

Connecting Devices and Virtual LANs

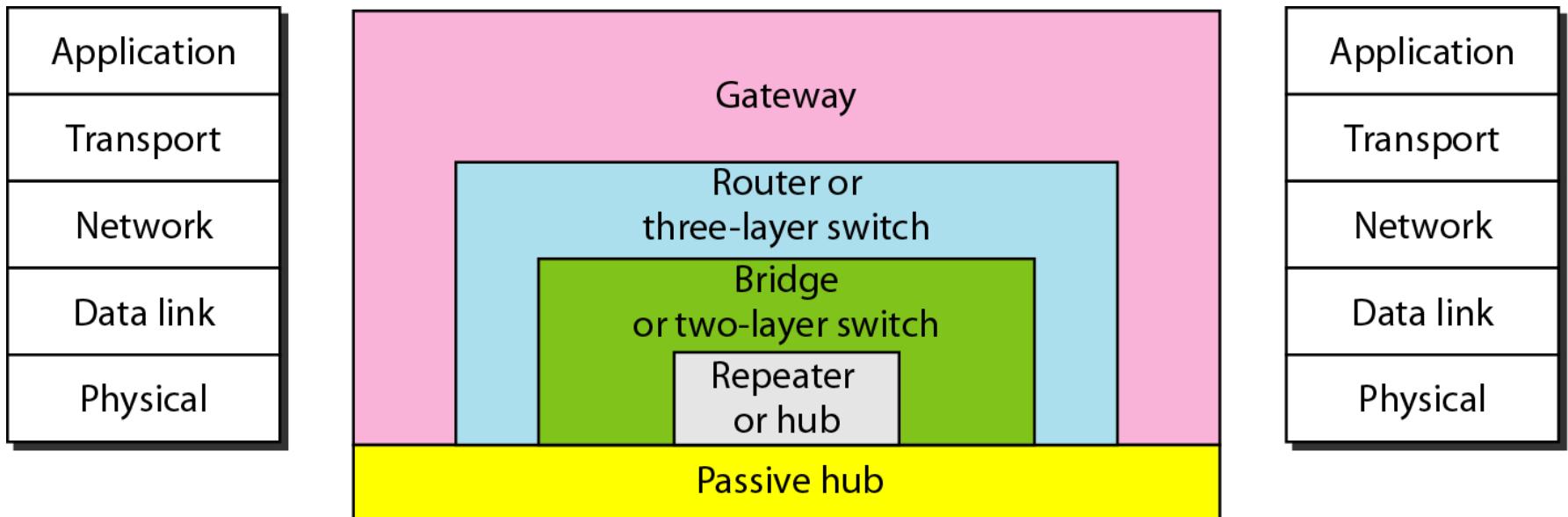
CONNECTING DEVICES

- *Connecting devices to connect hosts together to make a network or to connect networks together to make an internet.*
- *Connecting devices can operate in different layer of the internet model.*

Connecting Devices

- Repeaters
- Hubs
- Bridges
- Switches
- Routers

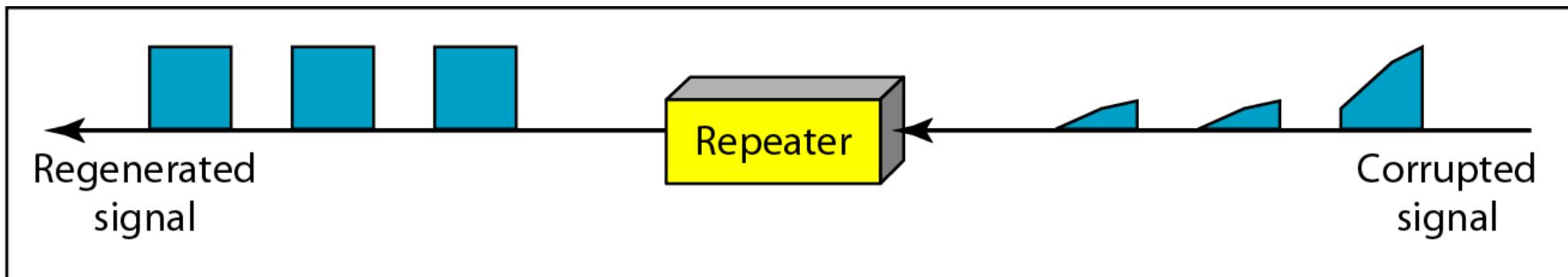
Figure Five categories of connecting devices



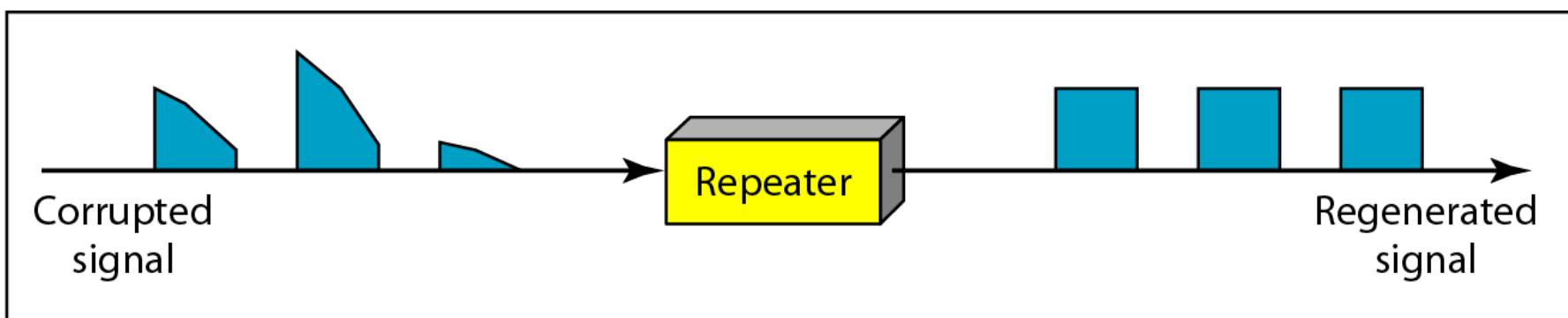
Repeaters

- A **physical layer** device that **acts on bits** not on **frames** or packets
- When a bit (0,1) arrives, the repeater receives it and **regenerates it**, then transmits it onto all other interfaces
- It regenerates the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network.
- **do not amplify the signal**

