CSET 150

NETWORK DESIGN AND MANAGEMENT

EVENING MASTERS EDITION

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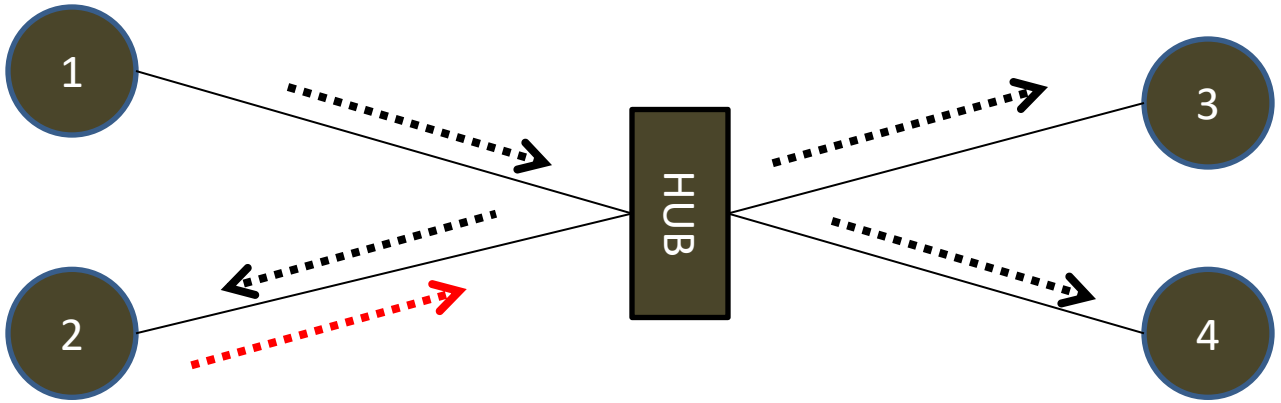
Week # 2

CHAPTER 2: SWITCHING DESIGN

- Old Days – LAN –
  - small geographical area
  - Small number of devices
  - HUB – layer1 of OSI model was good enough
  - All devices were in same collision domain

