Chapter 15

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.

Topics discussed in this section:

Passive Hubs
Active Hubs
Bridges
Two-Layer Switches
Routers
Three-Layer Switches
Gateways

15.2

Figure 15.1 *Five categories of connecting devices*

1. Below the physical layer: passive hub
2. At the physical layer: repeater or active hub
3. At the physical and data link layers: bridge or two-layer switch
4. At the physical, data link, network layers: router or three-layer switch
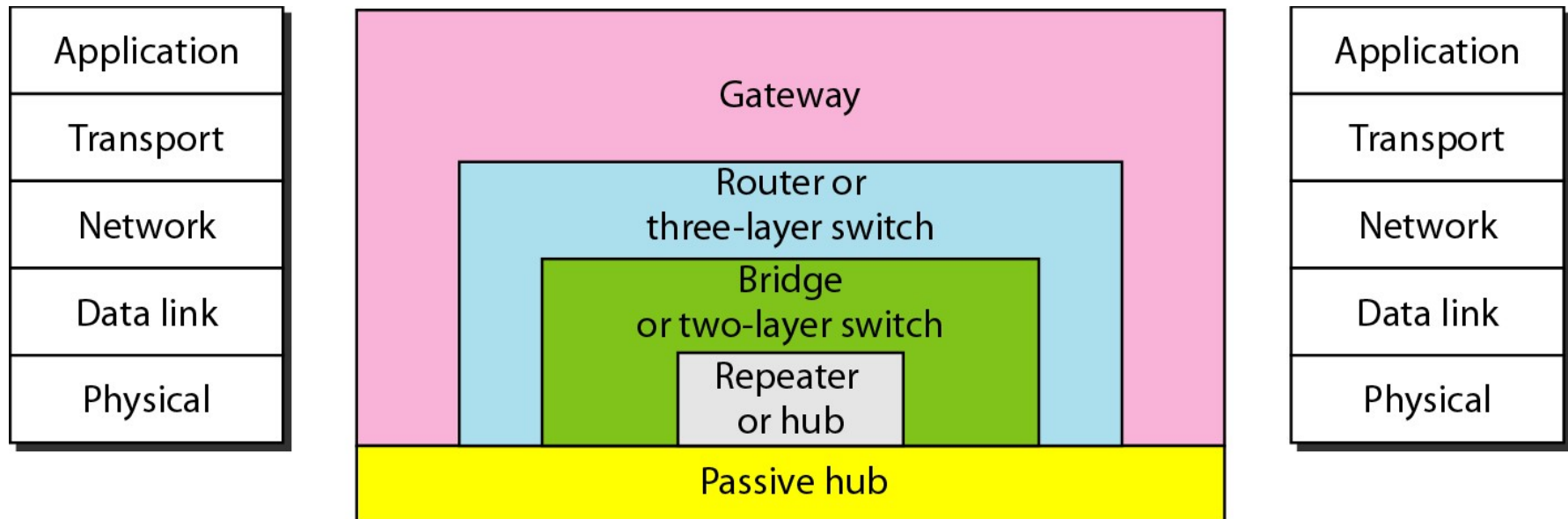5. At all five layers: gateway

