SWAMI VIVEKANANDASCHOOL OF ENGG. & TECH.

MADANPUR, BBSR

LECTURE NOTES

ON

WAVE PROPAGATION & BROADBAND COMMUNICATION

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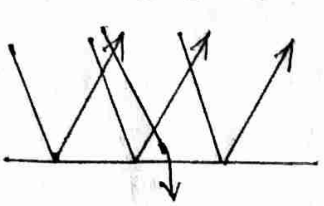
Effects of environments such as reflection, refraction, interference, diffraction, absorption and attenuation (Definition only)

Reflection => electromagnetic radiations / light bounces off the surface of the object. In order to see an object that doesn't make it's own light like the sun, light needs to bounce off the object and reach our eyes.

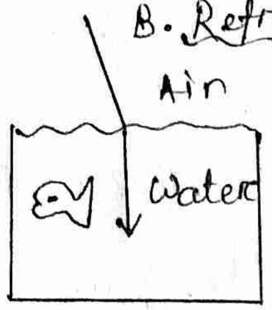
Refraction => The boundary of transmitted light as it travels across the boundary of one material into another material in which it's speed is different. Unlike diffraction, this change in direction of light occurs because light is changing its speed in the different substances in it travelling in.

The refractive index of a material is a number that describes how light will travel in it compared to how it travels in air or in a vacuum. The higher the refractive index of a substance, the slower light travels.

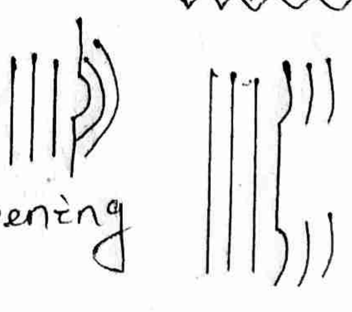
A. Reflection and obsorption



B. Refraction



C. Diffraction



White light composed of different wavelengths. Therefore, when white light hits/interacts with objects, what happens to the light ~~/interacts with objects~~ is complex/complicated with sum of the wavelengths reflected while others are absorbed or transmitted.

Sunlight that reaches out atmosphere is composed of all the colors of the rainbow. The different wavelengths of light are scattered differently by particles in the air. Smaller wavelengths scatter more than longere wavelengths.

Interference ⇒ Interference of light is the phenomenon that causes a reformation of the intensity of the light radiations. This mainly happens due to the superposition of two or more light waves. The superpositions of two or more waves occurs when the waves propagate in the seme medium at the same time and meet each other at the same point. The resultant wave is combination of all the incident waves. This means that the amplitude of the resultant wave is the algebraic sum of the amplitudes of indivisual waves.

diffreaction ⇒ The spreading/bending of light as it goes through openings ore around the edes of objects. The spredding of electromagnet radiations looks a lot like the ripples you make in watere when you dip youre toe in.

If the wavelength of the electromagnetic radiations is much smallere than the object around which is bends or opening it is going through, then very little to no diffraction is observed.

Absorption ⇒ energy from the electromagnetic, The light is observed depends on the wavelength of light and atoms that the object is made up of different atoms or molecules have specific vibrational frequencies and when the vibrational frequency of the molecule matches the wavelength of light that hits it, the light gets observed.

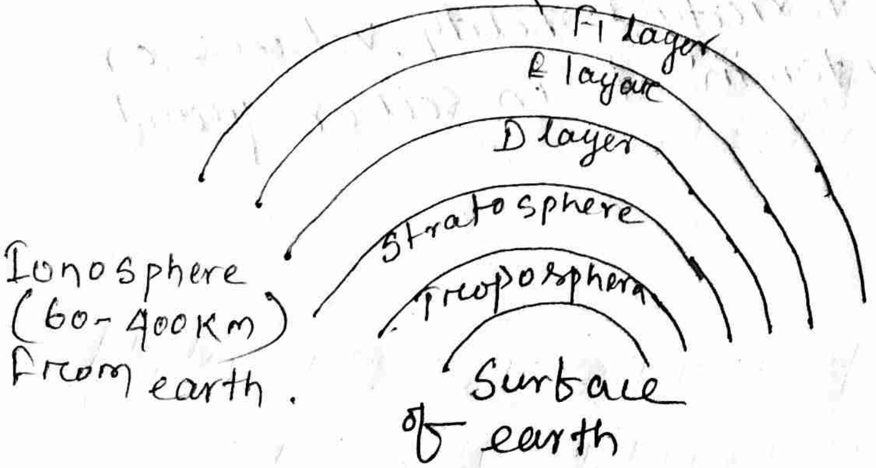
Attenuation ⇒ The environmental Protection Agency (EPA) defines natural attenuation as a variety of physical, chemical or biological processes that, under favorable conditions act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contaminants in soil or ground-watere.

Ground wave propagation

Groundwave Propagation is a type of radio Propagation which is also known as a surface wave. These waves propagate over the earth's surface in low and medium frequencies. These are mainly used for transmission between the surface of the earth and the ionosphere.

