BITT Polytechnic

Data Communication & Computer Network

Branch: E.C.E **Semester: 4th**

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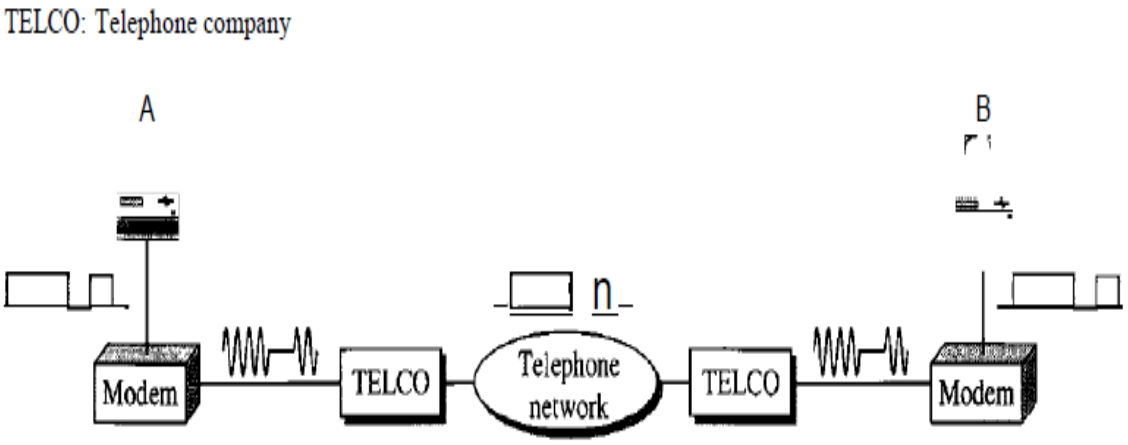
Modems

The term 'modem' actually stands for **Mo**dulator / **DEM**odulator, this being the process by which the digital signals from a computer are transformed into analogue signals, by a technique known as modulation, for transmission over telephone lines that were originally designed for the transmission of voice rather than digital data.

A modem, however, has to make sure that the data it sends can be received correctly, despite the existence of external influences, such as noise on the line. Finally, at the receiving end, the analogue signal has to be converted back to the original digital data by the technique known as demodulation.



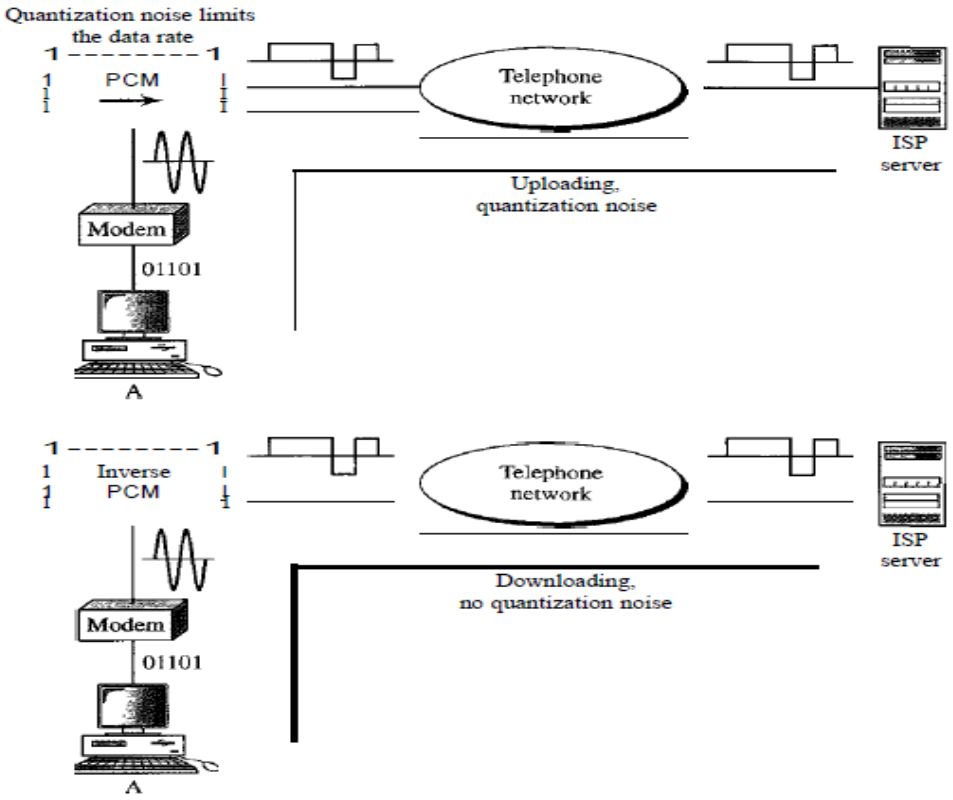
The computer on the left sends a digital signal to the modulator portion of the modem; the data are sent as an analog signal on the telephone lines. The modem on the right receives the analog signal, demodulates it through its demodulator, and delivers data to the computer on the right. The communication can be bidirectional, which means the computer on the right can simultaneously send data to the computer on the left, using the same modulation/demodulation processes.

