Computer Networks II

Lecture No. 7

Connecting Devices, Backbone Networks, and Virtual LANs

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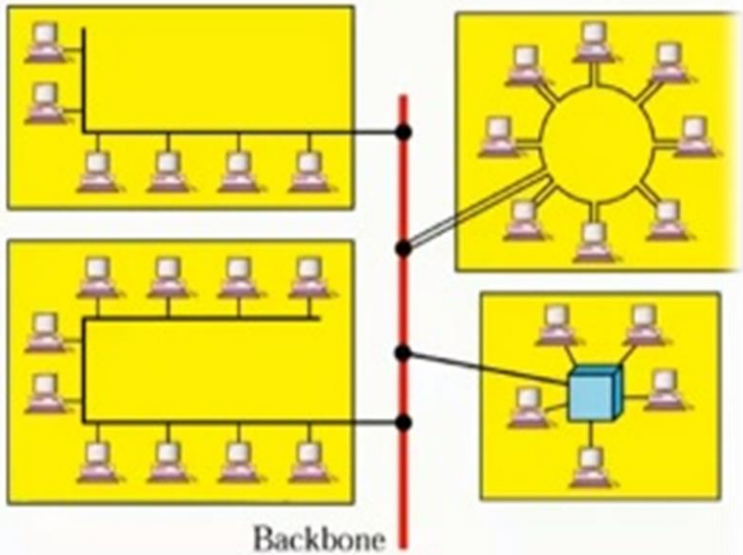
CONNECTING DEVICES

- LANs 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

Topics discussed in this section:

1. Passive Hub
2. Repeater and Active hub
3. Bridges and Two-Layer Switches
4. Routers and Three-Layer Switches
5. Gateways

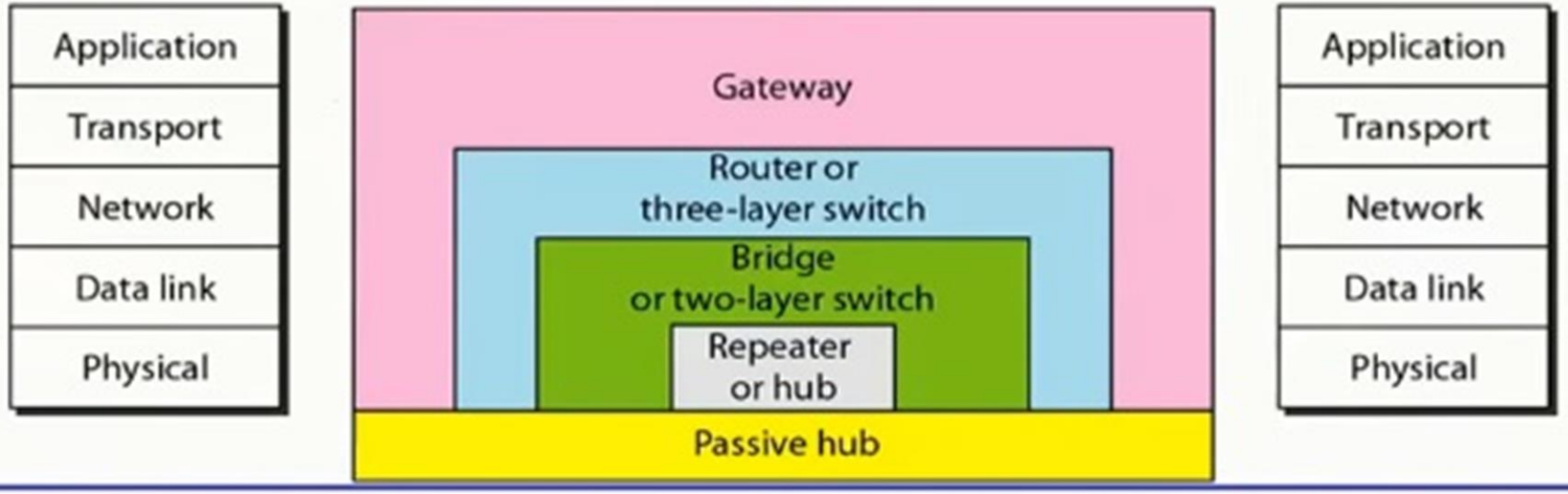


b. Multiple-building LAN

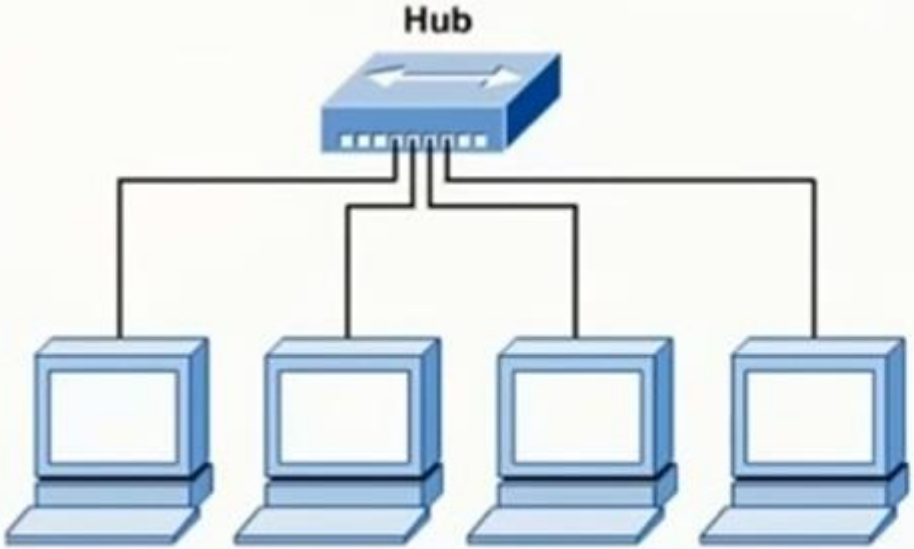
Connecting devices

Connecting devices divided into five different categories based on th e layer in which they operate in a network.:

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**



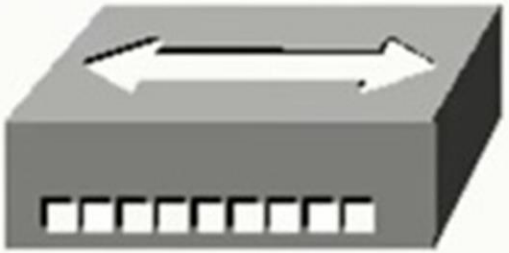
Passive Hubs



Passive Hubs

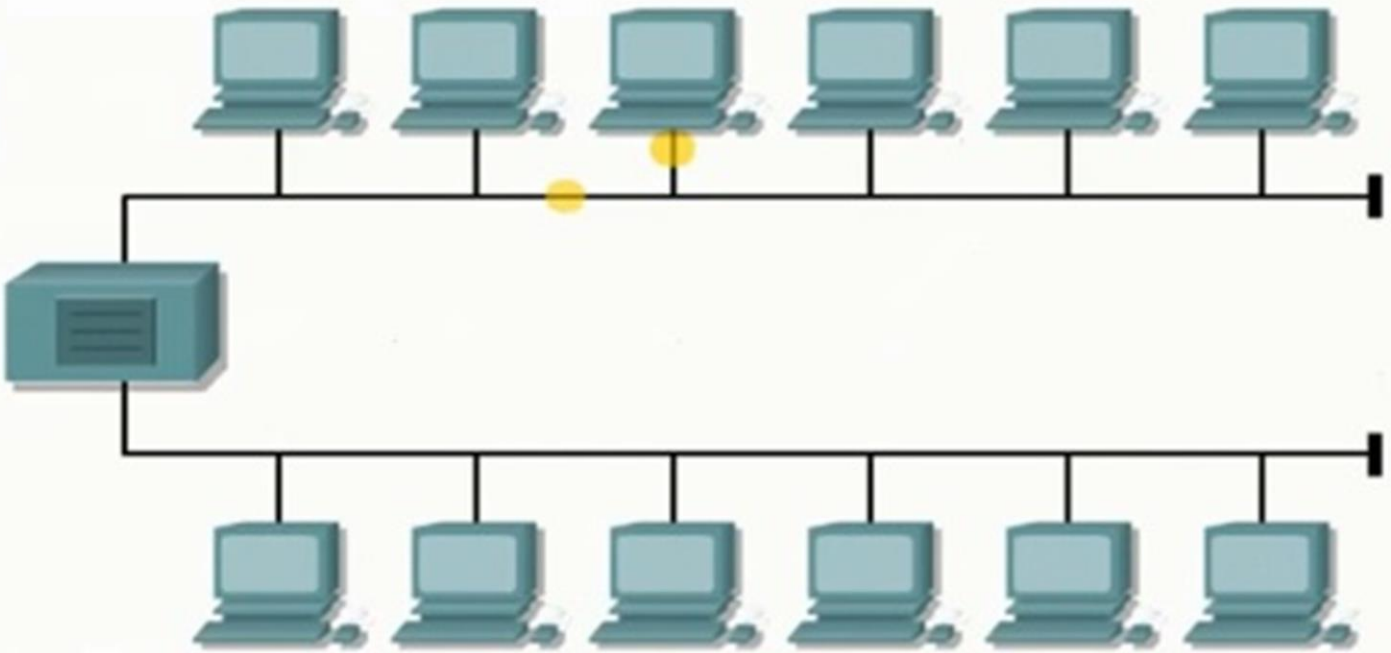
- Passive hub is just a connector.
- In a star-topology Ethernet LAN, it is just a point where signals coming from different stations collide.

  ➔ The hub is the collision point.



- This type of hub is part of the media
- its location in the Internet model is below the physical layer.

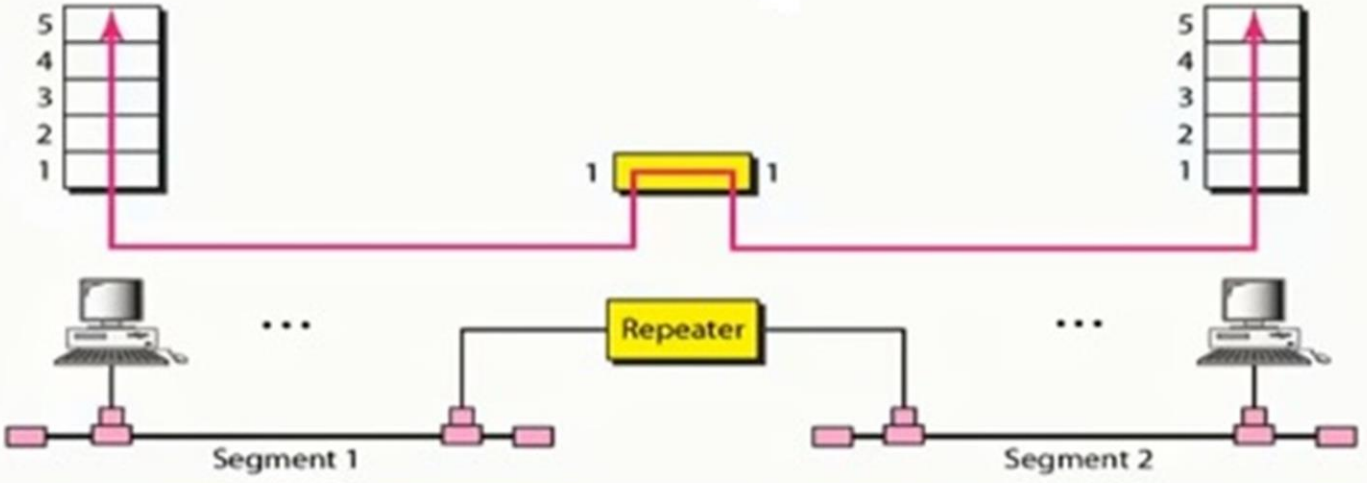
Repeaters



The purpose of a repeater is to regenerate and retime network signals at the bit level. This allows them to travel a longer distance on the media.

