NET 363
Introduction to LANs

Enhanced STP Protocols (RSTP, PVST+)

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STP Problems

- In general, STP works, but has several problems:
  - Convergence is slow!! Network can be down for over 30 seconds after a change!
  - Different VLANs may have different traffic patterns, but the basic STP protocol creates **one tree** for all data.

STP Enhancements

- PVST+ – one STP per vlan (Cisco proprietary)
  - Each VLAN has own root bridge, optimized tree.
- RSTP – Rapid STP (IEEE 802.1w)
  - Faster convergence, but single Tree.
- PVRST+ -- combines RSTP and PVST (proprietary)
  - Very fast; each VLAN has own root and tree; but uses lots of resources (based on 802.1w)
- MSTP – Multiple STP
  - Admin creates up to 16 instances, each of which can contain multiple VLANs.
  - One spanning tree per instance.

Characteristics of the 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

Overview of PVST+

Networks running PVST+ have these characteristics:

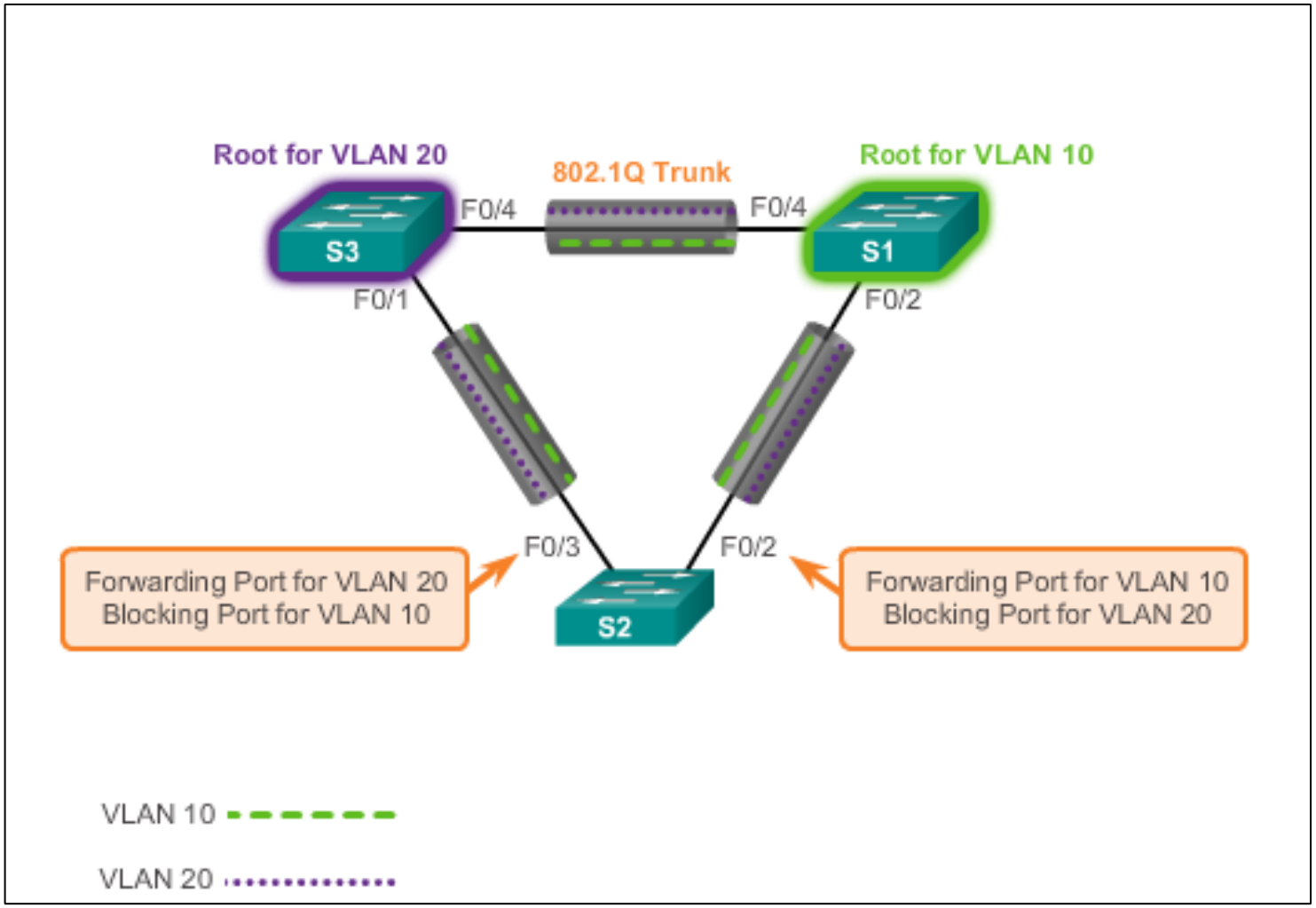
- An independent STP instance is run for each VLAN in the network.
- Each VLAN can have its own STP Root Switch.
- Improved load balancing can result by assigning different switches to be Root of each VLAN tree.
- Uses More Resources:

  Separate BPDUs for each VLAN increases bandwidth usage for BPDUs

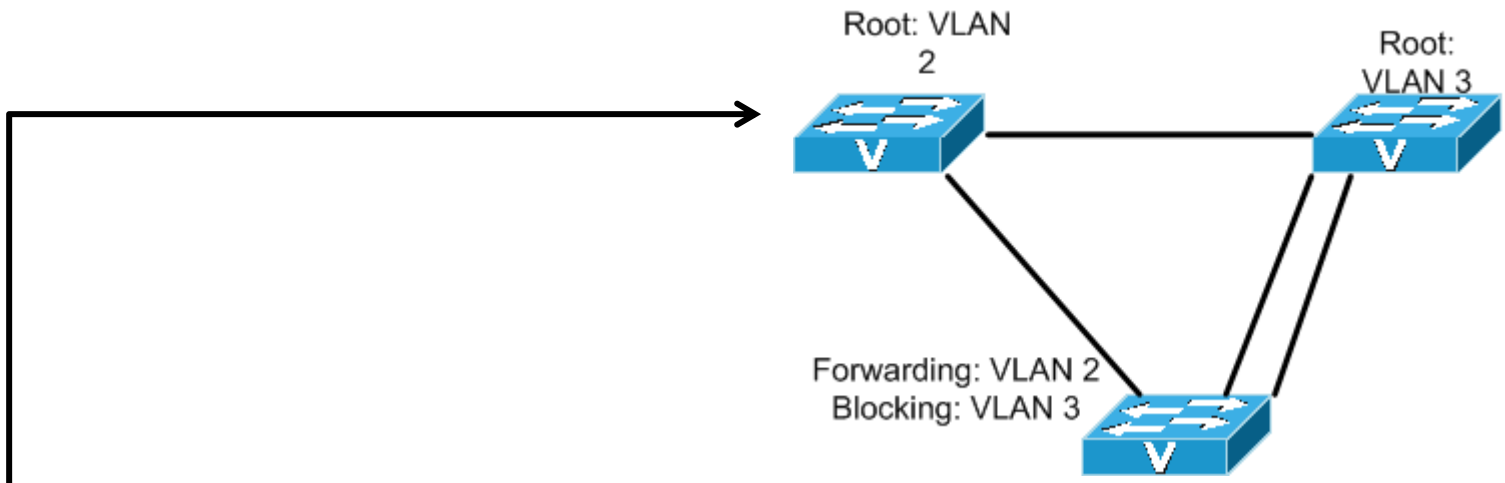
  Increased CPU time per switch to process BPDUs for each VLAN.

PVST+

Overview of PVST+



PVST+ Configuration
Choosing Root switches for each VLAN for Load Balancing




```
Switch(config)# spanning-tree mode pvst
Switch(config)# spanning-tree vlan 2 root primary
Switch(config)# spanning-tree vlan 3 root secondary
```

Rapid STP (802.1w)