Modem Standards

Today, many of the most popular modems available are based on the V-series standards published by the ITU-T, such as V.32, V.32 bis, V.34, V.90

i) V.90 (56K Modem)

- Traditional modems have a data rate limitation of 33.6 kbps, as determined by the Shannon capacity.
- However, V.90 modems with a bit rate of 56,000 bps, these are called 56K modems.
- These modems may be used only if one party is using digital signaling (such as through an Internet provider).
- They are asymmetric in that the downloading rate (flow of data from the Internet service provider to the PC) is a maximum of 56 kbps, while the uploading rate (flow of data from the PC to the Internet provider) can be a maximum of 33.6 kbps.
- When downloading over a 56K connection, the downstream data from the exchange to your modem is digitally encoded instead of modulated, and is changed from a digital signal to an analogue signal at the modem. Digital-to-analogue conversions are perfectly accurate, so downloading at speeds up to 56Kbps is possible. When uploading, data is sent in a modulated form and has to be converted from an analogue signal to a digital signal. Analogue-to-digital conversions are imperfect, so noise is introduced into the signal, resulting in a lower upload speed.
- The telephone companies sample 8000 times per second with 8 bits per sample. One of the bits in each sample is used for control purposes, which means each sample is 7 bits. The rate is therefore 8000 x 7, or 56,000 bps or 56 kbps.



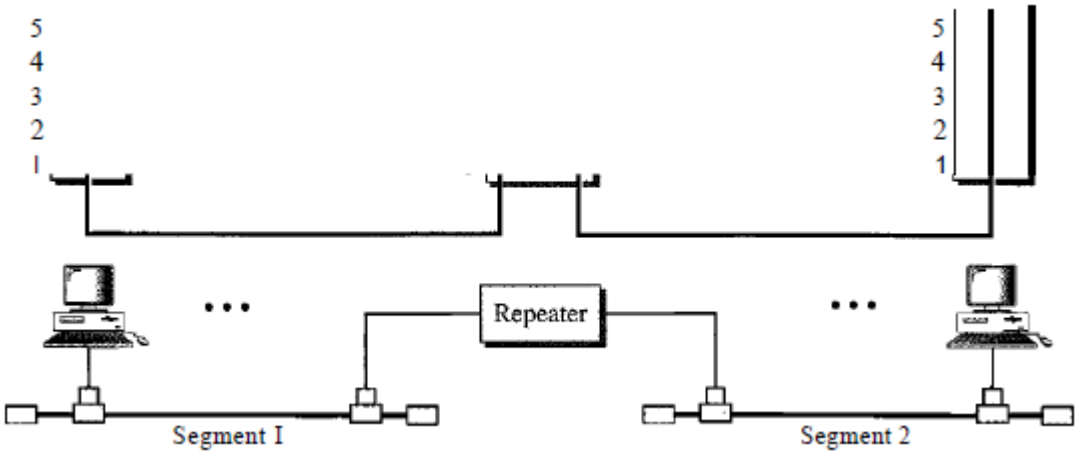
Connecting Devices

The device which connect one part or device of network to another device is known as connecting device. Connecting devices are divided into five different categories based on the layer in which they operate in a network:

1. Those which operate below the physical layer such as a passive hub.
2. Those which operate at the physical layer (a repeater or an active hub).
3. Those which operate at the physical and data link layers (a bridge or a two-layer switch).
4. Those which operate at the physical, data link, and network layers (a router or a three-layer switch).
5. Those which can operate at all five layers (a gateway).

