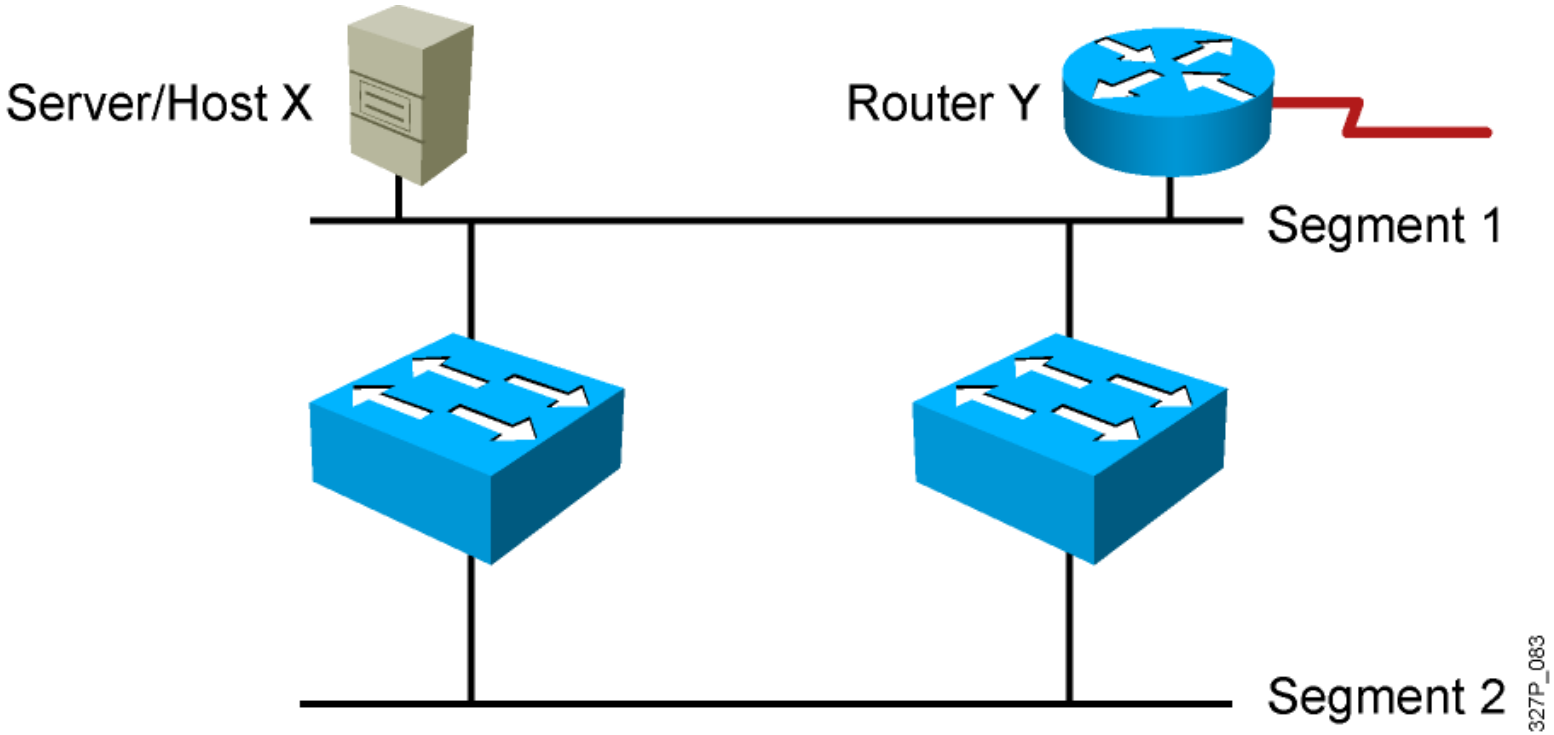
## Medium-Sized Switched Network Construction

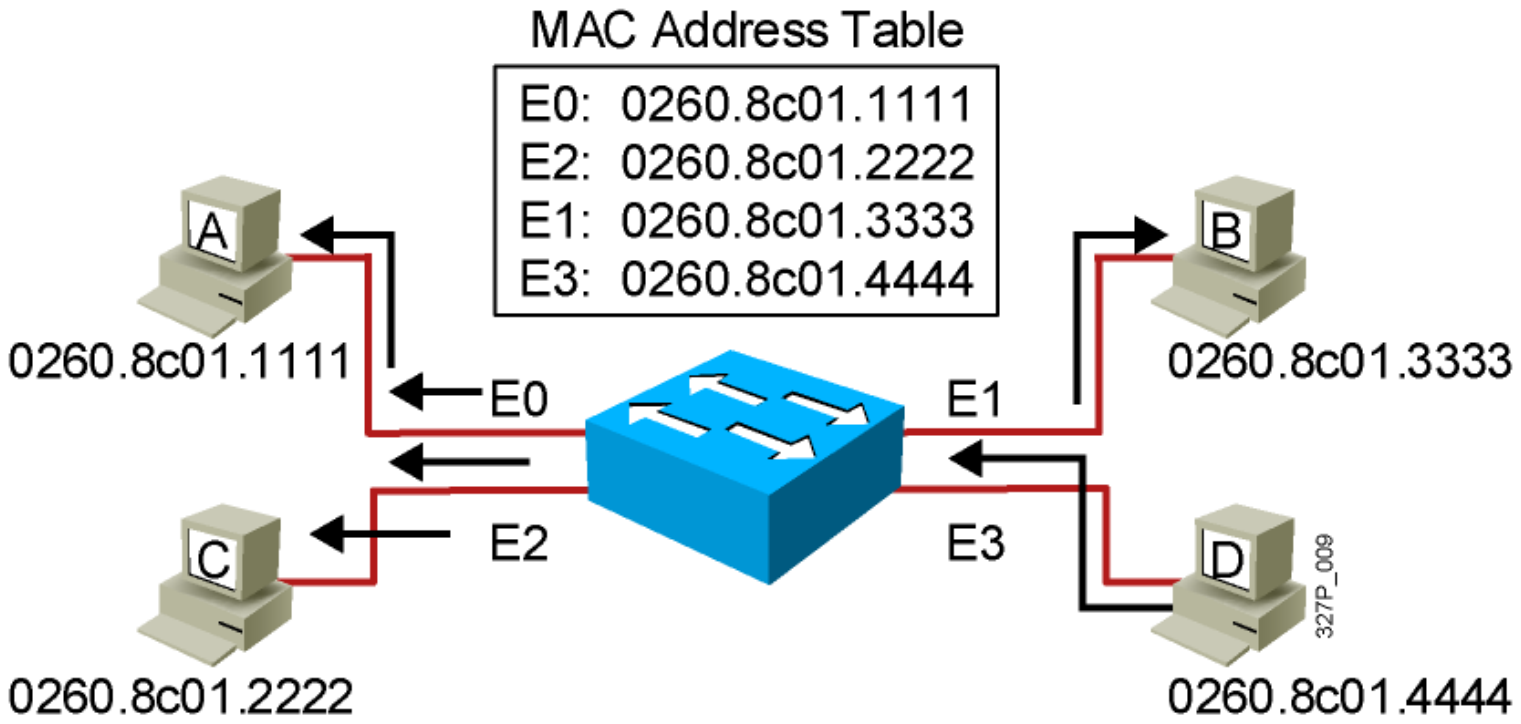
# Improving Performance with Spanning Tree

