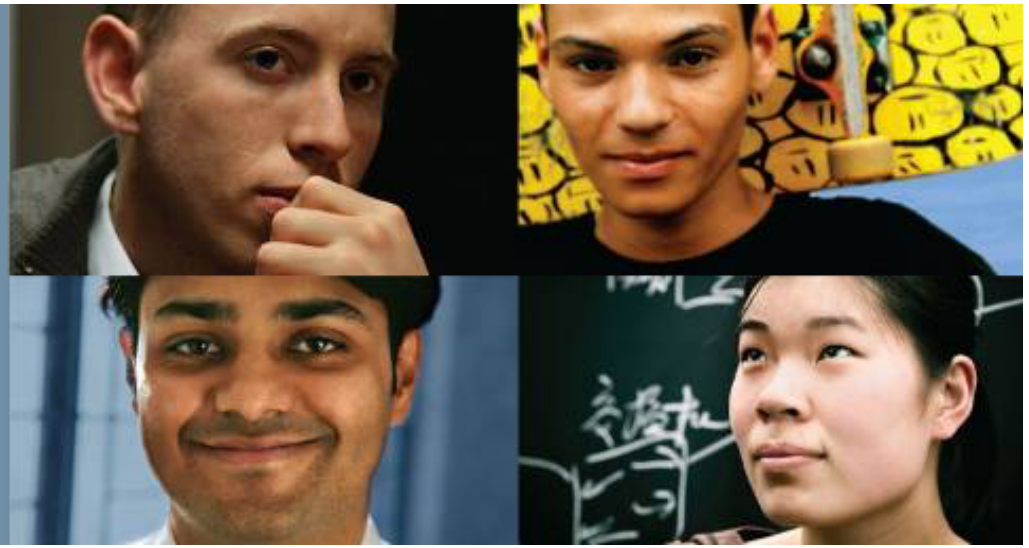
TNE10006/TNE60006: Networks and Switching



Spanning Tree Protocol (Advanced)

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Outline

- PVST+ – Per-VLAN Spanning Tree
- How to manage multiple concurrent spanning trees
- Extended System IDs
- Configuring Per-VLAN priorities
- Rapid PVST+
- New Port roles
- PortFast and BPDU Guard
- Load Balancing

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List of Spanning Tree Protocols

Protocol	Standard	Resources Needed	Convergence	Tree Calculation
STP	802.1D	Low	Slow	All VLANs
PVST+	Cisco	High	Slow	Per VLAN
RSTP	802.1w	Medium	Fast	All VLANs
Rapid PVST+	Cisco	Very high	Fast	Per VLAN
MSTP	802.1s Cisco	Medium or high	Fast	Per Instance

	Slow to converge	Fast to converge
One STP shared by all VLANs	**STP**	RSTP
Different STP for each VLAN	PVST+	**RPVST+**

Overview of PVST+

STP only maintains one Spanning Tree for the entire network

With PVST+, we run an independent IEEE 802.1D STP instance for each VLAN in the network