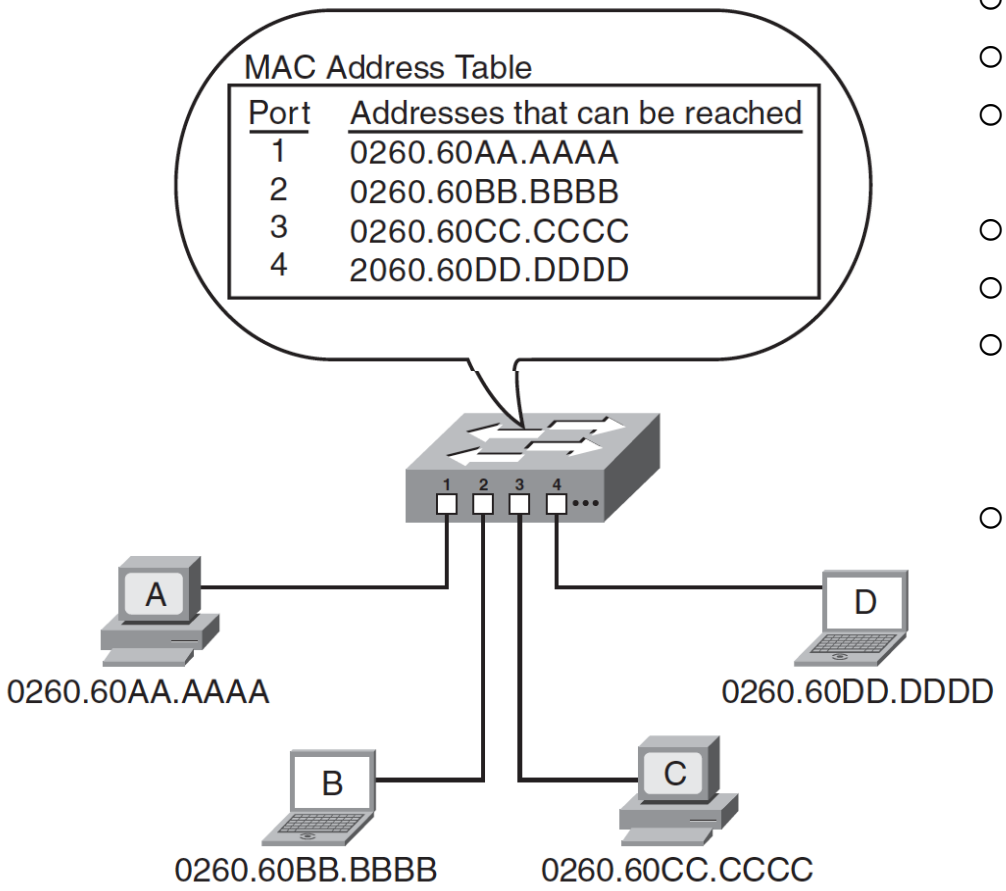


CHAPTER 2: SWITCHING DESIGN

- Layer2 switching
  - Multiple collision domain
  - The heart – MAC Address Table - CAM (Content Addressable memory)
  - MAC – Media Access Control
  - 48 bit address given by manufacturer of network devices.

- Learning Process
- Filtering Process

Source IP	Destination IP	Other Info.
Source MAC	Destination Mac	Other Info.



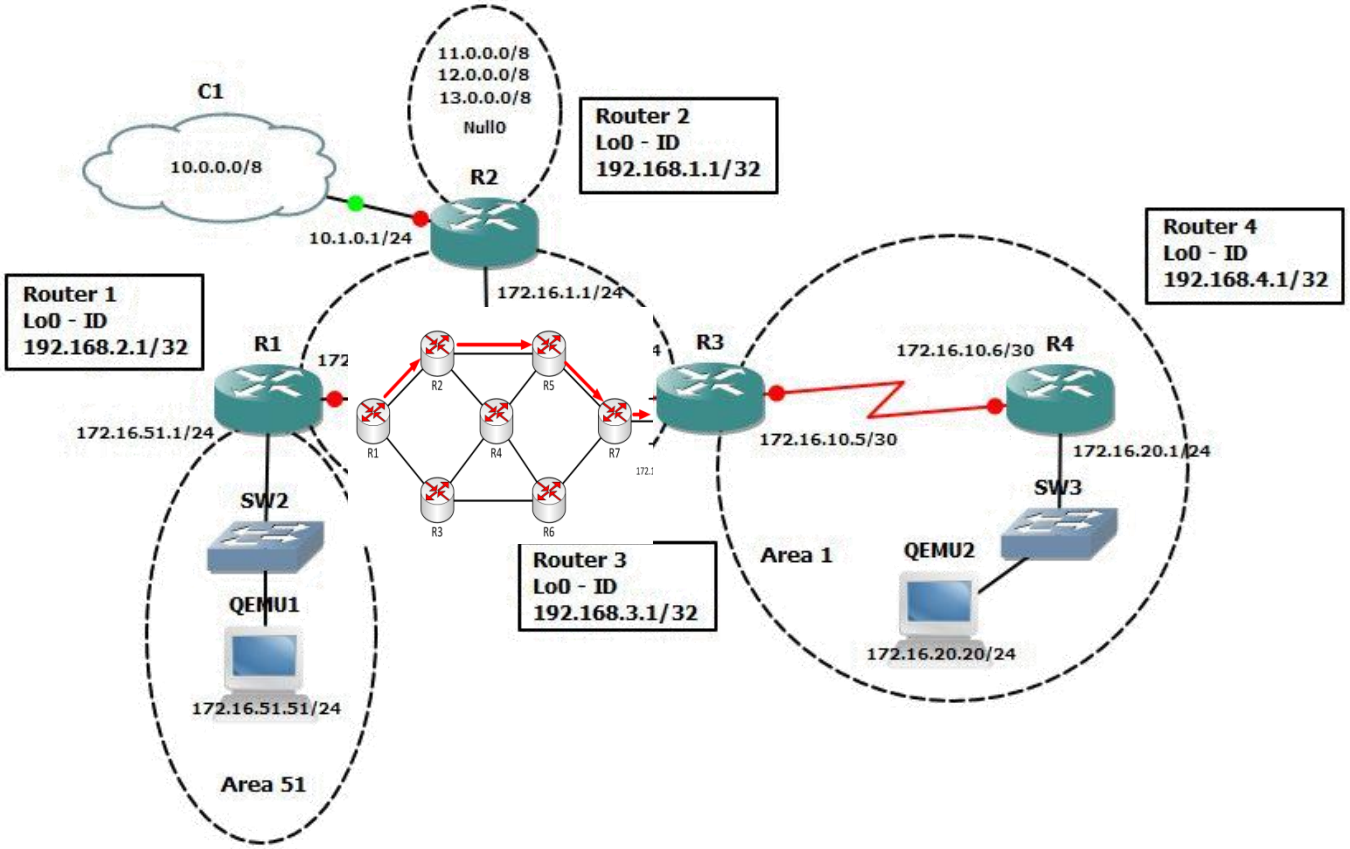
- A wants to Send D
- A creates a frame for D
- Layer 2 – Source and destination MAC Address
- Sends the frame
- Frame received @ port1
- 1st time switch's MAC table empty – it forwards to all ports.
- Only D response – Hence the switch learn about MAC of port 4