# Redundant Topology



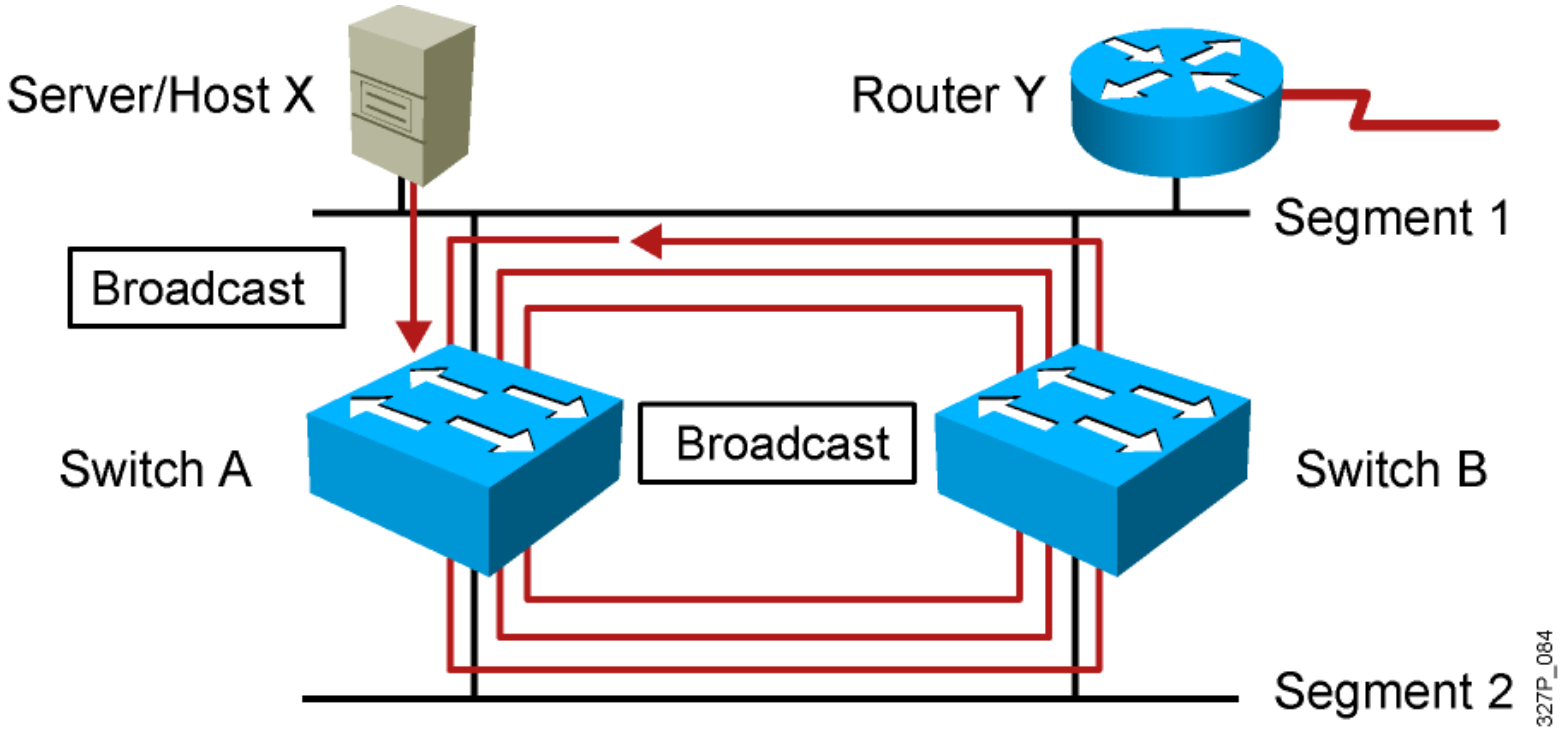

- Redundant topology eliminates single points of failure.
- Redundant topology causes broadcast storms, multiple frame copies, and MAC address table instability problems.

# Broadcast Frames



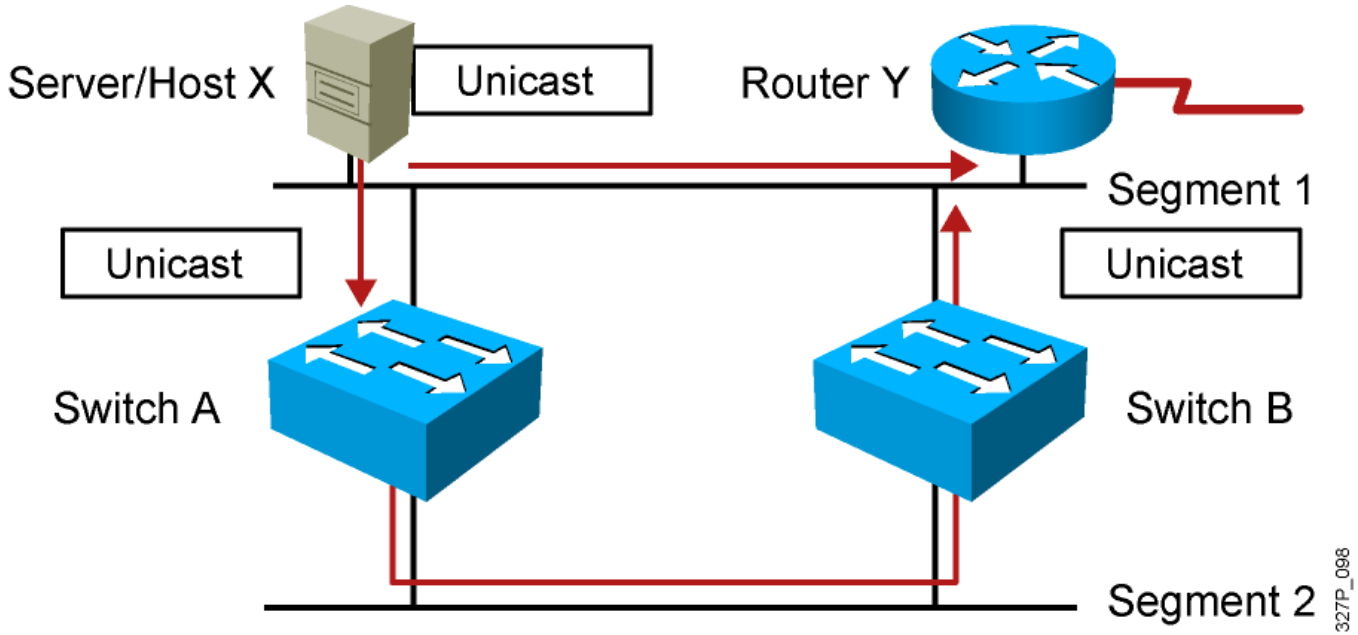

- Station D sends a broadcast frame.
- Broadcast frames are flooded to all ports except the originating port.