| Application |
| Transport |
| Network |
| Data link |
| Physical |

Gateway

Router or three-layer switch

Bridge or two-layer switch

Repeater or hub

Passive hub

| Application |
| Transport |
| Network |
| Data link |
| Physical |

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

A repeater connects segments of a LAN.
A repeater forwards every frame; it has no filtering capability.
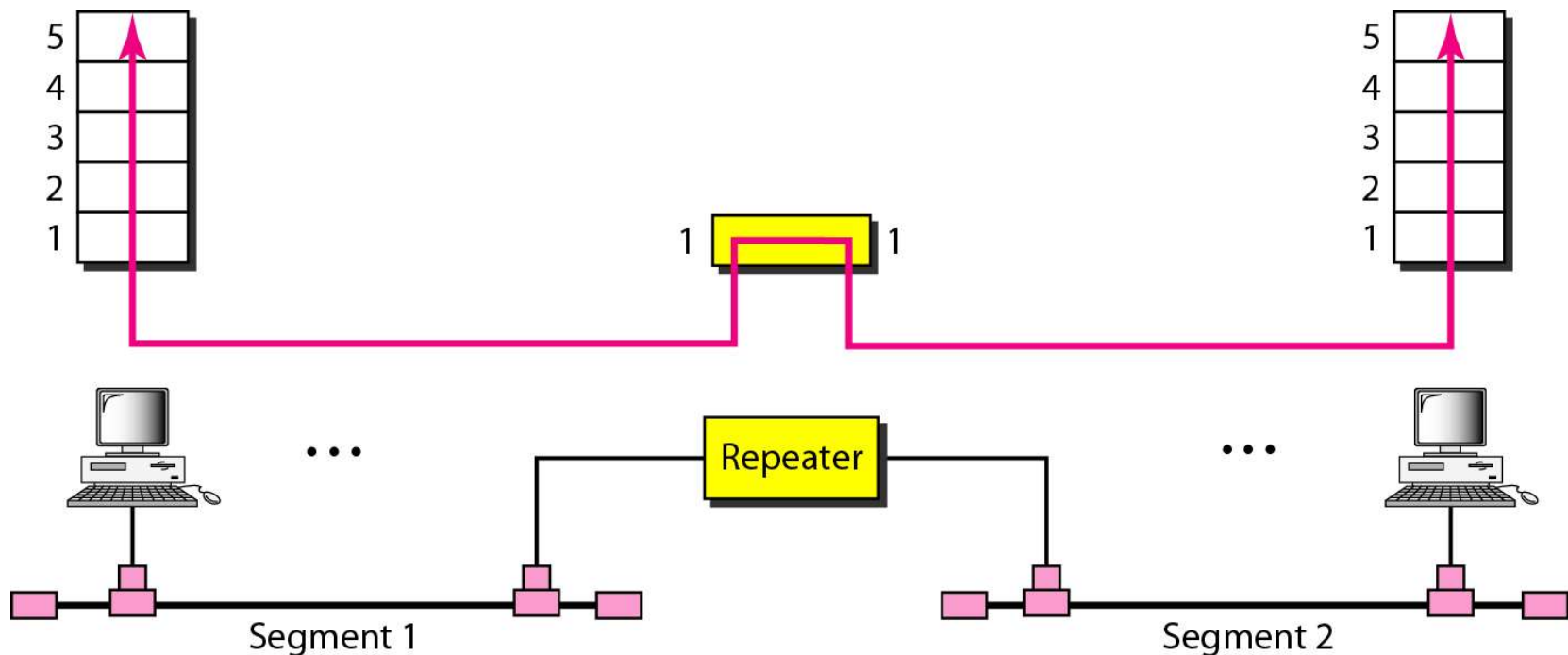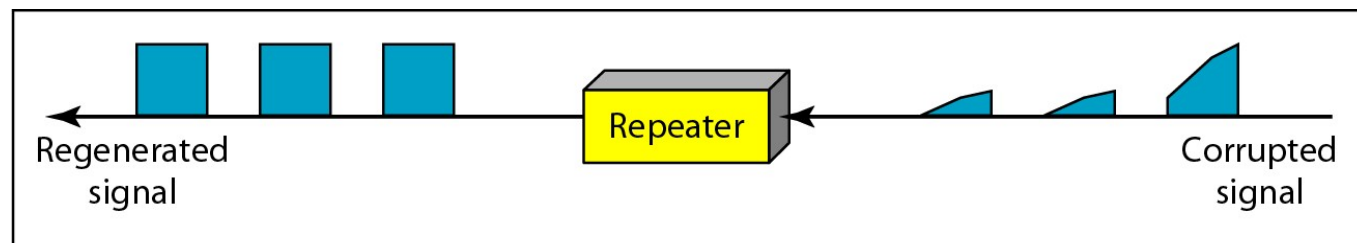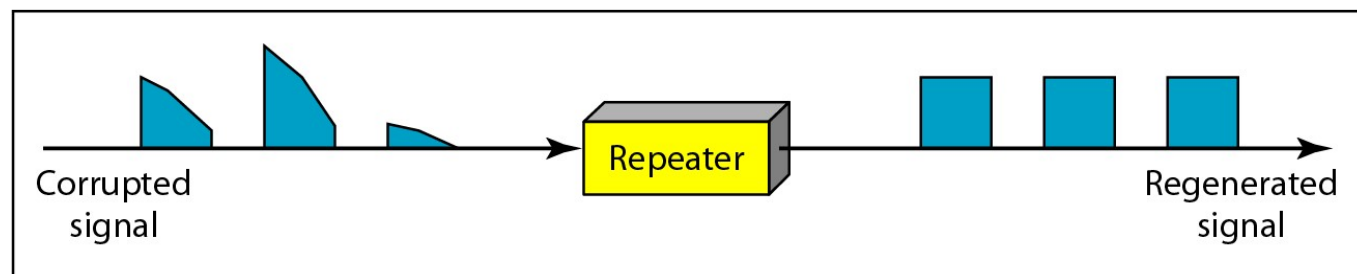A repeater is a regenerator, not an amplifier.