Figure Function of a repeater

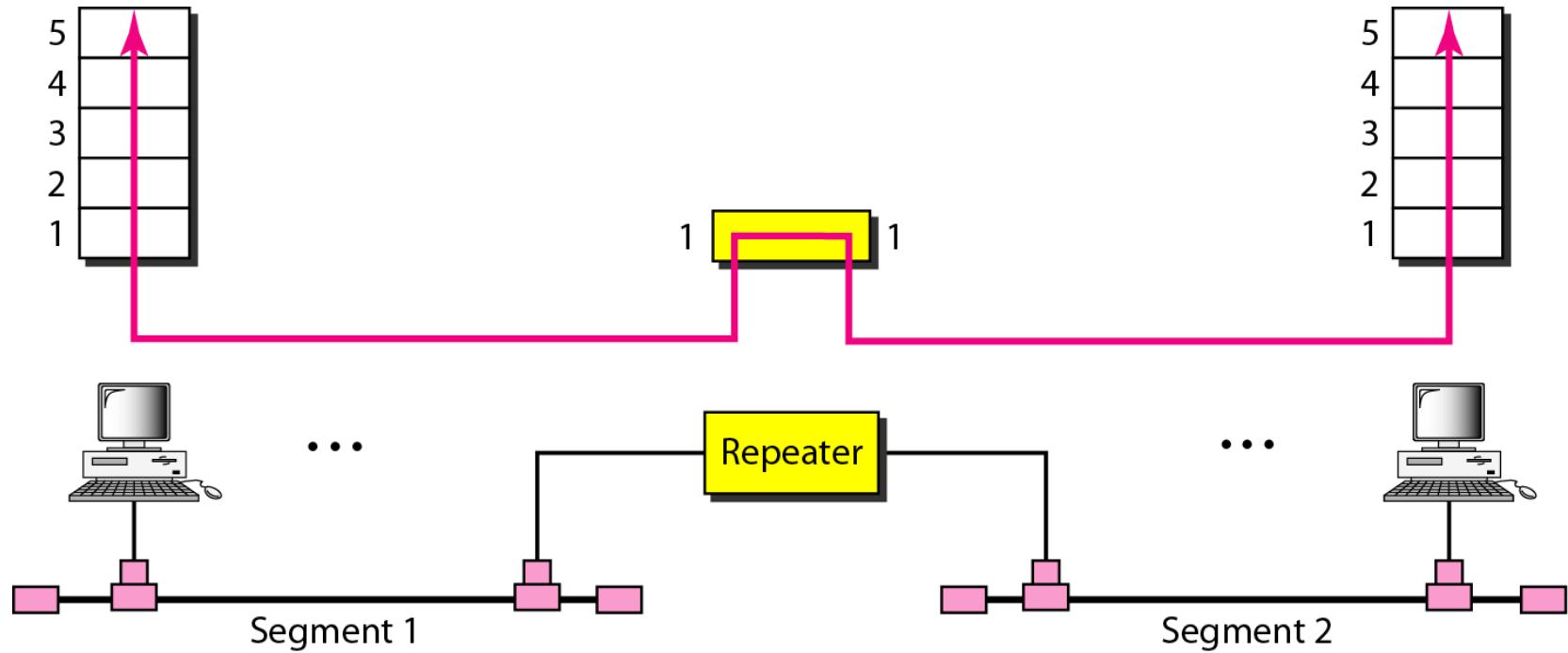


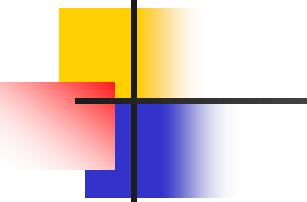
a. Right-to-left transmission.



b. Left-to-right transmission.

Figure A repeater connecting two segments of a LAN





Note

A repeater connects segments of a LAN.

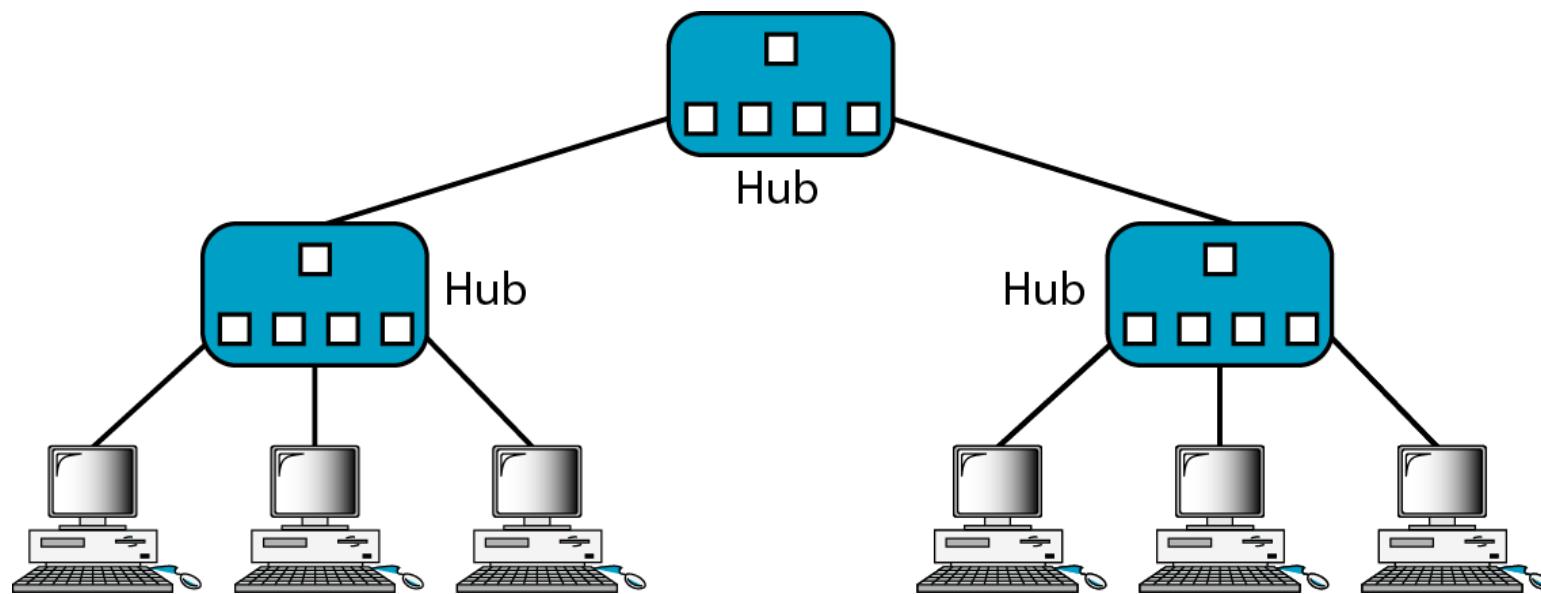
**A repeater forwards every frame;
it has no filtering capability.**