# Broadcast Storms



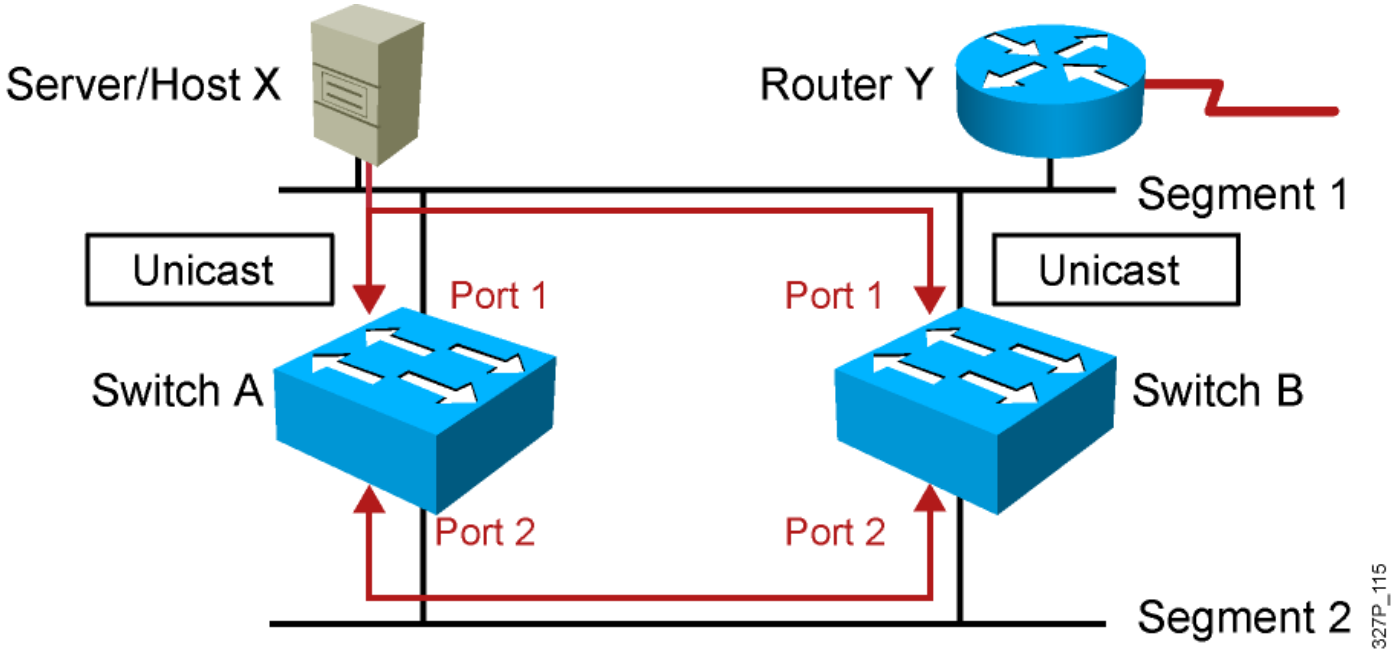

- Host X sends a broadcast.
- Switches continue to propagate broadcast traffic over and over.

# Multiple Frame Copies



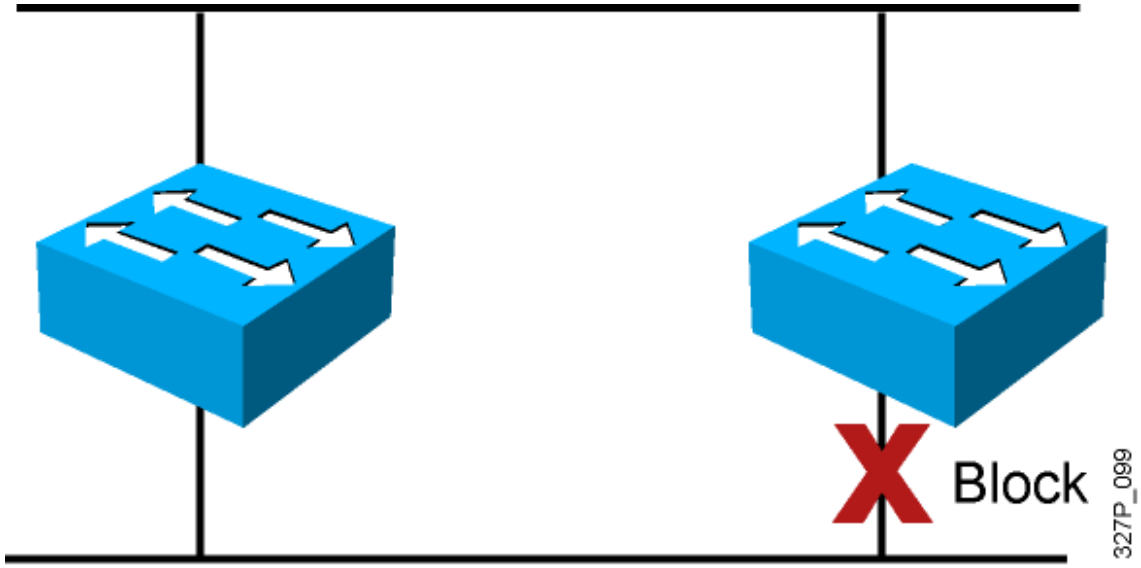

- Host X sends a unicast frame to router Y.
- The MAC address of router Y has not been learned by either switch.
- Router Y will receive two copies of the same frame.

# MAC Database Instability



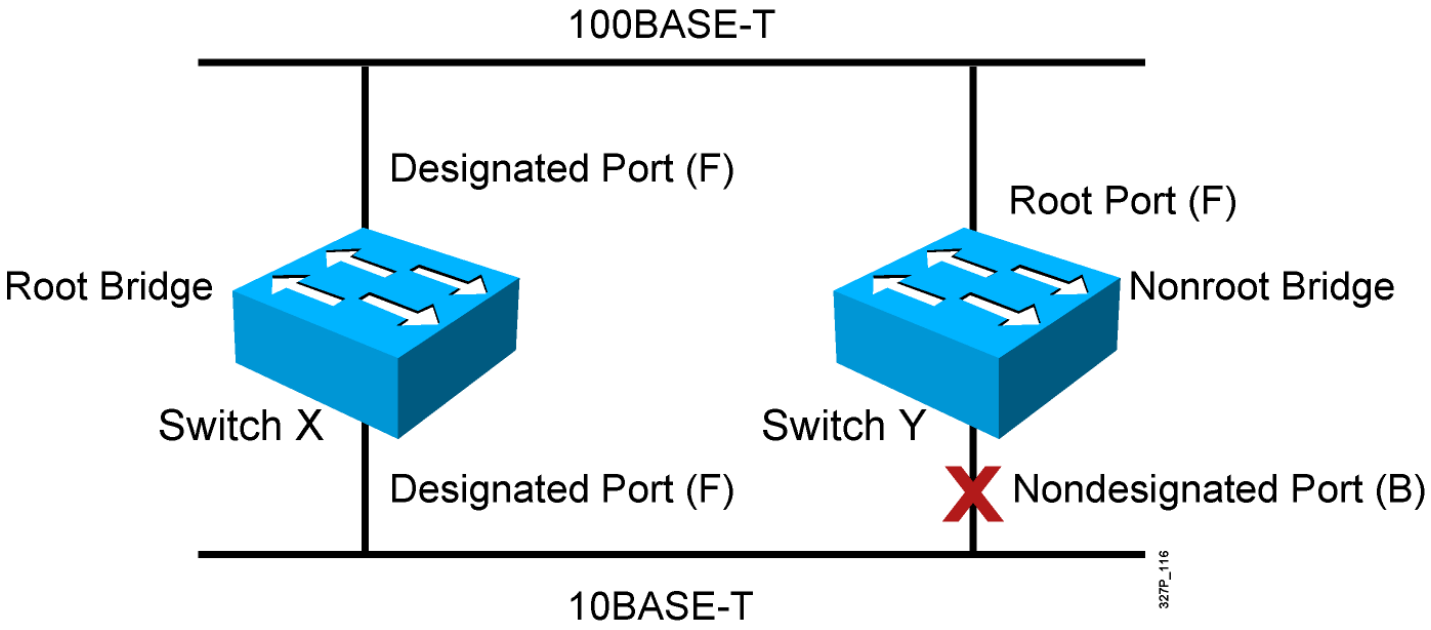

- Host X sends a unicast frame to router Y.
- The MAC address of router Y has not been learned by either switch.
- Switches A and B learn the MAC address of host X on port 1.
- The frame to router Y is flooded.
- Switches A and B incorrectly learn the MAC address of host X on port 2.