Ionosphere wave Propagation

The ionosphere contains a high propagation of free electrons which influence radio propagation. High frequency (HF) radio waves hitting the free electrons in the ionosphere cause them to vibrate and re-radiate the energy back down at the same frequency, effectively bouncing the radio wave back towards the earth.



Sky wave Propagation

Sky wave propagation, commonly known as the SKIP, is a kind of radio wave Propagation. It is either the reflected or refracted back waves to the earth from the ionosphere, which is an electrically charged layer of the upper atmossphere.

⇒ Radio waves can propagate through atmosphere and are reflected back by the ionosphere of earth's atmosphere.

⇒ waves go from transmitter antenna to receiver antenna while travelling through sky, hence their propagation is known as sky wave propagation

⇒ The skywave propagation is also known as ionosphere propagation.

⇒ The ionosphere is a region of the upper atmosphere from about 80km to 1000 km.

⇒ These waves propagate over the earth's surface in low and medium frequencies.

⇒ These are mainly used for transmission between the surface of the earth and the ionosphere.

critical frequency (Fc)

⇒ critical frequency is defined as the maximum frequency at which the total internal reflection takes place from the ionosphere.

$F_c = \sqrt{9 N_{max}}$ where F_c → Critical frequency in Hz.

N_{max} → maximum electron density per m^3

Advantage ⇒ i) signals can be send to almost entire earth area.

ii) Travel large distance in minimum power.

iii) No. of hops reduced

Disadvantage ⇒ i) Quality of output wave is not constant and uniform ii) wave affected by natural factors like sun, rain, fog etc. iii) Limited/useful frequency range.

Application ⇒

⇒ weather forecasting.

⇒ military application.

⇒ International broadcasts.

⇒ Radar Communication.

Space Wave Propagation

Space wave Propagation is defined for the radio waves that occur within the 20km of the atmosphere ie troposphere, consisting of a direct and reflected wave. These waves are also known as tropospheric propagation as they can travel directly from the earth's surface to the troposphere surface of the earth.

Applications ⇒ (a) It is used in various communication systems like (i) A line of sight Communication and Satellite Communication.
(ii) Radar Communication
(iii) Microwave linking.

Critical frequency→

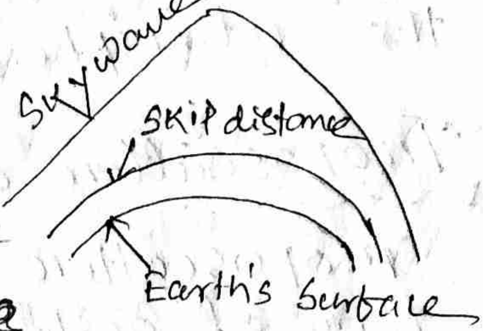
Critical frequency is the highest magnitude of frequency above which the waves penetrate the ionosphere and below which the waves are reflected back from the ionosphere. It is denoted by "fc". It's value is not fixed and it depends upon the electron density of the ionosphere.

Maximum usable frequency (MUF)→

In radio transmission maximum usable frequency (MUF) is the highest radio frequency that can be used for transmission between two points via reflection from the ionosphere (sky wave or "skip" propagation) at a specified time, independent of transmitter power.

Skip distance

A skip distance is the distance a radio wave travels, usually including a hop in the ionosphere.

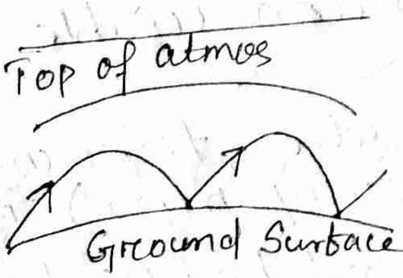


A skip distance is a distance on the Earth's surface between the two points where radio waves from a transmitter, refracted downwards by different layers of the ionosphere, fall.

Fading in Wave Propagation =>

In wireless communication, fading refers to the attenuation of the transmitted signal power due to various variable during wireless propagation. These variables can be atmospheric conditions such as rainfall and lighting, geographical position, time, radio frequency etc.

