

Data Communications

Connecting Devices

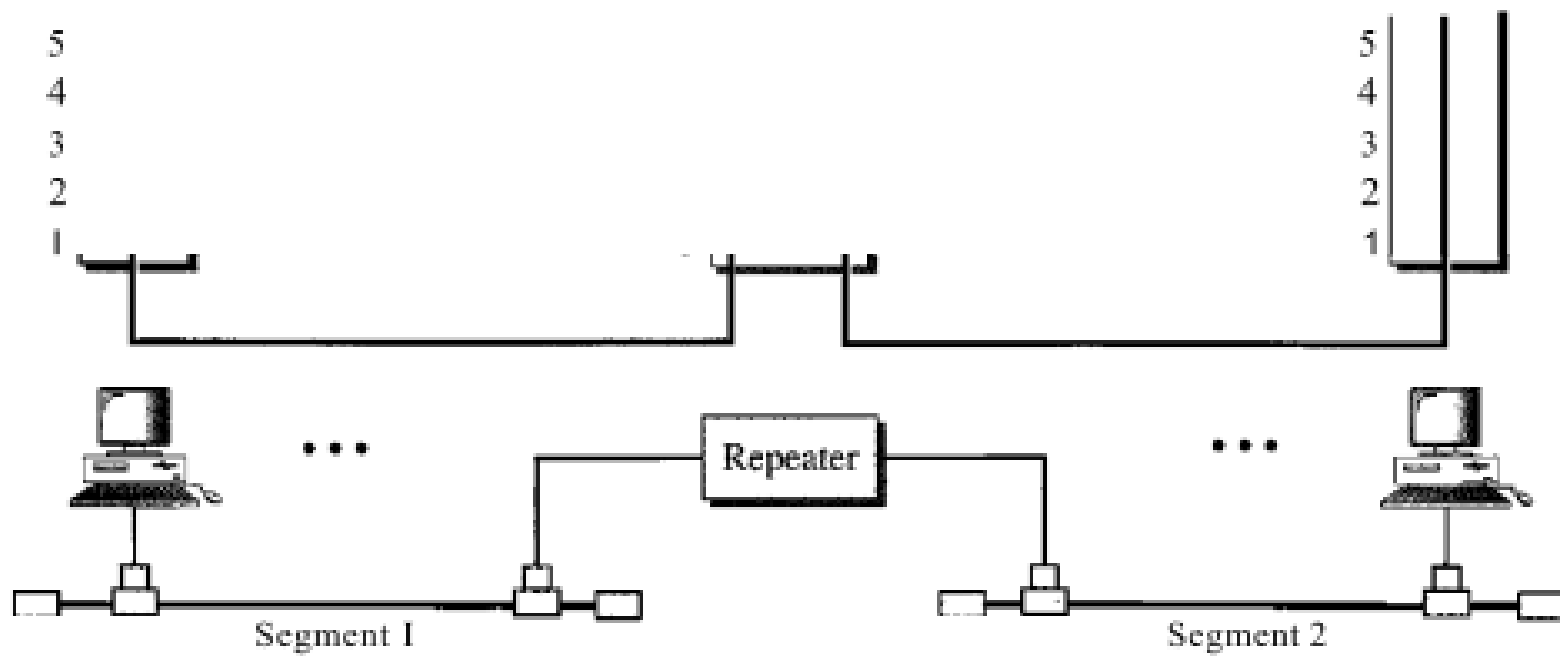
Connecting Devices

- Networks do not normally operate in isolation.
- They are connected to one another or to the Internet.
- To connect LANs, or segments of LANs, we use connecting devices.

Repeaters

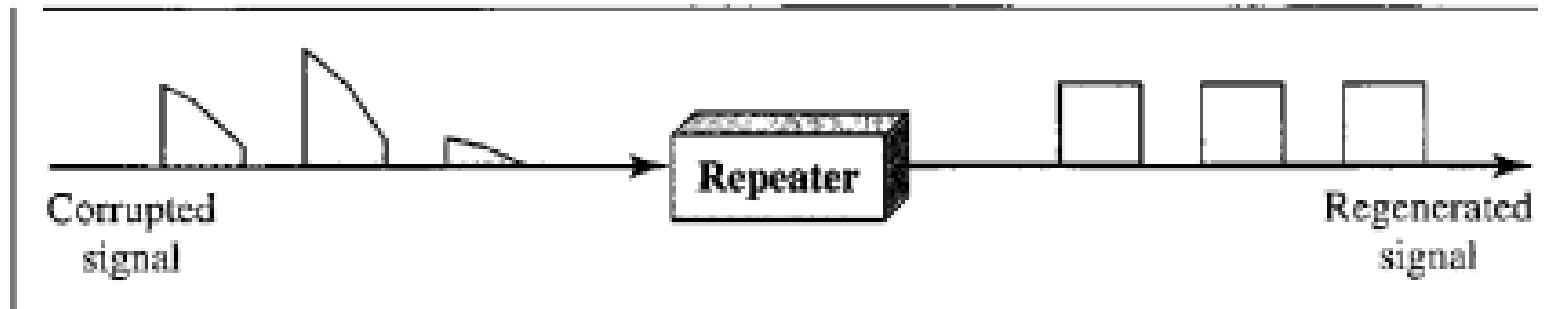
- A repeater receives a signal and, before it becomes too weak or corrupted, regenerates the original bit pattern.
- A repeater can extend the physical length of a LAN
- A repeater is a device that operates only in the physical layer.

