Computer Networks:

A computer network is a set of computers sharing the resources located on or provided by network nodes. The computers use common communication protocols over digital interconnections to communicate with each other. A computer network is mainly of 4 types
- i) LAN (Local Area Networks)
- ii) PAN (Personal Area Networks)
- iii) MAN (Metropolitan Area networks)
- iv) WAN (Wide Area Networks)

→ Some basic computer network components are servers, clients, Route, Switch, PC's, ethernet cable etc.

→ client server model, e-mail services, e-commerce are some of application

Representation of data: Information is represented in various forms such as text, numbers, images, audio and video. Text in data communication is represented as a bit pattern. Sequence of bit (0's and 1's)

→ Types of data representation:
1) decimal number system 2) Binary number system
3) Octal number system 4) hexadecimal number system.

→ 5 Basic components of data communication system are;
① Message ② Sender ③ Receiver ④ Transmission medium ⑤ Protocols

Flow of Networks: Network flow is a flow of sequence of packets from source to destination node. There are 3 different types of computer networking channels

a) Simplex :- which allows sending of information in one direction only

b) Half duplex :- in which information can be sent in both directions but both directions don't operate in same time

c) Full duplex :- Information can flow in both directions, but can also operate in both directions at same time.

Network:

Network topologies

It is defined as the logical connection of various computers in a network.

6 Basic topologies are:

1) Bus topology:

In bus topology all the computers are connected to a long cable called a bus. A node that wants to send the data places the data on the bus which carries it to the destination node.

→ In this topology any node (computer) can send the data over bus at any time, since the bus is shared among all the computers.

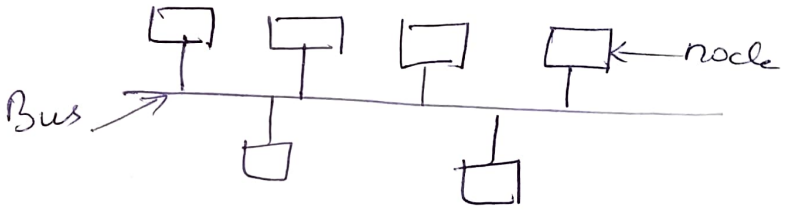


Fig: Bus topology

2) Ring topology:

In ring topology computers are connected in the form of ring. each ring has exactly two adjacent neighbors.

→ To send data to a distant node on a ring, it passes through many intermediate nodes to reach to its ultimate destination.

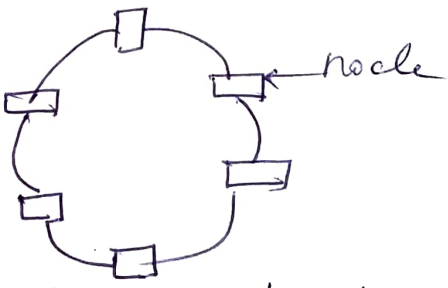


Fig: Ring topology

3) Star topology:

In Star topology all the nodes are connected to a central node called a 'hub'. A node that wants to send the data to other node initially sends the data to a hub then, it intern sends it to the destination node.

→ A hub plays a major role in such networks.

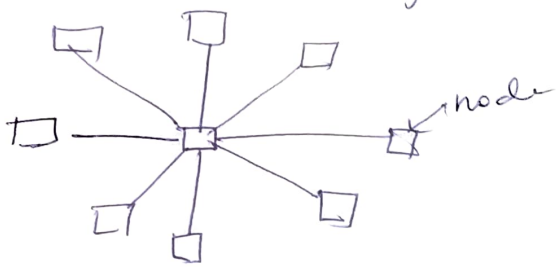


Fig: Star topology

4) Tree Topology

It is hierarchy of various hubs. All the nodes are connected to one hub or the other. There is a central hub to which only few nodes are connected directly

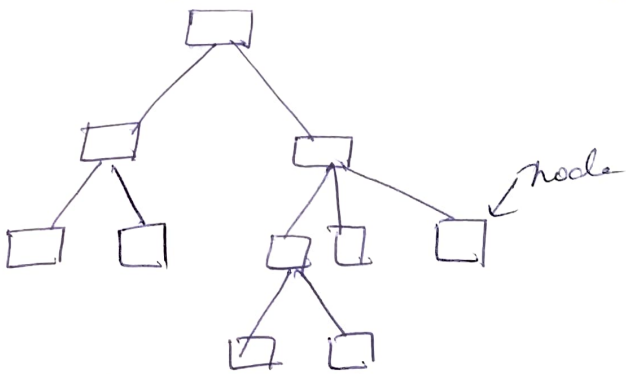


Fig:- tree topology

5) Mesh topology

Mesh topology is also called as complete topology. In this topology, each node is connected directly to every other node in network.

If there are 'n' nodes then there would be $n(n-1)/2$ physical links in the network.

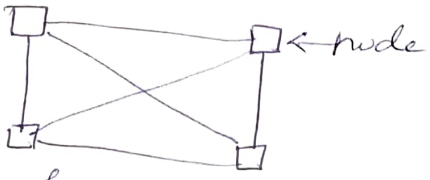


fig: Mesh topology

Adv:
→ Topology don't have congestion problems
→ It also ensures data security. [since links are not shared]

Disadvantage:
→ The main disadvantage is the complexity of network and cost associated with cable length.
→ It is not useful for large network

6) Hybrid topology

It is formed by connecting two or more topologies together.

eg: Hybrid topology is formed by connecting bus, star, ring topologies together.

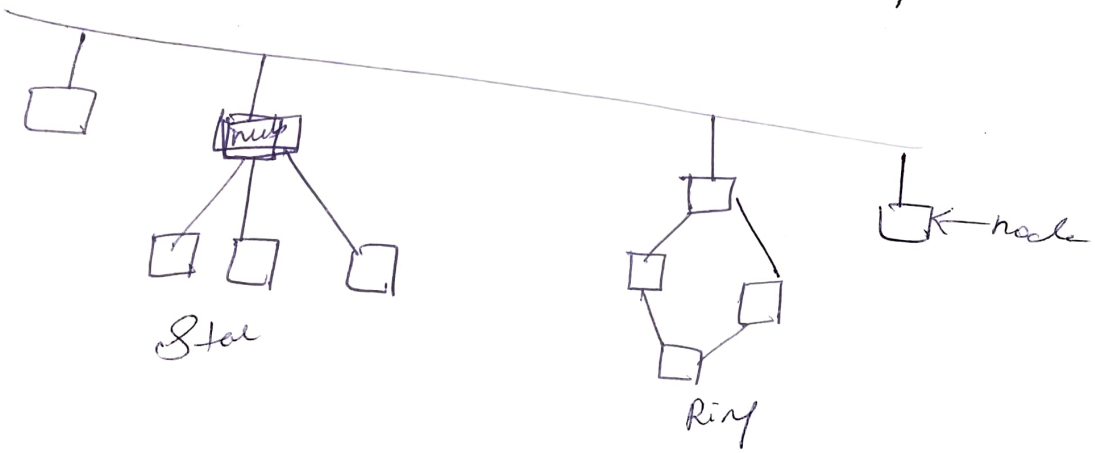


fig: Hybrid topology

Network Software

Network Software is designed based on layered model as it makes system more useful and perfect.

→ Each layer provides different functions and different services.

→ Advantages:

* It allows designers to focus on particular layers.
* It allows changes to be done on one layer without affecting its higher or lower layer
* It helps in learning and understanding model easily
* It organises and handles communication in effective manner.
* It provides standards for manufacturers while making products.

Reference Models

OSI Reference Model

This model is based on proposal developed by International Standard Organization as a first step toward International Standardization of protocols used in various layers.

→ The model is also called as ISO OSI (Open System Interconnection) reference model because it deals with connecting open systems.

→ Open system is a system open for communication with other systems.

This model has 7 layers which is shown in the following figure.

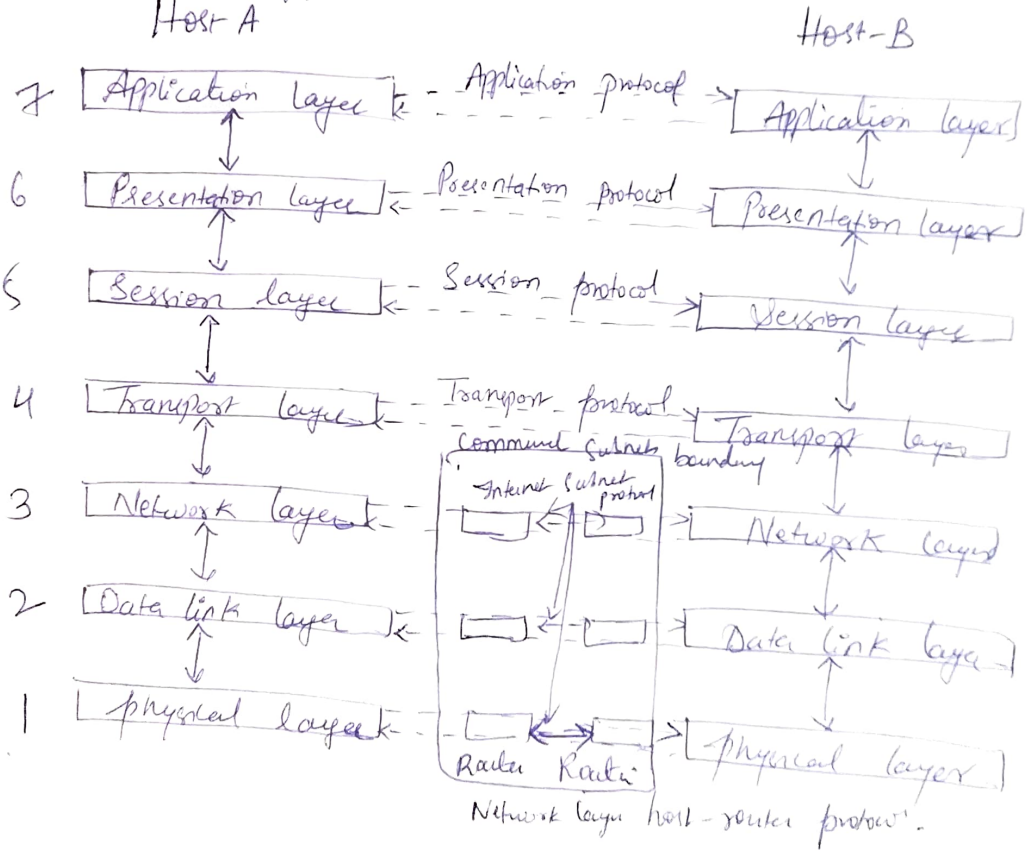


fig: OSI Reference Model

The OSI model has seven layers. The principles that were applied to arrive at the seven layers can be summarized as follows:

1) A layer should be created when different abstraction is needed.
2) Each layer should perform well defined function.
3) The function should be choosen based on internationally standardized protocols.
4) The number of layers should be large enough that distinct functions need not be thrown together in same layer.

(1) The physical layer

* It is the first layer of OSI model
* It deals with the transmission of information in the form of raw bit over the communication channel
* Here at the time of transmission, data is converted into electrical/optical signal and sent to the destination device, and when receiver receives them, it again convert back to data.
* Design issues here is to make sure that when one side sends a 1 bit, it is received by others side as 1 bit, not as 0 bit.
* other design issues include mechanical, electrical, and procedural interfaces along with the underlying physical medium (ex: What is mode of communication?

(2) Data Link layer

It is a layer above the physical layer whose function is to receive data from network layer, break the input data into frames and transmits frame sequentially and maintain acknowledgements

→ It regulates the flow of traffic in case of fast sender transmitting to a slow receiver.

→ It provides an error free transmission for the network layer and solves problem results from frames (ie damage, lost & duplication)

→ A special sub layer of data link layer which is called as Medium Access Control (MAC) sublayer provides controlled access to shared channel.

(3) Network Layer

→ It lies above data link layer, the network layer controls the operation of the subnet. A key design issue is how packets are routed from source to destination.

→ It routes packets from source to destination by applying routing algorithms.

→ If too many packets are present in subnet at the same time, the control of such congestion also belongs to network layer.

→ It also establishes connection with heterogenous networks

④ Transport layer

→ The basic function of transport layer is to accept data from above layer and split it up into smaller units if needed and pass these to network layer and ensure that pieces will arrive correctly at the other end

→ It sets up and terminate the connections across the network thereby regulating flow of information

→ The transport layer also determines what type of service to provide to the session layer and ultimately to the users of the network

⑤ Session Layer

Session layer is responsible for establishing sessions among various user on different machines

→ It manages Dialog control by keeping track of whose turn is to transmit.

→ It prevents occurence of simultaneous operation at both sides by using service called token management

→ Data synchronization is provided by inserting Checkpoints for large transmission to allow them to continue from where they were after crash.

⑥ Presentation layer

→ Unlike lower layers which are mostly concerned with moving bits around, the presentation layer is concerned with the syntax and semantics of information to be transmitted.

→ It converts the information between the representations used in individual computers and globally accepted standards.

→ Performs operations like encryption, decryption and compression of data.

ex: These layers manages the abstract data to be defined and exchanged (ex: Banking records)

⑦ Application layer

→ The Application layer contains variety of protocols that are commonly needed by users.

* One widely used protocol is HTTP, which is the basis of world wide web

* When a browser wants the web page, it sends name of the page to server using HTTP, Server then sends back the page.

→ Other application protocols like Telnet, FTP, SMTP etc are used for file transfer, electronic mails etc.

TCP/IP Reference Model

The TCP/IP reference model was developed before OSI model. The major goals of this model were
→ To connect multiple networks together so that they appear as single network.
→ To survive after partial subnet hardware failures
→ To provide flexible architecture.

Unlike OSI reference model, TCP/IP reference model has only four layers, they are
1. Host-to-network layer
2. Internet layer
3. Transport layer
4. Application layer.

1. Host-to-Network Layer

It is the lowest layer in TCP/IP model. All the data packets moves through this layer before it is transmitted to destination.

→ Host to network layer of TCP/IP reference model is similar to the combination of physical and data link layer in OSI model.

→ In TCP/IP this layer does not describe the functionality of this layer, except to point out that host has to connect to the network using some protocol so it can send IP packets to destination.

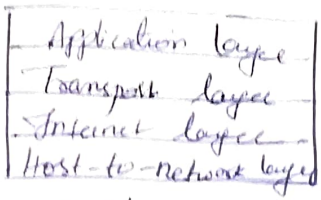


fig: TCP/IP reference model.

(2) Internet layer:

The job of the internet layer, is to permit hosts to inject packets into any network and have them travel independently to destination.

→ packets may even arrive in a different order than they were sent in which case it is the job of higher layers to rearrange them, if an order delivery is desired.

→ The internet layer defines an official packet format and protocol called IP (Internet protocol)

→ Packet routing is clearly the major issue here as is avoiding congestion. For this reason it is reasonable to say that the TCP/IP internet layer is similar in functionality to OSI network layer.

(3) Transport layer:

Transport layer allows reliable transfer of data from source to destination.

→ The layer defines two end-to-end protocols named TCP (Transmission control protocol) and UDP (User Datagram protocol) to interact with other layers

in the model.

→ TCP is a reliable connection-oriented protocol and allows error free transmission. At some end it breaks the incoming byte stream into individual messages and passes them. At receiving end it groups received messages into output stream.

* It also handles flow control so that fast sender doesnot effect slow receiver.

→ UDP is an unreliable connectionless protocol. Unlike TCP it doesn't handle message sequencing and flow control. It is widely used in applications where quick delivery is more important than accurate data. For example Speech and video.

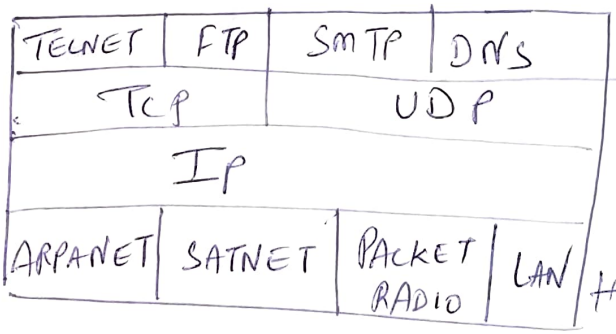


Fig:- Protocols and Networks in TCP/IP reference model.

(4) Application layer.

It is the top most layer in TCP/IP reference model

→ It provides services that support user in communication with the network

→ This layer defines all higher-level protocols like TELNET, FTP, SMTP, DNS.

Transmission Media

It is a path that enables the sender and receiver to be interconnected for the purpose of sending and receiving messages.

Classification of transmission media

(1) Guided transmission media

(2) Unguided transmission media (wireless transmission)

1) Guided transmission media

In this type a physical path is established between source and destination. The signal which are in form of electromagnetic waves utilizes the path for transmission.

Different types of Guided transmission media.

a) Twisted pair cable

b) coaxial cable

c) Fibre optics

a) Twisted pair cable :-

In this cable two ordinary copper wires which acts as a conductor are twisted around one another. These twisted wires are arranged to form a rectangular spiral pattern.

→ Combination of these wires forms a single communication link.

→ Twisted pair cables are used for both analog and digital signals transmission.

→ It is less expensive than coaxial cable and fibre optics.

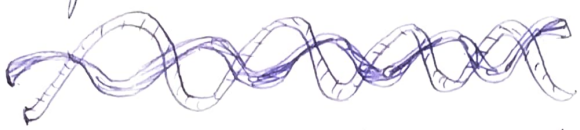


fig: Twisted pair cable.

2 types of twisted pair cable → Unshielded TP cable
→ shielded TP cable

Unshielded twisted pair cable

In UTP, there is no shielding except the twisted pair. They are generally used in telephone companies. UTP cables are used in ethernet systems and due to absence of shield there is greater flexibility & durability

fig: UTP cable.

Shielded twisted pair cable

In STP there is a tough protective shield over each pair of copper wire that is used to reduce electromagnetic interference.

→ STP cables are used in older telephone network and data communication.

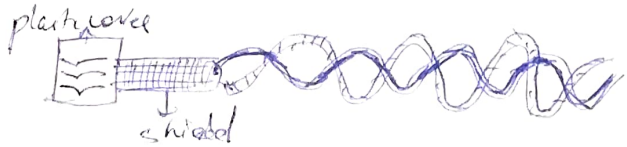


fig:- STP cable.

→ It is expensive when compared to UTP.

b) Coaxial cable:

Coaxial cable is the most preferred guided transmission media for transmitting signals.

→ Construction of this cable is different from twisted pair cable.

→ Coaxial cable comprises of two conductor, they are: i) Inner conductor which is surrounded by dielectric system

ii) Outer conductor surrounds the dielectric system.

→ Outer conductor is covered by a protective shield called jacket.