Duct Propagation =>

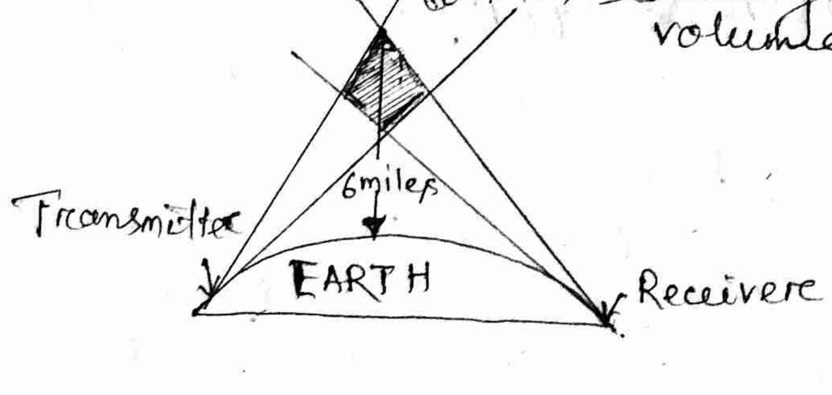


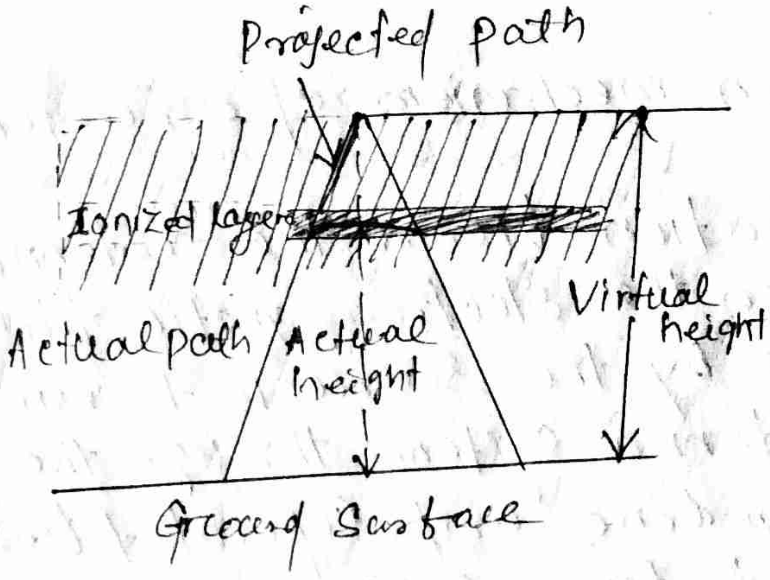
Waves trapped in duct

A radio wave propagation technique that allows the transmission of UHF (ultra high frequency) and VHF (very high frequency) electromagnetic waves through the region near the tropospheric layer of the atmosphere is known as dust propagation.

Troposcatter or tropospheric scatter =>

Troposcatter or tropospheric scatter is a form of radio signal propagation for radio communications links upto distance up to about 1000 Km using the troposphere.





(Troposphere scatter propagation actual height and virtual height)

Radiation mechanism of an antenna

The radiation from the antenna takes place when the Electromagnetic field generated by the source is transmitted to the antenna system through the transmission line and seperated from the antenna into free space.

What is antenna explain antenna radiation and its types?

An antenna is a metallic structure that is used to transmit radio EM waves. We can define it as the launching of waves or radiations in space, which is efficiently accomplished with dielectric structures called antennas.
An antenna acts as a transducer that converts the electrical power into EM waves.

Types of Antenna (I) Short Dipole Antenna (II) Slot antenna (III) Yagi-Uda Antenna (IV) Monopole antenna.

Which antenna is used in mobile?

Gsm antenna is a generic term used to describe an antenna suitable for mobile phones and wireless modems.

What is MIMO system?

multiple-input multiple-output (MIMO) is a wireless technology that uses multiple transmitters and receivers to transfer more data at the same time.

Which antenna is used in 4G mobile?

4G uses a technology called MIMO. Which means multiple input multiple output this is where your modem uses two separate antenna at once to deliver superfast speeds.

What is antenna efficiency and how does it relate to antenna gain ?

Antenna Gain is the ratio of powere transmitted in a certain direction with a specific reference point. Relation between gain and efficiency is
$G = e \times D$ Where D is the directive and E is the efficiency

Antenna efficiency is how much RF power delivered to the antenna (from radio) is actually transmitted into the air.

Directive gain ⇒

Directive Gain (Gd): It is the ratio of radiation intensity in a particulare direction to the average radiated power. Gd does not depend upon the power input to the antenna and its ohmic losses. The maximum value of directive gain is the directivity (D) of the antenna.

Directivity ⇒ The directivity of an antenna is the ratio of the maximum power density $P(\theta, \phi)_{max}$ to its average value over a sphere as observed in the farfield of an antenna.

Effective aperature of an antenna

The effective antenna aperature/area is a theoritical value which is a measure of how effective an antenna is at receiving power. The effective/area can be calculated by knowing the gain of the receiving antenna.

Antenna polarization

Antenna polarization is the term used in correspondence with the electromagnetic wave radiated through it. It is defind as the orientation of the electric field vector of the radiated electromagnetic wave by the antenna with a negligible amount of losses.

polarization of the antenna is regarded as a crucial parameter and must be considered at the time of choosing or installing the antenna. It is simply related to the characteristics of wave polarization.

Input Impedence of an antenna ⇒

Input impedence is defind as the ratio of voltage and current at the pair of the input antenna terminals

$$Z_a = R_a + jX_a$$

where R_a is the resistance at antenna terminals and X_a is the reactance at antenna terminals.

Radiation resistence of an antenna

Radiation resistance, Rrad or R_R, is proportional to the part of an antenna's feedpoint electrical resistance that is caused by power loss from the emission of radio waves from the antenna.

Radiation resistance is an effective resistance, due to power carried away from the antenna as radio waves.

Bandwidth and Beamwidth

Bandwidth refers to the amount of the frequency spectrum that a signal resides in, example the spacing between channels on your radio are determined by their bandwidth.