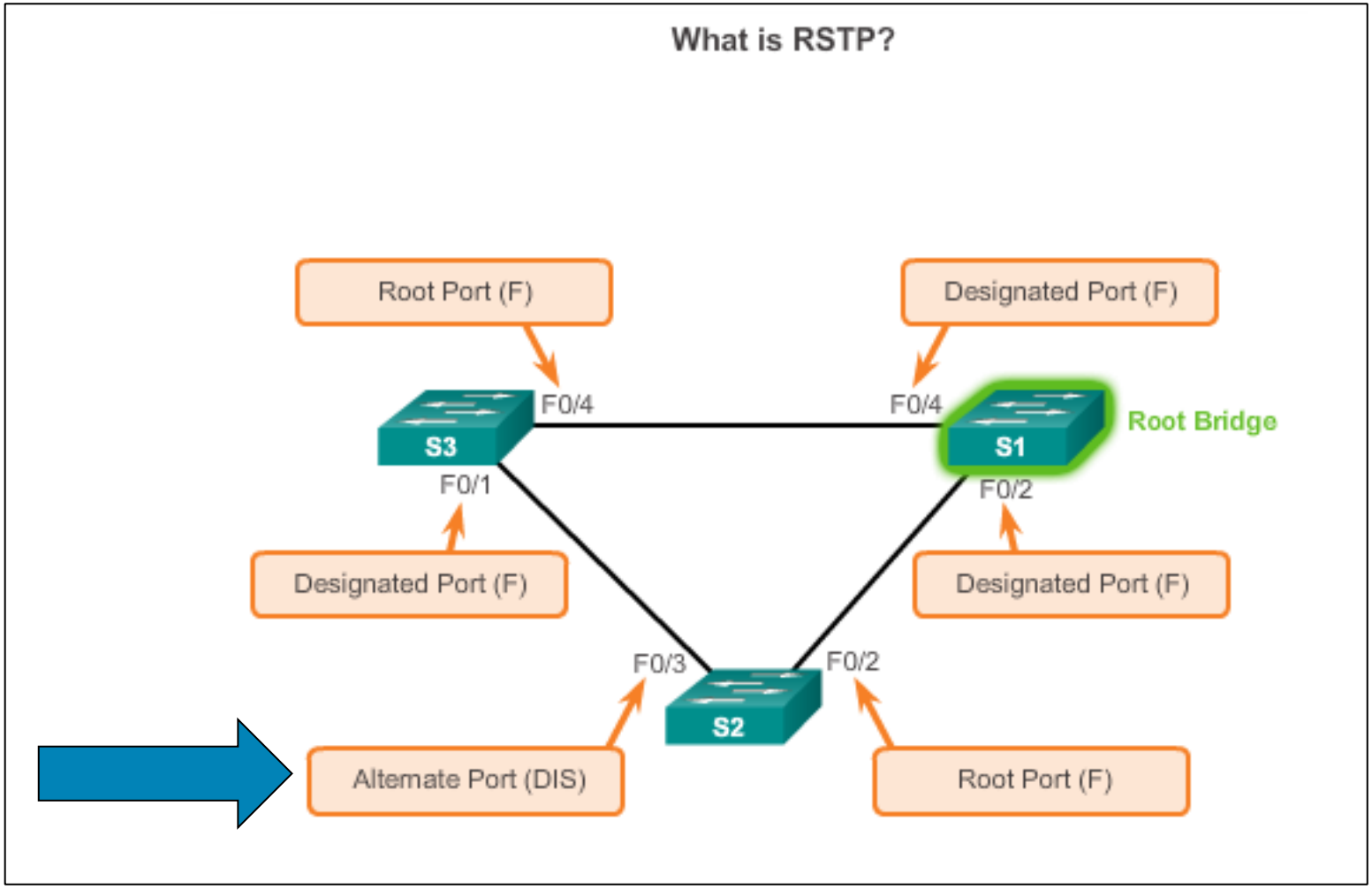
- Rapid STP provide much faster convergence than regular STP, with the following enhancements:
  - RSTP defines port states as discarding, learning, or forwarding.
  - RSTP defines Edge Ports, which don't connect to other switches and can transition to Forwarding immediately using PortFast configuration.
  - RSTP defines point-to-point links, which can converge much faster than standard STP links.
  - **Rapid PVST+** is Cisco proprietary per-VLAN RSTP.

Rapid STP (802.1w)

- Implements new handshake protocol for rapid convergence
- Fast convergence – generally < 2 secs.

