Computer Communication Network

Topic: Connecting Devices, VLAN

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CONNECTING DEVICES

- LANs or WANs do not normally operate in isolation. They are connected to one another or to the Internet.
- To connect LANs and WANs together we use connecting devices.
- These devices are operate in different layer of the internet model.
- The layer matters because different devices use different pieces of information to decide how to switch.
- For example, the user generates some data to be sent to a remote machine.
- Those data are passed to the transport layer, which then adds a header (for example, a TCP header) and passes the resulting unit down to the network layer.

- Then the packet goes to the data link layer, which adds its own header and checksum (CRC) and gives the resulting frame to the physical layer for transmission, i.e. over a LAN.
- Figure 1 shows the IP packet shaded in gray.

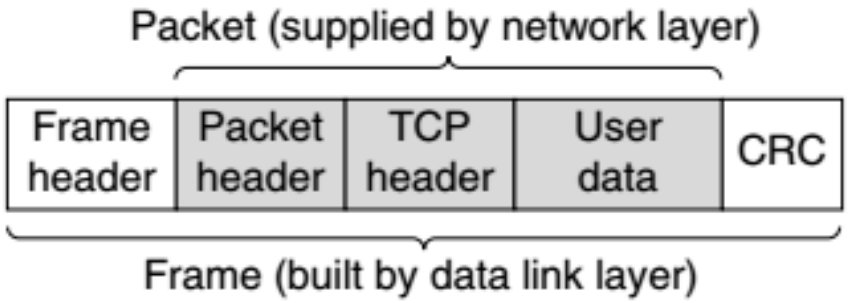


Fig. 1 . Frames, packets, and headers.

Layers in the TCP/IP Protocol Suite

- Figure 2 shows the different connecting devices at different levels.