**A repeater is a regenerator,
not an amplifier.**

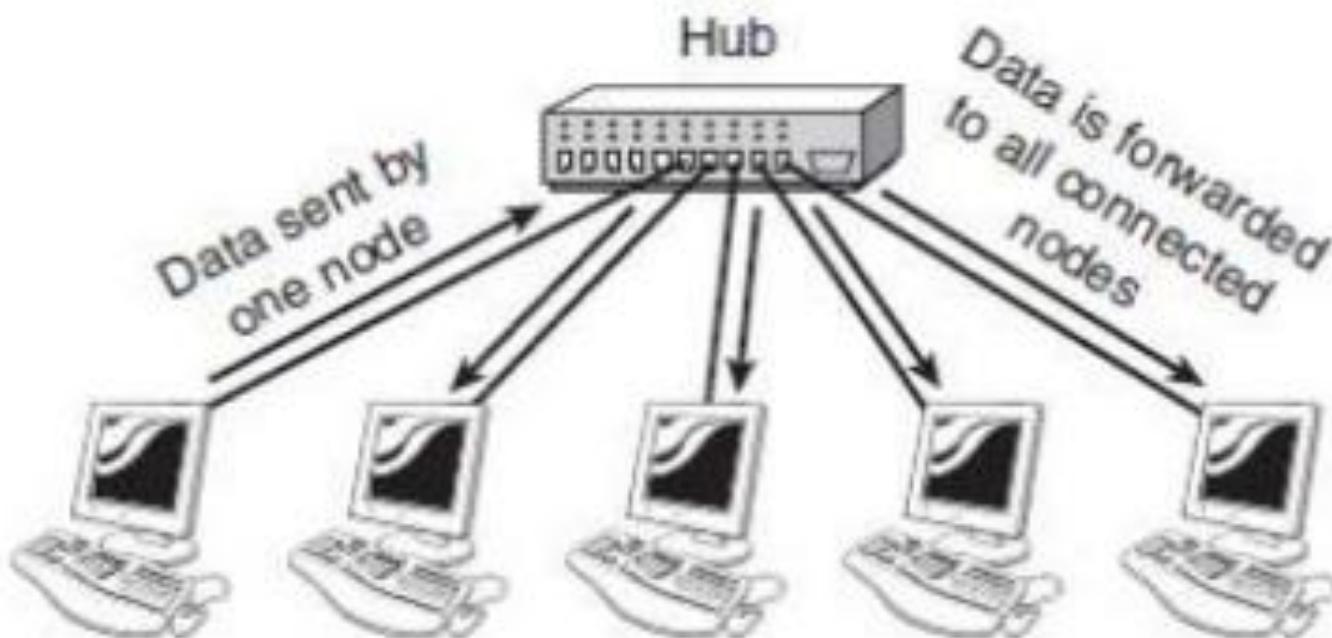
Hubs

- Acts on the **physical layer**
- Operate on **bits rather than frames**
- Also called **multiport repeater**
- Hub receives a bit from an adapter and sends it to **all** the other adapters without implementing any access method.
- does not do **filtering** (forward a frame into a specific destination or drop it) just it copy the received frame onto **all other links**
- Multiple Hubs can be used **to extend** the network length

Hubs



Hubs



Interconnecting with hubs

- **Advantage:**
 - Extends max distance between nodes
- **Disadvantages**
 - Individual segment collision domains become one large collision domain → **(reduce the performance)**

Bridges/switches

- Acts on both physical & **data link layer (MAC address level)**
- *switch* : N-Port bridge where N is equal to number of stations
- Bridge does not send the received frame to all other interfaces like hubs and repeaters, but **it performs filtering** which means:
 - Whether a frame should be **forwarded** to another interface that leads to the destination or **dropped**
- This is done by a bridge table (**forwarding table**) that contains entries for the nodes on the LAN
 - The bridge table is **initially empty** and **filled automatically by learning from frames movements** in the network
 - An entry in the bridge table consists of : **Node LAN (MAC) Address, Bridge Interface to which the node is connected to, the record creation time**

Address	Interface	Time
62-FE-F7-11-89-A3	1	9:32
7C-BA-B2-B4-91-10	3	9:36
...