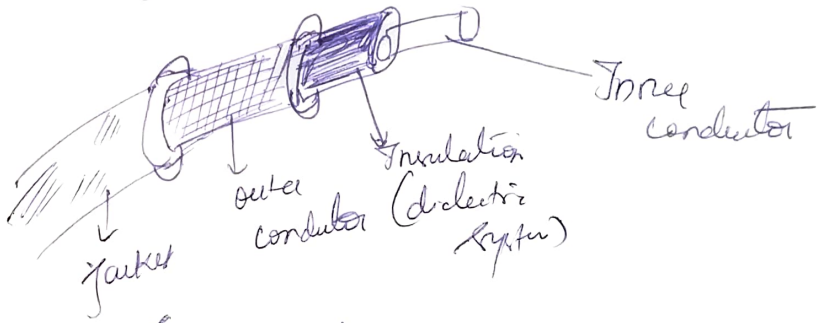


Fig Coaxial cable.

→ They can be used for both long and short distance transmission

→ For transmitting analog signals with higher frequencies amplifiers are required at few kilometers and for transmitting digital signals with high rate repeaters are required at every kilometer. Coaxial cable has higher frequency and data rates when compared to twisted pair.

→ They are less susceptible to electromagnetic interference because of presence of dielectric system

C) Fiber optics

Fiber optics are constructed using plastic or glass fibers which transmit the data through light.

→ Fibre optics consists of 3 layers:

* first layer is thin layer of glass called core
* second layer that the core is a concentric layer called cladding
* Third layer is protective sheath around cladding called jacket which is made of either glass or plastic.

→ The diameter ranges from 8 to 100 μm.

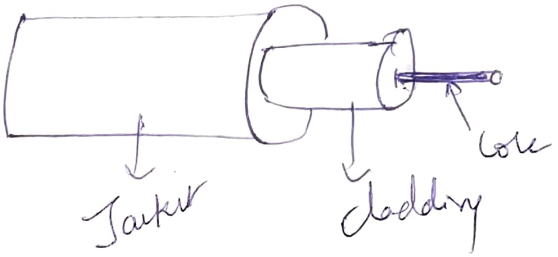


fig: optical fiber

Applications:
1) Metropolitan route
2) Rural exchange route
3) Subscriber loop
4) LAN

→ core and cladding are detached from each other by use of interface acting as a deflector

→ They are flexible in nature and is widely used in telecommunication networking

→ Used in applications such as illumination, imaginary and decorative purposes.

→ Mostly fiber optics are preferred while transmitting data over long distances

→ with the help of total internal reflection, fibre optic transfer the data in the form of light ray with frequency of 10^{14} to 10^{15} Hz that covers infrared and visible spectrum of electromagnetic spectrum

* Types of propagation mode of fibre optic

Multimode:
It allows multiple beam of light. This is more suitable for short distance transmission. There are 2 types of multimode

*Step index mode: It consists of large core through which the beam of light tend to bounce around and reflect back to cladding and core.

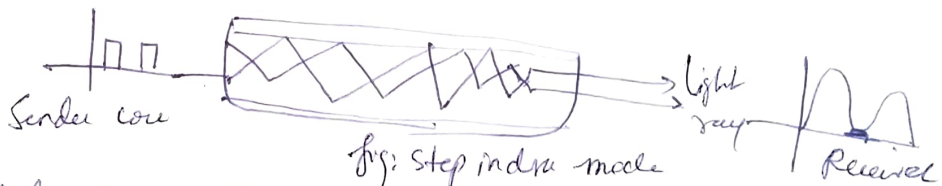


fig: step index mode

*Graded index multimode:
This mode allow the beam of light to reflect into the core path because of which performance of step index mode is improved

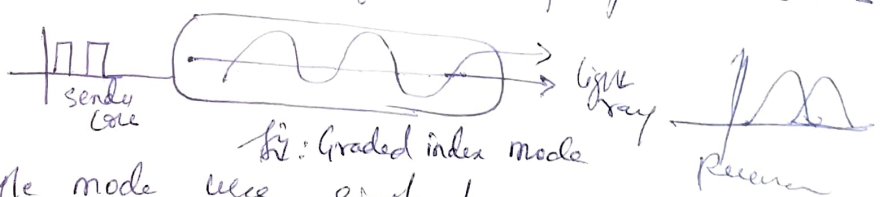


fig: Graded index mode

Single mode: Single mode uses single beam of light. The light ray passes through the core with fewer reflection due to which there is better performance and it is preferred for long distance

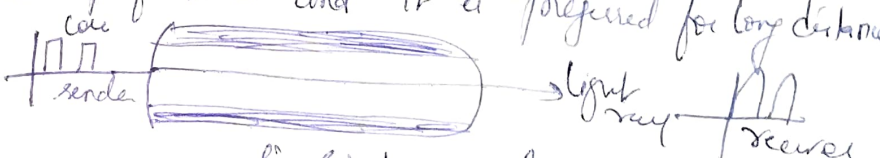


fig: Single mode.

→ It covers long distance than any other guided media
→ It is very expensive and difficult to maintain.

2) Unguided or wireless transmission media

In unguided or wireless transmission media there is no physical path between source and destination. This media is also known as wireless transmission media which doesnot guide the waves but provide methods or ways for transmitting them.

→ Waves are usually propagated through air, vacuum and sea water.

→ Wireless signal can be propagated in number of ways

a) propagation through ground waves:

In this type signals are propagated from ground which travel through air vacuum. the frequency of signals are very low and distance to be covered depends upon strength of signal. The transmitted signal follows outline of earth.

b) Propagation through sky waves:

In this type, signals with higher frequencies are transmitted upward into ionosphere layer, which are reflected back to ground.

uplink frequency is used for transmitting signal from ground to ionosphere

Downlink frequency for transmitting signal back from ionosphere to ground.

c) Propagation through line of sight: In this a point to point link is established the antennas that transmit high frequency signals.

Need for wireless Communication

→ Wireless communication play a major role in case of emergencies like natural diasters like floods, earthquakes e.t.c

→ They are cost effective and doesn't require any expensive infrastructure.

Types of wireless transmission media.

1) Electromagnetic Spectrum: Electromagnetic waves can be generated due to the movement of electrons in space. The propagated electromagnetic waves have same frequency f and wavelength λ, frequency is the number of oscillation per second.

→ It is measured in units called hertz (Hz).

→ It is denoted as λ. [ie wavelength]

→ In vacuum all waves travel at same speed of light $c = 3 \times 10^8$ m/sec

→ The parameter λ, f and c are related by expression

$$\lambda = \frac{c}{f} \quad \text{or} \quad f = \frac{c}{\lambda} \qquad \text{——— (1)}$$

Diff the equation (1)

$$\boxed{\frac{df}{d\lambda} = -\frac{c}{\lambda^2}}$$

A finite differ equation (2) becomes

$$\Delta f = \frac{c\,\Delta\lambda}{\lambda^2}$$

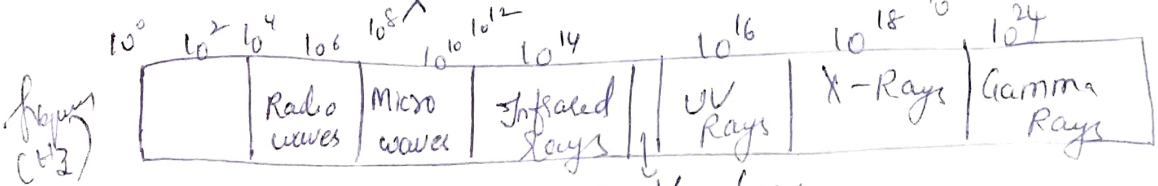


Fig: Electromagnetic Spectrum.

2) Radio wave transmission

It transmits/broadcast signals only in single direction. It is in contrast to the microwave transmission that broadcast in both directions.

→ One advantage is it doesn't require any antennas

→ Radio waves are propagated using ground wave and sky wave.

→ Radio waves are generally used for transmitting sound and images that include both voice signal and TV signals.

→ Radio waves are used for directing the movement of ships and aircraft with the help of radio compass & radio time signals.

→ Range of radio waves is from 3kHz to 300GHz.

3) Terrestrial microwave transmission

Microwave transmission make use of microwave link for transmitting information.

→ Terrestrial microwave use large height antennas to cover long sight distance.

→ The antennas are placed over larger height so that transmission is possible if some barriers are present.

→ Microwave act as a backbone carrier in cellular networks

→ They are used for television and telephone transmission

→ Frequency range of terrestrial microwave is from 1 GHz to 40 GHz.

→ The frequency is directly proportional to the bandwidth and data rate.

4) Infrared wave transmission

Infrared waves are electromagnetic waves that have wavelength longer than visible light but shorter than the radio waves.

→ They have the frequencies ranging from 300 to 400 THz.

→ They are used for short range distances.

ex: Many devices such as mobiles, computers, mouse, printers, smart phones etc have IRDA port that allows the user to transfer data from one device to another device using infrared light waves

5) Light wave transmission.

This transmission can be obtained with the help of lasers

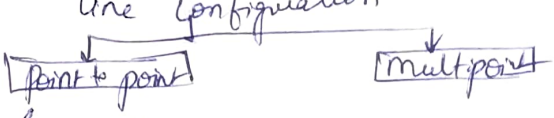
→ It is unidirectional and each system must have its own laser and photo detector.

→ Its cost is low and the bandwidth is high. It is very easy to install.

→ Problem is that it cannot penetrate through rain or fog.

Line configuration:

Line configuration defines the attachment of communication devices to link. A link is the physical communication pathway that transfers data from one device to another.



