

Connecting LANs, Backbone Networks, and Virtual LANs

15-1 CONNECTING DEVICES

In this section, we divide connecting devices into five different categories based on the layer in which they operate in a network.

Passive Hubs

Active Hubs

Bridges

Two-Layer Switches

Routers

Three-Layer Switches

Gateways

Figure 15.1 *Five categories of connecting devices*

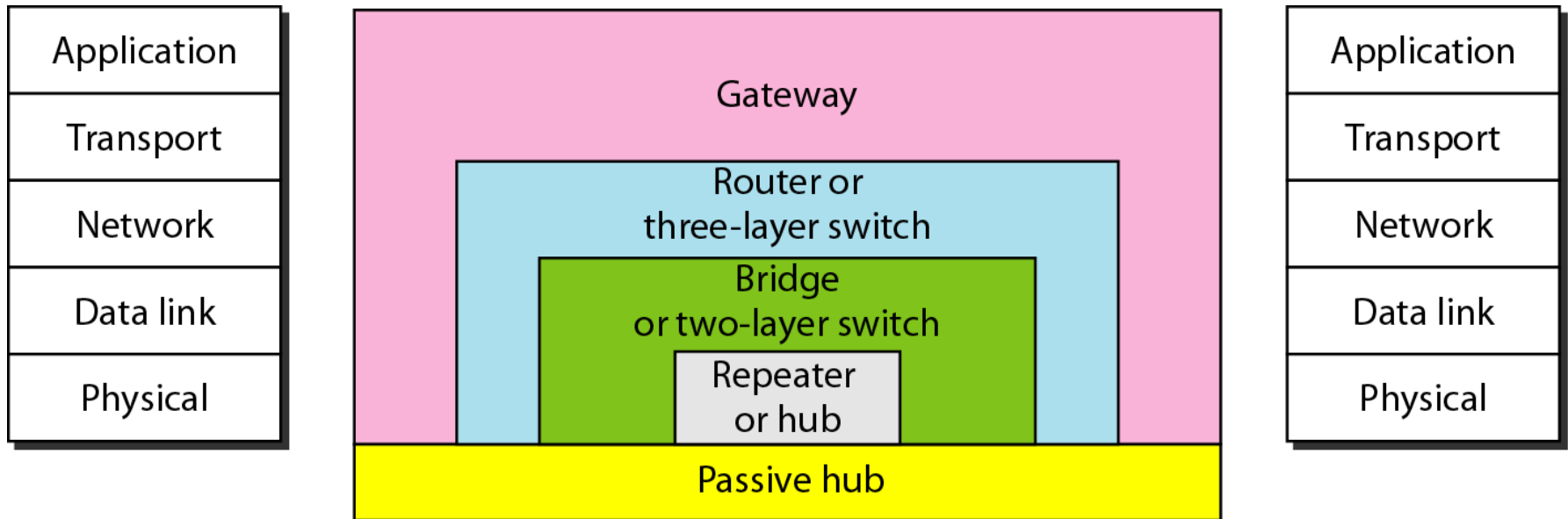
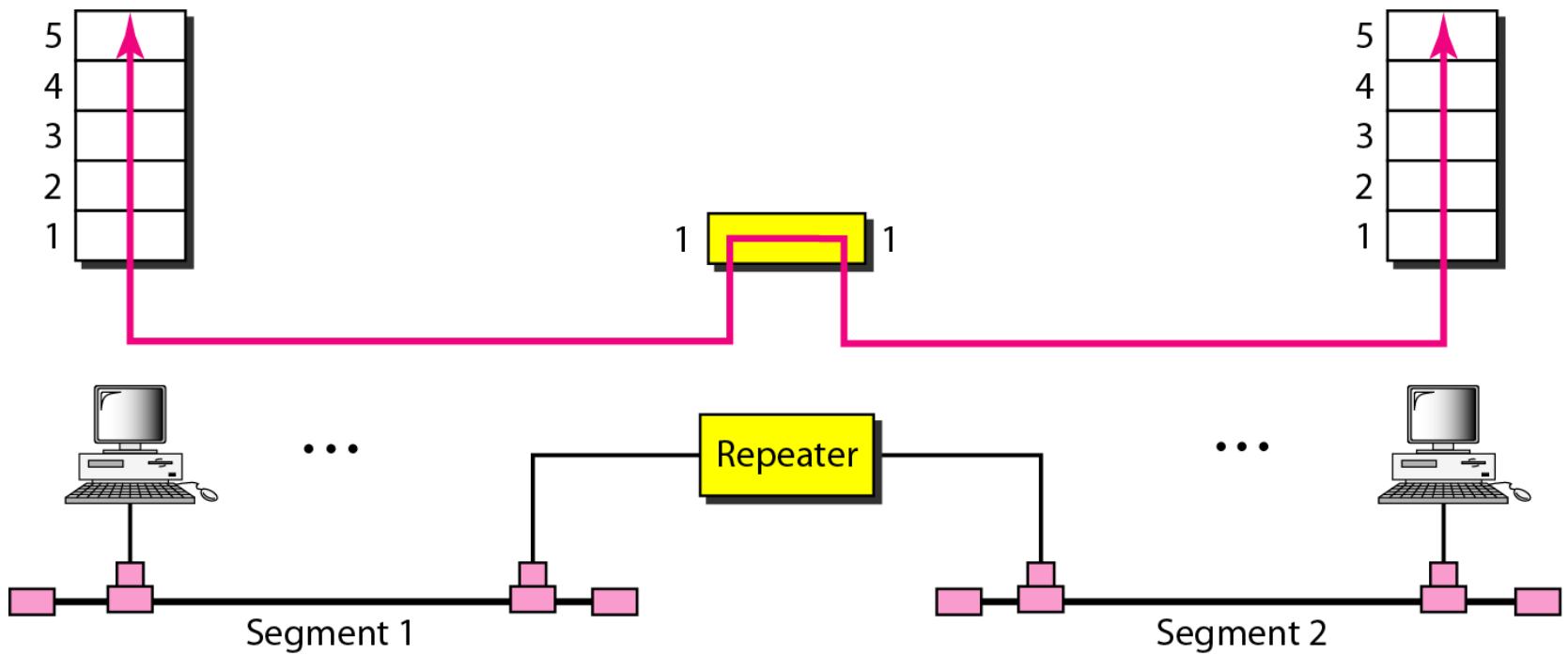
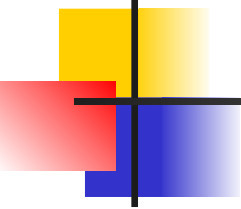


Figure 15.2 *A repeater connecting two segments of a LAN*



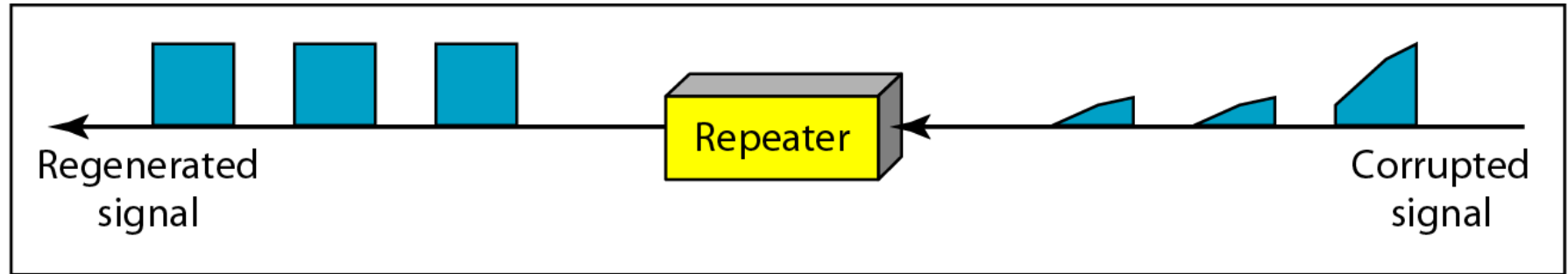


A repeater does not connect two different LANs, but connects segments of a same LAN.

