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:

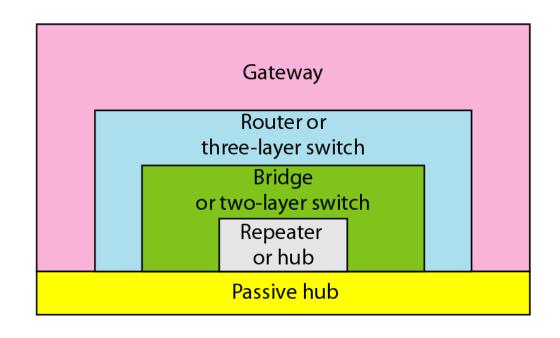**Passive Hubs**
Active Hubs
Bridges
Two-Layer Switches
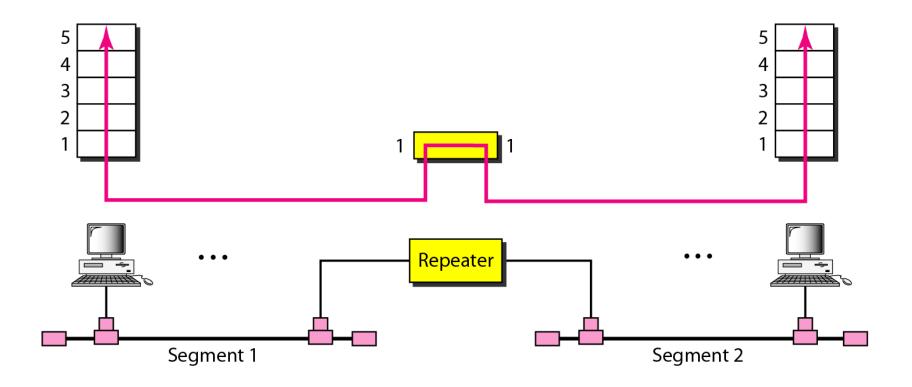**Routers**
Three-Layer Switches
Gateways
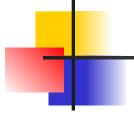
Figure 15.1 *Five categories of connecting devices*

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

15.3

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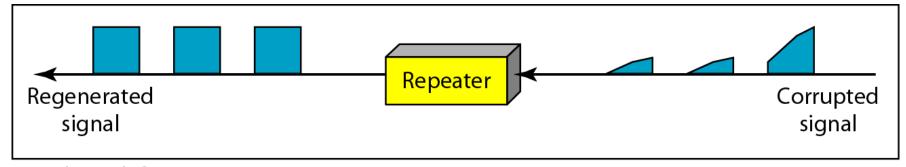
A repeater connects segments of a LAN.

Note

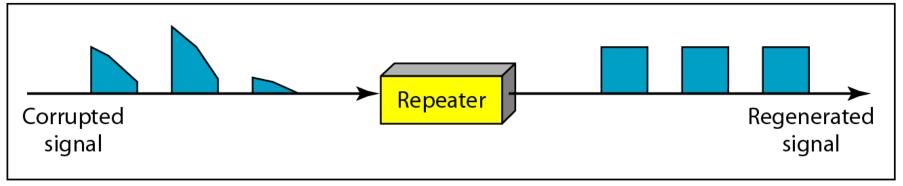A repeater forwards every frame;
it has no filtering capability.

A repeater is a regenerator, not an amplifier.
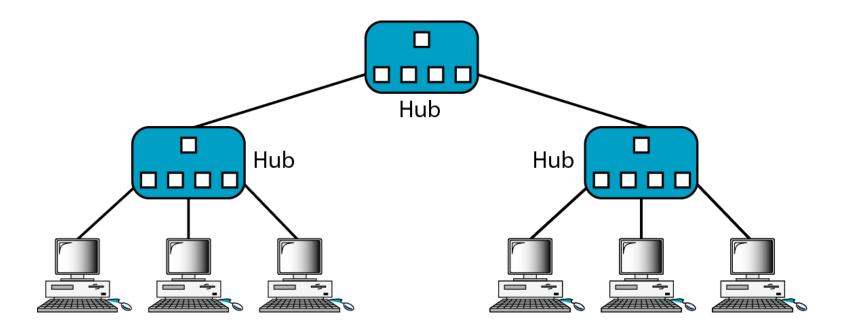
Figure 15.3 *Function of a repeater*

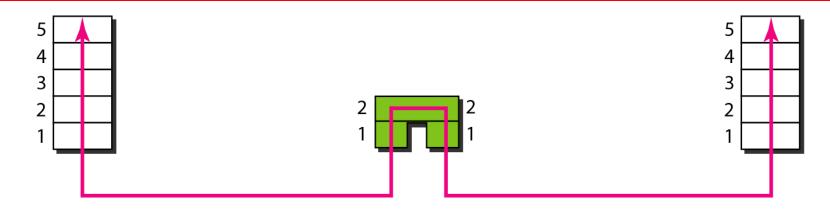a. Right-to-left transmission.