SWITCHING DESIGN

- The MAC address table is kept in the switch's memory and has a finite size
- The Cisco Catalyst 2950 switch defaults to a 300-second timeout.

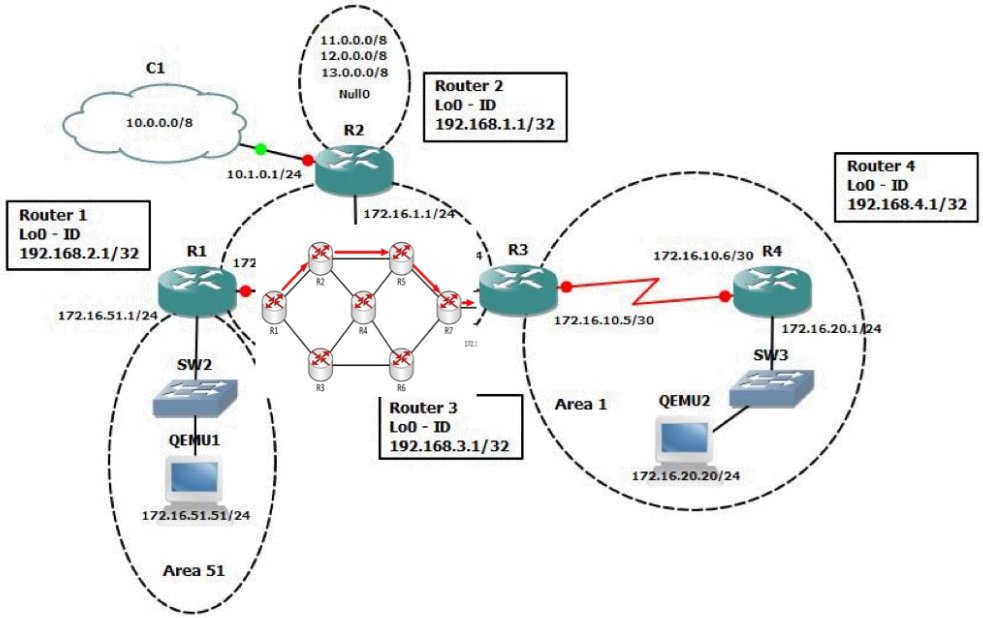
SWITCHING DESIGN

- Layer 3 Switching:
  - … is really a **router** with some of the functions implemented in **hardware** to improve performance.
  - In other words, some of the OSI model network layer routing functions are performed in high-performance ASICs rather than in software.

