Network Programming

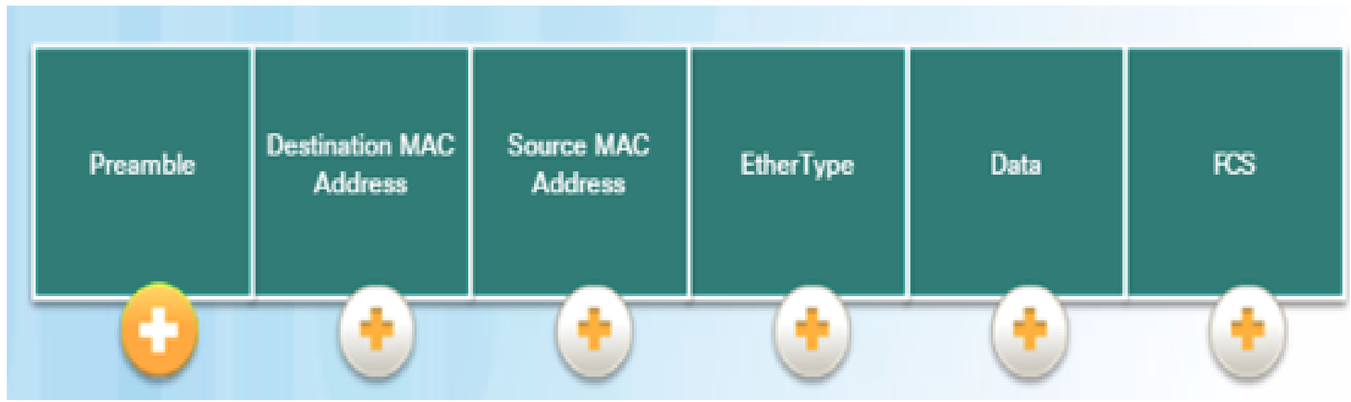
STP – Lecture 4

Unicast Vs Multi Vs Broadcast

Frame Overview

Ethernet Frame Fields

- The minimum Ethernet frame size from Destination MAC address to FCS is 64 bytes and the maximum is 1518 bytes.



- Frames less than 64 bytes are called a "collision fragment" or "runt frame" and are automatically discarded by receiving stations. Frames greater than 1500 bytes of data are considered "jumbo" or "baby giant frames".

- If the size of a transmitted frame is less than the minimum or greater than the maximum, the receiving device drops the frame.

Frame Overview

MAC Addresses and Hexadecimal

- An Ethernet MAC address is a 48-bit binary value expressed as 12 hexadecimal digits (4 bits per hexadecimal digit).

- Hexadecimal is used to represent Ethernet MAC addresses and IP Version 6 addresses.
  - Hexadecimal is a base sixteen system using the numbers 0 to 9 and the letters A to F.
  - It is easier to express a value as a single hexadecimal digit than as four binary bits.
  - Hexadecimal is usually represented in text by the value preceded by 0x (E.g., 0x73).

Decimal	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

- Convert the decimal or hexadecimal value to binary, and then to convert the binary value to either decimal or hexadecimal as needed.

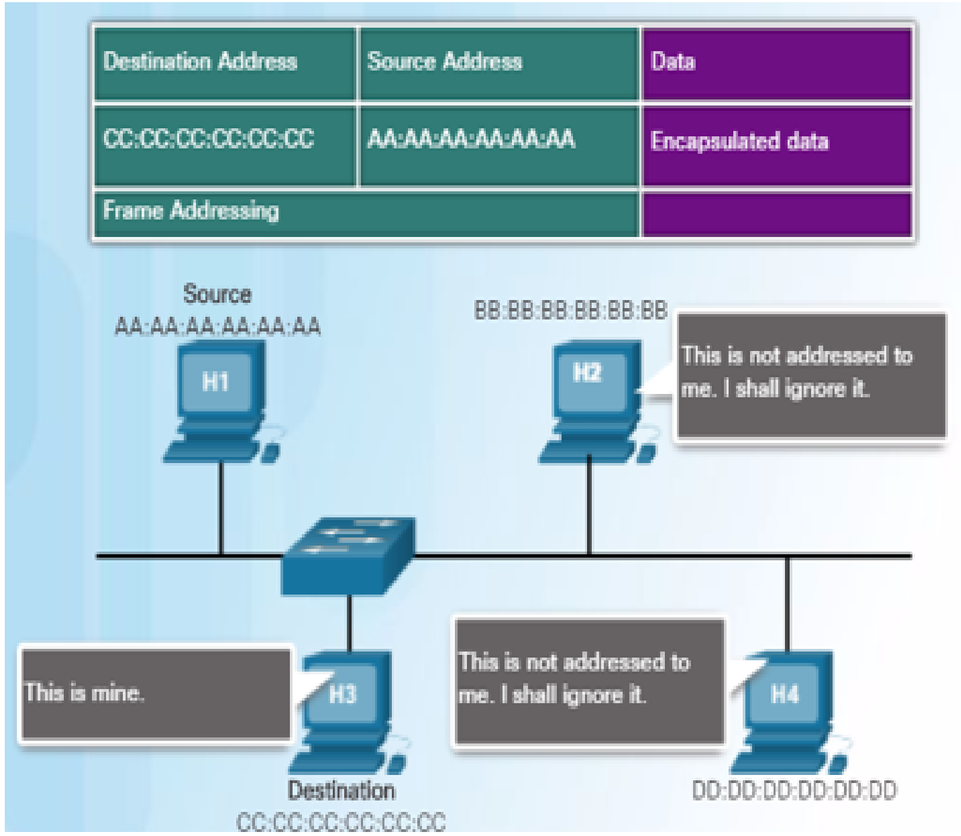
Frame Overview

Frame Processing

- The MAC address is often referred to as a burned-in address (BIA) meaning the address is encoded into the ROM chip permanently. When the computer starts up, the first thing the NIC does is copy the MAC address from ROM into RAM.

- When a device is forwarding a message to an Ethernet network, it attaches header information to the frame.

- The header information contains the source and destination MAC address.

