

Chapter 8: Layer-2 Switching

Chapter 8 Objectives

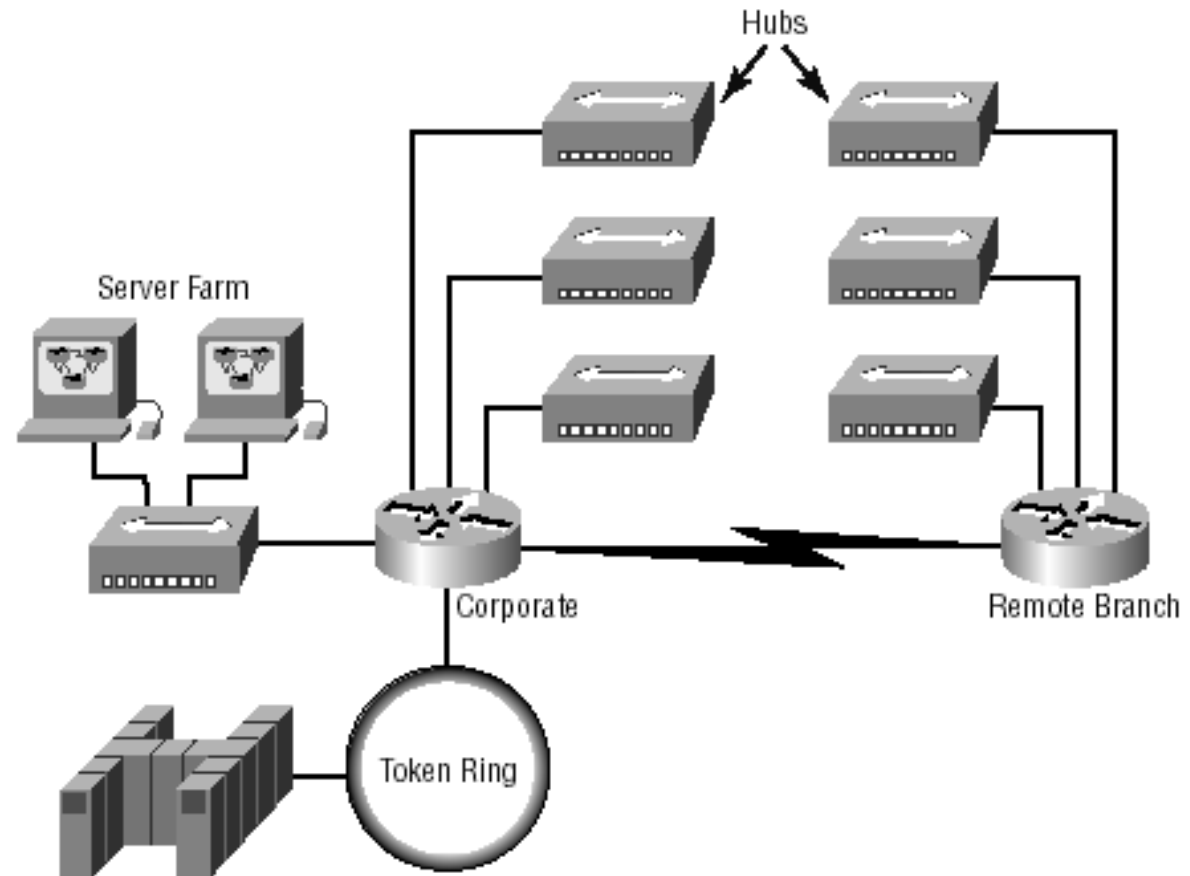
The Topics Covered in this chapter include:

- What is layer-2 switching
- Switching services
- Bridges vs. LAN switching
- Three switch functions
- MAC table
- Switching loops Spanning-Tree Protocol (STP)