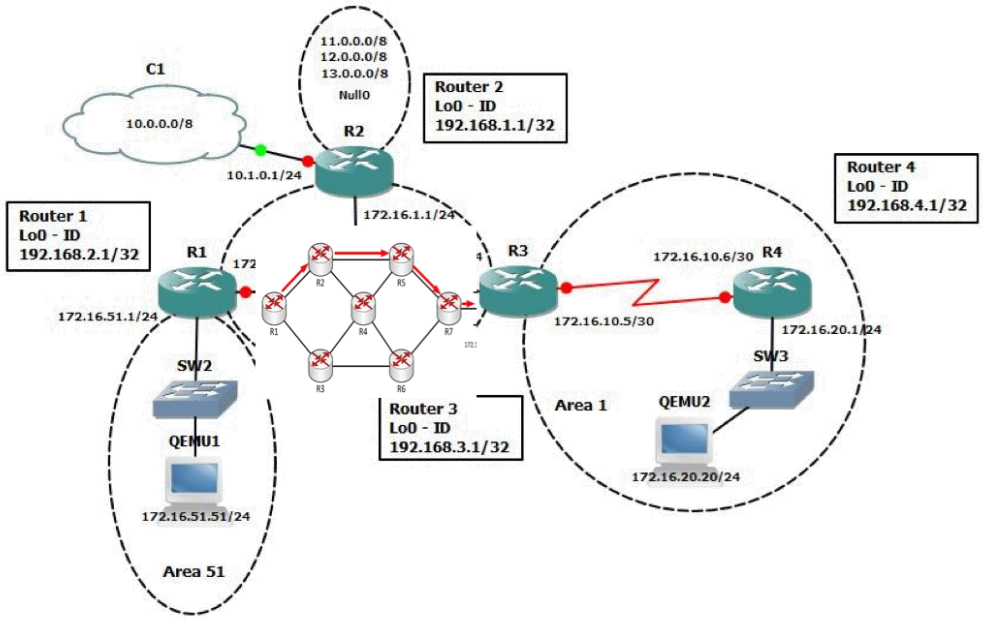

C1
10.0.0.0/8
11.0.0.0/8
12.0.0.0/8
13.0.0.0/8
Null0
R2
Router 2
Lo0 - ID
192.168.1.1/32
10.1.0.1/24
172.16.1.1/24
Router 1
Lo0 - ID
192.168.2.1/32
R1
172.16.51.1/24
R3
Router 4
Lo0 - ID
192.168.4.1/32
172.16.10.6/30
R4
172.16.10.5/30
172.16.20.1/24
SW3
SW2
QEMU1
172.16.51.51/24
Area 51
Router 3
Lo0 - ID
192.168.3.1/32
Area 1
QEMU2
172.16.20.20/24

- Learning routes and keeping the best path to each destination in a routing table.

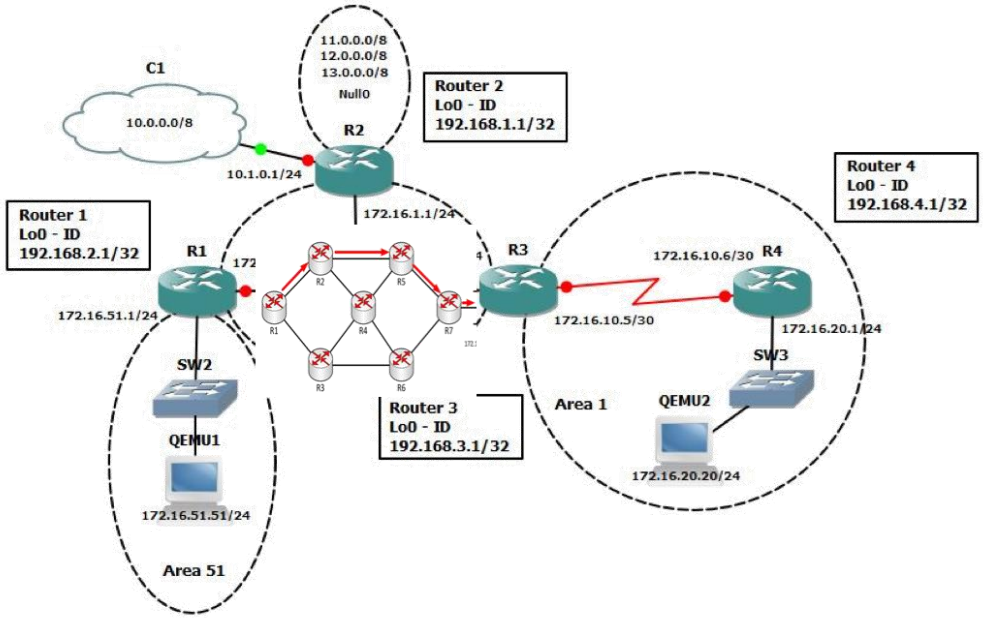
- Determining the best path that each packet should take to get to its destination, by comparing the destination address to the routing table.