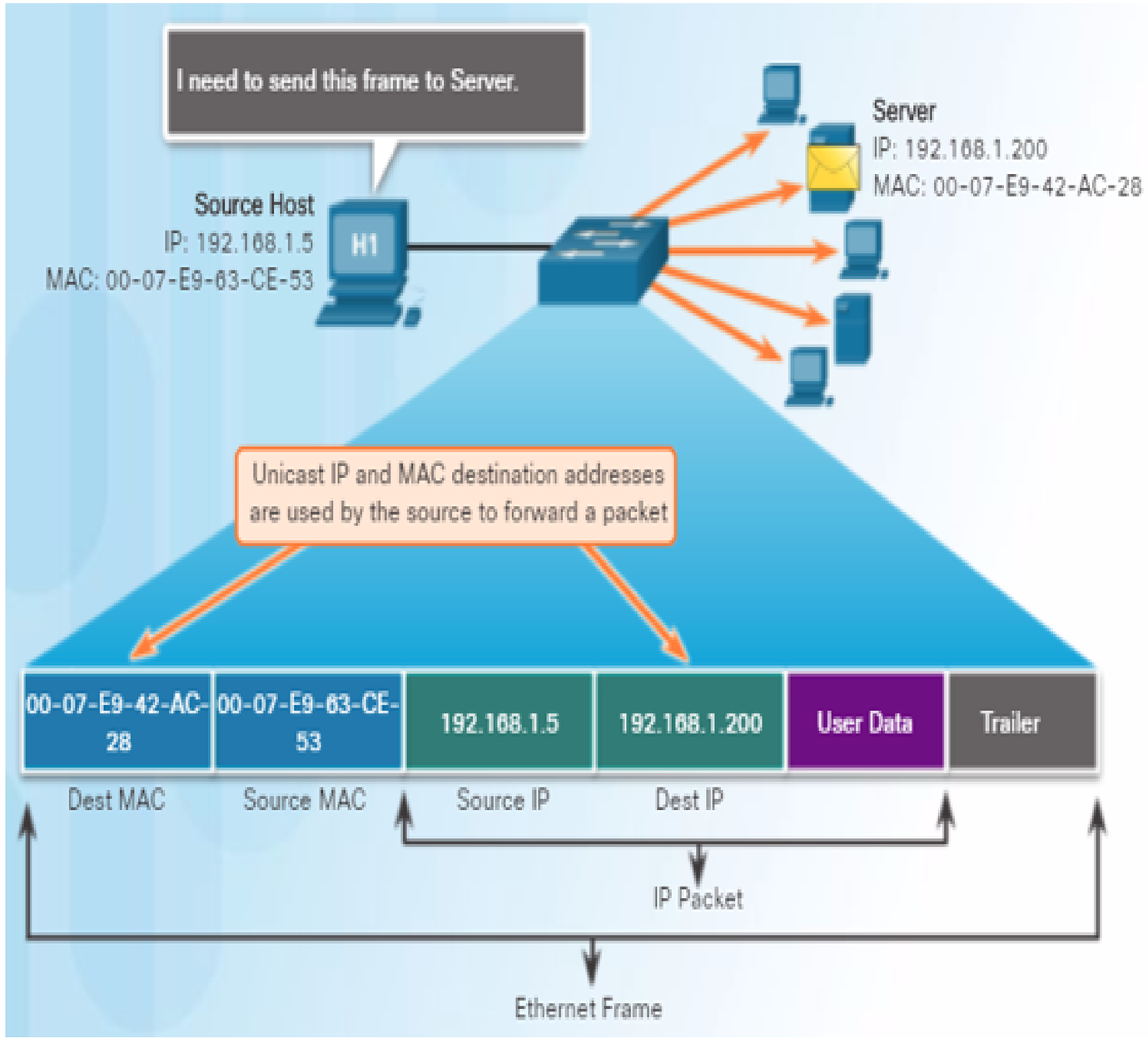


Transmission Type Overview

Unicast MAC Address

- A unicast MAC address is the unique address used when a frame is sent from a single transmitting device to a single destination device.

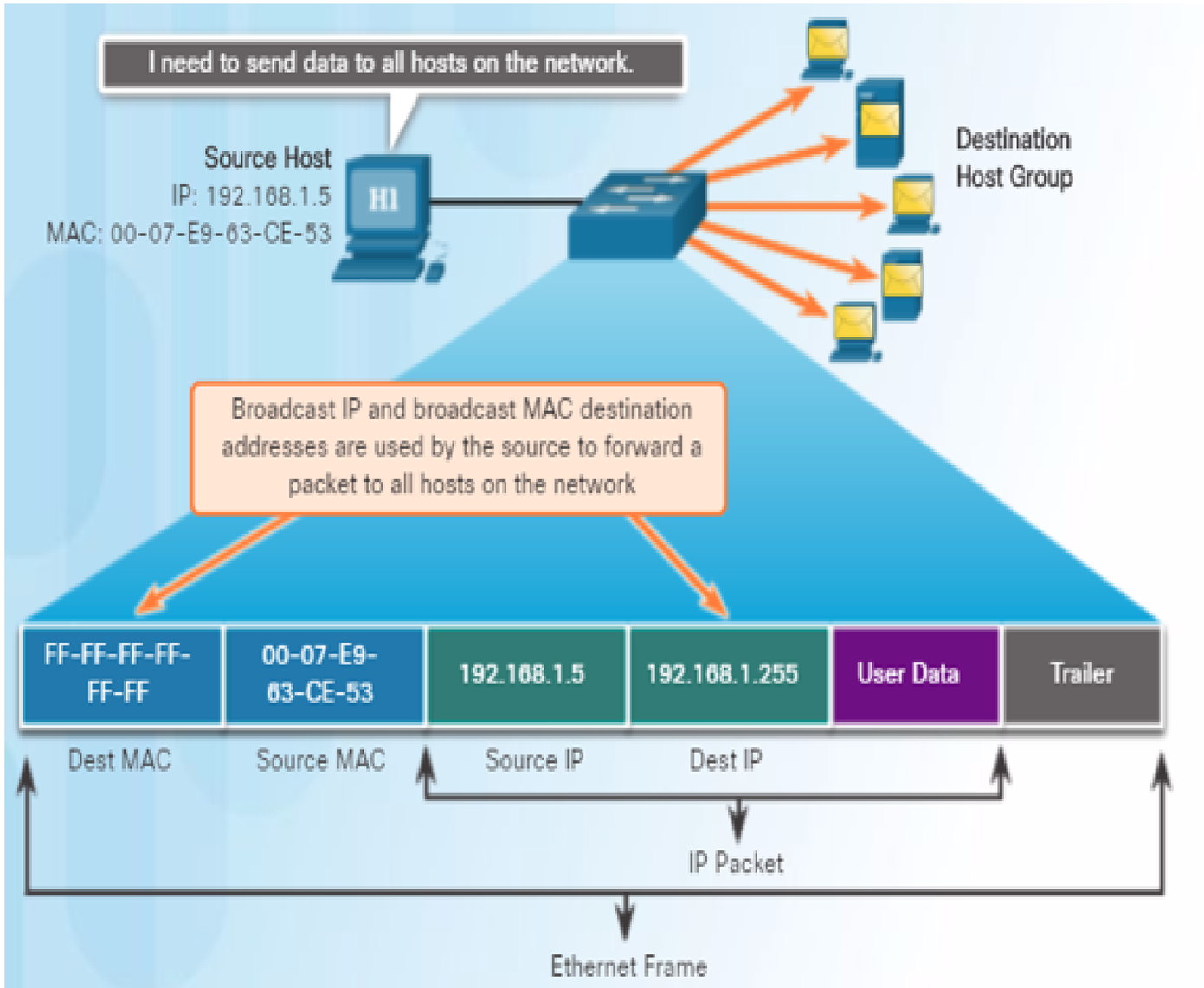
- For a unicast packet to be sent and received, a destination IP address must be in the IP packet header and a corresponding destination MAC address must also be present in the Ethernet frame header.