Repeaters

- A repeater operates only in the physical layers
- Can extend the physical length of a LAN
  - Receive the signal before it becomes too weak or corrupted and regenerates the original bit pattern
- Do not actually connect two LANs
  - connects two segments of the same LAN
  - segments connected are still part of one single LAN
- A repeater cannot connect two LANs of different protocols



Repeaters

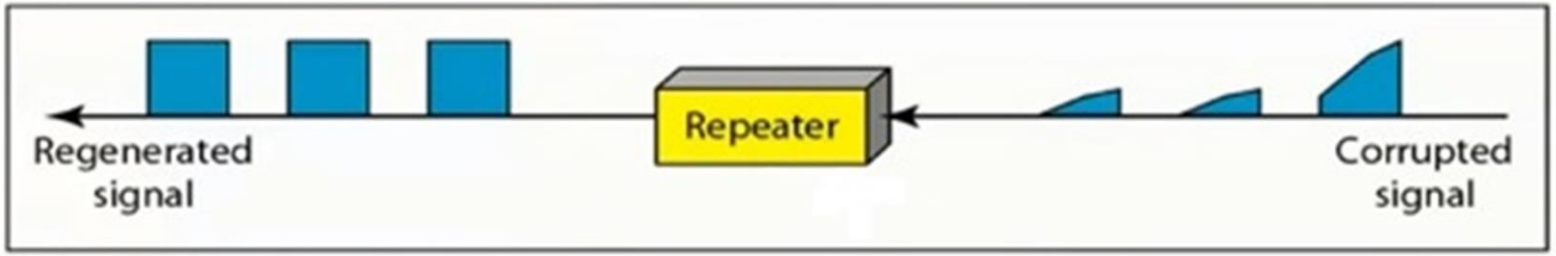
Repeaters is a regenerator, not an amplifier

Amplifier	Repeater
Cannot discriminate between the intended signal and noise. ➔ It amplifies equally everything fed into it	regenerates the signal ➔ receives a weakened or corrupted signal, creates a copy, bit for bit, at the original strength

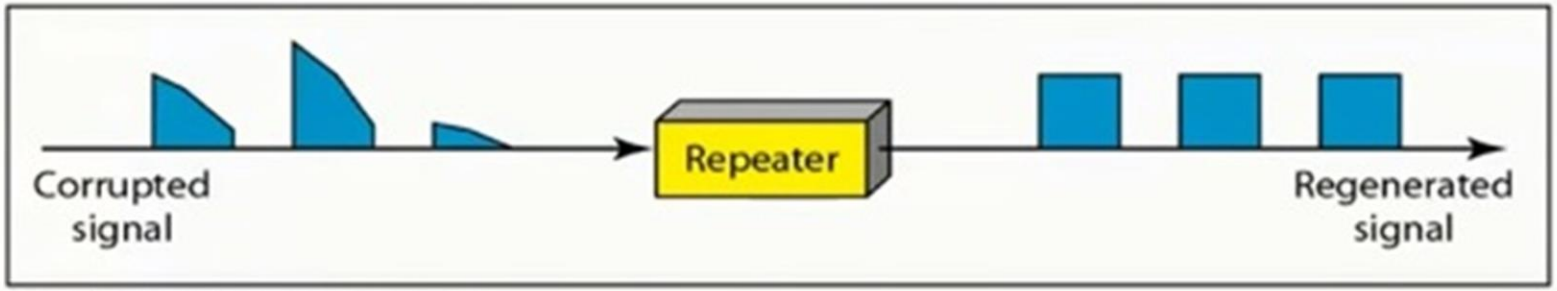
Function of a Repeater

location of a repeater on a link is **vital**

➔ it must be placed on the line before the legibility of the signal becomes lost can still read the signal well enough to determine the intended voltages and replicate them in their original form



a. Right-to-left transmission.



b. Left-to-right transmission.

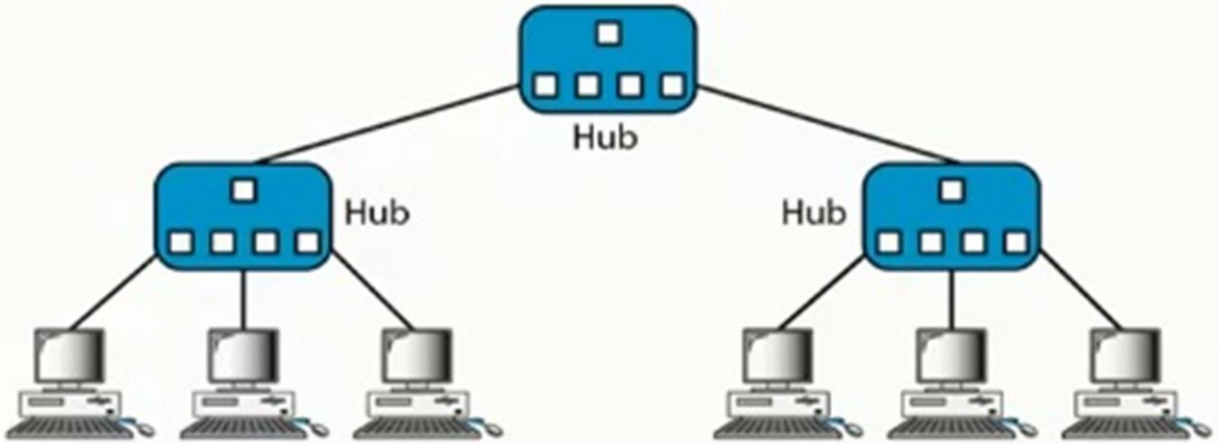
Repeaters

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.