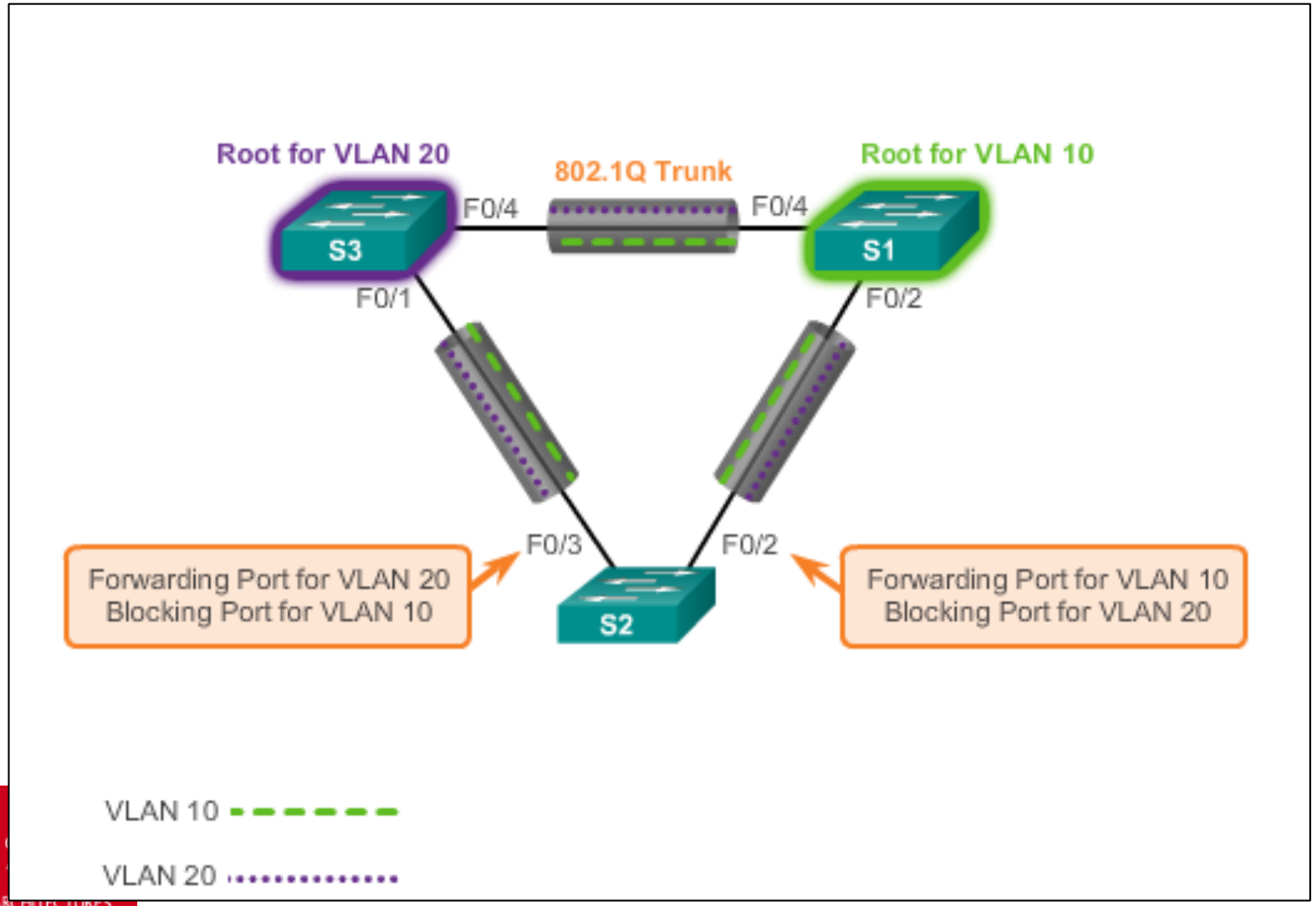
Pros

- Utilisation of previously unused links
- Better load balancing of traffic

Cons

- More CPU usage to calculate spanning-tree for each VLAN
- More bandwidth lost as we have a unique BPDU for each VLAN