Transmission Type Overview

Broadcast MAC Address

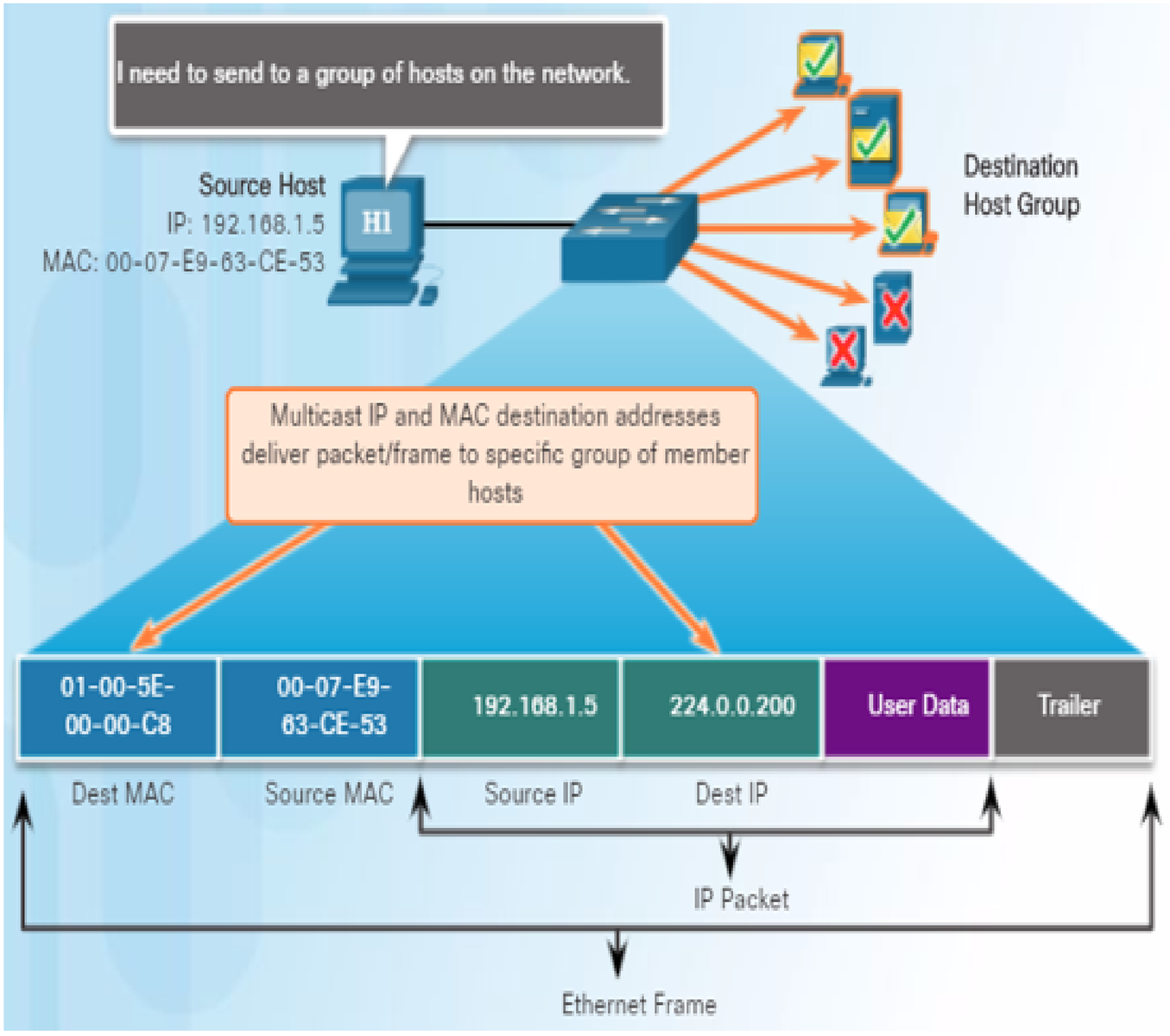
- Many network protocols, such as DHCP and ARP, use broadcasts.
- A broadcast packet contains a destination IPv4 address that has all ones (1s) in the host portion indicating that all hosts on that local network will receive and process the packet.
- When the IPv4 broadcast packet is encapsulated in the Ethernet frame, the destination MAC address is the broadcast MAC address of FF-FF-FF-FF-FF-FF in hexadecimal (48 ones in binary).



Transmission Type Overview

Multicast MAC Address

- Multicast addresses allow a source device to send a packet to a group of devices.
  - Devices in a multicast group are assigned a multicast group IP address in the range of 224.0.0.0 to 239.255.255.255 (IPv6 multicast addresses begin with FF00::/8).
- The multicast IP address requires a corresponding multicast MAC address that begins with 01-00-5E in hexadecimal.



