Spanning Tree protocol

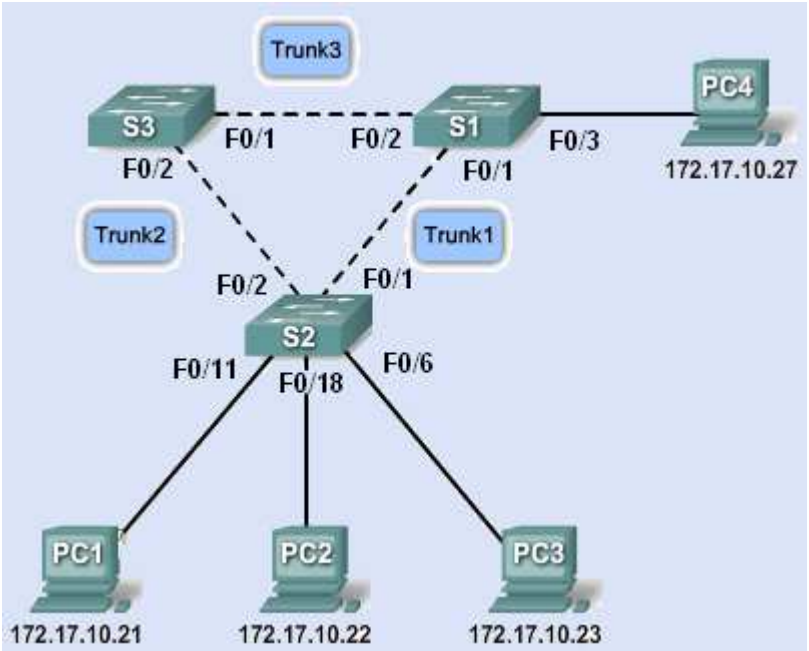
CCNA Exploration Semester 3

Topics

- Redundancy in a converged network
- How Spanning Tree Protocol (STP) eliminates layer 2 loops
- The STP algorithm and its 3 steps
- Rapid spanning tree protocol

We want:

- Redundancy at the distribution and core layers
- Multiple switches and trunk links
- One link or device fails – another takes over.



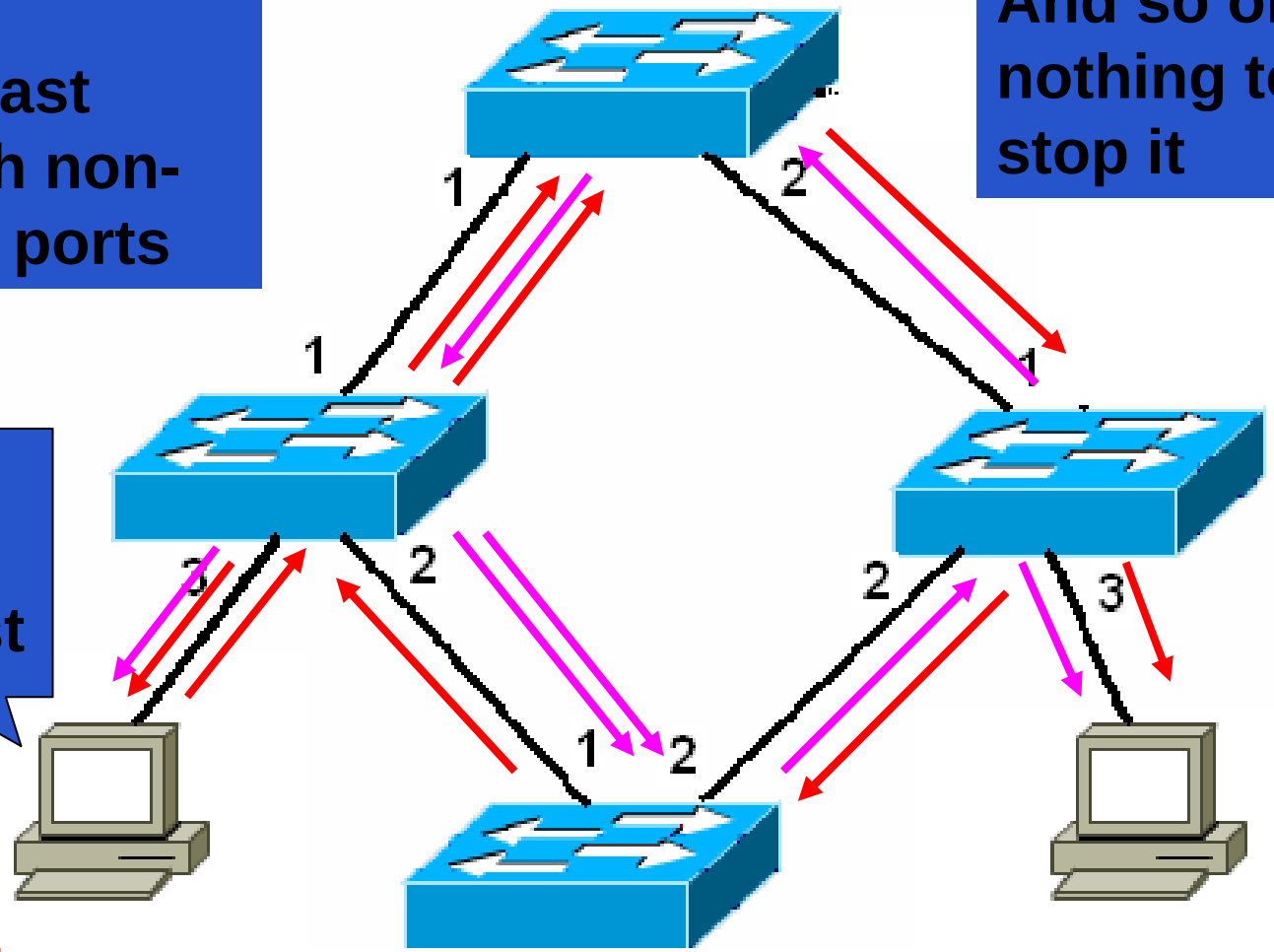
But redundancy gives loops

- Switching loops give problems if all the links are active:
- Broadcast storms
- Multiple frame transmission
- Inconsistent switch tables

