Chapter 3: LAN Redundancy

December 04, 2018 Annaba, Algeria

Purpose of Spanning Tree

Redundancy at OSI Layers 1 and 2

Multiple cabled paths between switches:

- Provide physical redundancy in a switched network.
- Improves the reliability and availability of the network.
- Enables users to access network resources, despite path disruption.

Considerations When Implementing Redundancy:

- **MAC database instability** - Instability in the content of the MAC address table results from copies of the same frame being received on different ports of the switch. Data forwarding can be impaired when the switch consumes the resources that are coping with instability in the MAC address table.
- **Broadcast storms** - Without some loop-avoidance process, each switch may flood broadcasts endlessly. This situation is commonly called a broadcast storm.
- **Multiple frame transmission** - Multiple copies of unicast frames may be delivered to destination stations. Many protocols expect to receive only a single copy of each transmission. Multiple copies of the same frame can cause unrecoverable errors.

Purpose of Spanning Tree

Issues with Layer 1 Redundancy: MAC Database Instability

- Ethernet frames do not have a time to live (TTL) attribute.
  - Frames continue to propagate between switches endlessly, or until a link is disrupted and breaks the loop.
  - Results in MAC database instability.
  - Can occur due to broadcast frames forwarding.
- If there is more than one path for the frame to be forwarded out, an endless loop can result.
  - When a loop occurs, it is possible for the MAC address table on a switch to constantly change with the updates from the broadcast frames, resulting in MAC database instability.

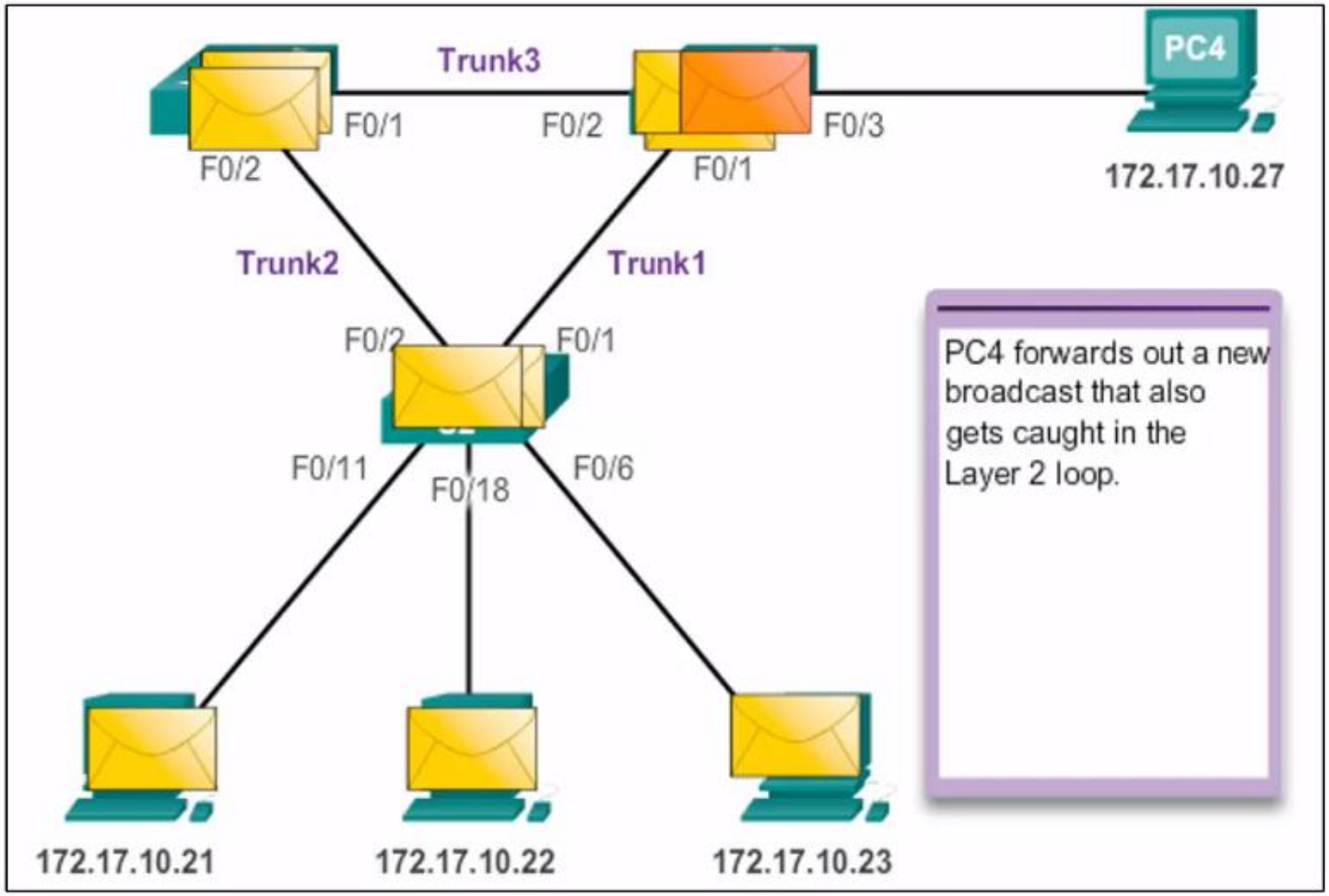
Purpose of Spanning Tree

Issues with Layer 1 Redundancy: Broadcast Storms

- A broadcast storm occurs when there are so many broadcast frames caught in a Layer 2 loop that all available bandwidth is consumed. It is also known as denial of service
- A broadcast storm is inevitable on a looped network.
  - As more devices send broadcasts over the network, more traffic is caught within the loop; thus consuming more resources.
  - This eventually creates a broadcast storm that causes the network to fail.