Active Hubs

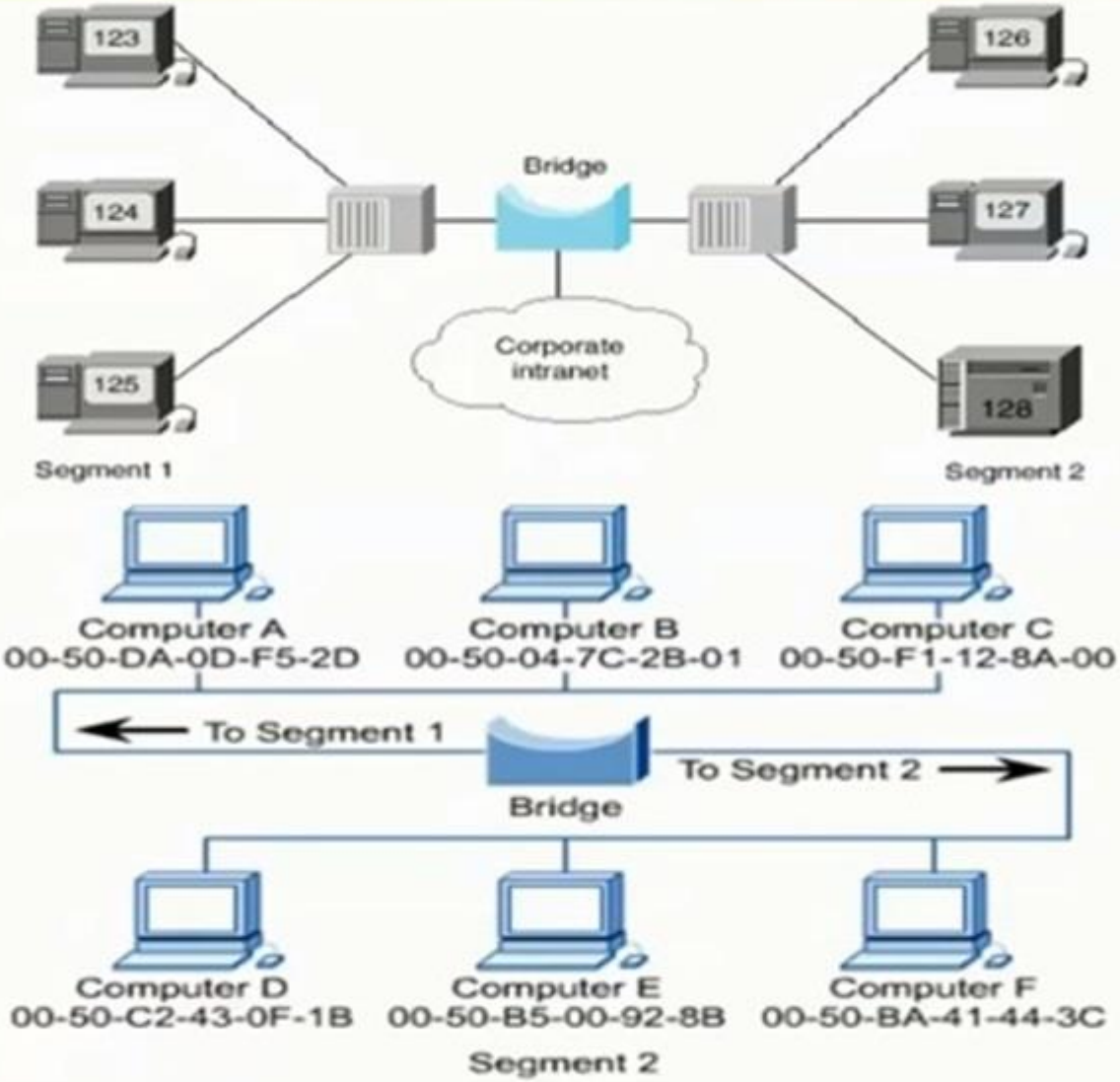
- Actually a multiport repeater
- Used to create connections between stations in a physical star topology
- Can also be used to create tree topology to remove the length limitation of star topology



Switches

- Operate at the Data Link layer .
- Increase network performance by reducing the number of frames transmitted to the rest of the network
- Usually used to connect individual computers not LANs like bridge.
- Allows more than one device connected to the switch directly to transmit simultaneously .
- Can operates in Full-duplex mode (can send and receive frames at the same time over the same interface).
- Performs MAC address recognition and frame forwarding in hardware.

Bridges


123
124
125
126
127
128
Bridge
Corporate intranet
Segment 1
Segment 2
Computer A
00-50-DA-0D-F5-2D
Computer B
00-50-04-7C-2B-01
Computer C
00-50-F1-12-8A-00
To Segment 1
To Segment 2
Bridge
Computer D
00-50-C2-43-0F-1B
Computer E
00-50-B5-00-92-8B
Computer F
00-50-BA-41-44-3C
Segment 2

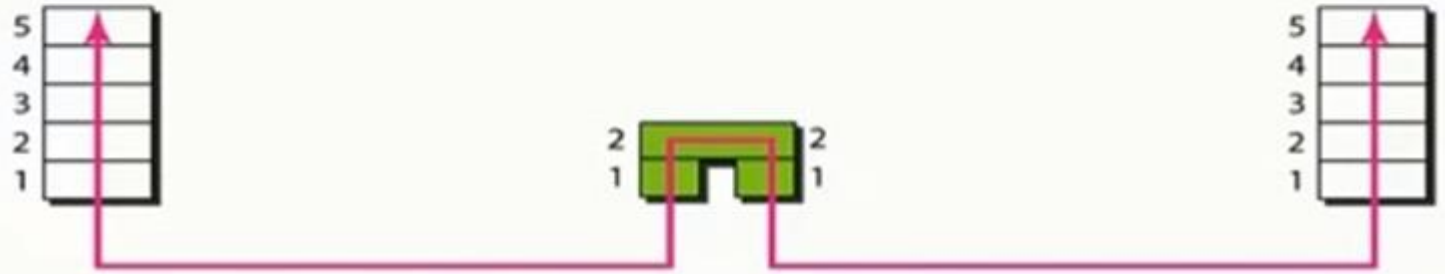
Bridges

- Operates in both the physical and the data link layer
  - physical layer: regenerates the signal
  - data link layer: check the physical (MAC) addresses (source and destination) contained in the frame
- Bridge has filtering capability, but repeater has not.
  - checks the MAC (physical) address of the destination when receives a frame, and decides if the frame should be forwarded or dropped
  - forwards the new copy only to the segment (specific port) to which the address belongs
  - Bridge has a table that maps addresses to the ports.

Bridges: Filtering

Bridge has a table:

- To map address to ports.
- Used in filtering decisions.



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

Bridges Connecting Different LANs

Theoretically a bridge should be able to connect LANs using different protocols at the data link layer.