- Sending the packet out of the appropriate interface, along the best path. This is also called switching the packet, because the packet is encapsulated in a new frame, with the appropriate framing header information, including MAC addresses.



- Communicating with other routers to exchange routing information.
- Allowing devices on different LANs to communicate with each other and with distant devices.
- Blocking broadcasts.



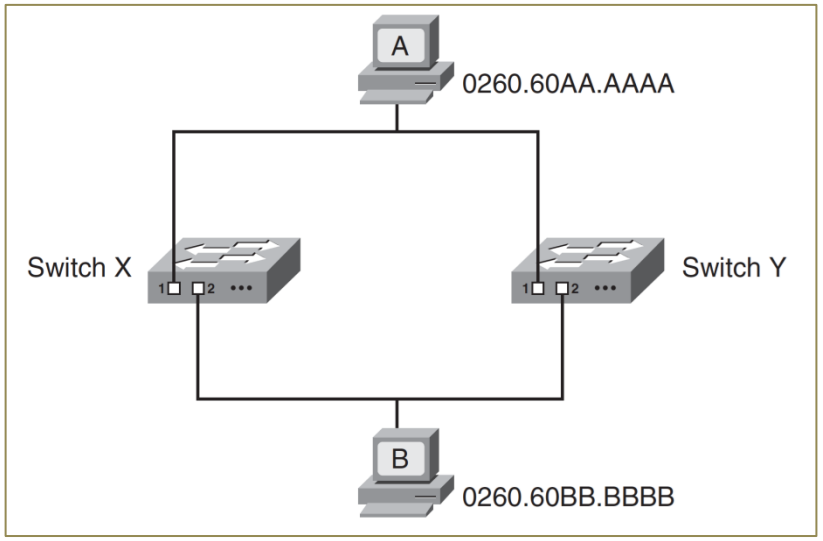
SWITCHING DESIGN

These tasks can be CPU intensive. Offloading the switching of the packet to hardware can result in a significant increase in performance.

A Layer 3 switch performs all the previously mentioned router functions; the differences are in the physical implementation of the device rather than in the functions it performs. Thus, functionally, the terms *router* and *Layer 3 switch* are synonymous.

Spanning Tree Protocol (STP)

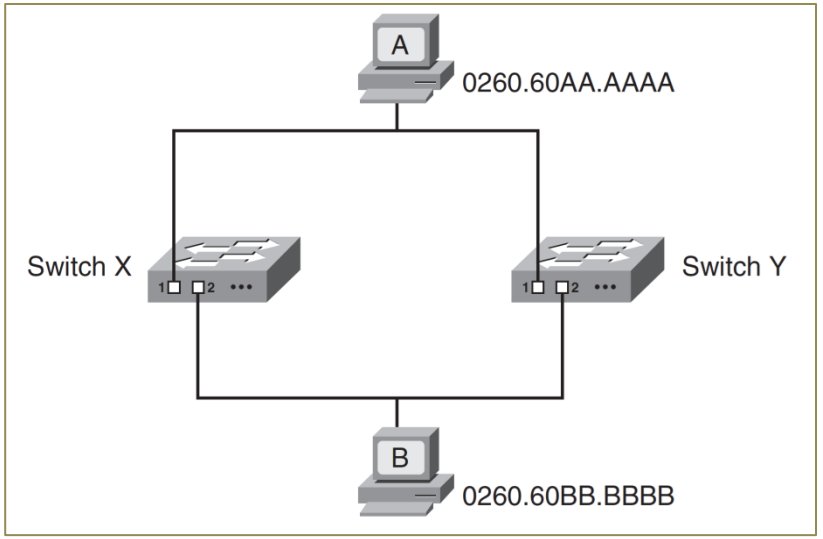
– STP is a Layer 2 protocol that prevents logical loops in switched networks that have redundant links



- **Redundancy in a network**
  - .. so that communication can still take place if a link or device fails.
  - However, in a switched network, redundancy can cause problems.