Repeater



Repeaters

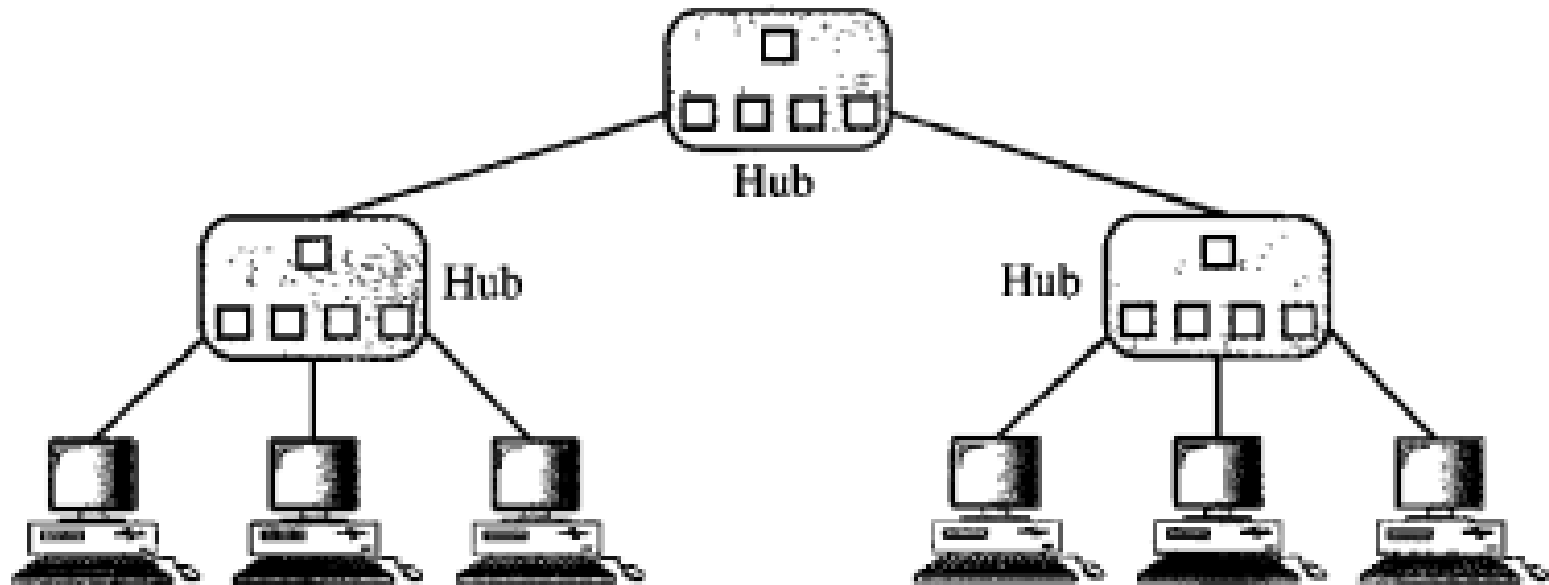
- A repeater connects segments of a LAN.
- A repeater forwards every frame; it has no filtering capability.
- A repeater is a regenerator, not an amplifier.