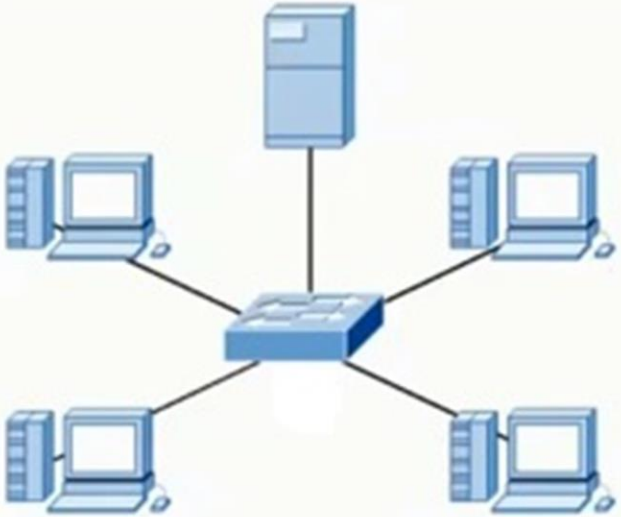
There are many issues to be considered:

- **Frame format**
  - Each LAN type has its own frame format. Compare an Ethernet frame with wireless LAN frame
- **Maximum data size**
  - Needs fragmentation/reassembly
  - No protocol at the data link layer allows the fragmentation/reassembly
  - fragmentation/reassembly is allowed in the network layer
  - Bridge discard any frames too large for its system
- **Data rate**
  - Each LAN type has its own data rate
  - Bridge must buffer the frame to compensate for this difference

Bridges: *Bridges Connecting Different LANs*

- **Bit order**
  - Each LAN type has its own strategy in sending of bits. Some send the MSB in a byte first; others the LSB first
- **Security**
  - Some LANs such as wireless, implement security measurements in the data link layer. Other LANs, such as Ethernet, do not
- **Multimedia support**
  - Some LANS support multimedia and the quality of services needed for this type; others do not.

Two-Layer Switch



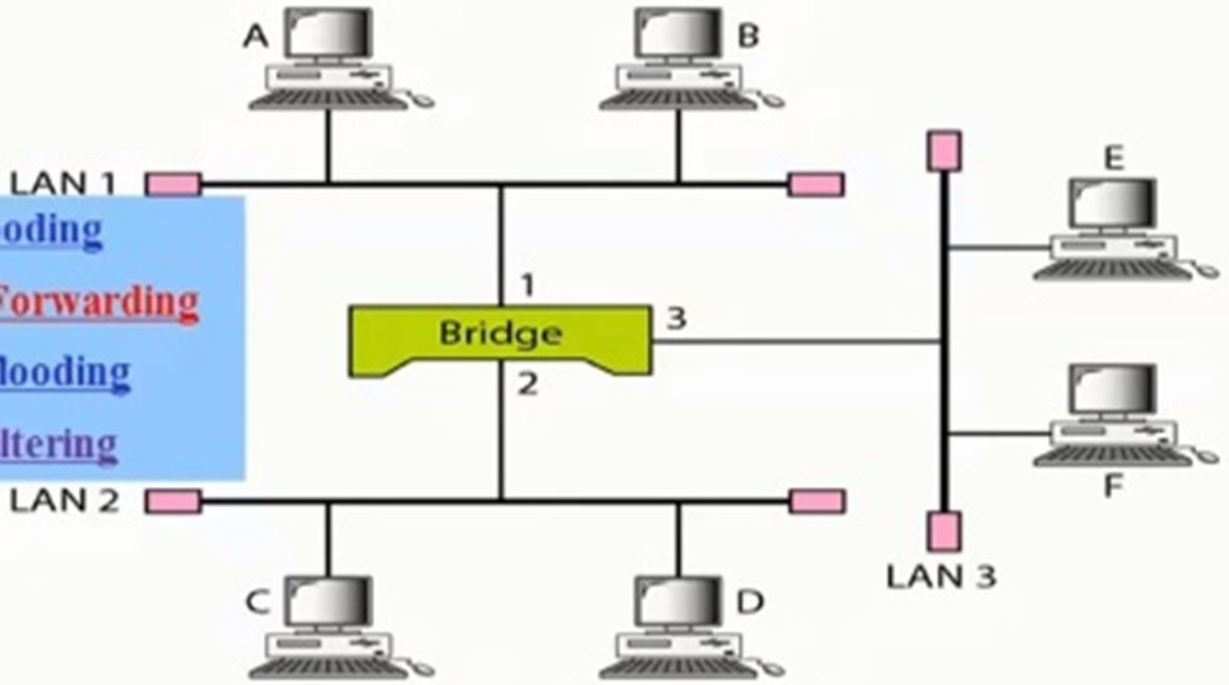
Two-Layer Switch

- Performs at the physical and data link layers.
- Is a bridge with many ports (**multi port bridge**) Design that allows better (faster) performance
- No collision
- Filtering based on the MAC address of the frame it received (like bridge)
- Builds switching table by "learning" MAC host addresses from source addresses of incoming packets
- Unknown destination addresses are flooded out other ports
- Broadcast frames are flooded out other ports.
- New two-layer switches (called **cut-through switches**):

  have been designed to forward the frame as soon as they check the MAC addresses in the header of the frame (first 6-bytes).

Destination physical address: used for the forwarding decision (table lookup).
Source physical address: used for adding entries to the table and for updating purposes.

1. A sends frame to D: flooding
2. E sends a frame to A: Forwarding
3. B sends a frame to C :flooding
4. F sends a frame to E: filtering