Purpose of Spanning Tree

Issues with Layer 1 Redundancy: Broadcast Storms



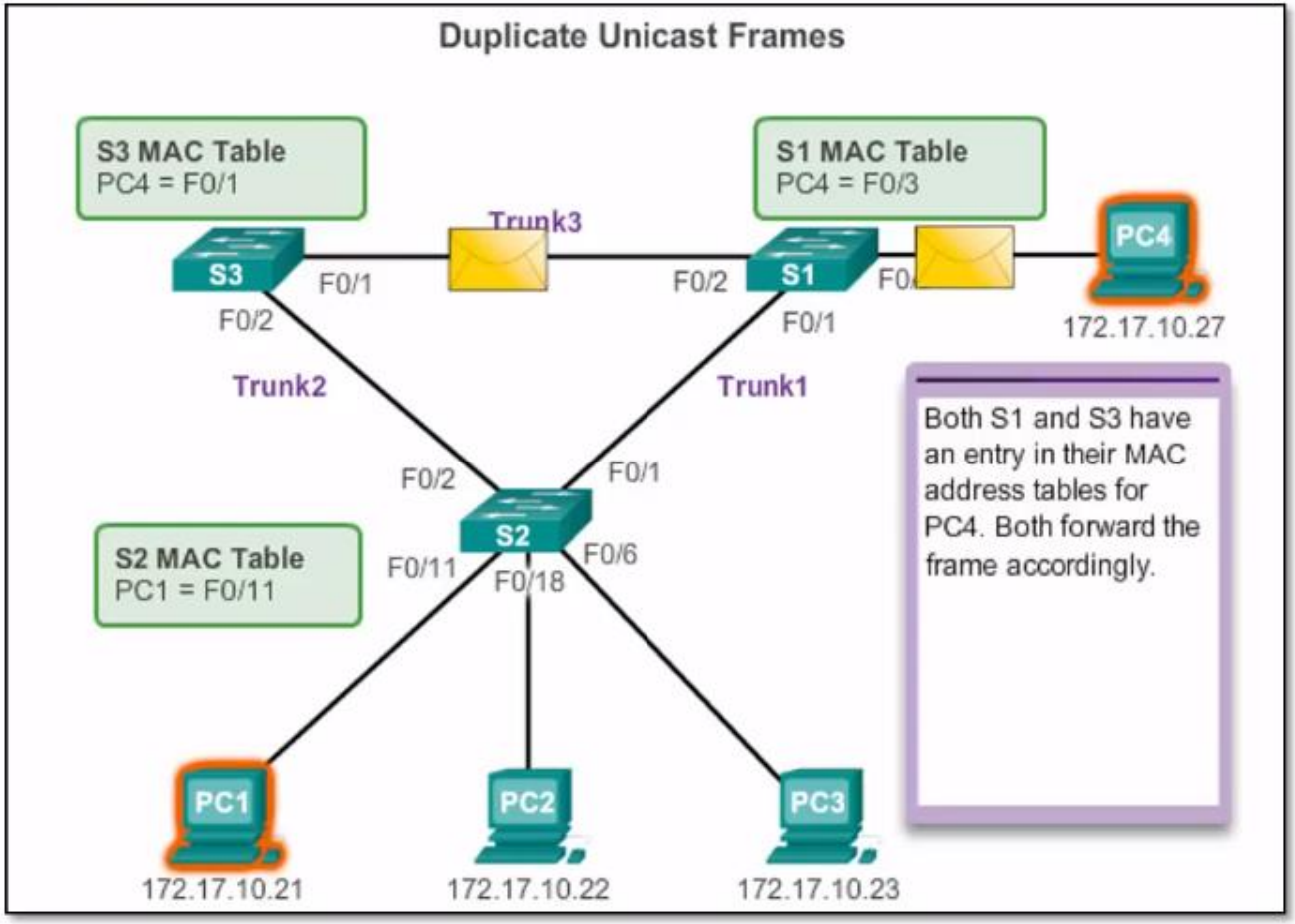
Purpose of Spanning Tree

Issues with Layer 1 Redundancy: Duplicate Unicast Frames

- Unicast frames sent onto a looped network can result in duplicate frames arriving at the destination device.
- Most upper layer protocols are not designed to recognize, or cope with, duplicate transmissions.
- Layer 2 LAN protocols, such as Ethernet, lack a mechanism to recognize and eliminate endlessly looping frames.

