Unit 2:

Physical Layer

Transmission Media : Guided media like coaxial , fiber, twisted pair and Wireless media, Transmission Impairments, interconnection Devices: Hub , Bridges ,Switches ,Router ,Gateway.

Data Communication Model :DTE,DCE,RS-232D Interface ,Null Modem ,

Multiplexing : FDM ,Syncronous TDM, Statical TDM ,ADSL, xDSL, cable Moderm

2.1 What is Transmission media?

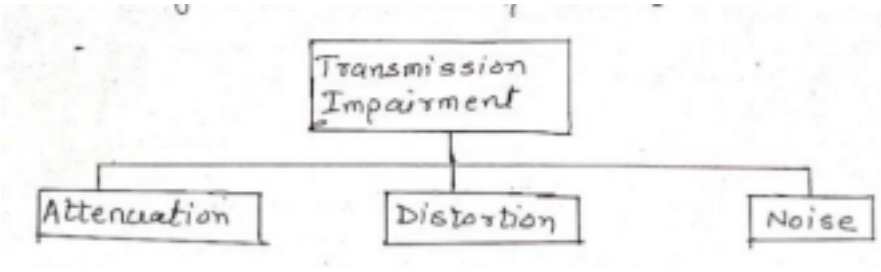
- Transmission media is a communication channel that carries the information from the sender to the receiver. Data is transmitted through the electromagnetic signals. ○ The main functionality of the transmission media is to carry the information in the form of bits through **LAN** (Local Area Network).
- It is a physical path between transmitter and receiver in data communication.
- In a copper-based network, the bits in the form of electrical signals. ○ In a fibre based network, the bits in the form of light pulses.
- In **OSI**(Open System Interconnection) phase, transmission media supports the Layer 1. Therefore, it is considered to be as a Layer 1 component.
- The electrical signals can be sent through the copper wire, fibre optics, atmosphere, water, and vacuum.
- The characteristics and quality of data transmission are determined by the characteristics of medium and signal.
- Transmission media is of two types are wired media and wireless media. In wired media, medium characteristics are more important whereas, in wireless media, signal characteristics are more important.
- Different transmission media have different properties such as bandwidth, delay, cost and ease of installation and maintenance.
- The transmission media is available in the lowest layer of the OSI reference model, i.e., **Physical layer**.

Some factors need to be considered for designing the transmission media:

- **Bandwidth:** All the factors are remaining constant, the greater the bandwidth of a medium, the higher the data transmission rate of a signal.
- **Transmission impairment:** When the received signal is not identical to the transmitted one due to the transmission impairment. The quality of the signals will get destroyed due to transmission impairment.
- **Interference:** An interference is defined as the process of disrupting a signal when it

travels over a communication medium on the addition of some unwanted signal.

Causes Of Transmission Impairment:



- **Attenuation:** Attenuation means the loss of energy, i.e., the strength of the signal decreases with increasing the distance which causes the loss of energy.
- **Distortion:** Distortion occurs when there is a change in the shape of the signal. This type of distortion is examined from different signals having different frequencies. Each frequency component has its own propagation speed, so they reach at a different time which leads to the delay distortion.
- **Noise:** When data is travelled over a transmission medium, some unwanted signal is added to it which creates the noise.

Classification Of Transmission Media:

- Guided Transmission Media
- UnGuided Transmission Media

2.2 Guided Media

It is defined as the physical medium through which the signals are transmitted. It is also known as Bounded media.

Types Of Guided media:

2.2.1 Twisted pair:

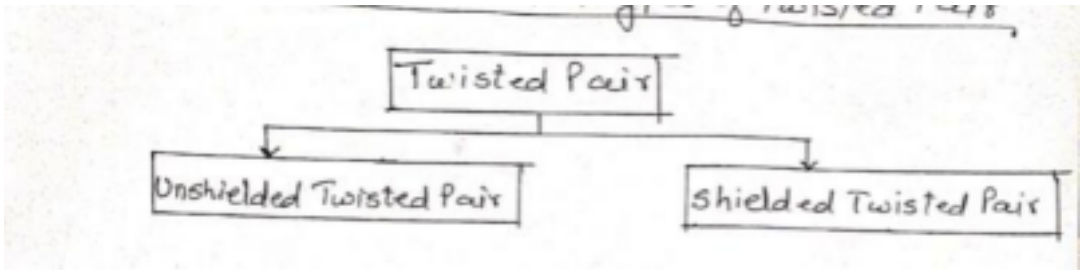
Twisted pair is a physical media made up of a pair of cables twisted with each other. A

twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz.

A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.

The degree of reduction in noise interference is determined by the number of turns per foot. Increasing the number of turns per foot decreases noise interference.

Types of Twisted pair:



1.Unshielded Twisted Pair:

An unshielded twisted pair is widely used in telecommunication. Following are the categories of the unshielded twisted pair cable:

- **Category 1:** Category 1 is used for telephone lines that have low-speed data.
- **Category 2:** It can support upto 4Mbps.
- **Category 3:** It can support upto 16Mbps.
- **Category 4:** It can support upto 20Mbps. Therefore, it can be used for long-distance communication.
- **Category 5:** It can support upto 200Mbps.

Table ***Categories ofunshielded twisted-pair cables***

Category	***Specification***	***Data Rate (Mbps)***	***Use***
I	Unshielded twisted-pair used in telephone	< 0.1	Telephone
2	Unshielded twisted-pair originally used in T-lines	2	T-llines

	Improved CAT 2 used in LANs	10	LANs
4	Improved CAT 3 used in Token Ring networks	20	LANs
5	Cable wire is normally 24 AWG with a jacket and outside sheath	100	LANs
SE	An extension to category 5 that includes extra features to minitni7e the crosstalk and electromagnetic interference	125	LANs
6	A new category with matched components coming from the same manufacturer. The cable must be tested at a 200-Mbps data	200	LANs
7	rate. Sometimes called SSTP (shielded screen twisted-pair). Each pair is individually wrapped in a helical metallic foil followed by a metallic foil shield in addition to the outside sheath. The shield decreases the effect of crosstalk: and increases the data	600	LANs

rate.

Advantages Of Unshielded Twisted Pair:

- It is cheap.
- Installation of the unshielded twisted pair is easy.
- It can be used for high-speed LAN.

Disadvantage:

- This cable can only be used for shorter distances because of attenuation.

Shielded Twisted Pair

A shielded twisted pair is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.

Characteristics Of Shielded Twisted Pair:

- The cost of shielded twisted pair cable is not very high and not very low. o

An installation of the STP is easy.

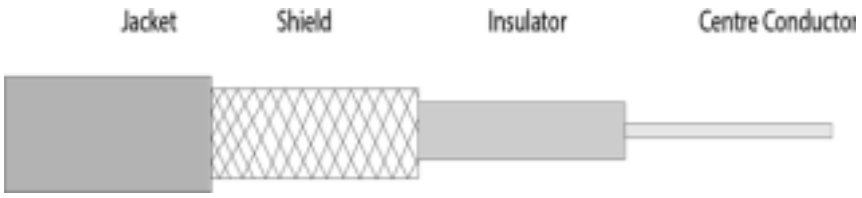
- It has higher capacity as compared to unshielded twisted pair cable.
- It has a higher attenuation.
- It is shielded that provides the higher data transmission rate.

Disadvantages

- It is more expensive as compared to UTP and coaxial cable.
- It has a higher attenuation rate.

2.2.2 **Coaxial Cable**

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the **EMI**(Electromagnetic interference).



Coaxial cable is of two types:

1. **Baseband transmission:** It is defined as the process of transmitting a single signal at high speed.
2. **Broadband transmission:** It is defined as the process of transmitting multiple signals simultaneously.

Table 7.2 *Categories ofcoaxial cables*

Category	*Impedance*	*Use*
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-ll	50 Ω	Thick Ethernet

Advantages Of Coaxial cable:

- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

Disadvantages Of Coaxial cable:

- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network.

2.2.3 **Fibre Optic**

- Fibre optic cable is a cable that uses electrical signals for communication. o Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.

Table 7.3 Fibre types

Type	Core (pm)	Cladding (etm)	Mode
501125	50.0	125	Multimode, graded index
62.51125	62.5	125	Multimode, graded index
100/125	100.0	125	Multimode, graded index
7/125	7.0	125	Single mode

Diagrammatic representation of fibre optic cable:

Basic elements of Fibre optic cable:

- **Core:** The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- **Cladding:** The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.
- **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

Following are the advantages of fibre optic cable over copper:

- **Greater Bandwidth:** The fibre optic cable provides more bandwidth as compared copper. Therefore, the fibre optic carries more data as compared to copper cable.
- **Faster speed:** Fibre optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.
- **Longer distances:** The fibre optic cable carries the data at a longer distance as compared to copper cable.
- **Better reliability:** The fibre optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.
- **Thinner and Sturdier:** Fibre optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

2.3 UnGuided Transmission: Wireless transmission

- An unguided transmission transmits the electromagnetic waves without using any physical medium. Therefore it is also known as **wireless transmission**.
- In unguided media, air is the media through which the electromagnetic energy can flow easily.

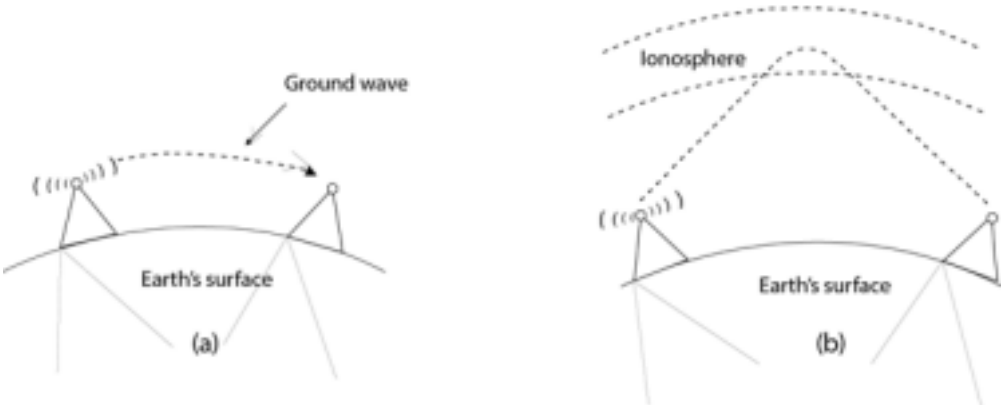
Unguided transmission is broadly classified into three categories:

Table 7.4 *Bands*

Band	*Range*	*Propagation*	*Application*
VLF (very low frequency)	3-30 kHz	Ground	Long-range radio navigation
LF (low frequency)	30-300 kHz	Ground	Radio beacons and navigational locators
MF (middle frequency)	300 kHz-3 MHz	Sky	AM radio
HF (high frequency)	3-30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF (very high frequency)	30-300 MHz	Sky and line-of-sight	VHF TV, FM radio
UHF (ultrahigh frequency)	300 MHz-3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
SHF (superhigh frequency)	3-30 GHz	Line-of-sight	Satellite communication
EHF (extremely high frequency)	30-300 GHz	Line-of-sight	Radar, satellite

2.3.1 Radio waves

- Radio waves are the electromagnetic waves that are transmitted in all the directions of free space.
- Radio waves are omnidirectional, i.e., the signals are propagated in all the directions.
- The range in frequencies of radio waves is from 3Khz to 1 khz.
- In the case of radio waves, the sending and receiving antenna are not aligned, i.e., the wave sent by the sending antenna can be received by any receiving antenna. o An example of the radio wave is **FM radio**.