Beamwidth is a physical characteristic of an antenna. They generally mark the point from bore sight of a directional antenna that you are at -3dB or half power.

The angular separation between the points at which the magnitude of the radiation pattern decreases by 50% (or -3dB) from the peak of the main beam is called as the Half-power Beamwidth (HPBW). The angular span between the first nulls adjacent to the main lobe in the radiation pattern is called as the First Null Beam width (FNBW).

Radiation pattern

The radiation patterm is defind as a mathematical function or a graphical representation of the far field (ie, for $r \gg 2D^2/\lambda$ with D being the largest dimension of the antenna) radiation properties of the antenna, as a function of the direction of departure of the electromagnetic (EM) wave.

What is difference between a monopolo and dipole antenna?

The difference between a monopole antenna and dipole antenna, is that a dipole antanna uses an additionally radiator to generate a synthetic ground plane between the symmetric radiator elements, where a monopole antenna required a physical ground plane. For a dipole antenna, the radiator elements are connected 180 degrees out of phase of each other, such as with the inner and outer conductor of a coaxial cable. For a monopolo antenna, the reference plane of the transmission line connection, outer conductor of a coavial cable is the ground plane of the monopole. Both monopole and dipole antennas exhibit similar radiation patterns and performance, except that monopole antennals are not symmetric vertically. Dipoles to be more common. The size and design constraints of requiring a ground plane for monopole antennas is often restrictive and the radiation pattern of the monopole depends on the orientation of the ground plane. Dipole antennas however, have a vertically symmetric radiation pattern and can relatively easily be oriented in the direction of optimum reception / transmission.

As dipole tend to be more common than monopole antennas, there are more varieties and topologies of dipole antennas, including the common half-wavelength dipoles. Common monopole antennas include automotive AM antenna, naval low frequency antennas. There are types of monopolo antennas used in the very high frequency (VHF) broadcast applications that use several ground radial wires as the ground plane of the monopole antenna, and these conductive wires can be designed and oriented to optimize the radiation pattern of the "ground plane" antenna for ideal broadcasting performance.

omnidirectional antenna => Omnidirectional antennas are widely used for radio broadcasting antennas, and in mobile devices that use radio such as cell phone, FM radios, walkie-talkies, wireless computer networks, cordless phones, GPS, as well as for base stations that communicate with mobile radios, such as police and taxi dispatchers.

Directional High Frequency Antenna:

Directional High frequency antenna are likely to differe from lower-frequency ones for two reasons. These are the HF transmission/reception requirements and the ability to meet them. Since much of HF communication is likely to be point-to-point the requirement is for fairly concentrated beams of instead of omnidirectional radiation. Such radiation patterns are achievable at Directional High frequency Antenna, Because of the shortere wavelengths. Antenna can be constructed with overall dimensions of several wavelengths while retaining a menegeable size.

Advantages

1. It has a large forward gain.
2. It can suppress the backward signal, which is very usefull when the cell will cause potential interference to the cells behind it.

Applications ⇒ Improving transmission and reception of communications and reducing interference.

What is a Yagi Antenna?

A Yagi antenna or a Yagi-Uda antenna, is a directional antenna that radiates signals in one main direction. It consists of a long transmission line with a single driven element consisting of two rods connected on either side of the transmission line. It also consists of a single reflector on one side of the transmission line and a number of parasitic elements which act as directors. The driven element of a Yagi is equivalent of a center-fed, half-wave dipole antenna. Parallel to the driven element are straight rods or wires called reflectors and directors. A reflector is placed behind the driven element and is slightly shorter than driven element. A typical Yagi antenna has one reflector and one or more directors.

The Yagi antenna propagates electromagnetic field energy in the direction running from the driven element toward the director(s), and is most sensitive to incoming electromagnetic field energy in this same direction. The more directors a Yagi has, the greater the forward gain and the longer the antenna becomes.

This type of antenna has become particularly popular for televisionn reception, but it is also used in a number of other domestic and commercial applications where an RF antenna with high gain and directivity is needed.

Advantages of Yagi UDA antenna:-

- It is simple to build.
- It is compact size and lightweight.
- It offers wide bandwidth due to the use of folder dipole
- It is lower cost and handling easy and maintenance.
- It offers a unidirectional radiation pattern which is reasonably good.

Applications

- Yagi antenna used as a directional antenna on the HF, VHF and UHF bands. or
- It has moderate to high gain of up to 20dBi, depending on the number of elements used, and a front-to-back ratio of up to 20dB.

What is Dish TV antenna?

A Satellite dish is a dish-shaped type of parabolic antenna designed to receive or transmit information by radio waves to or from a communication satellite. The term most commonly means a dish which receives direct-broadcast satellite television from a direct broadcast satellite in geostationary orbit.

Horn Antenna => A horn antenna or microwave horn is an antenna that consists of a flaring metal waveguide shaped like a horn to direct radio waves in a beam. Horns are widely used as antennas at UHF and microwave frequencies, above 300 MHz.

What is Smart antenna in 5g?

Smart antenna arrays use multiple input/multiple output (MIMO) at both the source (transmitter) and the destination (receiver) to improve signal quality. This is in contrast to non-array systems in which a single antenna (and signal path) is used at the source and the destination.