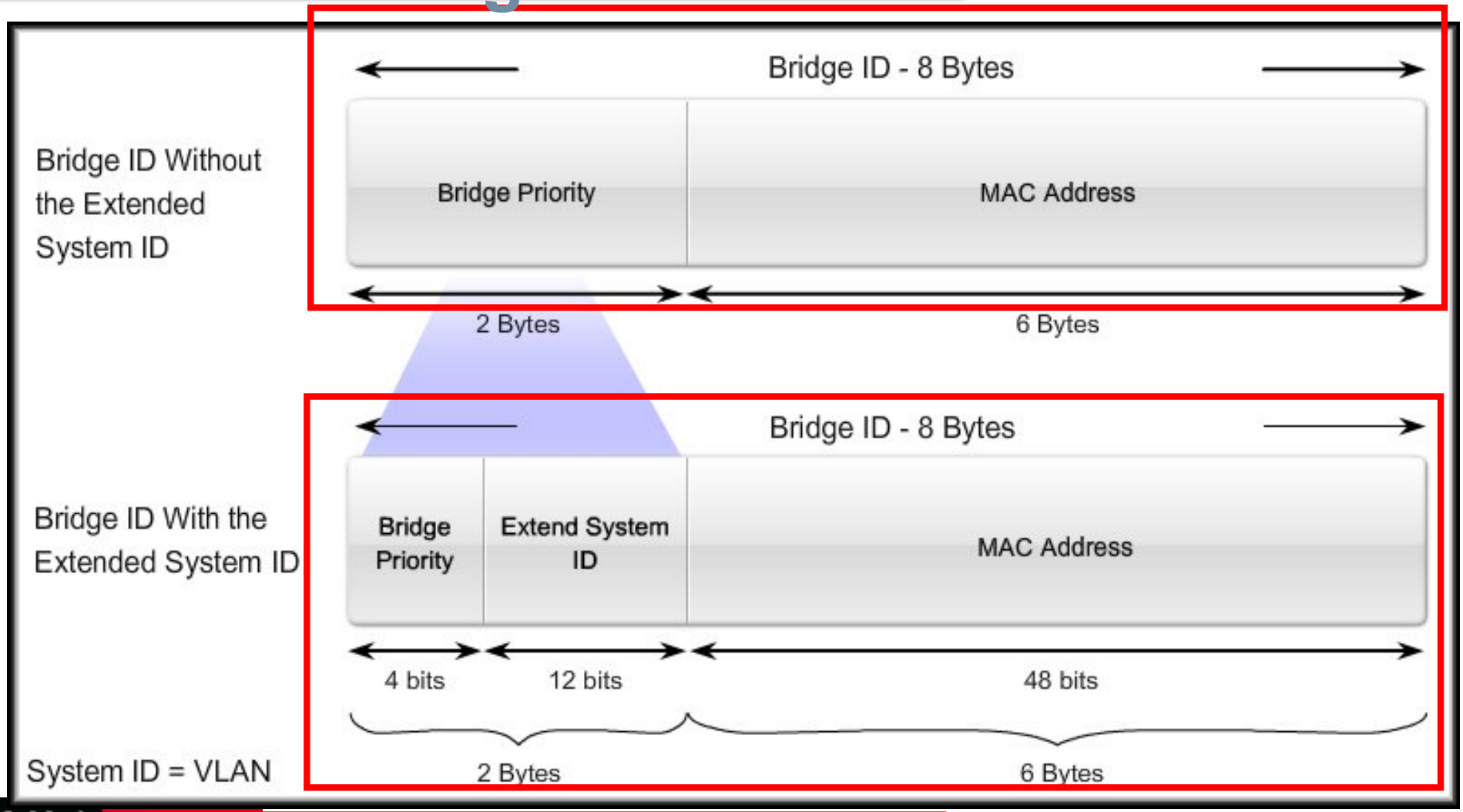
Overview of PVST+



PVST+

Early STP implementation – no VLANs.

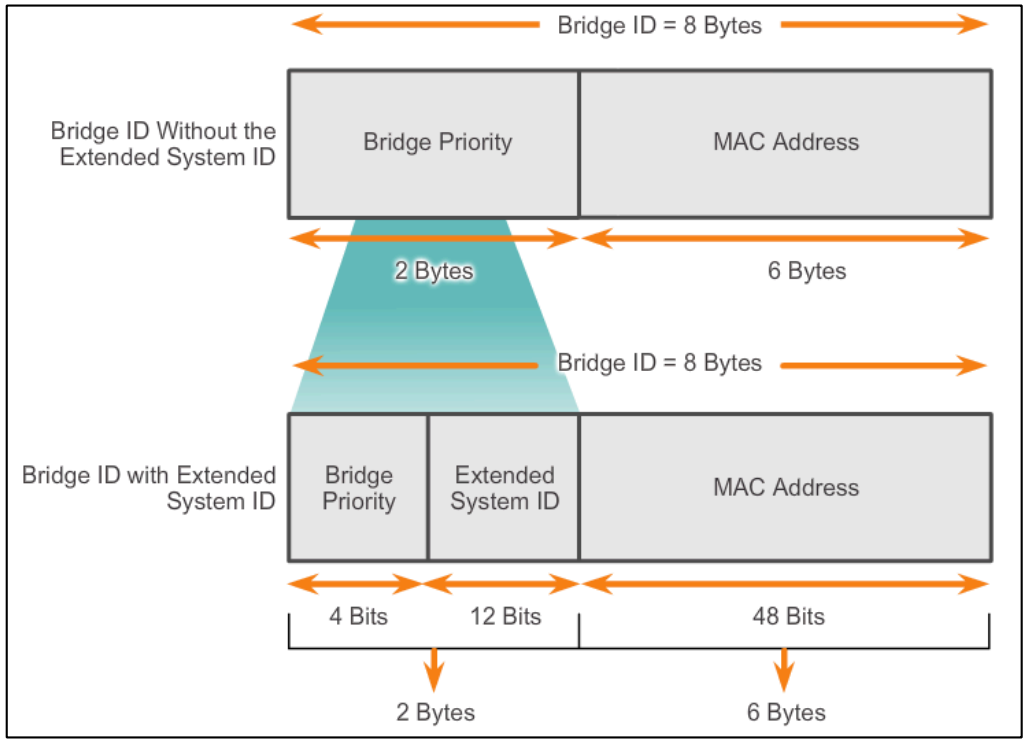
PVST and Bridge IDs



Changed to include VLAN ID.