Figure 15.3 *Function of a repeater*

Repeaters are used to extend the range of a network by retransmitting signals. They also operate at the Physical Layer and are often used in long-distance connections.

a. Right-to-left transmission.

b. Left-to-right transmission.

Figure 15.4 *A hierarchy of hubs*

Hubs operate at the Physical Layer and simply serve as a central connection point for network devices. They are responsible for signal distribution without making any intelligent decisions. Hubs are considered a basic connecting device.
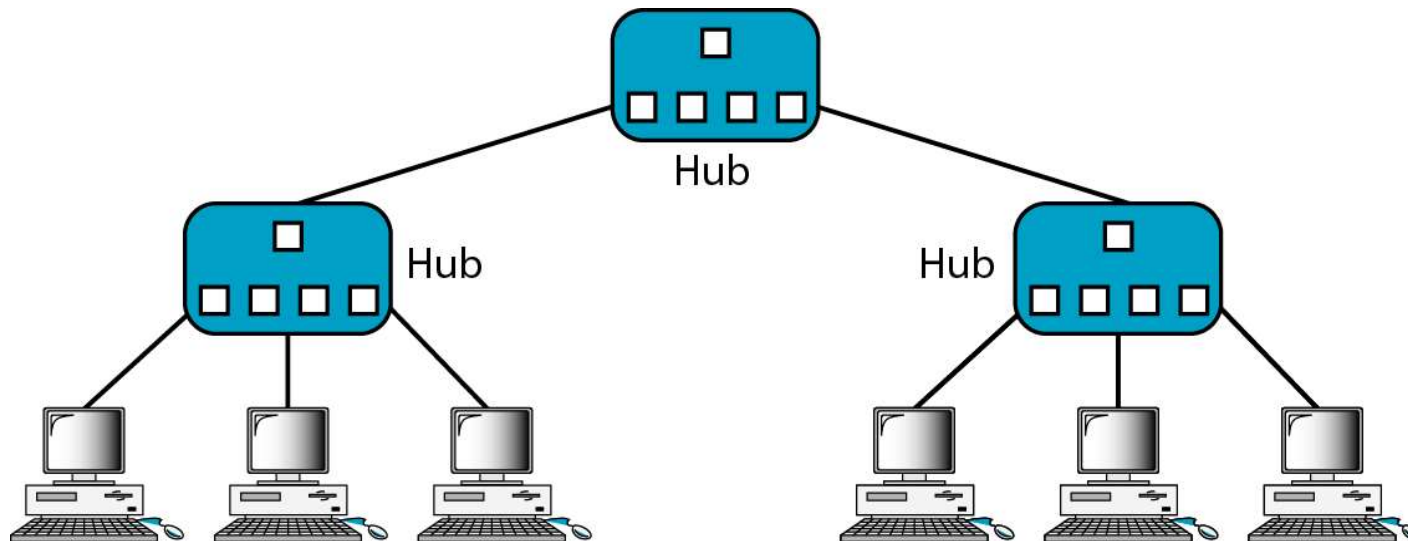
Figure 15.5 *A bridge connecting two LANs*

A bridge has a table used in filtering decisions. A bridge does not change the physical (MAC) addresses in a frame.

Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	1
64:2B:13:45:61:12	2
64:2B:13:45:61:13	2

Bridge Table

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

64:2B:13:45:61:12   64:2B:13:45:61:13
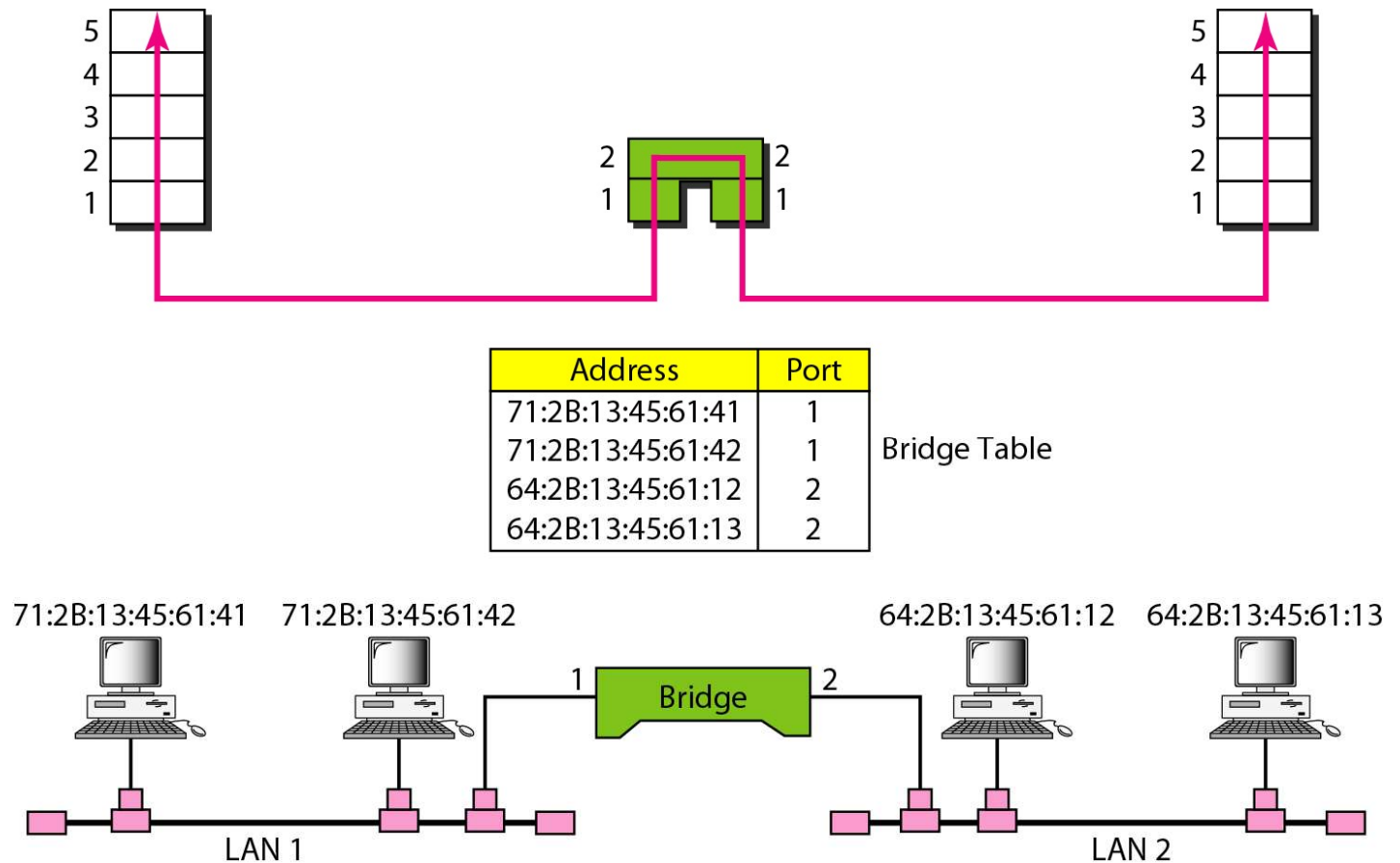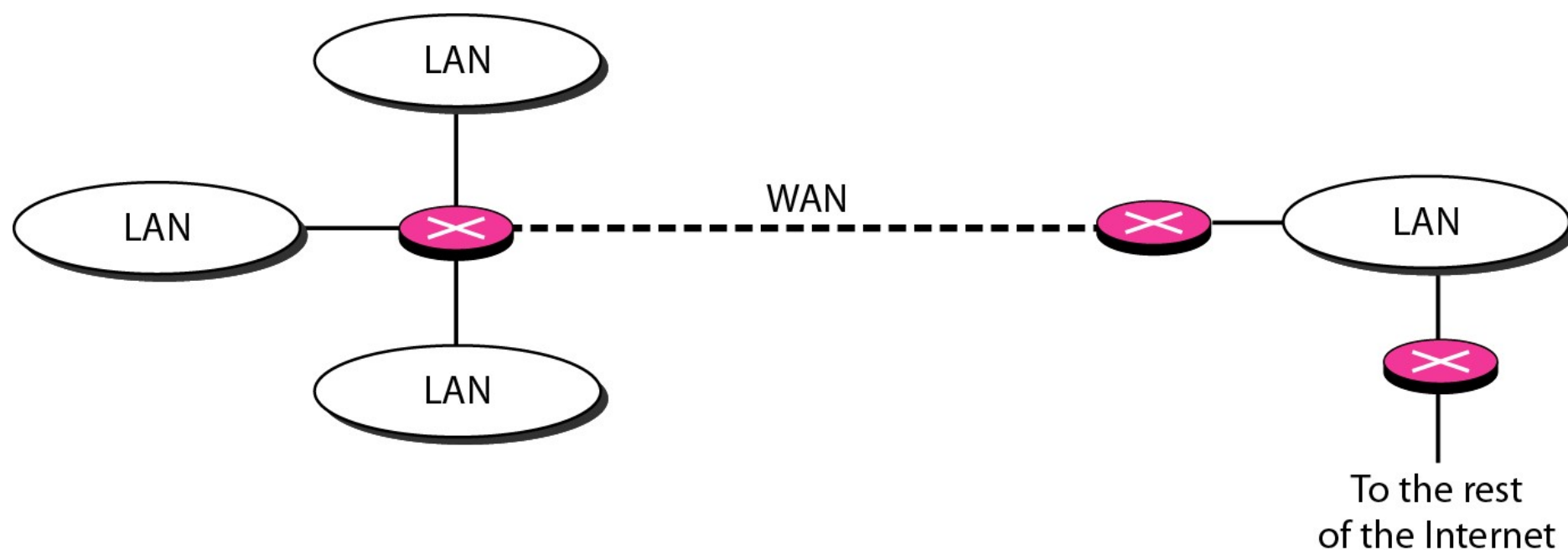
Bridge