Point to point:

A point to point line configuration provides a dedicated link between two devices. The entire capacity is reserved for transmission between those two devices. Most point-to-point configurations use an actual length of wire or cable for connecting

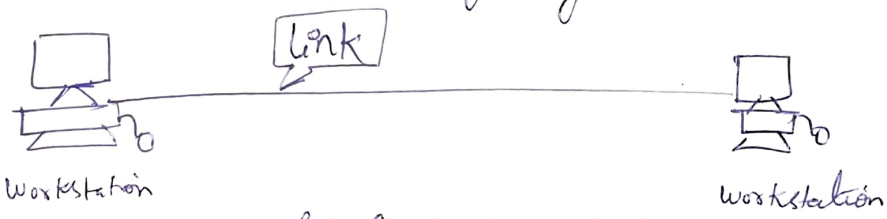


fig: Point to point configuration

Multipoint:

A multipoint (also called as multidrop) line configuration is the one in which more than two specific devices share a single link.

In multipoint, the capacity of channel is shared either spatially or temporally.

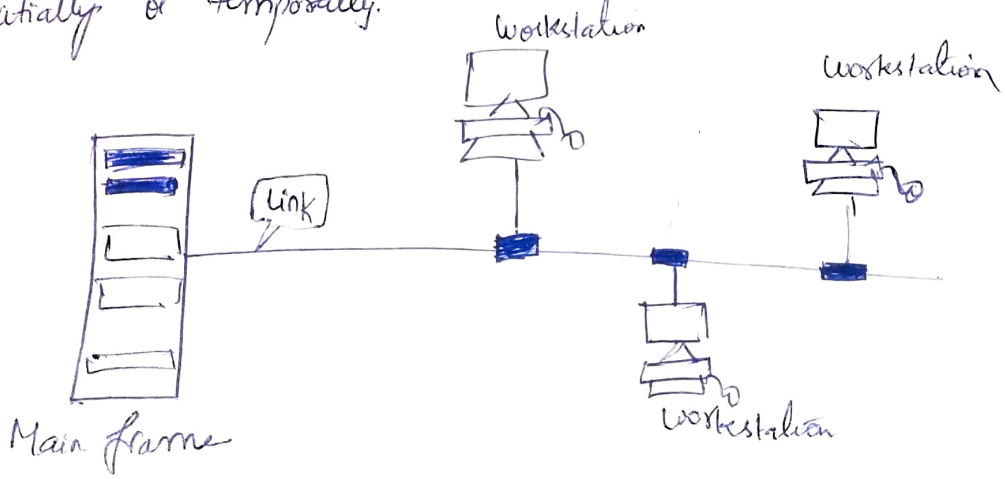
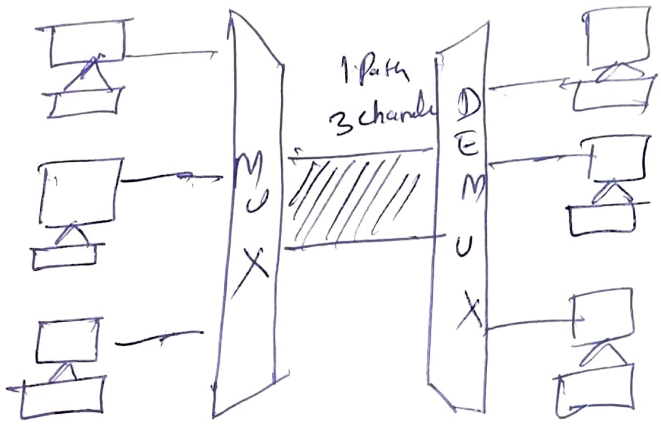


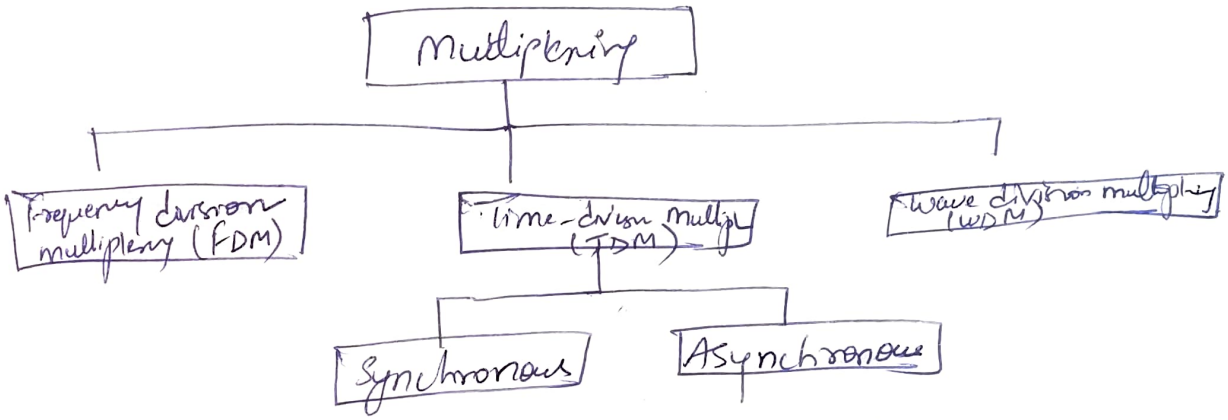
fig: Multipoint line configuration

Multiplexing:

Multiplexing is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link.



Categories of multiplexing



① Frequency division multiplexing: (FDM)

FDM is an analogue technique that can be applied when bandwidth of a link is greater than combined bandwidths of the signals to be transmitted.

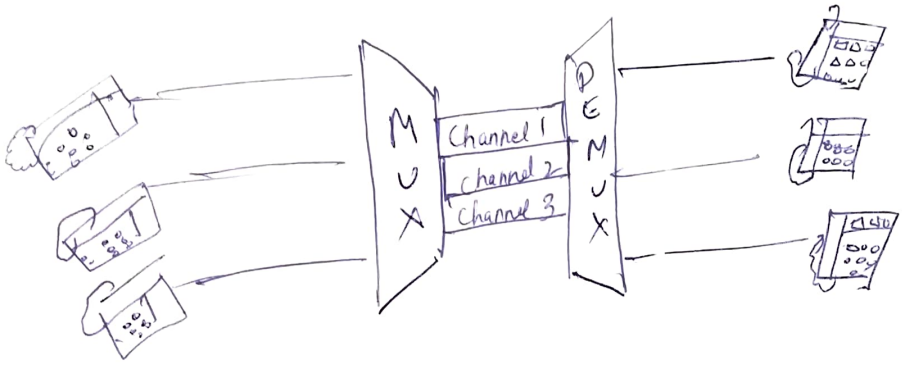
→ In FDM signals generated by each sending device modulate different carrier frequencies

→ These modulated signals are then combined into a single composite signal that can be transported by the link.

Carrier frequencies are seperated by enough bandwidth to accomodate the modulated signal.

→ These bandwidth ranges are the channels through which various signals travel.

→ channels must be seperated by strips of unused bandwidth (guard bands) to prevent signals from overlapping



FDM process

It is a conceptual time-domain illustration of multiplexing process. FDM is an analog process and we show it here using telephones as input and output devices.

→ In the below figure it shows frequency domain illustration for the same concept.

* Horizontal axis of the figure denotes frequency not time (All the 3 carrier frequencies exist at the same time within the bandwidth.

→ FDM signals are modulated onto seperate carriers frequencies (f_1, f_2, f_3) using either AM or FM

modulating one signal onto another. Results in a bandwidth atleast twice the original.

→ To allow more efficient use of path the actual bandwidth can be lowered by suppressing half the band.

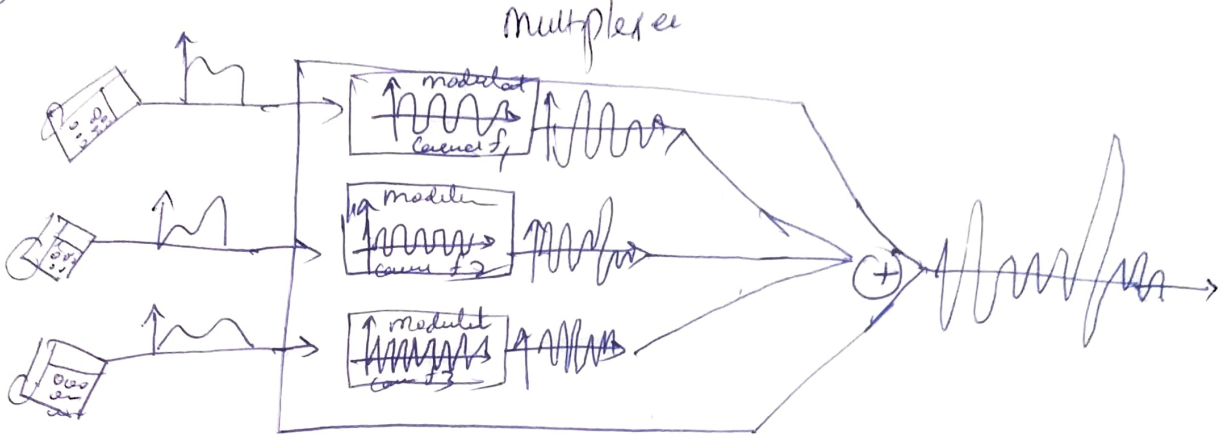


fig: FDM multiplexing process, time domain

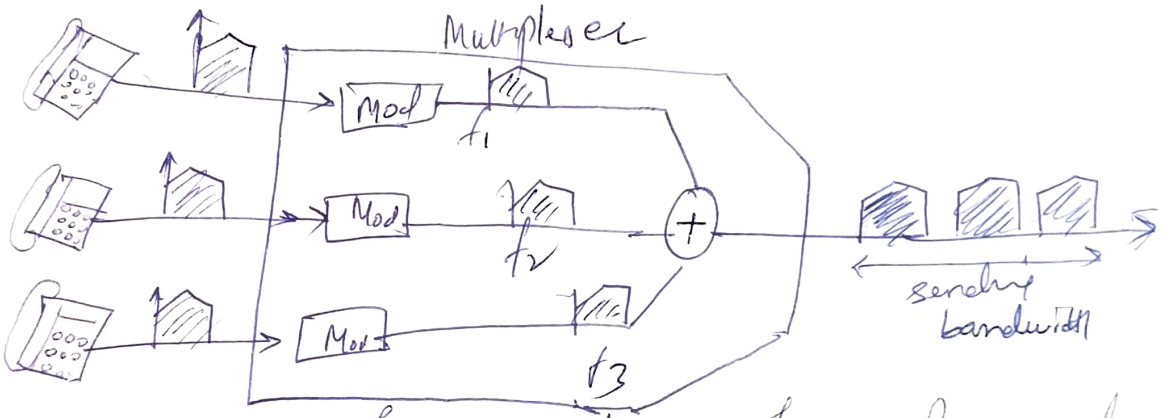


fig: FDM multiplexing process, frequency domain

Demultiplexing:

Demultiplexer uses a series of filter to decompose the multiplexed signal into its constituent component signals.

→ The individual signals are then passed to a demodulator that separates them from their carriers and passes them to waiting receiver.

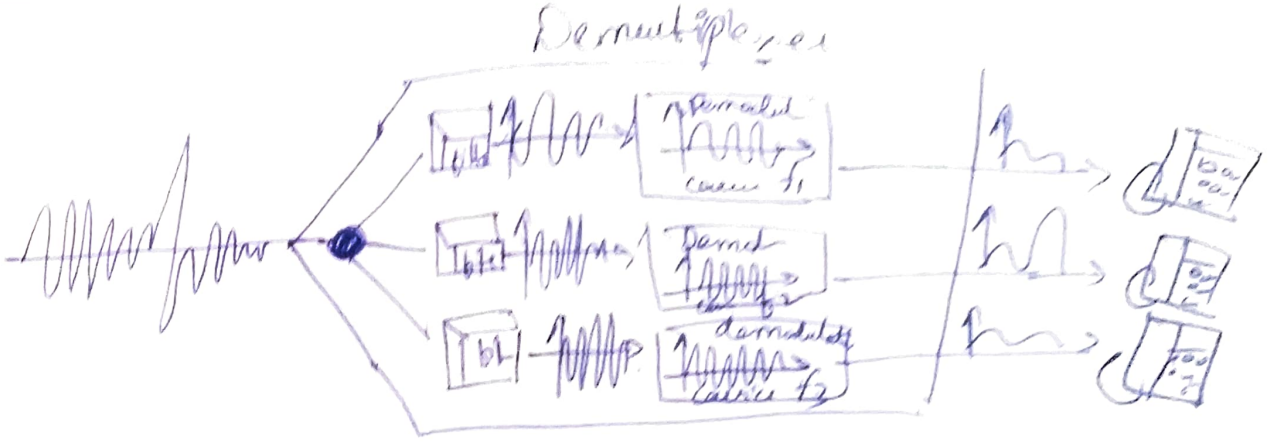


fig: FDM demultiplexing, time domain.

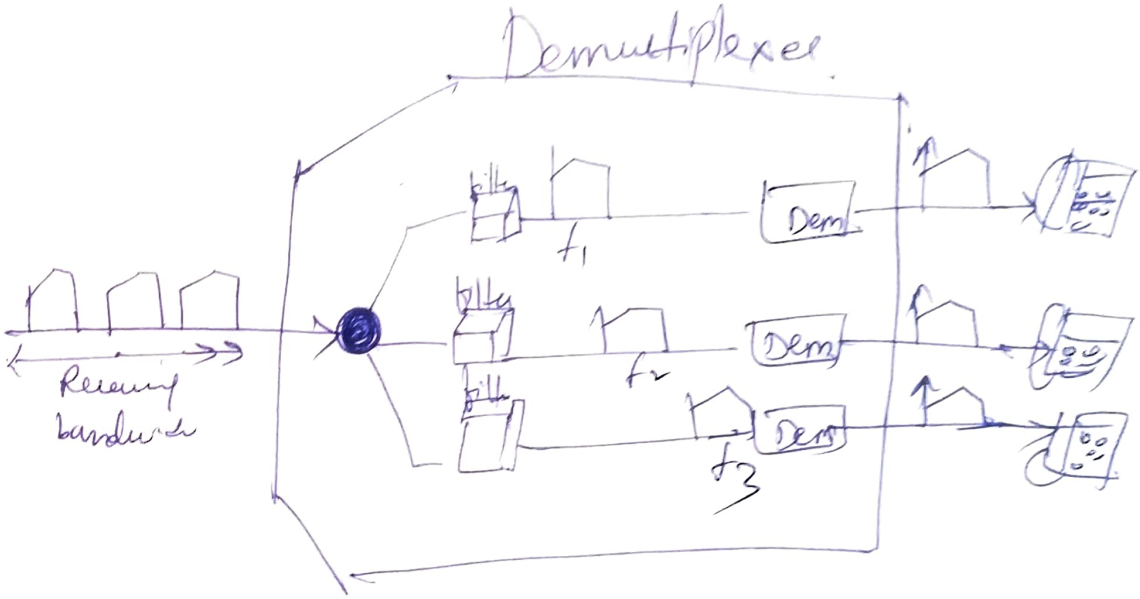


fig: FDM demultiplexing / frequency domain.

(2) Wave Division multiplexing (WDM)

Wave Division multiplexing is conceptually the same as FDM, except that the multiplexing and demultiplexing involve light signals transmitted through fibre optic channels. The idea is same: we are combining different signals of different frequencies, however the difference is that frequencies are very high.

Below figure gives a conceptual view of a WDM multiplexer and demultiplexer. Very narrow bands of light from different sources are combined to make a wider band of light. At the receiver the signals are separated by demultiplexer.

Although the technology is very complex, the idea is very simple. We want to combine multiple light sources into one single light at the multiplexer and do reverse at demultiplexer. Combining and splitting of light sources are easily handled by prism.

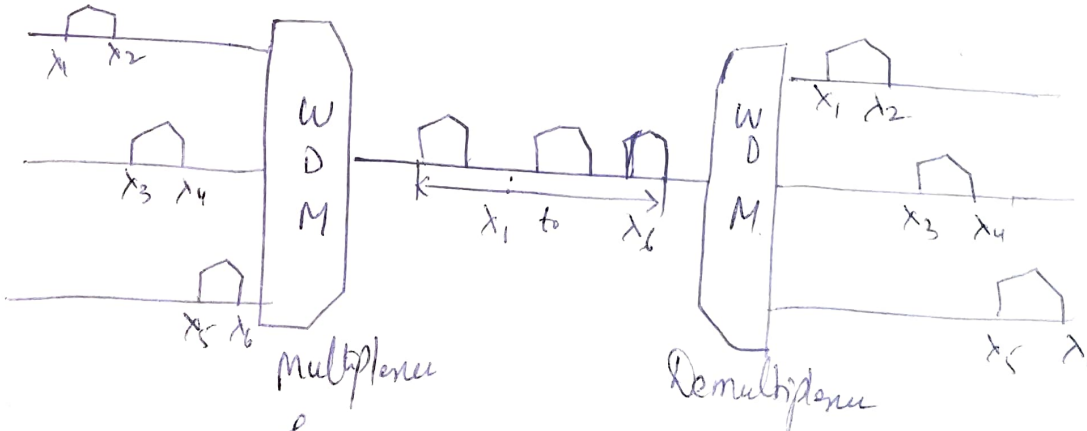


Fig: Wave Division multiplexing (WDM)

Concept is that a prism bends a beam of light based on the angle of incidence and the frequency using this technique, a multiplexer can be made to combine several input beams of light, each containing a narrow band of frequencies, into one output beam of a wider band of frequencies. Demultiplexer is ~~used~~ Made to reverse the process

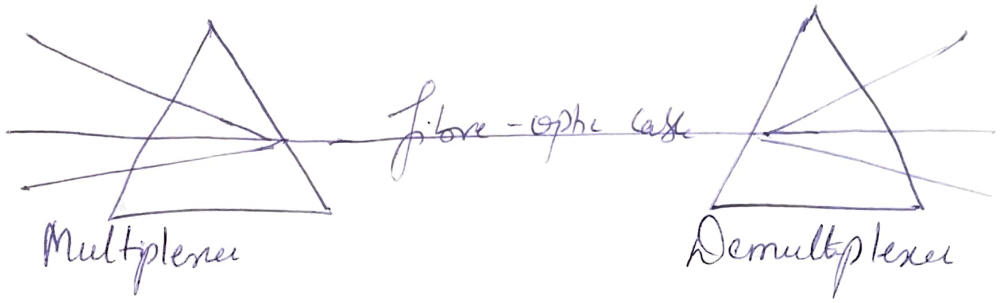


fig: Prisms in WDM multiplexing & demultiplexing

(3) Time-DIVISION MULTIPLEXING (TDM)

TDM is a digital process that can be applied when the data rate capacity of the transmission medium is greater than the data required by the sending & receiving devices.

In the below figure it gives conceptual view of TDM. Note that the same link is used as in FDM. here however the link is shown sectioned by time rather than frequency.