Repeater

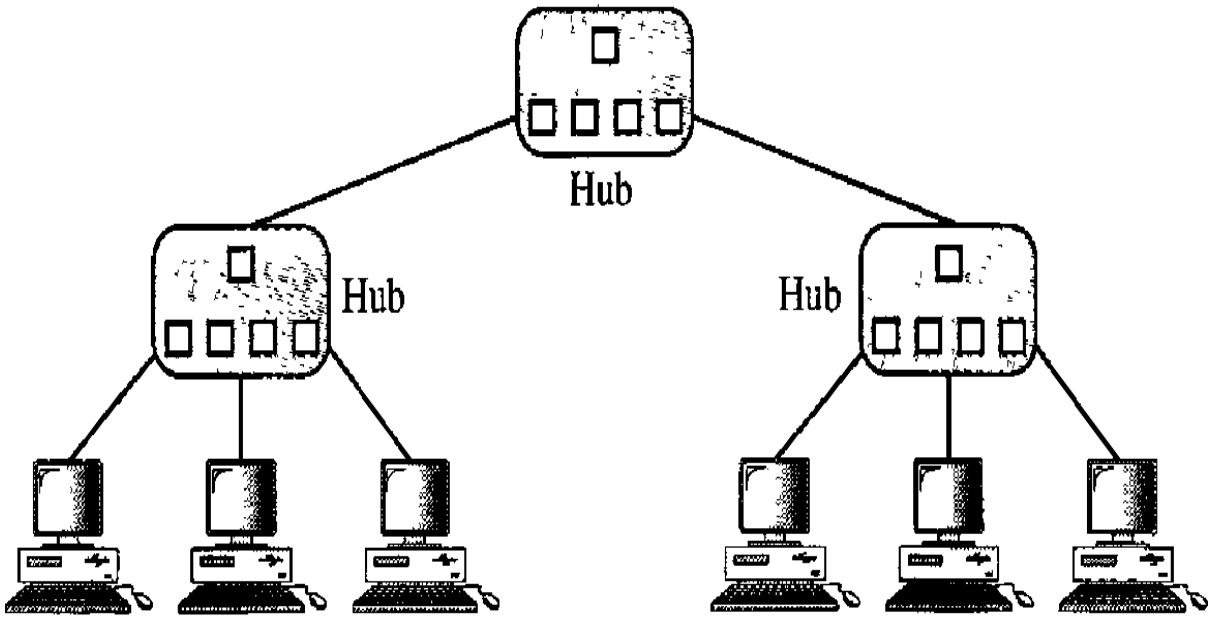
- A repeater is a device that operates only in the physical layer.
- Signals that carry information within a network can travel a fixed distance before attenuation endangers the integrity of the data. A repeater receives a signal and, before it becomes too weak or corrupted, regenerates the original bit pattern. The repeater then sends the refreshed signal.
- A repeater can extend the physical length of a LAN.
- A repeater is not a device that can connect two LANs of different protocols.
- A repeater forwards every frame; it has no filtering capability.



- A repeater is a regenerator, not an amplifier.
- The location of a repeater on a link is vital. A repeater must be placed so that a signal reaches it before any noise changes the meaning of any of its bits. A little noise can alter the precision of a bit's voltage without destroying its identity.

Hub

- A hub is basically a multiport repeater.
- A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations.
- Hubs cannot filter data, so data packets are sent to all connected devices.
- Hubs cannot provide routing capabilities or other advanced network services.



It is of two types: **i) Passive Hub ii) Active Hub**

i) **Passive Hub:** These are the hubs which collect wiring from nodes and power supply from active hub. These hubs relay signals onto the network without cleaning and boosting them and can't be used to extend the distance between nodes. It operates below the physical layer.

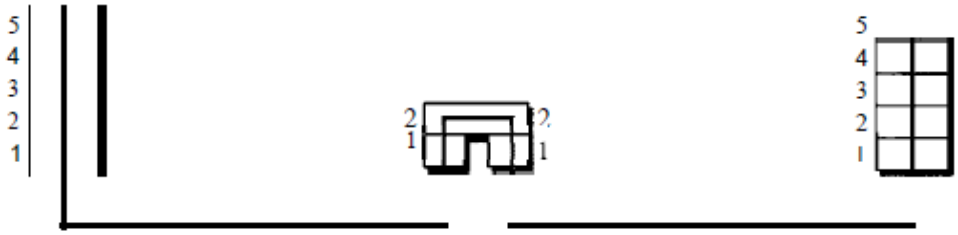
ii) **Active Hub**: These are the hubs which have their own power supply and can clean, boost and relay the signal along with the network. It serves both as a repeater as well as wiring centre. These are used to extend the maximum distance between nodes. It operates at the Physical layer.

Bridge

- A bridge operates in both the physical and the data link layer.
- As a physical layer device, it regenerates the signal it receives.
- As a data link layer device, the bridge can add the functionality of filtering by checking the physical (MAC) addresses (source and destination) contained in the frame.
- A bridge does not change the physical (MAC) addresses in a frame.
- It is also used for interconnecting two LANs working on the same protocol.
- It has a single input and single output port, thus making it a 2 port device.