Bridges

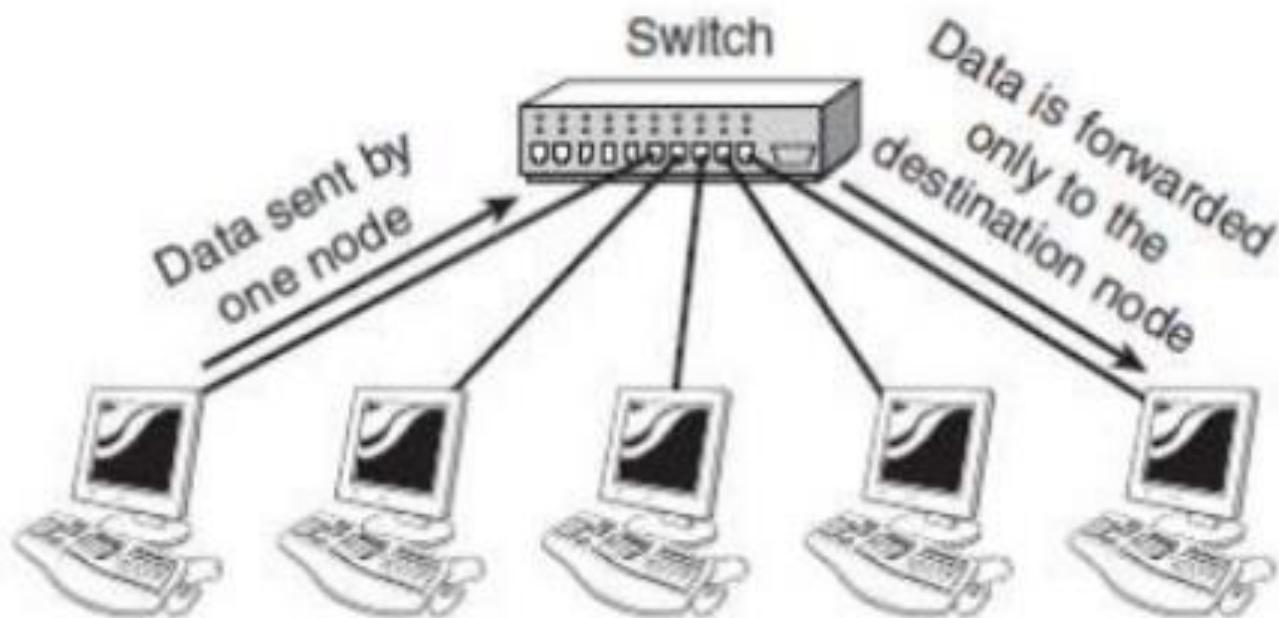
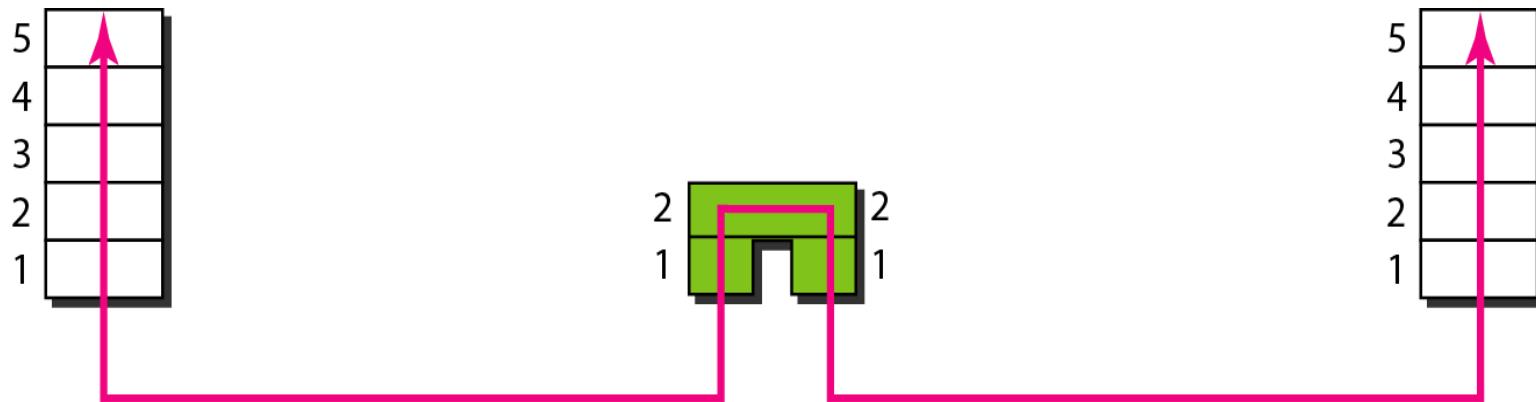
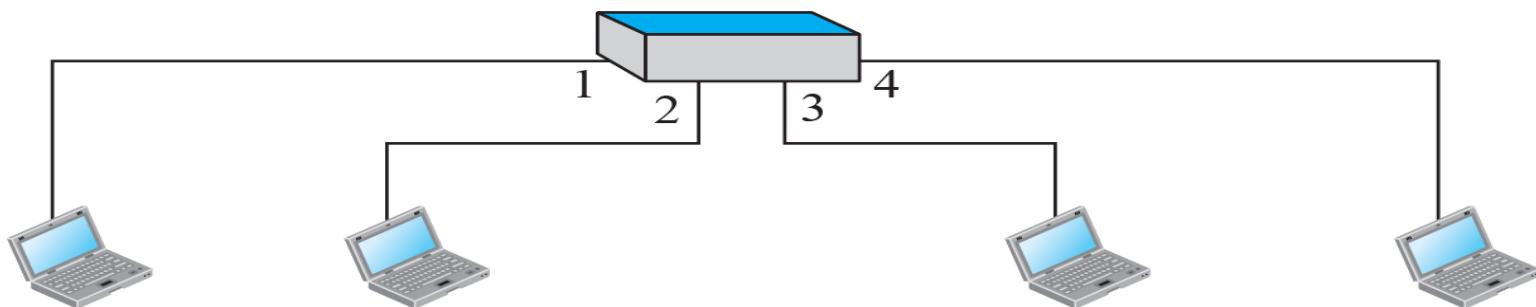


Figure A bridge connecting two LANs



Switching table

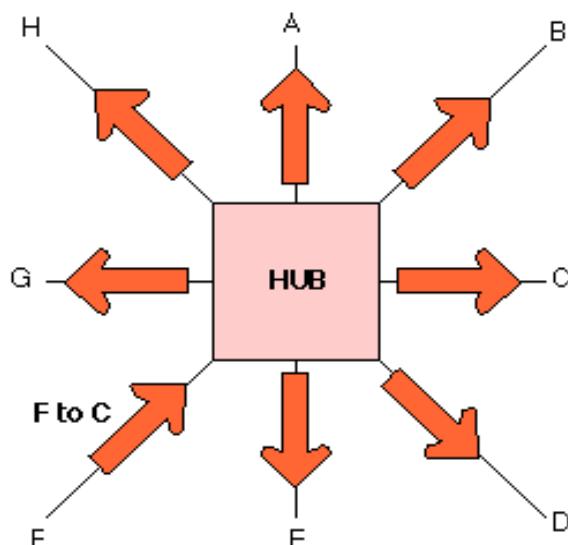
Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	2
64:2B:13:45:61:12	3
64:2B:13:45:61:13	4



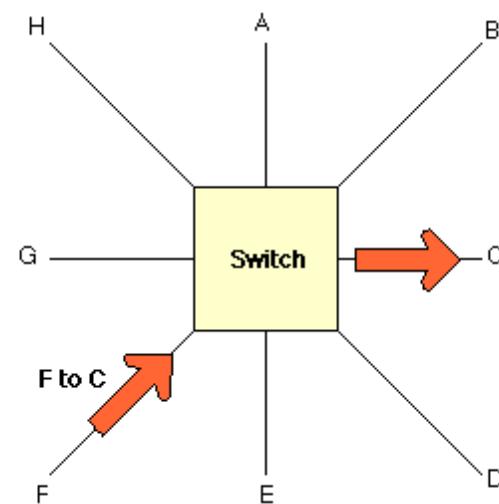
71:2B:13:45:61:41 71:2B:13:45:61:42

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

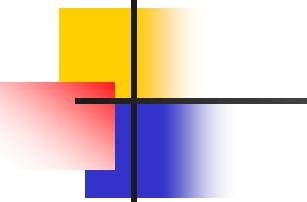
Bridges (Switches) Vs. Hubs



A Hub sending a packet from F to C.