Purpose of Spanning Tree

Issues with Layer 1 Redundancy: Duplicate Unicast Frames



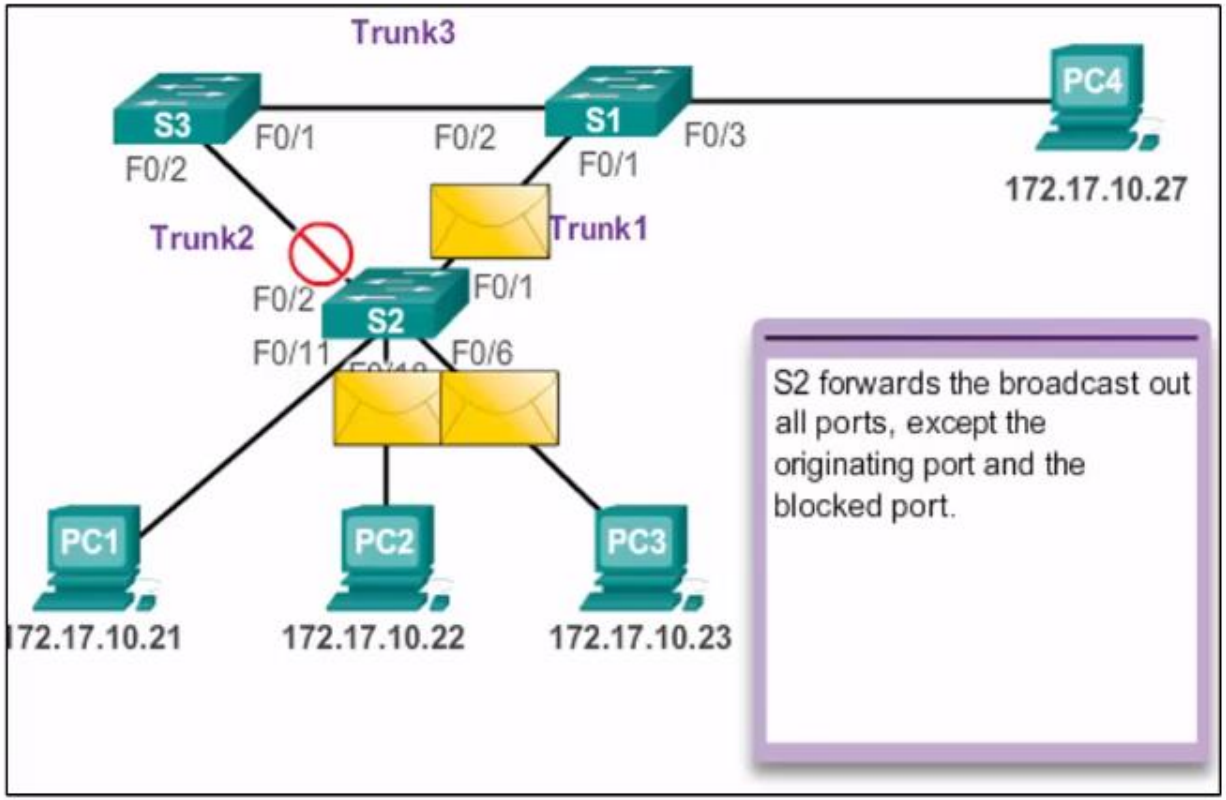
STP Operation

Spanning Tree Algorithm: Introduction

- STP ensures that there is only one logical path between all destinations on the network by intentionally blocking redundant paths that could cause a loop.
- A port is considered blocked when user data is prevented from entering or leaving that port. This does not include bridge protocol data unit (BPDU) frames that are used by STP to prevent loops.
- The physical paths still exist to provide redundancy, but these paths are disabled to prevent the loops from occurring.
- If the path is ever needed to compensate for a network cable or switch failure, STP recalculates the paths and unblocks the necessary ports to allow the redundant path to become active.