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

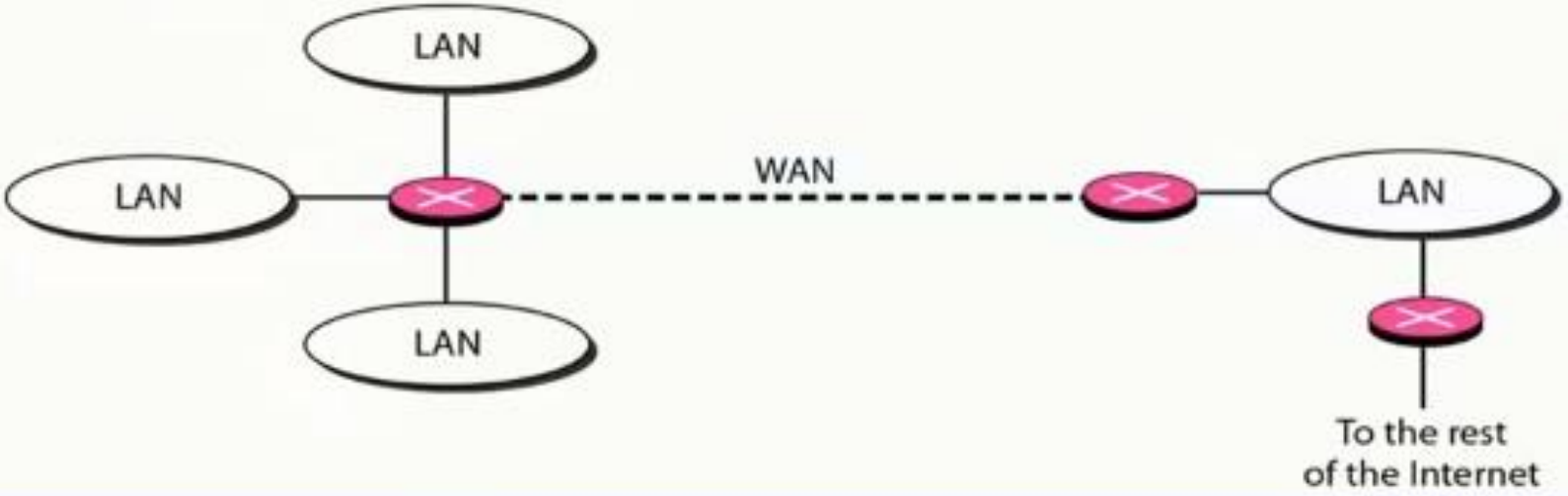
d. After B send a frame to C

Routers

Routers

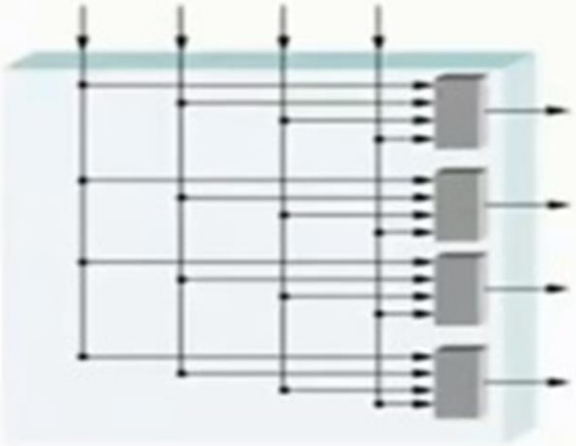
Three-layer devices that routes packets based on their logical addresses (IP)

- Connects LANs and WANs in the Internet.
- Has a routing table that is used for making decisions about the route.
- Routing table are dynamic and updated using routing protocol.
- Builds routing table by neighbor routers using routing protocols



Three layer switch

- **Is a router,** but a faster and more sophisticated.
- The switching fabric in a three-layer switch allows **faster table lookup and forwarding**.
- We can use the terms router and three-layer switch interchangeably.



Gateway

- Normally a computer that operates in all five layers of the Internet or seven layers of OSI model.
- It takes an application message, reads it, and interprets it
- Used as connecting device between two internetworks that use different models.
- Can provide security (filter unwanted application-layer messages)

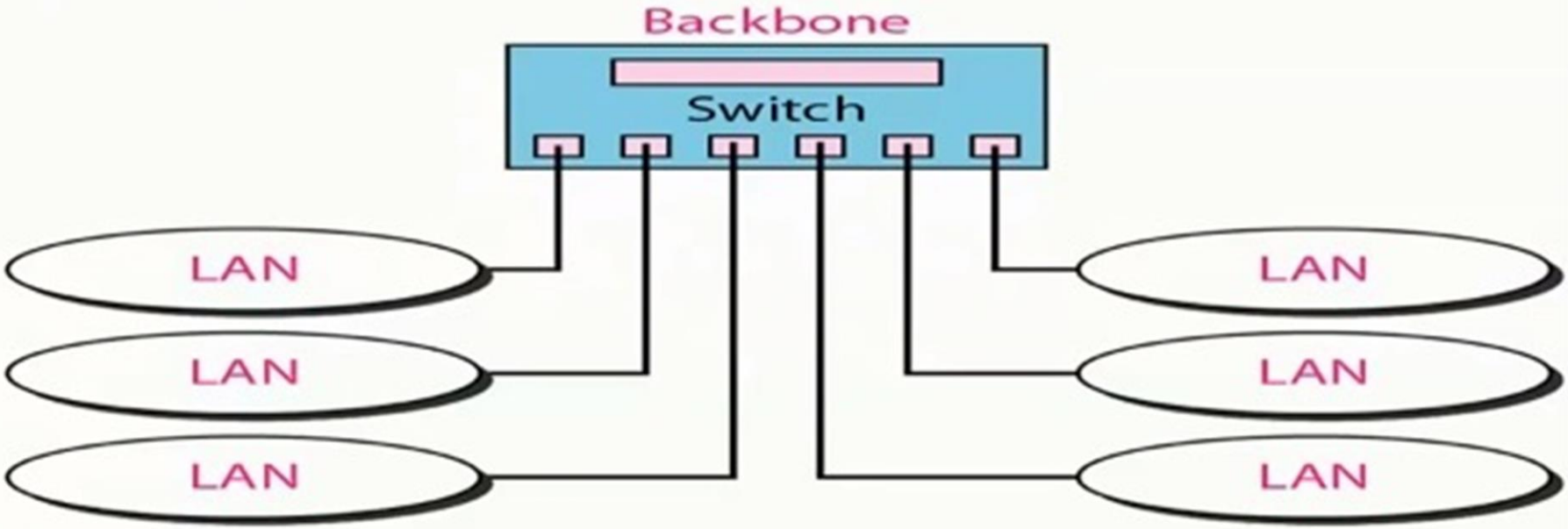
Backbone Networks

- Backbone network allows several LANs to be connected
  - No station is directly connected to the backbone
  - It is itself a LAN that uses a LAN protocol such as Ethernet