Router Vs Switch Vs Hub

Intermediate Devices

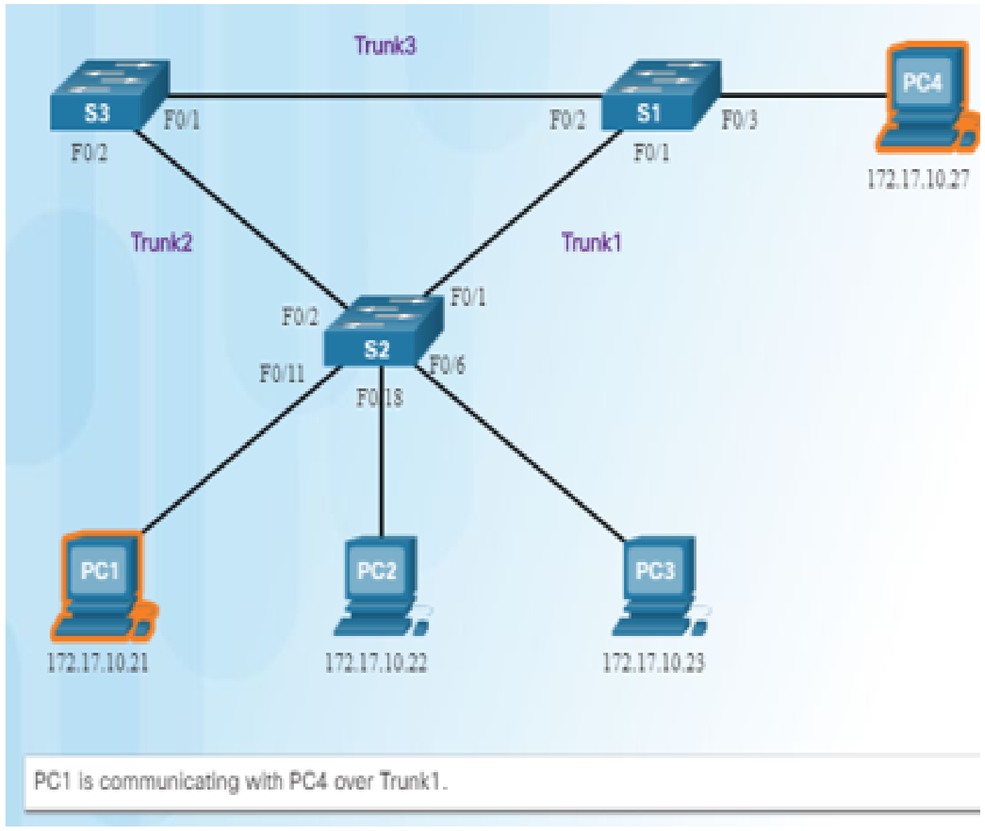
- Each Router interface included in one broadcast domain
- (Router - Layer 3)
- Each Switch interface included in one collision domain and all interfaces included in same one broadcast domain
- (Switch - Layer 2)
- All interfaces of hub included in same one collision domain
- (Hub - Layer 1)

Spanning Tree

STP Overview

Redundancy at OSI Layers 1 and 2

- Switched networks commonly have redundant paths and even redundant links between the same two devices.
  - Redundant paths eliminate a single point of failure in order to improve reliability and availability.
  - Redundant paths can cause physical and logical Layer 2 loops.
- Spanning Tree Protocol (STP) is a Layer 2 protocol that helps especially when there are redundant links.

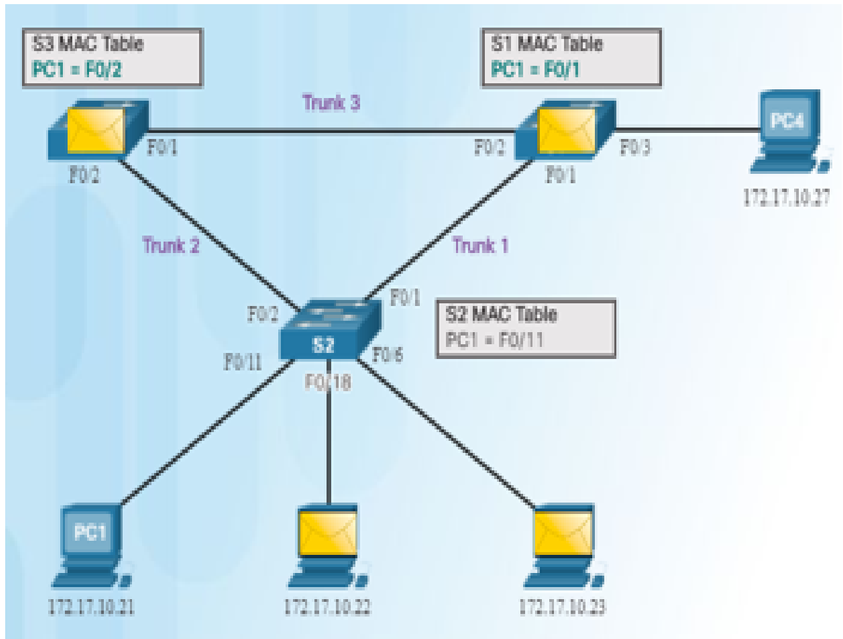


- Layer 2 loop issues
  - Mac database instability – copies of the same frame being received on different ports.
  - Broadcast storms – broadcasts are flooded endlessly causing network disruption.
  - Multiple frame transmission – multiple copies of unicast frames delivered to the same destination.

STP Overview

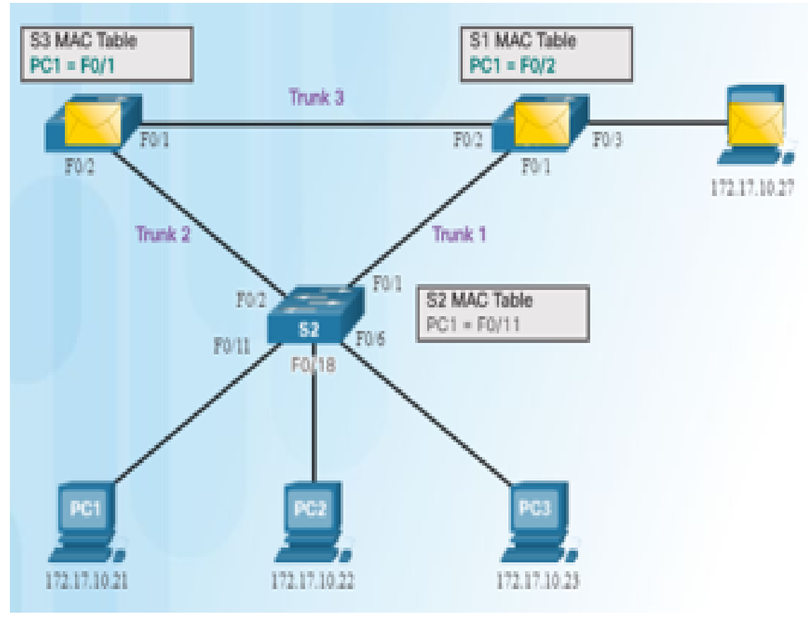
Issues with Layer 1 Redundancy: MAC Database Instability

- Ethernet frames do not have a time to live (TTL) field like the Layer 3 IP header has. This means that Ethernet has no mechanism to drop frames that propagate endlessly. This can result in MAC database instability.



