# Chapter 17

# Connecting Devices & Virtual LANs



Internet Gateway
192.168.10.1 /24

NETGEAR
Managed Switch

VLAN 10
192.168.10.0 /24

VLAN 20
192.168.20.0 /24

VLAN 30
192.168.30.0 /24
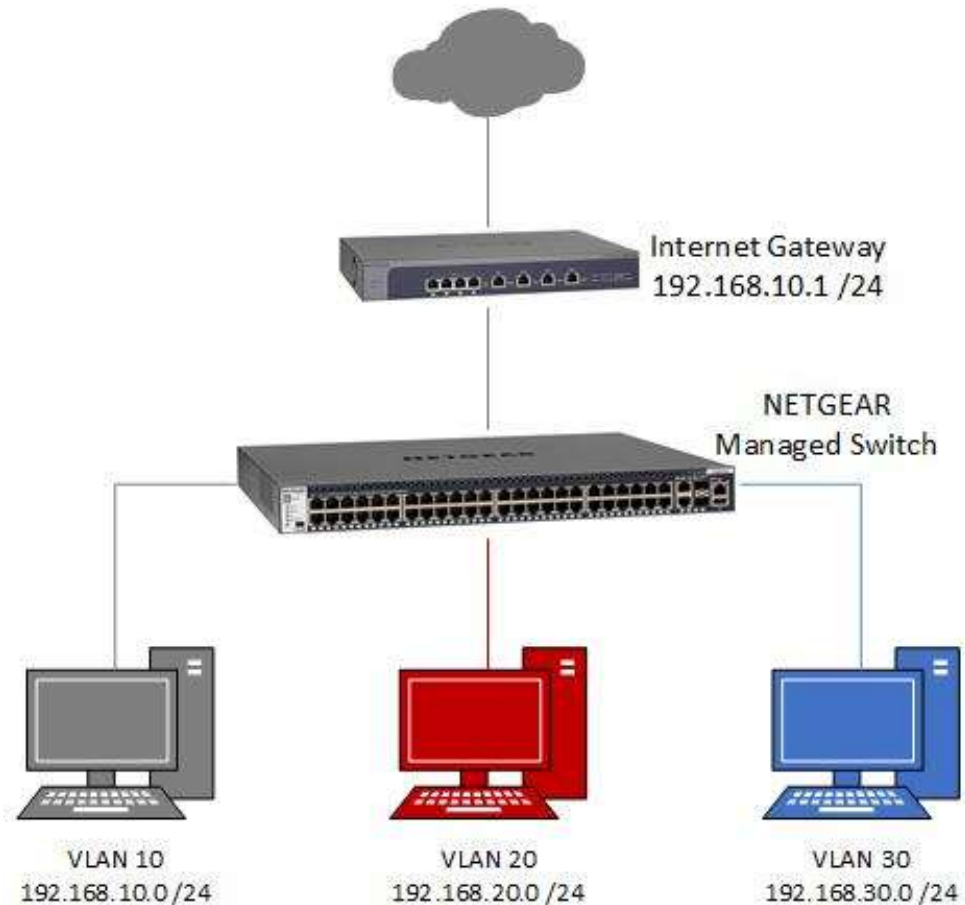
# Objective

- Hubs and switches.

- Virtual LANs.

- How switches can communicate in a VLAN.

- Advantages of a VLAN.
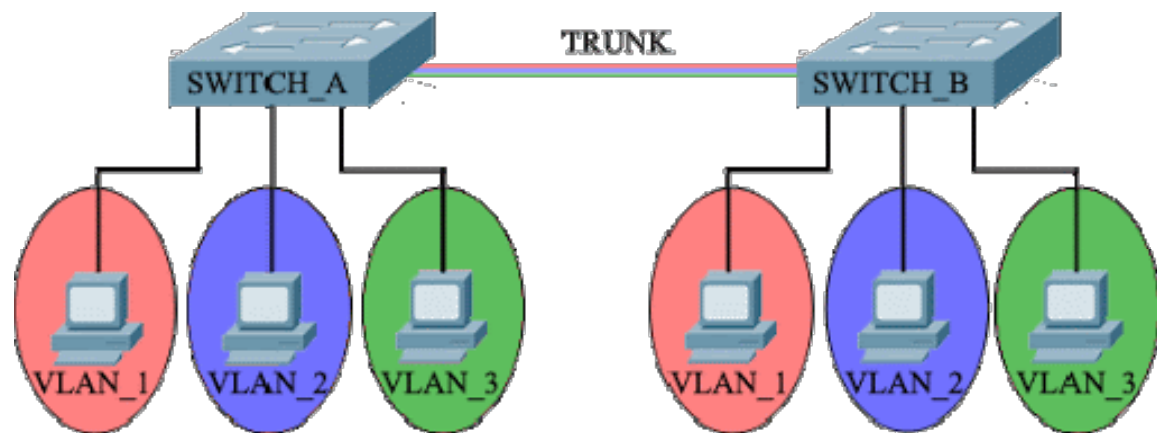
# Connecting Devices

- Hosts and networks do not normally operate in isolation. We use connecting devices to connect hosts together to make a network or to connect networks together to make an internet.

- Connecting devices - hubs, link-layer switches, and routers - can operate in different layers of the Internet model connecting devices.
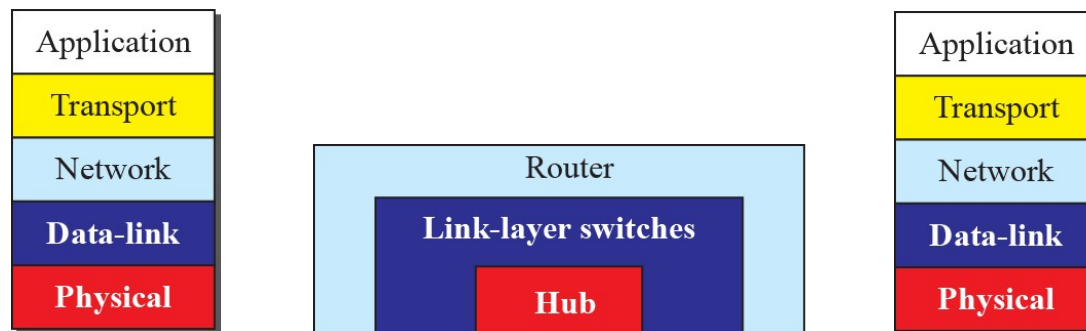


*Three categories of connecting devices*

# Hubs

- A hub is a device that operates only in the physical layer.

- Signals that carry information within a network can travel a fixed distance before attenuation endangers the integrity of the data.