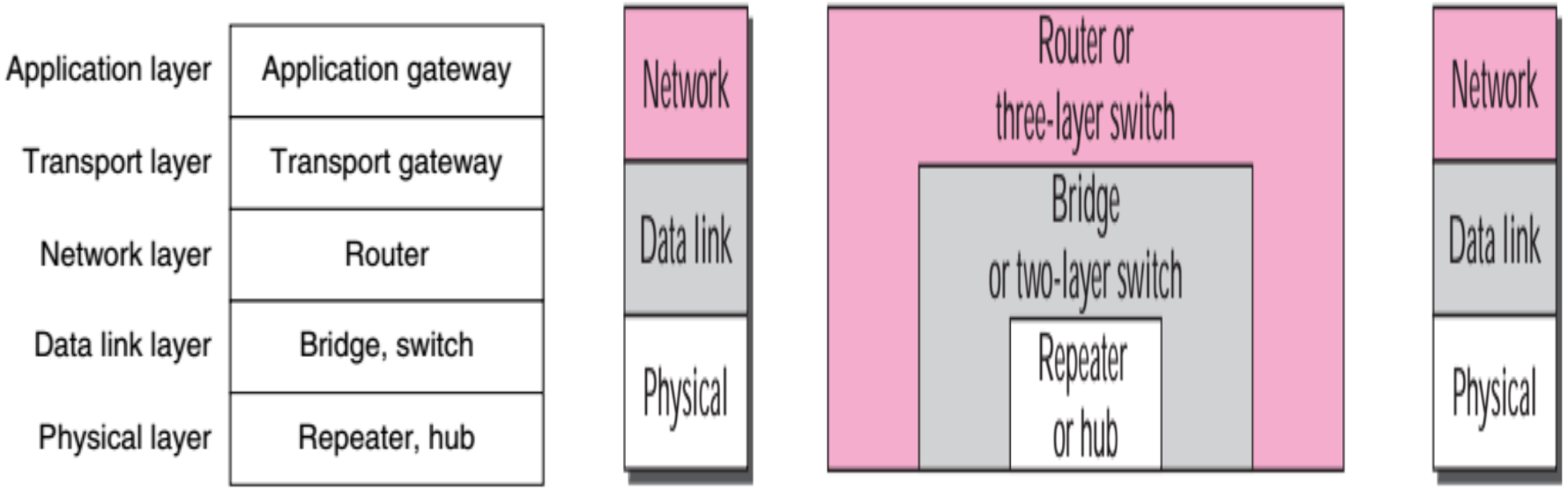


Fig. 2 Which device is in which layer

Repeaters

- Repeaters operate in the first
  layer of the Internet model (i.e. Physical Layer) .
- These are analog devices that work with signals on the cables to which they are connected.
- Signals that carry information within a network can travel a fixed distance before attenuation endangers the integrity of the data.
- A repeater receives a signal and, before it becomes too weak or corrupted, *regenerates* and *retimes* the original bit pattern.
- The repeater then sends the refreshed signal.
- Repeaters do not understand frames, packets, or headers. They understand the symbols that encode bits as volts.
- For example in classic Ethernet LANs which were using bus topology, a repeater was used to connect two segments of a LAN to overcome the length restriction of the coaxial cable.
- A repeater forwards every bit; it has no filtering capability.

Hubs

- It is also a layer one Device.
- A hub has a number of input lines that it joins electrically.
- All the lines coming into a hub must operate at the same speed.
- Hubs differ from repeaters in that they do not (usually) amplify the incoming signals and are designed for multiple input lines.
- They do not have any data-link address and they do not check the data-link address of the received frame

- The figure definitely shows that a hub does not have a filtering capability; it does not have the intelligence to find from which port the frame should be sent out.
- Frames arriving on any of the lines are sent out on all the others.

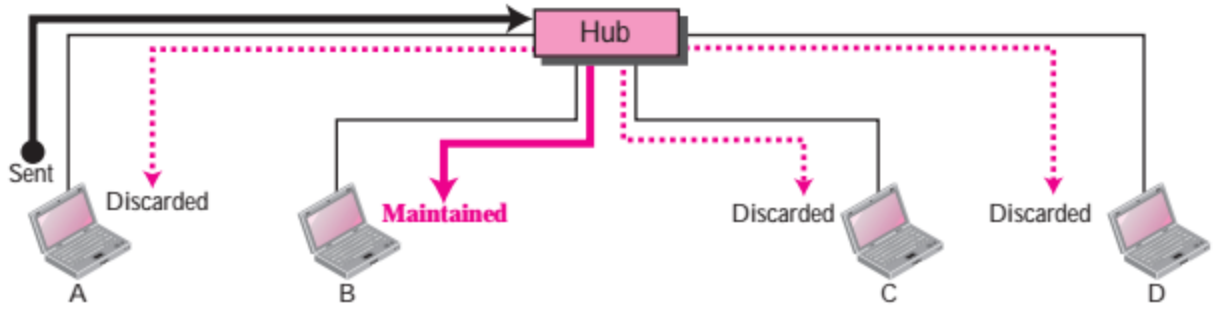
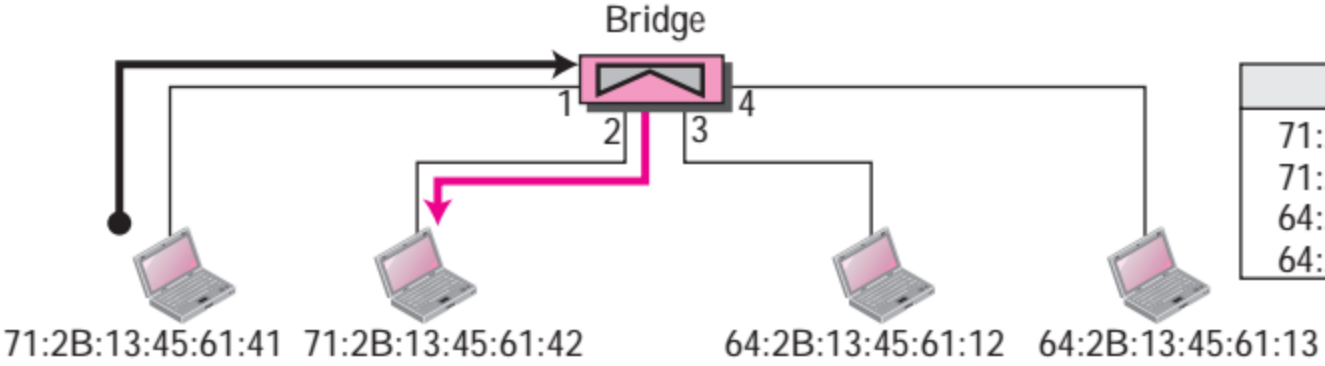