A Switch sending a packet from F to C



Note

A bridge has a table used in filtering decisions.

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

Backbone network

- A **backbone network** is the **central part of a computer network** that interconnects different parts (subnetworks, LANs, or smaller networks) and carries the **majority of data traffic**. You can think of it as the **main highway** in a road system that connects different local roads together.
- It ensures **high speed, reliability, and scalability**, allowing different smaller networks to communicate efficiently.

Real-Life Examples:

University Campus Network

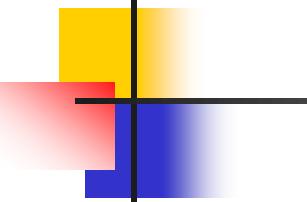
- Each department (CSE, EEE, Business Studies) has its own **LAN**.
- All these LANs are connected to the **university's backbone network** (high-speed fiber lines).
- The backbone then connects to the **internet gateway**.

Without the backbone, the departments would be isolated.

City Internet Service

- In a city, local ISPs connect households via smaller networks.
- All ISPs' traffic passes through a **city backbone network** (high-capacity fiber cables).
- This backbone then connects to **national and international backbones** for global communication.

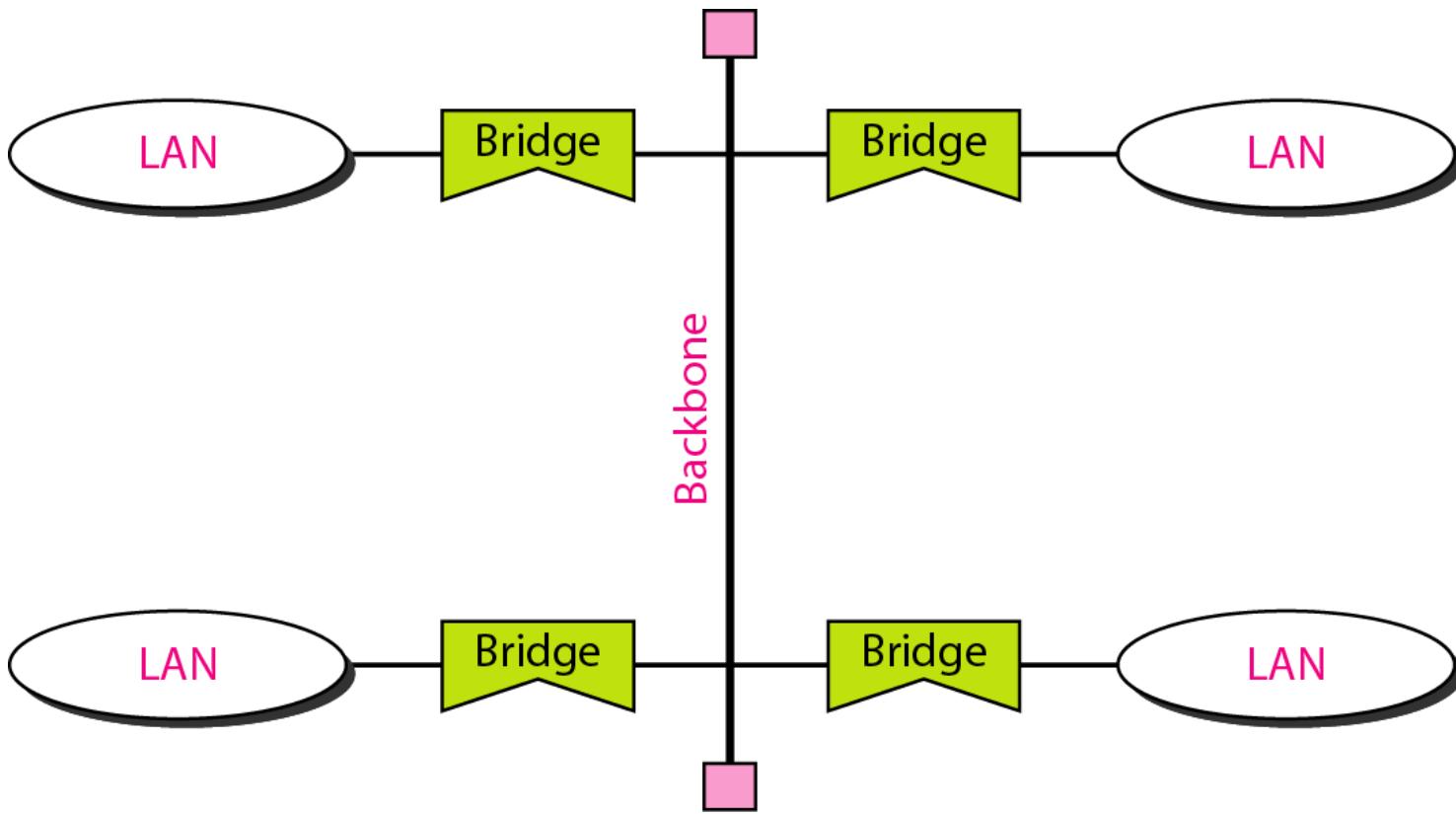
Example: When you browse a website, your request travels from your home Wi-Fi → ISP local network → ISP backbone → global internet backbone → destination server.