HUBs

- A hub is actually a multipart repeater.
- Hubs are normally used to create connections between stations in a physical star topology
- Hubs can also be used to create multiple levels of hierarchy
- Hubs are considered as collision domains

HUBs



HUBs

- Repeater hubs also participate in collision detection, forwarding a jam signal to all ports if it detects a collision.
- Hubs are used for connecting multiple Ethernet devices together and making them act as a single network segment



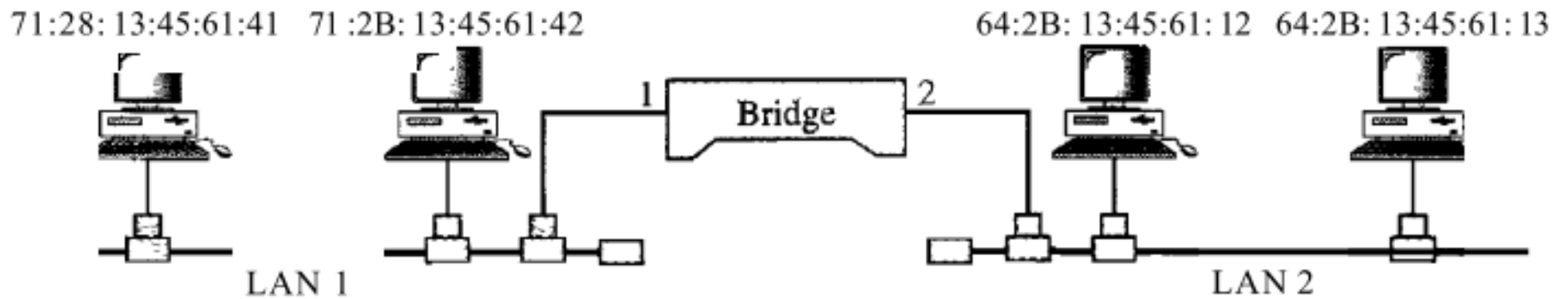
Bridges

- A bridge operates in both the physical and the data link layer.
- As a data link layer device, the bridge can check the physical (MAC) addresses (source and destination) contained in the frame.
- A bridge has filtering capability. It can check the destination address of a frame and decide if the frame should be forwarded or dropped.

Bridges

Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	1
64:2B:13:45:61:12	2
64:28:13:45:61:13	2

Bridge Table



Bridges

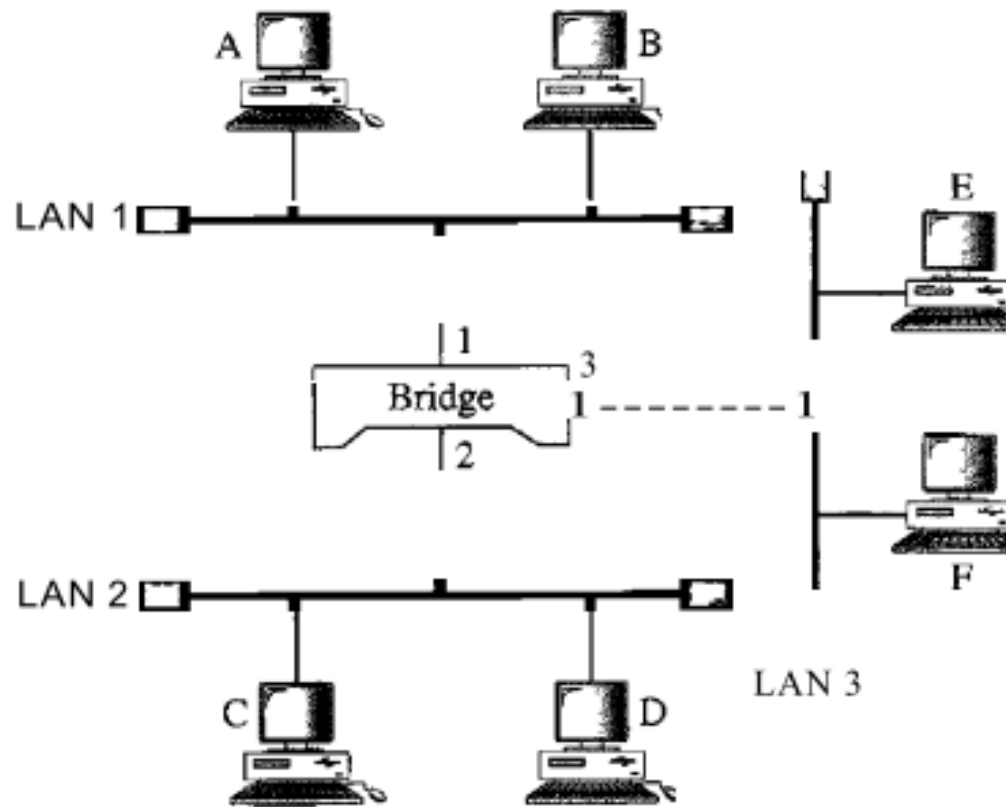
- A bridge does not change the physical (MAC) addresses in a frame.
- A bridge reduces the collision rate and increases the network performance by isolating the network segments.