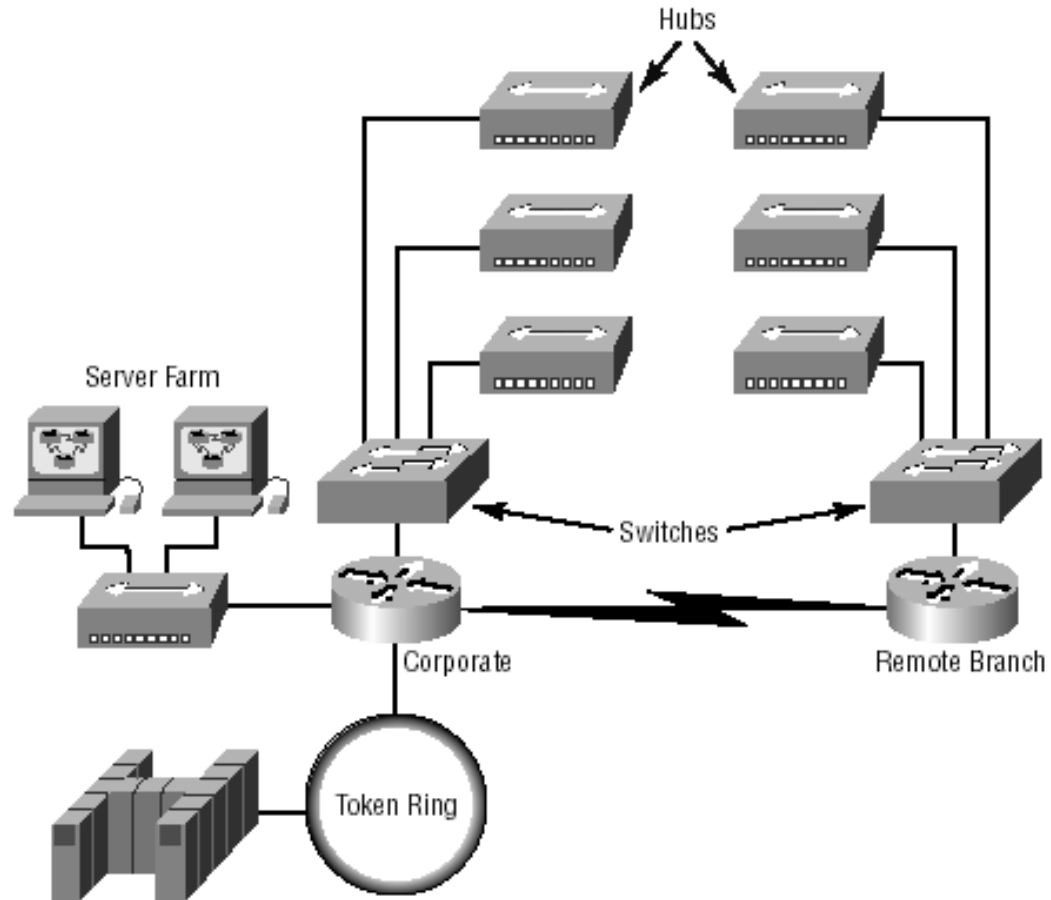
Layer 2 Switching

- Purposes for using switching
 - Breaks up collision domains
 - Cost-effective, resilient internetwork
- Purpose for Spanning-Tree Protocol (STP)
 - Stops loops in layer 2 switched networks

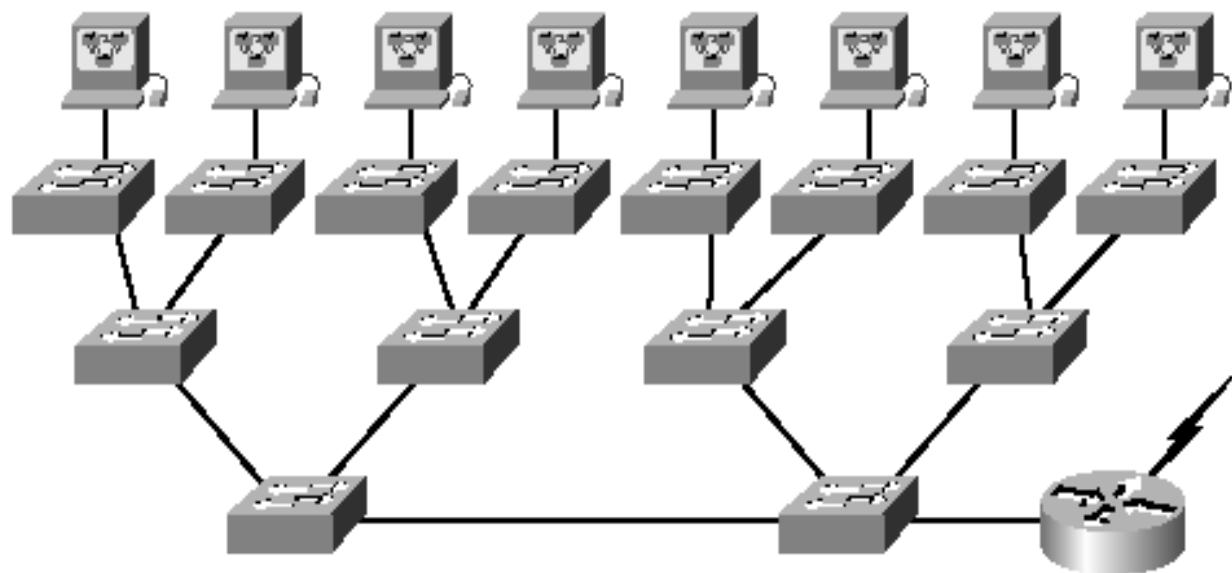
Before Layer 2 Switching



Switched LANs



Typical Switched Designs



Switching Services

Layer 2 switching provides:

- Hardware-based bridging (ASIC)
- Wire speed
- Low latency
- Low cost

Limitations of Layer 2 Switching

- Must break up the collision domains correctly.
- Make sure that users spend 80 percent of their time on the local segment.
- Switches do not break up broadcast domains by default.

Bridging vs. LAN switching

- Bridges are software based, while switches are hardware based.
- A switch can be viewed as a multiport bridge.
- Only one spanning-tree instance per bridge.
- Switches have a higher number of ports than most bridges.
- Bridges and switches learn MAC addresses by examining the source address of each frame received.
- Both bridges and switches make forwarding decisions based on layer 2 addresses.