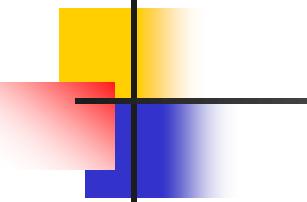


Note

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

Figure 15.12 Bus backbone





Note

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

Figure 15.13 *Star backbone*

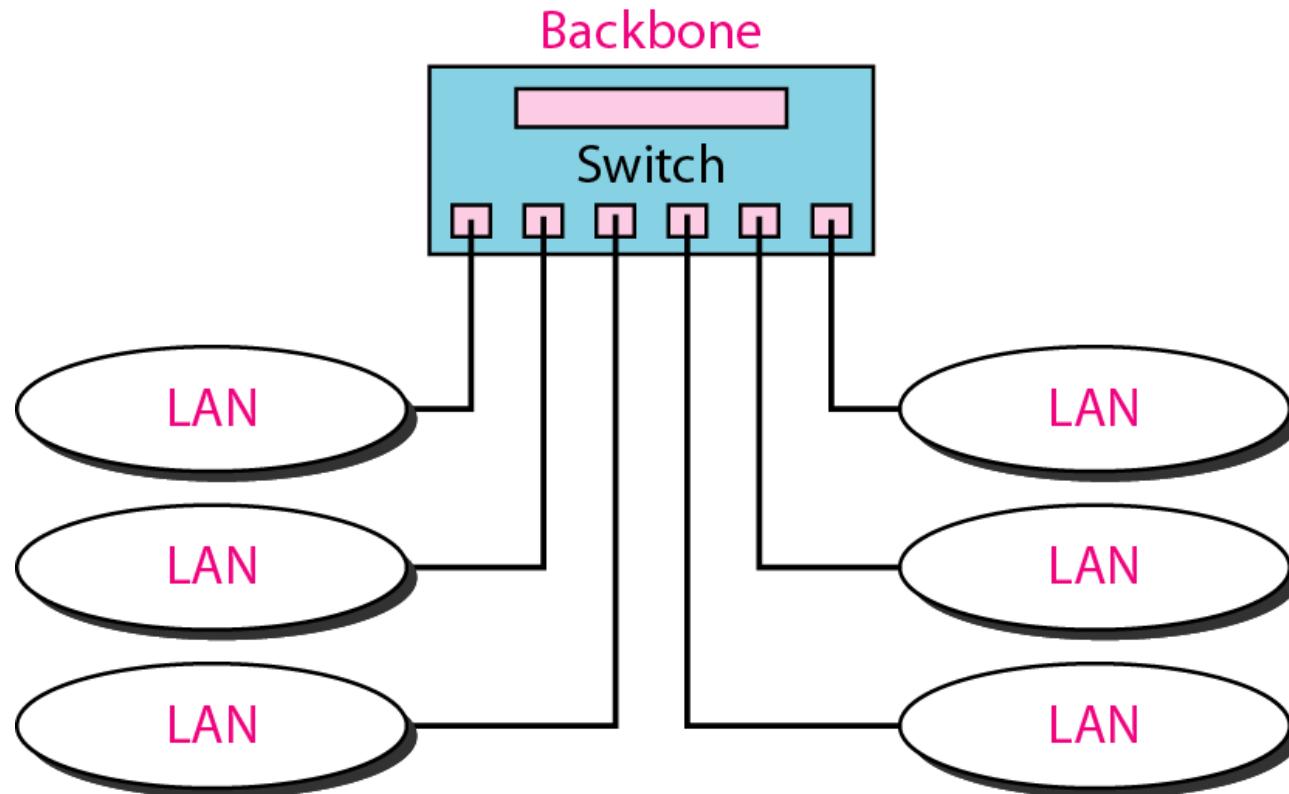
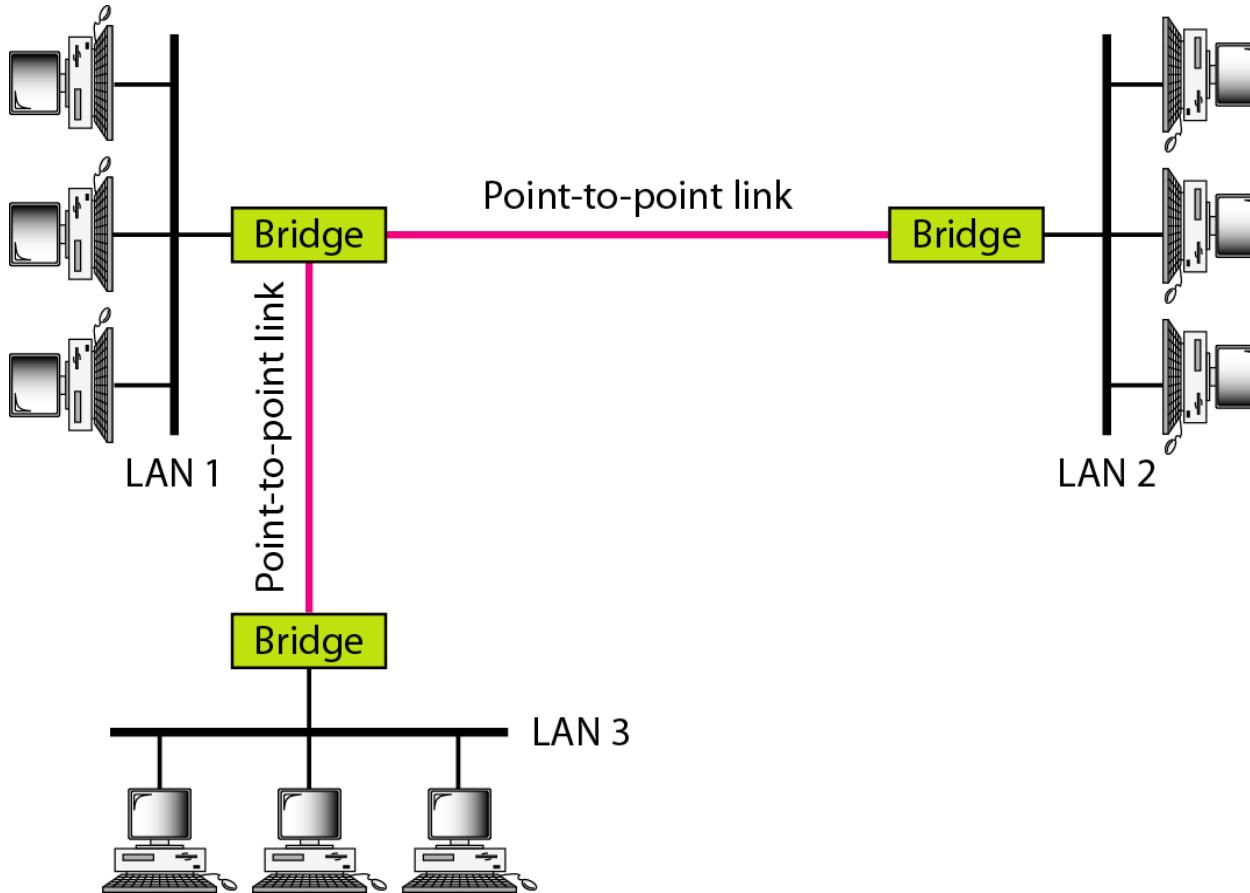
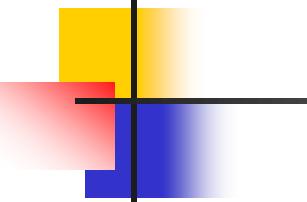