- A repeater receives a signal and, before it becomes too weak or corrupted, regenerates the original bit pattern.
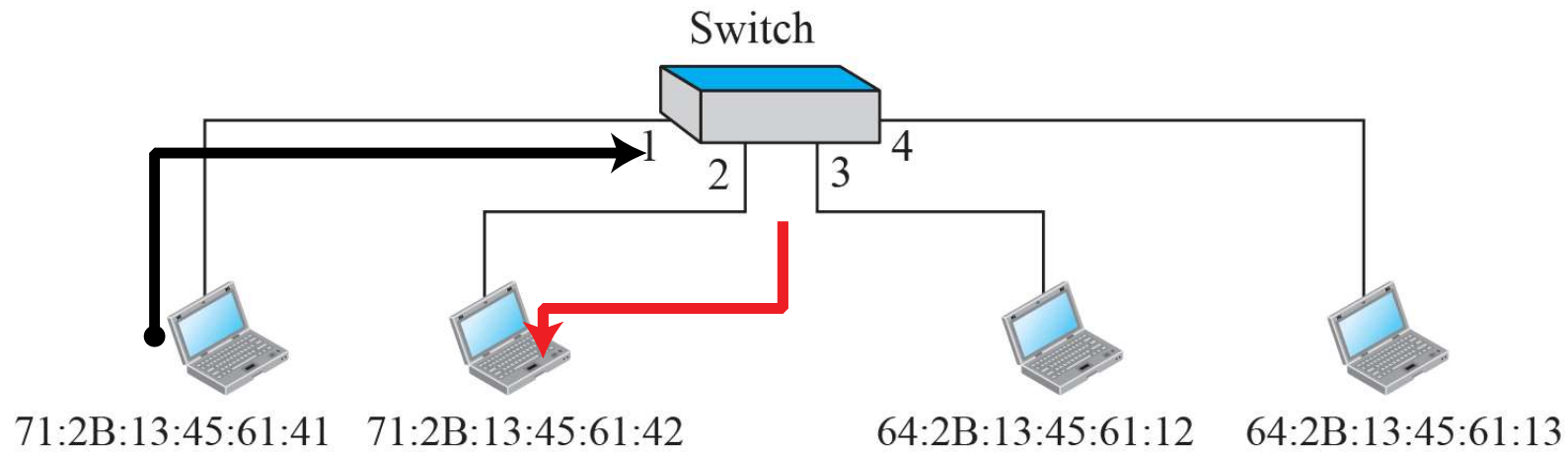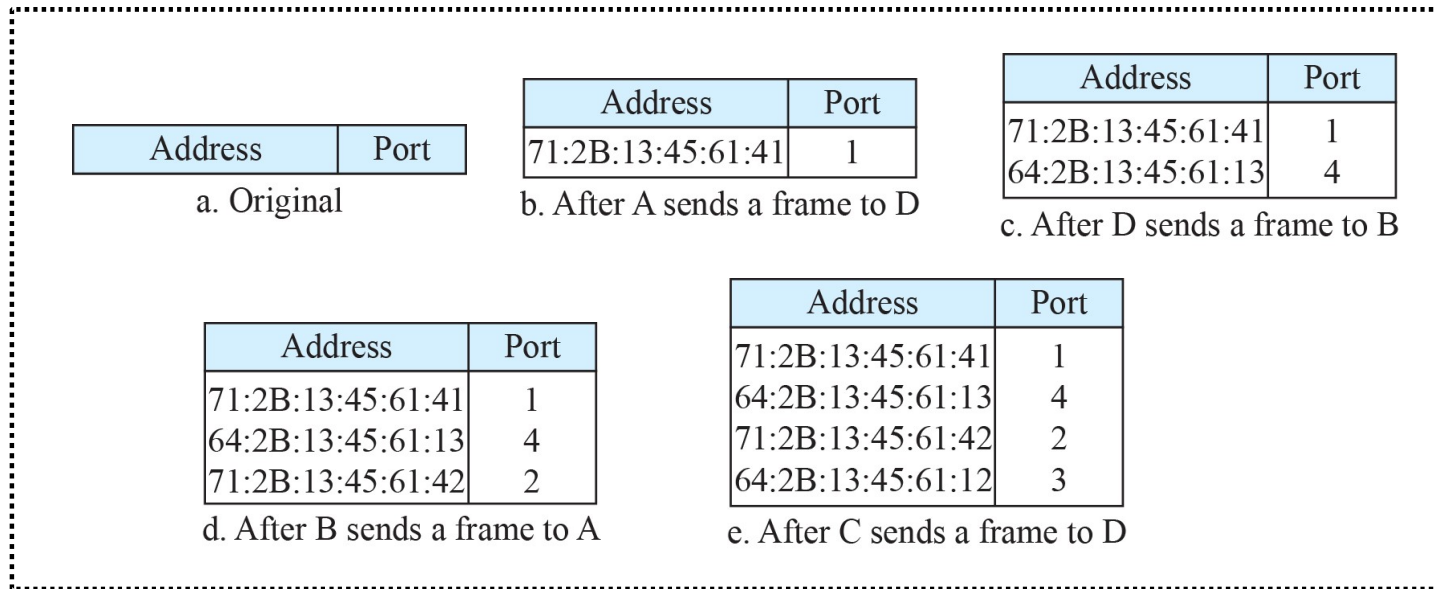
**Hub**
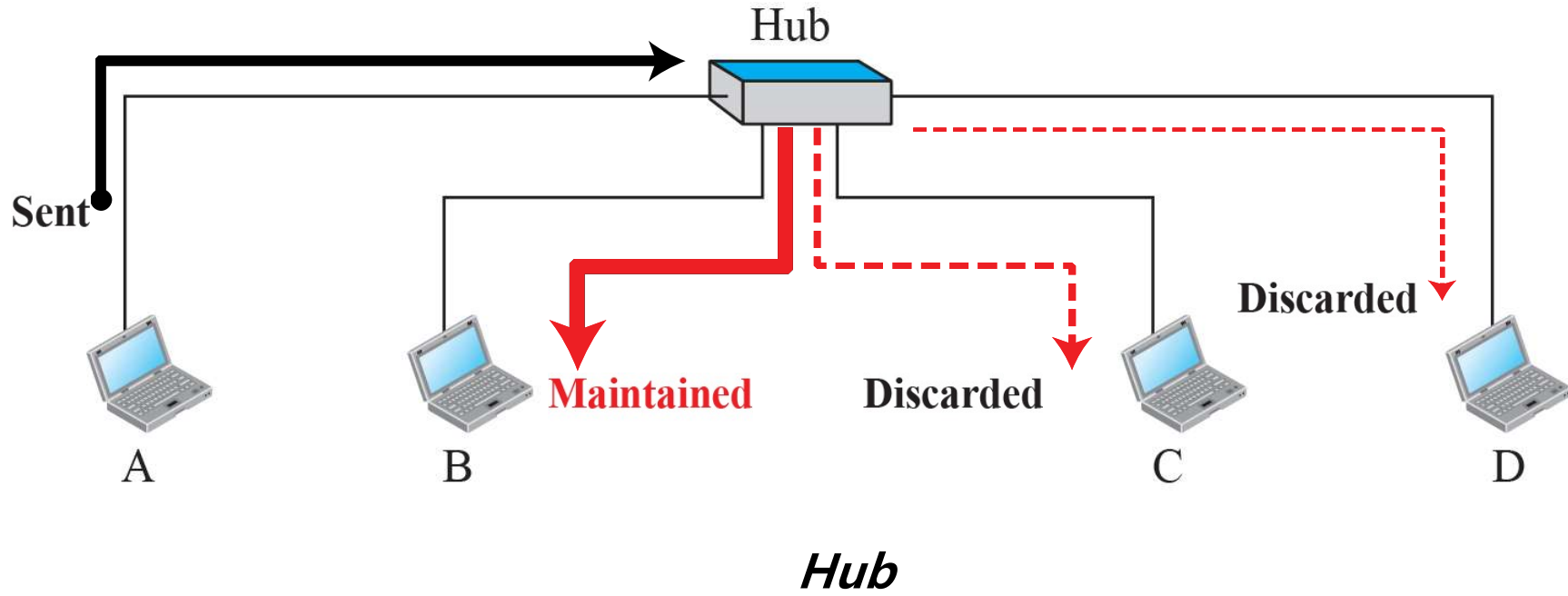
# Link-Layer Switches