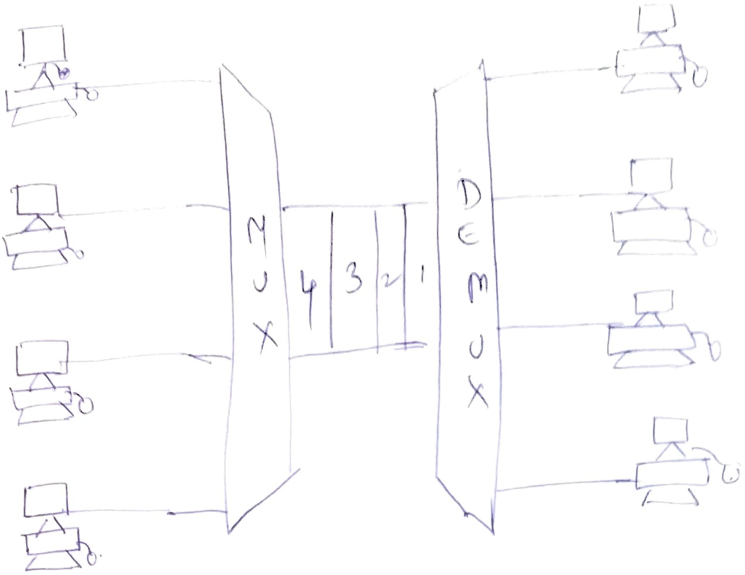


fig: Time Division Multiplexing (TDM)

TDM can be implemented in two ways

a) Synchronous TDM

b) and Asynchronous TDM.

a) Synchronous TDM:

In Synchronous TDM, the term Synchronous has diffuent meaning, here Synchronous means that the multiplexer allocates exactly the same time slot to each device at all times, whether or not a device has anything to transmit. For example time slot to device 4 is assigned can't be used by other device. Each time its allocated time slot comes up a device has the opportunity to send a portion of its data. if a device doesn't have its data to send, then its time slot is empty.

Frames: Time slots are grouped into frames. A frame consists of one complete cycle of time slots including one or more slots dedicated to each sending device.

→ In a system with n input lines, each frame has atleast n slots, with each slot allocated to carry data from a specific input line.

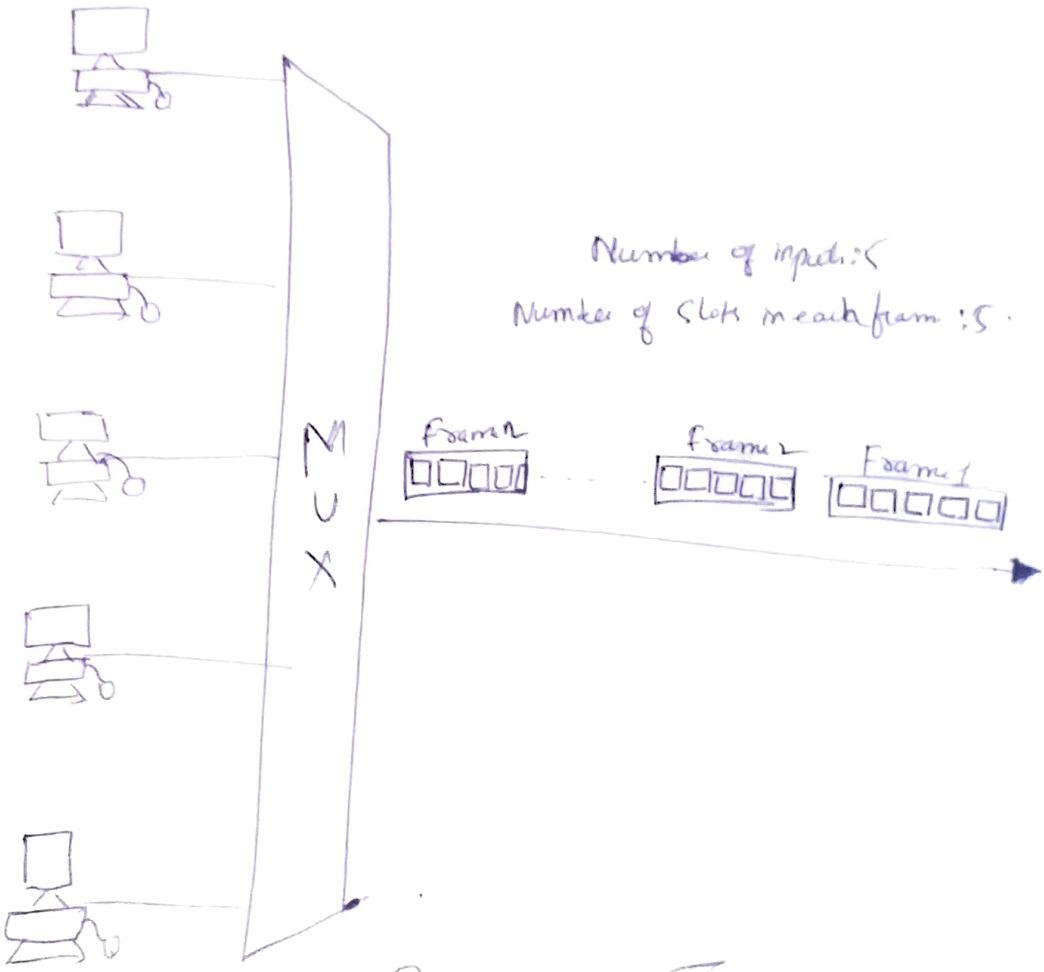


fig. Synchronous TDM.

→ If all the input devices sharing a link are transmitting at the same data rate, each device has one time slot per frame.

However if there are varying data rates, a transmission with two slots per frame will service three as quickly as one with one slot per frame.

The above figure shows 5 input lines multiplexed onto a single path using synchronous TDM. In this example all the inputs have same data rate, also the number of time slots in each frame is equal to number of input lines.

Interleaving: Synchronous TDM can be compared to a very fast rotating switch. A switch opens in front of a device that device has the opportunity to send specified amount of data (4 bits) onto the path. The switch moves from device to device at a constant rate and fixed order. This process is called interleaving.

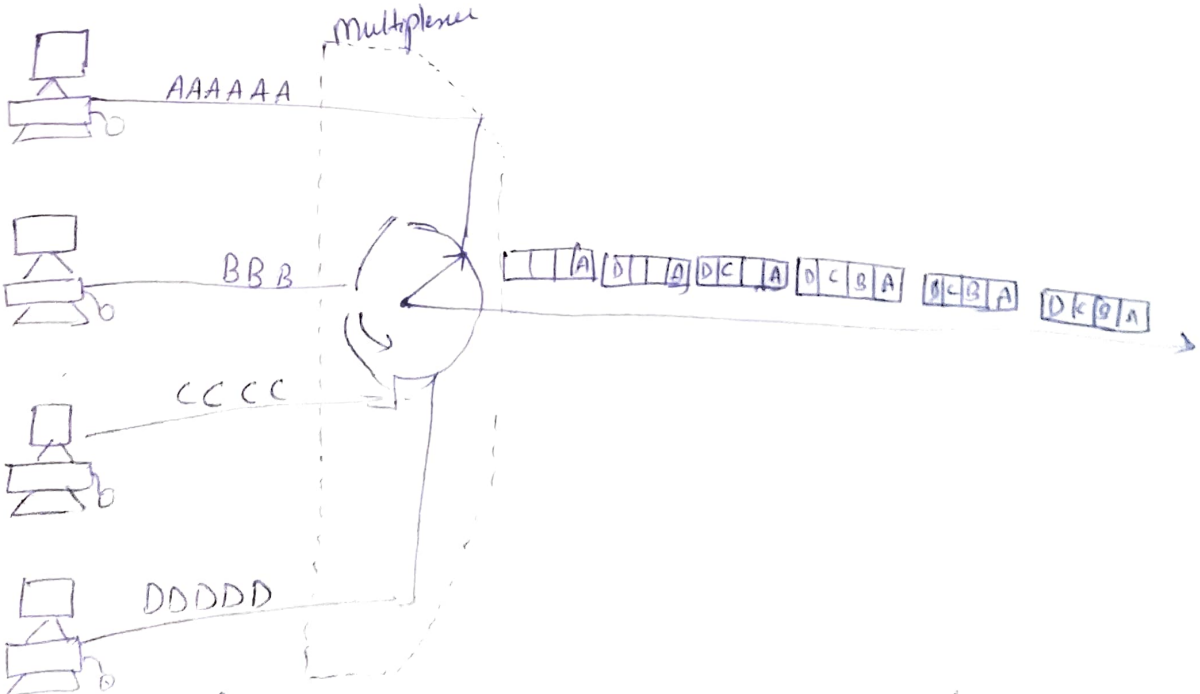


Fig: Synchronous TDM, multiplexing process.

figure above shows interleaving and frame building. here we can see each device is sending a different message. The multiplexer interleaver the different messages and forms them into frames before putting them onto link.