Broadcast storm

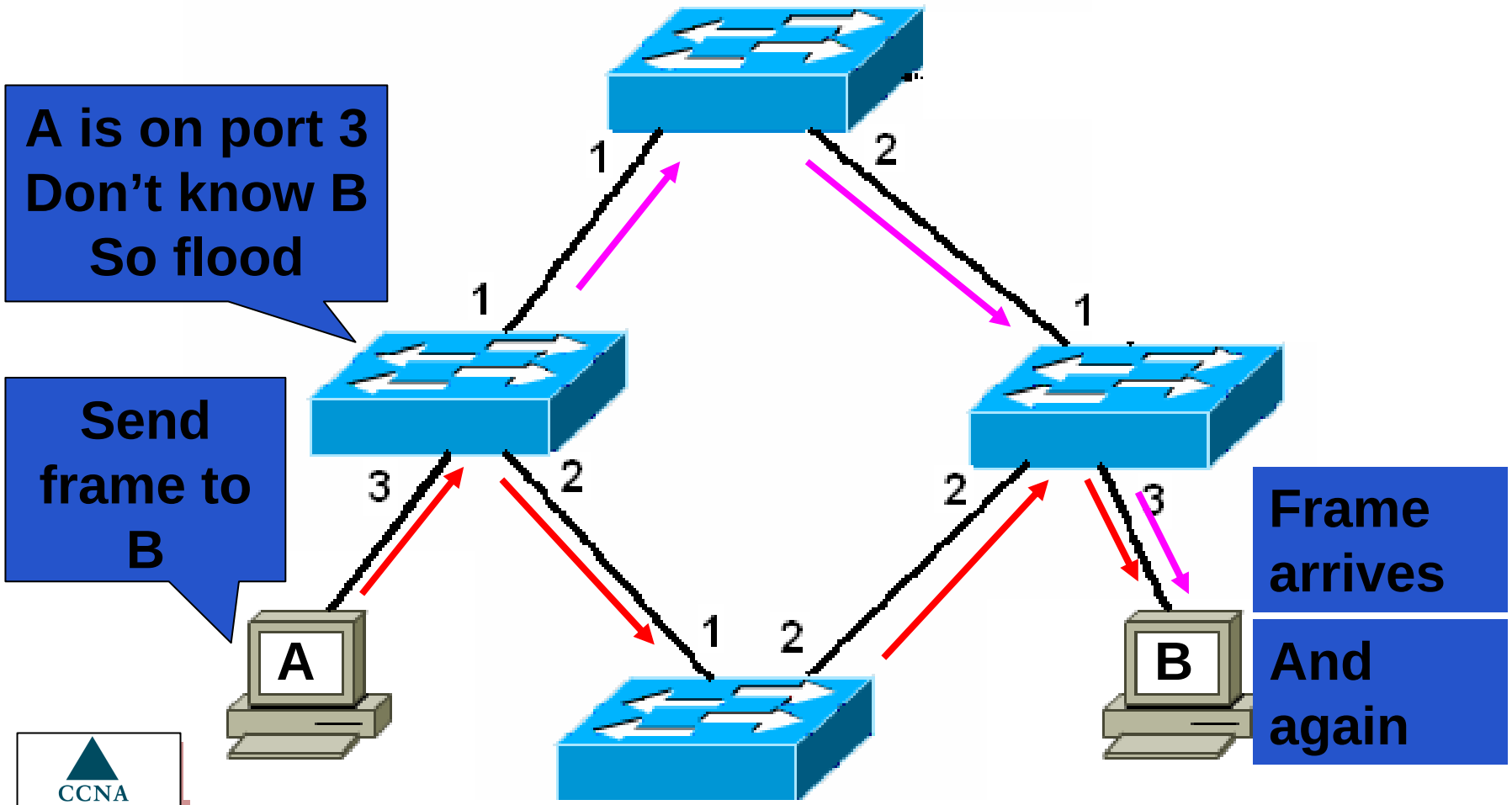
Flood broadcast through non-source ports