- A link-layer switch (or switch) operates in both the physical and the data-link layers.

- As a physical-layer device, it regenerates the signal it receives.

- As a link-layer device, the link-layer switch can check the MAC addresses (source and destination) contained in the frame.

## Switching table

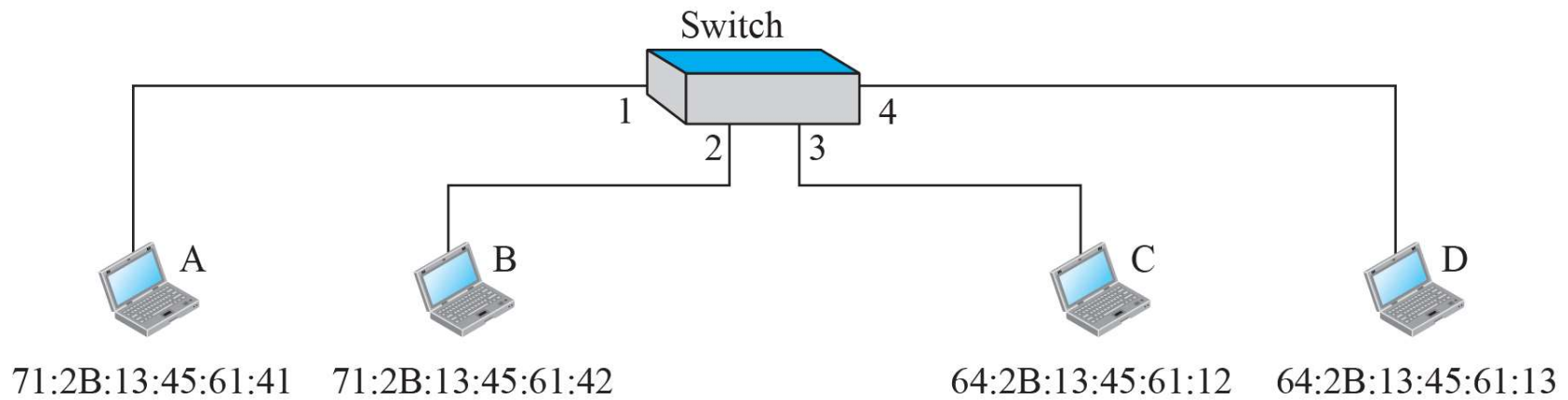| Address | Port |
|---|---|
| 71:2B:13:45:61:41 | 1 |
| 71:2B:13:45:61:42 | 2 |
| 64:2B:13:45:61:12 | 3 |
| 64:2B:13:45:61:13 | 4 |

Switch

1  2  3  4

71:2B:13:45:61:41    71:2B:13:45:61:42           64:2B:13:45:61:12    64:2B:13:45:61:13

## *Link-Layer Switch*

**17.7**

## Gradual building of Table

| Address | Port |
|---------|------|

a. Original

| Address | Port |
|---------|------|
| 71:2B:13:45:61:41 | 1 |

b. After A sends a frame to D

| Address | Port |
|---------|------|
| 71:2B:13:45:61:41 | 1 |
| 64:2B:13:45:61:13 | 4 |

c. After D sends a frame to B

| Address | Port |
|---------|------|
| 71:2B:13:45:61:41 | 1 |
| 64:2B:13:45:61:13 | 4 |
| 71:2B:13:45:61:42 | 2 |

d. After B sends a frame to A

| Address | Port |
|---------|------|
| 71:2B:13:45:61:41 | 1 |
| 64:2B:13:45:61:13 | 4 |
| 71:2B:13:45:61:42 | 2 |
| 64:2B:13:45:61:12 | 3 |

e. After C sends a frame to D

Switch

1    2    3    4

A    B    C    D

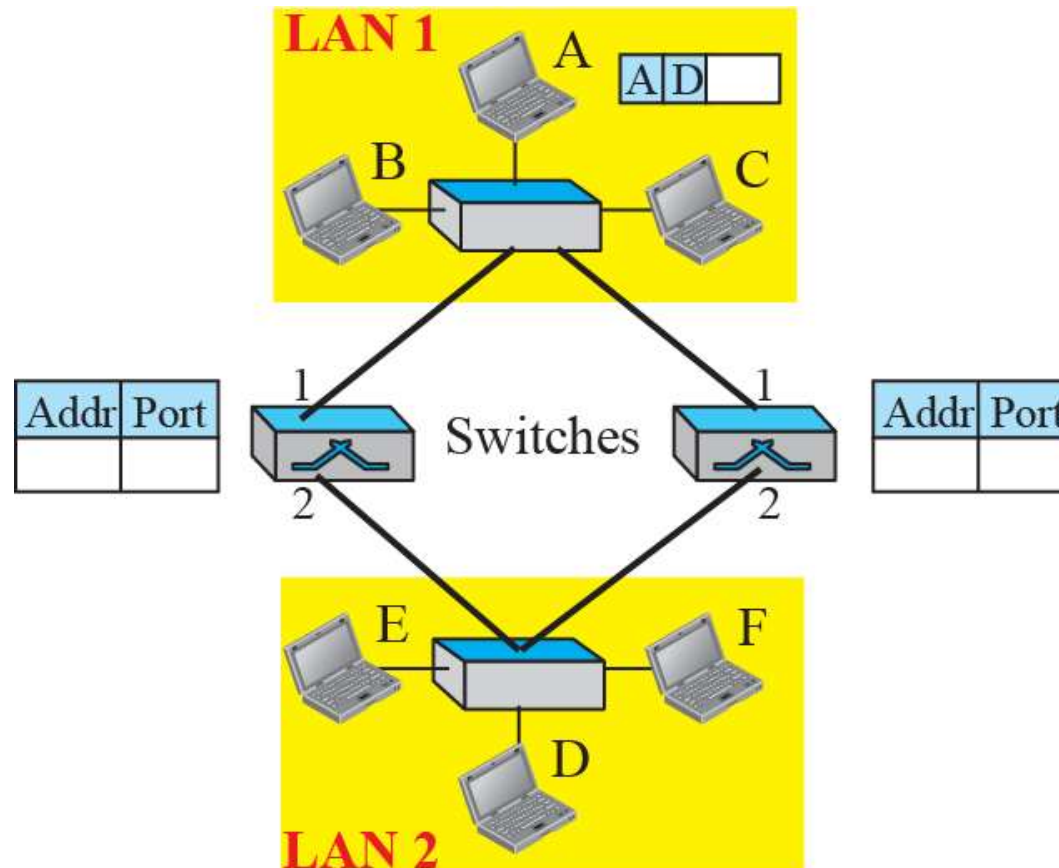71:2B:13:45:61:41    71:2B:13:45:61:42    64:2B:13:45:61:12    64:2B:13:45:61:13