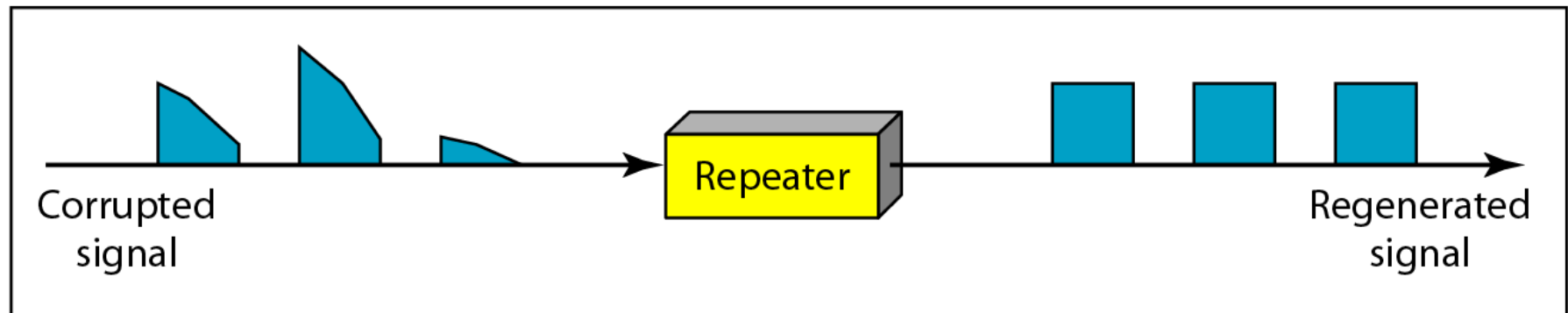
A repeater forwards every frame; it has no filtering capability.

A repeater is a regenerator, not an amplifier.

Figure 15.3 *Function of a repeater*

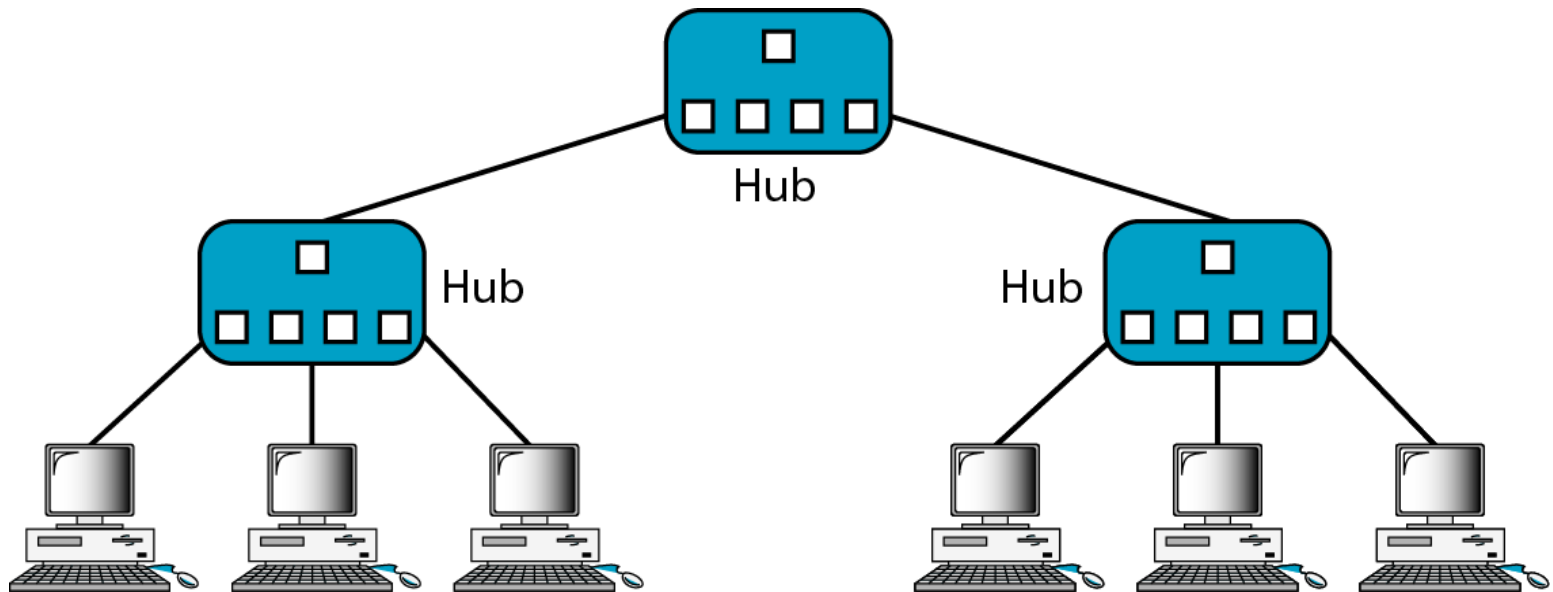


a. Right-to-left transmission.



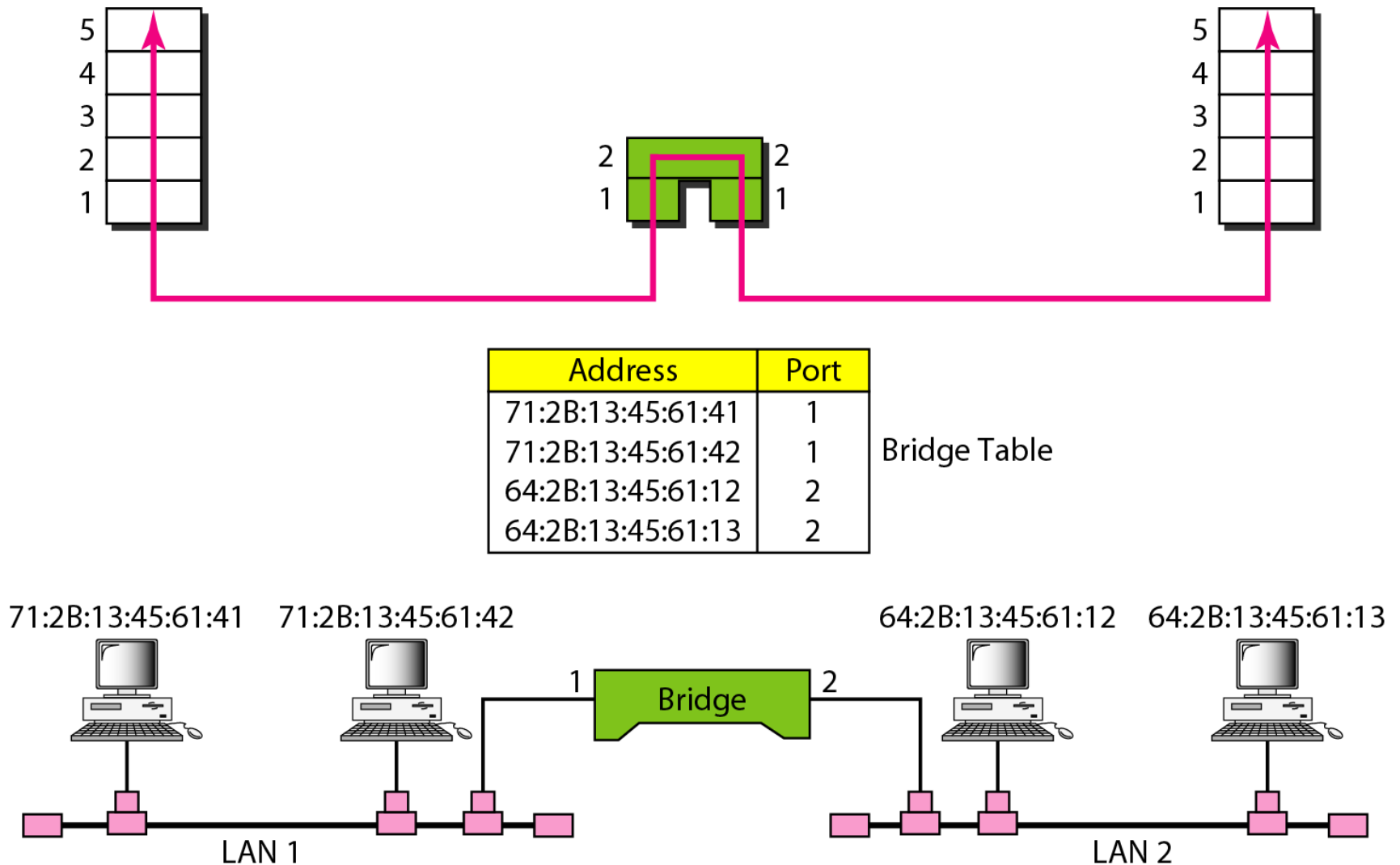
b. Left-to-right transmission.