# Loop Resolution with STP



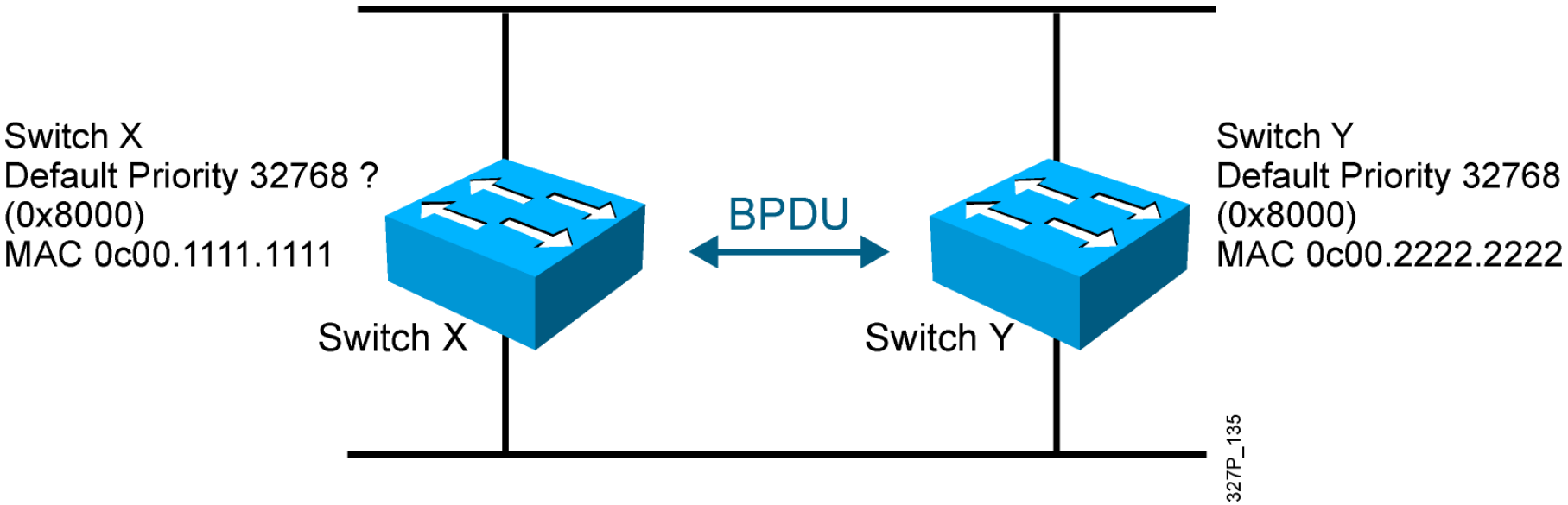

- Provides a loop-free redundant network topology by placing certain ports in the blocking state
- Published in the IEEE 802.1D specification
- Enhanced with the Cisco PVST+ implementation

# Spanning-Tree Operation




- One root bridge per broadcast domain.
- One root port per non-root bridge.
- One designated port per segment.
- Non-designated ports are unused.