*Learning switch*

# Loop problem



a. Station A sends a frame to station D

Loop problem *in a learning switch (Part a)*

# Loop problem



**LAN 1**

A

B  C

| Addr | Port |
|------|------|
| A | 1 |

1  Switches  1

2  2

| Addr | Port |
|------|------|
| A | 1 |

E  F

D  | A | D |  |
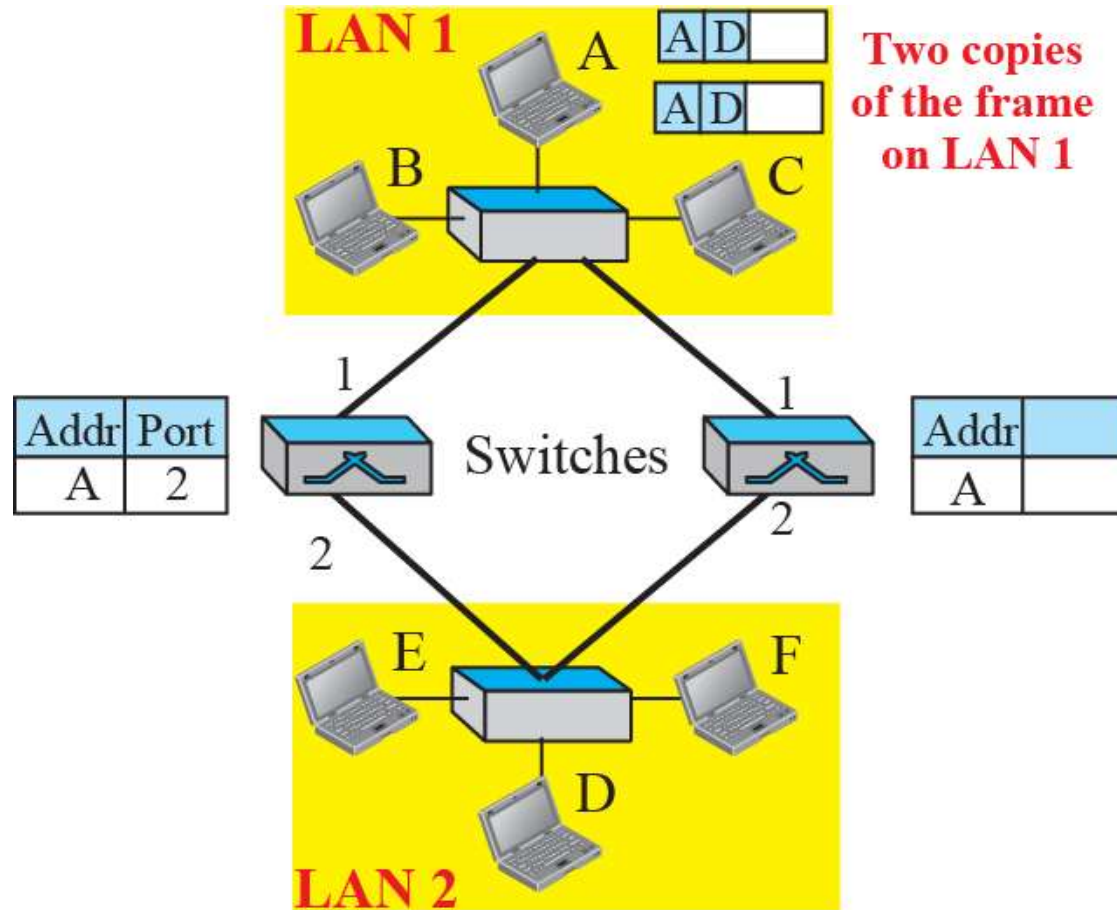   | A | D |  |

**Two copies of the frame on LAN 2**

**LAN 2**
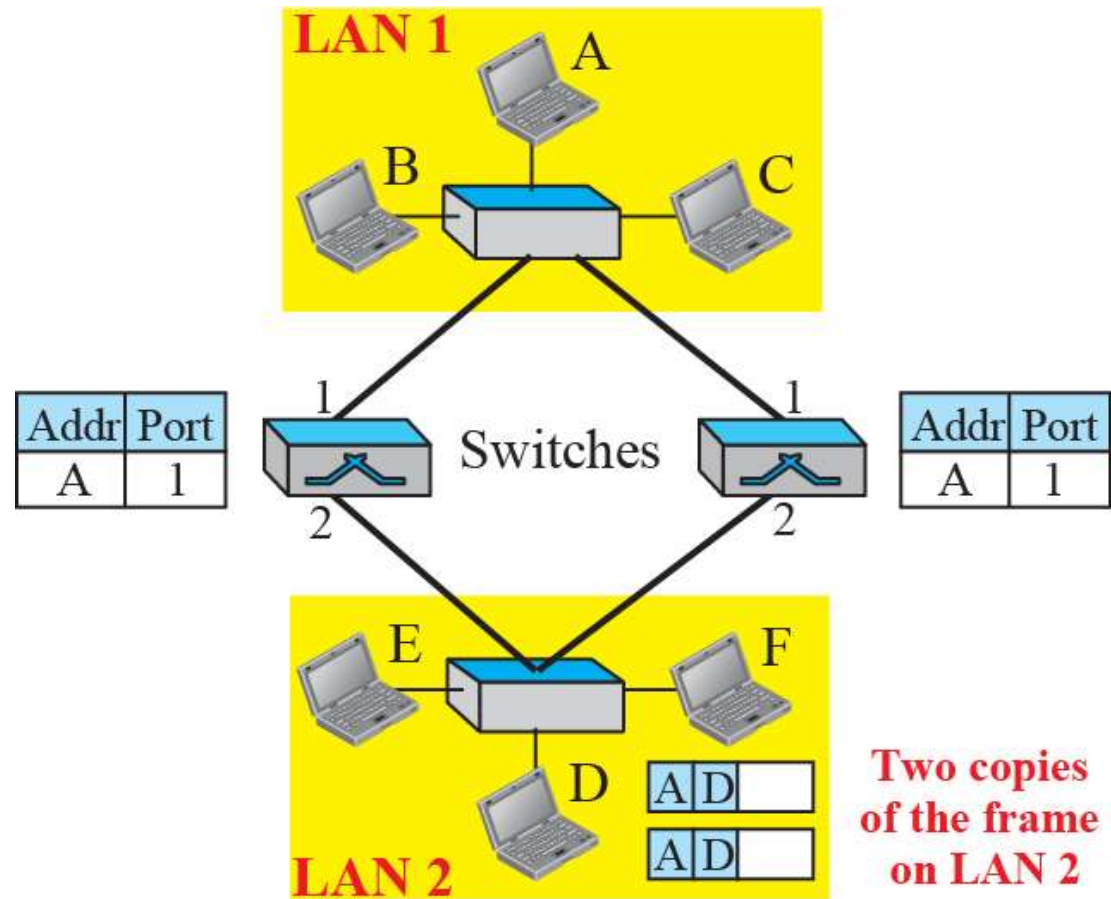
b. Both switches forward the frame

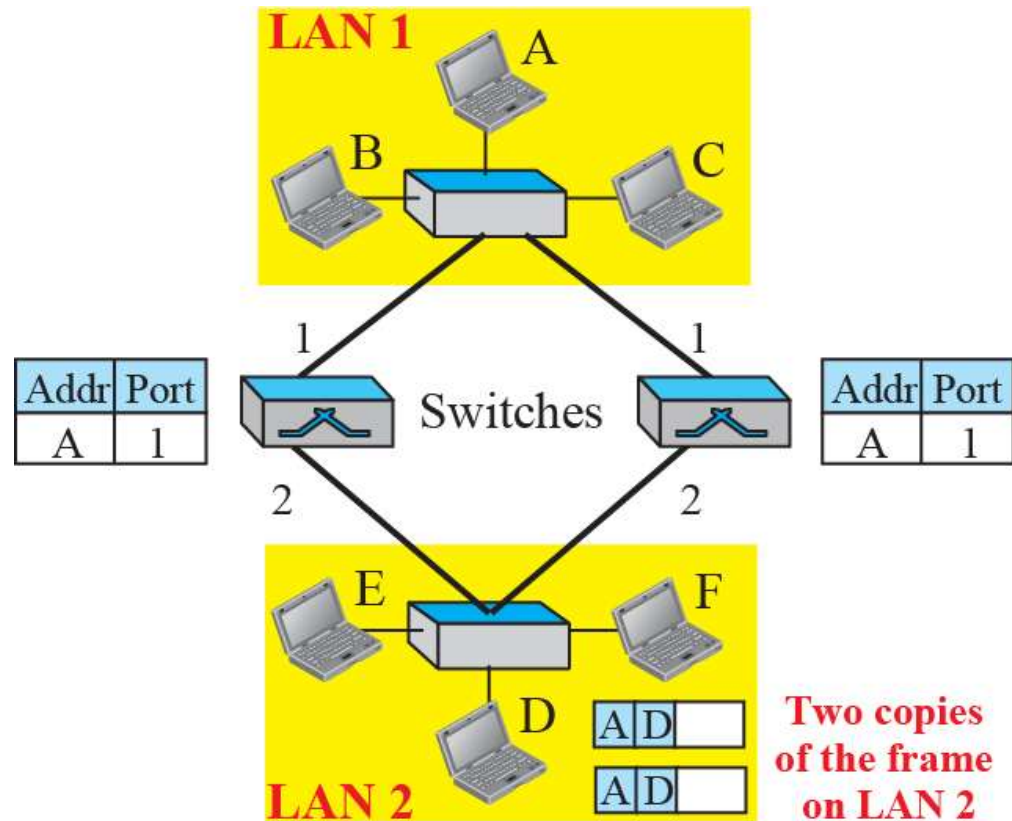Loop problem *in a learning switch (Part b)*

# Loop problem



c. Both switches forward the frame