Active hub or Bridge works on physical layer and data link layer



A bridge has a table used in filtering decisions.

Figure 15.5 *A bridge connecting two LANs*





Note

A bridge does not change the physical (MAC) addresses in a frame.

Figure 15.6 *A learning bridge and the process of learning*

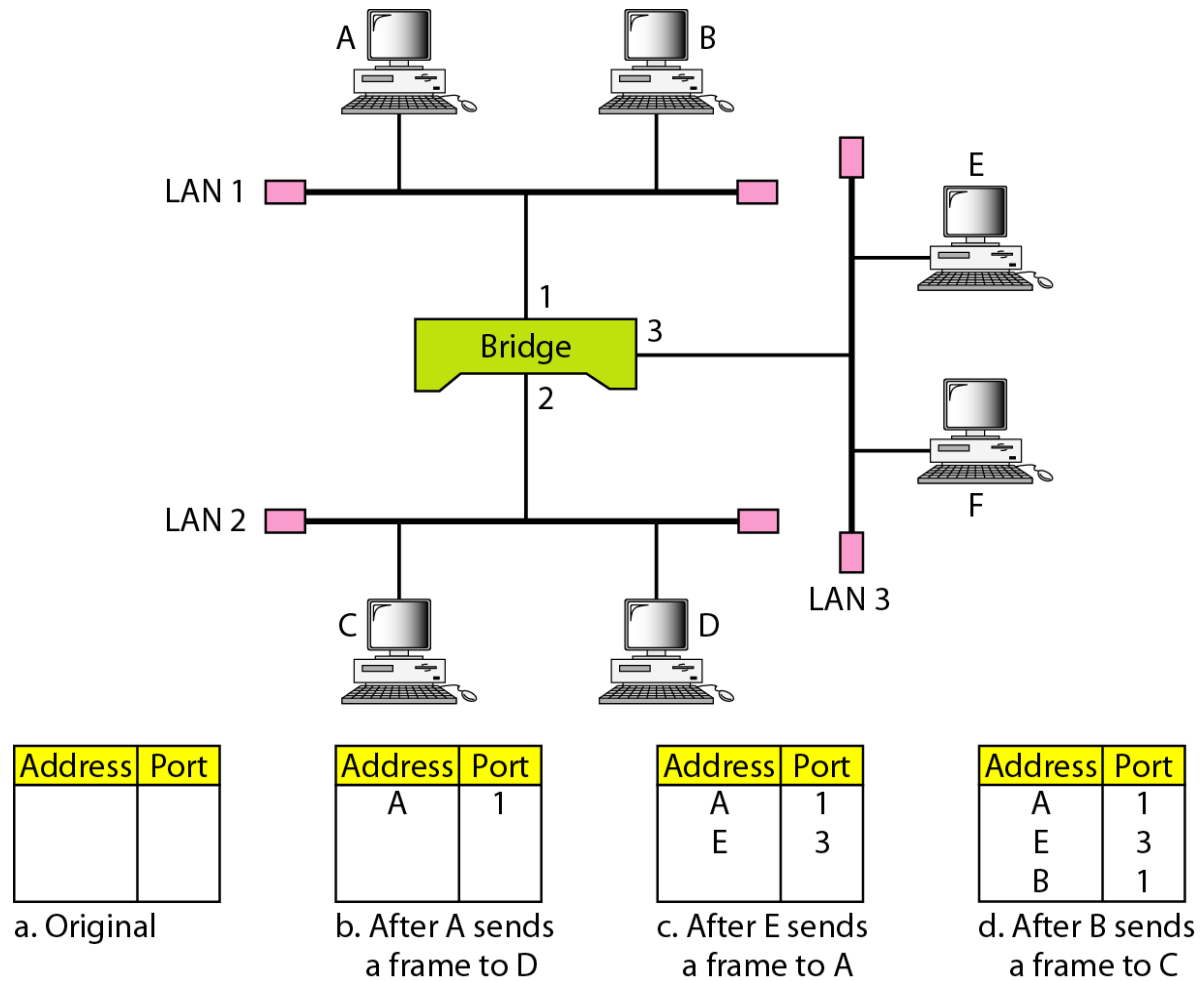
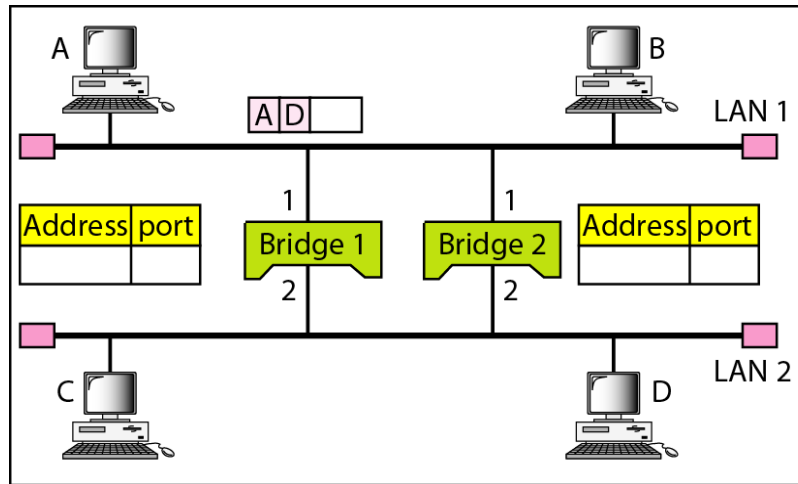
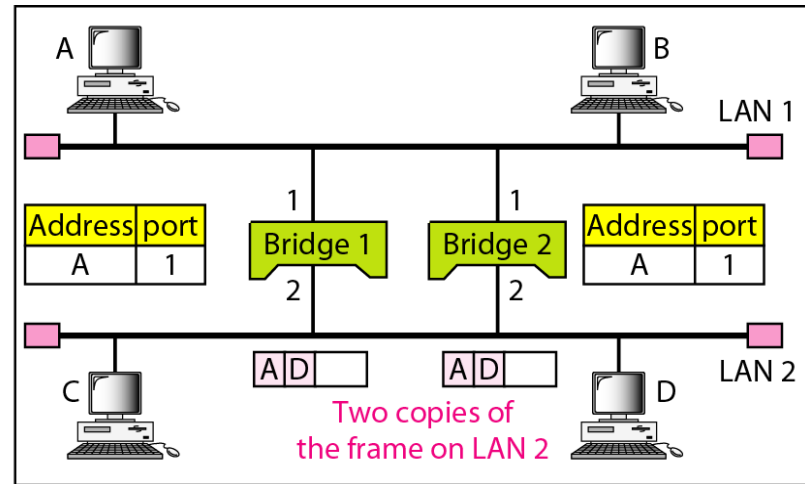


