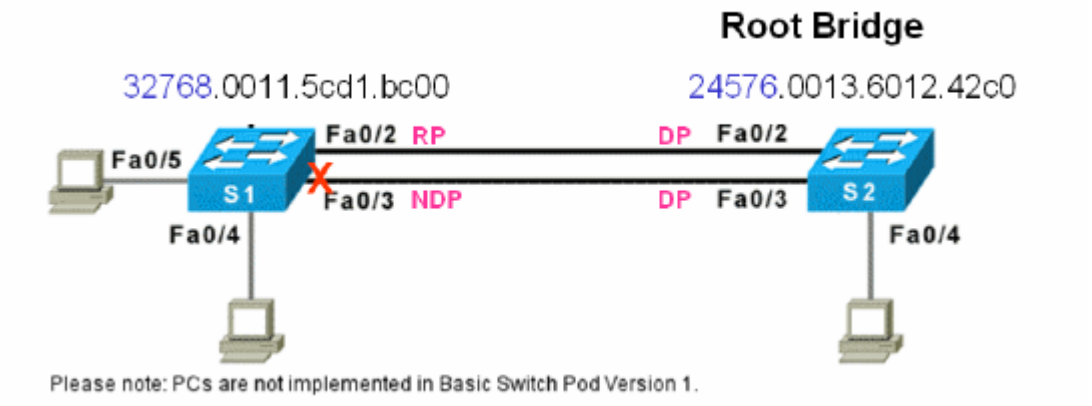
Summary

The first thing you discover is that the Cisco switches run IOS. All the normal commands we have been learning also work the same on switches with little if any changes. Basic configuration includes hostnames, passwords, telnet access, etc. For the spanning tree protocol (and not for the basic operation of the switch) you can configure an IP address for management purposes. This allows one switch to ping another.

The show command also works in a similar fashion to routers and can be used to display flash, version, interface, and CDP information. CDP works whether a port is forwarding or not. The normal CDP commands will show what is connected to the interfaces. It also can be used to display switch specific information like the MAC-port table.

While we can't see the port lights on NETLAB it is now clear why they start off as amber and then change to green. This is because the switch is running the spanning tree protocol to insure there are no loops enabled that will crash the network (broadcast storms and duplicate packets that overwhelm the network).

The spanning tree information shows all the information about root switch, bridge IDs, which ports are forwarding and which are blocked etc. In this lab a loop was created. We rig Switch-2 to be the Root switch and then you can see the interface on Switch-1 is a non-designated port and is blocked to prevent a loop.



Switch-2 has a higher MAC (0013.6012.42c0) but since it has a lower priority (24576) it is the Root switch. All Switch-2 ports are DP (designated ports) and in the forwarding state. Swithc-2 has a lower MAC address (0011.5cd1.bc00) but a higher priority (32768) so it is not the root switch. Its port Fa 0/3 is a NDP (non-designated port) so it is blocked and nor forwarding any packets (which prevents a loop).