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

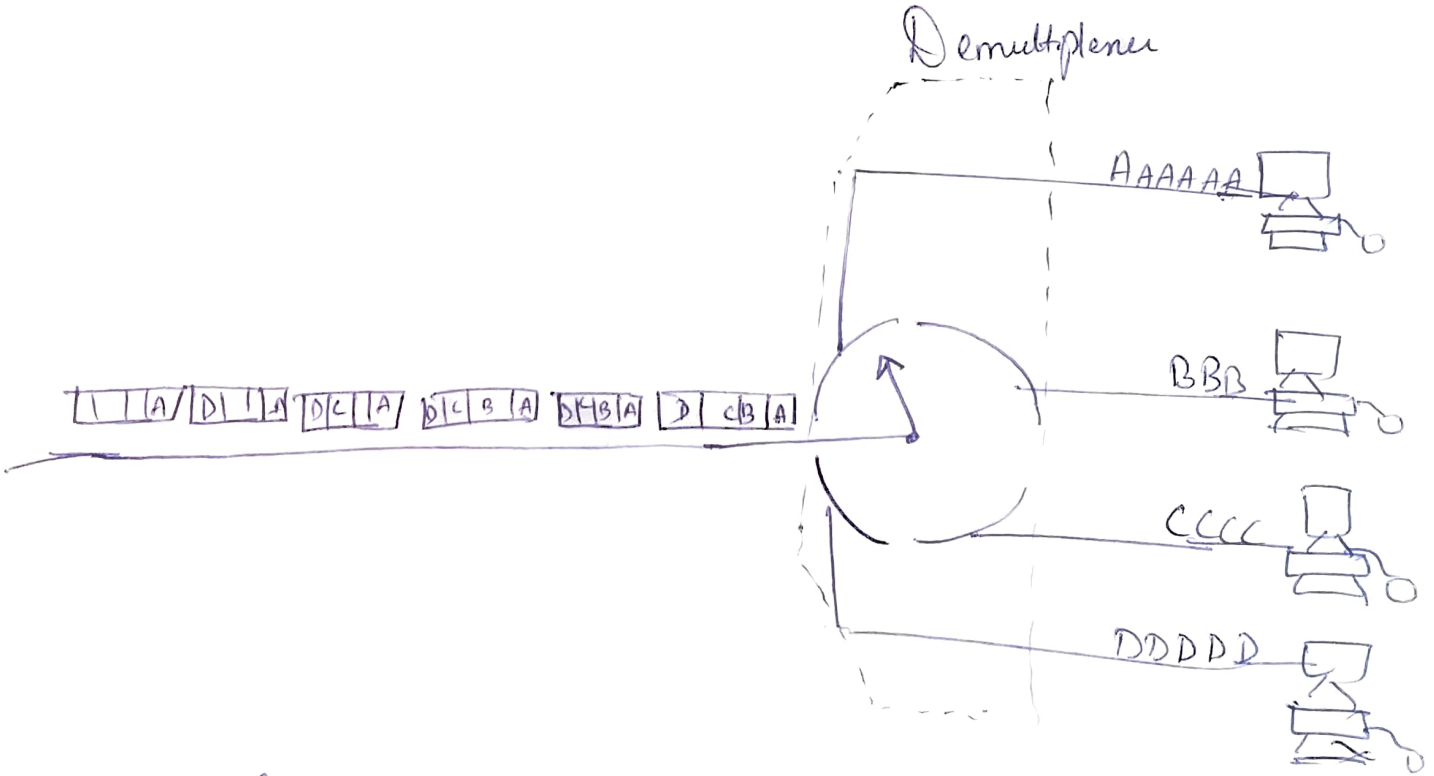


fig: Synchronous TDM, demultplexing process

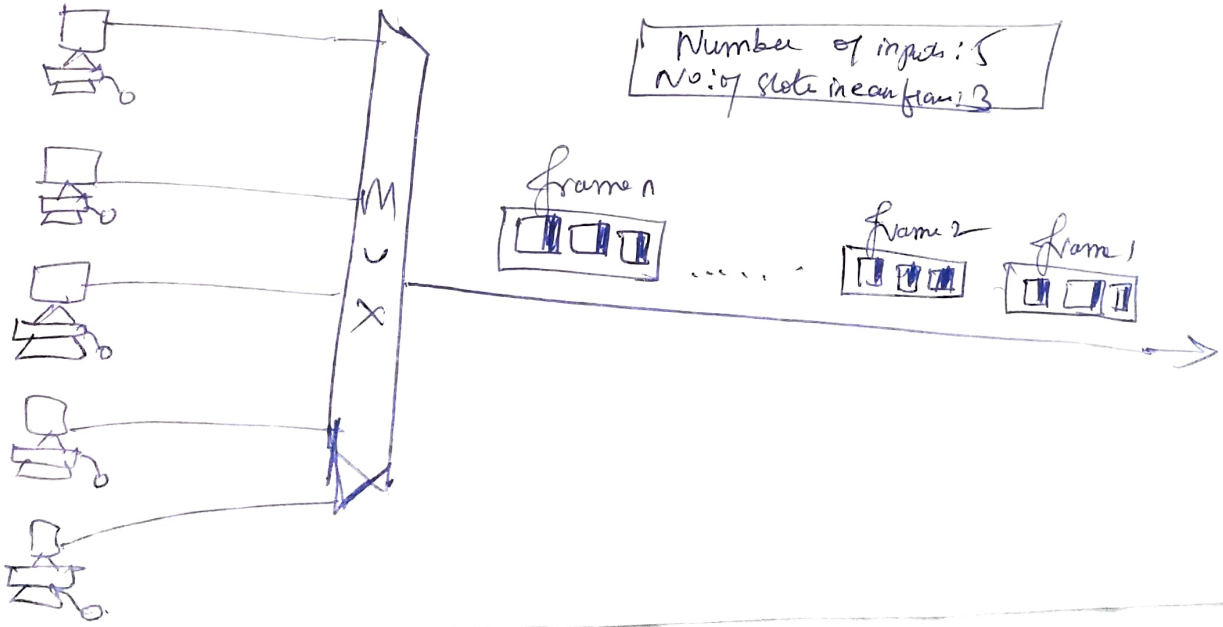
Asynchronous TDM:

As discussed Synchronous TDM does not guarantee the full capacity of link is used. Because the time slots are preassigned and fixed whenever a connecting device is not transmitting the corresponding slot is empty and that much of the the path is wasted.

Asynchronous time division multiplexing or Statistical time division multiplexing is designed to avoid this type of waste. The term asynchronous means flexible or not fixed.

→ Like Synchronous TDM, asynchronous TDM allows a number of lower speed input lines to be multiplexed to a single higher speed line.

→ In Synchronous TDM if we have n input lines the frame contains fixed number of at least n time slots But in asynchronous system if we have n input lines the frame contains no more than m slots, with m less than n.



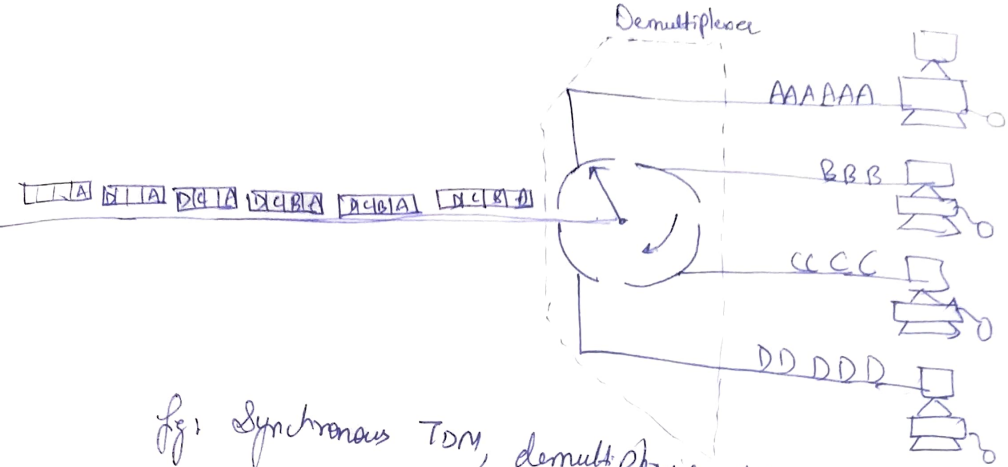
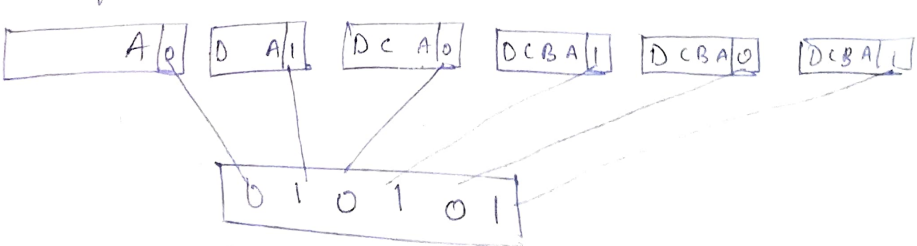


fig: Synchronous TDM, demultiplexing process

Framing Bits: The time slot order in a synchronous TDM system doesn't vary from frame to frame. Very little overhead information needs to be included in each frame. The order of receipt tells the demultiplexer where to direct each time slot so no ordering is necessary. Various factors however can cause timing inconsistencies for this reason one or more synchronizing bits are usually added to the beginning of each frame. These bits are called framing bits.

→ In most cases this synchronization information consists of one bit per frame, alternating btw 0 and 1 as shown in below figure



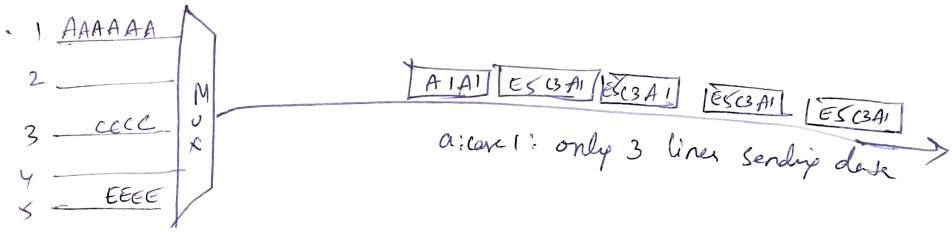
Synchronization pattern.