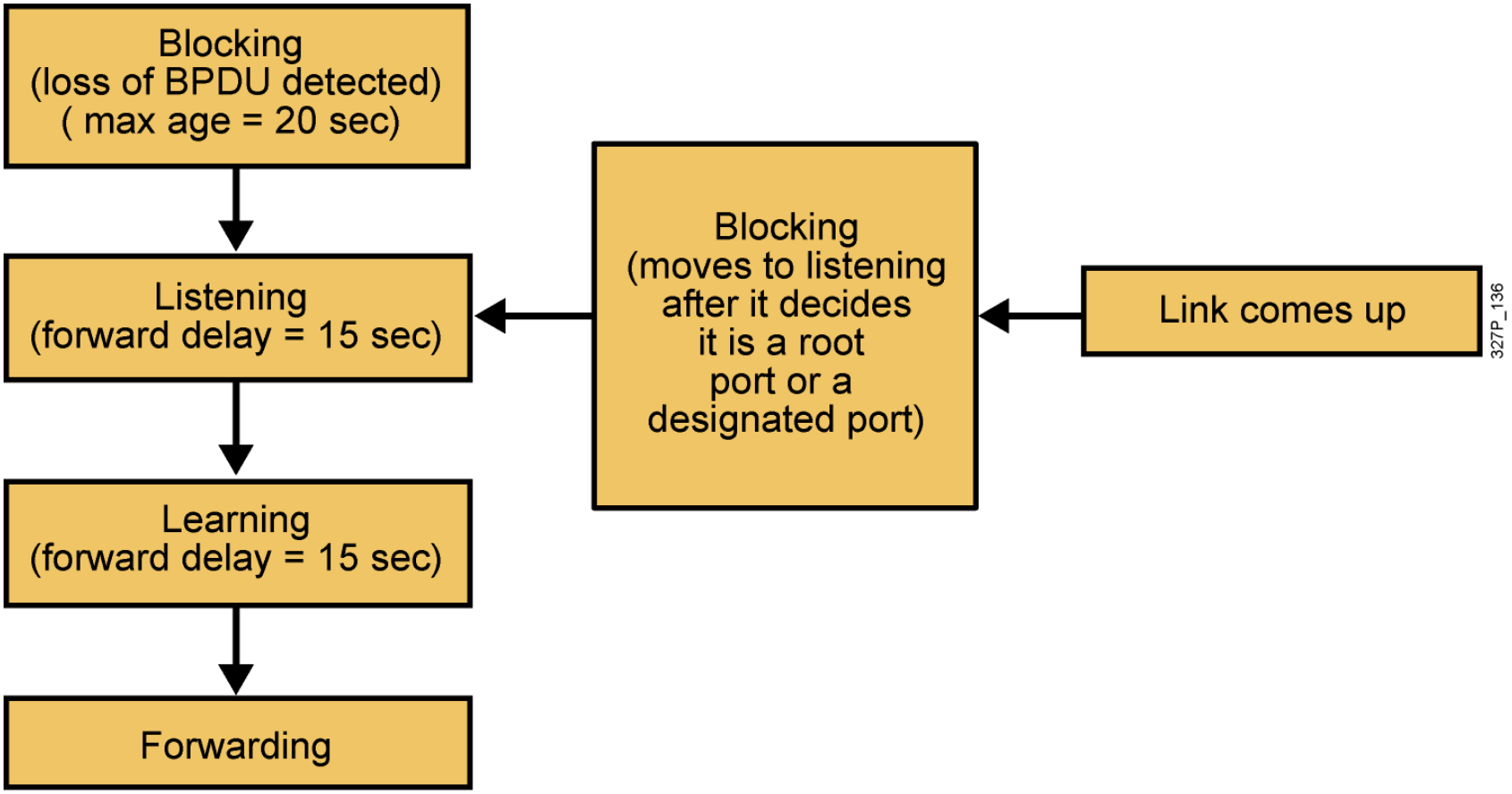
# STP Root Bridge Selection



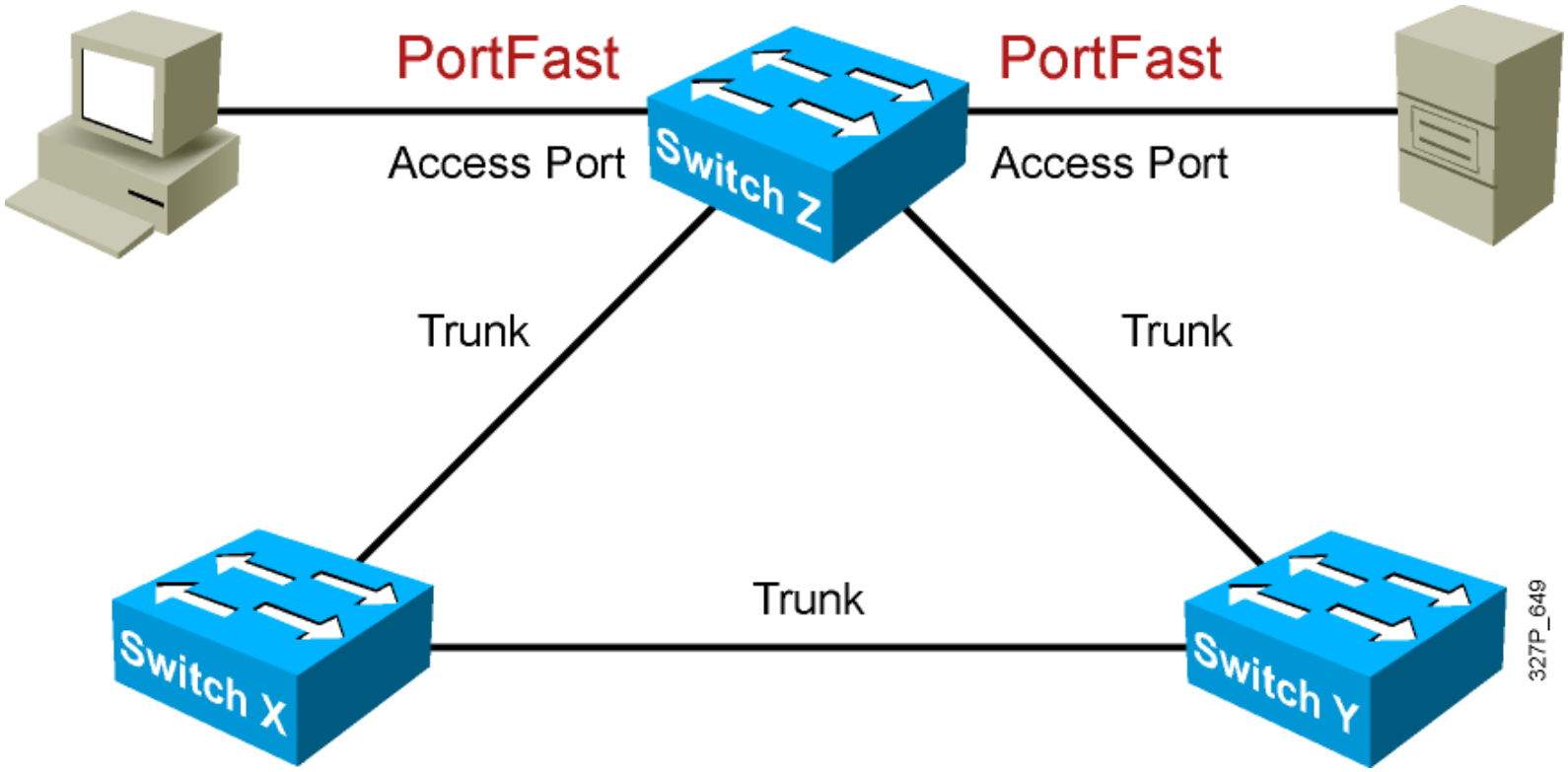

- BPDU (default = sent every 2 seconds)
- Root bridge = bridge with the lowest bridge ID
- Bridge ID = | Bridge Priority | MAC Address |

# Spanning-Tree Port States

Spanning tree transits each port through several different states:



# Describing PortFast




PortFast is configured on access ports, not trunk ports.

# Configuring and Verifying PortFast

```
SwitchX(config-if)# spanning-tree portfast
```

- Configures PortFast on an interface

OR

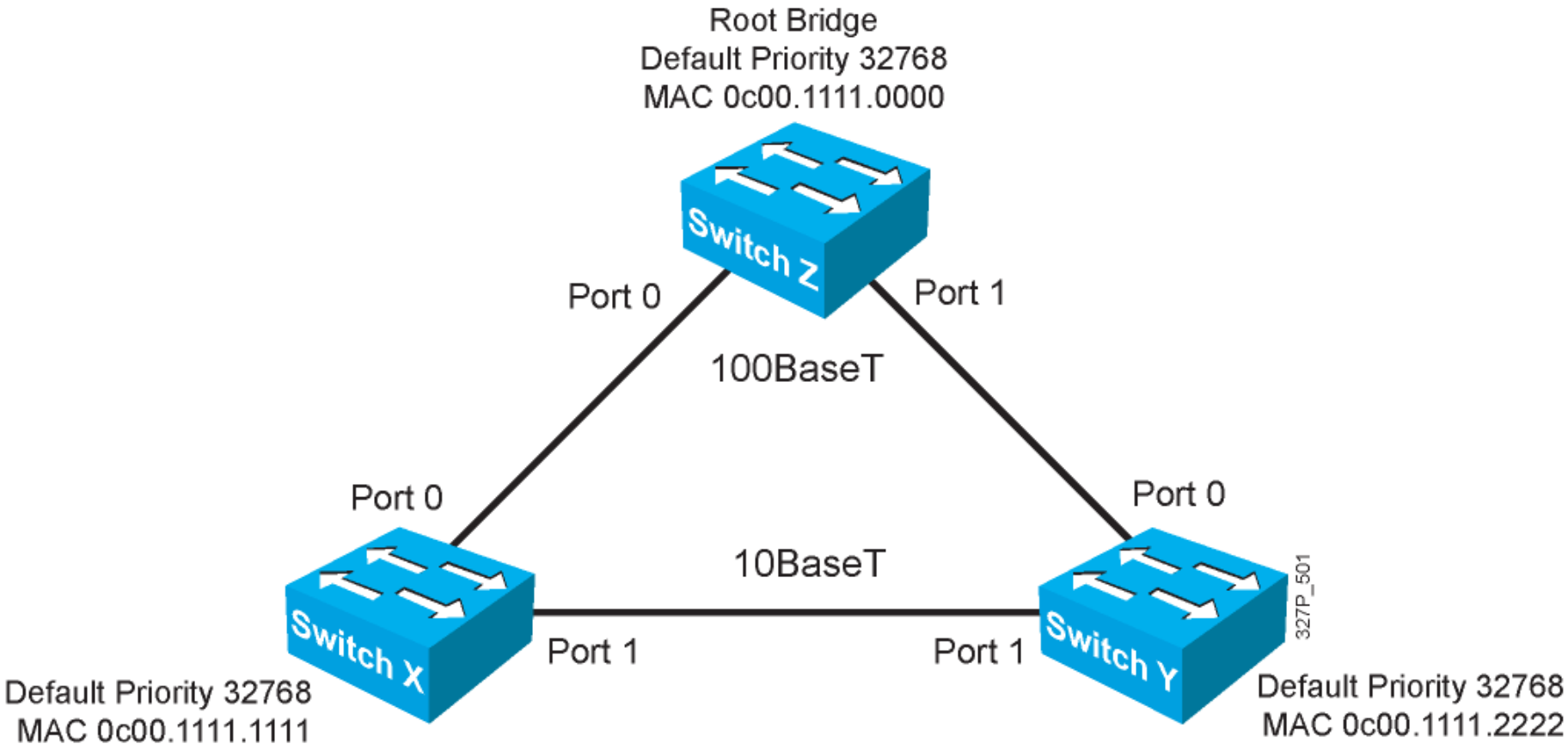
```
SwitchX(config)# spanning-tree portfast default
```