Send ARP request

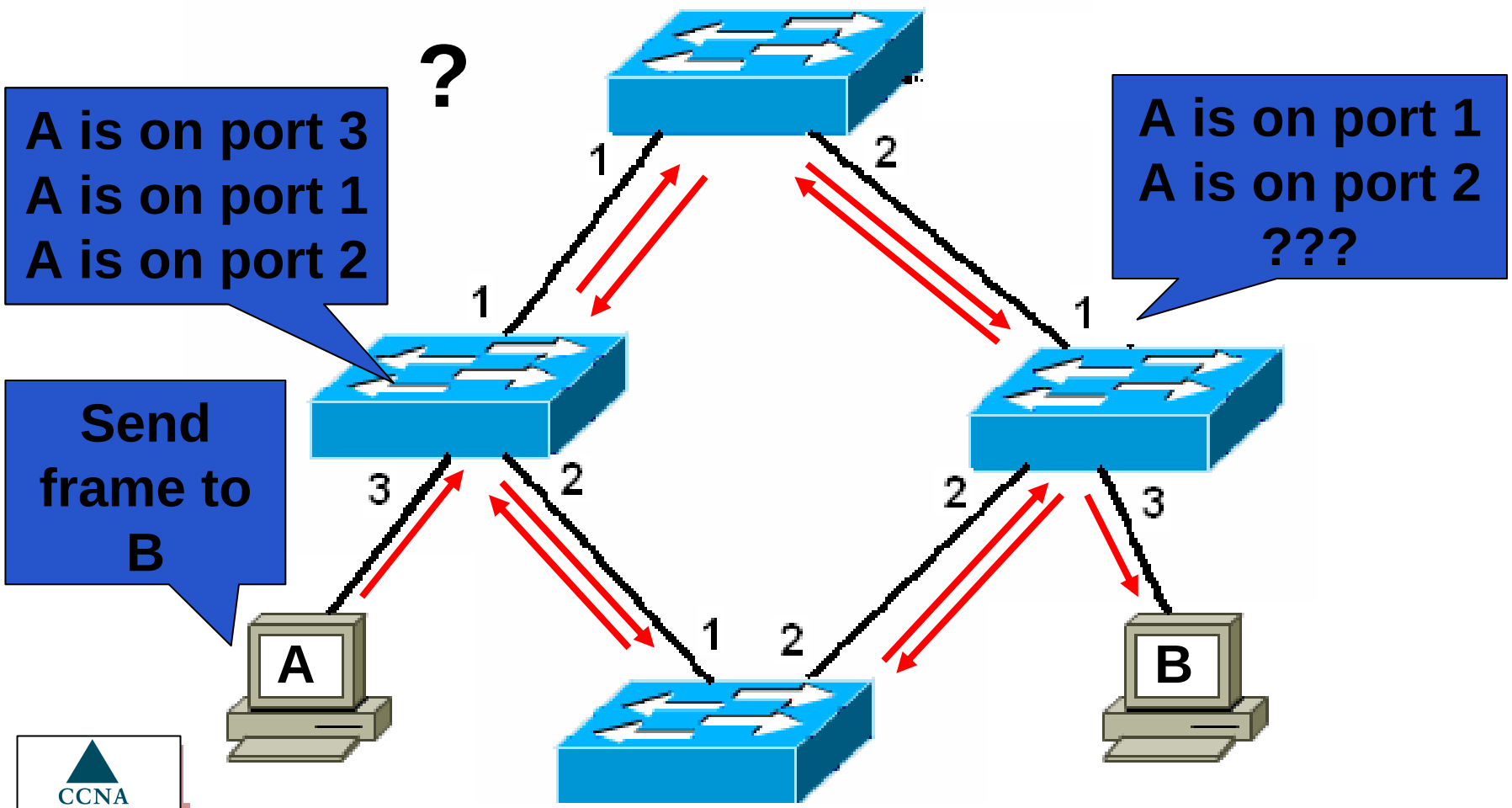


And so on with nothing to stop it

Multiple Frame Transmissions



Inconsistent switch tables



Loops by mistake

- Even if there are no deliberate loops for redundancy, there can be loops set up by mistake.

Redundancy without loops

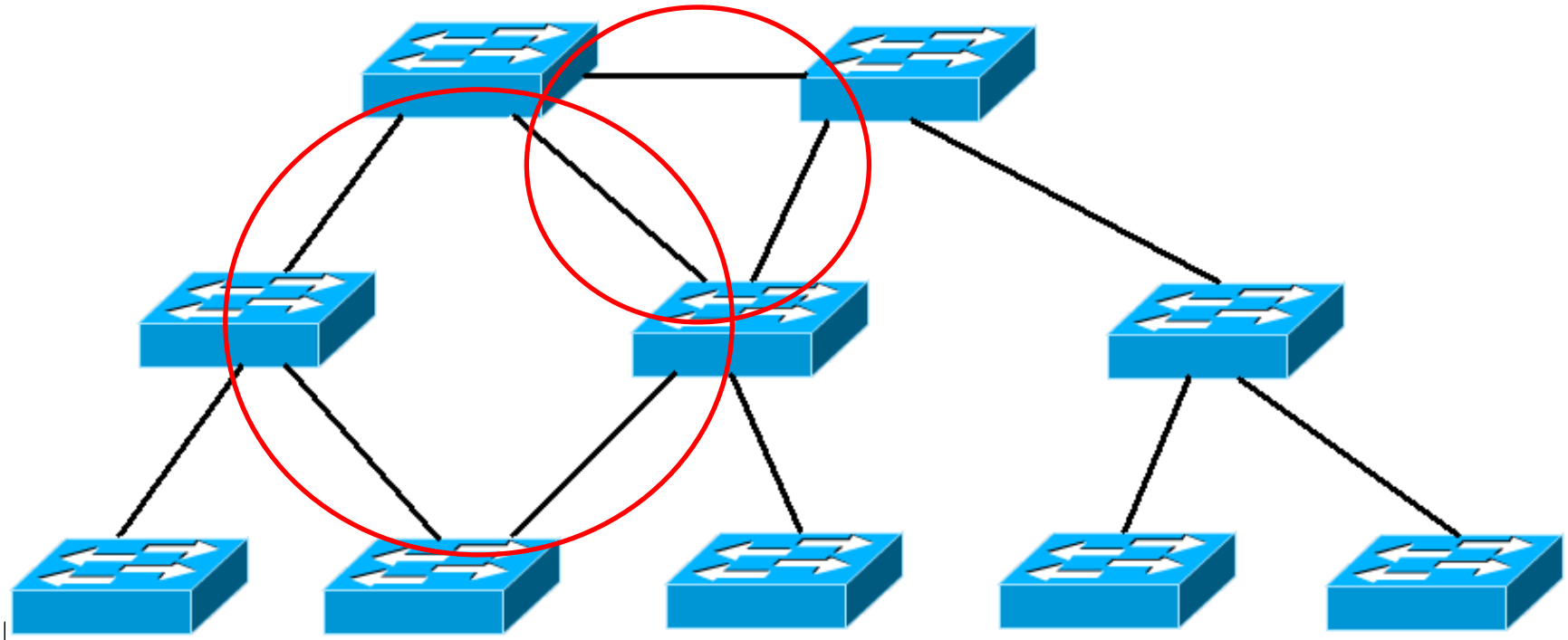
- There needs to be just one path at a time.
- Redundant paths must be shut down, but ready to be opened when they are needed.
- This must be done quickly and automatically.
- **Spanning Tree Protocol** does this.