Fig. Repeater or hub

Bridges

- A bridge connects two or more LANs.
- A bridge operates in both the physical and the data link layers. That's why known as two layer switch.
- As a data link layer device, the bridge can check the MAC addresses (source and destination) contained in the frame.
- A bridge has a table used in filtering decisions.
- A bridge does not change the physical (MAC) addresses in a frame.



Bridge 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

Fig. Bridge

Types of bridge

- **Transparent Bridge**: 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.
- It must meet three criterion:
  I. Frames must be forwarded from one station to another.
  II. The forwarding table is automatically made by learning frame movements in the network.
  III. Loops in the system must be prevented.
- **Source Routing Bridges:** In these bridges, routing operation is performed by source station and the frame specifies which route to follow.
- The host can discover frame by sending a special frame called discovery frame, which spreads through the entire network using all possible paths to destination.

Switch

- A switch is a multiport bridge with a buffer and a design that can boost its efficiency(a large number of ports imply less traffic) and performance.
- A switch is a data link layer device.
- The switch can perform error checking before forwarding data, that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only.
- In other words, switch divides collision domain of hosts, but broadcast domain remains same.

Routers

- A **router** is a three-layer device; it operates in the physical, data link, and network layers.
- As a physical layer device, it regenerates the signal it receives.
- As a data link layer device, the router checks the physical addresses (source and destination) contained in the packet.
- As a network layer device, a router checks the network layer addresses (addresses in the IP layer).
- A router can connect LANs together; a router can connect WANs together; and a router can connect LANs and WANs together.
- In other words, a router is an internetworking device; it connects independent networks together to form an internetwork.

1. There are three major differences between a router and a repeater or a bridge.
   I. A router has a physical and logical (IP) address for each of its interfaces.
   II. A router acts only on those packets in which the physical destination address matches the address of the interface at which the packet arrives.
   III. A router changes the physical address of the packet (both source and destination) when it forwards the packet.