- Enables PortFast on all non-trunking interfaces

```
SwitchX# show running-config interface interface
```

- Verifies that PortFast has been configured on an interface

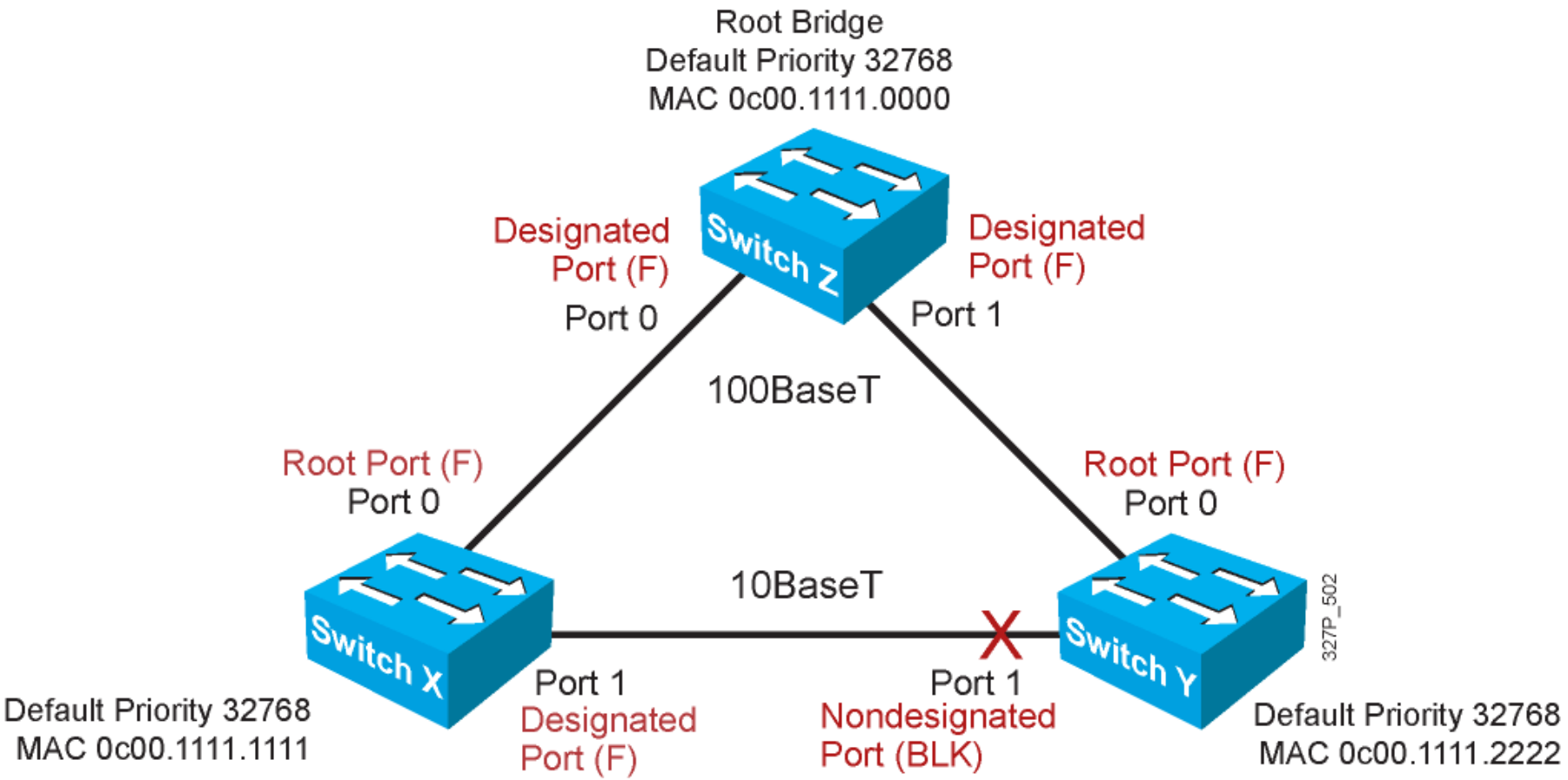
# Spanning-Tree Operation Example



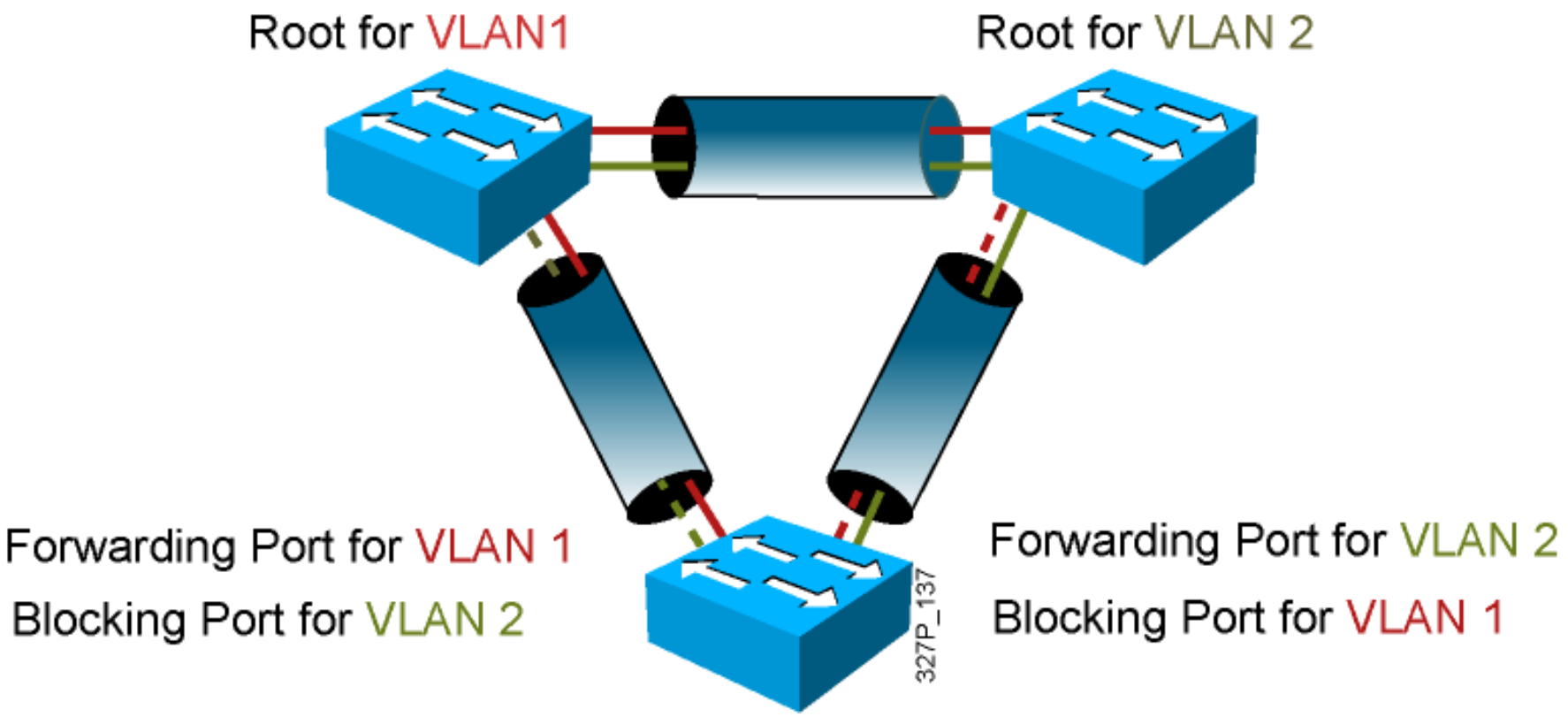
# Spanning-Tree Path Cost

| Link Speed | Cost (Revised IEEE Specification) | Cost (Previous IEEE Specification) |