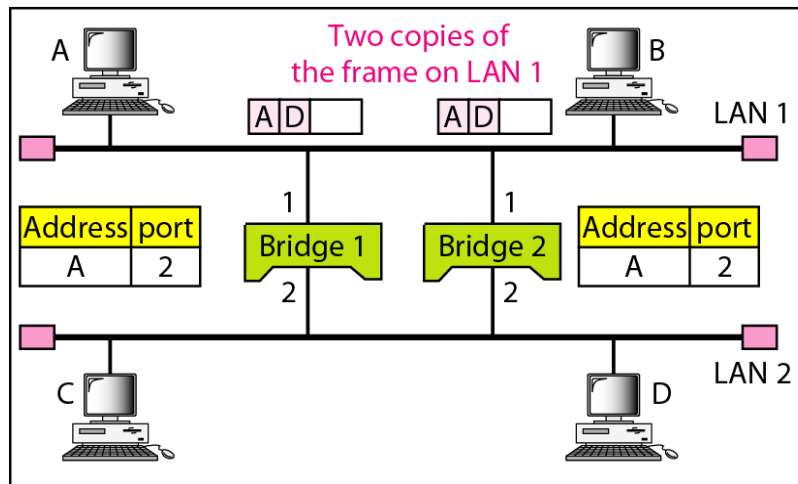
Figure 15.7 *Loop problem in a learning bridge*