What is a spanning tree?

- A tree (extended star) topology
  - A tree has no loops
- Spanning all devices
  - All devices are connected

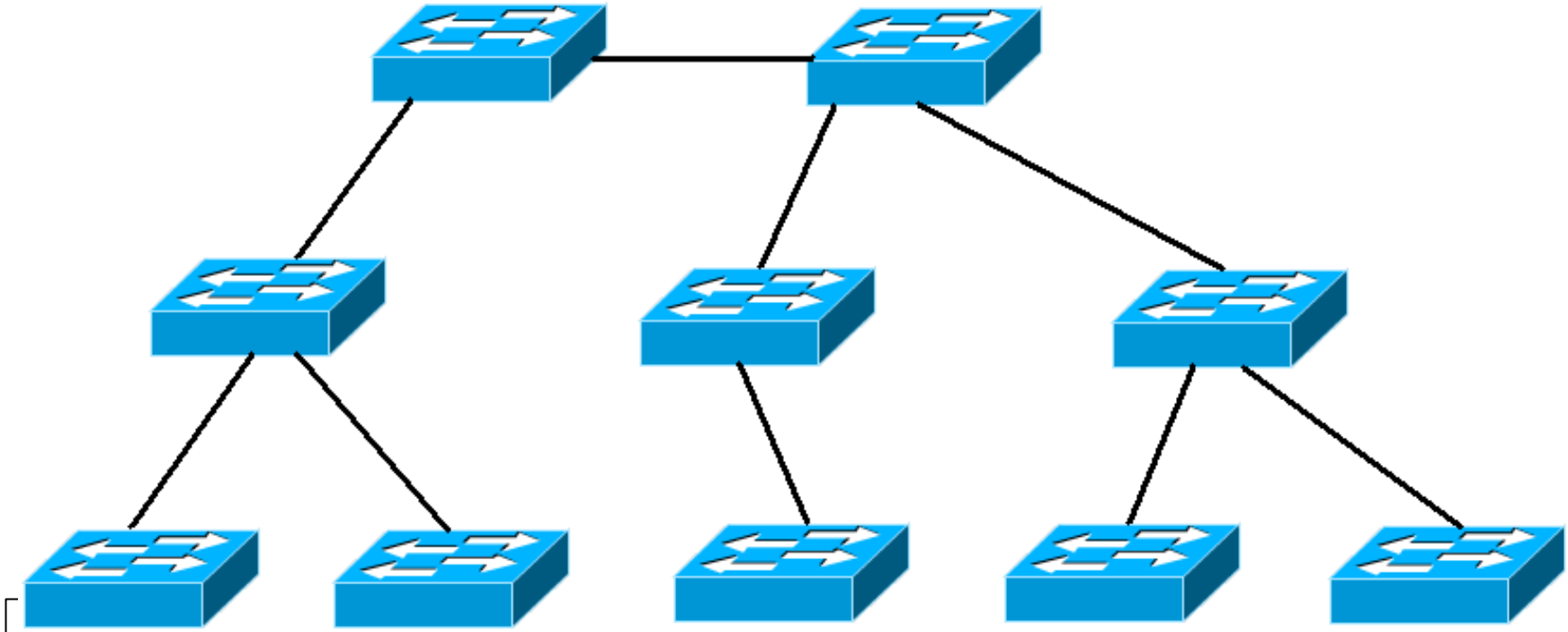
Not a spanning tree

- Not a tree - it has loops.



Spanning tree

- No loops. Includes all devices.