1. PC1 sends a broadcast frame to S2.
2. S2 updates the MAC address table for PC1's MAC address on port 11.
3. S2 forwards the frame out all ports except the port the frame came in on. S1 and S3 receive the frame on a trunk and update their own MAC address tables that PC1 is reachable through the trunk port.
4. S1 and S3 send the frame out all ports except the port it came in on.
5. When S1 sends the frame out port 2 (Trunk 3), S3 updates the MAC address table to reflect that PC1 is now reachable through port 1.

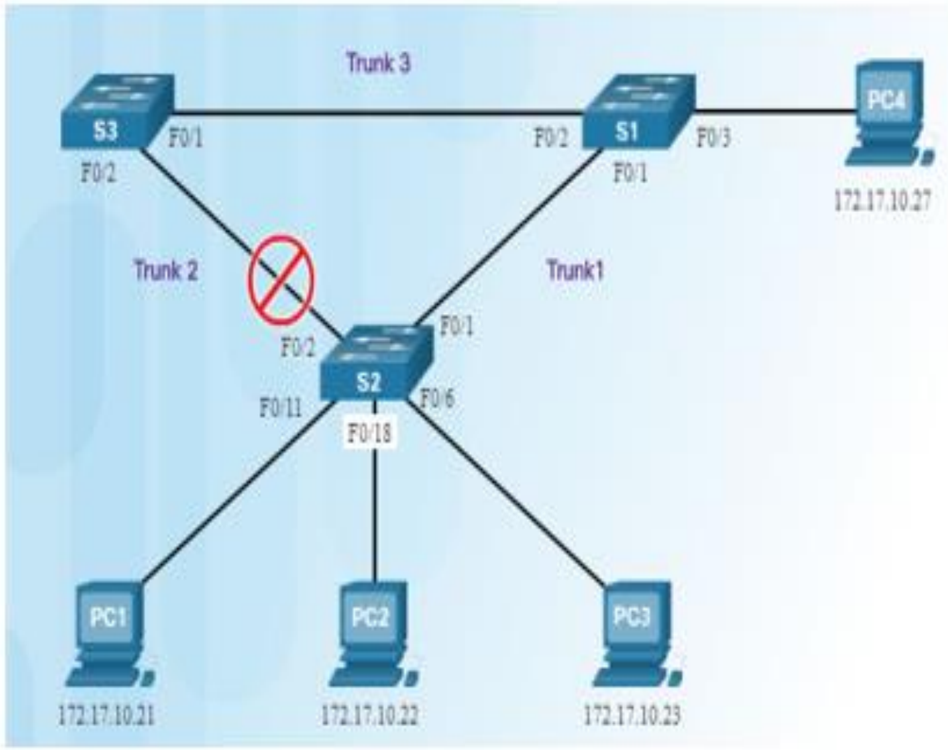
- A host caught in a network loop is not accessible to other hosts.
- Due to constant changes in the MAC address table, Switches S3 and S1 do not know which port to forward frames.

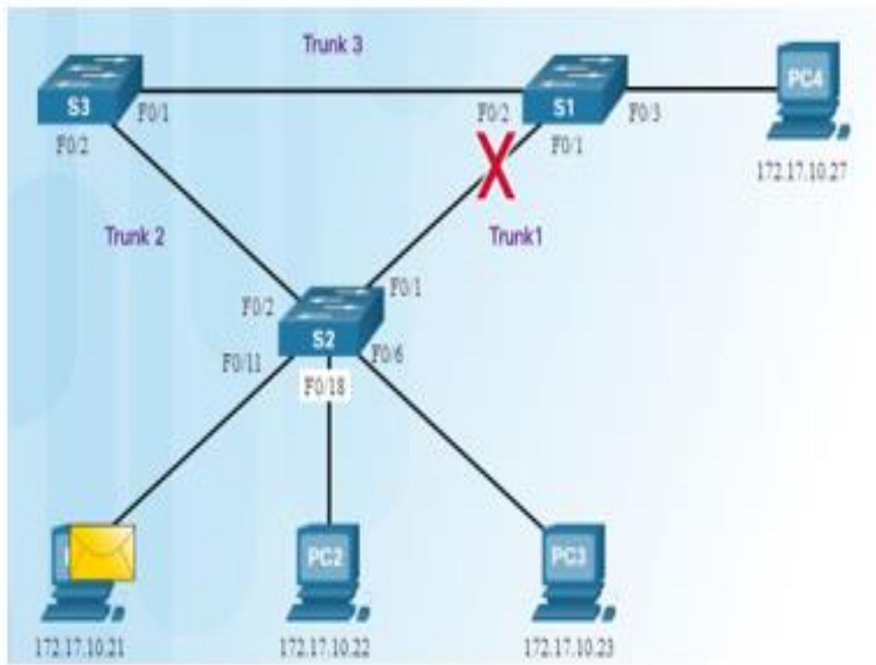


STP Overview

Spanning Tree Algorithm: Introduction

- The Spanning Tree Protocol (STP) creates one logical path through the switch network (all destinations on the network).
  - Blocks redundant paths that could cause a loop.
  - STP sends bridge protocol data units (BPDUs) between Layer 2 devices in order to create the one logical path.
- A port on S2 is blocked so traffic can only flow one way between any two devices.
- When Trunk1 fails, the blocked port on S2 is unblocked and traffic can flow between S2 and S3.