Unit-2: TRANSMISSION LINES

Fundamentals of Treansmission Lines:

Fundamental of Treansmission Lines are considered to be impedance matching circuits designed to be impedance matching deliver power (RF) from the transmittere to the antenna and maximum signal from the antenna to the receiver. From such a broad definition, any system of wires can be considered as forming one or more transmission lines. If the properties of these lines must be taken into account, the lines might as well be arranged in some simple, constant pattern. This will make the properties much easier to calculate and it will also make them constant for any type of transmission line. All practical fundamentals of Transmission lines are arranged in some uniform pattern. This simplifies calculations, reduces costs and increases convenience.

Losses in treansmission line

There are two mainly two types of losses in treansmission line: tenchnical losses and non-technical losses. In technical losses we have radiation loss, conductore loss, dielectric heating loss, Coupling loss and corona loss. In case of non-technical losses there are powere theft, meterring inaccuracies etc

In a treansmission line we face the following types of losses.

(I) Radiation loss: It happens when the distance between the conductors in the treansmission line is comparable to the wave length. In such cases the electromagnetic and electrostatic field of the conductors acts as small antennas which conducts out energy to the nearby conducting materials

(II) Conductore loss => Conductor losses are often called power loss. It is mainly due to the resistance of the conductor. Conductor is also due to freqnency which is known as skin effect.

Skin effect is the tendency of the alternating current by which they tend to increase the current density near the surface more than that at the core i.e. the current appears to flow on the skin of the conductor.

(iii) Dielectric heating loss: Dielectric electric heating loss is due to the potential difference between the two conductors of a transmission line. When air is the dielectric, loss is negligible. However, in case of solid conductors it increases with the frequency.

Two more types of loss should be kept in mind i.e coupling loss and corona loss.

Coupling loss :- Coupling loss occures when connection between two transmission lines are made.

Corona loss :- Corona is the luminous discharge that occurs between two transmission lines. It generally destroys the transmission line.

Standing wave - SWR

SWR (Standing wave ratio) =>

Standing wave ratio is the ratio of the maximum magnitude or amplitude of a standing wave to its minimum magnitude. It indicates whether there is an impedance mismatch between the load and the internal impedance on a radio frequency (RF) transmission line, or waveguide.

VSWR (Voltage standing wave ratio) =>

Voltage standing wave ratio (VSWR) is defined as the ratio between transmitted and reflected voltage standing waves in a radio frequency (RF) electrical transmission system. It is a measure of how efficiently RF power is transmitted from the power source, through a transmission line, and into the load.

Reflection coefficient =>

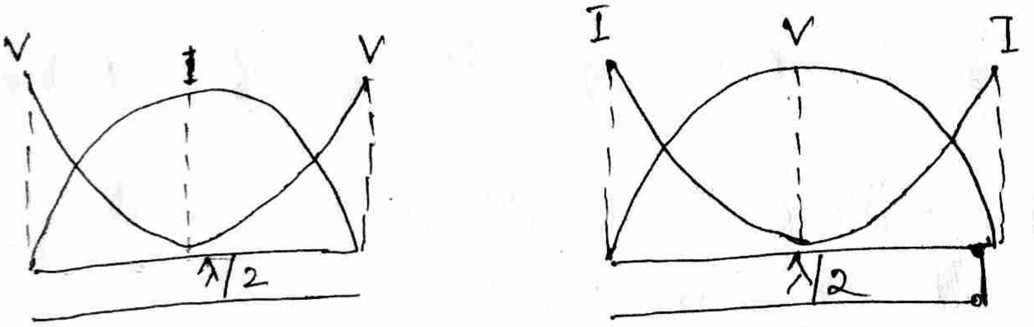
Reflection coefficient is a parameter that describes how much of a wave is reflected by an impedance discontinuity in the transmission medium.

Quartere wave & half wavelength line

Half wave Length Transmission Line

As shown in the given diagramm the half wave length transmission line can be open circuited or short circuited. The length of the transmission line is valid only for the particulare frequency at which λ/2 of that transmission line is calculated. Other than that frequency. The transmission line will not behave as a half wave length line.

As shown in the diagram No (a), the half wave length transmission line is open circuited. In this case at the load end or at the last end the voltage will be maximum and the current will be minimum. This behavior is repeated at the starting end of the same transmission line. It means that at this starting end of half wave length transmission line the voltage will be also maximum and the current will be minimum.



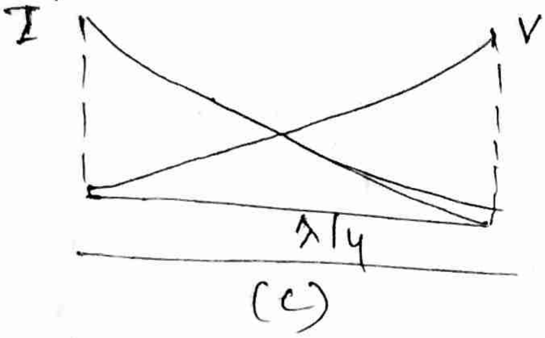
(a) (b)

Half wave Length Transmission Line open and Short Circuited diagram.