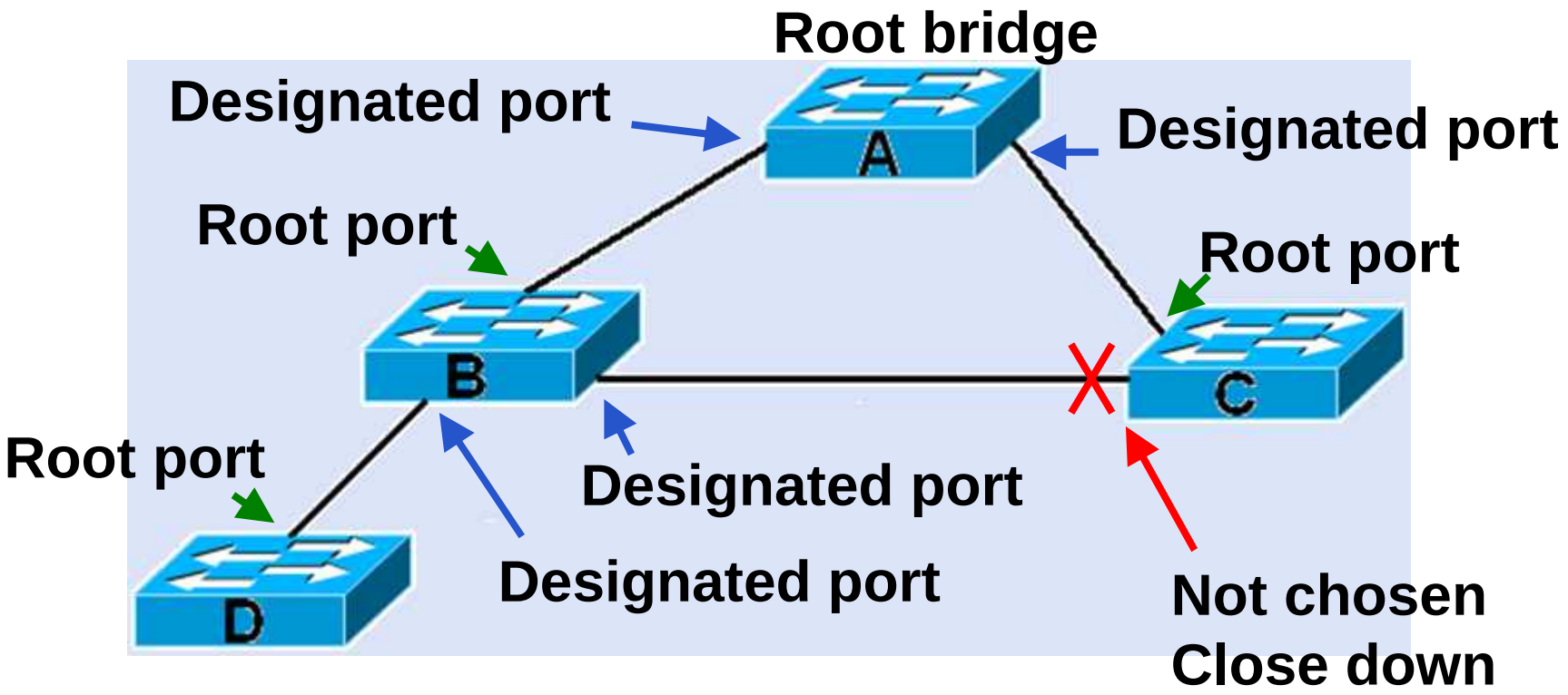


Spanning tree algorithm

The switches use this algorithm to decide which ports should be shut down.

1. Choose one switch to be “root bridge”
2. Choose a “root port” on each other switch
3. Choose a “designated port” on each segment.
4. Close down all other ports.

Outline of process



1 Choose the root bridge

- Each switch has a bridge ID (BID) of priority value followed by MAC address
- Switches exchange Bridge Protocol Data Units (BPDUs) to compare bridge IDs
- The switch with the **lowest** bridge ID becomes the root bridge
- Administrator can set the priority to fix the selection

Bridge ID

- The bridge ID consists of bridge priority, extended system ID, and MAC address
- By default the priority is 32768
- Lowest priority wins
- Value 1 - 65536, multiples of 4096
- Extended system ID identifies VLAN.
- MAC address used if priority is the same. Better not to rely on MAC address.

Configure priority

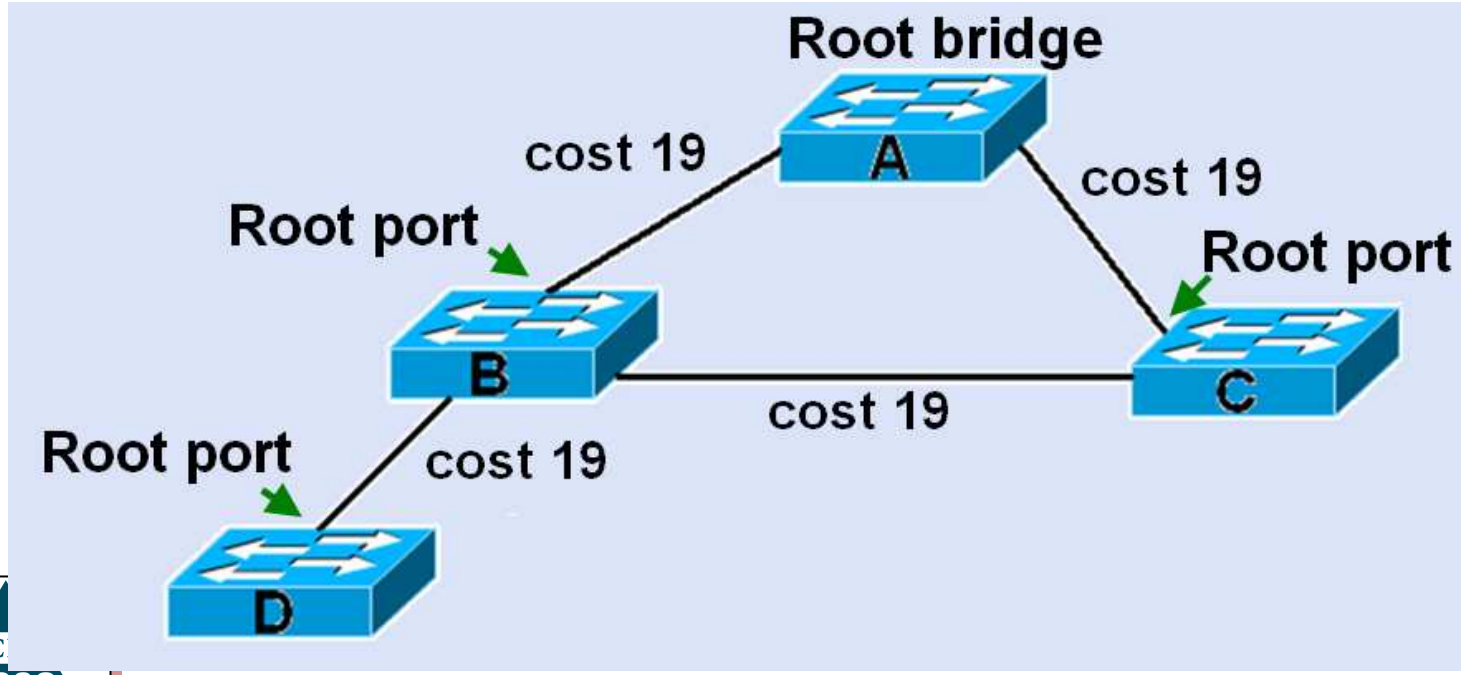
- Set priority directly
- SW1#**spanning-tree vlan 1 priority 24576**
- Or indirectly
- SW1#**spanning-tree vlan 1 root primary**
- Sets value to 24576 or 4096 less than lowest priority detected.
- SW1#**spanning-tree vlan 1 root secondary**
- Sets value to 28672. This switch should become the root bridge if the primary root bridge fails.