Transparent Bridges

- A transparent bridge is a bridge in which the stations are completely unaware of the bridge's existence.
- If a bridge is added or deleted from the system, reconfiguration of the stations is unnecessary.
- Transparent bridges must meet have three criteria:
 - Frames must be forwarded from one station to another.
 - The forwarding table is automatically made by learning frame movements in the network.
 - Loops in the system must be prevented.

Learning in a Bridge

- The bridge inspects both the destination and the source addresses.
- The destination address is used for the forwarding decision (table lookup).
- The source address is used for adding entries to the table and for updating purposes.



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

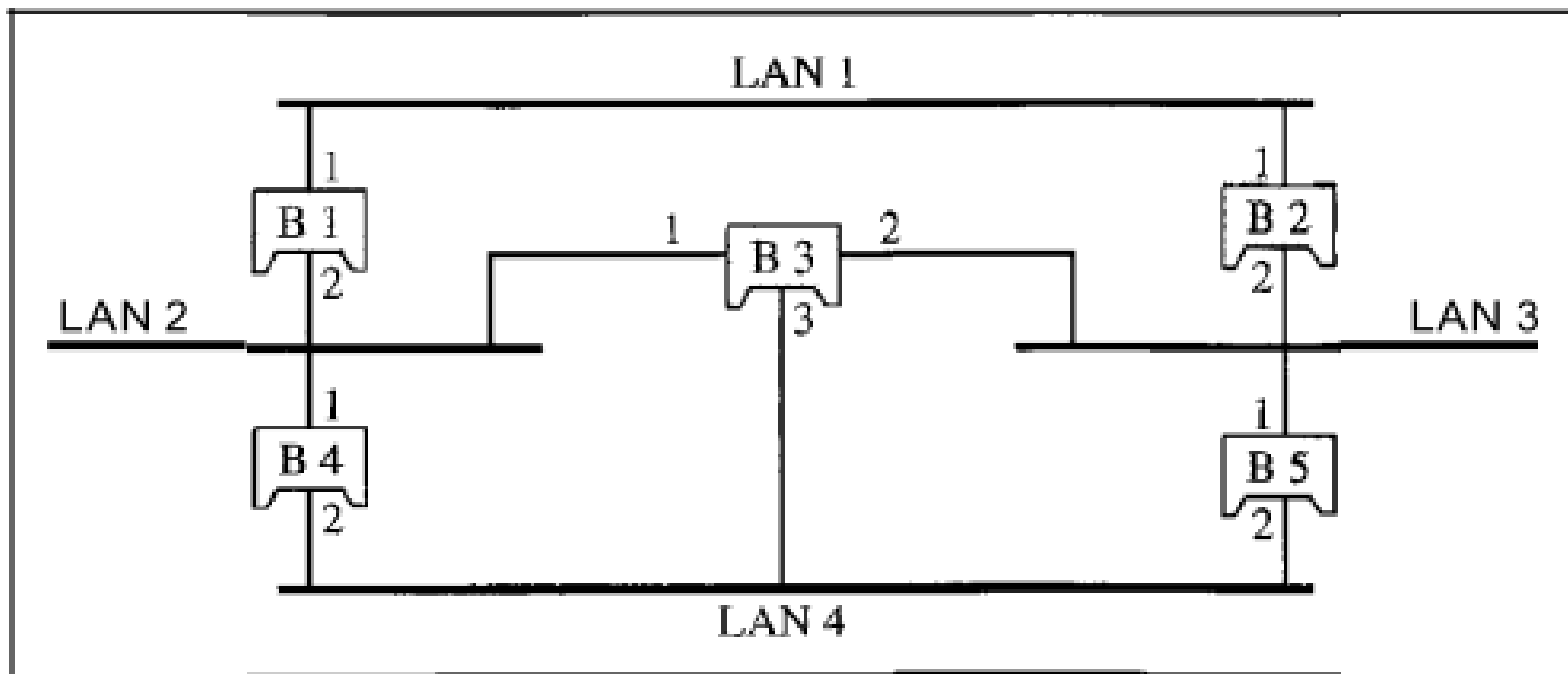
Address	Port
A	1
E	3
B	1

d. After B sends a frame to C

Preventing Loops

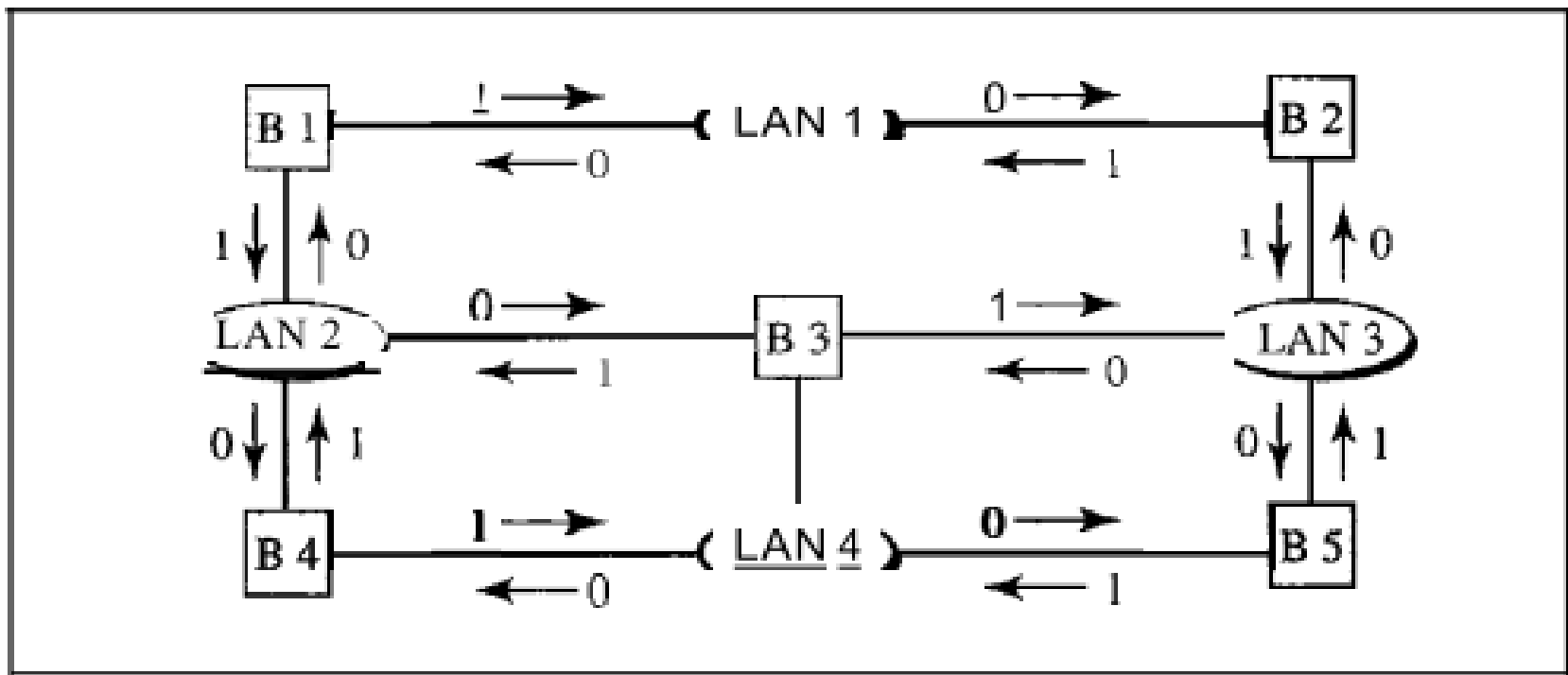
- If LANs are connected through different bridges, there exists the possibility of delivering a frame twice through different bridges to a destination network.
- This problem happens when a loop is created in the graph of the networks.