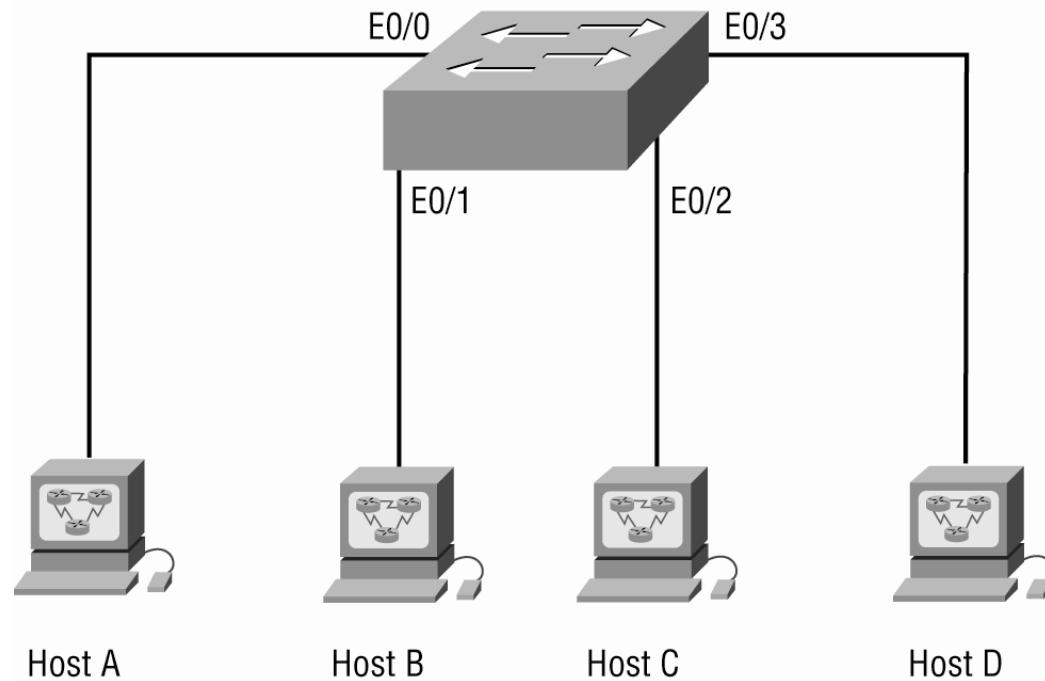
Three Switch Functions at Layer-2

- Address learning
- Forward/filter decisions
- Loop avoidance

Empty MAC table

MAC Forward/Filter Table

E0/0:
E0/1:
E0/2:
E0/3:



How Switches Learn Hosts' Locations

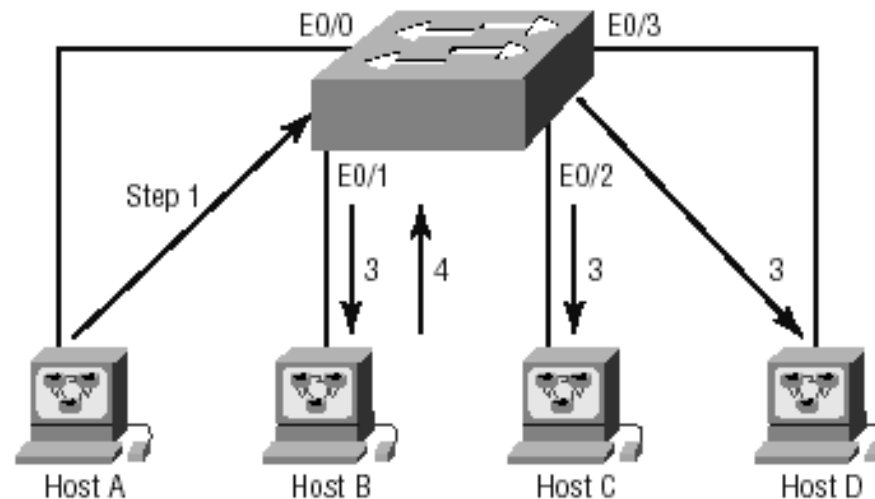
MAC Forward/Filter Table

E0/0: 0000.8c01.000A step 2

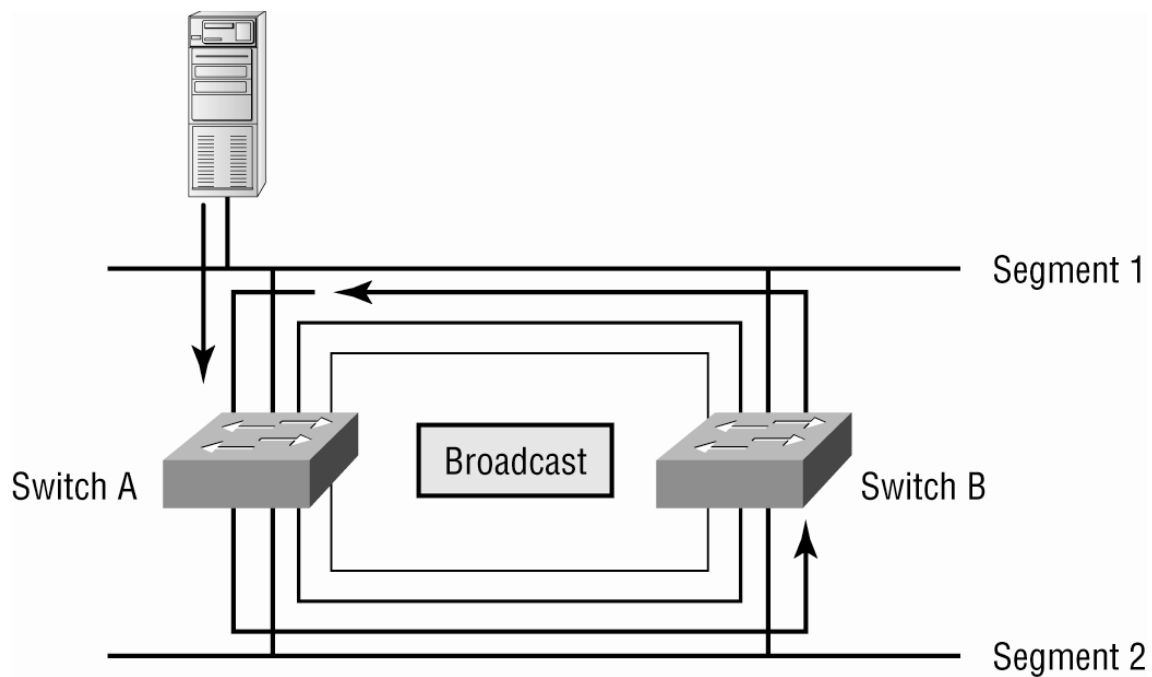
E0/1: 0000.8c01.000B step 4

E0/2:

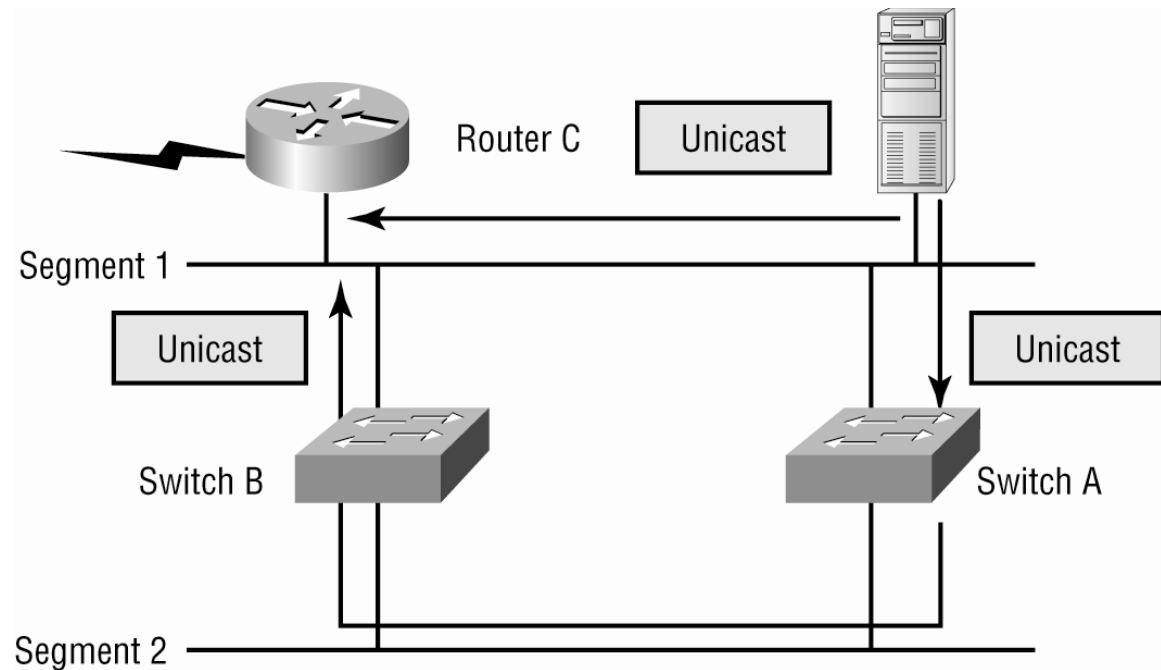
E0/3:

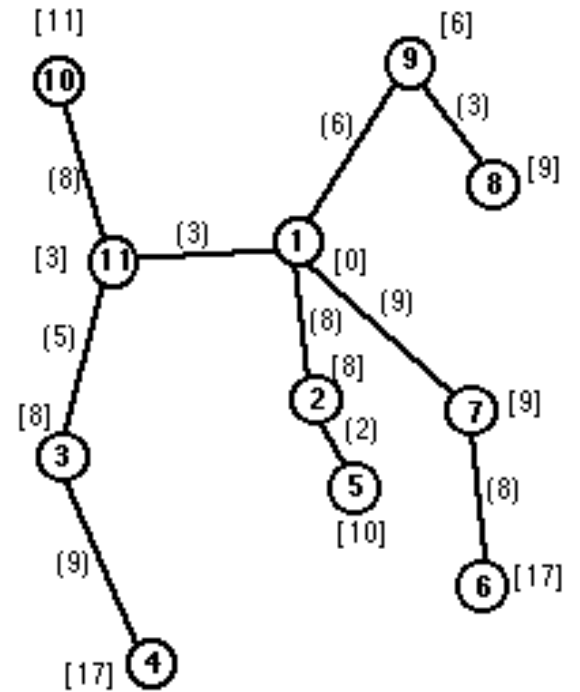
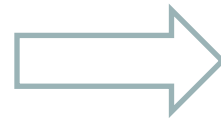
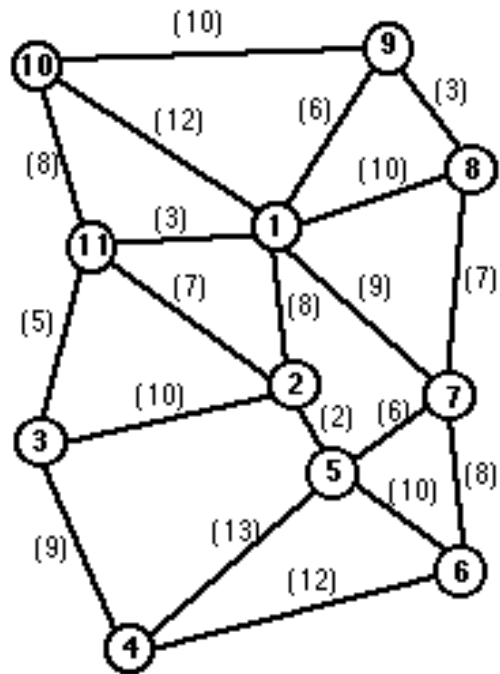


Switching Loops



Switching Loop Problems





http://www.me.utexas.edu/~jensen/exercises/mst_spt/mst_spt.html

Spanning-Tree Protocol (STP) Solves Switching loops at layer 2

- STP
- Root Bridge
- BPDU
- Bridge ID
- Nonroot Bridge
- Root port
- Designated port
- Port cost
- Nondesignated port
- Forwarding port
- Block port

*I think that I shall never see
A graph more lovely than a tree.
A tree whose crucial property
Is loop-free connectivity.
A tree that must be sure to span
So packets can reach every LAN.
First, the root must be selected.
By ID, it is elected.
Least cost paths from root are traced.
In the tree, these paths are placed.
A mesh is made by folks like me,
Then bridges find a spanning tree.*