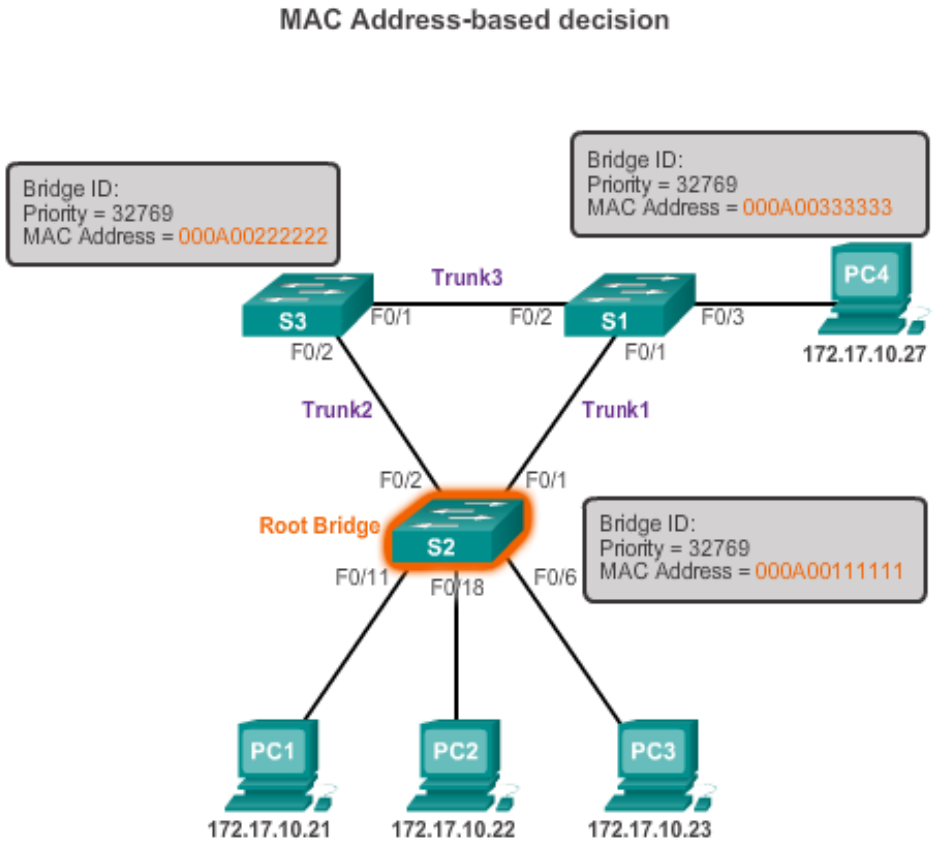
Extended System ID

- The extended ID ensures each switch has a unique BID for each VLAN
- The new VLAN ID leaves fewer bits available for the bridge priority
- As a result, the bridge priority is assigned in multiples of 4096
- For example, the VLAN 2 default BID would be 32770; priority 32768, plus the extended system ID of 2

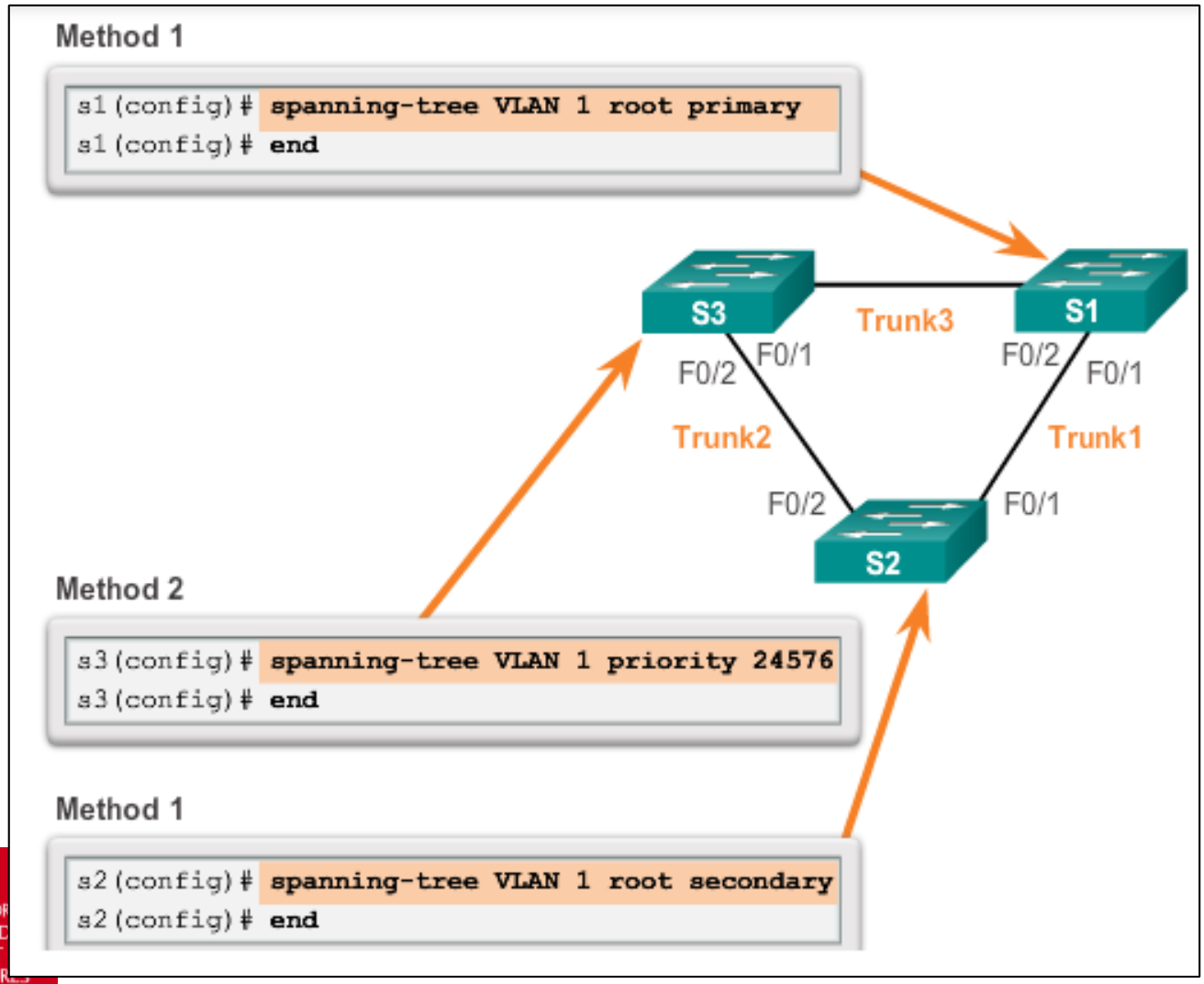


Extended System ID

In the example, the priority of all the switches is 32769. The value is based on the 32768 default priority and the VLAN 1 assignment associated with each switch (32768+1)