Spanning Tree Protocol (STP)

- Problems:
  - The first type of problem occurs if a broadcast frame is sent on the network.

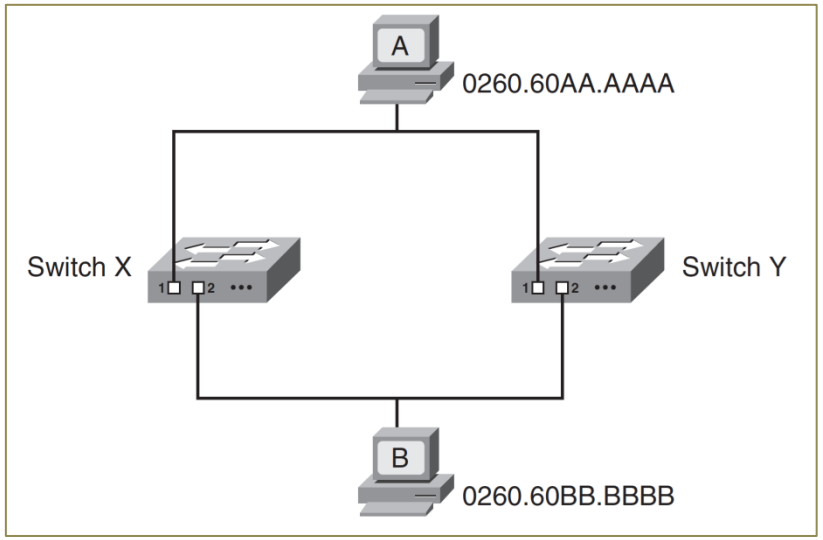


  - ARP: Address Resolution Protocol

The broadcast continues to loop around the network, consuming bandwidth and processing power.
This situation is called **a broadcast storm.**

Spanning Tree Protocol (STP)

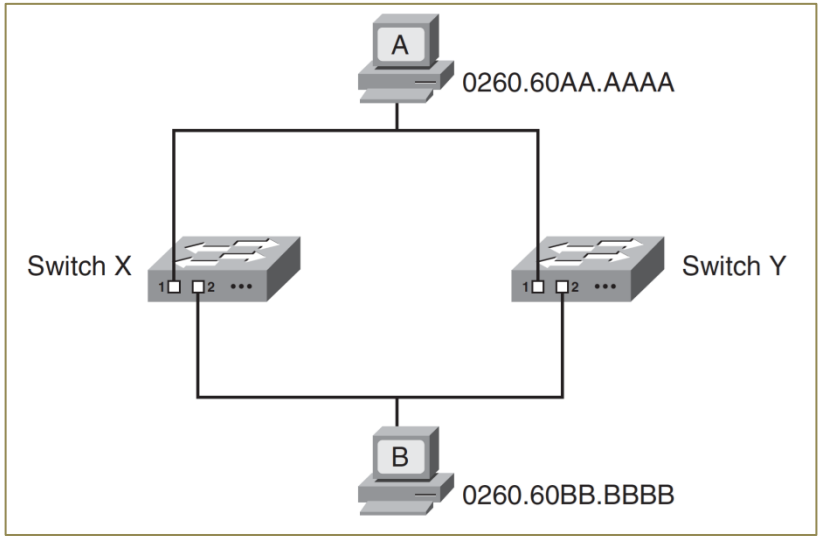
– The second problem that can occur in redundant topologies is that **devices can receive multiple copies of the same frame.**