1 Choose the root bridge

- A switch starts up. It sends out BPDU frames containing the switch BID and the root ID every 2 seconds.
- At first each switch identifies itself as the root bridge.
- If a switch receives a BPDU with a lower BID then it identifies the switch with that BID as root bridge. It passes on this information in its own BPDUs.
- Eventually all switches agree that the switch with the lowest BID is the root bridge.

Select root ports

- Every non-root bridge (Switch) selects a root port
- This is the port with the lowest cost path to the root bridge



Finding the cost of a link

- Default port costs depend on the speed of the link. Set by IEEE.
- Costs may change as faster Ethernet is developed.

Link speed	Revised cost	Previous cost
10 Gbps	2	1
1 Gbps	4	1
100 Mbps	19	10
10 Mbps	100	100

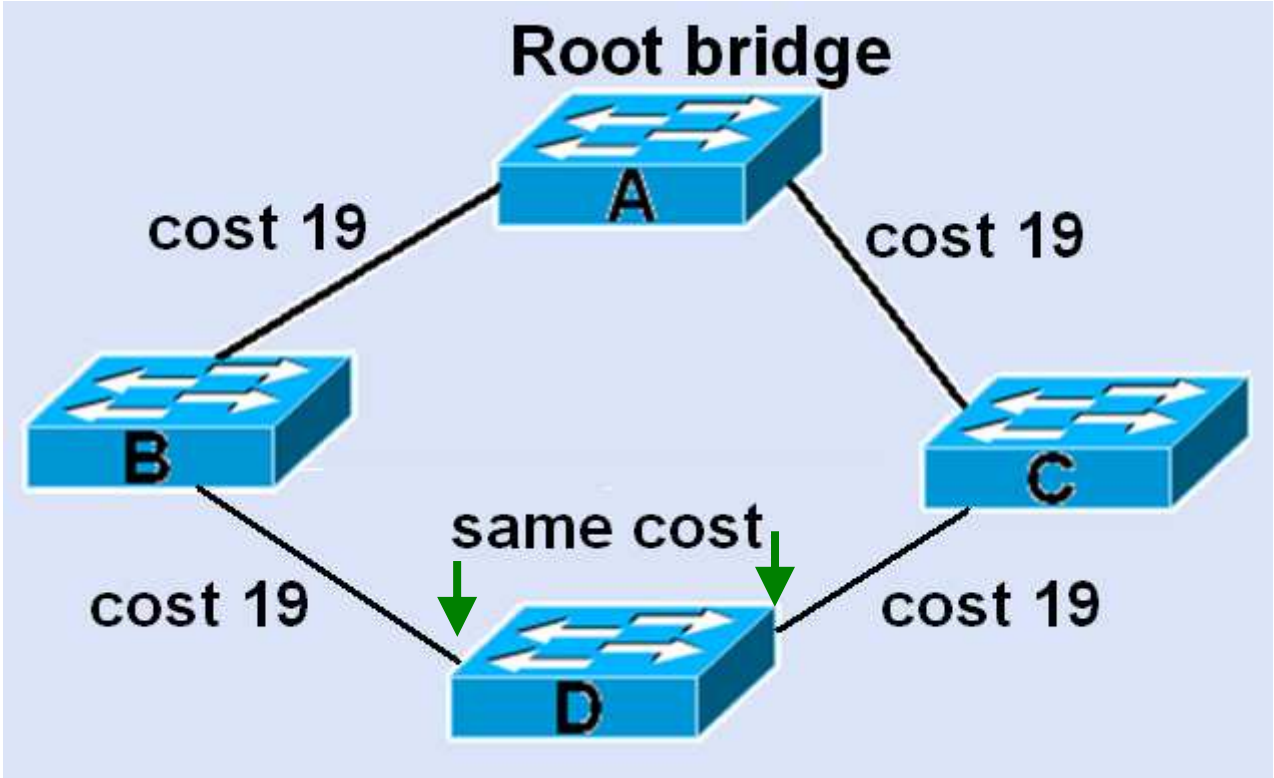
Changing the cost of a link

- SW1(config)#**int fa0/1**
- SW1(config-if)#**spanning-tree cost 25**
- SW1(config-if)#**end**

- SW1(config)#**int fa0/1**
- SW1(config-if)#**no spanning-tree cost**
- SW1(config-if)#**end**

What if ports have the same cost?