LAN 1

LAN 2

Figure 15.11 *Routers connecting independent LANs and WANs*

Routers operate at the Network Layer and are responsible for forwarding data between different IP subnets or networks. They make routing decisions based on IP addresses and are crucial for interconnecting networks.

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.

Topics discussed in this section:

Bus Backbone
Star Backbone
Connecting Remote LANs

15.9

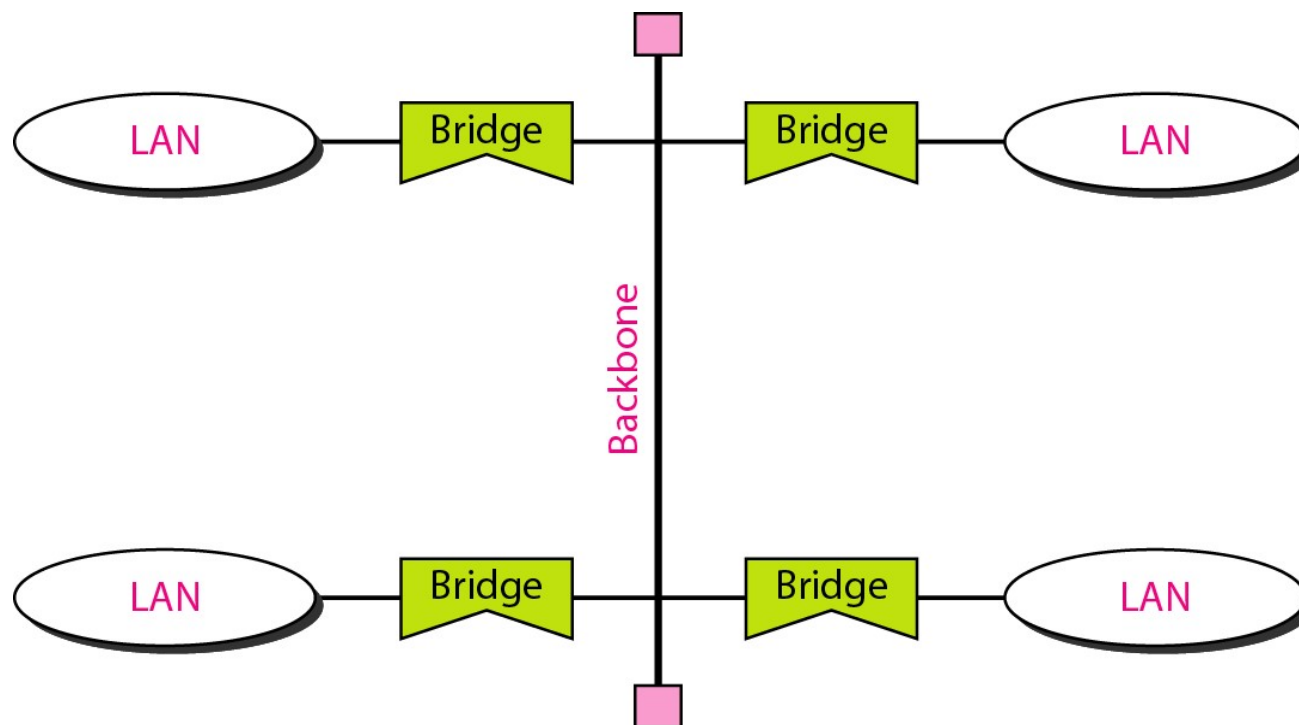**Figure 15.12** *Bus backbone*

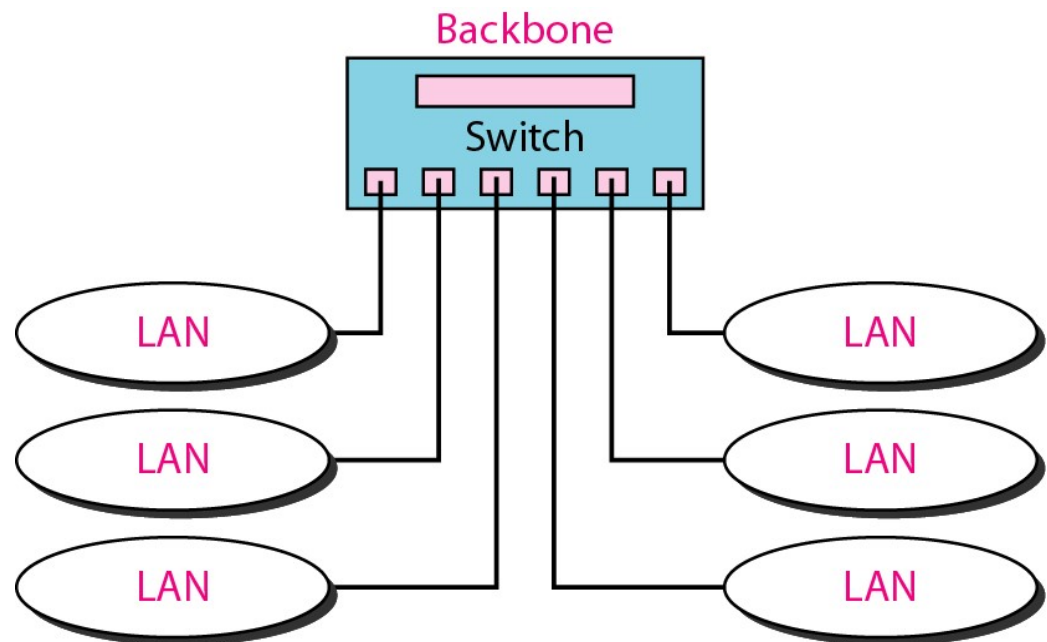In a bus backbone, the topology
of the backbone is a bus.