Configuring Priorities



PVST+ Configuration

Verifying Root Bridges and Priorities

```
S3# show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID     Priority    24577
              Address     00A.0033.3333
              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     000A.0033.3333
              Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
              Aging Time  300

Interface      Role    Sts    Cost      Prio.Nbr       Type
-------------  -----   ----   -----     ----------     ------
Fa0/1          Desg    FWD    4         128.1          p2p
Fa0/2          Desg    FWD    4         128.2          p2p
S3#
```

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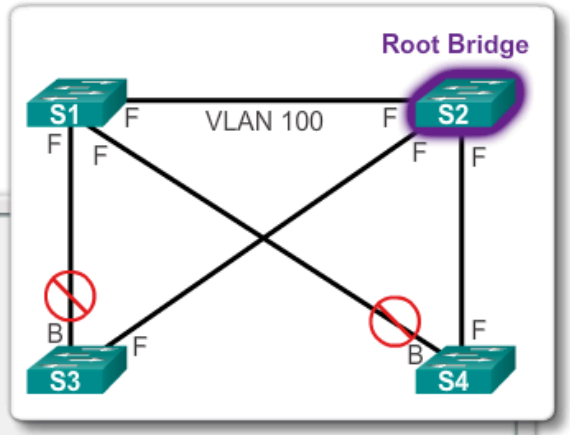
Verifying Per-VLAN Configuration

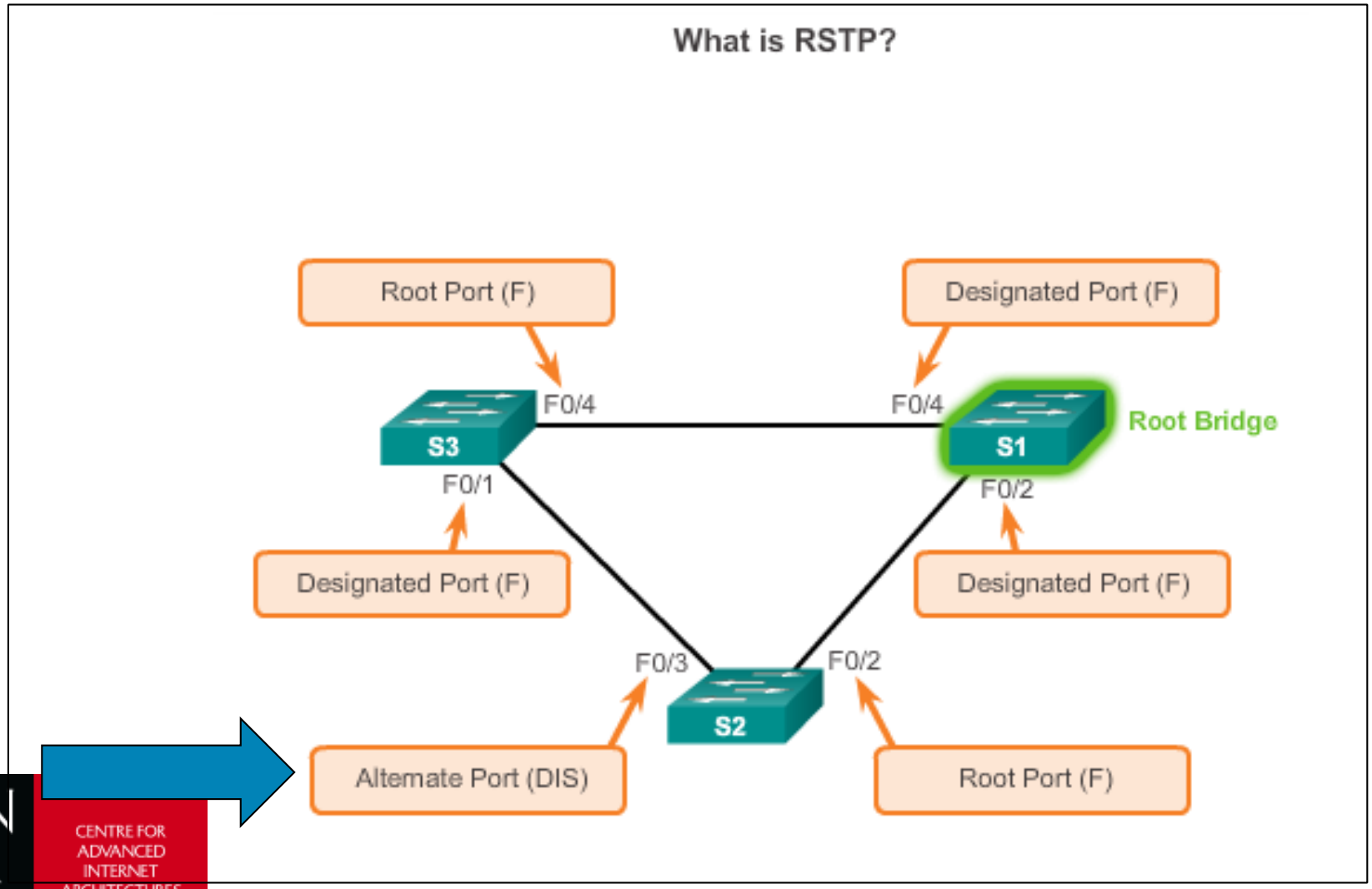



```
S1# show spanning-tree vlan 100

VLAN0100
 Spanning tree enabled protocol rstp
 Root ID     Priority    28772
             Address     0000.0c9f.3127
             Cost        2
             Port        88 (TenGigabit9/1)
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
 Bridge ID   Priority    28772 (priority 28672 sys-id-ext 100)
             Address     0000.0cab.3724
             Hello Time  2 sec Max Age 20 sec Forward Delay 15 sec
             Aging Time  300

Interface        Role Sts Cost      Prio.Nbr Type
---------        ------------      --------------------------------
Gi3/1            Desg FWD 4         128.72   P2p
Gi3/2            Desg FWD 4         128.80   P2p
Te9/1            Root FWD 2         128.88   P2p
```