Preventing Loops



Algorithm for Preventing Loops

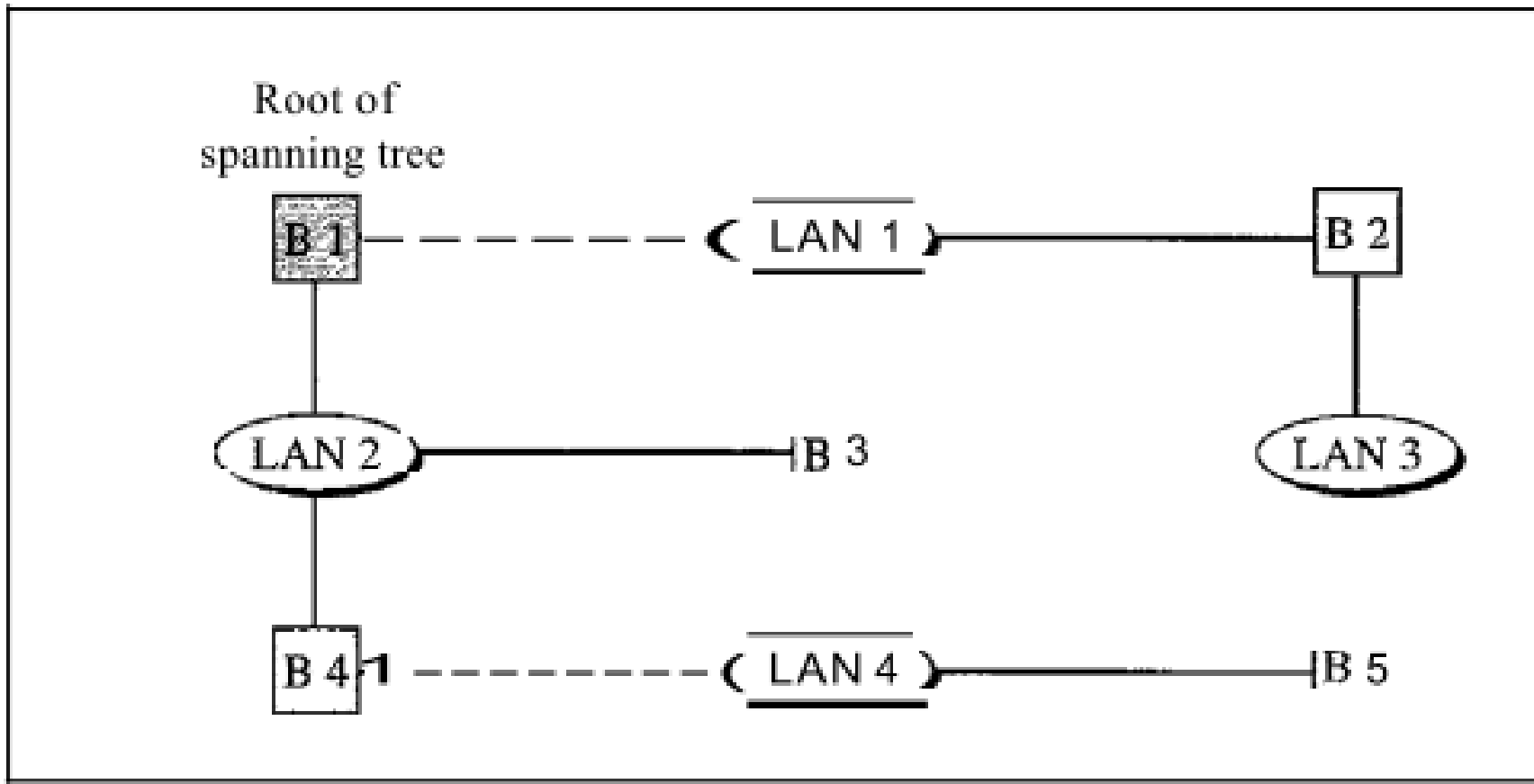
- Consider the cost of each bridge to LAN connection as 1 and LAN to bridge as 0



Algorithm for Preventing Loops

- Use the bridge with smallest ID as root
- Find the shortest path from root to all networks
- Keep the connections on the shortest paths and disable the rest
- The network with shortest paths is called a spanning tree