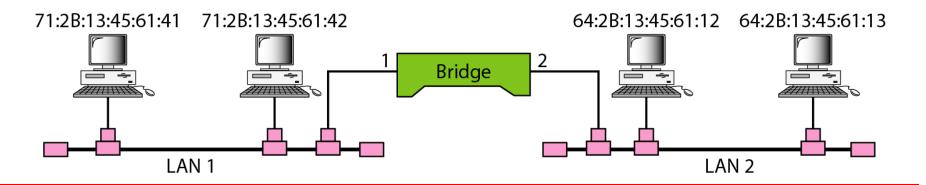b. Left-to-right transmission.

Figure 15.4 *A hierarchy of hubs*

A bridge has a table used in filtering decisions.
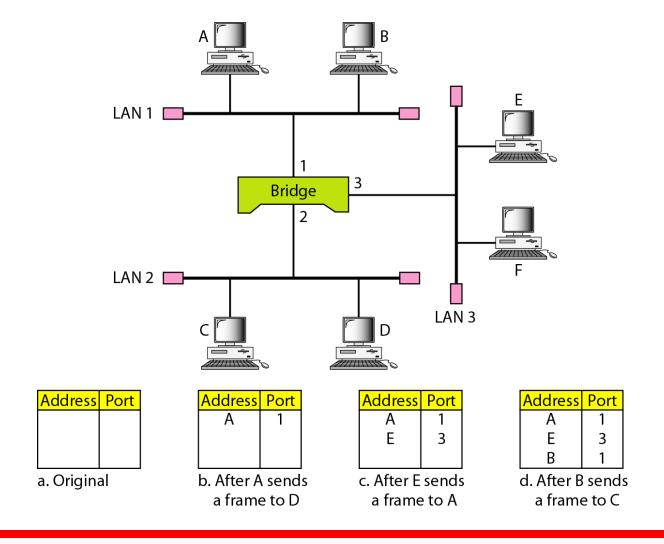
Figure 15.5 *A bridge connecting two LANs*

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

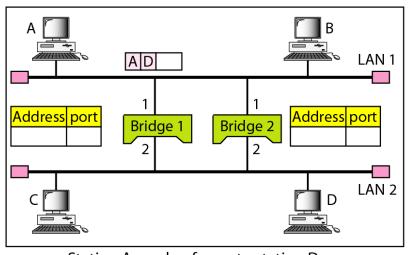**A bridge does not change the physical (MAC) addresses in a frame.**
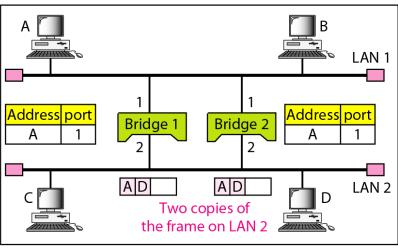
Figure 15.6 *A learning bridge and the process of learning*

Address	Port

a. Original

Address	Port
A	1

b. After A sends
a frame to D

Address	Port
A	1
E	3

c. After E sends
a frame to A

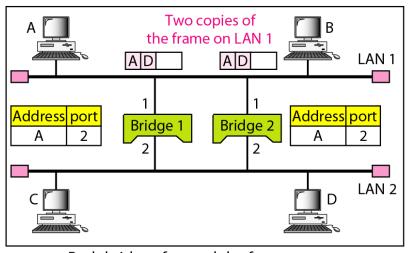| Address	Port
A	1
E	3
B	1

d. After B sends
a frame to C
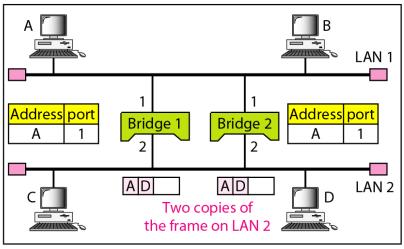
Figure 15.7 *Loop problem in a learning bridge*