- **Discuss only the two most common:**
  - Bus Backbone
  - Star Backbone

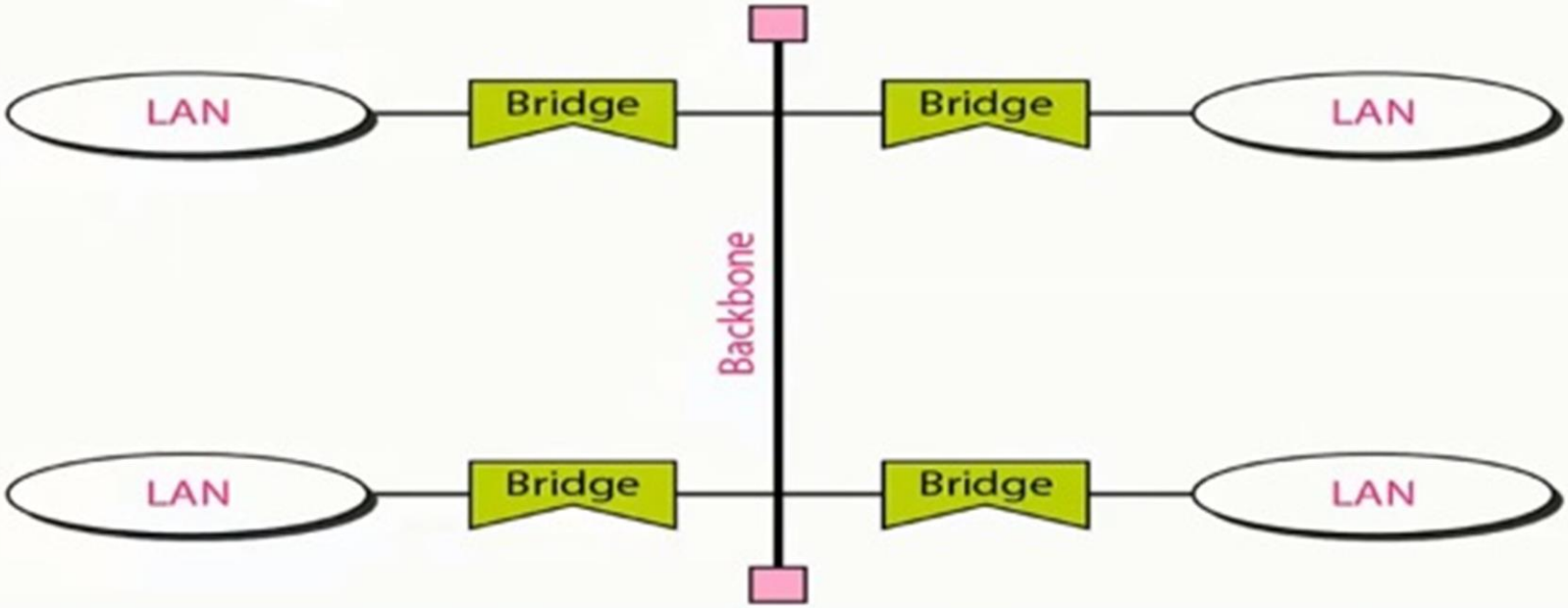
Star Backbone

- Topology is a star: sometimes called a collapsed or switched backbone
- It is just one switch that connects the LANs
- Mostly used as a distribution backbone inside a mutifloor building



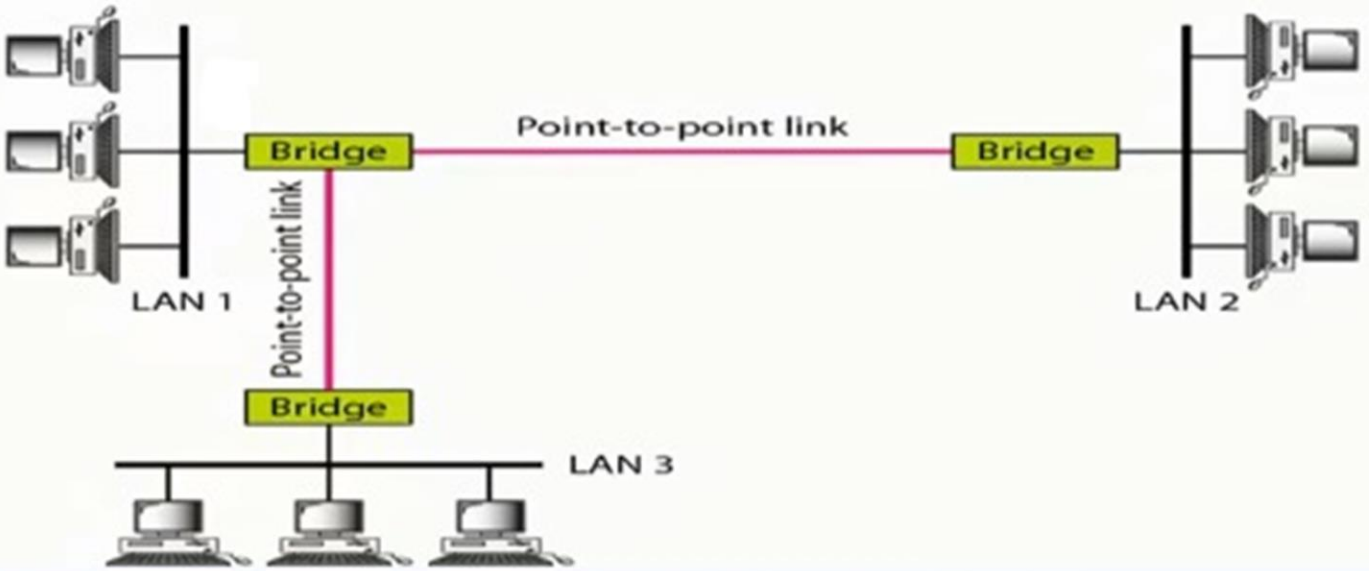
Bus Backbone

- **The topology of the backbone is a bus.**
- Backbone itself can use one of the protocols that support a bus topology such as 10Base5 or 10Base2
  - normally used as a distribution backbone to **connect different buildings in an organization**
  - example: one that connects buildings on a campus