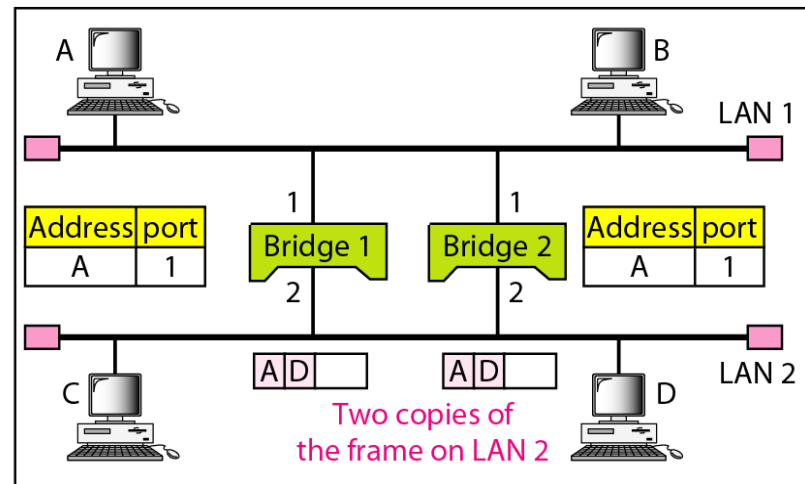
a. Station A sends a frame to station D



b. Both bridges forward the frame

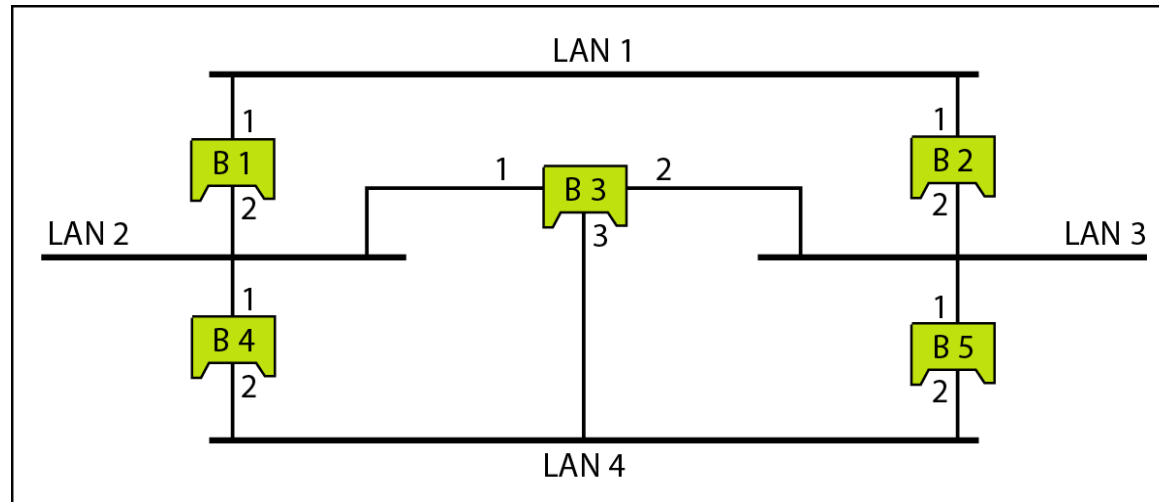


c. Both bridges forward the frame

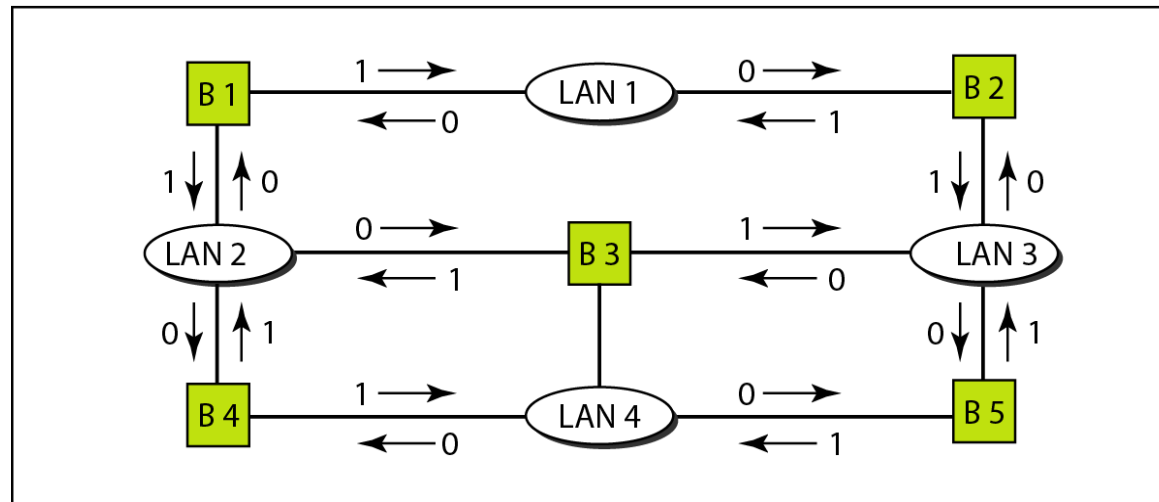


d. Both bridges forward the frame

Figure 15.8 *A system of connected LANs and its graph representation*

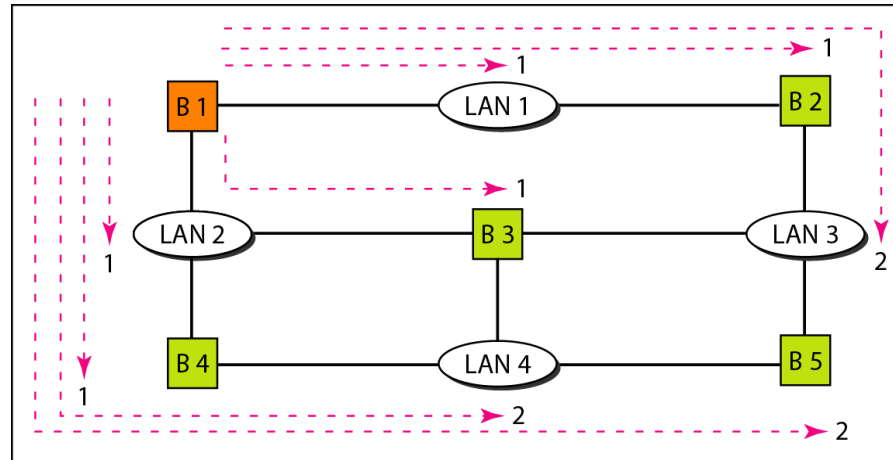


a. Actual system

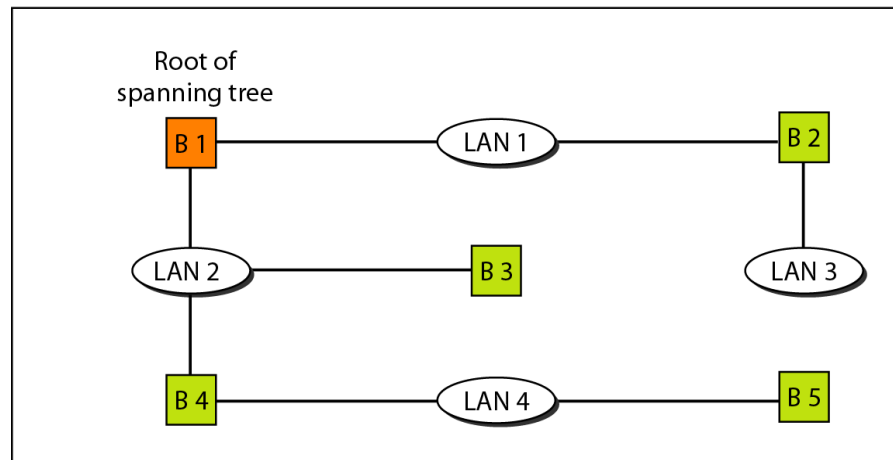


b. Graph representation with cost assigned to each arc

Figure 15.9 *Finding the shortest paths and the spanning tree in a system of bridges*

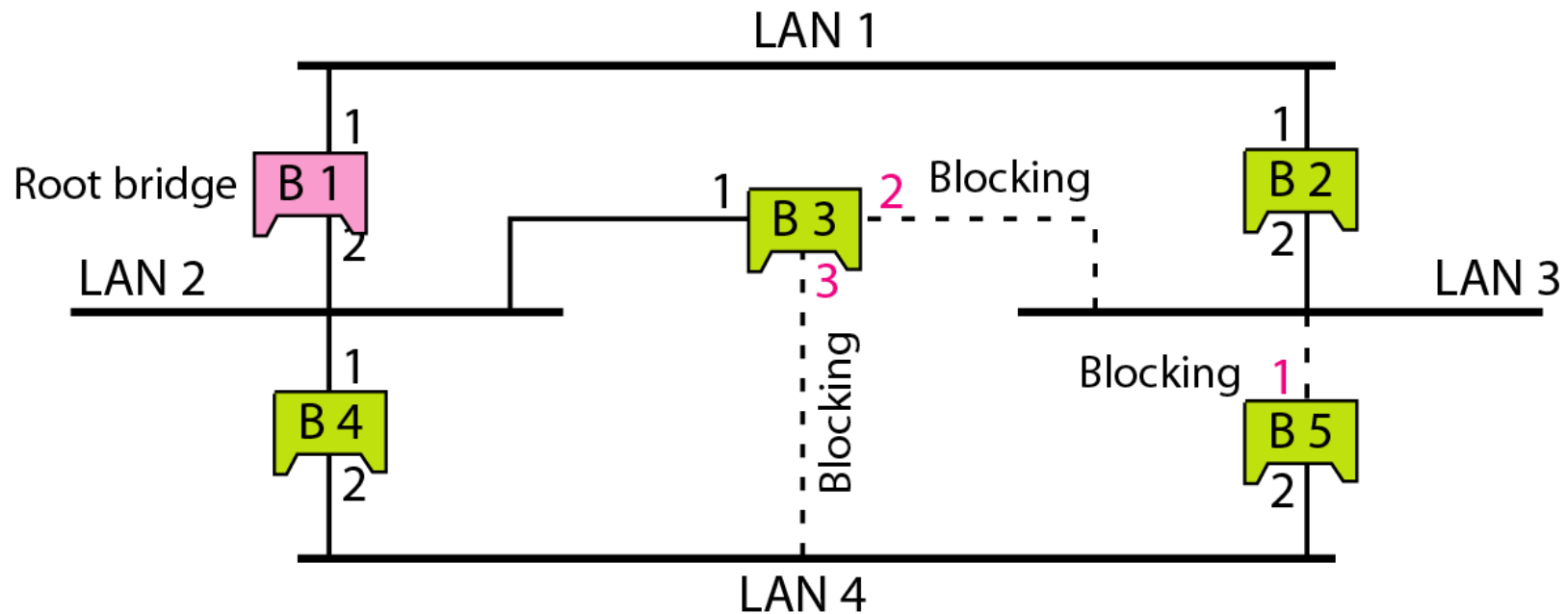


a. Shortest paths



b. Spanning tree

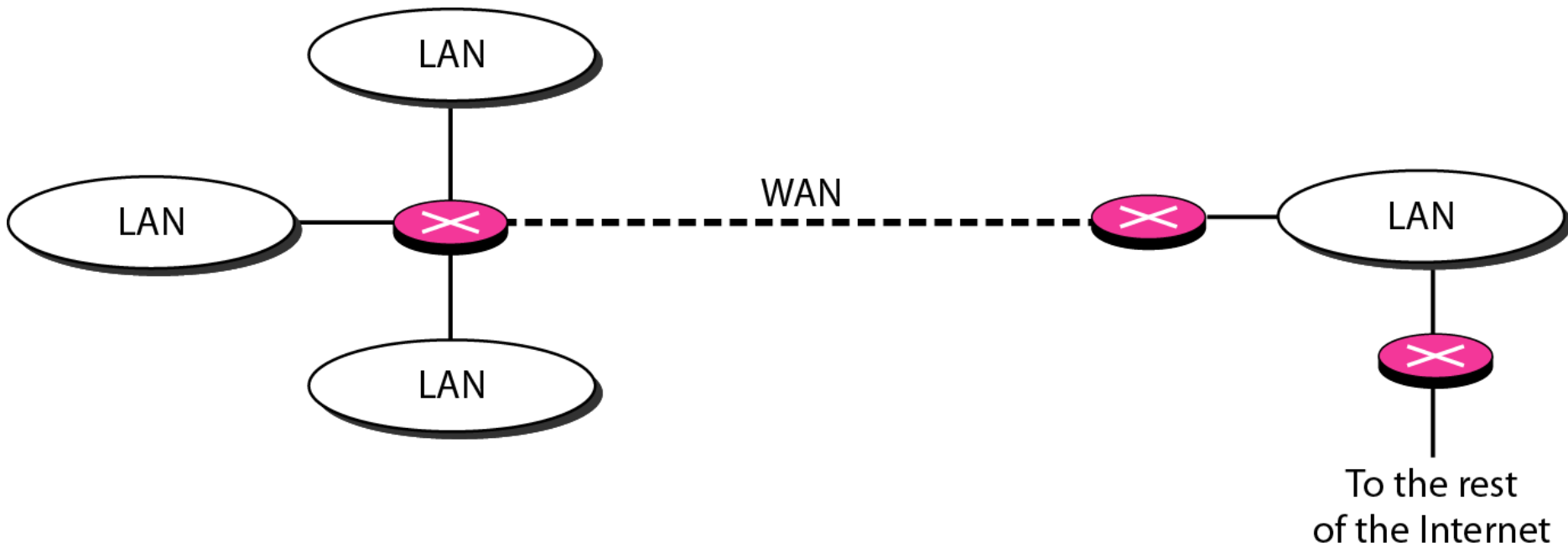
Figure 15.10 *Forwarding and blocking ports after using spanning tree algorithm*



Ports 2 and 3 of bridge B3 are blocking ports (no frame is sent out of these ports). Port 1 of bridge B5 is also a blocking port (no frame is sent out of this port).