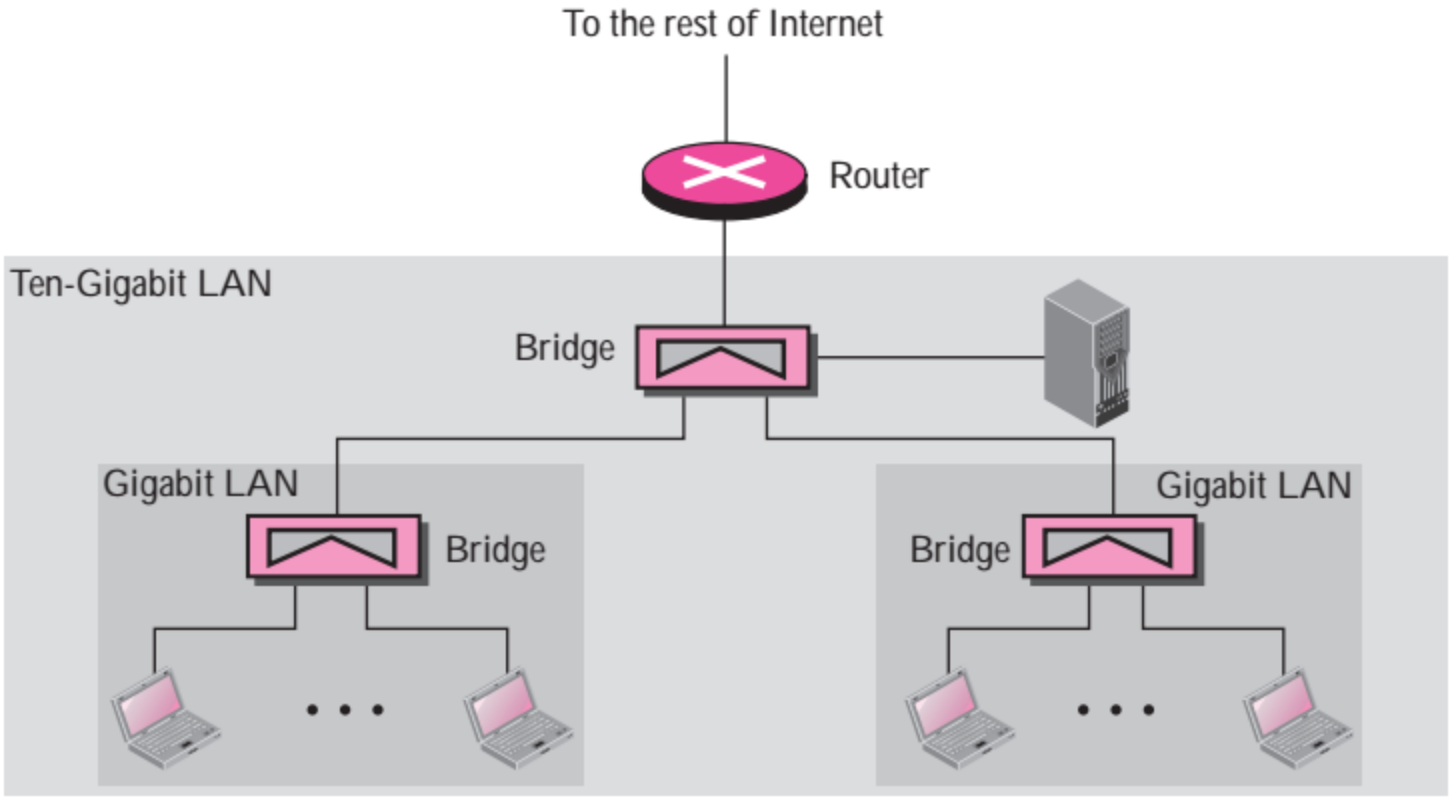


Fig. Routing example

Virtual LAN

- Virtual Local Area Networks or Virtual LANs (VLANs) are a logical group of computers that appear to be on the same LAN irrespective of the configuration of the underlying physical network.
- Network administrators partition the networks to match the functional requirements of the VLANs so that each VLAN comprise of a subset of ports on a single or multiple switches or bridges.
- This allows computers and devices in a VLAN to communicate in the simulated environment as if it is a separate LAN.