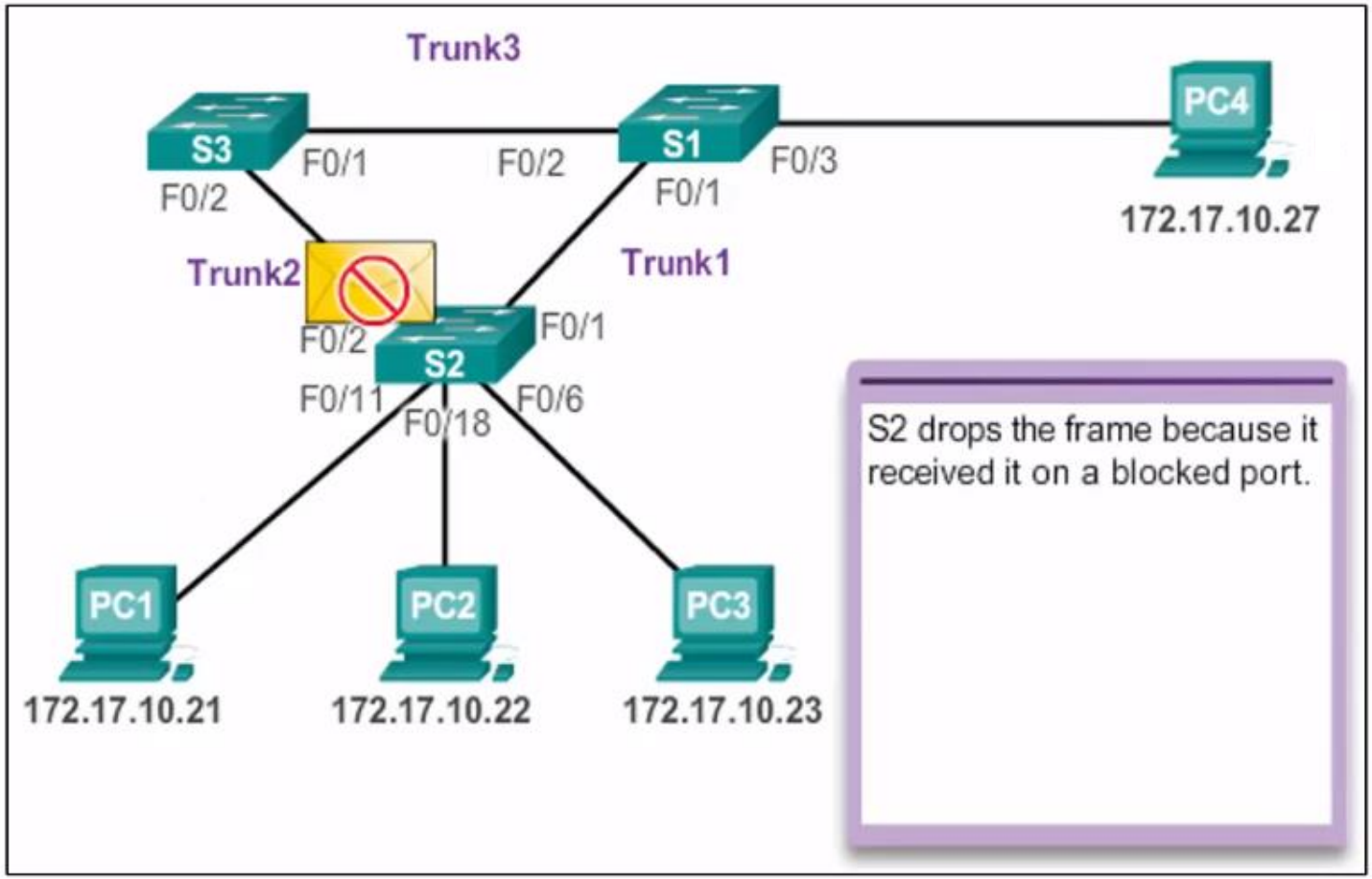
STP Operation

Spanning Tree Algorithm: Introduction



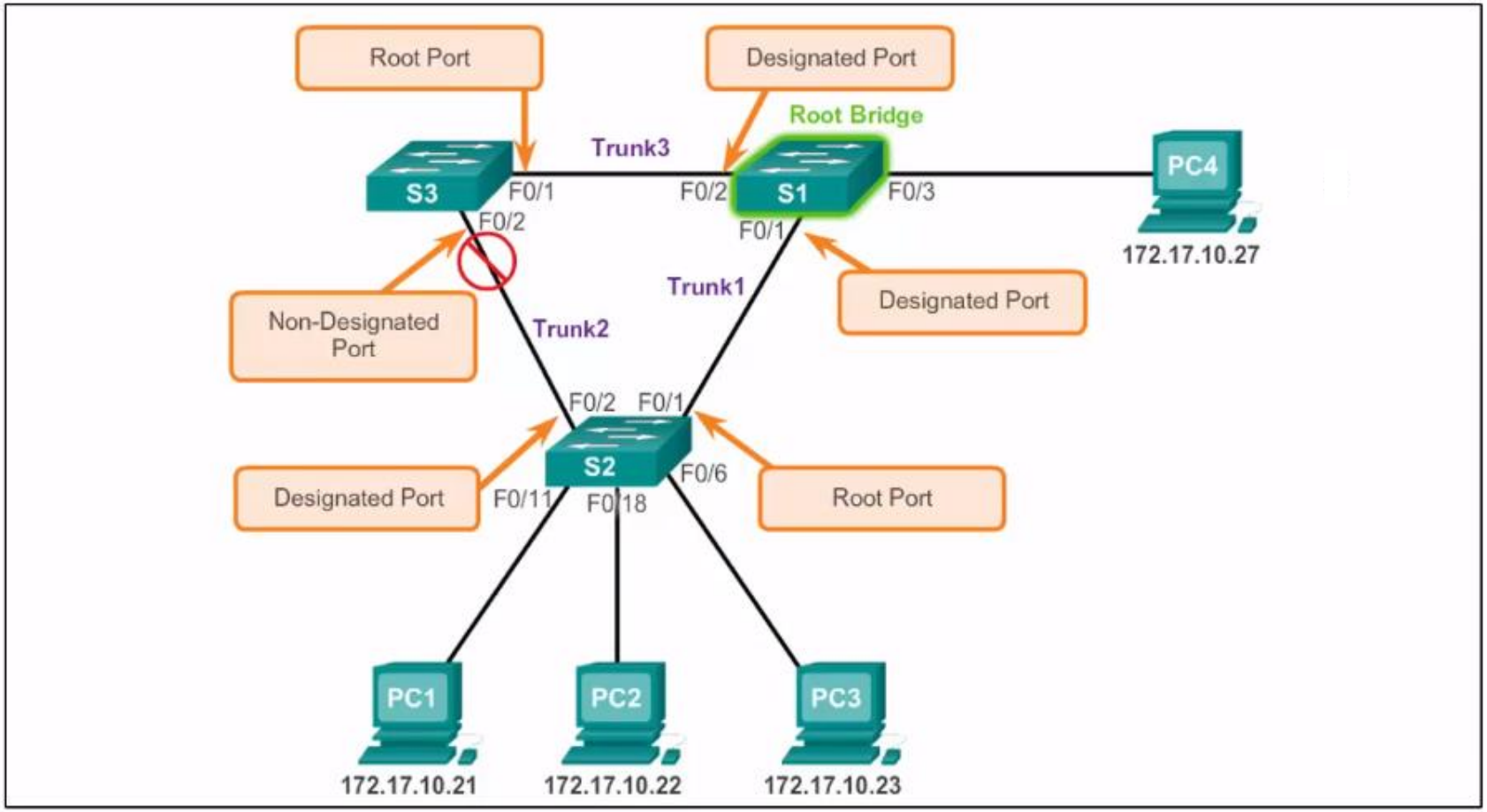
STP Operation

Spanning Tree Algorithm: Introduction