Spanning Tree of the Network



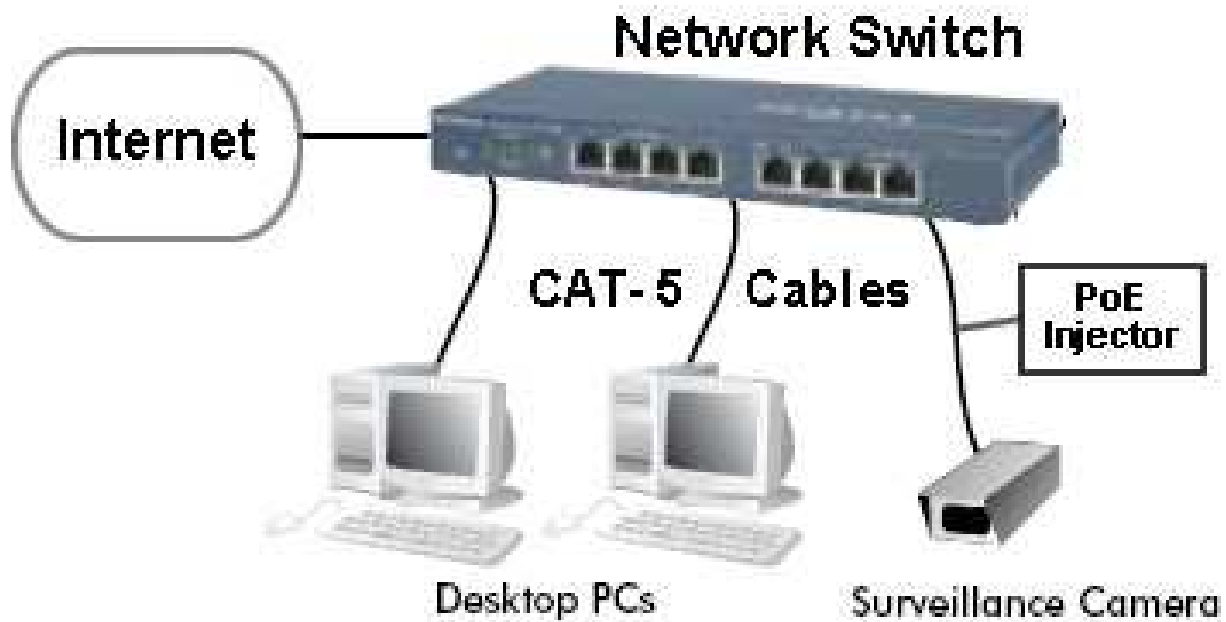
Dual-Speed HUBs

- Hubs suffered from the problem that if there were any 10BASE-T devices connected then the whole network needed to run at 10 Mbit/s.
- Therefore a hub behaving such as a bridge was developed, known as a dual-speed hub.
- These devices consist of an internal two-port switch, bridging the 10 Mbit/s and 100 Mbit/s segments.

Switches

- A network switch is a device that links network segments or network devices.
- Unlike hubs which broadcast any packet entering a port on every other port, switches select which packets are forwarded to which port(s).
- Switches eliminate collisions

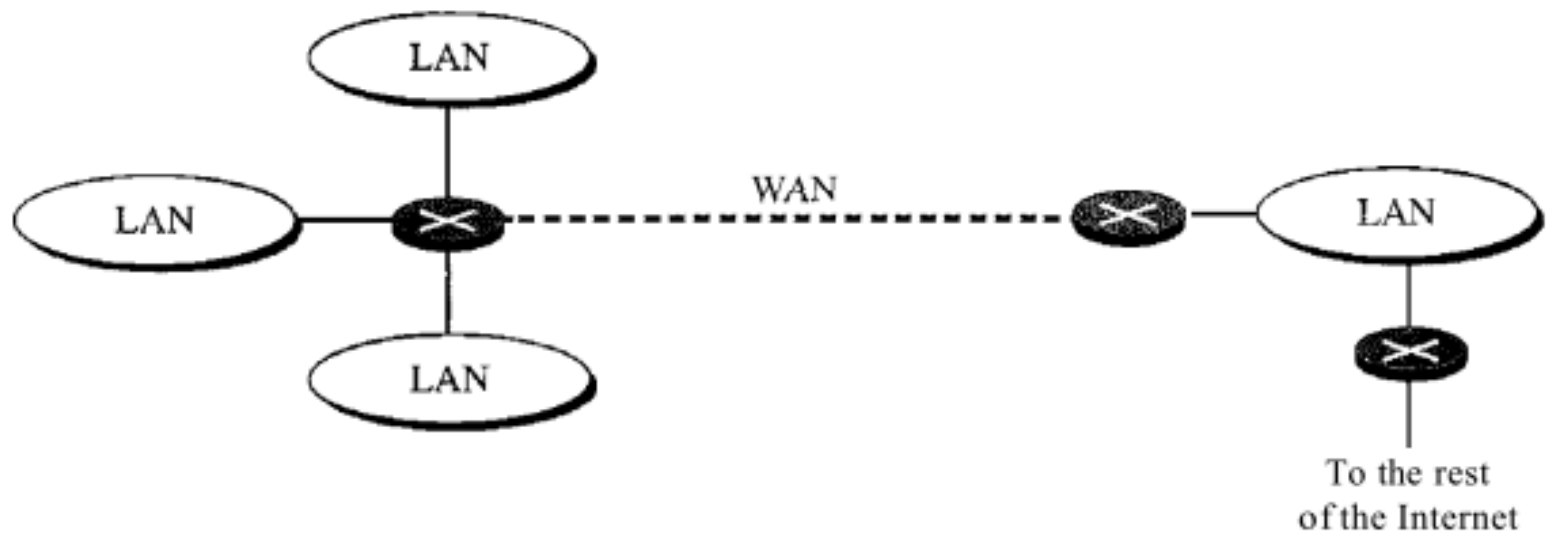
Switches



Routers

- A router is a three-layer device that routes packets based on their logical addresses (host-to-host addressing).
- A router normally connects LANs and WANs in the Internet and has a routing table that is used for making decisions about the route.