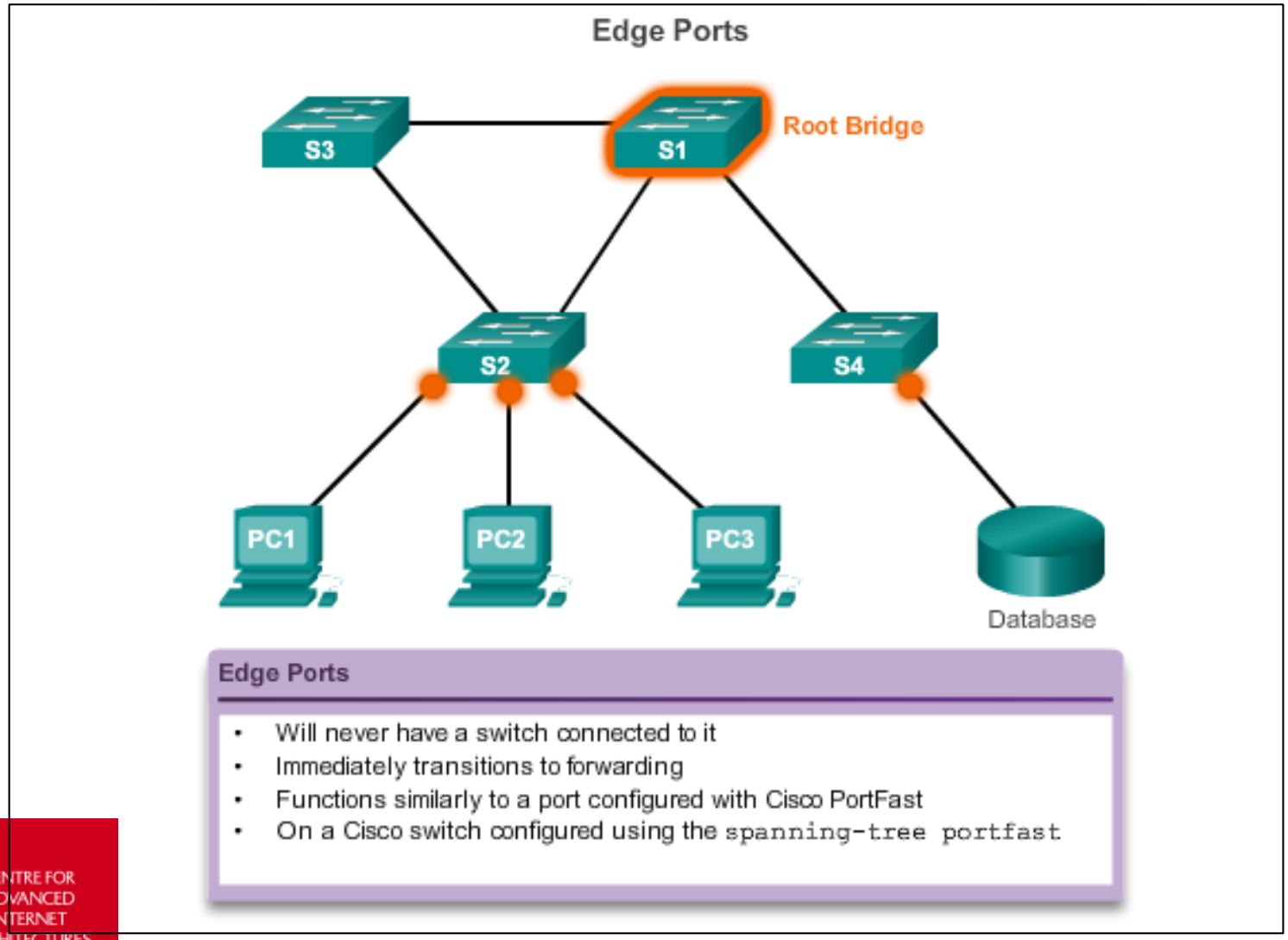
Overview of Rapid PVST+

- RSTP is the preferred protocol for preventing Layer 2 loops in a switched network environment
- RSTP supports a new port type: an alternate port in discarding state.
- There are no blocking ports. RSTP defines port states as discarding, learning, or forwarding
- RSTP (802.1w) supersedes STP (802.1D) while retaining backward compatibility
- Rapid PVST+ is an independent instance of RSTP for each VLAN

Overview of Rapid PVST+