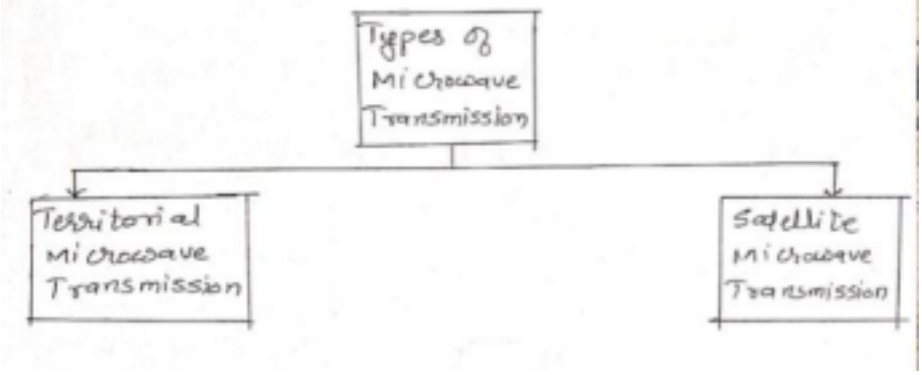
Applications Of Radio waves:

- A Radio wave is useful for multicasting when there is one sender and many receivers.
- An FM radio, television, cordless phones are examples of a radio wave.

Advantages Of Radio transmission:

- Radio transmission is mainly used for wide area networks and mobile cellular phones.
- Radio waves cover a large area, and they can penetrate the walls.
- Radio transmission provides a higher transmission rate.

2.3.3Microwaves



Microwaves are of two types:

- Terrestrial microwave
- Satellite microwave communication.

Terrestrial Microwave Transmission

- The Terrestrial Microwave transmission is the technology that transmits focused beam of the radio signal from one ground-based microwave transmission antenna to the another.
- Microwaves are the electromagnetic waves having the frequency in the range from 1GHz to 1000 GHz.
- Microwaves are unidirectional as the sending and receiving antenna is to be aligned, i.e., the waves sent by the sending antenna are narrowly focussed.
- In this case, antennas are mounted on the towers to send a beam to another antenna which is km away.
- It works on the line of sight transmission, i.e., the antennas mounted on the towers are the direct sight of each other.

Characteristics of Microwave:

- **Frequency range:** The frequency range of terrestrial microwave is from 4-6 GHz to 21-23 GHz.
- **Bandwidth:** It supports the bandwidth from 1 to 10 Mbps.
- **Short distance:** It is inexpensive for short distance.

- **Long distance:** It is expensive as it requires a higher tower for a longer distance.
- **Attenuation:** Attenuation means loss of signal. It is affected by environmental conditions and antenna size.

Advantages Of Microwave:

- Microwave transmission is cheaper than using cables.
- It is free from land acquisition as it does not require any land for the installation of cables.
- Microwave transmission provides an easy communication in terrains as the installation of cable in terrain is quite a difficult task.
- Communication over oceans can be achieved by using microwave transmission.

Disadvantages of Microwave transmission:

- **Eavesdropping:** An eavesdropping creates insecure communication. Any malicious user can catch the signal in the air by using its own antenna.
- **Out of phase signal:** A signal can be moved out of phase by using microwave transmission.
- **Susceptible to weather condition:** A microwave transmission is susceptible to weather condition. This means that any environmental change such as rain, wind can distort the signal.
- **Bandwidth limited:** Allocation of bandwidth is limited in the case of microwave transmission.

Satellite Microwave Communication

- A satellite is a physical object that revolves around the earth at a known height.
- Satellite communication is more reliable nowadays as it offers more flexibility than cable and fibre optic systems.
- We can communicate with any point on the globe by using satellite communication.

How Does Satellite work?

The satellite accepts the signal that is transmitted from the earth station, and it amplifies the signal. The amplified signal is retransmitted to another earth station.

Advantages Of Satellite Microwave Communication:

- The coverage area of a satellite microwave is more than the terrestrial microwave.
- The transmission cost of the satellite is independent of the distance from the centre of the coverage area.

- Satellite communication is used in mobile and wireless communication applications.
- It is easy to install.
- It is used in a wide variety of applications such as weather forecasting, radio/TV signal broadcasting, mobile communication, etc.

Disadvantages Of Satellite Microwave Communication:

- Satellite designing and development requires more time and higher cost.
- The Satellite needs to be monitored and controlled on regular periods so that it remains in orbit.
- The life of the satellite is about 12-15 years. Due to this reason, another launch of the satellite has to be planned before it becomes non-functional.

2.3.4 Infrared

- An infrared transmission is a wireless technology used for communication over short ranges.
- The frequency of the infrared in the range from 300 GHz to 400 THz.
- It is used for short-range communication such as data transfer between two cell phones, TV remote operation, data transfer between a computer and cell phone resides in the same closed area.

Characteristics of Infrared:

- It supports high bandwidth, and hence the data rate will be very high.
- Infrared waves cannot penetrate the walls. Therefore, the infrared communication in one room cannot be interrupted by the nearby rooms.
- An infrared communication provides better security with minimum interference.
- Infrared communication is unreliable outside the building because the sun rays will interfere with the infrared waves.

2.3 Transmission Impairment

In the data communication system, analog and digital signals go through the transmission medium. Transmission media are not ideal. There are some imperfections in transmission mediums. So, the signals sent through the transmission medium are also not perfect. This imperfection cause **signal impairment**.

It means that signals that are transmitted at the beginning of the medium are not the same as the signals that are received at the end of the medium that is what is sent is not what is received. These impairments tend to deteriorate the quality of analog and digital signals.

Consequences

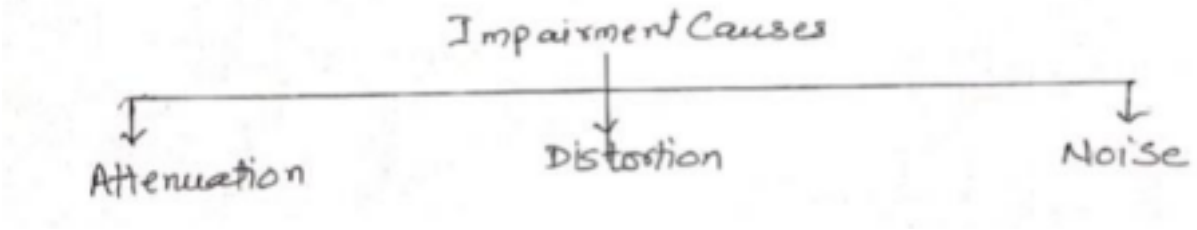
1. For a digital signal, there may occur bit errors.

2. For analog signals, these impairments degrade the quality of the signals.

Causes of impairment

There are three main causes of impairment are,

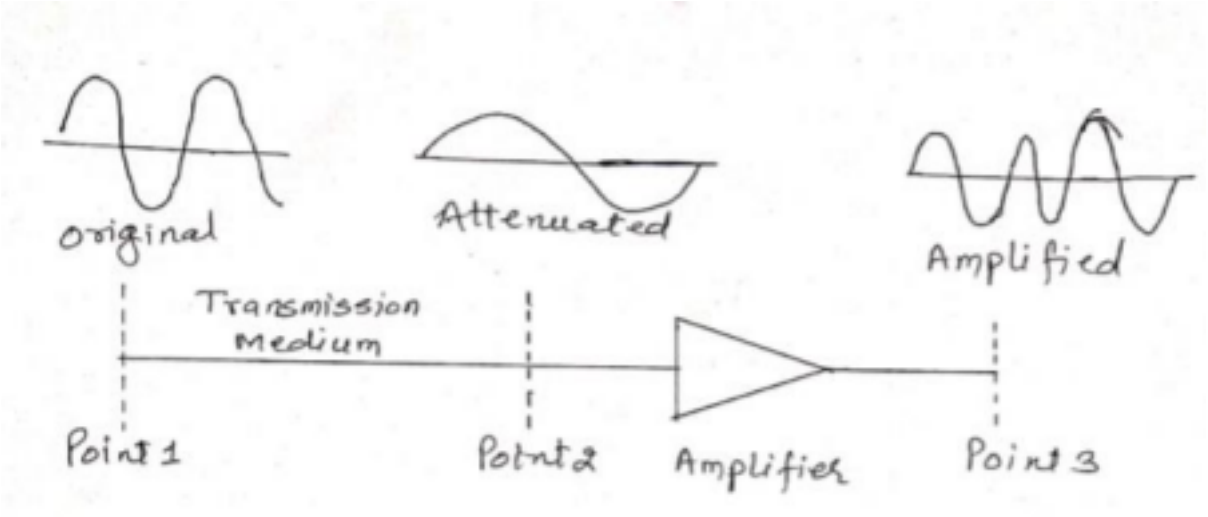
1. Attenuation
2. Distortion
3. Noise



1) Attenuation

Here attenuation Means loss of energy that is the weaker signal. Whenever a signal transmitted through a medium it loses its energy, so that it can overcome by the resistance of the medium.

- That is why a wire carrying electrical signals gets warm, if not hot, after a while. Some of the electrical energy is converted to heat in the signal.
- Amplifiers are used to amplify the signals to compensate for this loss.
- This figure shows the **effect of attenuation and amplification**:



- A signal has lost or gained its strength, for this purpose engineers use the concept of decibel(dB).
- Decibel is used to measure the relative strengths of two signals or a signal at two different points.
- If a signal is attenuated then dB is negative and if a signal is amplified so the db is

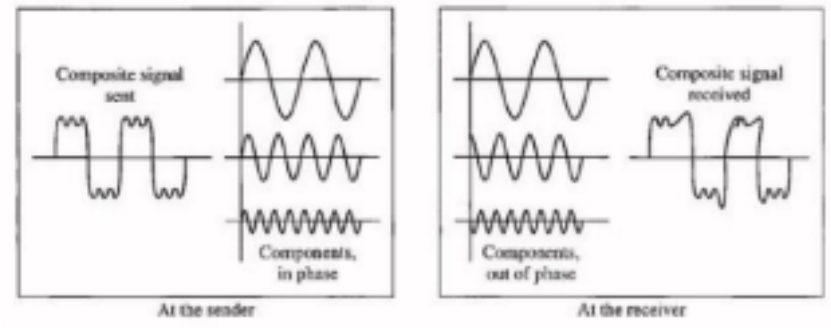
positive.
Attenuation(dB) = 10log10(P2/P1)

where P2 and P1 are the power of a signal at points1 and 2.

2) Distortion

If a signal changes its form or shape, it is referred to as distortion. Signals made up of different frequencies are composite signals. Distortion occurs in these composite signals.

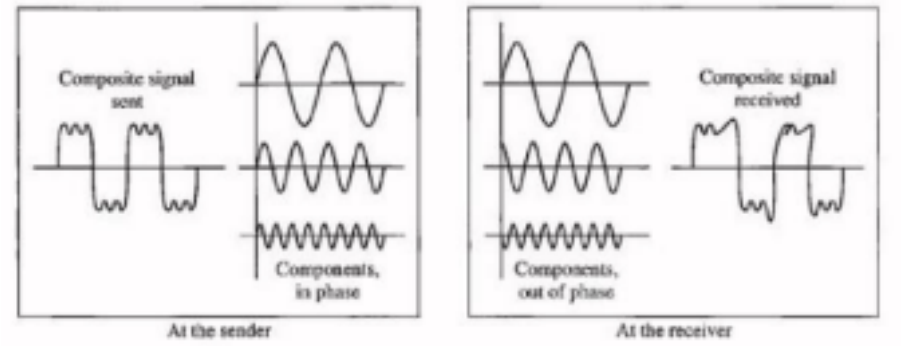
- Each component of frequency has its propagation speed traveling through a medium and therefore, different components have different delay in arriving at the final destination.
- It means that signals have different phases at the receiver than they did at the source.
- This figure shows the effect of distortion on a composite signal:



Distortion

3) Noise

Noise is another problem. There are some random or unwanted signals mix up with the original signal is called noise. Noises can corrupt the signals in many ways along with the distortion introduced by the transmission media.