|---|---|---|
| 10 Gb/s | 2 | 1 |
| 1 Gb/s | 4 | 1 |
| 100 Mb/s | 19 | 10 |
| 10 Mb/s | 100 | 100 |

# Spanning-Tree Recalculation



# Per VLAN Spanning Tree Plus

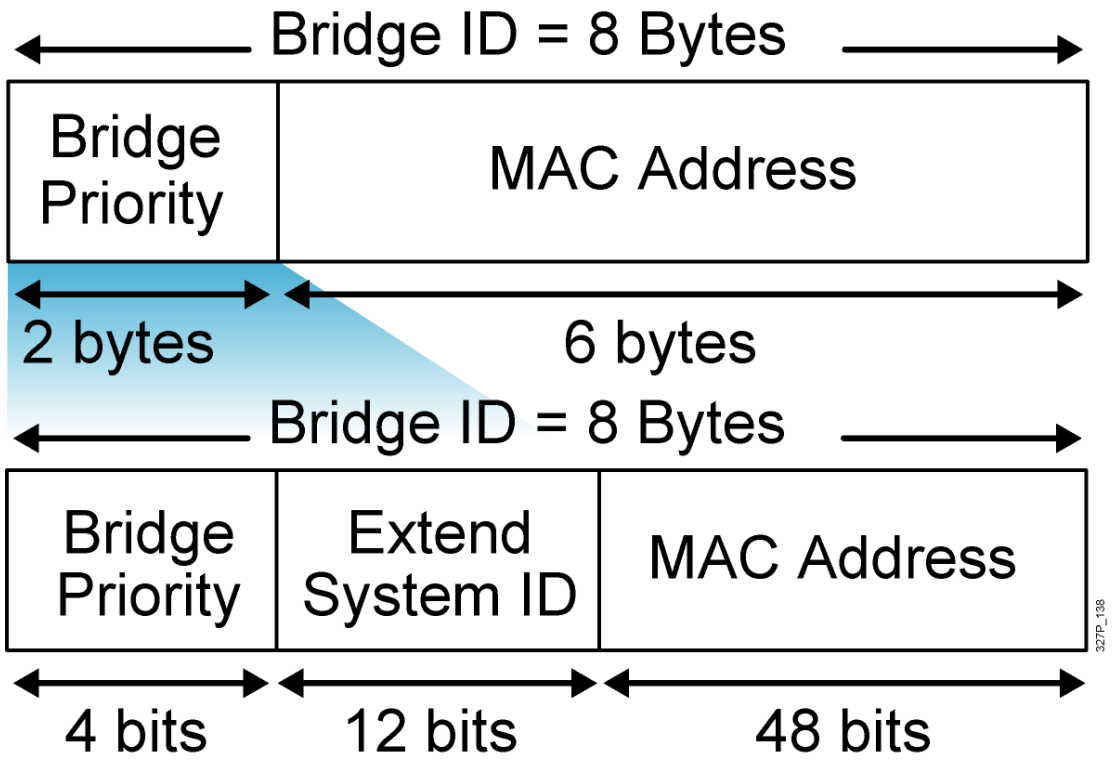


# PVST+ Extended Bridge ID

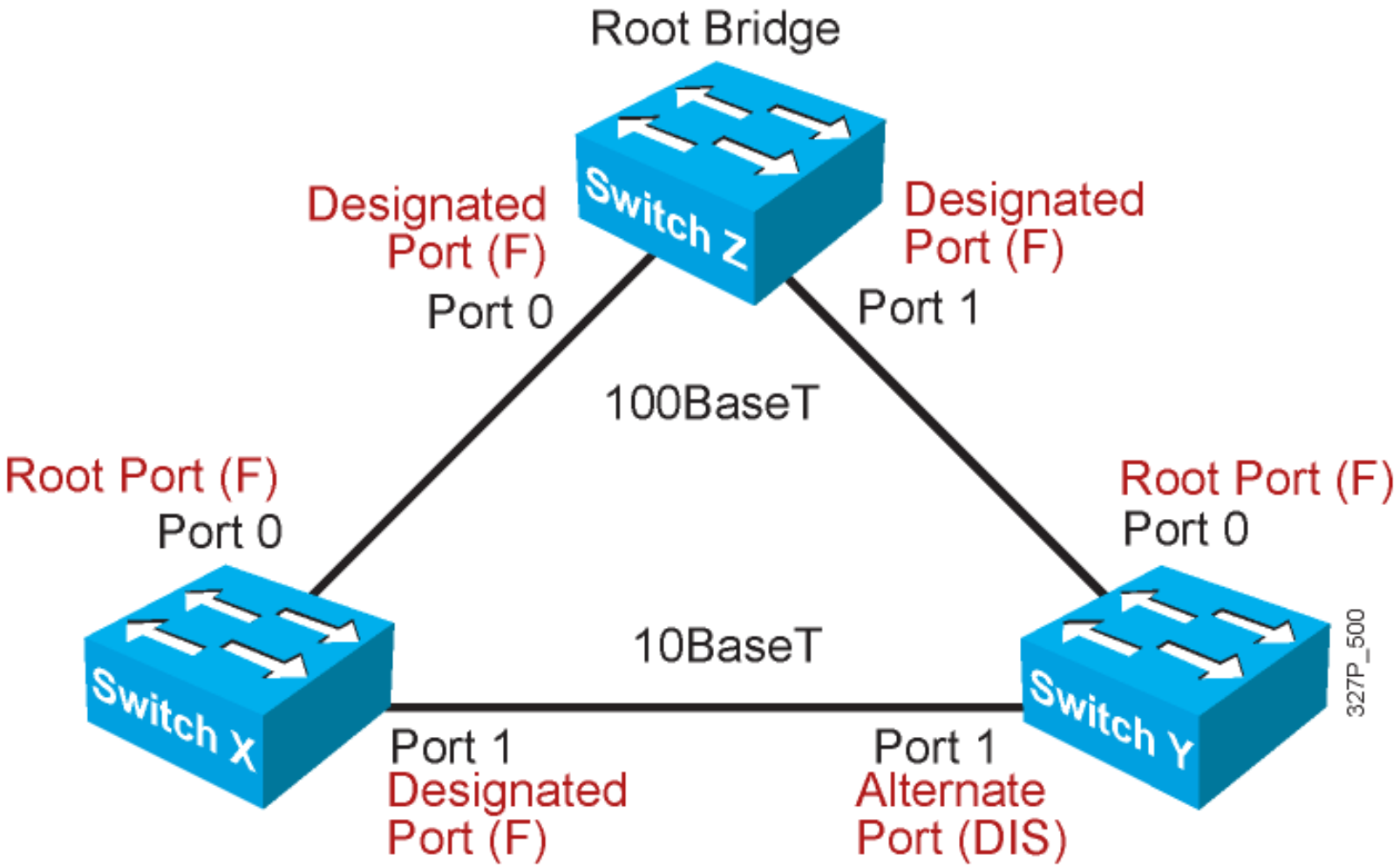
Bridge ID without the extended system ID