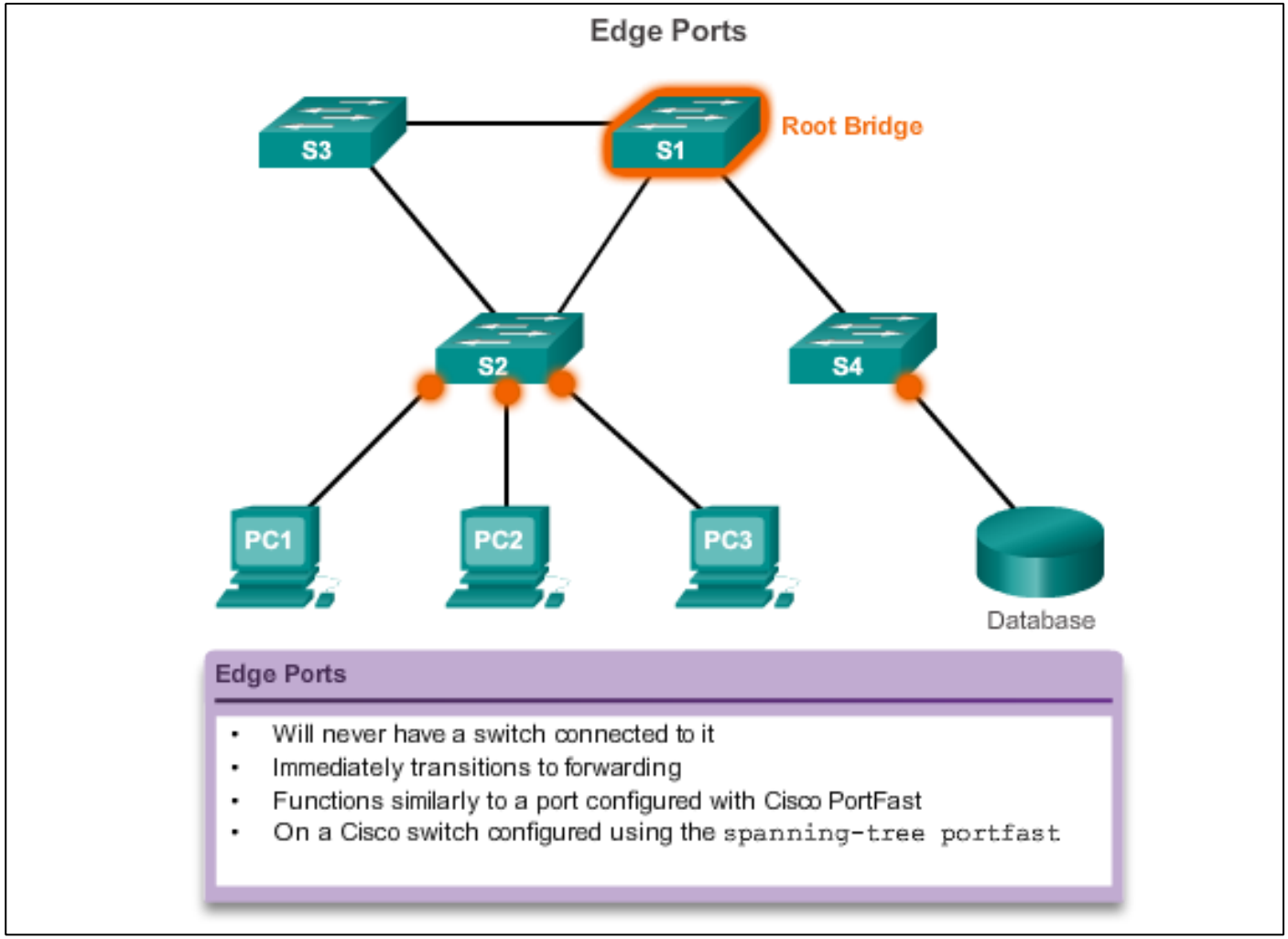
Rapid PVST+

Overview of Rapid PVST+



Rapid PVST+

Edge Ports



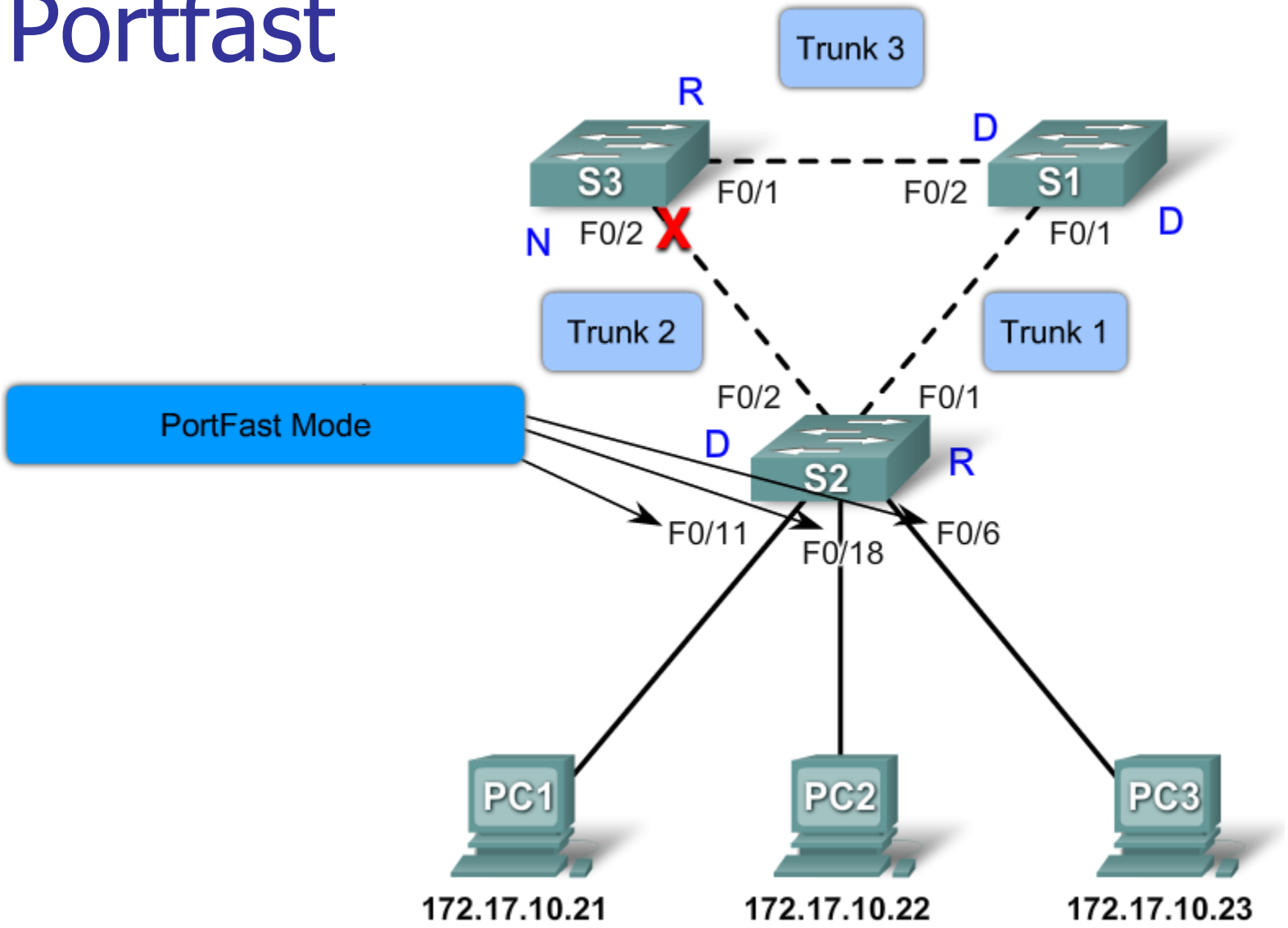
Edge Ports

- 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`

PortFast

- Enabling Portfast (on Access port only)
  - Allows rapid transition to Forwarding state
  - Can be enabled globally for all Access ports
    - SW(config)# **spanning-tree portfast default**
  - Can be enabled for a specific interface
    - Working only in NON-trunking mode
    - SW(config-if)# **spanning-tree portfast**