- Use the port priority and port number.
- By default F0/1 has 128.1 F0/2 has 128.2



Configure port priority

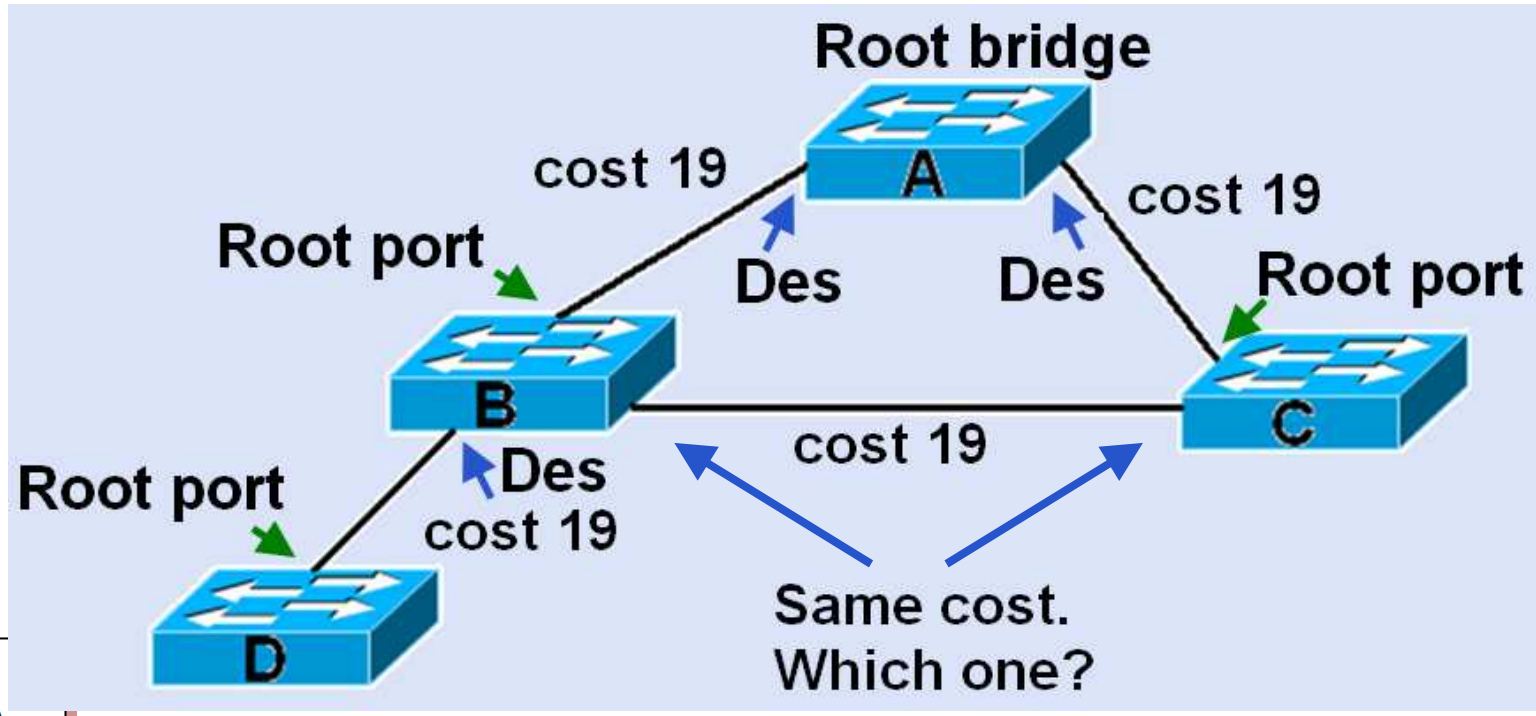
- SW2(config-if)#spanning-tree port-priority 112
- Priority values range from 0 - 240, in increments of 16.
- The default port priority value is 128.
- Lower port priority value wins.
- Losing port is shut down.

Passing cost information

- Each BPDU includes the cost of the path back to the root bridge.
- The cost is the total cost of all the links.
- As a switch receives a BPDU, it updates the cost by adding on the cost of the port through which the BPDU was received.