Extended bridge ID with system ID

System ID = VLAN



# Rapid Spanning Tree Protocol



# Default Spanning-Tree Configuration

- **Cisco Catalyst switches support three types of STPs:**
  - PVST+
  - PVRST+
  - MSTP
- **The default STP for Cisco Catalyst switches is PVST+:**
  - A separate STP instance for each VLAN
  - One root bridge for all VLANs
  - No load sharing

# PVRST+ Configuration Guidelines

1. **Enable PVRST+.**
2. **Designate and configure a switch to be the root bridge.**
3. **Designate and configure a switch to be the secondary root bridge.**
4. **Verify the configuration.**

# PVRST+ Implementation Commands

```
SwitchX(config)# spanning-tree mode rapid-pvst
```

- Configures PVRST+

```
SwitchX# show spanning-tree vlan vlan# [detail]
```

- Verifies the spanning-tree configuration

```
SwitchX# debug spanning-tree pvst+
```

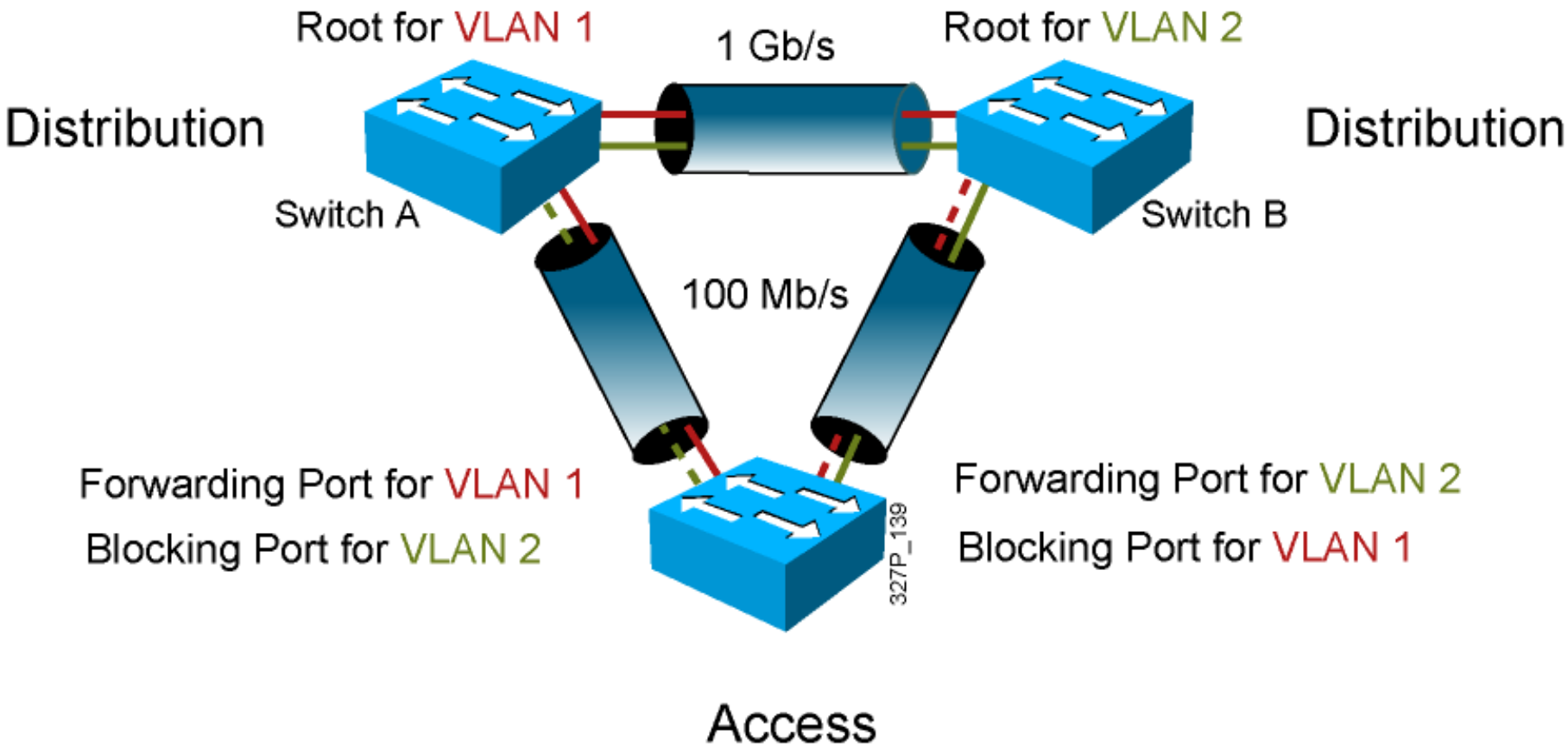
- Displays PVST+ event debug messages

# Verifying PVRST+

```
SwitchX# show spanning-tree vlan 30
VLAN0030
Spanning tree enabled protocol rstp
Root ID Priority 24606
Address 00d0.047b.2800
This bridge is the root
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 24606 (priority 24576 sys-id-ext 30)
Address 00d0.047b.2800
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300
Interface Role Sts Cost Prio.Nbr  Type
-------- ----- --- ---  --------  ----
Gi1/1     Desg FWD  4    128.1     P2p
Gi1/2     Desg FWD  4    128.2     P2p
Gi5/1     Desg FWD  4    128.257   P2p
```

The spanning-tree mode is set to PVRST.

# Configuring the Root and Secondary Bridges



# Configuring the Root and Secondary Bridges: SwitchA

```
SwitchA(config)# spanning-tree vlan 1 root primary
```

- This command forces this switch to be the root for VLAN 1.

```
SwitchA(config)# spanning-tree vlan 2 root secondary
```

- This command configures this switch to be the secondary root for VLAN 2.

OR

```
SwitchA(config)# spanning-tree vlan # priority priority
```

- This command statically configures the priority (increments of 4096).

# Configuring the Root and Secondary Bridges: SwitchB

```
SwitchB(config)# spanning-tree vlan 2 root primary
```

- This command forces this switch to be the root for VLAN 2.

```
SwitchB(config)# spanning-tree vlan 1 root secondary
```

- This command configures this switch to be the secondary root for VLAN 1.

OR

```
SwitchB(config)# spanning-tree vlan # priority priority
```

- This command statically configures the priority (increments of 4096).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