a. Station A sends a frame to station D
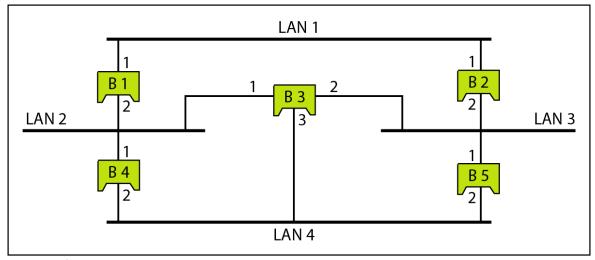
b. Both bridges forward the frame
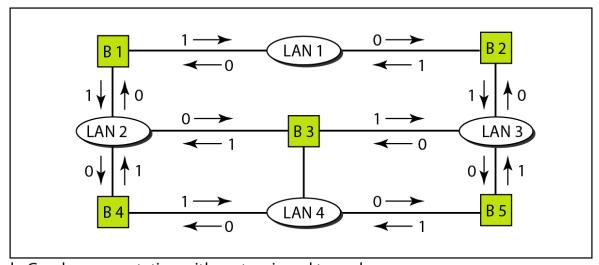
c. Both bridges forward the frame

d. Both bridges forward the frame

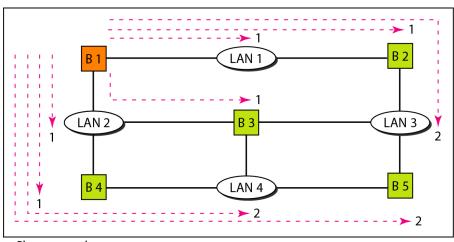# Figure 15.8 *A system of connected LANs and its graph representation*
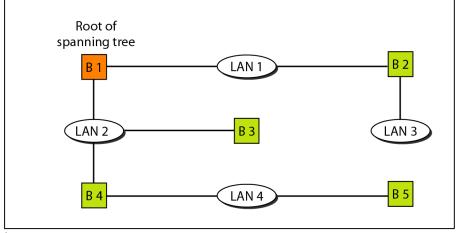

a. Actual system

b. Graph representation with cost assigned to each arc

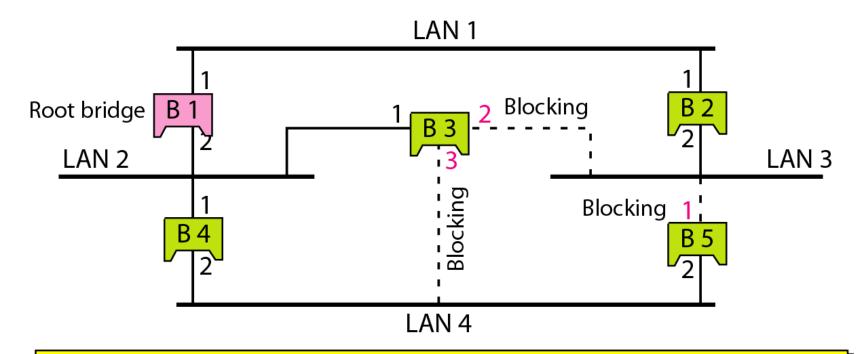# Figure 15.9 *Finding the shortest paths and the spanning tree in a system of bridges*
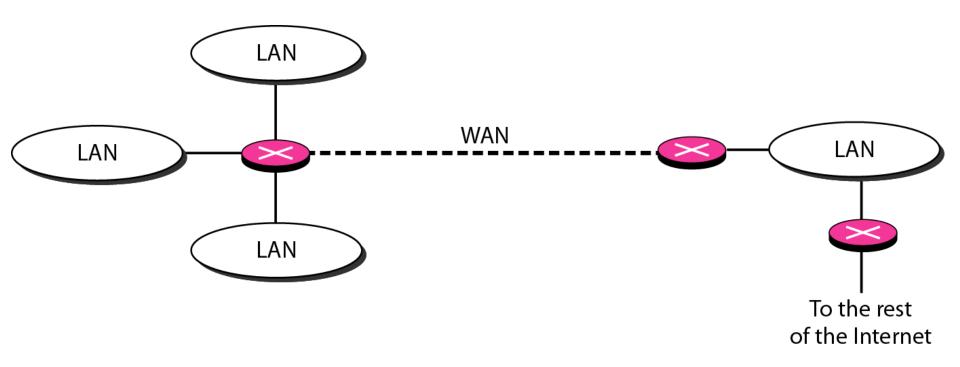

a. Shortest paths

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).