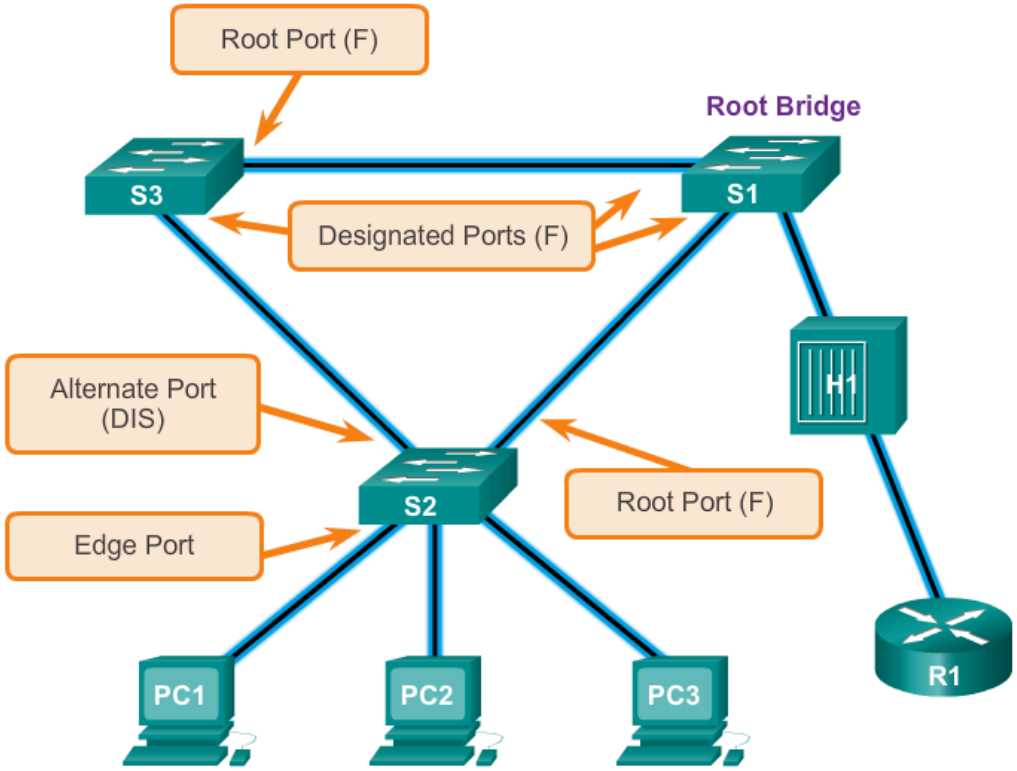
Edge Ports



Edge Ports

- Will never have a switch connected to it
- Immediately transitions to forwarding
- Functions similarly to a port configured with Cisco PortFast
- On a Cisco switch configured using the `spanning-tree portfast`

Link Types



The link type can determine whether the port can immediately transition to forwarding state. Edge port connections and point-to-point connections are candidates for rapid transition to forwarding state