Loop problem *in a learning switch (Part c)*

# Loop problem



d. Both switches forward the frame

Loop problem *in a learning switch (part d)*

# spanning tree algorithm

- To solve the looping problem, the IEEE specification requires that switches use the spanning tree algorithm to create a loopless topology. In graph theory, a spanning tree is a graph in which there is no loop.

- In a switched LAN, this means creating a topology in which each LAN can be reached from any other LAN through one path only (no loop).
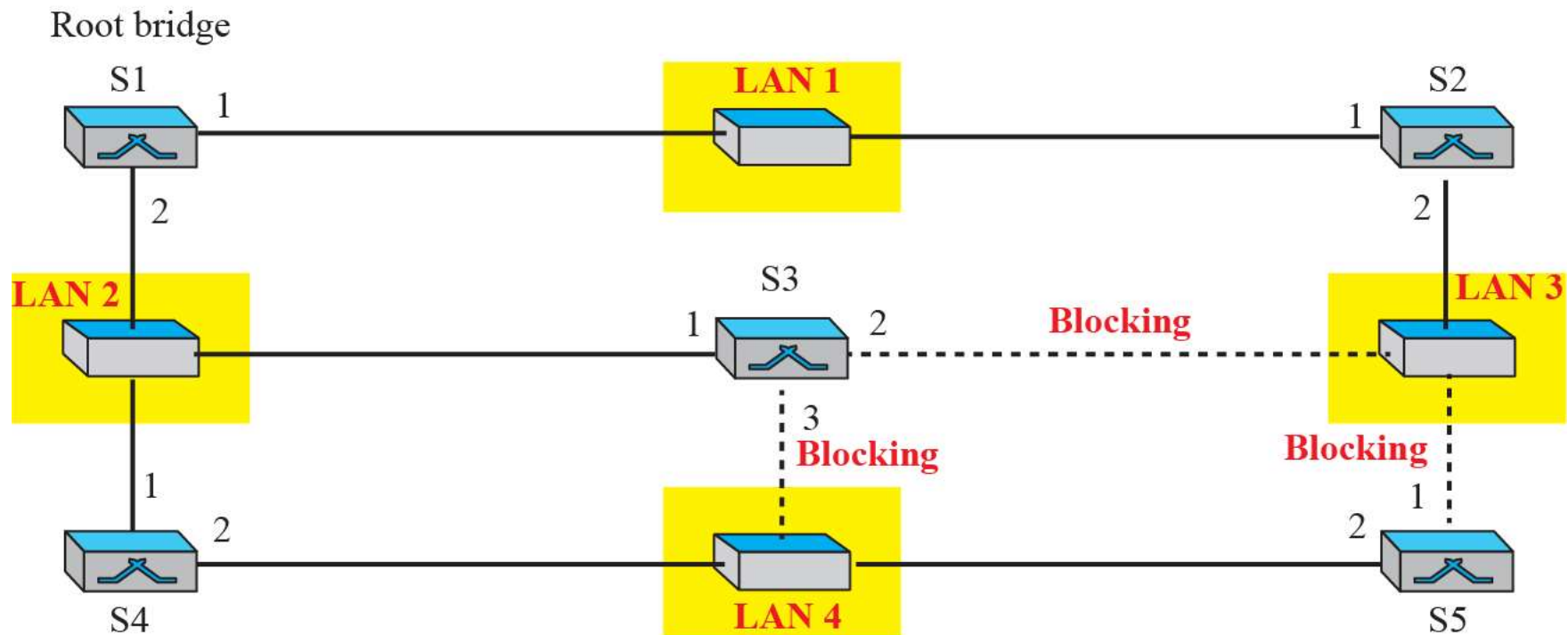
S1   LAN 1   S2