Distortion

Different types of noises are:

a. Thermal noise
b. Intermodulation noise

c. Crosstalk
d. Impulse noise

a) Thermal noise

The thermal noise is random motion of electrons in a conductor that creates an extra signal not originally sent by the transmitter.

It is also known as white noise because it is distributed across the entire spectrum (as the frequency encompass over a broad range of frequencies).

b) Intermodulation noise

More than one signal share a single transmission channel, intermodulation noise is generated.

For instance, two signals S1 and S2 will generate signals of frequencies (S1 + S2) and (s1 - S2), which may interfere with the signals of the same frequencies sent by the sender. due to If nonlinearity present in any part of the communication system, intermodulation noise is introduced.

c) Cross talk

Cross talk is an effect a wire on the another. One wire acts as a sending antenna and the transmission medium acts as the receiving antenna.

Just like in telephone system, it is a common experience to hear conversation of other people in the background. This is known as cross talk.

d) Impulse noise

Impulse noise is irregular pulses or spikes(a signal with high energy in a very short period) generated by phenomena like that comes from power lines, lightning, spark due to loose contact in electric circuits and so on.

It is a primary source of bit-errors in digital data communication that kind of noise introduces burst errors.

2.4 Interconnecting Devices:

- An Interconnecting device is any device that can enable computers to exchange data on a network.

- Backbone of a network.

INTERCONNECTING DEVICES

1. Hubs
2. Bridges
3. Switches

4. Routers
5. Gateways

2.4.1 Hubs

• The Hubs are used in the networks that use twisted pair cabling to connect the devices. The Hubs can also be joined together to create the larger networks. • The Hubs are the simple devices that direct data packets to all the devices connected to the hub, regardless of whether data package is destined for a device. This makes them inefficient devices and can be create a performance bottleneck on busy networks. In its most basic form, the hub does nothing except provide the pathway for the electrical signals to travel along. Such a device is called a passive hub. • Far more common now a days is an active hub, which, as well as providing a path for the data signals, regenerates the signal before it forwards it to all of the connected devices.

• The hub does not perform any processing on data that it forwards, nor does it perform any error checking.

• The Hubs come in the variety of shapes and sizes. The hubs with five or eight connection ports are commonly referred to as workgroup hubs. Others can accommodate larger numbers of devices. These are referred to as high density devices. Because hubs do not perform any processing, they do little except enable communication between connected devices.

• For today's high demand network applications, something with a little more intelligence is required. That is where switches come in.

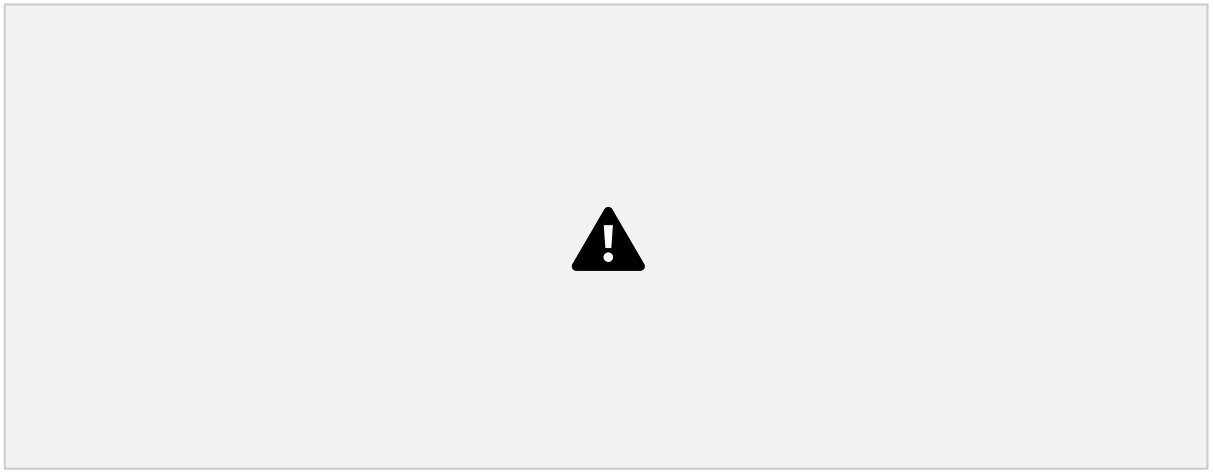


Fig hierarchic of hub

1. Passive Hubs

The passive hub is just the connector. It connects wires coming from different branches. In the star-topology Ethernet LAN, a passive hub is just a point where the signals coming from different stations collide; the hub is the collision point. This type of a hub is part of the media; its location in the Internet model is below the physical layer.

2.Active Hubs

An active hub is actually a multipart repeater. It is normally used to create connections between stations in a physical star topology. We have seen examples of hubs in some

Ethernet implementations (lOBase-T, for example). However, hubs can also be used to create multiple levels of hierarchy, as shown in Figure 15.4. The hierarchical use of hubs removes the length limitation of 10Base-T (100 m).

There are two primary types of hubs in the computing world: 1) network hubs and 2) USB hubs.

1. Network hub

The network hub is the device that allows multiple computers to communicate with each other over network. It has several Ethernet ports that are used to connect two or more network devices together. Each computer or device connected to a hub can communicate with any other device connected to one of hub's Ethernet ports.

The Hubs are similar to switches, but are not as "smart." While switches send incoming data to the specific port, hubs broadcast all incoming data to all active ports. For example, if five devices are connected to 8-port hub, all the data received by a hub is relayed to five active ports. While this ensures data gets to a right port, it also leads to inefficient use of a network band width. For this reason, switches are more commonly used than hubs.

2. USB hub

The USB hub is the device that allow multiple peripherals to connect through a single USB port. It is designed to increase the number of USB devices you can connect to a computer. For example, if your computer has two USB ports, but you want to connect five USB devices, you can connect 4-port USB hub to one of the ports. The hub will create four ports out of one, giving you five total ports. The USB interface allows you to daisy chain USB hubs together and the connect up to 127 devices to the single computer.

Some USB hubs include the power supply, while others do not. If you are connecting the basic devices such as a mouse, keyboard, and the USB flash drive, an unpowered or "passive" USB hub should work fine. However, some peripherals, such as external hard drives and the backlit keyboards, require additional electrical power. In order for these types of the devices to function through the USB hub, you may need use the powered or "active" hub that the provides 5 volts of the power to connected devices.

2.4.2 Switches

- The Switches Like hubs, switches are connectivity points of an Ethernet network. Devices connect to the switches from twisted pair cabling, one cable for each device. • The difference between the hubs and the switches is in how the devices deal with data that they receive. Whereas a hub forwards the data it receives to all of the ports on the device, the switch forwards it only to the port that connects to the destination device. It does this by learning the MAC address of the devices attached to it, and then by matching the destination MAC address in the data it receives.below Figure shows how a switch works.

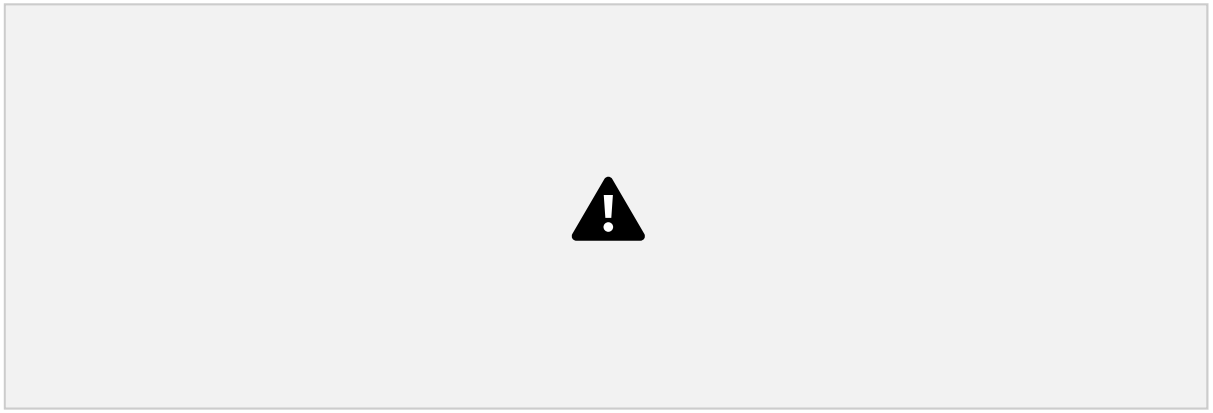


Figure : How a switch works.

- By forwarding data only to connection that must receive it, switch can improve the network performance in two ways.
- First, by creating the direct path between two devices and controlling their communication, it can greatly reduce number of collisions on a network. As you might recall, collisions occur on the Ethernet networks when two devices attempt to transmit at exactly the same time.
- In addition, lack of collisions enables switches communicate with the devices in full duplex mode. In the full-duplex configuration, devices can send and the receive data from switch at a same time.
- The Contrast this with half duplex communication, in which communication can occur in only one the direction at the time.
- The Full duplex transmission speeds are double that of the standard, half duplex, connection. So, the 10Mbps connection becomes 20Mbps, and the100Mbps connection becomes 200Mbps.
- The net result of these measures is that switches can offer significant performance improvements over hub based networks, the particularly when network use is high. • Irrespective of the whether a connection is at full or the half duplex, method of switching dictates how switch deals with data it receives.

The following is a brief explanation of each method:

➢ **Cut-through**—In the cut-through switching environment, a packet begins to be forwarded as soon as it is received. This method is very fast, but creates a possibility of errors being propagated through a network, as there is no error checking.

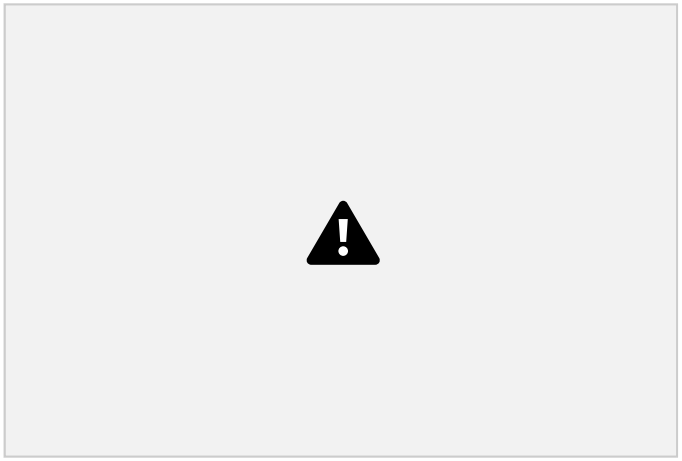
➢ **Store-and-forward**—Unlike cut through, in the store-and-forward switching environment, a entire packet is received and the error checked before being forwarded. The upside of this method is that errors are not propagated through network. A downside is that a error checking process takes the relatively long time, and store-and-forward switching is considerably slower as the result.

➢ **Fragment Free—**To take advantage of a error checking of store-and forward switching,

but still offer performance levels nearing that of cut through switching, Fragment Free switching can be used. In the FragmentFree-switching environment, enough of a packet is read so that switch can determine whether packet has been involved in the collision.

2.4.3 Bridges

- The Bridges are used to divide larger networks in to smaller sections. They do this by sitting between two physical network segments and also managing the flow of data between the two.
- By looking at a MAC address of the devices connected to each segment, bridges can elect to forward the data, or block it from crossing. Figure shows how a bridge can be used to segregate a network.