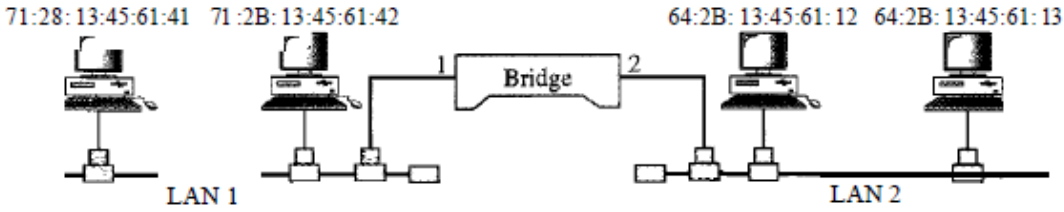
Difference between bridge and repeater: A bridge has filtering capability. It can check the destination address of a frame and decide if the frame should be forwarded or dropped. If the frame is to be forwarded, the decision must specify the port. A bridge has a table that maps addresses to ports.

Let us give an example. In Figure 15.5, two LANs are connected by a bridge. If a frame destined for station 712B13456142 arrives at port 1, the bridge consults its table to find the departing port. According to its table, frames for 7l2B13456142 leave through port 1; therefore, there is no need for forwarding, and the frame is dropped. On the other hand, if a frame for 712B13456141 arrives at port 2, the departing port is port 1 and the frame is forwarded. In the first case, LAN 2 remains free of traffic; in the second case, both LANs have traffic.



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



Types of Bridges

- **Transparent Bridges:-** These are the bridge in which the stations are completely unaware of the bridge's existence i.e. whether or not a bridge is added or deleted from the network, reconfiguration of the stations is unnecessary. These bridges make use of two processes i.e. bridge forwarding and bridge learning.
- **Source Routing Bridges:-** In these bridges, routing operation is performed by source station and the frame specifies which route to follow. The hot 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 **network switch** (also called **switching hub**, **bridging hub**, officially **MAC bridge**) is networking hardware that connects devices on a computer network by using packet switching to receive and forward data to the destination device.

Types: **i) Two layer switch ii) Three layer switch**

i) Two layer switch

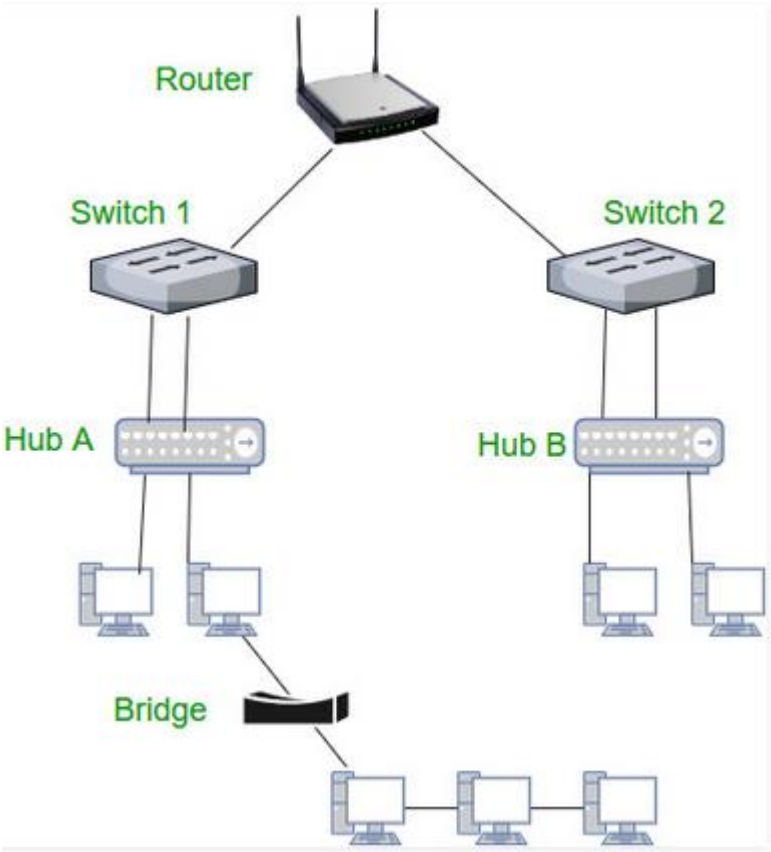
- The **two-layer switch** performs at the physical and data link layers.
- A two-layer switch is a bridge, a bridge with many ports and a design that allows better (faster) performance. A bridge with a few ports can connect a few LANs together.
- A two-layer switch, as a bridge does, makes a filtering decision based on the MAC address of the frame it received. However, a two-layer switch can be more sophisticated.
- It can have a buffer to hold the frames for processing. It can have a switching factor that forwards the frames faster.

ii) Three layer switch

- A 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.

Router

- A router is a device like a switch that routes data packets based on their logical addressing (host to host address).
- Router is mainly a Network Layer device.
- Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets. Router divide broadcast domains of hosts connected through it.



Gateway

- A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models.
- They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system.
- Gateways are also called protocol converters and can operate at any network layer.
- The gateway is used to filter unwanted application-layer messages.

For example:

a network designed to use the OSI model can be connected to another network using the Internet model.