1   1

2   2

LAN 2   S3   LAN 3

1   2

3

1   1

2   2

S4   LAN 4   S5
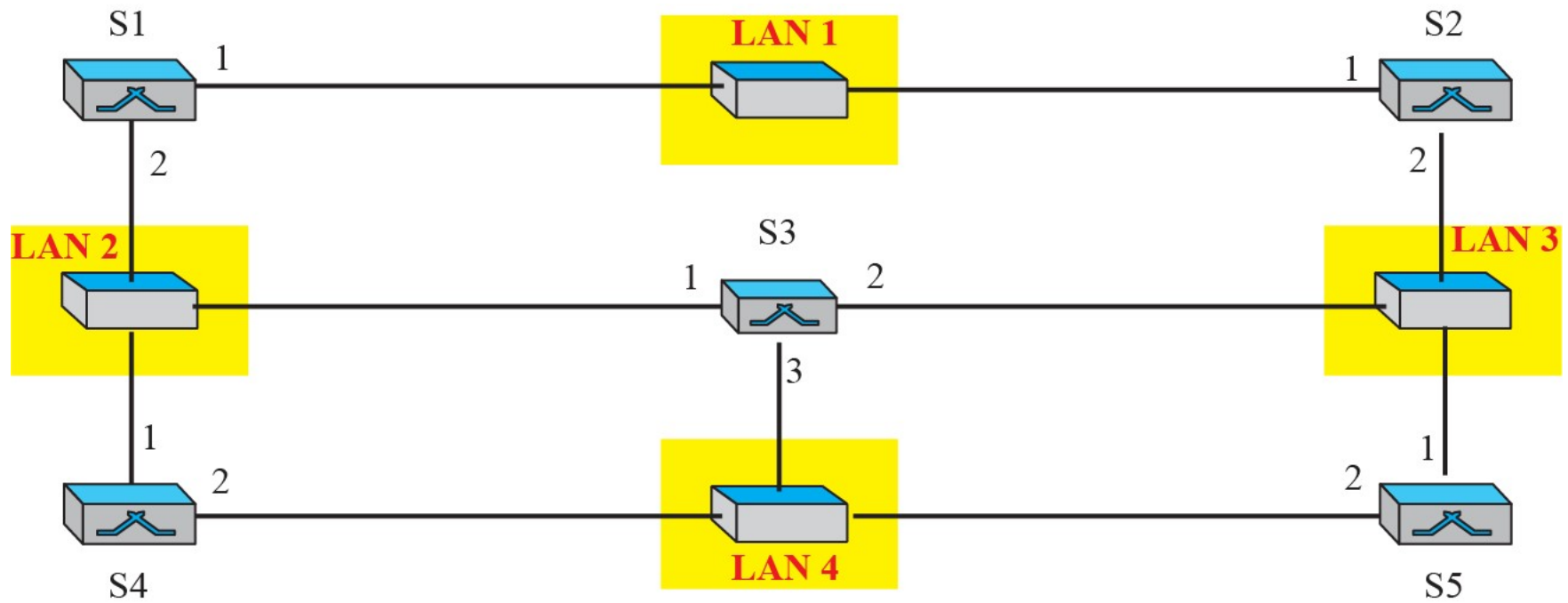
a. Actual system

A system of connected LANs and its graph (Part a)
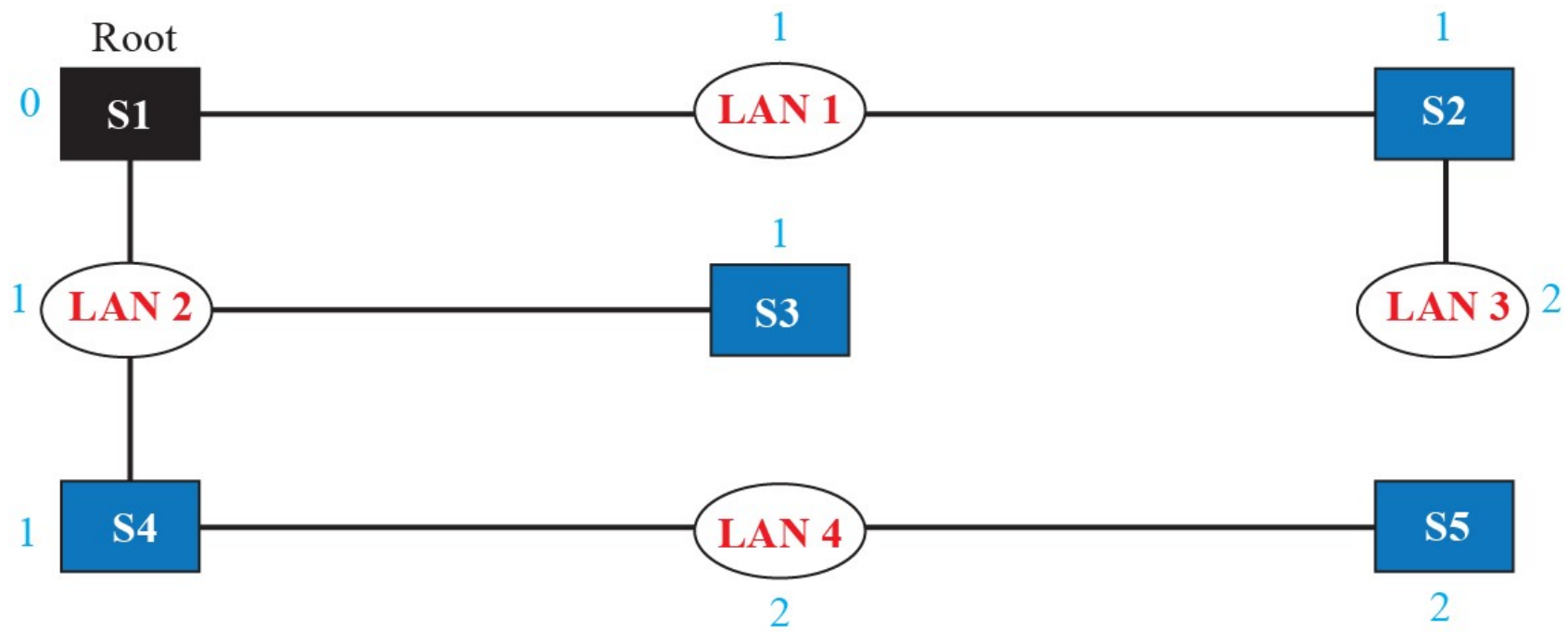
*Finding the shortest path and the spanning tree for a switch.*

Ports 2 and 3 of bridge S3 are blocking ports (no frame is sent out of these ports). Port 1 of bridge S5 is also a blocking port (no frame is sent out of this port).