Figure 15.14 Connecting remote LANs with bridges





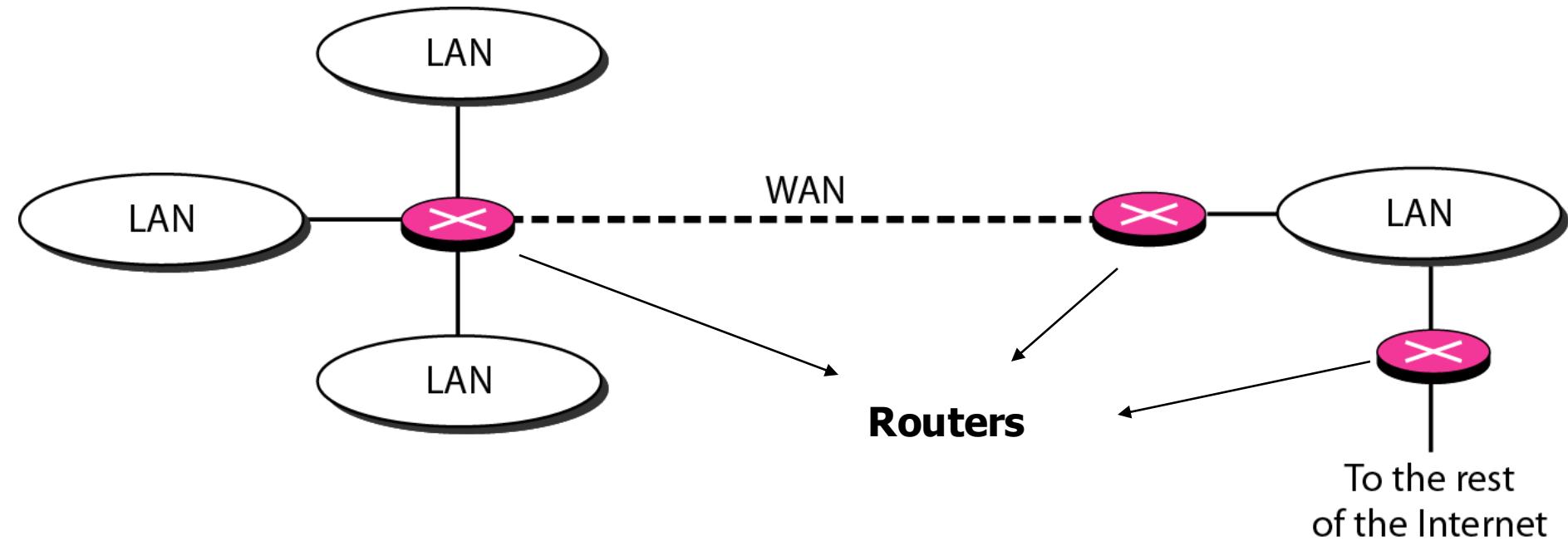
Note

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

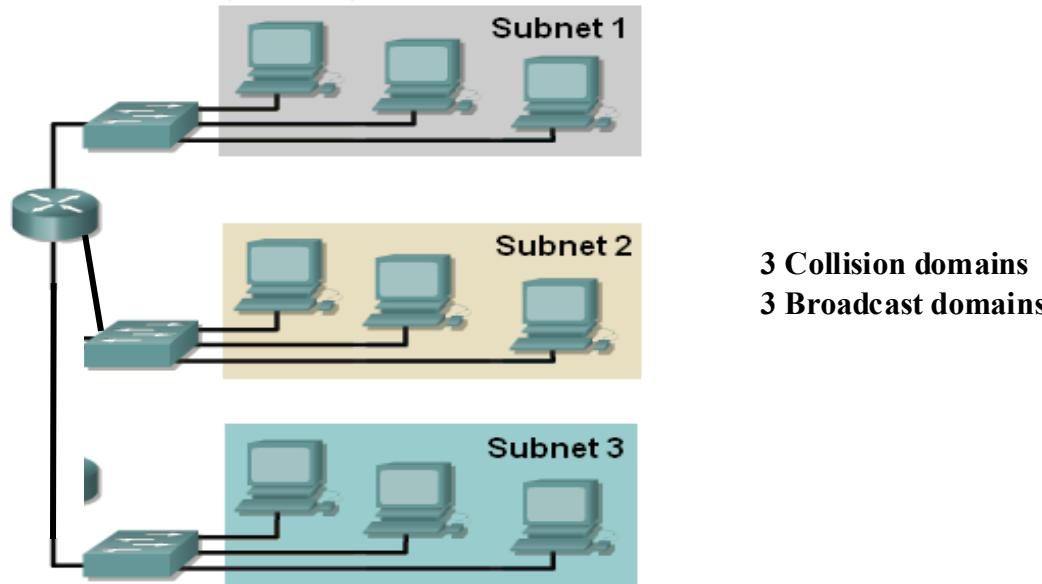
Routers

- Operates at network layer = deals with **packets** not **frames**
- Connect LANs and WANs with similar or different protocols together
- Acts like normal stations on a network, but have **more than one** network address (an address to each connected network)
- Deals with global address (network layer address (IP)) not local address (MAC address)
- Routers **Communicate with each other** and exchange routing information
- Determine best route using **routing algorithm** by special software installed on them
- **Forward traffic if information on destination** is available otherwise **discard** it (not like a switch or bridge)