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.
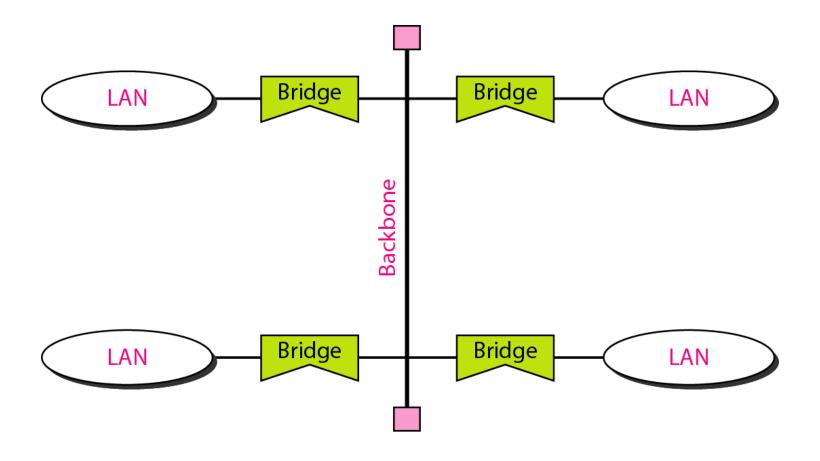
Topics discussed in this section:

Bus Backbone
Star Backbone
Connecting Remote LANs

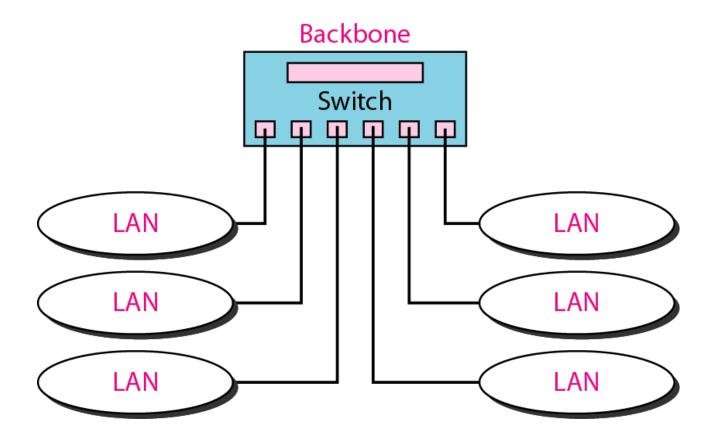**In a bus backbone, the topology
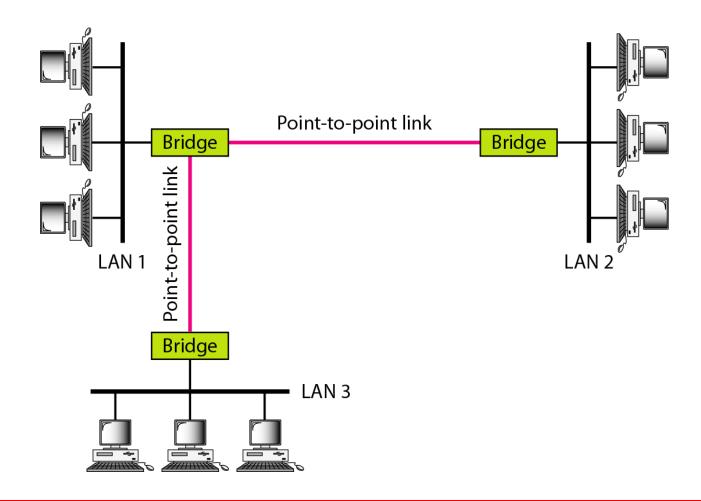of the backbone is a bus.**

Figure 15.12 *Bus backbone*

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

Figure 15.13 *Star backbone*

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.
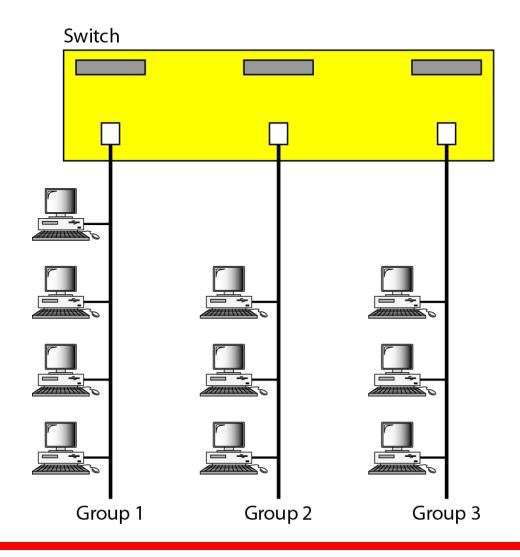
15-3   VIRTUAL LANs