- When bridges were introduced, MAC addresses of a devices on connected networks had to be entered manually, the time consuming process that had plenty of opportunity for error.
- Today, almost all bridges can build the list of the MAC addresses on an interface by watching the traffic on the network. Such devices are called learning bridges because of this functionality
- The Bridge Placement and the Bridging Loops There are two issues that you should consider when using bridges.
- The first is bridge placement, and other is a elimination of bridging loops:

➢ **Placement**—The Bridges must be positioned in a network using 80/20 rule. This rule dictates that 80% of a data must be local and that other 20% must be destined for devices on other side of a bridge.

➢ **Bridging loops**—The Bridging loops can occur when more than one bridge is implemented on a network. In this scenario, a bridges can confuse each other by leading one another to believe that the device is located on the certain segment when it is not. To combat the bridging loop problem, a IEEE 802.1d Spanning Tree protocol enables the bridge interfaces to be assigned the value that is then used to control a bridge-learning process.

Types of Bridges Three types of the bridges are used in networks:

➢ **Transparent bridge**—The Derives its name from a fact that devices on network are unaware of its existence. A transparent bridge does nothing except block or forward data based on a MAC address.

➢ **Source route bridge**—The Used in Token Ring networks. The source route bridge derives its name from a fact that entire path that a packet is to take through network is embedded with in packet.

➢ **Translational bridge**—The Used to convert one networking data format to another; for example, from Token Ring to Ethernet and the vice versa.

2.4.4 Routers

- Today, the bridges are slowly but surely falling out of the favour.
- Ethernet switches offer similar functionality; they can provide logical divisions, or segments, in the network. In fact, switches are sometimes referred to as multiport bridges because of the way they operate.
- The Routers in a common configuration, routers are used to create larger networks by joining two network segments. Such as the SOHO router used to connect the user to a Internet.
- The router can be a dedicated hardware device or a computer system with more than one network interface and the appropriate routing software.
- All modern network operating systems include the functionality to act as a router. • The router derives its name from fact that it can route data it receives from one network on to another. When the router receives a packet of data, it reads header of packet to determine destination address.
- Once it has determined a address, it looks in its routing table to determine whether it knows how to reach destination and, if it does, it forwards the packet to the next hop on the route.
- The next hop might be the final destination, or it might be another router. Figure 3.5 shows, in basic terms, how a router works.
- As you can see from this example, routing tables play a very important role in the routing process. They are the means by which the router makes its decisions. For this reason, a routing table needs to be two things.
- It should be up-to-date, and it must be complete. There are two ways that the router can get the information for the routing table—through static routing or dynamic routing.

1.Static Routing

- In the environments that use static routing, routes and the route information are entered in to routing tables manually. Not only can this be the time consuming task, but also errors are more common.
- Additionally, when there is the change in layout, or the topology, of network, statically

configured routers should be manually updated with changes. Again, this is the time consuming and the potentially error laden task. For these reasons, static routing is suited to only smallest environments with perhaps just one or two routers.

- A far more practical solution, particularly in the larger environments, is to use dynamic routing

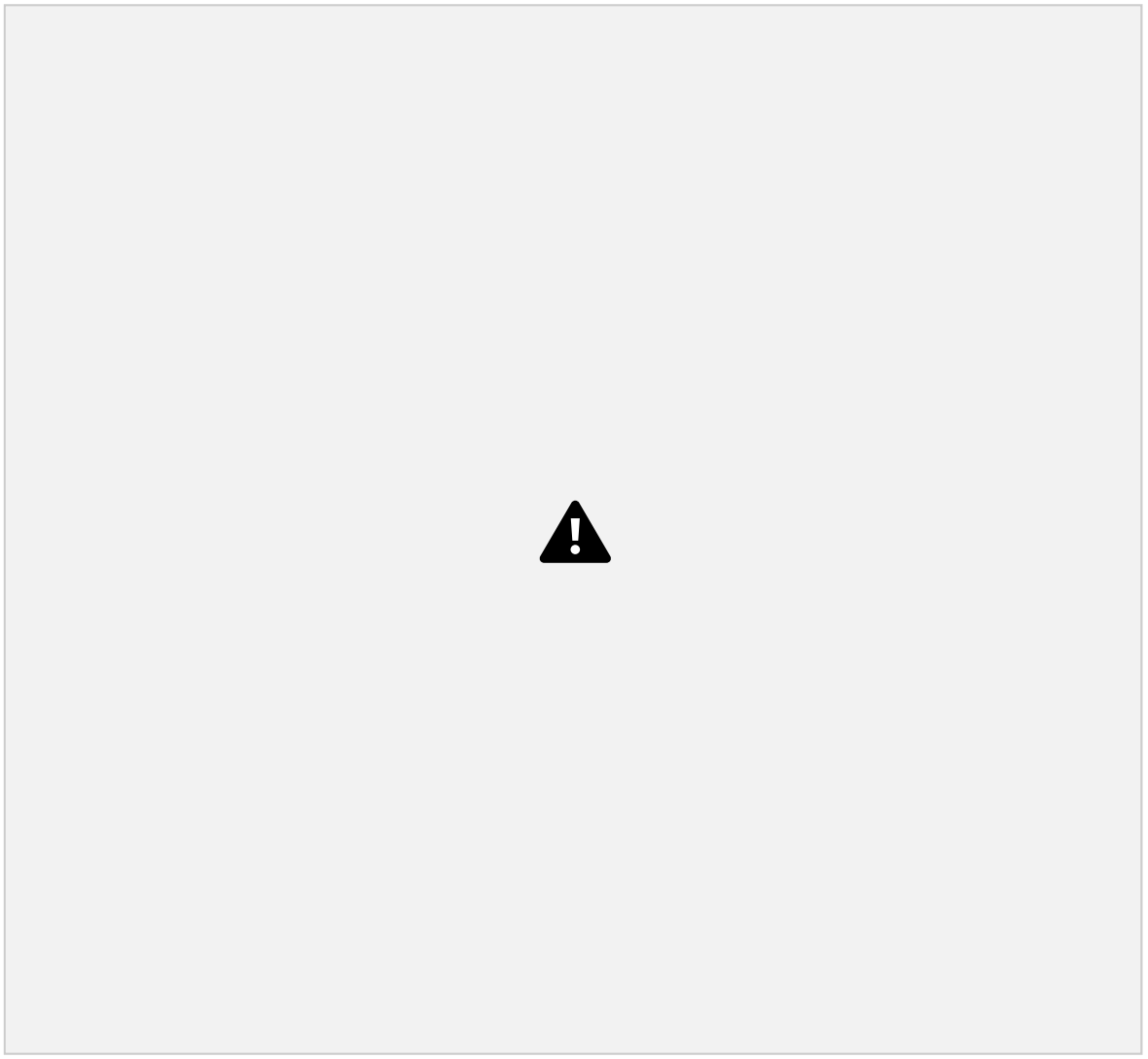


Figure : How a router works

2. Dynamic Routing

- In the dynamic routing environment, the routers use special routing protocols to communicate.
- The purpose of these protocols is simple; they enable the routers to pass on information about them selves to other routers so that other routers can build routing tables. • There are two types of the routing protocols used older **distance vector protocols and the newer link state protocols.**

a.Distance Vector Routing

- The two most commonly used distance vector routing protocols are both called Routing Information Protocol (RIP). One version is used on networks running TCP/IP. The other, sometimes referred to as IPX RIP, is designed for use on networks running the IPX/SPX protocol.
- RIP works on the basis of hop counts. A hop is defined as one step on the journey to the data's destination. Each router that the data has to cross to reach its destination constitutes a hop.
- The maximum number of hops that RIP can accommodate is 15. That is to say that in a network that uses RIP, all routers must be within 15 hops of each other to communicate. Any hop count that is in excess of 15 is considered unreachable.
- Distance vector routing protocols operate by having each router send updates about all the other routers it knows about to the routers directly connected to it. These updates are used by the routers to compile their routing tables.
- The updates are sent out automatically every 30 or 60 seconds. The actual interval depends on the routing protocol being used.
- Apart from the periodic updates, routers can also be configured to send a triggered update if a change in the network topology is detected. The process by which routers learn of a change in the network topology is known as convergence.

b.Link State Routing

- Link state routing works quite differently from distance vector-based routing. Rather than each router telling each other connected router about the routes it is aware of, routers in a link state environment send out special packets, called link state advertisements (LSA), which contain information only about that router.
- These LSAs are forwarded to all the routers on network, which enables them to build a map of the entire network.
- The advertisements are sent when the router is first brought onto the network and when a change in the topology is detected.
- Of the two (distance vector and link state), distance vector routing is better suited to small networks and link state routing to larger ones.
- Link state protocols do not suffer from the constant updates and limited hop count, and they are also quicker to correct themselves (to converge) when the network topology changes.
- On TCP/IP networks, the most commonly used link state routing protocol is the Open Shortest Path First (OSPF).
- On IPX networks, the NetWare Link State Protocol (NLSP) is used. Table 3.1 summarizes the distance vector and link state protocols used with each network protocol.

Network protocol	Distance Vector	Link state

TCP/IP	RIP	OSPF
IPX/SPX	RIP*	NLSP

Fig: Router Protocols

2.4.5 Gateways

- The gateway is the node (router) in the computer network, a key *stopping point* for data on its way to or from other networks. The Internet would not be any use to us with out gateways.
- In a workplace, the gateway is the computer that routes traffic from a workstation to the outside network that is serving up the Web pages.
- For basic Internet connections at home, the gateway is the Internet Service Provider that gives you access to the entire Internet.
- A node is simply a physical place where the data stops for either transporting or reading/using. (A computer or modem is a node; a computer cable isn't.) Here are a few node notes:
    - On the Internet, the node that's a stopping point can be a gateway or a host node.
    - A computer that controls the traffic your Internet Service Provider (ISP) receives is a node.

- If you have a wireless network at home that gives your entire family access to the Internet, your gateway is the modem (or modem-router combo) your ISP provides so you can connect to their network.
- On the other end, the computer that controls all of the data traffic your Internet Service Provider (ISP) takes and sends out is itself a node.
- When a computer-server acts as a gateway, it also operates as a firewall and a proxy server. A firewall keeps out unwanted traffic and outsiders off a private network. - A proxy server is software that "sits" between programs on your computer that you use (such as a Web browser) and a computer server—the computer that serves your network.
- The proxy server's task is to make sure the real server can handle your online data requests.
- A gateway is often associated with a router. A router is hardware—a small piece of computer/network-related equipment that connects you to the Internet. - In home networks, the router comes with special software that you install on one computer. You're then able to use the software to set up your home network so everyone allowed on your network can connect to the ISP and the Internet.
- A router can be connected to two or more networks at a time, but for home networks that's generally not the case.

2.5 Data Communication Model

- The Data Communications is the transfer of data or information between the source and the receiver. The source transmits data and receiver receives it.
- Data communication involved the following like communication networks, the different communication services required, kind of networks available, protocol architectures, OSI models, TCP/IP protocol models etc.
- The Data Communication is interested in the transfer of data, the method of transfer and the preservation of the data during the transfer process.
- In the Local Area Networks(LAN) , we are interested in "connectivity", connecting computers together to share resources. Even though computers can have different disk operating systems, languages, cabling and the locations, they still can communicate to one another and share resources.

  The purpose of Data Communications is to provide rules and the regulations that allow computers with different disk operating systems, languages, cabling and the locations to share resources. The rules and the regulations are called protocols and the standards in Data Communications.

1.Source

It is generator of data that will pass on a destination using networks. With out any request source never passes data to destination. So, if the source is passing data means any of a destinations is requesting for data using some query languages.

2.Transmitter

It is simply the device used to convert a data as per destination requirement. For example modem, converts analog (telephonic signals) signal to the digital (computer signals) signals and also alternatively digital to analog .