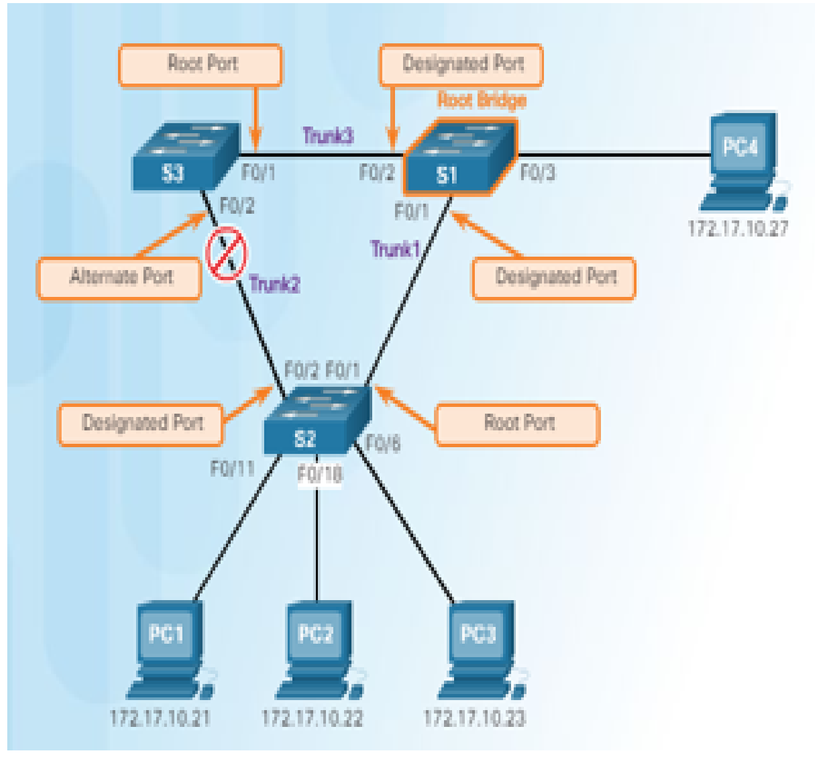




STP Overview

Spanning Tree Algorithm: Port Roles

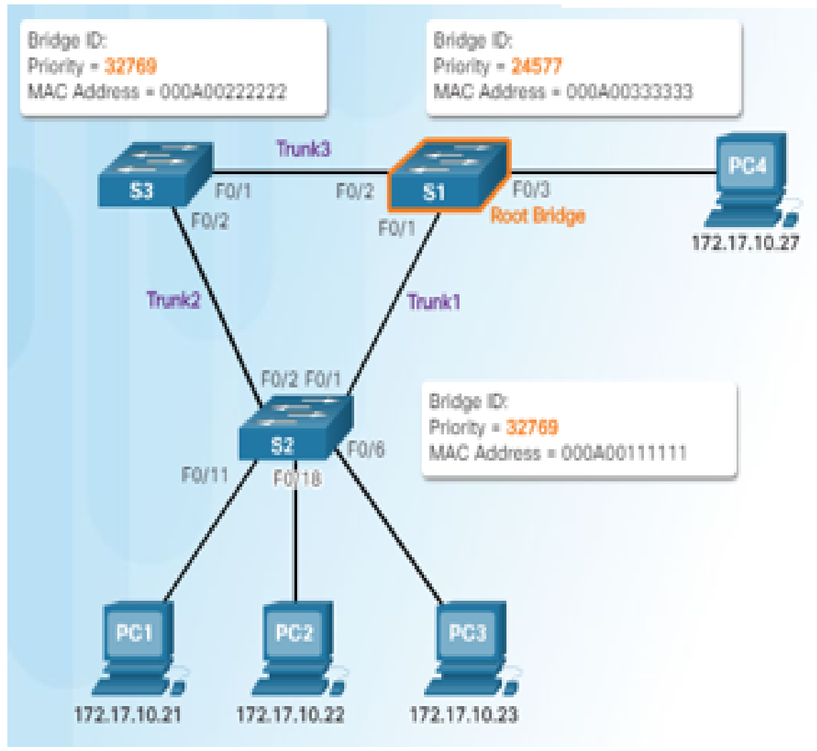
- Root bridge – one Layer 2 device in a switched network.
- Root port – one port on a switch that has the lowest cost to reach the root bridge.
- Designated port – selected on a per-segment (each link) basis, based on the cost to get back to root bridge for either side of the link.
- Alternate port – (RSTP only) backup port for the designated port when the other side is not a root port.
- Backup port – (RSTP only) backup port for the root port.



STP Overview

Spanning Tree Algorithm: Root Bridge

- Lowest bridge ID (BID) becomes root bridge
  - Originally BID had two fields: bridge priority and MAC address
  - Bridge priority default is 32,768 (can change)
  - Lowest MAC address (if bridge priority is not changed) becomes determinant for root bridge.