Routers

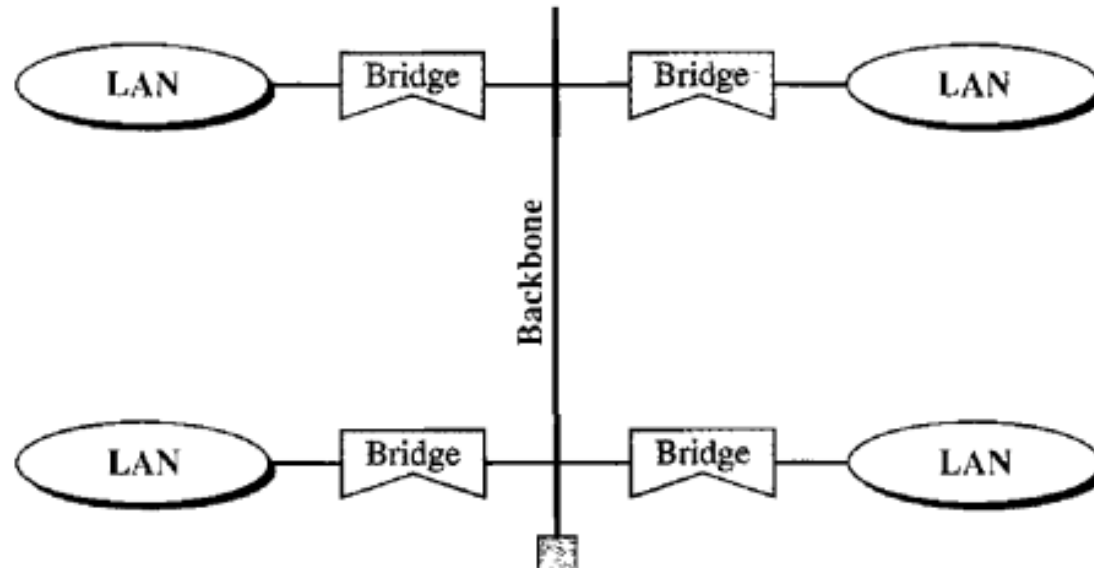


Backbone Networks

- 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.
- The backbone is itself a LAN that uses a LAN protocol such as Ethernet; each connection to the backbone is itself another LAN.

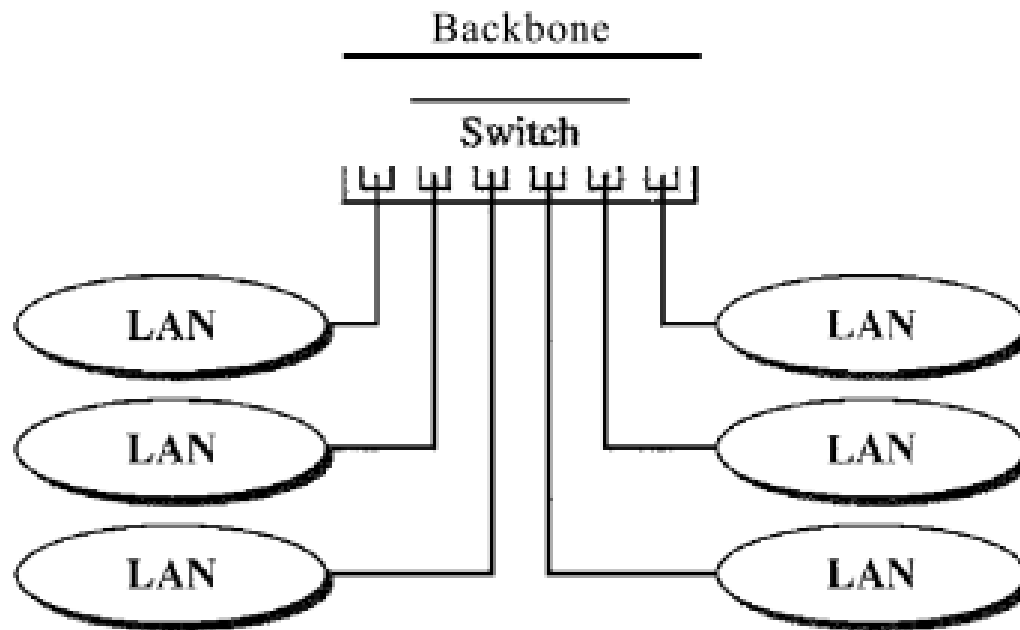
Most Common Backbone Types

- Bus Backbone
 - In a bus backbone, the topology of the backbone is a bus.



Most Common Backbone Types

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



Questions?