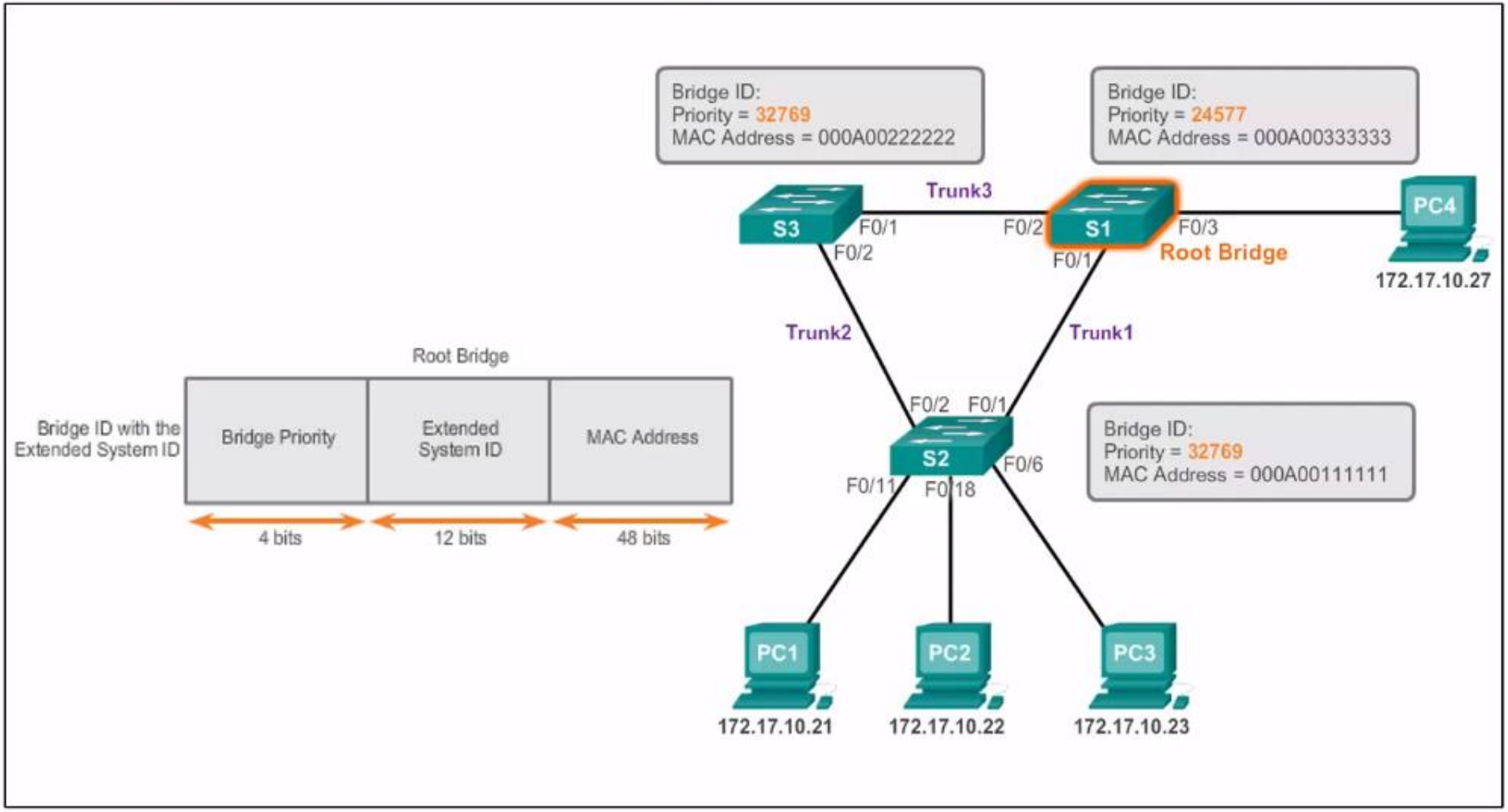
STP Operation

Spanning Tree Algorithm: Port Roles



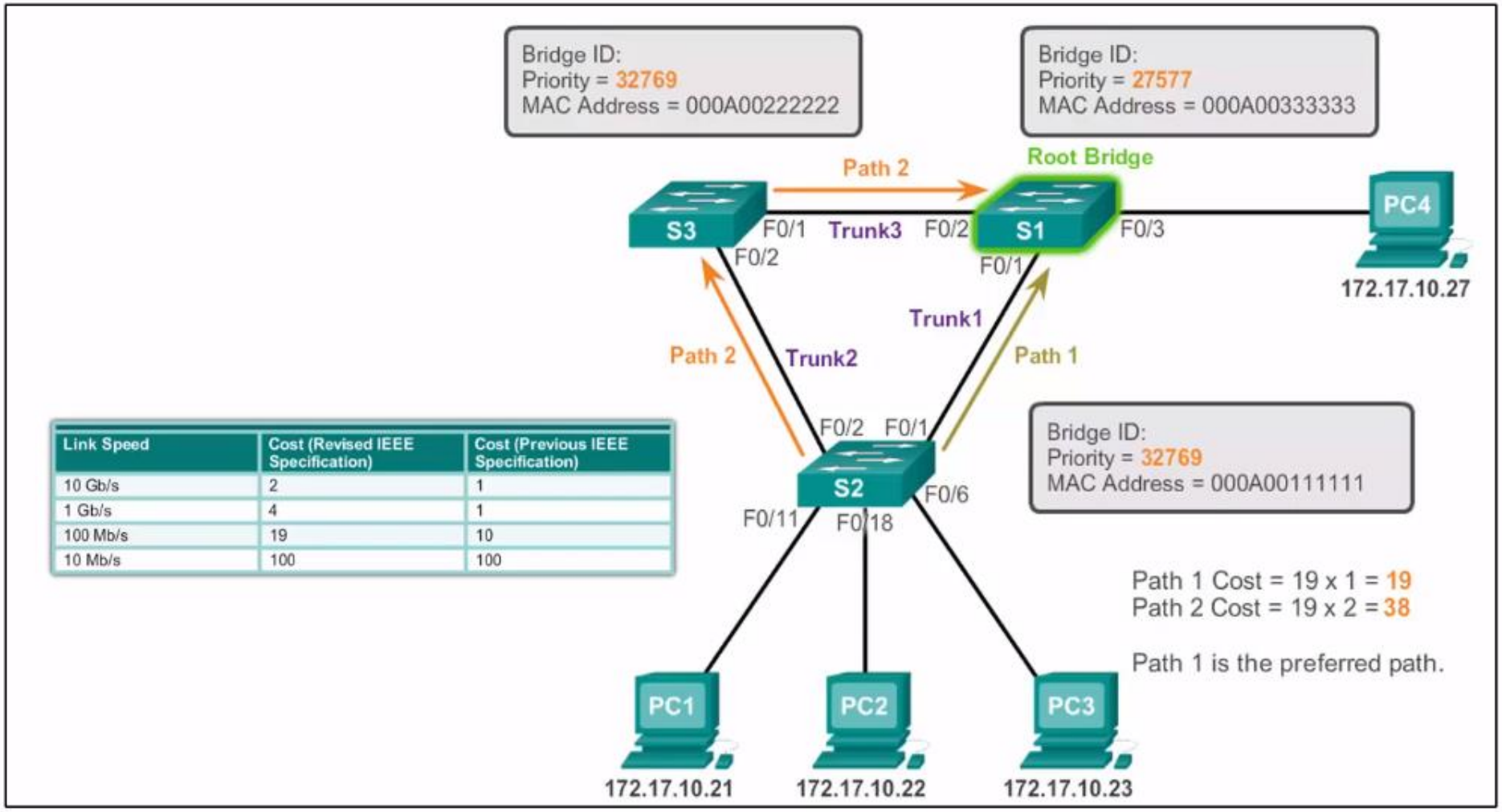
STP Operation

Spanning Tree Algorithm: Root Bridge



STP Operation