3.Transmission System

To transmit data on different connected systems we use different transmission systems. The Data transmission using transmission system means a physical transfer of the data over point-to-point or point-to-multipoint communication channels. Example of such channels are the copper wires, optical fibers even wireless communication channels etc.

4.Receiver

This receives signals from a transmission system and converts it in to a form that is suitable to destination device. For example, a modem accepts analog signal from the transmission channel and the transforms it into digital bit stream which is acceptable by computer system.

5.Destination

It is simply a device for which source device sends the data.

2.6 DTE (Data Terminal Equipment)

The data terminal equipment is the end instrument that is used to convert user input into digital signals and vice versa. The DTE can also be referred to as tail circuits. This device communicates with the DCE(Data Communications Equipment) typically a modem.

The data terminal equipment is a high speed serial interface that has the ability to support both higher data rates and connectivity between data communications equipment. This is primarily done over digital coaxial cable lines.

The data terminal equipment serves as the functional part of the data station which can be referred to as the data sink. This is where the data will originate, or it's source. It also allows for the data communication control function to be performed.

There can be many different configurations of data terminal equipment it can be a simple laptop, or it can be a number of different devices connected together. An example of this would be a computer, printer, and an external hard drive all connected and having the ability to each send information to the data communications equipment.

For an example, you turn on your computer and have a memo to write for your company. You open up a word document, type out the memo and proceed to send the memo in an email as

an attachment. When you click send, your computer becomes the data terminal equipment.

2.7 Data Communications Equipment(DCE)

Data Communications Equipment (DCE) can be classified as equipment that transmits or receives analogue or digital signals through a network. Two types of Data Communication Equipment

1. Modem- allows DTE to access and interface analog transmission facilities. It converts digital signal to analog and vice versa. With these, modem includes ADC and DAC. ADC is used for modem's receiver and DAC for modem transmitter

2. Channel Service Unit (CSUs) and Digital Service Unit (DSUs)- two devices that allow DTE to access and interface with digital transmission facilities. They have diff function but often combined in one unit.

-used to terminate a digital circuit at a subscriber's location and allow the subscriber to connect to a local central telephone office.

-allows devices connected to LAN to access and connect digital transmission facilities leased from service providers.

a. DSU- converts unipolar digital signal from a local area network's digital terminal into self clocking bipolar digital signal.

b. CSU- serves as the demarcation point between the digital station equipment and telecommunications lines. It converts digital signals to a format more suitable for transmission over digital transmission facility.

2.8 RS-232D Serial Interface Standard

The RS-232D Serial Interface Standard added the mechanical characteristics to the RS-232C

Standard. The RS-232D standard defines:

a. The Mechanical Characteristics of the Interface
b. The Electrical Characteristics of the Interface
c. The Function of Each Signal
d. Subsets of the Signals for Certain Applications

The European version of RS-232D is defined in:

- V.24 - Mechanical Standard
- V.28 - Electrical Standard

2.8.1 Mechanical Characteristics of the RS-232D

Mechanical Characteristics of the RS-232D Interface defines:

i. The connector is a DB25 connector. DB9 is not universally accepted. ii. The connector gender is Male at the DTE and Female at the DCE. iii. The assignments of signals to pins
iv. The maximum cable length is 50 ft.
v. The maximum cable capacitance = 2500 pF. Typical cable has 50 pF/foot capacitance.

2.8.2 RS-232D Flow Control

The Flow control is communication between the data transmitter and the data receiver to determine whose turn it is to talk. Another name for flow control is handshaking. Flow control is exchange of predetermined codes and the signals between two devices to establish and maintain a connection.

The Modem flow control is used between PC and the modem to determine if a modem is ready to receive data from the terminal, if carrier is present, if line is ringing, etc.

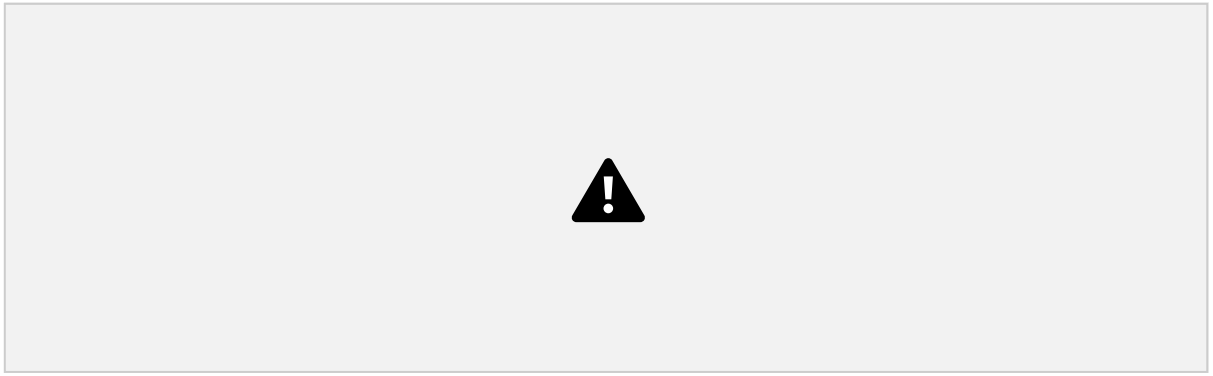
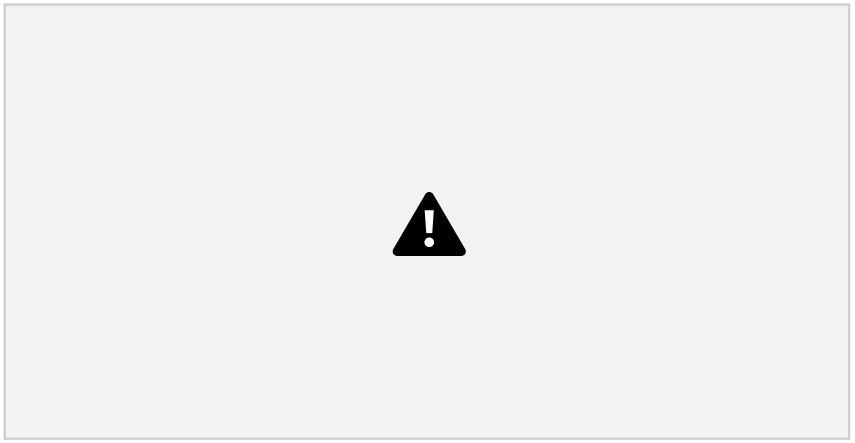


Fig : Source to Destination (End to End) flow control

2.9 Hardware Null Modems

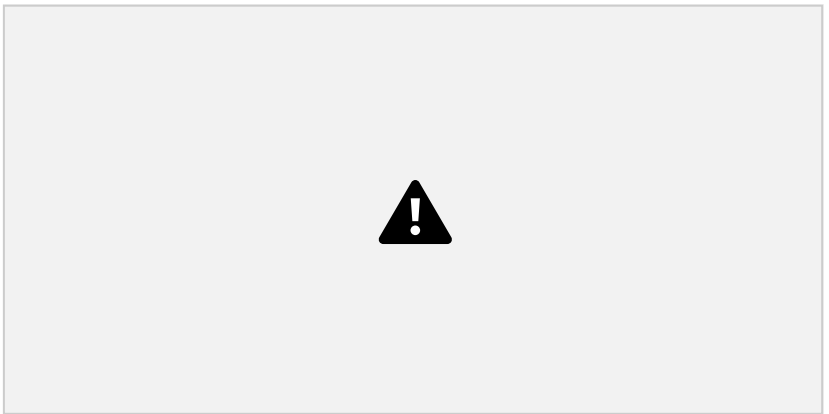
Null modems are a way of connecting 2 DTEs together without using a modem - we are nulling out the modems. This gives way to the term Null Modem. When 2 DTEs are connected together, the TXD Pin2 of one DTE is crossed to Pin 3 RXD of the other DTE. We also have to fool the DTEs into believing that they are connected to DCE devices. This is done by crossing the control lines as follows:



- Notice that RI (Ring Indicator) and CD (Carrier Detect) are not used when connecting directly from DTE to DTE. They are a function of a telephone system and by nulling out the modems, we've eliminated the telephone system. This can cause problems when transferring files directly because most communication programs detect loss of carrier (CD) as a disconnect command. The communication program will abort the data transfer if CD is not present. This can usually be over-ridden by de-selecting "Transfer Aborted if CD Lost" (or something similar) in one of the communication software configuration menus.

2.9.1 Software Null Modem

As using software to control the data flow, we can eliminate a few of the control lines used in the Hardware Null Modem cable. In its simplest form, the Null Modem cable consists of SGND, and the TXDs & RXDs crossed.

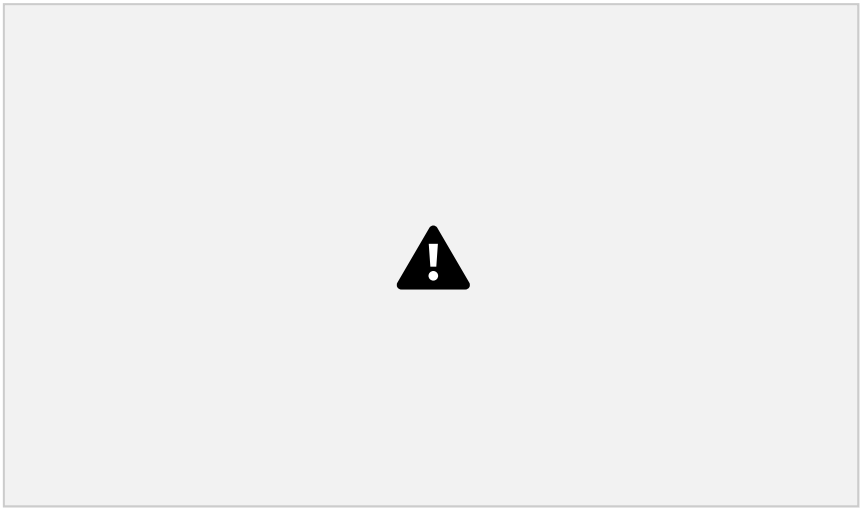


Usually we find that we have to add a few control lines to fool the DTE's hardware. There is

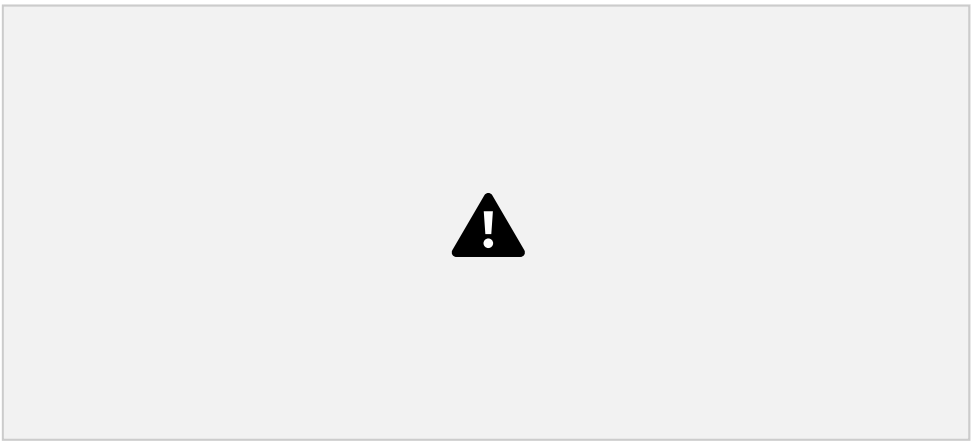
no standard Software Null Modem configuration for Xon/Xoff. The exact connection will vary from device manufacturer to device manufacturer.

2.10 Multiplexing :

Multiplexing is the transmission of multiple data communication sessions over a common wire or medium. Multiplexing reduces the number of wires or cable required to connect multiple sessions. A session is considered to be data communication between two devices: computer to computer, terminal to computer, etc..