Connecting Remote LANs

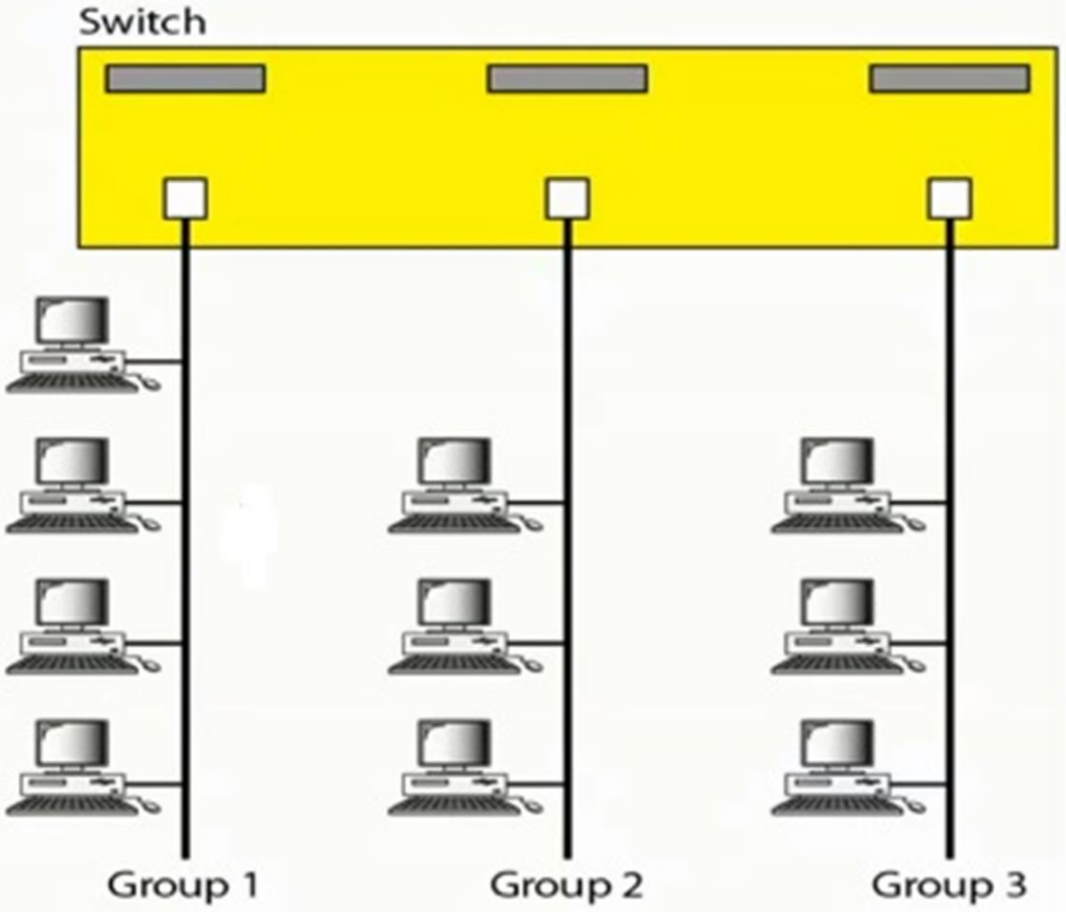
- Another common application for a backbone network
- useful when a company has several offices with LANs and needs to connect them
- connection can be done through bridges, sometimes called remote bridges
- connect LANs and point-to-point networks (leased telephone lines or ADSL lines)
- point-to-point link can use a protocol such as PPP (Point-to-Point Protocol)



Virtual LANs

- In a switched LAN, change the work group mean physical changes in the network configuration.
- What happens if we need a virtual connection between two stations belonging to two different physical LANs?

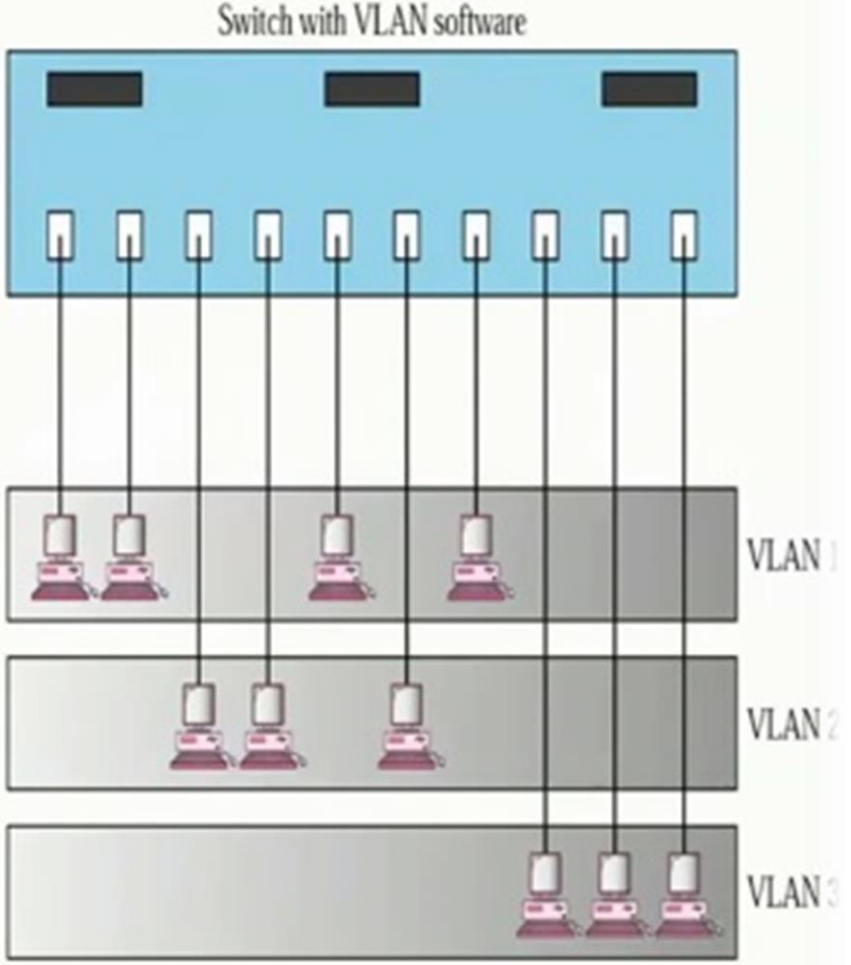
➔ Virtual LANs



Virtual LANs

- A network of stations that behave as if they are connected to the same LAN even though they may actually be physically located on different segments of a LAN
- **VLANs are configured through software rather than hardware**, which makes them extremely flexible

- the whole idea of VLAN technology: divide a LAN into **logical,** instead of physical, segments
- a LAN can be divided into several logical LANs called **VLANs**
- each VLAN is a workgroup in the organization.
- One of the biggest advantages is that when a station moves from one group to another, without any hardware reconfiguration.



Virtual LANs Membership

Membership is characterized by:

- Port numbers,
- MAC addresses,
- IP addresses,
- Multicast IP addresses
- A combination of the above

Advantages of VLAN

1. Cost and time reduction:

Can reduce the migration cost of stations from one group to another

- physical reconfiguration takes time and is costly
- it is much easier and quicker to move it using software

2. Creating virtual workgroup

3. Security:

provide an extra measure of security: people belonging to the same group can send broadcast messages with the guaranteed assurance that users in other groups will not receive these messages

Thank you for listening

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