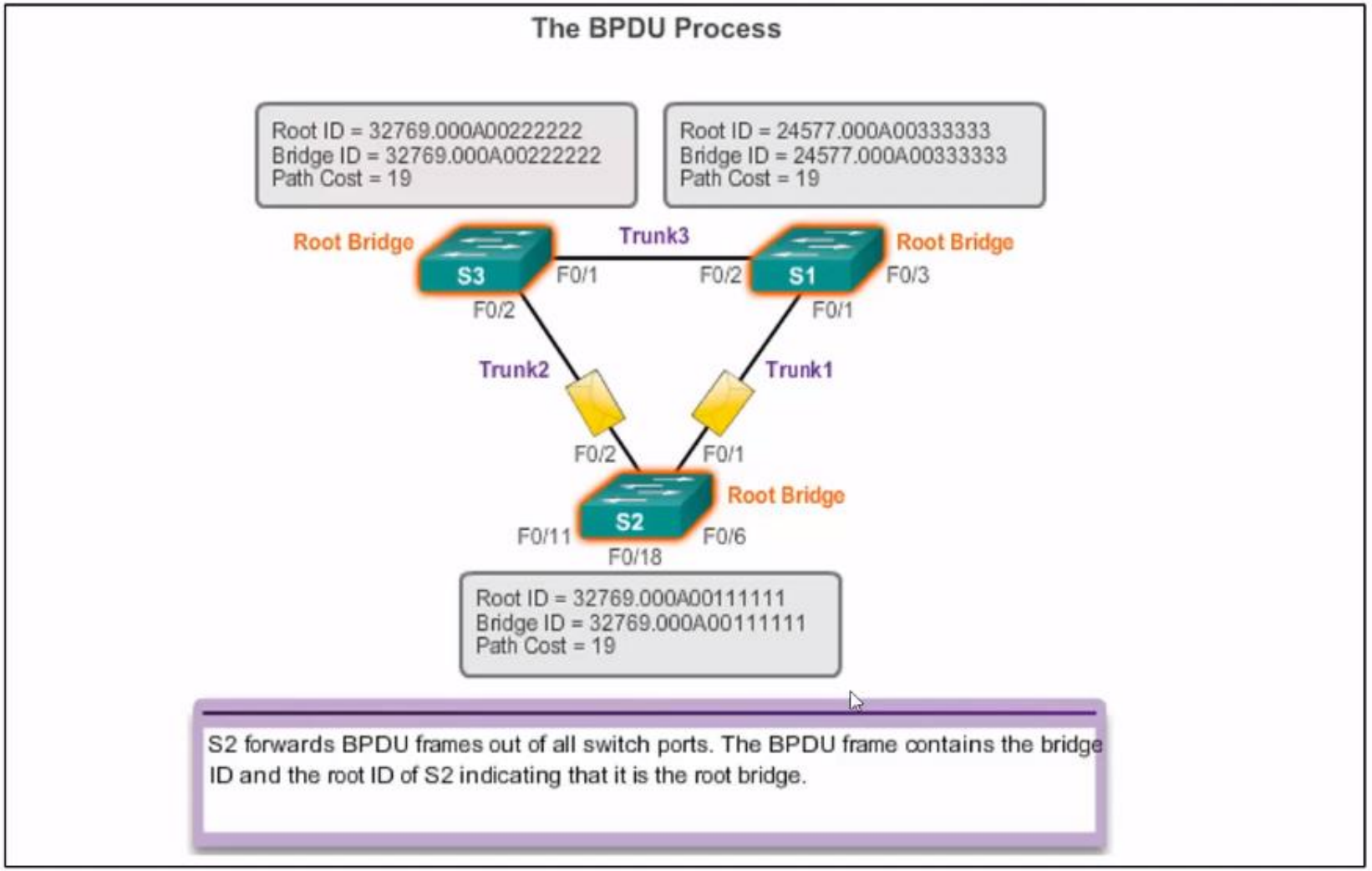
Spanning Tree Algorithm: Path Cost



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

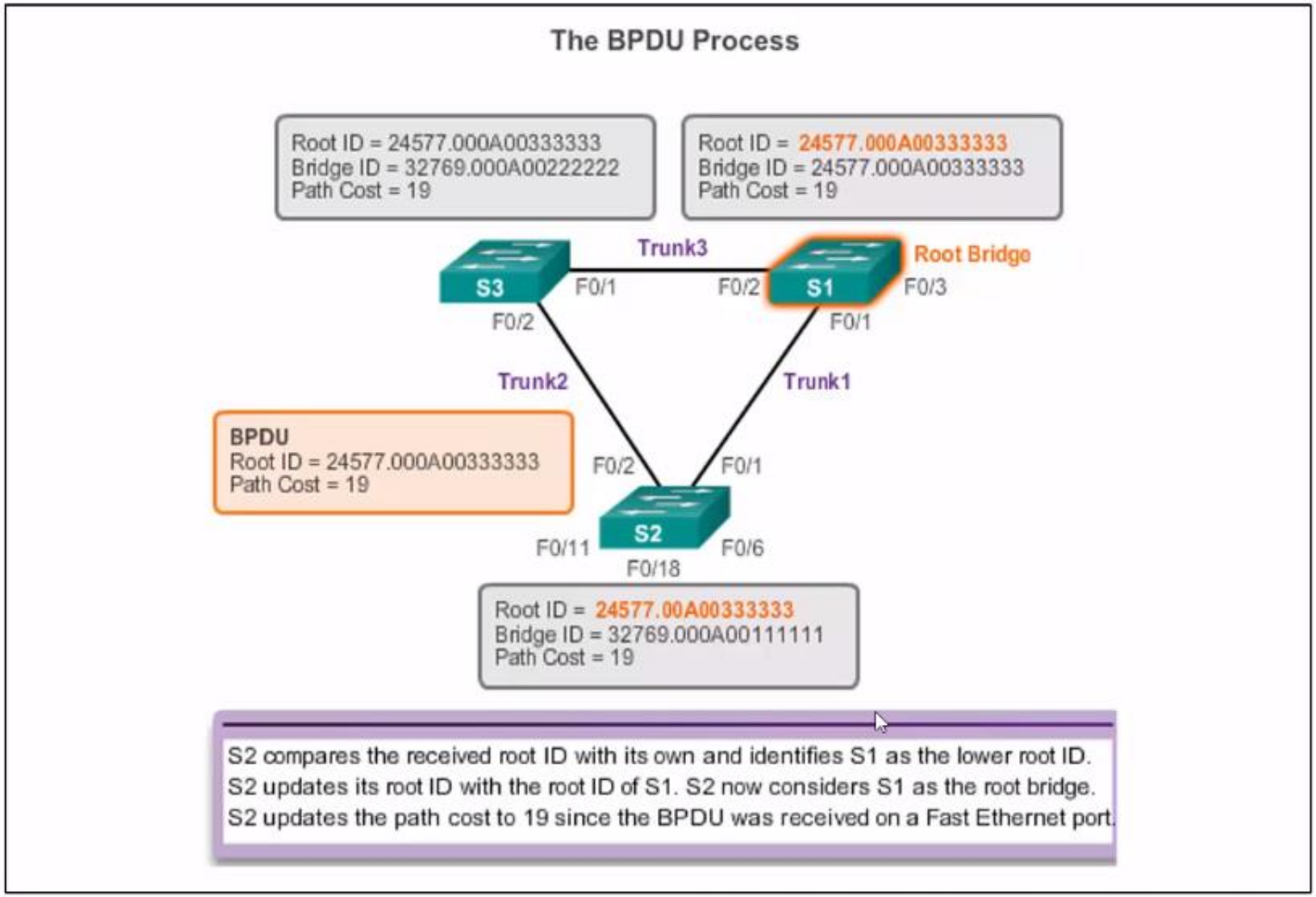
STP Operation

BPDU Propagation and Process