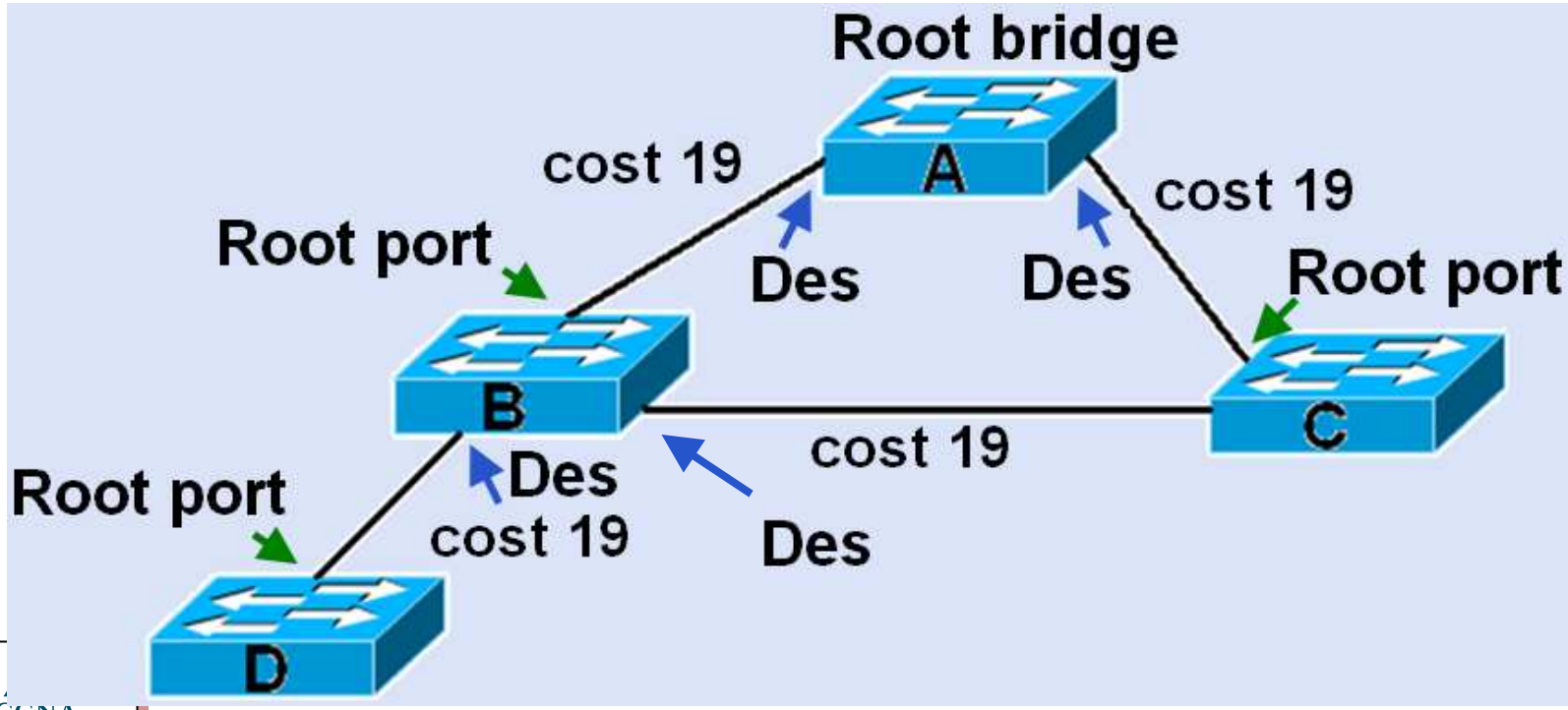
Select designated ports

- On every **segment**, the port with the lowest cost path to the root bridge becomes the designated port



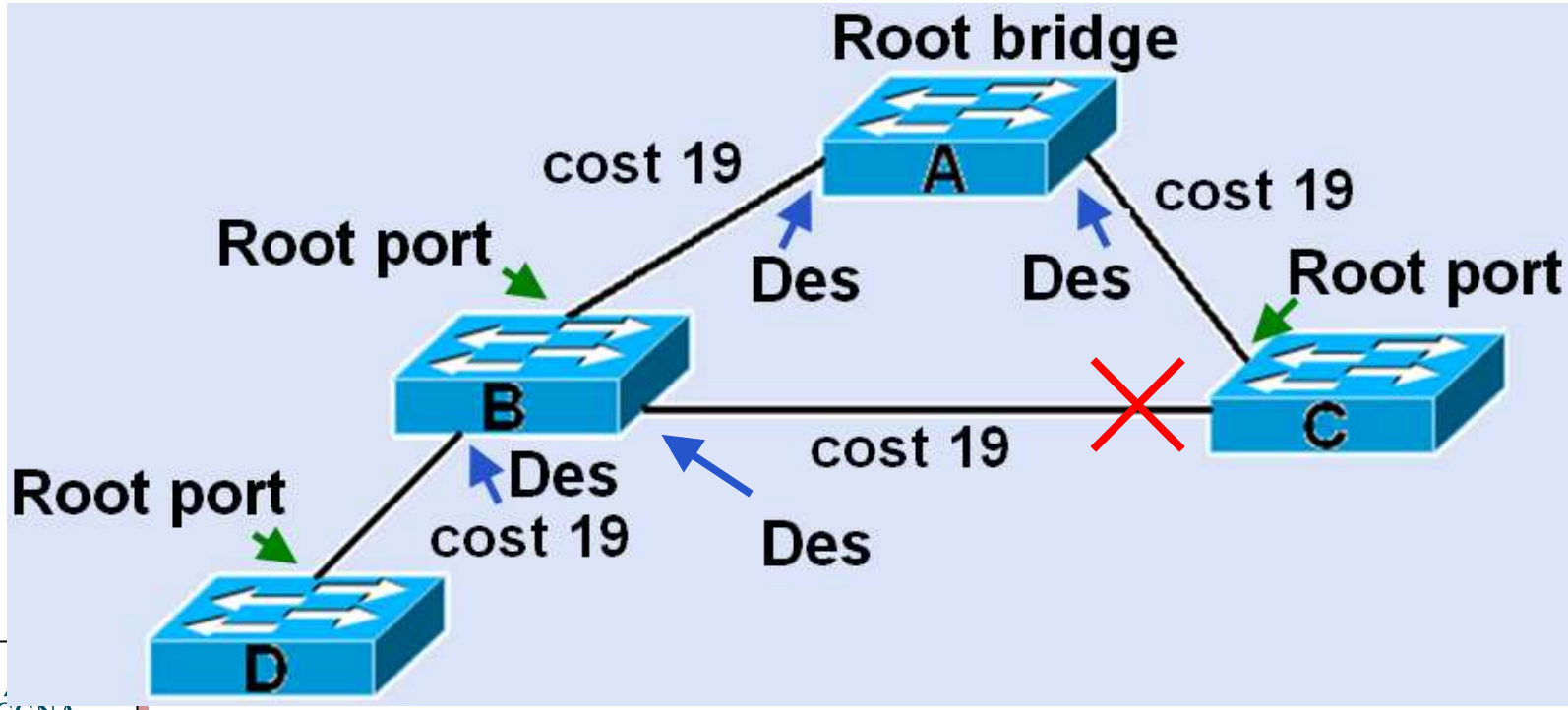
Designated port if same cost

- Choose the port on the switch with the lower bridge ID. Suppose this is switch B.



Close down redundant links

- Any port that is not a root port or a designated port is put in blocking state



BPDU

- The BPDU message is encapsulated in an Ethernet frame.
- The destination MAC address is 01:80:C2:00:00:00, which is a multicast address for the spanning-tree group.

Port roles

- STP makes ports:
- Root ports (forwarding)
- Designated ports (forwarding)
- Non-designated ports (blocked)

Port states in traditional STP

- Blocking – receives and transmits BPDU frames.
- Listening - receives and transmits BPDU frames.
- Learning - receives and transmits BPDU frames. Learns MAC addresses.
- Forwarding – Fully active, forwards user data.
- Disabled – Administratively shut down.