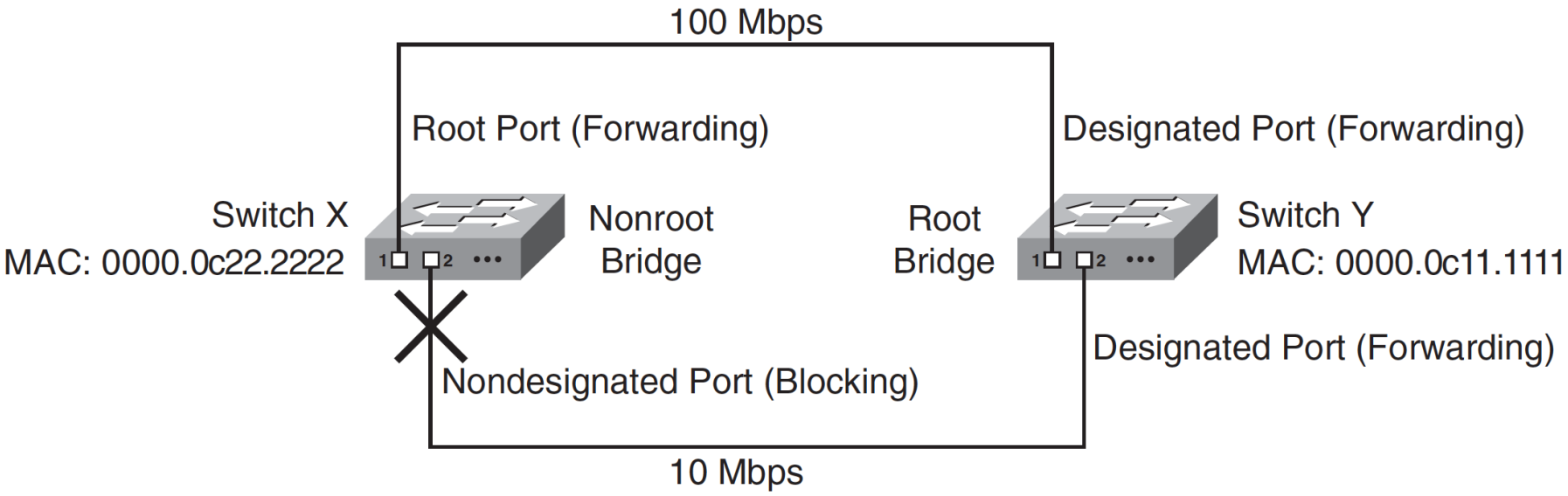
This might be a problem for device B, depending on what it is and how it is programmed to handle such a situation

Spanning Tree Protocol (STP)

– The third difficulty that can occur in a redundant situation is within the switch itself the MAC address table can change rapidly and contain wrong information.



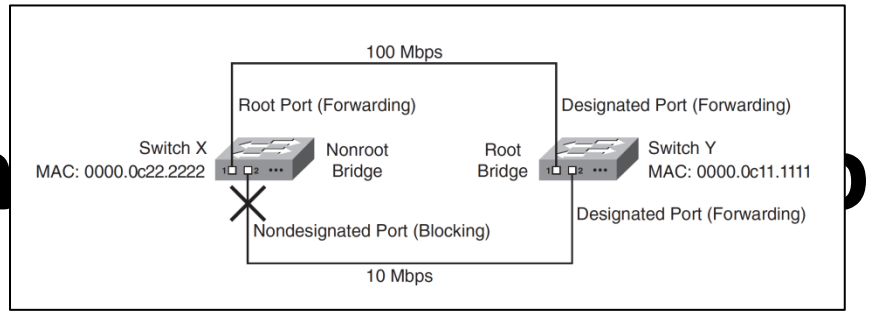
Spanning Tree Protocol (STP)



Spanning Tree Protocol (STP)