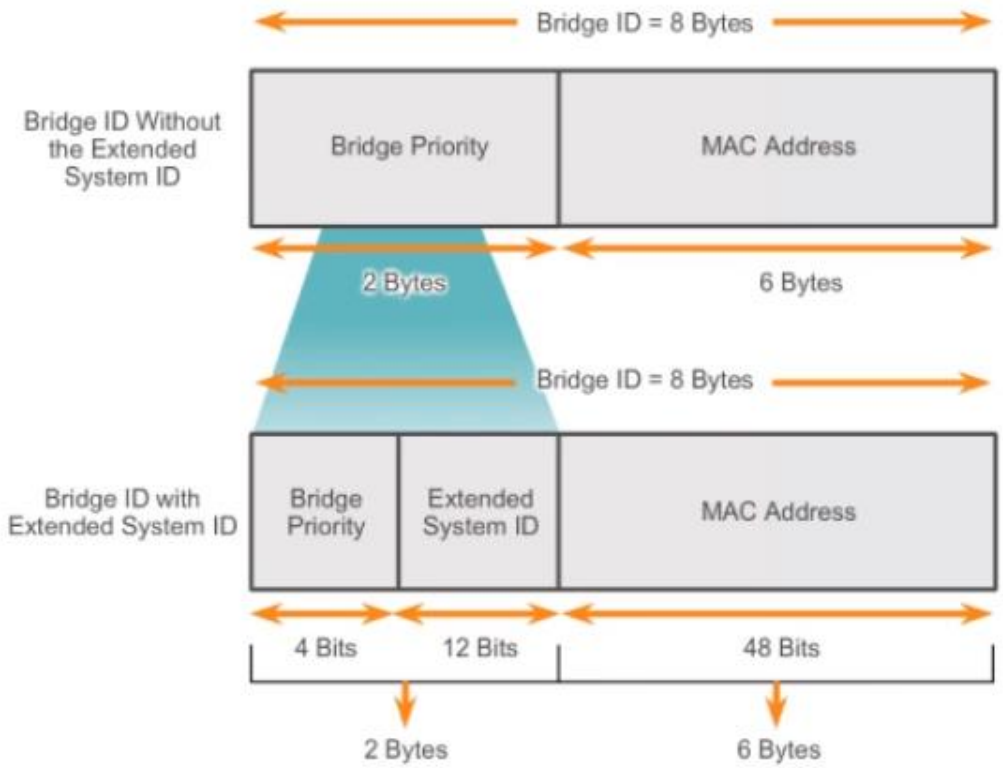
STP Operation

BPDU Propagation and Process



STP Operation

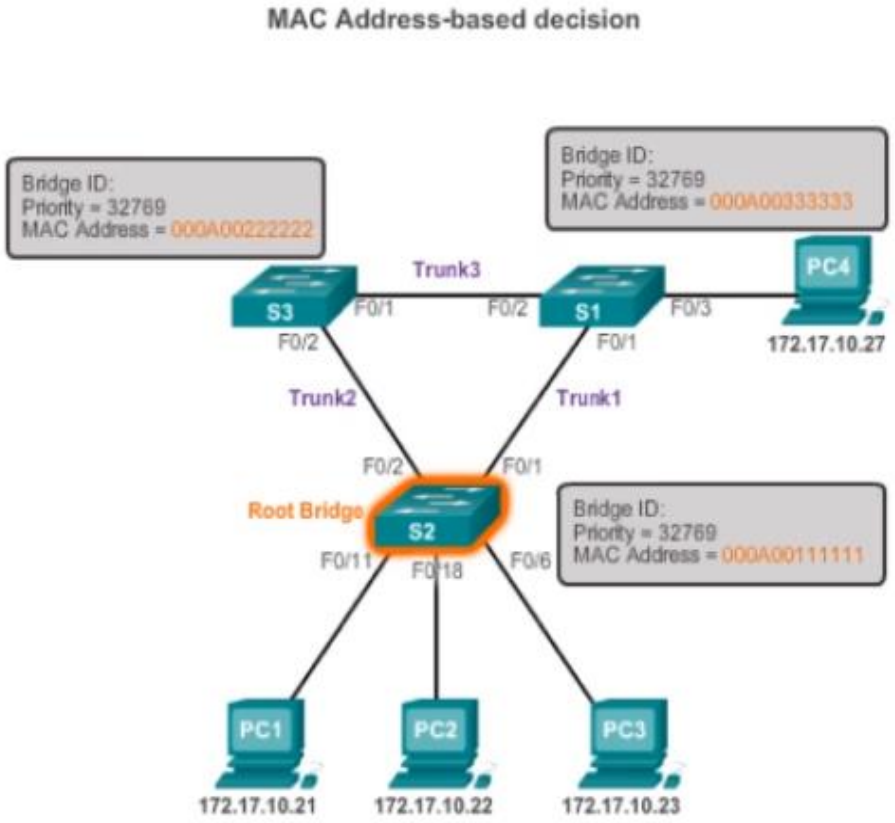
Extended System ID



STP was enhanced to include support for VLANs, requiring the VLAN ID to be included in the BPDU frame through the use of the extended system ID

STP Operation

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).

Thank you for your attention