- Two layer switch is a bridge
- Generally, bridge have few ports
- Switch can have many ports, can hold frames for processing
- Three layer switch is called Router which works on physical, data link and network layer
- Router are devices which route packets based on their logical address.

Figure 15.11 *Routers connecting independent LANs and WANs*



15-2 BACKBONE NETWORKS

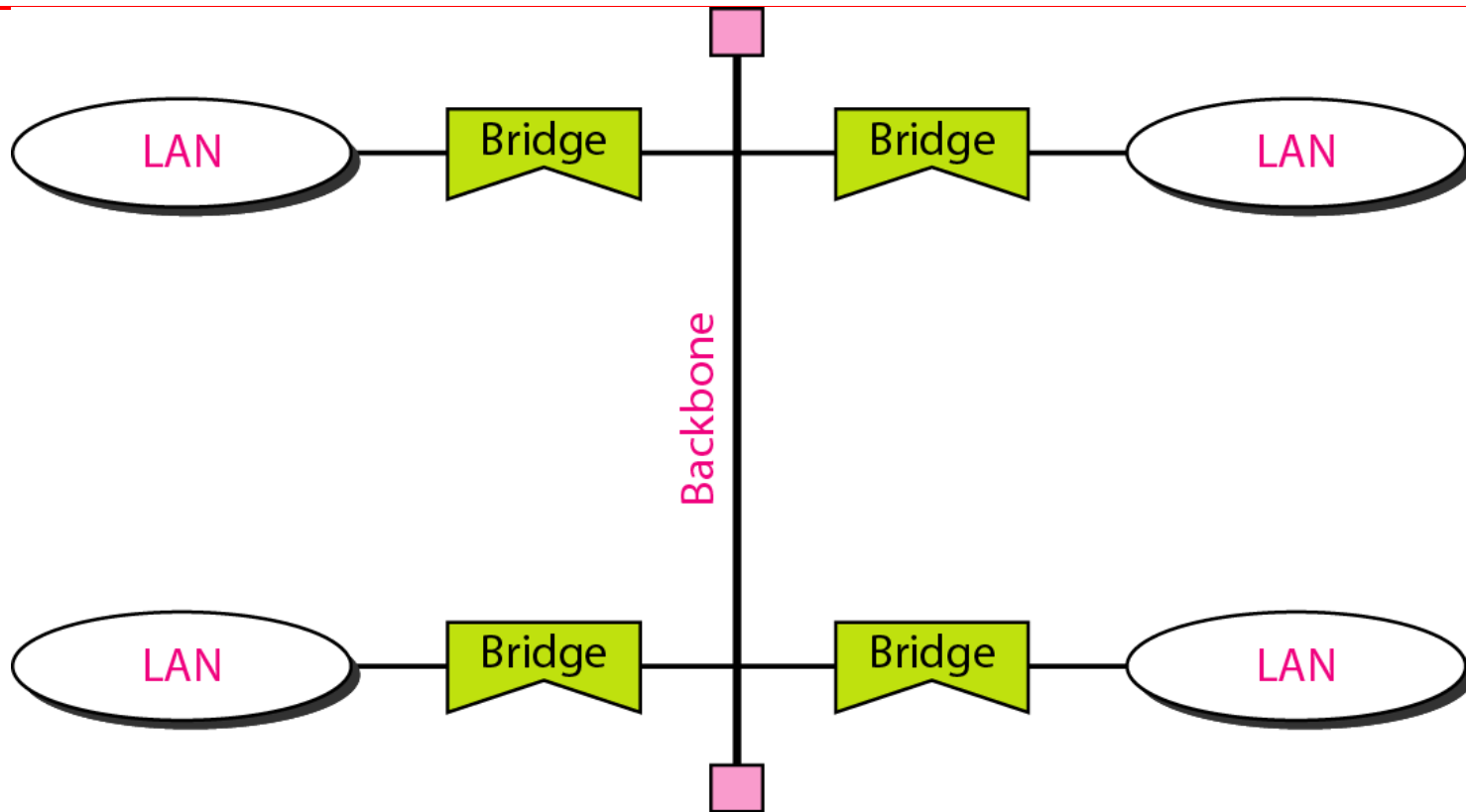
A backbone network allows several LANs to be connected. In a backbone network, no station is directly connected to the backbone; the stations are part of a LAN, and the backbone connects the LANs.