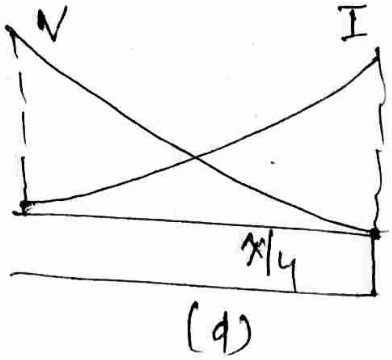
As shown in the diagram a/o(b). The half wave length transmission line is short circuited. In this case at the load end or at the last end the voltage will be minimum and the current will be maximum. This behavior is repeated at the Starting end of the same transmission Line. It means that at the Starting end of half wave length line the voltage will be also minimum and the current will be maximum.

Quartere Wave Length Transmission Line

As shown in the given diagram the quartere wave length transmission line can be open circuited or short circuited. The length of the transmission line is valid only for particulare frequency at which $\lambda/4$ of the transmission line is calculated other than that frequency the transmission line will not behave as a quartere wave length transmission line.



(c)



(d)

Quartere Wave length Transmission Line open & short circuit Diagram.

As shown in the diagram No(c). The quarter wave length transmission line is open circuited. In this case at the load or at the last end the voltage will be maximum and the current will be minimum. This behavior is repeated at the starting end of the same transmission line. It means that at the starting end of the quarter wave length transmission line the voltage will also be maximum and the current will be minimum.

As shown in the diagram No(d) The quarter wave length transmission line is short circuited, in this case at the load end or at the last end the voltage will be minimum, and the current will be maximum, the behavior is repeated at the starting end of the same transmission line, It means that at the starting end of the quarter wave length transmission line the voltage will be maximum and the current will be minimum.

STUB

A stub is a piece of transmission line It is possible to connect Sections of open or short circuited line called stub in shunt with the main line at some point or ponts to effect impedance matching. This is called sub matching. It has two advantages:

a) The length and characteristic impedance of the line remains unchanged.

b) Adjustable susceptance can be added in Shunt with the transmission line.

Stubmatching is of two types

(i) Single Stub matching

(ii) Double Stub matching.

Primary and Secondary constant of X-mission Line

The Primary line constants are parameters that describe the characteristics of conductive transmission lines, such as pairs of copper wires, in terms of the physical electrical properties of the line. The Primary line constants are only relevant to transmission lines and are to be contrasted with the Secondary line constants, which can be derived from them, and more generally applicable. The Secondary line constants can be used, for instance, to compare the characteristics of a waveguide to a copper line, whereas the primary constants have no meaning for a waveguide.

Unit-3: TELEVISION ENGINEERING

Aspect ratio ⇒ The aspect ratio states the comparison of width to height and is commonly used to describe the shape of a TV or computer screen. For example, the aspect ratio of an earlier Standard definition(SD) screen was 4:3, which is a relatively square rectangle. The 4:3 means "4 to 3", or four units wide to three units high.

Flicker ⇒ Flicker is a visible change in brightness between cycles displayed on video displays. It applies to the refresh interval on cathode ray tube(CRT) televisions and computer monitors as well as plasma computer displays and televisions.

Horizontal resolution ⇒ Horizontal resolution is determined by the 4.2MHz bandwidth (B) alloted to the video signal. It is expressed in terms of the maximum number of lines that can be resolved in a TV picture along the horizontal direction.