Root bridge

S1

LAN 1

S2

1

1

2

2

LAN 2

S3

LAN 3

1

2

Blocking

3

Blocking

Blocking

1

2

S4

LAN 4

S5

*Forwarding and blocking ports after using spanning tree algorithm*

# Routers

- In this section, we mention routers to compare them with a two-layer switch and a hub.

- A router is a three-layer device; it operates in the physical, data-link, and network layers.
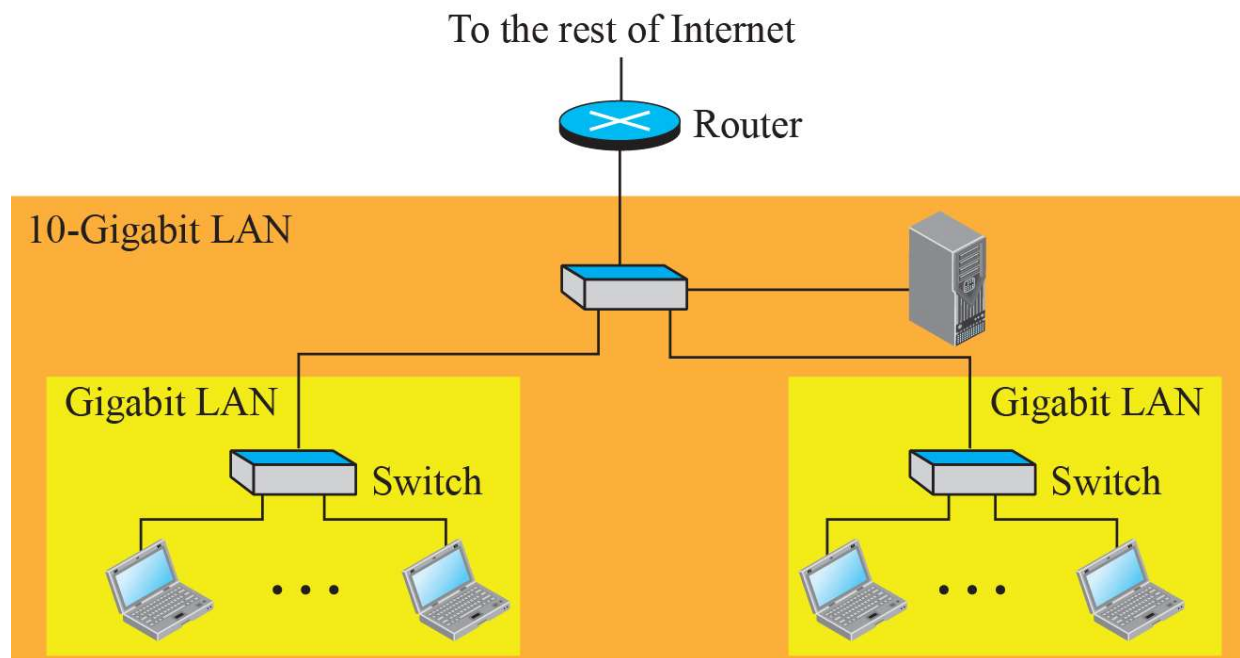
# Virtual LANs

- A station is considered part of a LAN if it physically belongs to that LAN. The criterion of membership is geographic.

- What happens if we need a virtual connection between two stations belonging to two different physical LANs?