Bus Backbone

Star Backbone

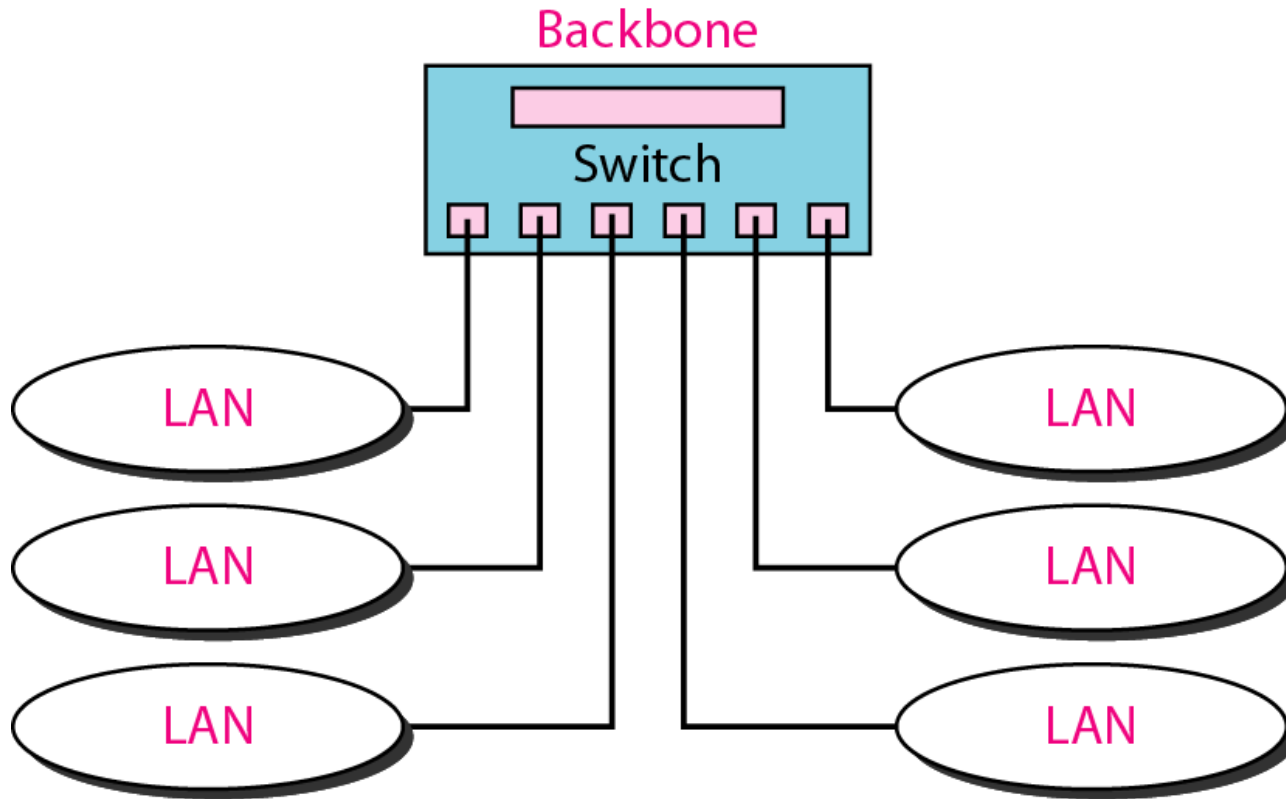
Connecting Remote LANs

Figure 15.12 *Bus backbone*



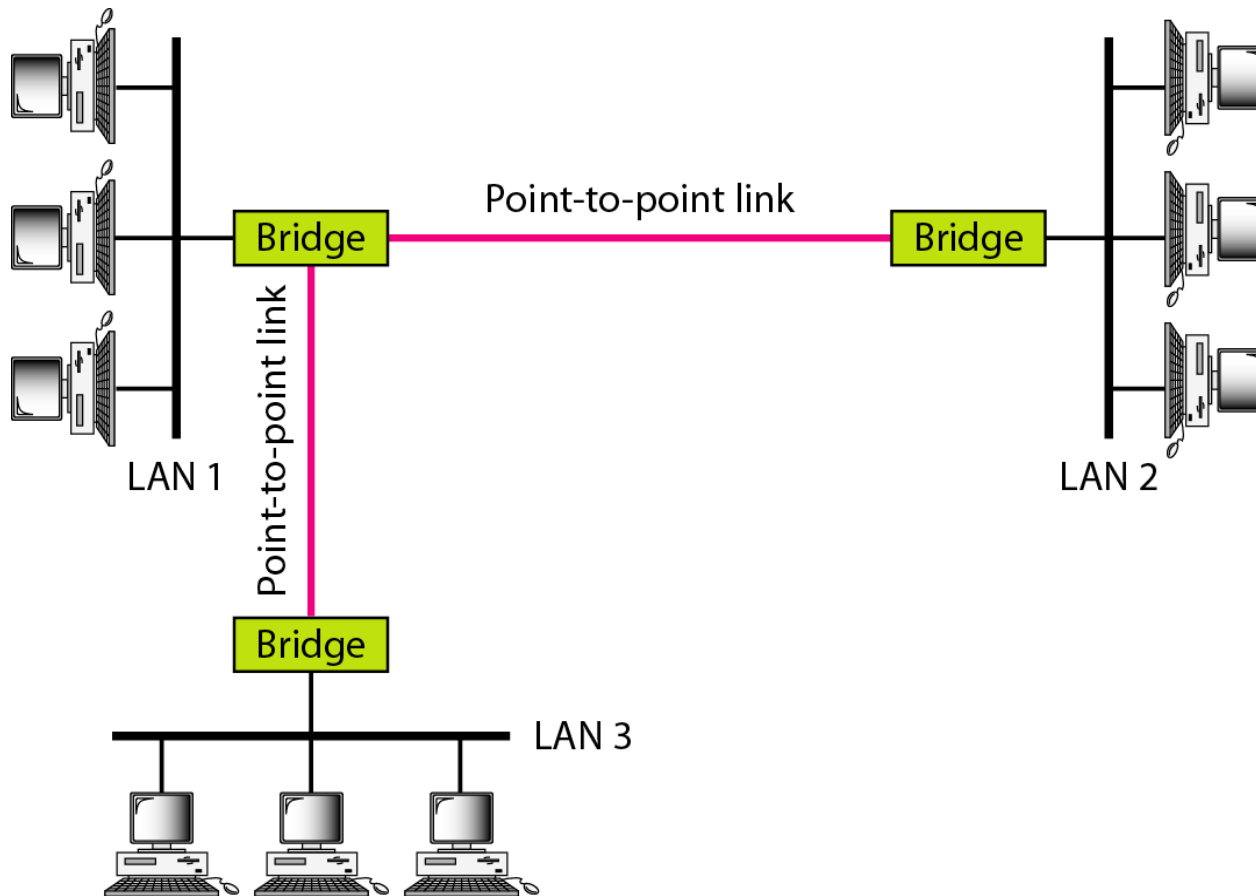
In a bus backbone, the topology of the backbone is a bus.

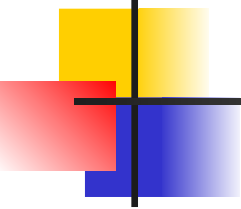
Figure 15.13 *Star backbone*



**In a star backbone, the topology of the backbone is a star;
the backbone is just one switch.**

Figure 15.14 *Connecting remote LANs with bridges*





A point-to-point link acts as a LAN in a remote backbone connected by remote bridges.

15-3 VIRTUAL LANs

*We can roughly define a **virtual local area network** (VLAN) as a local area network configured by software, not by physical wiring.*