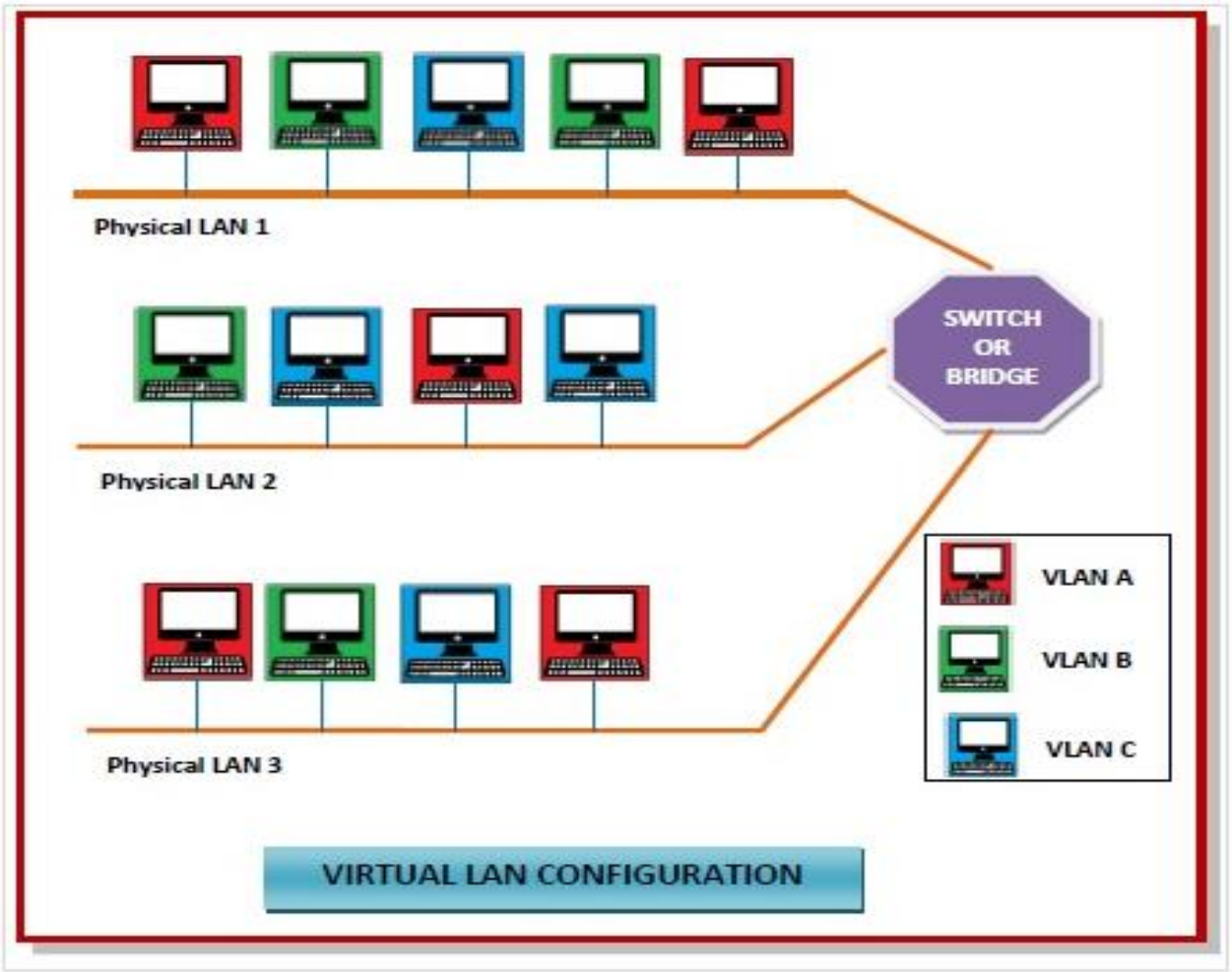

Physical LAN 1
Physical LAN 2
Physical LAN 3
SWITCH
OR
BRIDGE
VLAN A
VLAN B
VLAN C
VIRTUAL LAN CONFIGURATION

Fig. VLAN

Features of VLANs

- A VLAN forms sub-network grouping together devices on separate physical LANs.
- VLAN's help the network manager to segment LANs logically into different broadcast domains.
- VLANs function at layer 2, i.e. Data Link Layer of the OSI model.
- There may be one or more network bridges or switches to form multiple, independent VLANs.
- Using VLANs, network administrators can easily partition a single switched network into multiple networks depending upon the functional and security requirements of their systems.

Features of VLANs

- VLANs eliminate the requirement to run new cables or reconfiguring physical connections in the present network infrastructure.
- VLANs help large organizations to re-partition devices aiming improved traffic management.
- VLANs also provide better security management allowing partitioning of devices according to their security criteria and also by ensuring a higher degree of control connected devices.
- VLANs are more flexible than physical LANs since they are formed by logical connections. This aids is quicker and cheaper reconfiguration of devices when the logical partitioning needs to be changed.

Types of VLANs

- **Protocol VLAN** − Here, the traffic is handled based on the protocol used. A switch or bridge segregates, forwards or discards frames that come to it based upon the traffics protocol.
- **Port-based VLAN** − This is also called static VLAN. Here, the network administrator assigns the ports on the switch / bridge to form a virtual network.
- **Dynamic VLAN** − Here, the network administrator simply defines network membership according to device characteristics.