Figure Routers connecting independent LANs and WANs



Virtual LANs



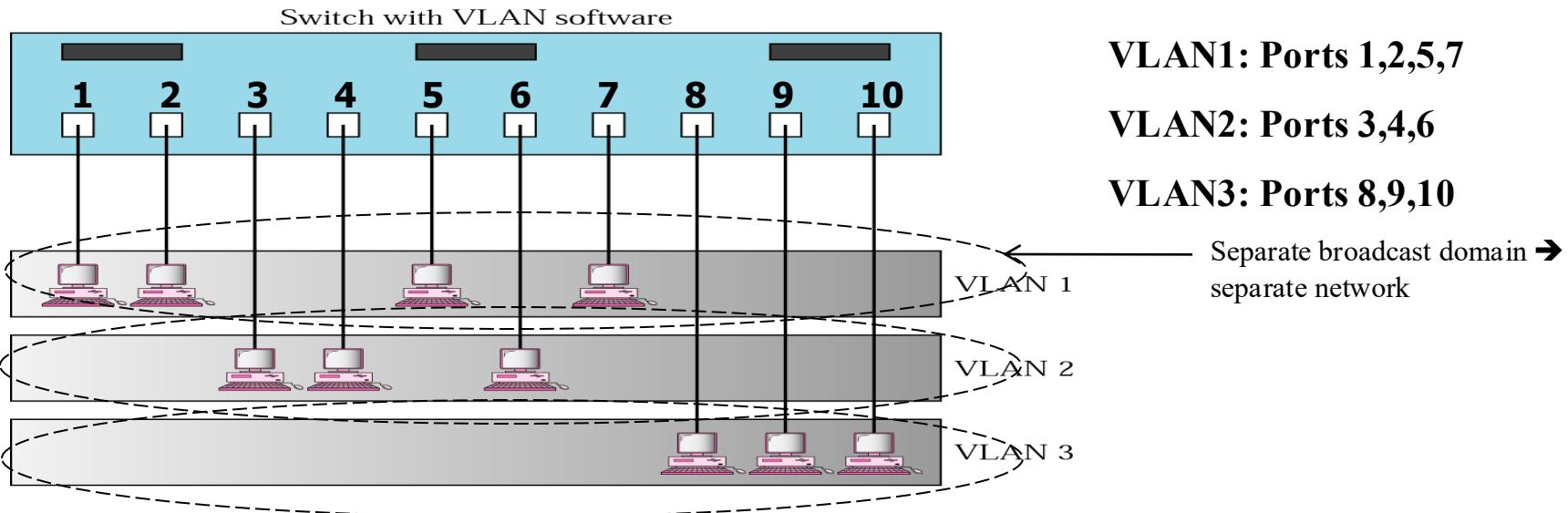
**3 Collision domains
3 Broadcast domains**

If we want to move computers from group1 to group3, then **rewiring** (physical replacement) has to be done

What is the alternative solution??

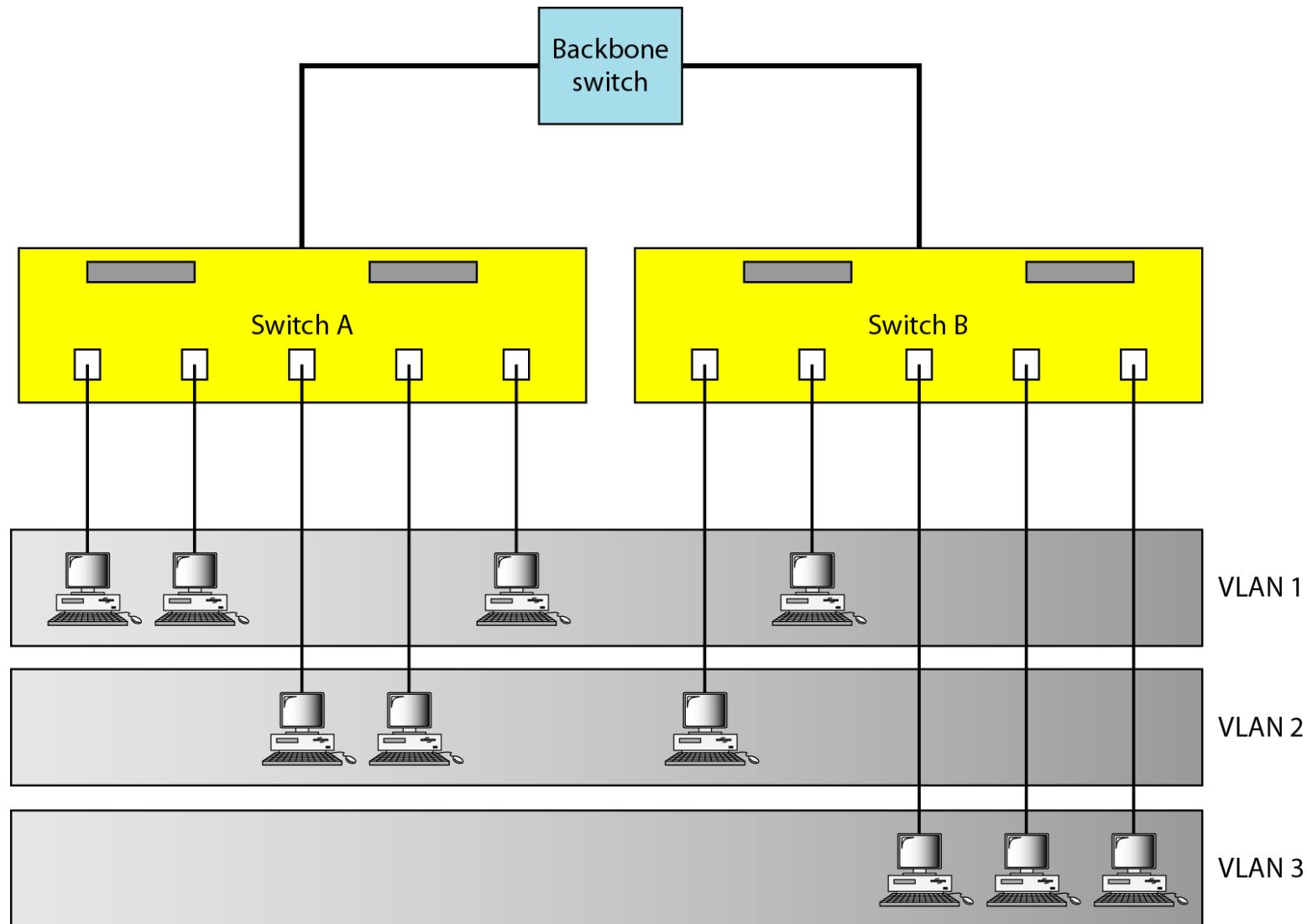
VLAN: Virtual (logical) Local Area Network : Local Area Network configured by **software** not by physical wiring

Figure A switch using VLAN software



- Using the Virtual LAN technology will allow **grouping** computers **logically** instead of **physically**.
- VLAN divides the physical LAN into several **Logical LANs** called VLANs
- Switch maintains a look up table to know to which LAN a machine belongs to.

Figure Two switches in a backbone using VLAN software



Advantages Of VLAN

- **Reduce cost and installation time:**
 - Instead of **physically moving** a station to another segment or another switch, it can be moved by *software*.
- **Increase security:**
 - A group of users needing a high security can be put into a VLAN so that NO users outside the VLAN can communicate with them.
 - Stations belong to the same group can send **broadcast messages** that will NOT be received by users in others VLAN groups
- **Creating Virtual Workgroups**
 - Stations located at physically different locations can be added easily to the same broadcast domain so that they can send broadcast messages to one another.
 - EXAMPLE: people from different departments working on the same project