Figure 15.15 *A switch connecting three LANs*

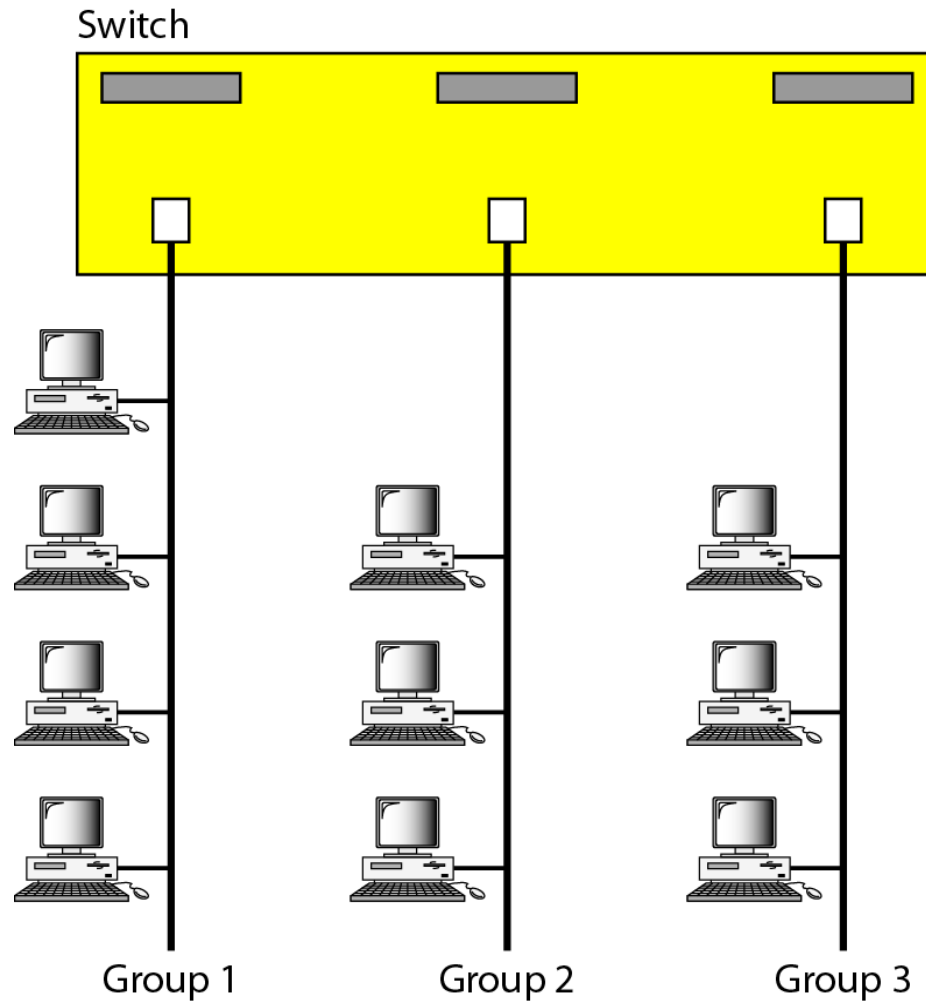


Figure 15.16 *A switch using VLAN software*

Switch with VLAN software

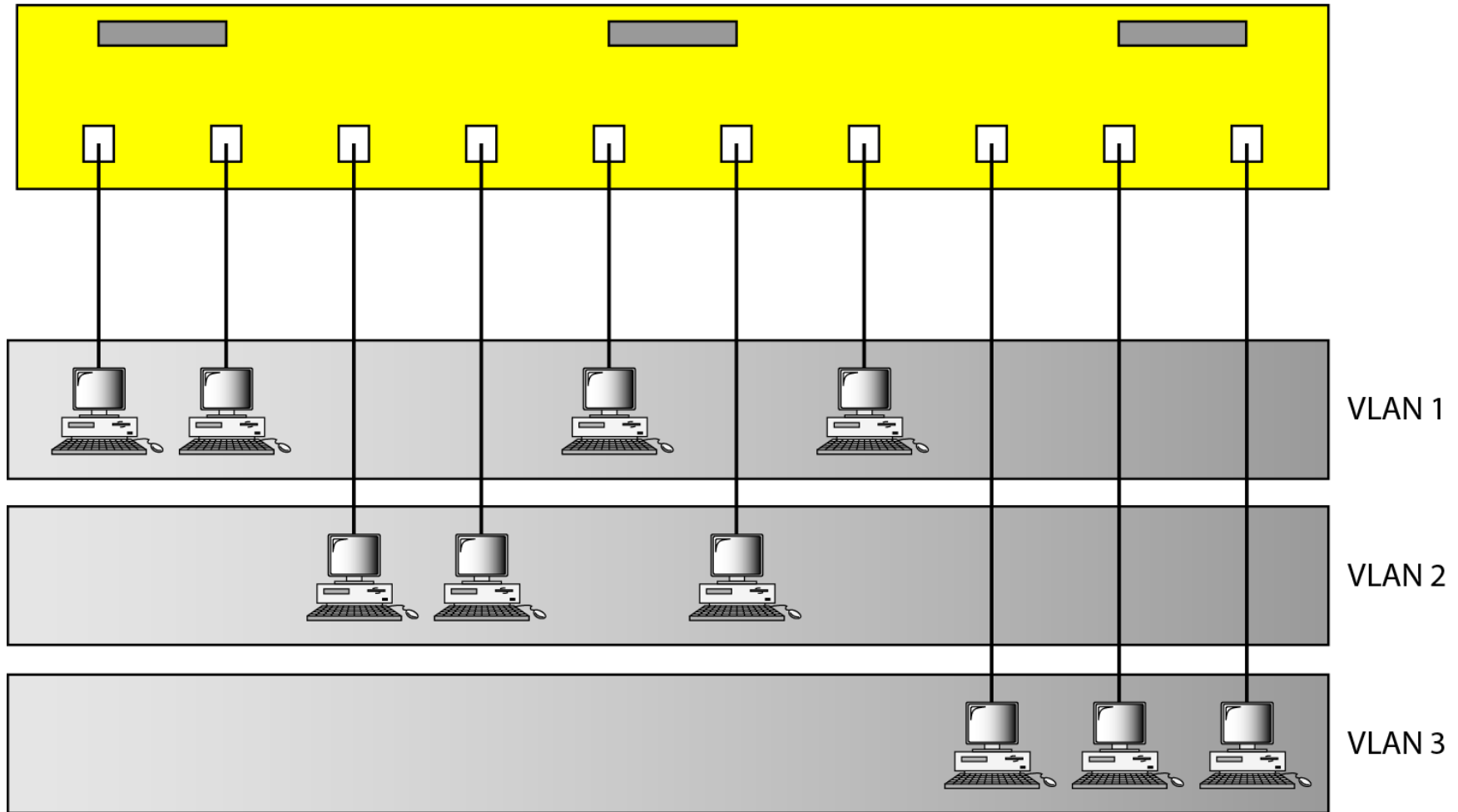
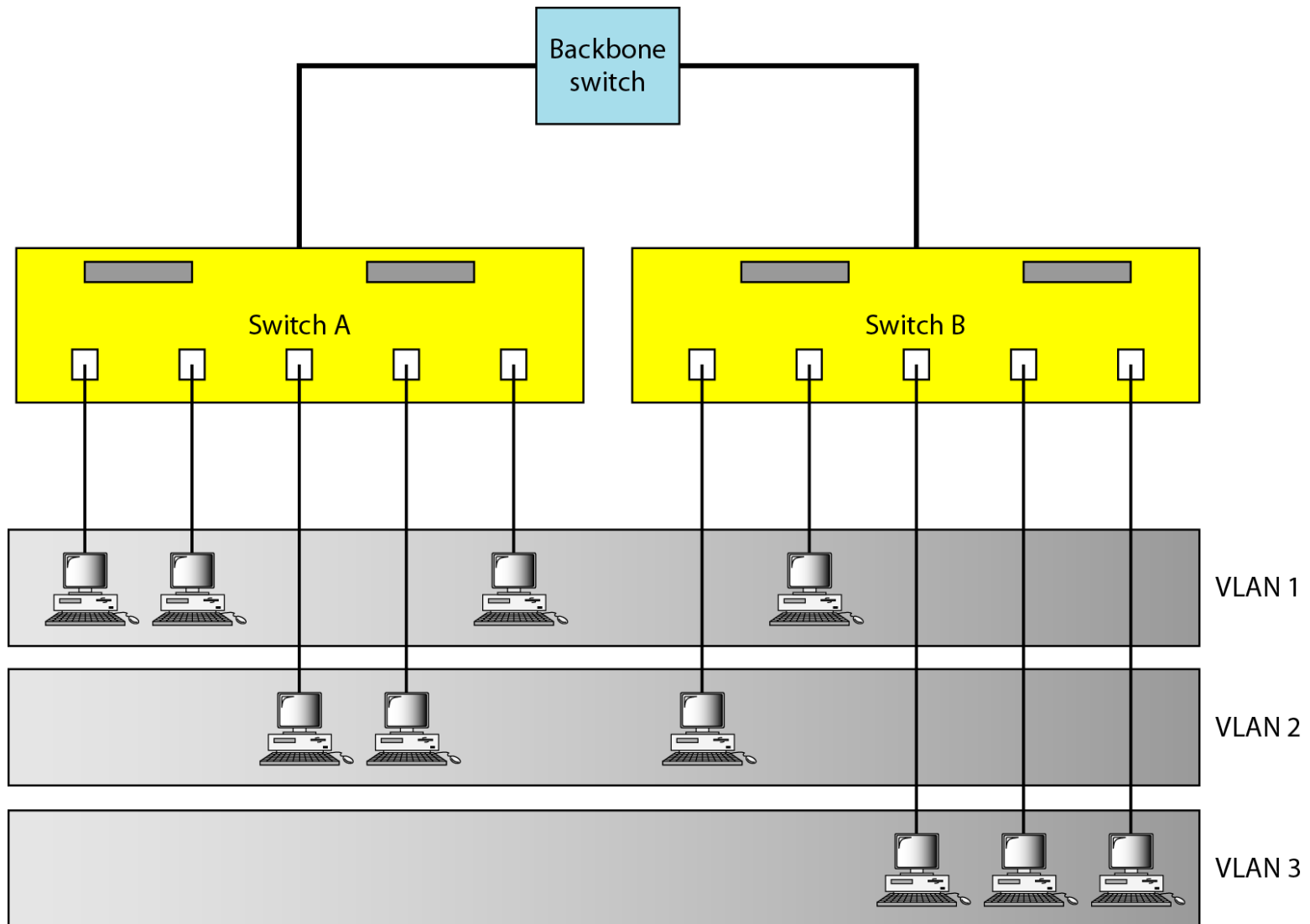


Figure 15.17 *Two switches in a backbone using VLAN software*





VLANs create broadcast domains.

- Membership – Port Numbers of a switch, MAC Addresses, IP Addresses, Multicast IP Addresses, Any combination of above
- Configuration – Manual configuration using VLAN software, Automatic configuration using pre-defined criteria
- Advantages- Cost and time reduction, Creating virtual work groups, Security