— Radia Perlman *Algorhyme*

https://www.youtube.com/watch?v=iE_AbM8Zyki

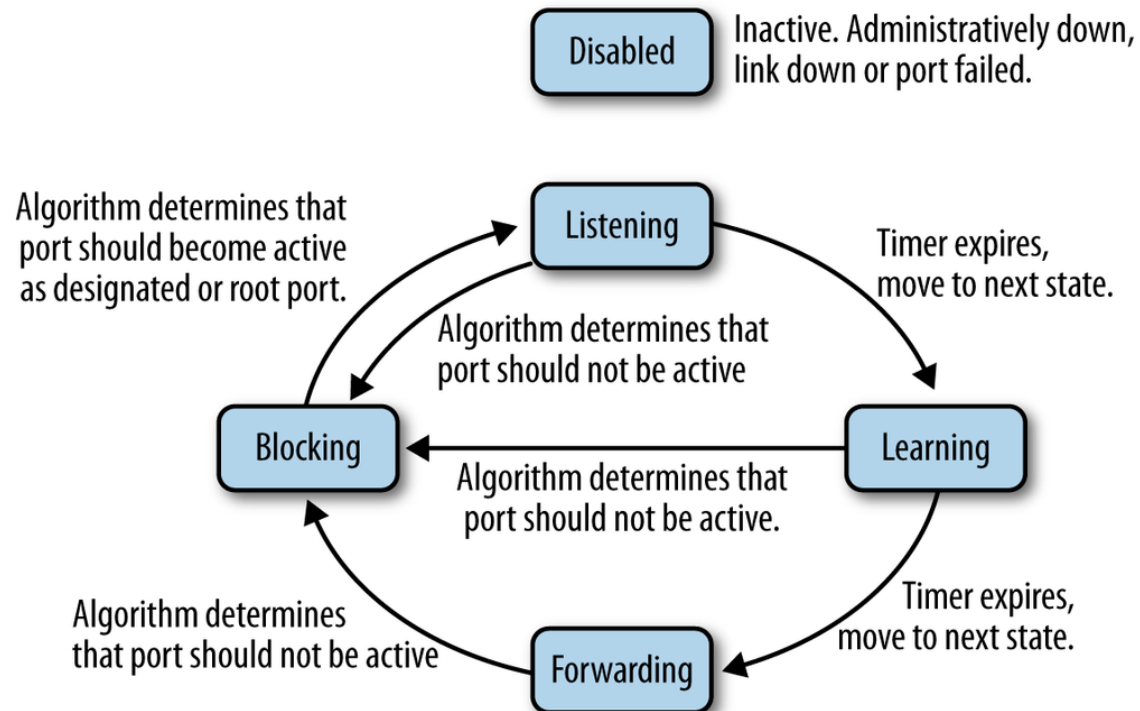
Spanning-Tree Operations

- Selecting the root bridge
- Selecting the designated port

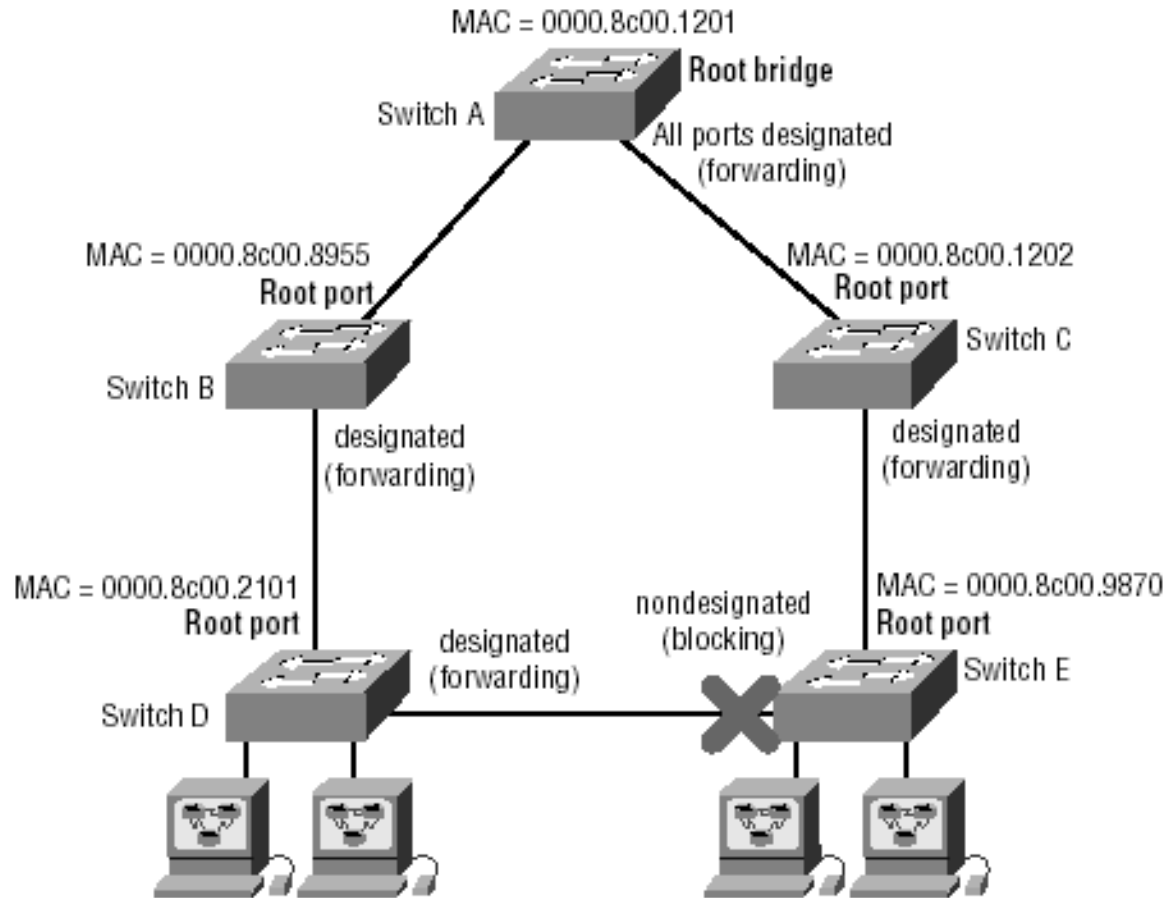
Speed	New IEEE Cost	Original IEEE Cost
10Gbps	2	1
1Gbps	4	1
100Mbps	19	10
10Mbps	100	100