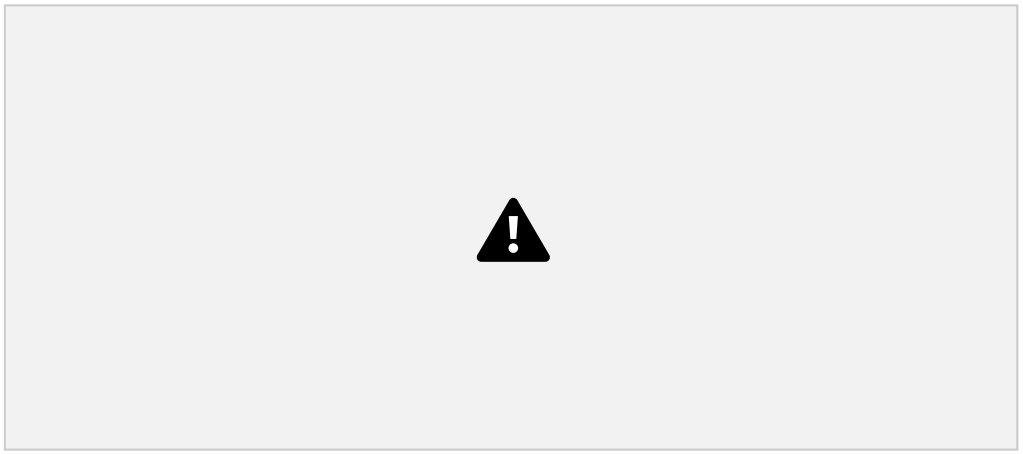
Individual lines running from 3 terminals to one mainframe is not a problem but when the number of terminals increases to 10 and up, it becomes a problem. Imagine a mainframe computer with 1200 terminals connected and each terminal running its own wire to the mainframe. If each wire was 1/4" in diameter (typical Cat 5 cable), you would have a wiring bundle going into the computer, roughly 2 feet in diameter.



A multiplexer allows sharing of a common line to transmit the many terminal communications as in the above example. The connection between the multiplexer and the mainframe is normally a high speed data link and is not usually divided into separate lines.

The operation of multiplexers (abbreviated MUXs) is transparent to the sending and receiving computers or terminals. Transparent means that as far as everyone is concerned, they appear to be directly connected to the mainframe with individual wires. The multiplexer does not interfere with the normal flow of data and it can allow a significant reduction in the overall cost of connecting to remote sites, through the reduced cost of cable and telephone line charges.

Multiplexers are used to connect terminals located throughout a building to a central mainframe. They are also used to connect terminals located at remote locations to a central mainframe through the phone lines.



There are 3 basic techniques used for multiplexing:

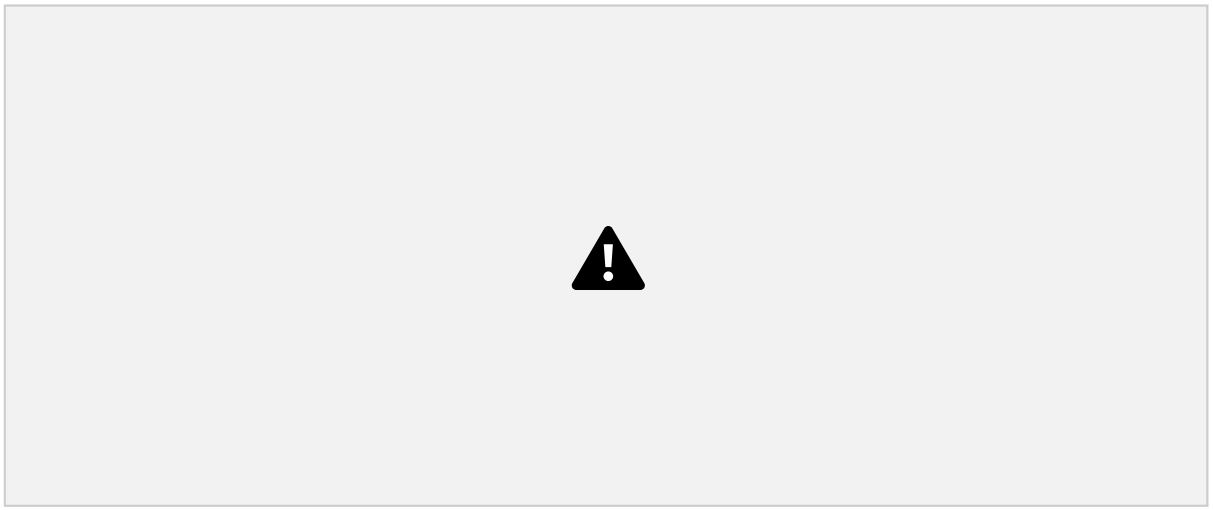
a. Frequency Division Multiplexing (FDM)
b. Time Division Multiplexing (TDM)
c. Statistical Time Division Multiplexing (STDM)

2.11 FDM

Frequency Division Multiplexing (FDM) is an analog technique where each communications channel is assigned a carrier frequency. To separate the channels, a guard-band would be used. This is to ensure that the channels do not interfere with each other.

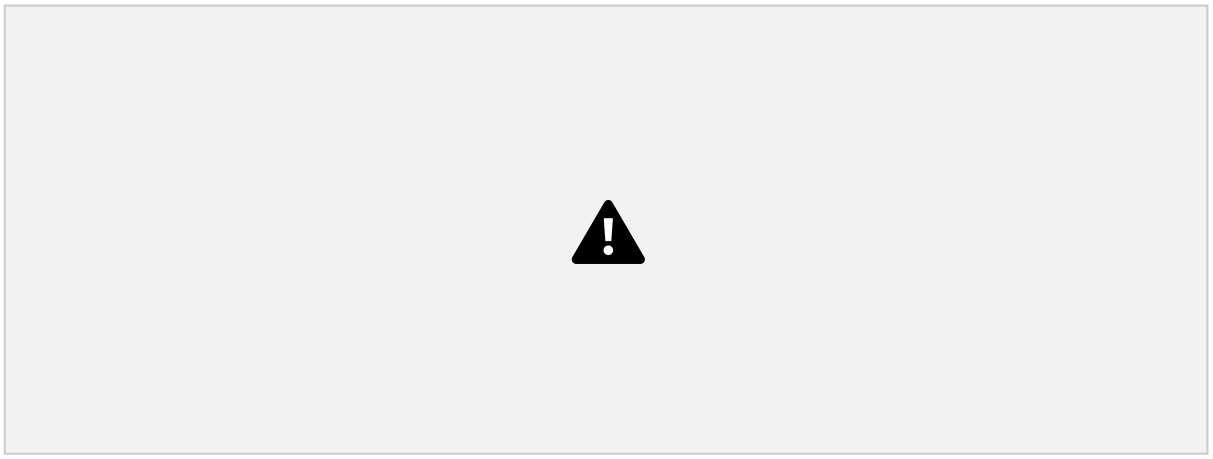
For example, if we had our 3 terminals each requiring a bandwidth of 3 kHz and a 300 Hz guard-band, Terminal 1 would be assigned the lowest frequency channel 0 - 3 kHz, Terminal 2 would be assigned the next frequency channel 3.3 kHz - 6.3 kHz and Terminal 3 would be assigned the final frequency channel 6.6 kHz - 9.6 kHz.

The frequencies are stacked on top of each other and many frequencies can be sent at once. The downside is that the overall line bandwidth increases. Individual terminal requirement were 3 kHz bandwidth each, in the above example: the bandwidth to transmit all 3 terminals is now 9.6 kHz.



FDM does not require all channels to terminate at a single location. Channels can be extracted using a multi-drop technique, terminals can be stationed at different locations within a building or a city.

FDM is an analog and slightly historical multiplexing technique. It is prone to noise problems and has been overtaken by Time Division Multiplexing which is better suited for digital data.



2.12 ,**Synchronous TDM (STDM)**

1. In synchronous TDM, each device is given same **time slot** to transmit the data over the link, irrespective of the fact that the device has any data to transmit or not. Hence the name Synchronous TDM. Synchronous TDM requires that the total

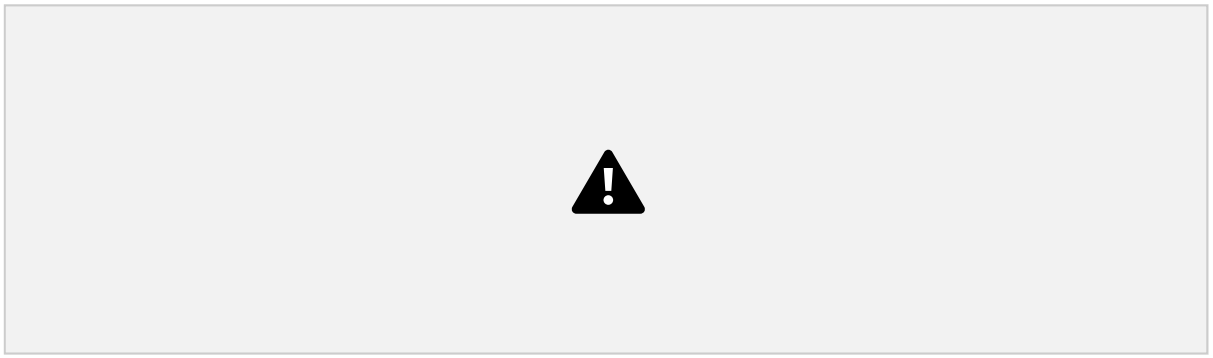
speed of various input lines should not exceed the capacity of path.

2. Each device places its data onto the link when its **time slot** arrives *i.e.* each device is given the possession of line turn by turn.

3. If any device does not have data to send then its time slot remains empty.

4. The various time slots are organized into **frames** and each frame consists of one or more time slots dedicated to each sending device.

5. If there are *n* sending devices, there will be *n* slots in frame *i.e.* one slot for each device.



6. As show in fig, there are 3 input devices, so there are 3 slots in each frame.

2.12.1 Multiplexing Process in STDM

1. In STDM every device is given the opportunity to transmit a specific amount of data onto the link.

2. Each device gets its turn in fixed order and for fixed amount of time. This process is known as interleaving.

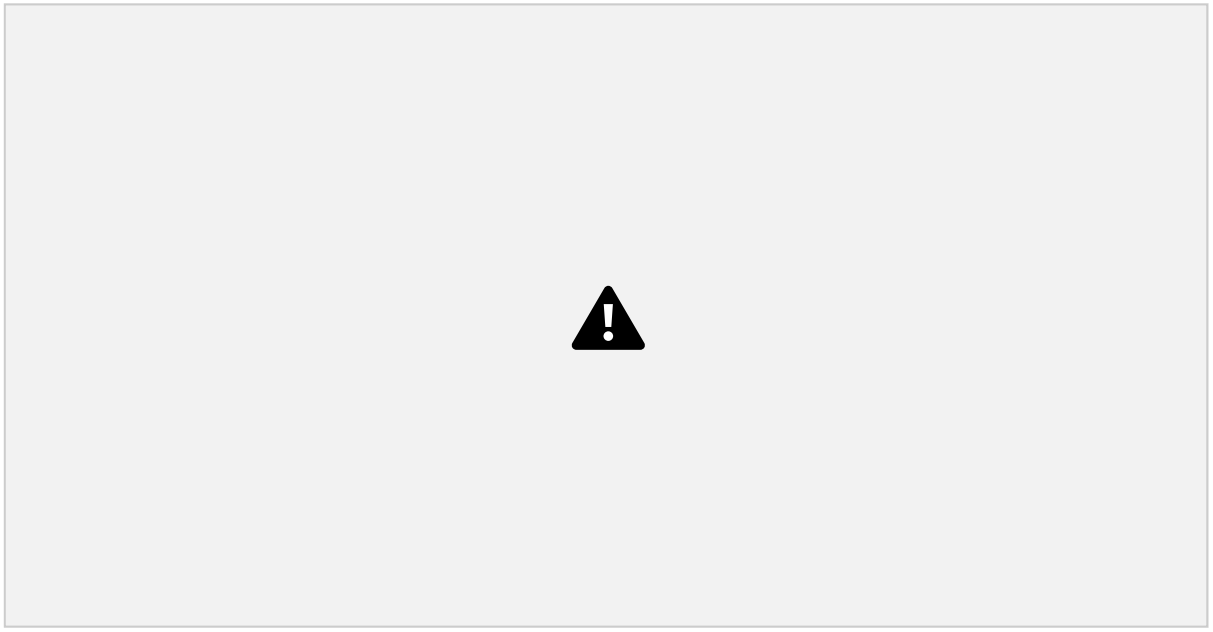
3. We can say that the operation of STDM is similar to that of a fast interleaved switch. The switch opens in front of a device; the device gets a chance to place the data onto the link.