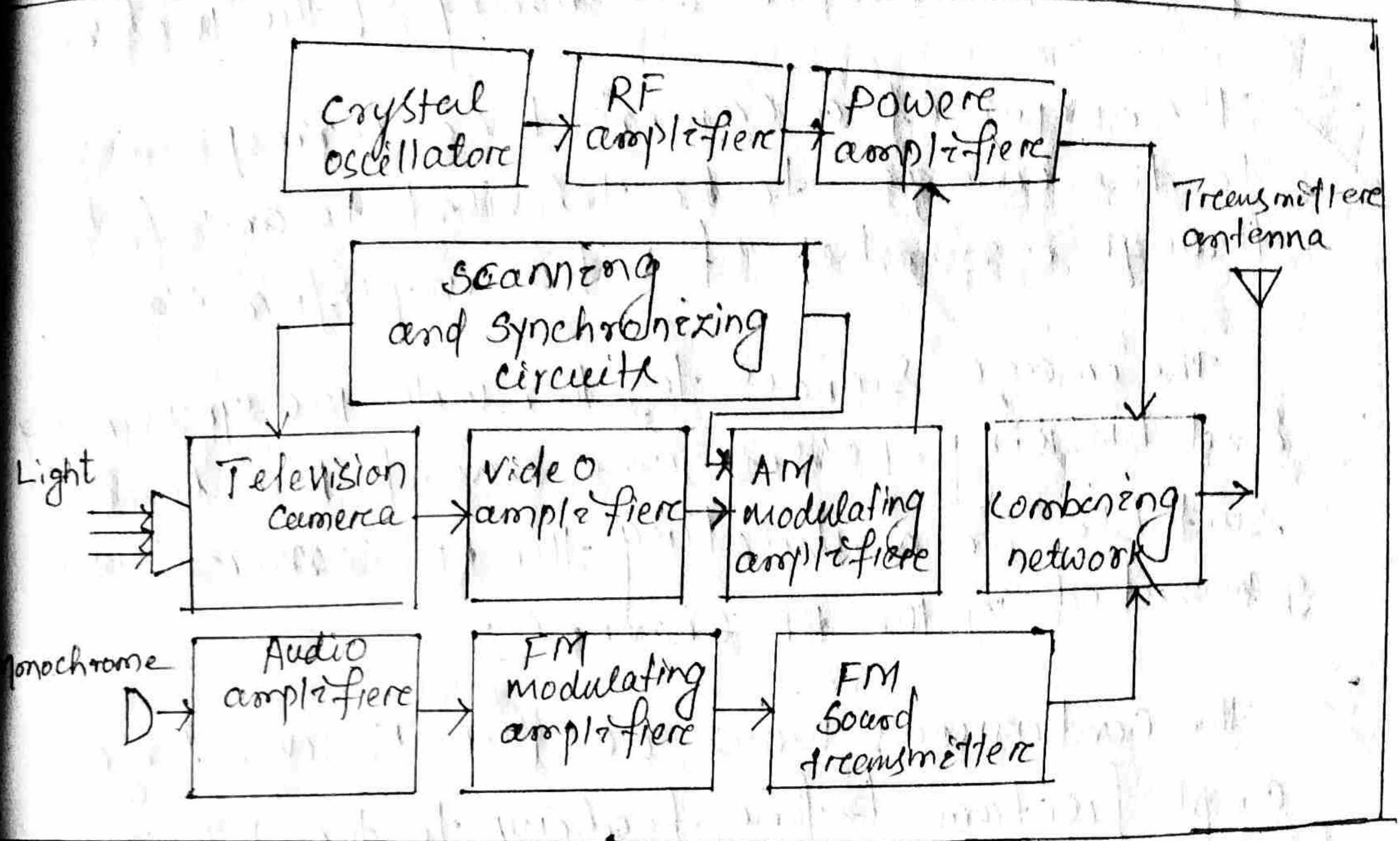
Video bandwidth → In broadcast television systems, VF bandwidth, video bandwidth or more formally video frequency bandwidth is the range of frequencies between 0 and the highest frequency used to transmit a line television image.

Composite Video Signal ⇒ A composite video signal contains video picture information for color, brightness and synchronization (horizontal and vertical)

Synchronizing pulses → The synchronizing pulses are transmitted or stored along with the analog video signal for each line. These synchronizing pulses are then used to trigger the receiver's circuitry to make sure that the scene is sequenced properly on the screen.

Television Transmitter

Block diagram of monochrome TV Transmitter



=> In most television systems the picture signal is amplitude modulated and sound signal is frequency modulated before transmission.

=> The carrier frequency are suitably spaced and the modulated outputs radiated through a common antenna.

=> Thus each broadcasting station can have its own carrier frequency and the receiver can then be tuned to select any desired station.

Picture Transmission

=> A TV camera, the heart of which is a camera tube, is used to convert the optical information into a corresponding electrical signal, the amplitude of which varies in accordance with the variations of brightness.

⇒ The synchronising and scanning circuits produces sets of pulses for providing synchronising pulses for proper functioning of the TV system.

⇒ The output of a camera tube corresponding to the image to be telivised to amplified through a number of video amplifier stages.

The image signals together with the synchronising and blanking pulses are raised to a level suitable for modulating the RF carrier wave generated in the RF channel.

⇒ The continuous wave output is given large amplification before feeding to the power amplifier

⇒ In the modulation, its amplitude is made to vary in accordance with the modulating signal received from the modulating amplifier.