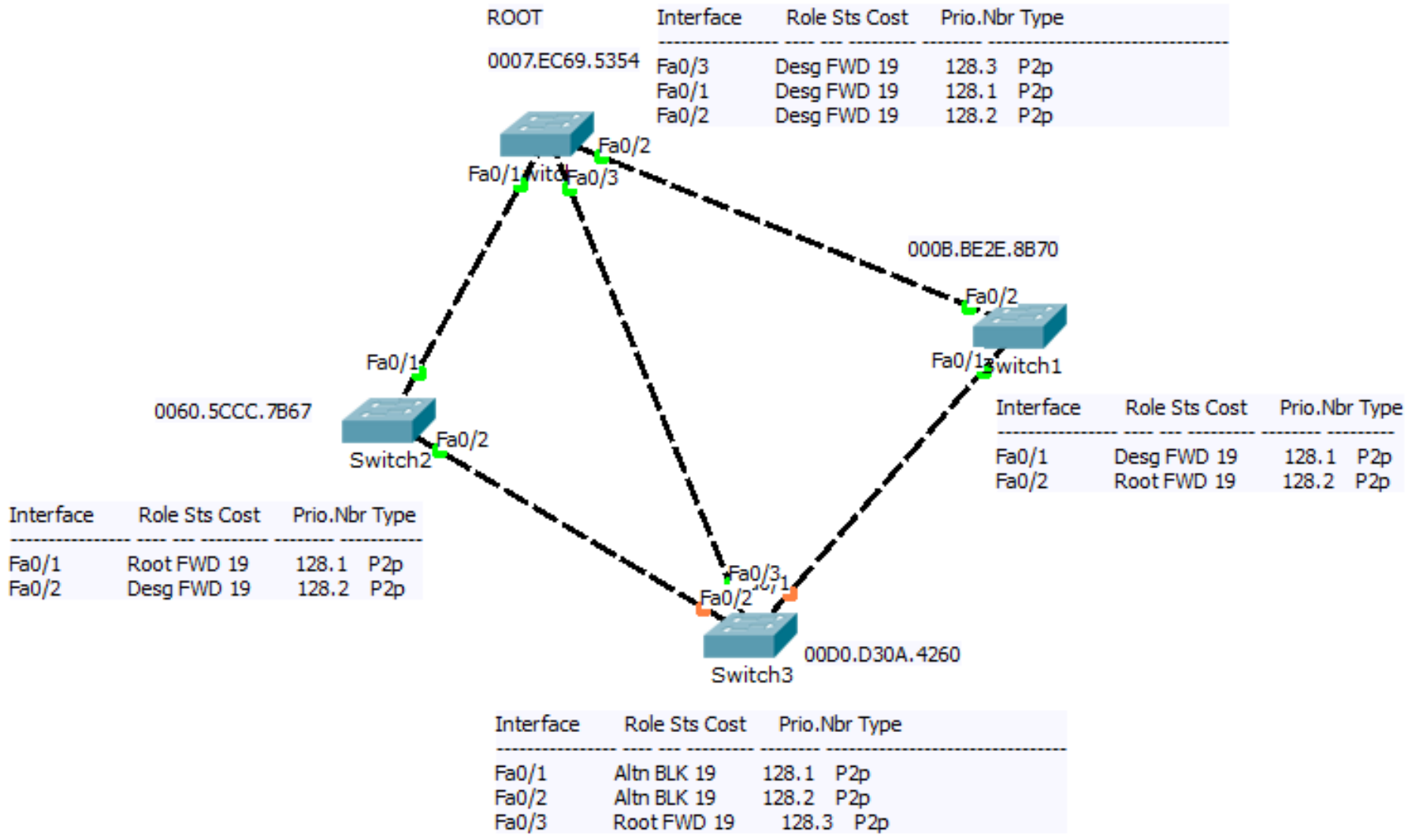
Spanning-Tree Port States

- Blocking
- Listening
- Forwarding
- Disabled



Spanning-Tree Example





ROOT	Interface	Role	Sts	Cost	Prio.Nbr	Type
0007.EC69.5354	Fa0/3	Desg FWD	19	128.3	128.3	P2p
	Fa0/1	Desg FWD	19	128.1	128.1	P2p
	Fa0/2	Desg FWD	19	128.2	128.2	P2p

0060.5CCC.7B67

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Root FWD	19	128.1	128.1	P2p
Fa0/2	Desg FWD	19	128.2	128.2	P2p

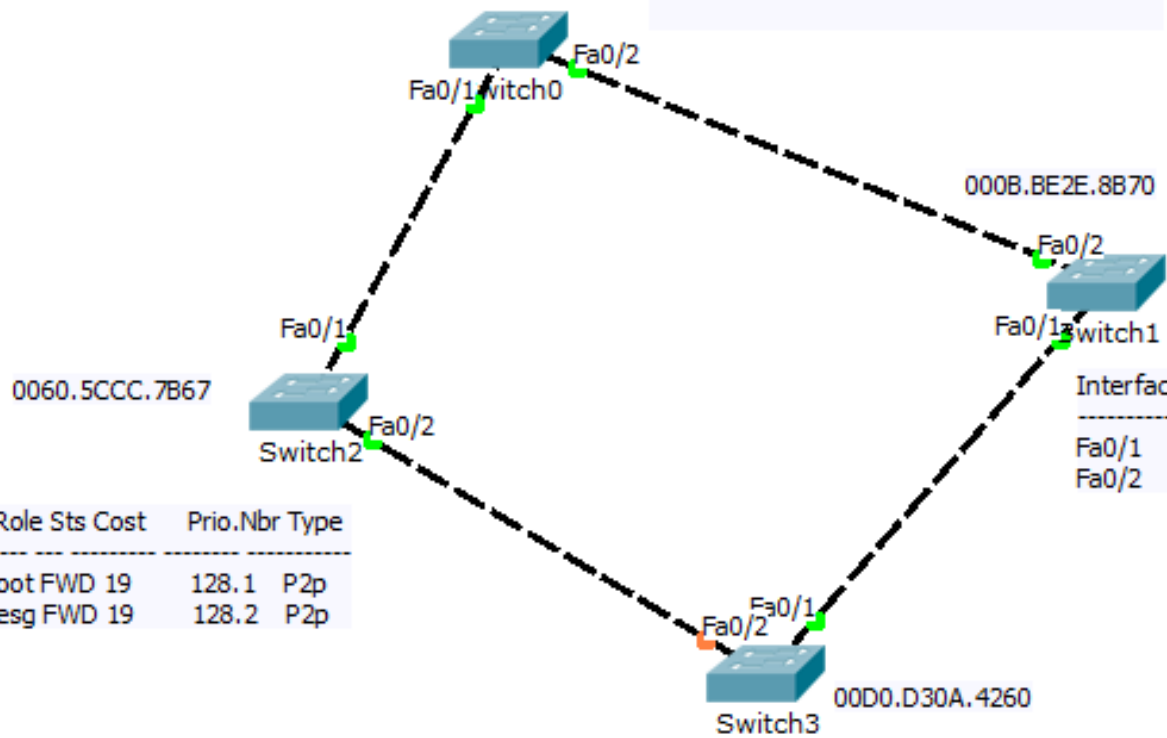
000B.BE2E.8B70

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.1	128.1	P2p
Fa0/2	Root FWD	19	128.2	128.2	P2p