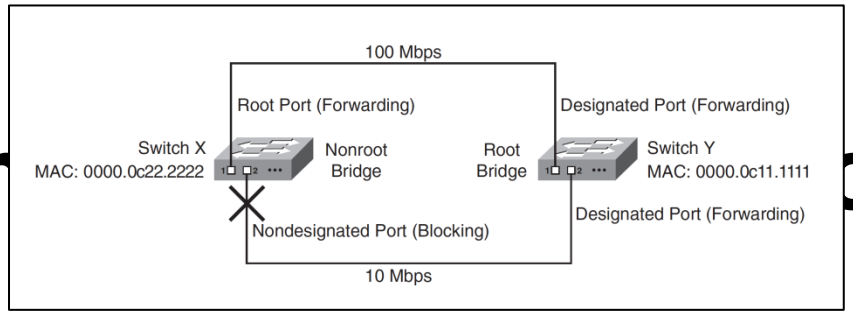
- One switch is elected as the **root bridge** it is at the root of the spanning tree.
- All other switches calculate their **best path** to the **root bridge**.
  - Their alternate paths are put in the **blocking** state.
  - These alternate paths are logically disabled from the perspective of regular traffic, but the switches still communicate with each other on these paths so that the alternate paths can be unblocked in case an error occurs on the best path.

Span ol (STP)



- All switches running **STP** send out bridge protocol data units **(BPDUs)**
- Switches running STP use **BPDUs** to exchange information with neighboring switches.
- One of the fields in the BPDU is the bridge identifier (ID);
  - it is comprised of a 2-octet bridge priority and a 6-octet **MAC** address.
- STP uses the bridge ID to elect the root bridge the switch with the lowest bridge ID is the root bridge.
  - If all bridge priorities are left at their default values, the switch with the lowest MAC address therefore becomes the root bridge.
  - switch Y is elected as the root bridge.

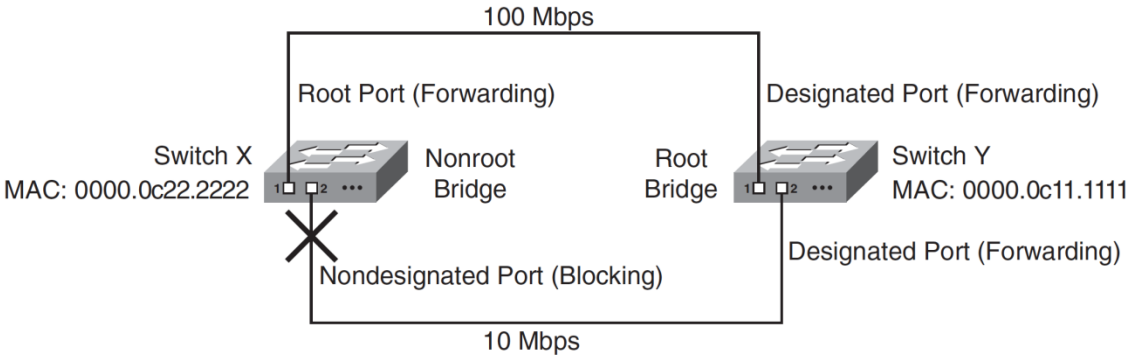
Spar ol (STP)



- All the ports on the **root bridge** are called **designated** ports,
- They are all in the **forwarding state** → can **send** and **receive** data.
- On all **non-root** bridges
  - One port becomes the root port, and it is also in the **forwarding state**.
  - The root port is the one with the **lowest cost to** the root.
  - The **cost of each** link is by default **inversely proportional** to the bandwidth of the link, so the port with the **fastest total** path from the switch to the root bridge is selected as the root port on that switch.
  - Port 1 on switch X is the root port for that switch because it is the fastest way to the root bridge.

Spanning Tree Protocol (STP)

- All ports on a LAN segment that are **not root ports** or **designated ports** are called **nondesignated** ports and transition to the **blocking state**
  - they do not send data, so the redundant topology is logically disabled, port 2 on switch X is the **nondesignated** port, and it is in the blocking state.
  - Blocking ports do, however, listen for **BPDUs**.



Spanning Tree Protocol (STP)

- If a failure happens
  - if a designated port or a root bridge fails
    - the switches send topology change BPDUs and recalculate the spanning tree.
    - The new spanning tree does not include the failed port or switch, and the ports that were previously blocking might now be in the forwarding state.