Figure 15.13 *Star backbone*

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

Backbone

Switch

LAN

LAN

LAN

LAN

LAN

LAN

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.

Topics discussed in this section:

Membership
Configuration
Communication between Switches
Advantages

15.12

Figure 15.15 *A switch connecting three LANs*

❑ In a switched LAN, changing the workgroup means physical changes in the network configuration.

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

Virtual LANs

❑ One biggest advantages is that when a station moves from one group to another, without any hardware reconfiguration
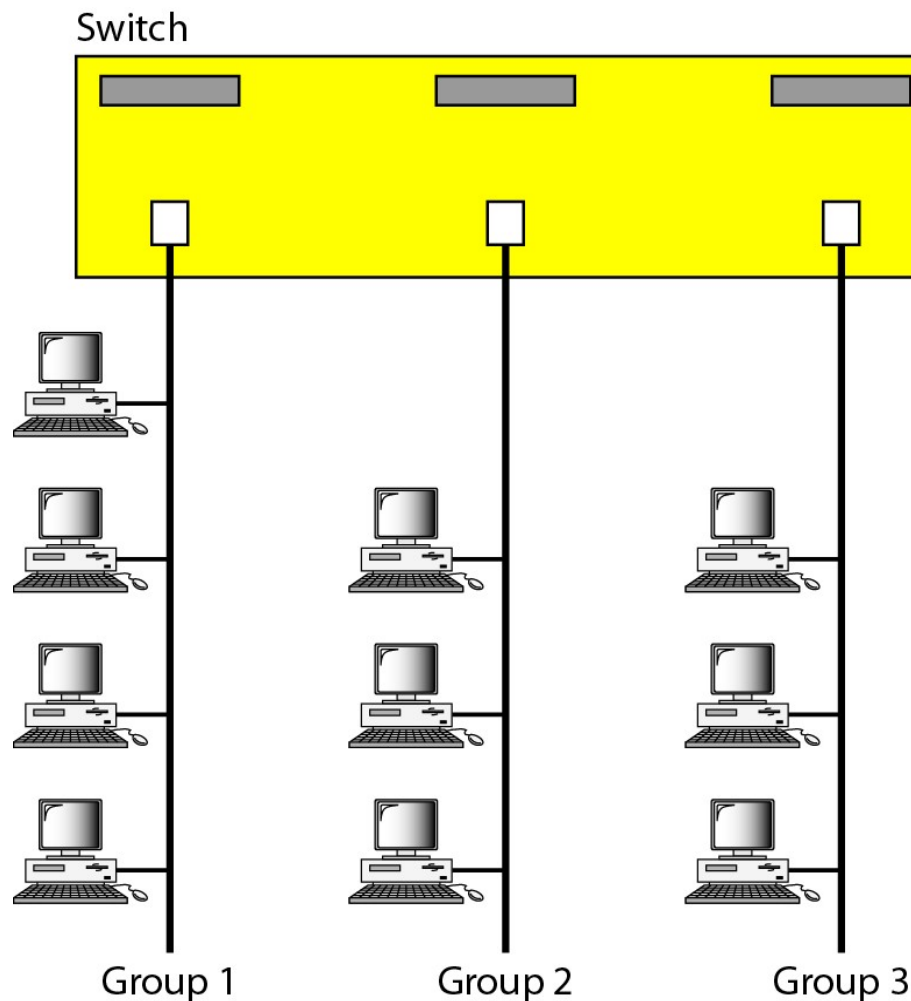
Switch

Group 1   Group 2   Group 3

Figure 15.16 *A switch using VLAN software*

❑ VLANs are configured through software rather than hardware, which makes them extremely flexible