00D0.D30A.4260

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Altn BLK	19	128.1	128.1	P2p
Fa0/2	Altn BLK	19	128.2	128.2	P2p
Fa0/3	Root FWD	19	128.3	128.3	P2p

ROOT	Interface	Role	Sts	Cost	Prio.	Nbr	Type
0007.EC69.5354	Fa0/1	Desg	FWD	19	128.1		P2p
	Fa0/2	Desg	FWD	19	128.2		P2p



Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/1	Desg	FWD	19	128.1		P2p
Fa0/2	Root	FWD	19	128.2		P2p

Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/1	Root	FWD	19	128.1		P2p
Fa0/2	Desg	FWD	19	128.2		P2p

Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/1	Root	FWD	19	128.1		P2p
Fa0/2	Altn	BLK	19	128.2		P2p

```
Switch#sh spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 4097
Address 0060.4732.786B
This bridge is the root
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
```

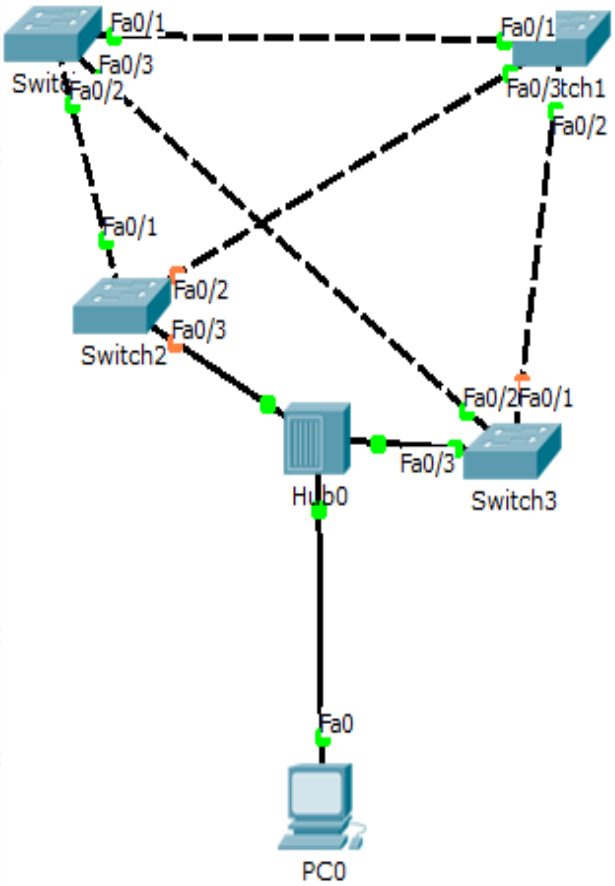
```
Bridge ID Priority 4097 (priority 4096 sys-id-ext 1)
Address 0060.4732.786B
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
```

Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/2	Desg	FWD	19	128.2		P2p
Fa0/3	Desg	FWD	19	128.3		P2p
Fa0/1	Desg	FWD	19	128.1		

```
Switch#sh sp
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 4097
Address 0060.4732.786B
Cost 19
Port 1(FastEthernet0/1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
```

```
Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 000A.F3E9.CE22
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
```

Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/1	Root	FWD	19	128.1		P2p
Fa0/2	Altn	BLK	19	128.2		P2p
Fa0/3	Altn	BLK	19	128.3		



```
Switch#sh sp
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 4097
Address 0060.4732.786B
Cost 19
Port 1(FastEthernet0/1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
```

```
Bridge ID Priority 8193 (priority 8192 sys-id-ext 1)
Address 00D0.5865.94B6
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
```

Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/1	Root	FWD	19	128.1		P2p
Fa0/2	Desg	FWD	19	128.2		P2p
Fa0/3	Desg	FWD	19	128.3		P2p

```
Switch#sh sp
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority 4097
Address 0060.4732.786B
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 0007.ECBE.AC75
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 20
```

Interface	Role	Sts	Cost	Prio.	Nbr	Type
Fa0/1	Altn	BLK	19	128.1		P2p
Fa0/2	Root	FWD	19	128.2		P2p
Fa0/3	Desg	FWD	19	128.3		

Port Security

```
Switch#config t
```

```
Switch(config)#int f0/1
```

```
Switch(config-if)#switchport port-security maximum 1
```

```
Switch(config-if)#switchport port-security violation  
shutdown
```

```
Switch(config-if)#switchport port-security mac-address  
sticky
```

```
Switch(config-if)#switchport port-security maximum 2
```

```
Switch(config-if)#switchport port-security violation  
shutdown
```