Commands

```
! Basic switch configuration
Switch>enable
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname Switch-2
Switch-2(config)#line con 0
Switch-2(config-line)#logging synchronous
Switch-2(config-line)#exec-timeout 0 0
Switch-2(config-line)#exit
Switch-2(config)#interface vlan 1
Switch-2(config-if)#ip address 192.168.1.2 255.255.255.0
Switch-2(config-if)#no shutdown
Switch-2(config-if)#exit
Switch-2(config)#enable secret class
Switch-2(config)#line vty 0 15
Switch-2(config-line)#password cisco
Switch-2(config-line)#login


! Testing
!
```

```
Switch-2#ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms
Switch-2#


! Show int commands
!

Switch-1#show flash
Directory of flash:/

    2 -rwx 2980731 Mar 01 1993 00:03:31 c2950-i6q4l2-mz.121-19.EA1c.bin
    3 -rwx 286 Jan 01 1970 00:00:21 env_vars
    4 -rwx 1495 Mar 01 1993 00:06:12 config.text
    5 -rwx 5 Mar 01 1993 00:06:12 private-config.text
    7 -rwx 110 Mar 01 1993 00:01:58 info
    8 drwx 2432 Mar 01 1993 00:04:58 html
   85 -rwx 110 Mar 01 1993 00:05:01 info.ver

7741440 bytes total (1758720 bytes free)

Switch-1#show int fa 0/1
FastEthernet0/1 is down, line protocol is down (notconnect)
  Hardware is Fast Ethernet, address is 0011.5cd1.bc01 (bia 0011.5cd1.bc01)
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed
  input flow-control is off, output flow-control is off
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 00:22:17, 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
     1 packets input, 64 bytes, 0 no buffer
     Received 0 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     0 input packets with dribble condition detected
     66 packets output, 6485 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 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
Switch-1#

Switch-1#show int fa 0/2
FastEthernet0/2 is up, line protocol is up (connected)
  Hardware is Fast Ethernet, address is 0011.5cd1.bc02 (bia 0011.5cd1.bc02)
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s
```

```
  input flow-control is off, output flow-control is off
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:02, output 00:00:01, 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
     244 packets input, 26107 bytes, 0 no buffer
     Received 83 broadcasts (0 multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 82 multicast, 0 pause input
     0 input packets with dribble condition detected
     1686 packets output, 120884 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 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
Switch-1#

Switch-1#show version
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(19)EA1c, RELEASE
SOFTWARE (fc2)
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Mon 02-Feb-04 23:29 by yenanh
Image text-base: 0x80010000, data-base: 0x8058A000

ROM: Bootstrap program is C2950 boot loader

Switch-1 uptime is 20 minutes
System returned to ROM by power-on
System image file is "flash:/c2950-i6q4l2-mz.121-19.EA1c.bin"

cisco WS-C2950-24 (RC32300) processor (revision P0) with 20808K bytes of
memory.
Processor board ID FOC0824X3ME
Last reset from system-reset
Running Standard Image
24 FastEthernet/IEEE 802.3 interface(s)

32K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address: 00:11:5C:D1:BC:00
Motherboard assembly number: 73-5781-13
Power supply part number: 34-0965-01
Motherboard serial number: FOC08250BXS
Power supply serial number: DAB08178H4C
Model revision number: P0
Motherboard revision number: A0
Model number: WS-C2950-24
System serial number: FOC0824X3ME

! CDP information
!
Switch-1#show cdp neighbors
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
Switch-2         Fas 0/3            150          S I      WS-C2950T-Fas 0/3
Switch-2         Fas 0/2            150          S I      WS-C2950T-Fas 0/2
```

```
Switch-1#

Switch-1#show cdp entry Switch-2
-------------------------
Device ID: Switch-2
Entry address(es):
  IP address: 192.168.1.2
Platform: cisco WS-C2950T-24,  Capabilities: Switch IGMP
Interface: FastEthernet0/3,  Port ID (outgoing port): FastEthernet0/3
Holdtime : 174 sec

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA2, RELEASE SOFTWARE
(fc1)
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Sun 07-Nov-04 23:14 by antonino

advertisement version: 2
Protocol Hello:  OUI=0x00000C, Protocol ID=0x0112; payload len=27, value=0000000
0FFFFFFFF010221FF0000000000000013601242C0FF0000
VTP Management Domain: ''
Native VLAN: 1
Duplex: full
Management address(es):
  IP address: 192.168.1.2

-------------------------
Device ID: Switch-2
Entry address(es):
  IP address: 192.168.1.2
Platform: cisco WS-C2950T-24,  Capabilities: Switch IGMP
Interface: FastEthernet0/2,  Port ID (outgoing port): FastEthernet0/2
Holdtime : 171 sec

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA2, RELEASE SOFTWARE
(fc1)
Copyright (c) 1986-2004 by cisco Systems, Inc.
Compiled Sun 07-Nov-04 23:14 by antonino

advertisement version: 2
Protocol Hello:  OUI=0x00000C, Protocol ID=0x0112; payload len=27, value=0000000
0FFFFFFFF010221FF0000000000000013601242C0FF0000
VTP Management Domain: ''
Native VLAN: 1
Duplex: full
Management address(es):
  IP address: 192.168.1.2

Switch-1#


! show MAC addresses learned by each port
Switch-1#show mac-address-table
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
 All    0011.5cd1.bc00    STATIC      CPU
 All    0100.0ccc.cccc    STATIC      CPU
```

```
 All    0100.0ccc.cccd    STATIC      CPU
 All    0100.0cdd.dddd    STATIC      CPU
   1    0013.6012.42c2    DYNAMIC     Fa0/2
   1    0013.6012.42c3    DYNAMIC     Fa0/3
Total Mac Addresses for this criterion: 6
Switch-1#


! Changing the root switch (using a lower priority setting)
!
Switch-2(config)#spanning-tree vlan 1 root primary
!or
Switch-2(config)#spanning-tree vlan 1 priority 4096

Switch-2#
00:31:21: %SYS-5-CONFIG_I: Configured from console by console
Switch-2#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0013.6012.42c0
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
             Address     0013.6012.42c0
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 15

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/3            Desg LIS 19        128.3    P2p
Fa0/5            Desg FWD 100       128.5    Shr

Switch-2#
```