4. Such an interleaving may be done on the basis of a hit, a byte or by any other data unit.

5. In STDM, the interleaved units are of same size *i.e.* if one device sends a byte, other will also send a byte and so on.

6. As shown in the fig. interleaving is done by a character (one byte). Each frame consists of four slots as there are four input devices. The slots of some devices go empty if they do not have any data to send.

7. At the receiver, demultiplexer decomposes each frame by extracting each character in turn. As a character is removed from frame, it is passed to the appropriate receiving device.



Disadvantages of Synchronous TDM

1. The channel capacity cannot be fully utilized. Some of the slots go empty in certain frames. As shown in fig only first two frames are completely filled. The last three frames have 6 empty slot. It means out of 20 slots in all, 6 slots are empty. This wastes the l/4th capacity of links.

2. The capacity of single communication line that is used to carry the various transmission should be greater than the total speed of input lines.

2.13 Asynchronous TDM

1. It is also known as statistical time division multiplexing.

2. Asynchronous TDM is called so because is this type of multiplexing, time slots are not fixed *i.e.* the slots are flexible.

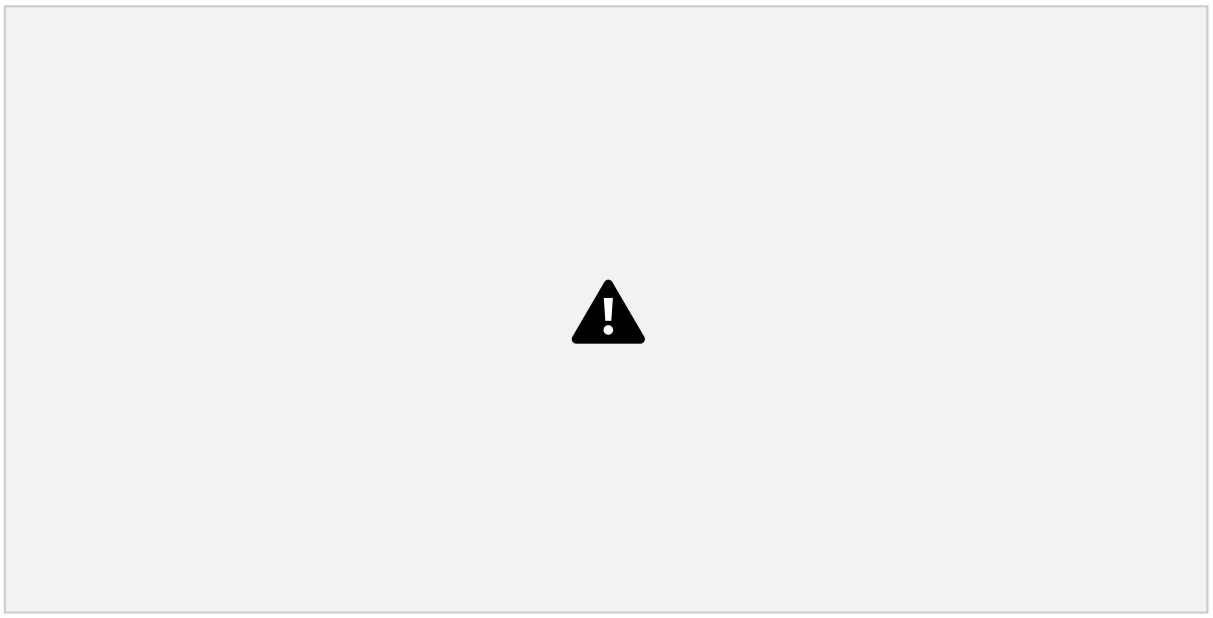
3. Here, the total speed of input lines can be greater than the capacity of the path.

4. In synchronous TDM, if we have *n* input lines then there are *n* slots in one frame. But in asynchronous it is not so.

5. In asynchronous TDM, if we have *n* input lines then the frame contains not more

than m slots, with m less than n $(m < n)$.

6. In asynchronous TDM, the number of time slots in a frame is based on a statistical analysis of number of input lines.



7. In this system slots are not predefined, the slots are allocated to any of the device that has data to send.
8. The multiplexer scans the various input lines, accepts the data from the lines that have data to send, fills the frame and then sends the frame across the link.

9. If there are not enough data to fill all the slots in a frame, then the frames are transmitted partially filled.

10. Asynchronous Time Division Multiplexing is depicted in fig. Here we have five input lines and three slots per frame.

11. In Case 1, only three out of five input lines place data onto the link *i.e.* number of input lines and number of slots per frame are same.

12. In Case 2, four out of five input lines are active. Here number of input line is one more than the number of slots per frame.

13. In Case 3, all five input lines are active.

In all these cases, multiplexer scans the various lines in order and fills the frames and transmits them across the channel.

The distribution of various slots in the frames is not symmetrical. In case 2, device

1 occupies first slot in first frame, second slot in second frame and third slot in third frame.

Advantages of TDM :

1. Full available channel bandwidth can be utilized for each channel. 2.lntermodulation distortion is absent. 3.TDM circuitry is not very complex. 4. The problem of crosstalk is not severe.

Disadvantages of TDM :

1. Synchronization is essential for proper operation. 2. Due to slow narrowband fading, all the TDM channels may get wiped out.

2.14 ADSL(Asymmetrical Digital Subscriber Line)

Asymmetrical Digital Subscriber Line (ADSL) is a method to use the existing analog local loop lines for digital data transfer to and from the home. It shares the local loop bandwidth with the voice channel so that you can use the regular phone line while using ADSL.

2.14.1 ADSL Standards

Initially, there were 3 competing standards for ADSL:

- Carrierless Phase Modulation ADSL,
- Splitterless ADSL
- Discrete Multitone ADSL.

1.Carrierless Phase Modulation (CAP) ADSL is a modulation technique similar to Quadrature Amplitude Modulation. It provides Echo Cancellation and overlaps upstream and downstream signals.

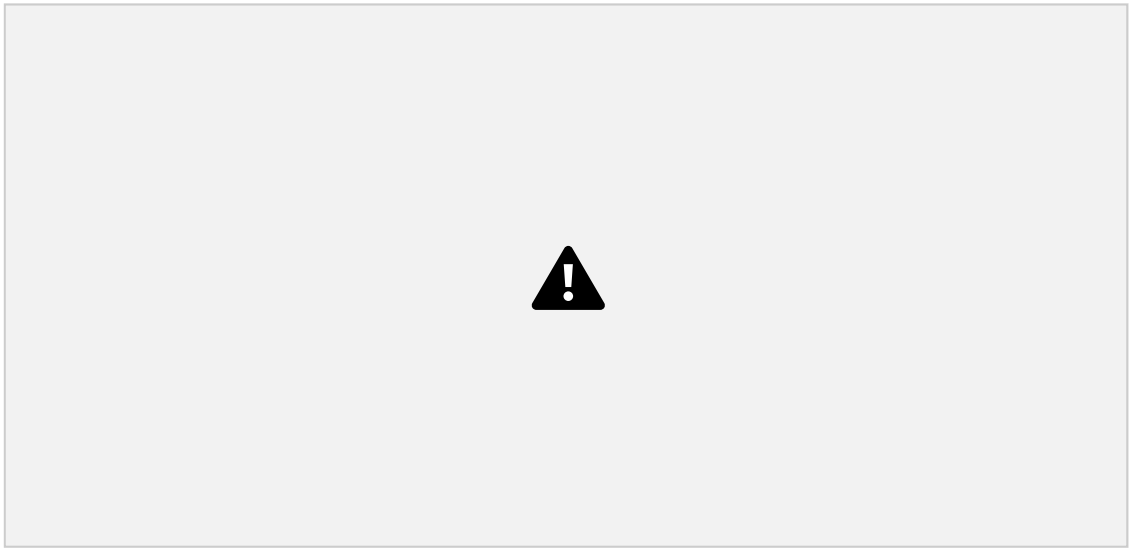
2.Splitterless ADSL (also called PnP ADSL, Universal ADSL) has a lower transmitting rate and is easier to implement.

3.DMT - Discrete Multitone is an ANSI T1.413 standard which uses a broadband modem that covers the 4 kHz to 2.2 MHz range. It has 256 channels of 4 kHz QAM, each channel is assigned 15 bits of data to transfer. In addition each channel is checked for signal quality and bits assigned accordingly. A poor responding channel may less bits assigned or none at all. DMT adjusts for the local loop line conditions and attempts to make the fastest transfer rate possible.

The winner of the ADSL battles was ADSL DMT which became the ITU G.992.1 standard (sometimes called G.DMT). A less bandwidth intensive version is ITU G.992.2 (G.lite) used to reduce the bandwidth requirements of the telco.

2.14.2 ITU G.992.1 (G.DMT) - Discrete Multitone

It has upstream transfer rates of up 1 Mbps and downstream transfer rates of up to 8 Mbps. There are 256 channels of 4 khz QAM available, channel 0 is not used and channels 1-6 (in the 4 to 25 kHz range) are used as a guard band between the voice channel and ADSL. The upstream bandwidth uses 31 channels and the downstream uses 224 channels.



ADSL shares local loop with the voice channel

2.14.3 ITU G.992.2 (G.LITE)

It has upstream transfer rates of up 512 kbps and downstream transfer rates of up to 1.5 Mbps.

ADSL is asymmetrical in that the upstream transfer rate is slower than the downstream data rate. This means that the data transfer from the premise (home) to the CO is a different rate

than the data transfer from the CO to the home.

The data transfer is rate adaptive. This means that depending on the condition of the local loop lines, ADSL will automatically compensate and find the fastest transfer rate possible. The range for upstream data transfer is 64 kbps to 1 Mbps. The range for downstream data transfers is 1.5 Mbps to 8 Mbps.

The reasoning for the asymmetrical transfer rate is that most users will be surfing the Internet, upstream requests tend to be small webpage addresses. The downstream data consists of downloads of large graphic intensive webpages. Small upstream requests, larger downstream response.

The data transfer rate depends on the distance from the central office, the quality of the line and the wire gauge. If the distance from the central office is 15,000 to 18,000 ft, then the maximum transfer rate is 1.5 Mbps. If the distance is 9,000 ft or less, the maximum transfer rate is 8 Mbps.

2.14.2 ADSL OSI Model

ADSL is a Physical layer protocol which covers the transmission of data, and cabling requirements.