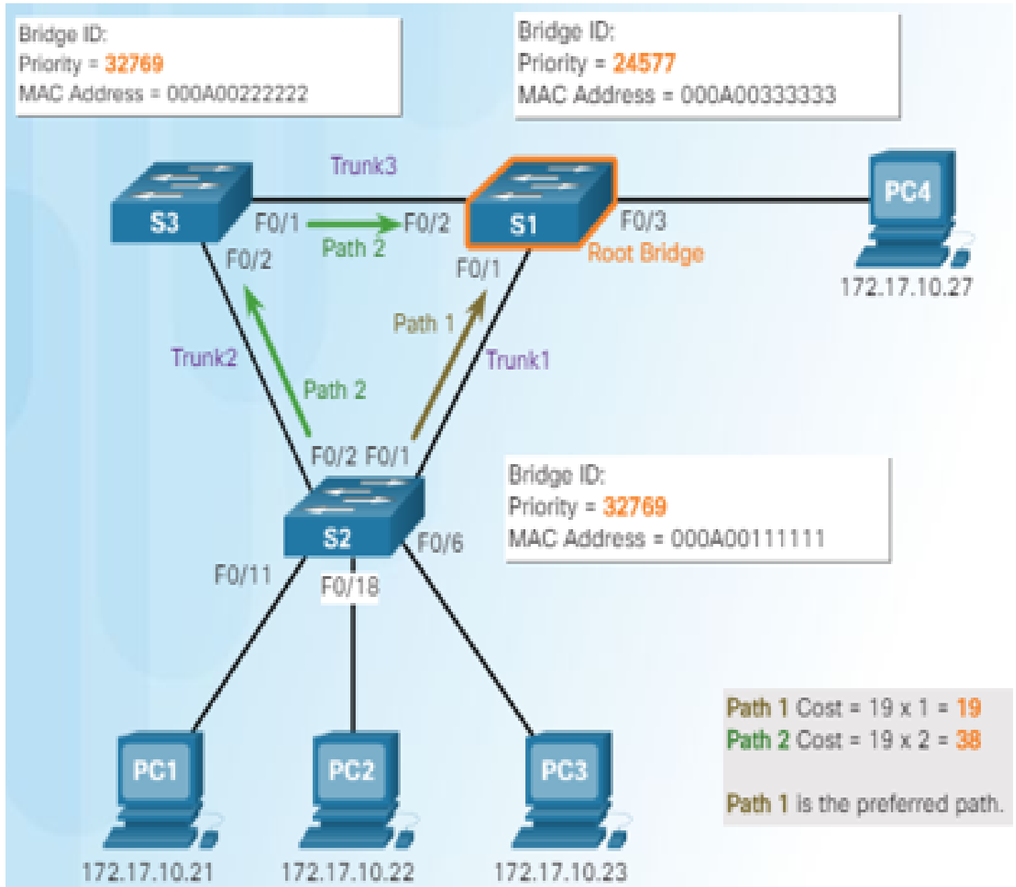


STP Overview

Spanning Tree Algorithm: Root 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

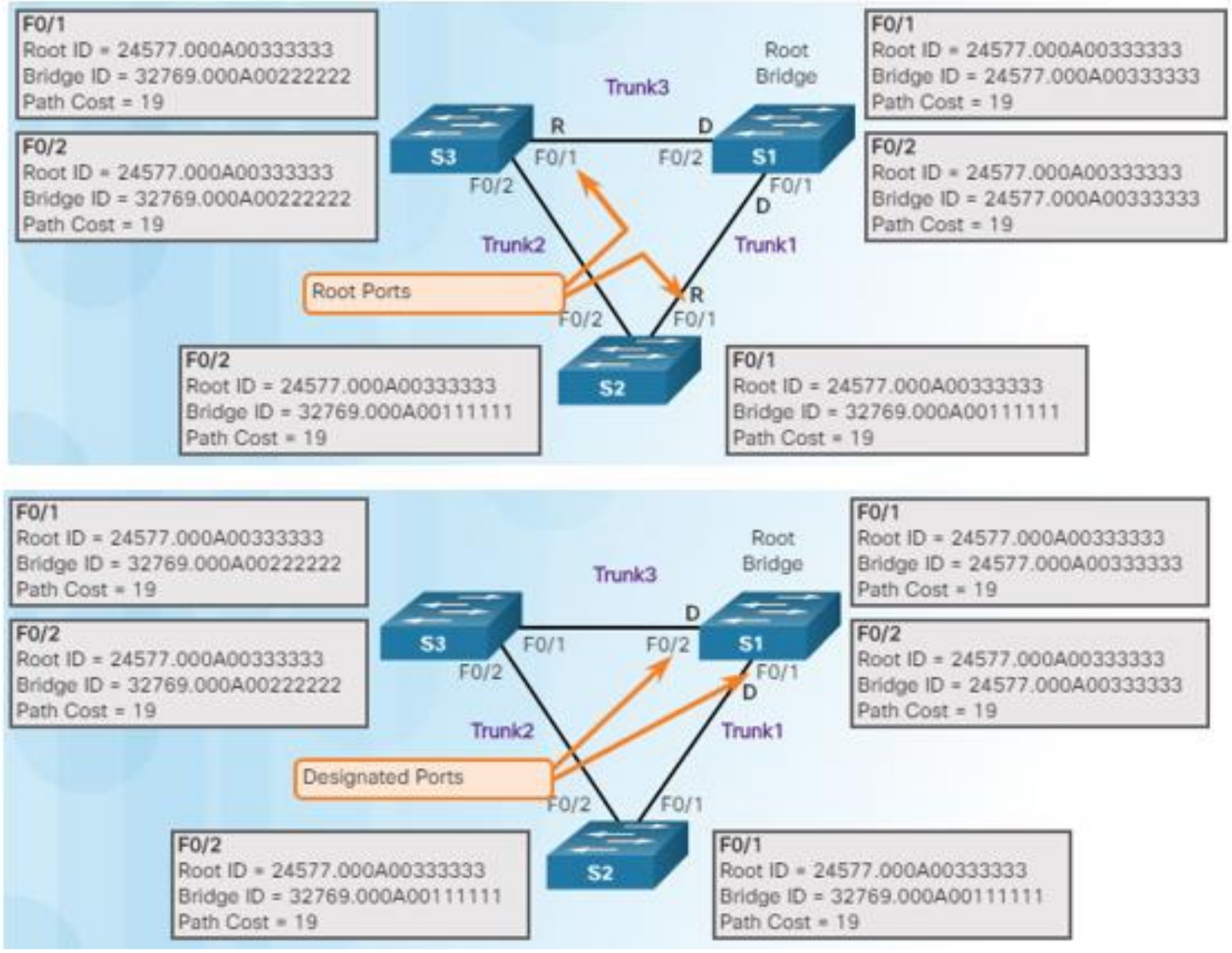
- Root path cost is used to determine the role of the port and whether or not traffic is blocked.
- Can be modified with the **spanning-tree cost** interface command.