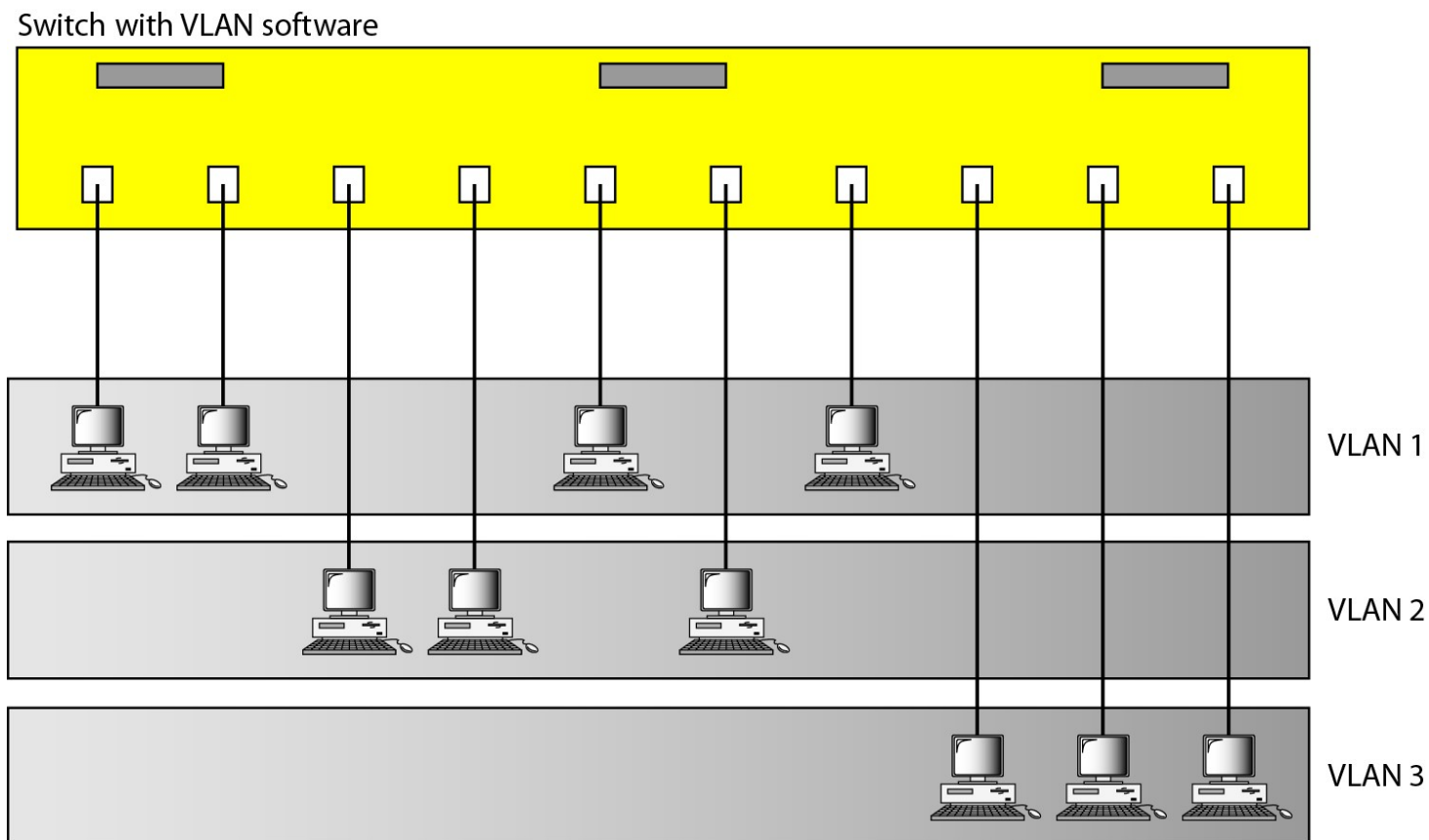Switch with VLAN software

VLAN 1

VLAN 2

VLAN 3

15.14

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

VLANs create broadcast domains.

❑ All members belonging to a VLAN can receive broadcast messages sent to that particular VLAN.