ADSL Premise Equipment

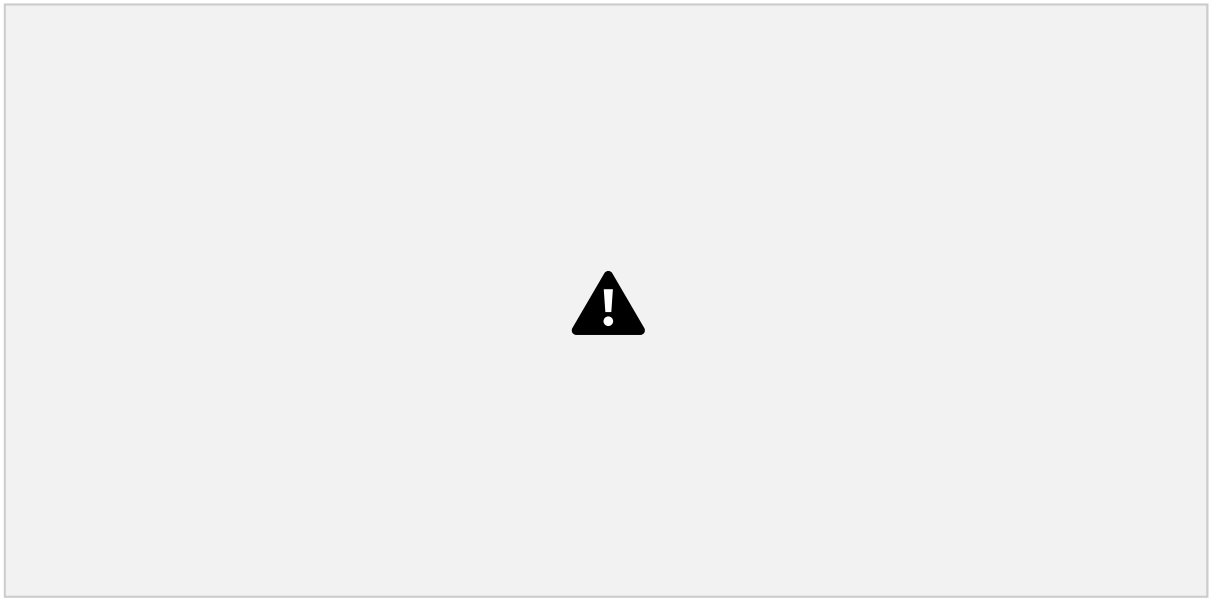


Fig : ADSL Premise Equipment

ADSL shares the bandwidth of the local loop with the existing phone system. It does not require modification to the central office switch. Instead a splitter combines the ADSL information with the POTS switch's analog information. At the central office end, the ADSL signal is sent to the Digital Subscriber Line Access Module (DSLAM) and then to a communication server.

At the premise end, another splitter separates the ADSL information from the analog information. An ADSL modem called an ATU-R device decodes the ADSL information and sends it to the Service Module (SM). The Service Module translates it to Ethernet. In plain network terms, in comes ADSL and out comes an Ethernet signal for connection to a network interface card (NIC).

ADSL Advantages

- No expensive modification is required to CO switch.
- Simple splitter splits ADSL signal from the existing analog line.
- High bandwidth is available.
- The POTS works regardless of ADSL.
- ADSL has competitive pricing versus other technologies

ADSL Disadvantages

- The transfer rate depends on distance from the central office.
- The presence of bridged taps and load coils on the local loop affect the transfer rate. ·

ADSL must be installed to test if it will work.

- 25% of existing local loops will not work with ADSL
- There is an 18,000 ft distance limit from the central office.
- There can be a bottleneck at the communication server at central office.

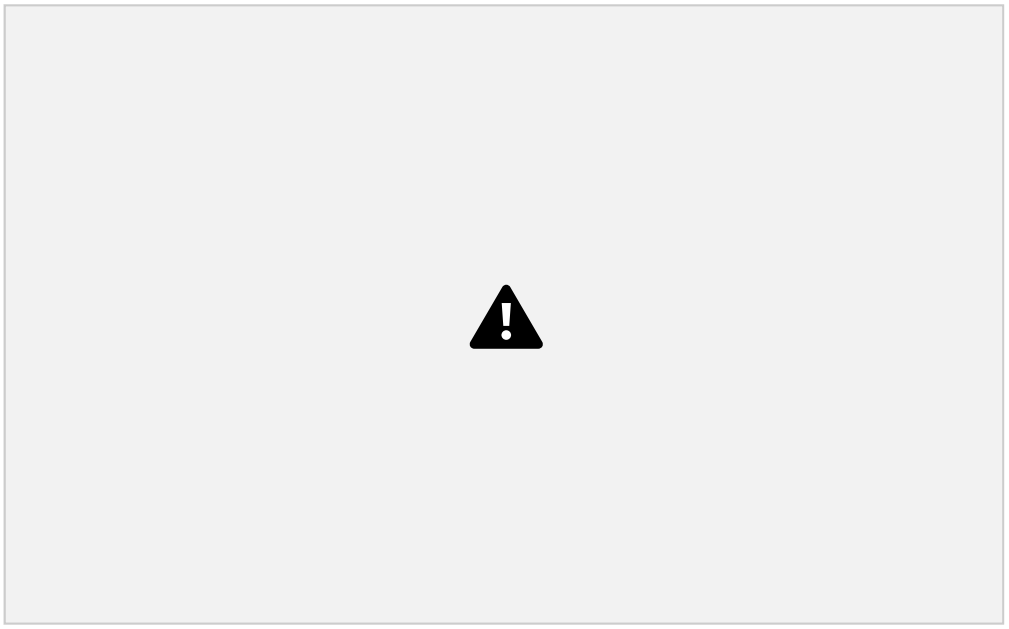
2.15 xDSL,

xDSL uses digital encoding to provide more bandwidth over existing twisted-pair telephone lines. Many iterations of xDSL allow the phone to be used for data communication at the same time it's being used to transmit data. In this article, Kyle Cassidy explores the different digital subscriber lines and Frame Relay.

xDSL ranges from 6.1Mbps to 155Mbps incoming, and from 600Kbps to 15Mbps outgoing. The "x" is a wildcard that can be ADSL (asynchronous) or SDSL (synchronous). xDSL uses digital encoding to provide more bandwidth over existing twisted-pair telephone lines

(POTS). Many iterations of xDSL allow the phone to be used for data communication at the same time it's being used to transmit data. This is because phone conversations use frequencies below 4KHz, above which xDSL tends to operate. Several types of xDSL modems come with "splitters" for using voice and data concurrently.

xDSL connections use frequencies of more than 4000KHz to achieve their great bandwidth. This comes at the expense of attenuation. The two most popular types of line coding, CAP and DMT, use lower frequencies and therefore are able to support longer loops between the user and the phone company. You can see a breakdown of their capacity in Figure



2.16 cable Moderm

The cable modem technology is a competitive technology to bridge the last mile. Cable television companies are battling head to head with the telephone companies to provide high speed bandwidth to the homes. The telephone companies have the digital equipment backbone starting at the central office but are crippled by the existing local loop cable.

The cable television companies have the high speed bandwidth to the homes but don't have the digital equipment backbones at the head end (the head end is where all the television signals in a cable TV line originate from). Cable modems use the existing cable TV line to provide the high speed bandwidth.

It is an asymmetrical transfer rates with the upstream data transfer rate at 2 Mbps. The downstream data transfer rate is a maximum of 30 Mbps. Most users connect the cable modem to their 10 Mbps ethernet NIC and don't utilize the cable modems full bandwidth.. Switching to a 100 Mbps ethernet NIC would give them full bandwidth.

The actual transfer speed depends on number of users that are on-line. The cable line is shared with the other subscribers in the local neighborhood. Most cable companies use dynamic IP addressing, each time the user connects, the user is assigned a new IP address. For a fee, permanent static IP addresses can be assigned.

Most cable TV companies are placing high performance web proxy servers at the head end. These servers store the most commonly accessed webpages and files locally at the head end. The user's web browser first checks the proxy server to see if the file has been downloaded there. If it hasn't then it goes out on the Internet to download it. The storing of the webpages and files on the local proxy server reduces the load on the communication servers to the Internet and gives the impression of extremely fast Internet access.

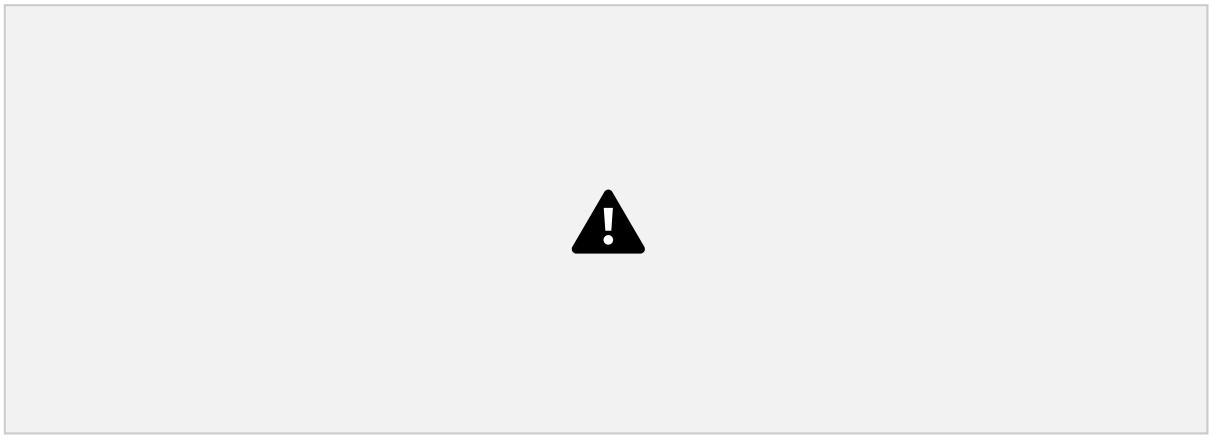
Cable Modems Standards

There are three competing standards for cable modems at the time of this writing:

- the European standard DVB/DAVIC
- the American standard MCNS
- the Geneva standard IEEE 802.14.

Only the Geneva standard guarantees the transfer rate.

Cable Modems Premise Equipment



Cable Modems Premise Equipment

The cable modem is connected to the existing cable TV RG59 coax line using a standard RF connector. The output of the cable modem is a 10BaseT or 100BaseT ethernet connection to your NIC.

Cable Modems Security Issues

Cable modems did have security issues early on when first implemented. Users ccould see others through Network Neighborhood in Windows. Now most systems have each cable modem connection encrypted.

The assignment of IP addresses is based on the MAC address of the ethernet card. Hackers can theoretically access the network if they know another users MAC address. All in all, cable modems are now pretty secure.

Cable Modem Advantages

- Fast data transfers, up to 30 Mbps if using a 100BaseT NIC · Competitive pricing against competing technologies.
- Easy to install - home prewired.

Cable Modem Disadvantages

- The available bandwidth depends on the number of users on the local cable TV line segment.
- There is an asymmetrical transfer rate. Upstream is slower than downstream. · There can be a bottleneck at the communication server at the head end.

University Questions:

May 2019

Q. List the categories of UTP cables. How is noise interference minimized in twisted pair cables? (5 Marks)

Q. Write short note on – ADSL (5 Marks)

Dec 2019

Q. Coaxial cable is much less susceptive to interference and cross talk than twisted pair. Why? (5 Marks)

Review Questions:

Q. Explain the various Connecting devices used in computer networks. (5 Marks)
Q. Write short notes on - Guided and unguided mcdia

Q. List the categories of UTP cables. How noise interference minimized in twisted pair cables?

Q. Explain various transmission media in brief.

Q. Coaxial cable is much less susceptible to interference & cross talk than twisted pair. Why?

Q. What is DSL technology? Explain various DSL technologies & compare them. Q. Sketch

and explain construction of graded index optical fiber.

Q. Explain the various physical media with the help of neat diagrams.