STP Overview

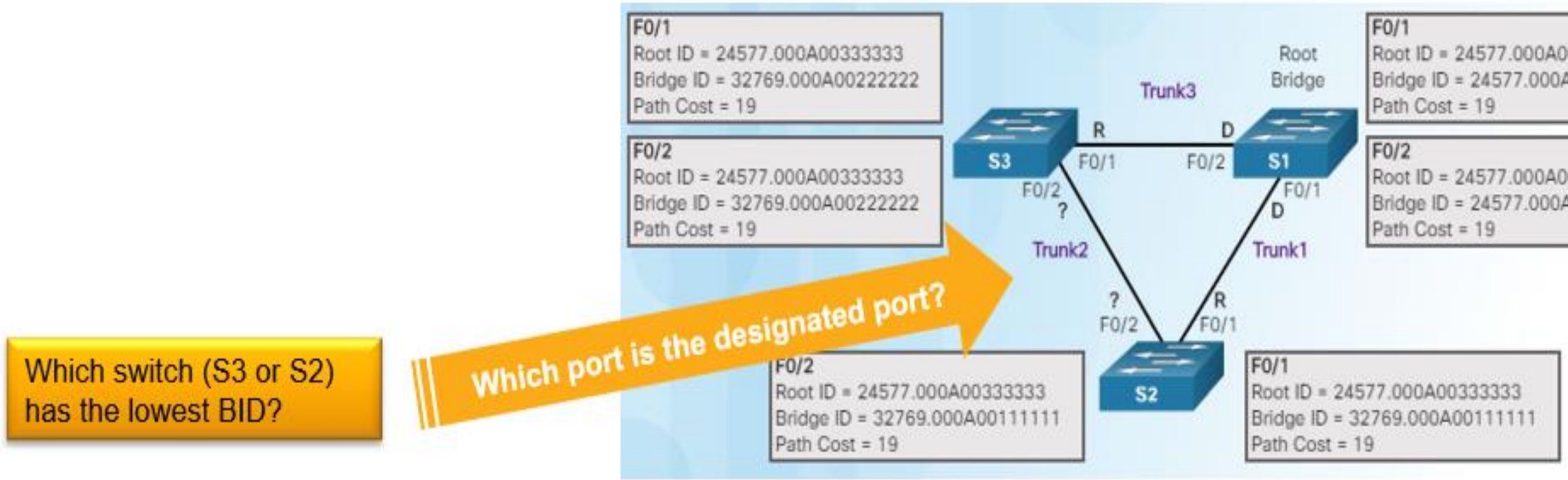
Port Role Decisions for STP

- S1 is root bridge



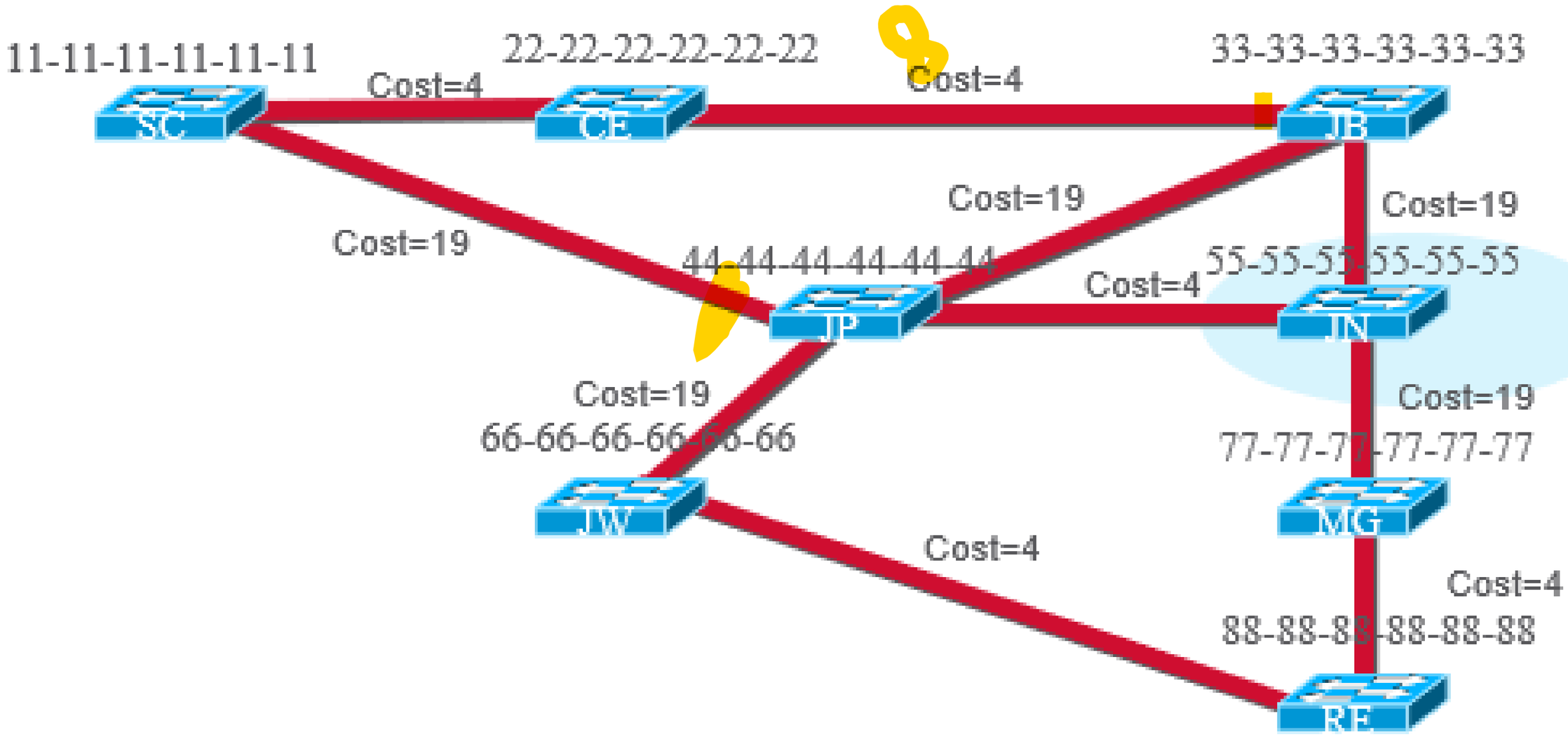
STP Overview

Port Role Decisions for RSTP (Cont.)



- After S3 and S2 exchange BPDUs, STP determines that the F0/2 port on S2 becomes the designated port and the S3 F0/2 port becomes the alternate port, thus going into the blocking state so there is only one path through the switched network.

Task


11-11-11-11-11-11
22-22-22-22-22-22
33-33-33-33-33-33
Cost=4
Cost=4
SC
CE
JB
Cost=19
Cost=19
Cost=19
44-44-44-44-44-44
55-55-55-55-55-55
Cost=4
JP
JN
Cost=19
Cost=19
66-66-66-66-66-66
77-77-77-77-77-77
JW
MG
Cost=4
Cost=4
88-88-88-88-88-88
RE

Thank You

Any Questions ??