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

Topics discussed in this section:

Membership
Configuration
Communication between Switches
IEEE Standard
Advantages

15.26

Figure 15.15 *A switch connecting three LANs*

Figure 15.16 *A switch using VLAN software*

Switch with VLAN software
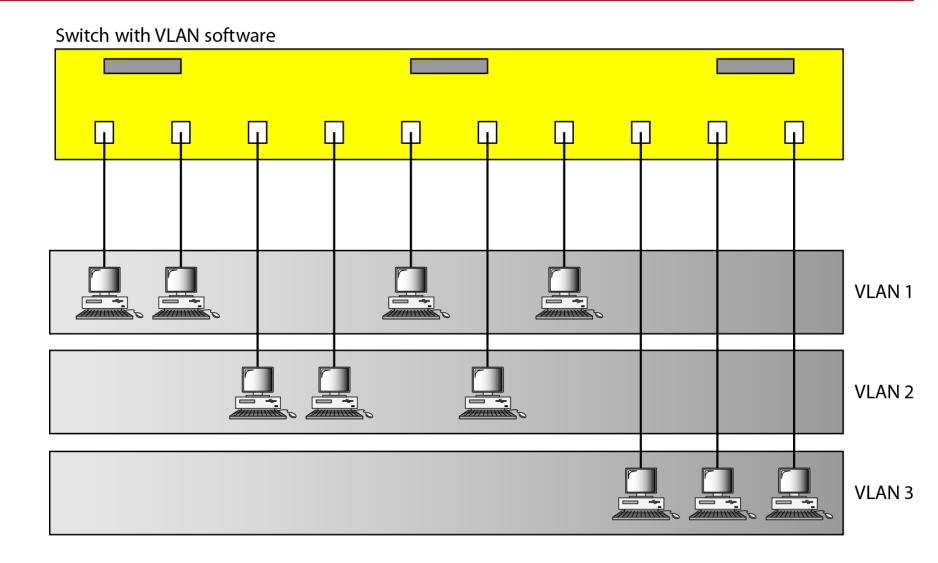

VLAN 1

VLAN 2

VLAN 3

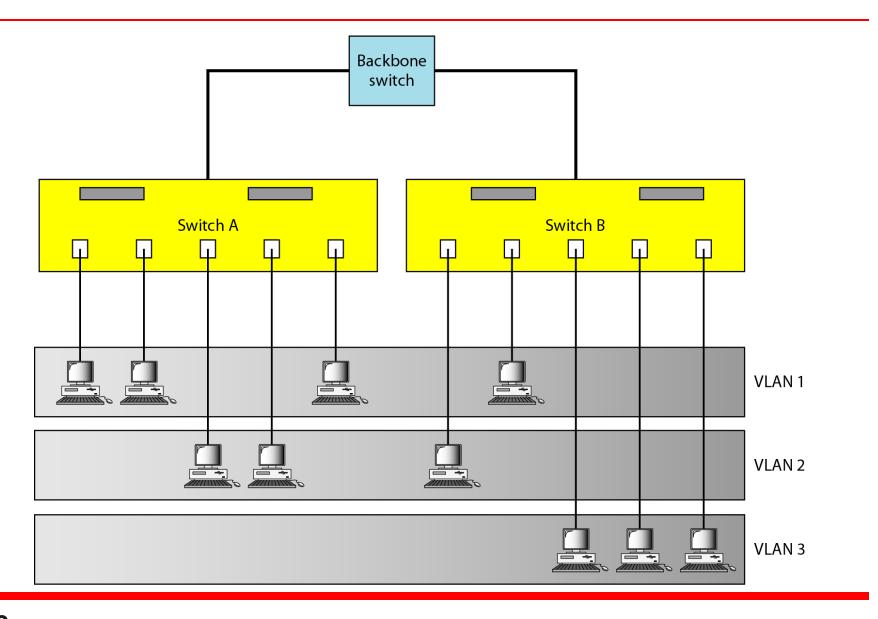# Figure 15.17 *Two switches in a backbone using VLAN software*

Note

VLANs create broadcast domains.