The number of time slots in an asynchronous TDM frame is based on statistical analysis of the number of input lines that are likely to be transmitting at any given time.

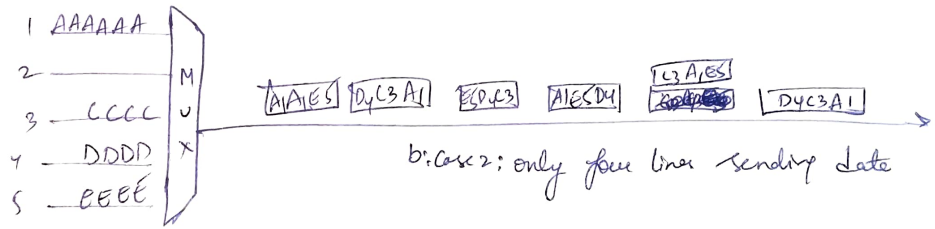
→ Rather than being preassigned each slot is available to any of the attached input lines that has data to send.

→ The multiplexer scans the input lines accepts portions of data until frame is filled, and then sends the frame across the link.

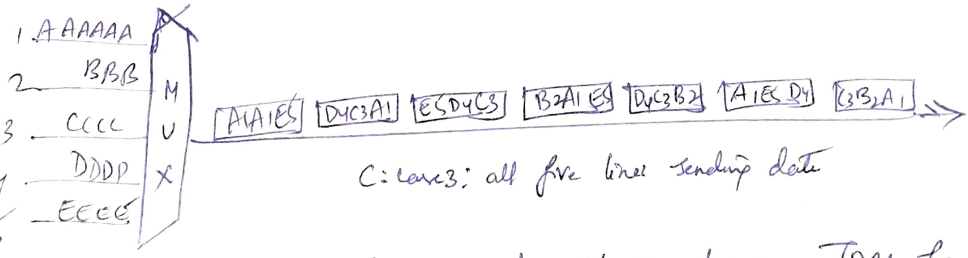
→ If there are not enough data to fill all the slots in a frame the frame is transmitted only partially filled thus full link capacity is not used 100% at the time.



a: case 1: only 3 lines sending data



b: case 2: only four lines sending data



C: case 3: all five lines sending data

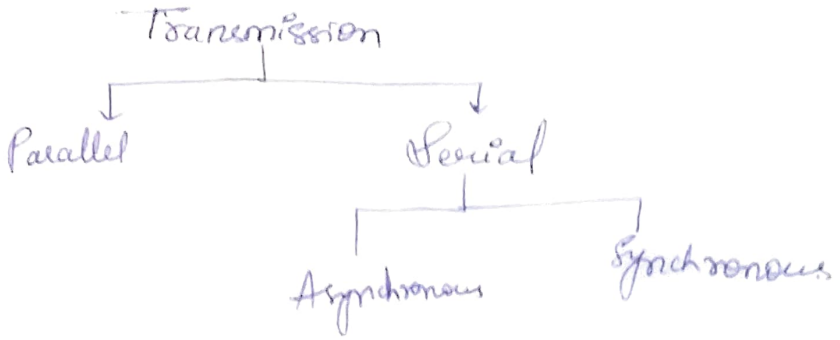
fig. examples of asynchronous TDM frames.

The above figure shows a system where 5 computers are sharing a data link using asynchronous TDM. In this example the frame size is three slots. The figure shows how the multiplexer handles three levels of traffic

→ In first case only three of the five computers have data to send.

→ In second case, four lines are sending data, one more than number of slots per frame

→ In third case all the lines are sending data. In each case the multiplexer scans the device in order from 1 to 5, filling time slots as it encounters data to be sent.



In Serial transmission one bit follows another so we need only one communication channel rather than n to transmit data between two or more communicating devices

→ Serial transmission occurs in one of two ways:

a) Asynchronous transmission.

It is so named as asynchronous because the timing of signal is unimportant, instead information is received and translated by agreed upon patterns. As long as that pattern is followed the receiving device can retrieve information without any regard.

Without an synchronizing pulse, the receiver cannot use timing to predict when the next group will arrive To alert receiver to arrival of new group an extra bit is added to the beginning of each byte. This bit is usually a 0, called as Start bit

→ To let the receiver know that the byte is finished

One or more additional bits are appended to the end of byte, these bits usually 1's are called Stop bits

→ In asynchronous transmission, we send one start bit (0) at the beginning and one or more stop bits (1s) at the end of each byte. There may be gap between each byte

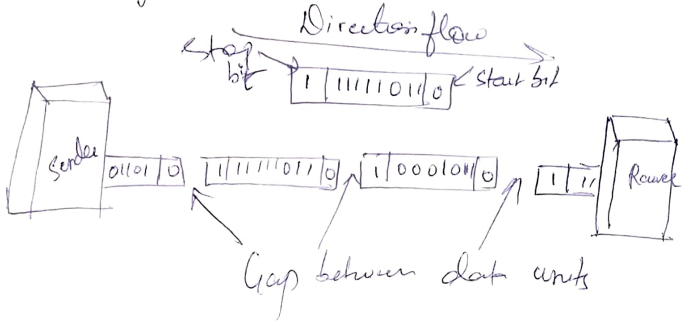


fig: Asynchronous transmission

→ Addition of start and stop bits and insertion of gaps into bit make asynchronous transmission slower than forms of transmission that can operate without the addition of control information. But it is cheap and effective

Synchronous transmission:

In synchronous transmission, the bit stream is combined into longer frame, which may contain multiple bytes. Each byte however is introduced onto the transmission link without a gap between it and the

next one. It is left to the receiver to separate the bit stream into bytes for decoding purposes.

→ In other words data is transferred as an unbroken string of 1s and 0s and the receiver separates the string into bytes of characters.

→ In Synchronous transmission, we send bits one after another without start/stop bit or gaps. It is the responsibility of the receiver to group the bits.

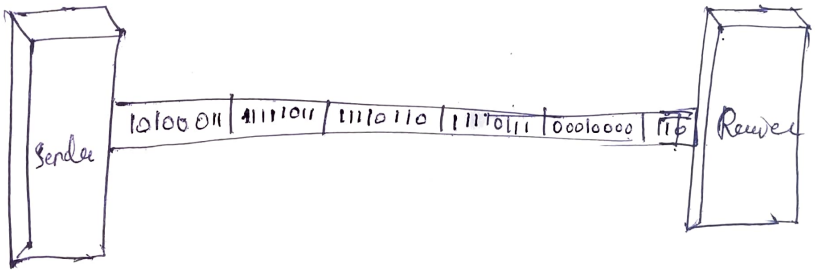


fig: Synchronous transmission.

Difference between WIRED and WIRELESS LAN

1) Medium

In wired LANs wires are used as a medium to connect to hosts

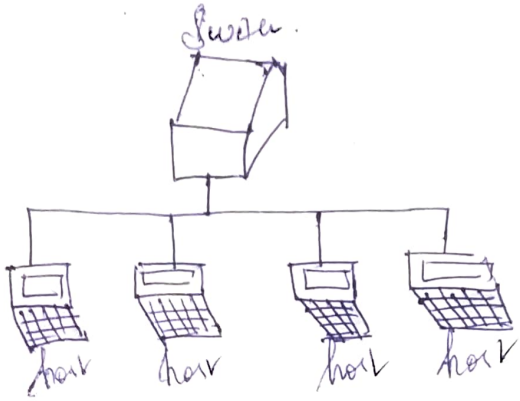
In wireless LANs air is used as medium for broadcasting. Hosts share the same medium when they communicate with each other

2) Hosts

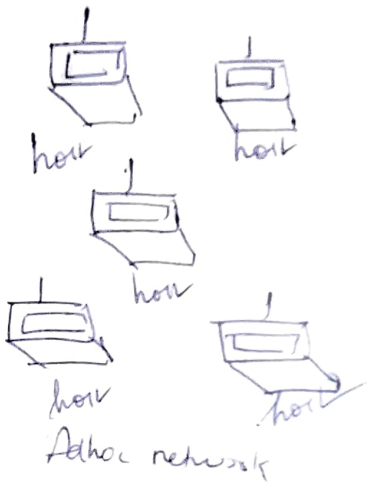
Hosts cannot move from one point to another in intent since it is connected to with wires

In wireless LAN hosts can move freely since they are not physically connected

3) Isolated LANs

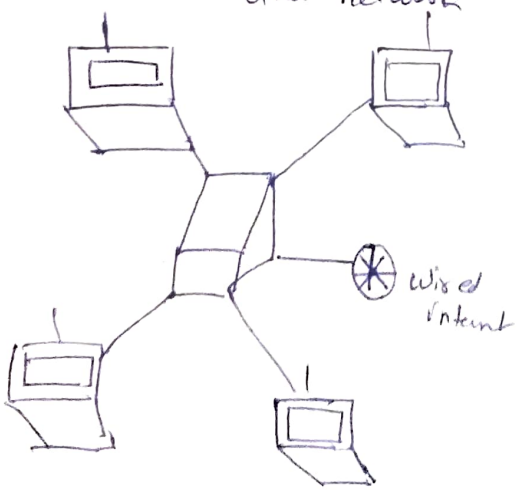


wired isolated LANs



Adhoc network

4) Connection of another network : Routers are used for connecting a wired LAN to other network



It can be connected to other network using access point