Portfast


Trunk 3
R
D
S3
F0/1
F0/2
S1
N
F0/2
X
F0/1
D
Trunk 2
Trunk 1
F0/2
F0/1
PortFast Mode
D
S2
R
F0/11
F0/18
F0/6
PC1
PC2
PC3
172.17.10.21
172.17.10.22
172.17.10.23

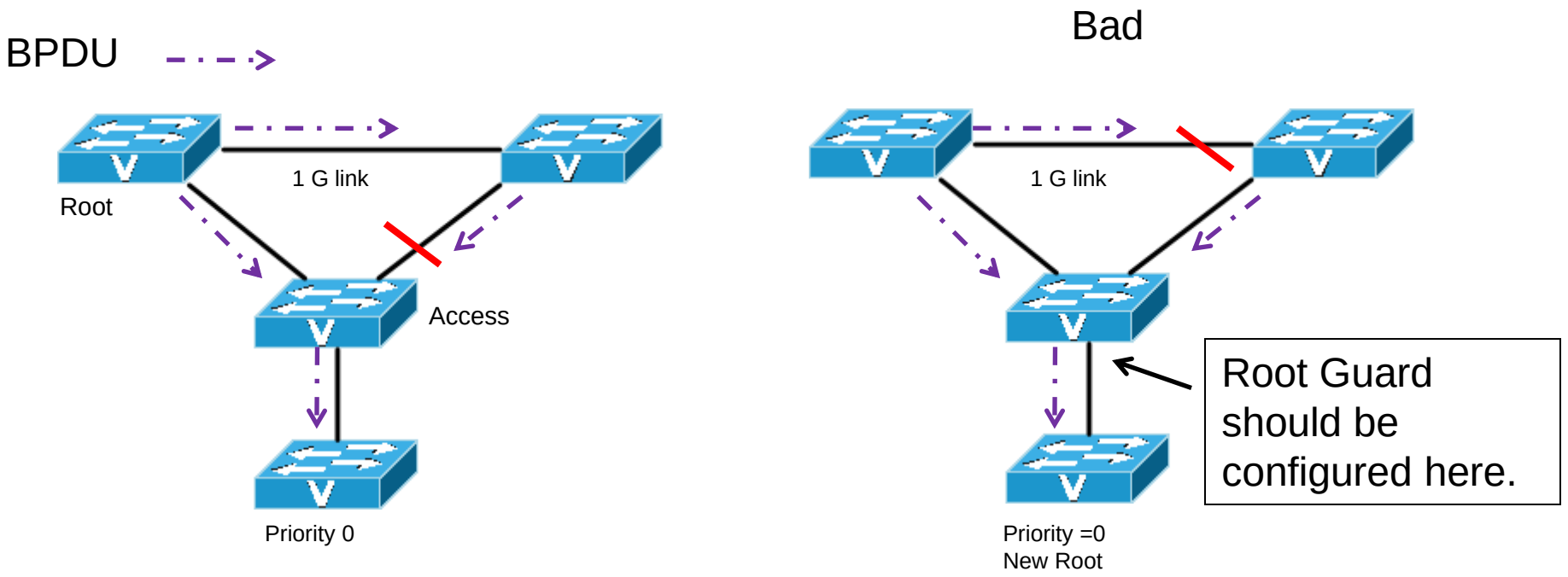
Port States (STP vs. RSTP)
(FYI – not required)

Op Status	STP Port State	RSTP Port State	Port in Active Topology
Enabled	Blocking	Discarding	No
Enabled	Listening	Discarding	No
Enabled	Learning	Learning	Yes
Enabled	Forwarding	Forwarding	Yes
Disabled	Disabled	Disabled	No

Other Enhancements

- BPDU filtering
  - Prevents switch from sending BPDUs on Portfast interfaces
- BPDU Guard
  - Shuts down a Portfast interface if it receives BPDU
- Root guard
  - Prevents isolated switches from becoming Root switch.

Root Guard


BPDU
1 G link
Root
Access
Priority 0
Bad
1 G link
Root Guard should be configured here.
Priority =0
New Root