- We can roughly define a <span style="color:red">virtual local area network (VLAN)</span> as a local area network configured by software, not by physical wiring.
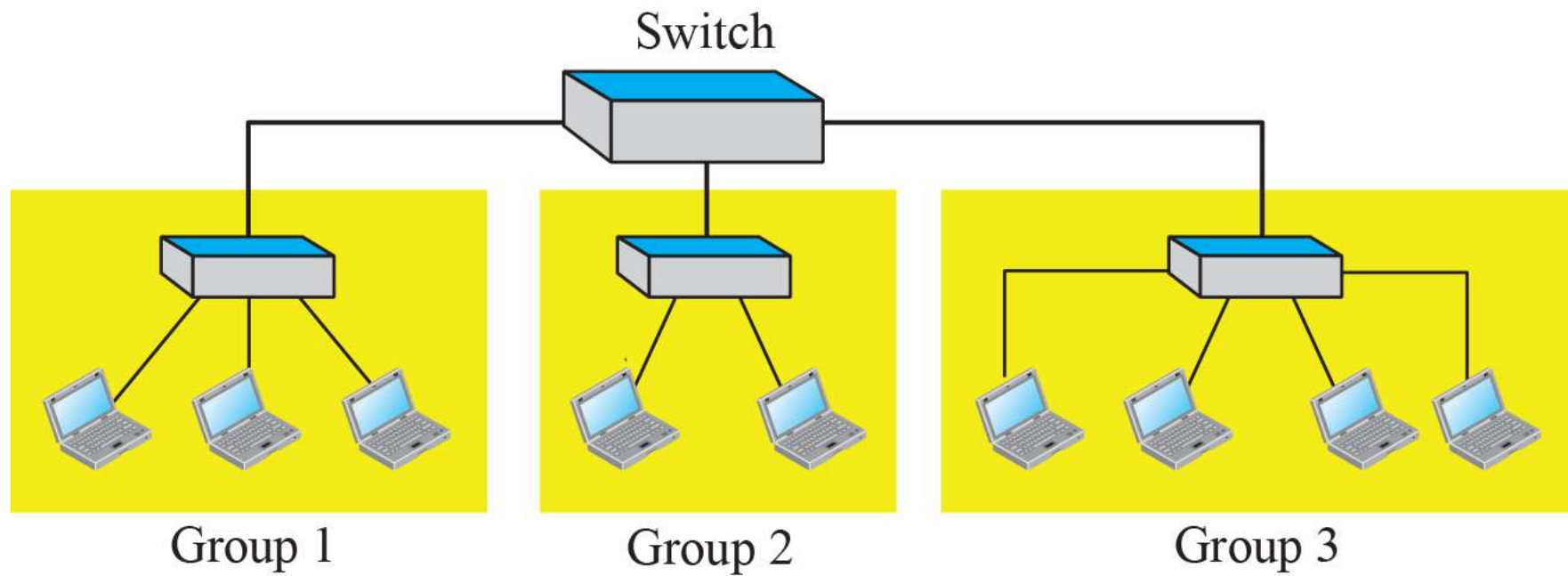
*A switch connecting three LANs*
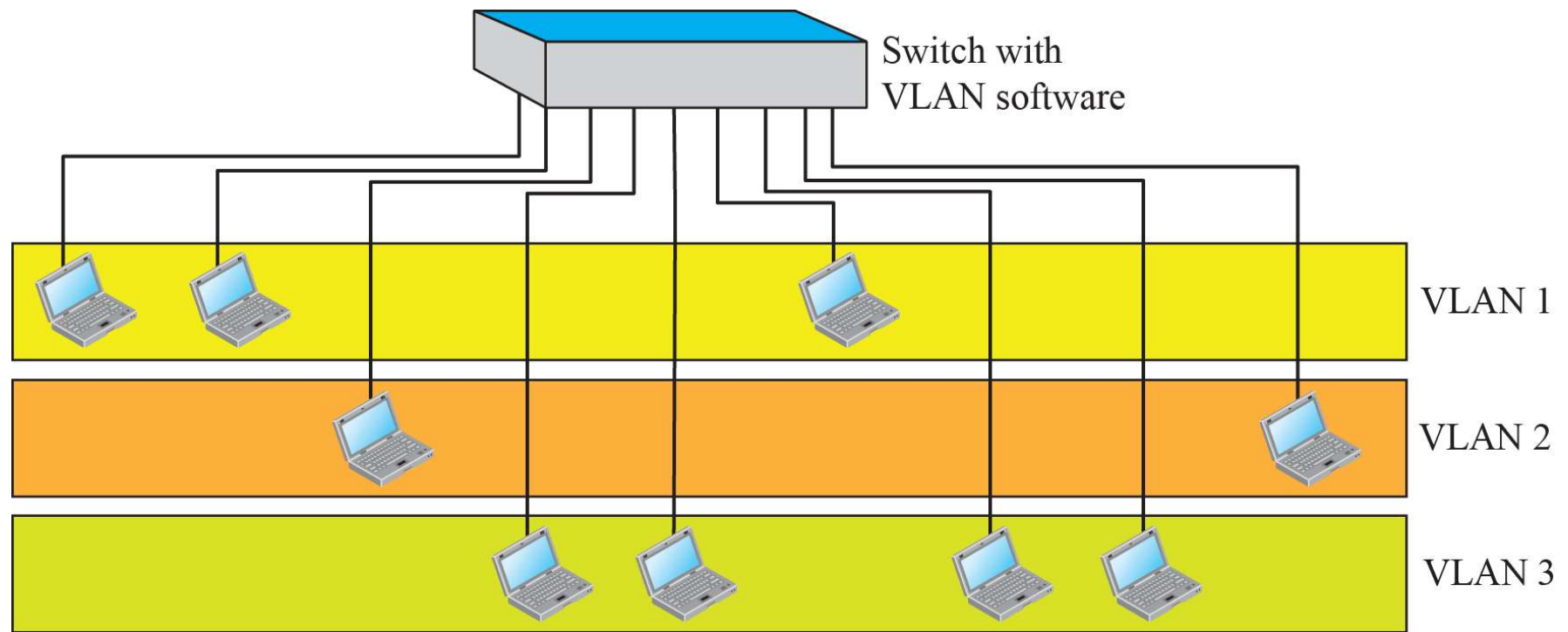
*A switch using VLAN software*
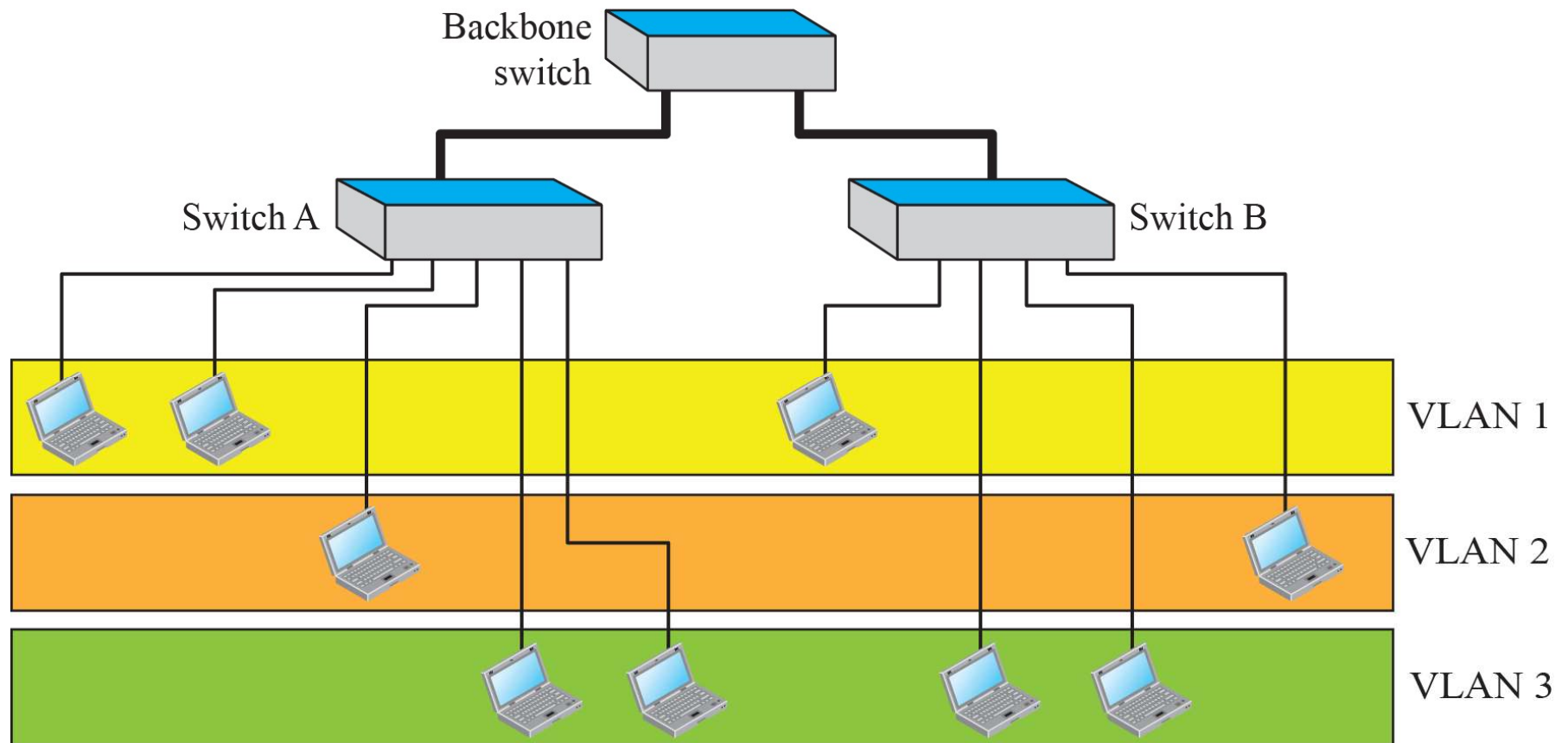
*Two switches in a backbone using VLAN software*

# Membership

- What characteristic can be used to group stations in a VLAN?

- Vendors use different characteristics such as interface numbers, port numbers, MAC addresses, IP addresses, IP multicast addresses, or a combination of two or more of these.

- How are the stations grouped into different VLANs? Stations are configured in one of three ways: manually, semi-automatically, and automatically.

# Advantages

- **Cost and Time Reduction**: Physical reconfiguration takes time and is costly. It is much easier and quicker to move it by using software.

- **Creating Virtual Work Groups**: It can reduce traffic in the multicasting.

- **Security** :VLANs provide an extra measure of security when people belonging to the same group can send broadcast messages.