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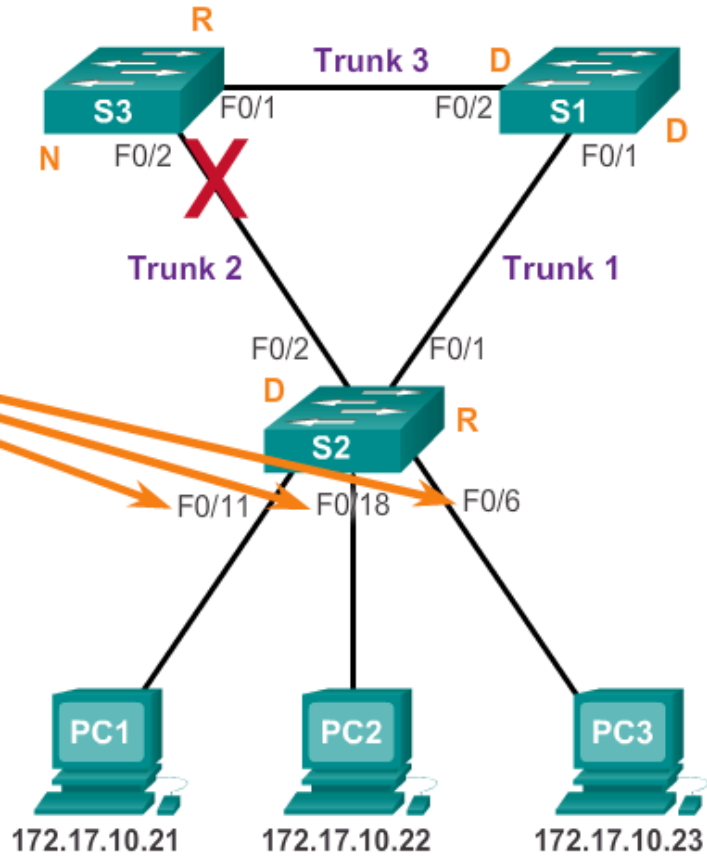
PortFast and BPDU Guard

- When a switch port is configured with PortFast that port transitions from blocking to forwarding state immediately
- BPDU guard puts the port in an *error-disabled* state on receipt of a BPDU

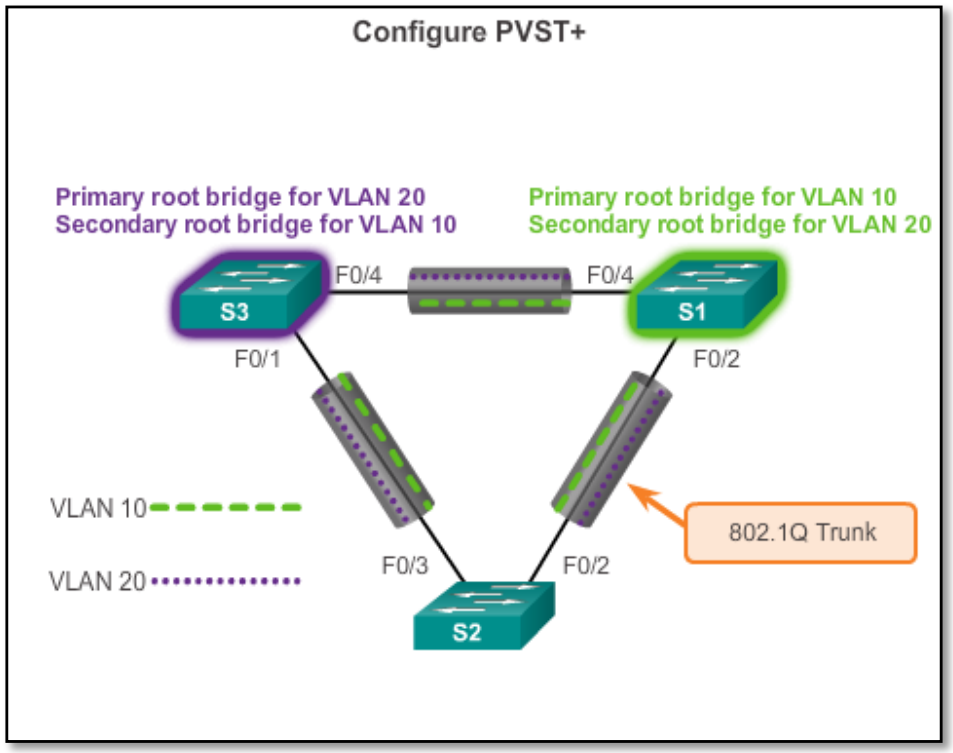
PortFast and BPDU Guard




```
S2(config)# interface FastEthernet 0/11
S2(config-if)# spanning-tree portfast
%Warning: portfast should only be enabled on ports connected to
a single host. Connecting hubs, concentrators, switches,
bridges, etc... to this interface  when portfast is enabled,
can cause temporary bridging loops.
 Use with CAUTION

%Portfast has been configured on FastEthernet0/11 but will only
 have effect when the interface is in a non-trunking mode.
S2(config-if)# spanning-tree bpduguard enable
S2(config-if)# end
```

PVST+ Load Balancing



Configure PVST+

```
S3(config)# spanning-tree vlan 20 root primary
```

This command forces S3 to be the primary root for VLAN 20.

```
S3(config)# spanning-tree vlan 10 root secondary
```

This command forces S3 to be the secondary root for VLAN 10.

```
S1(config)# spanning-tree vlan 10 root primary
```

This command forces S1 to be the primary root for VLAN 10.

```
S1(config)# spanning-tree vlan 20 root secondary
```

This command forces S1 to be the secondary root for VLAN 20.

Summary

In this lecture, we covered:

- PVST+ – Per-VLAN Spanning Tree
- How to manage multiple concurrent spanning trees
- Extended System IDs
- Configuring Per-VLAN priorities
- Rapid PVST+
- New Port roles
- PortFast and BPDU Guard
- Load Balancing