Sound Transmission

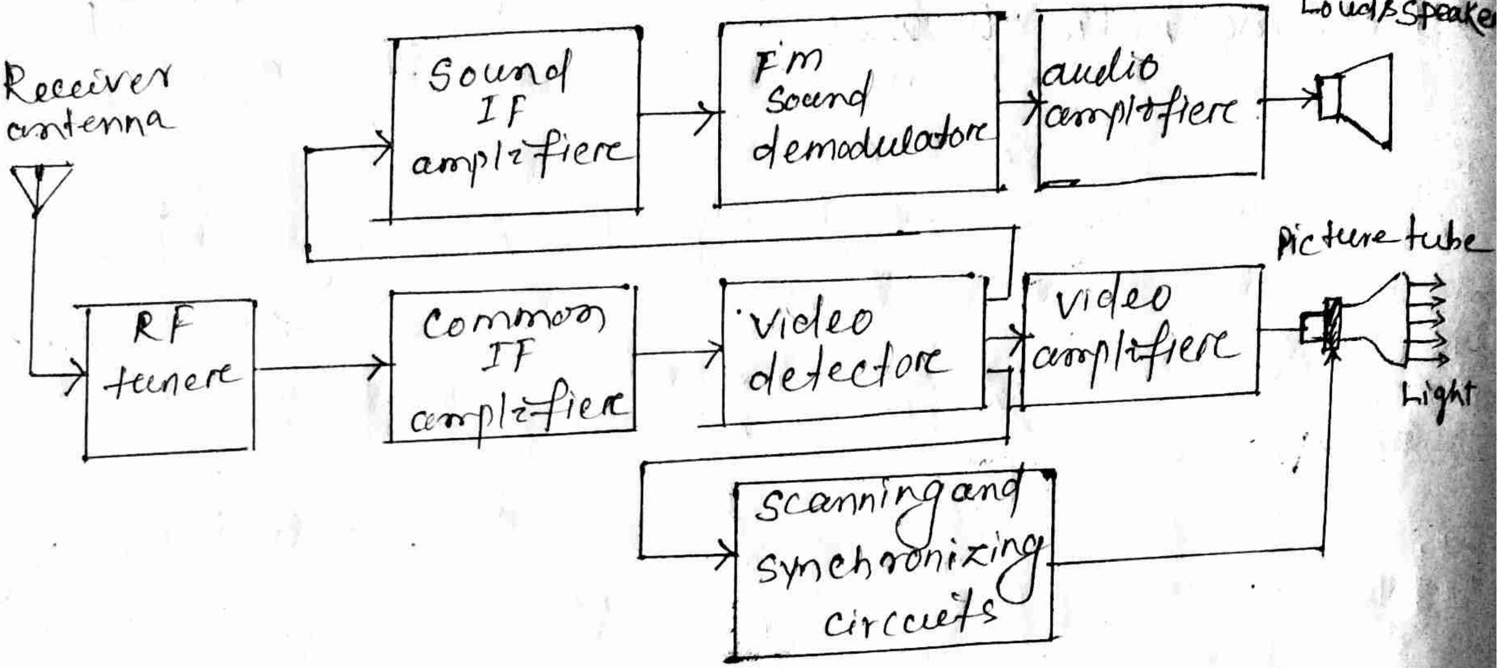
⇒ The microphone converts the sound associated with the picture being televised into proportional electrical signal.

⇒ The audio signal from the microphone after amplification is frequency modulated, employing the assigned carrier frequency.

=> The output of Sound FM transmitter is finally combined with the AM picture transmitter output through a combining network and feed to a common antenna for radiation of energy in the form of electromagnetic waves.

Television Receivere

Block diagram of monochrome TV Receivere



Picture Reception

=> The receiving antenna intercepts the radiated picture and sound carriere signals and feeds them to the RF tuner.

=> The receiver is of the heterodyne type and employs two or three stages of intermediate frequency (IF) amplification.

=> The output from the last IF stage is demodulated to receiver the vedio signal.

=> This signal that carries the picture information is amplified and coupled to the picture tube which converts the electrical signal back onto picture elements of the same degree of black and white the rate at which the spot of light moves is so fast that the eye is unable to follow it and so a complete picture is seen because of the storage capability of the human eye.

Sound Reception

=> The path of the sound signal is common with the picture signal from antenna to the video detector section of the receiver.

=> The frequency modulated audio signal is demodulated after at least one stage of amplification

=> The audio output from the FM detector is given due amplification before feeding it to the loudspeaker

Synchronization

=> To ensure perfect synchronization between the scene being televised and the picture produced on the raster, synchronizing pulses are transmitted during the retrace, i.e fly-back intervals of horizontal and vertical motions.

=> Thus, in addition to carrying picture detail the radiated signal at the transmitter also contains synchronizing pulses.

=> These pulses which are distinct for horizontal and vertical motion control, are processed at the receiver and fed to the picture tube sweep circuitry.

⇒ This ensure that the receivere picture tube beam is in step with the transmittere camera tube beam.

Colore TV signals

~~Croomi~~ chrominance signal ⇒

Chrominance signal is the signal used in video systems to convey the color information of the picture.

Luminance signal ⇒ The luminance signal is formed by combining a proportion of 30% red, 59% green and 11% blue from the colour signal. This combined output becomes the luminance (brightness/monochrome) signal.

Cathode-ray tube ⇒ A cathode-ray tube is a vacuum tube containing one or more electron guns, which emit electron beams that are manipulated to display images on a phosphorescent screen. The image may represent electrical waveforms, pictures.

Plasma Display panel ⇒ Plasma Display panel is composed of two parallel sheets of glass that enclose a mixture of discharge gases composed of helium, neon.

What is the differenie between LCD and plasma display panel?

LCDs tend to have a highere native resolution than plasmas of similarc size, which means more pixels on the screen. LCDs also tend to consume less powere than plasma screens, with some of the newere "Eco" LCD panels able to use half of the powere than equivalent plasmas, with the trade-off being lowere brightness

Is plasma bettere than LED?

Plasma produces a bettere pictere quality due to their superior contrast ratio, but LED TVs became more popularc because of other factors, like a lower cost and greatere availability.

DLP) Digital Light processing => Digital Light processing is a set of chipsets based on optical micro-electro-mechanical technology that uses a digital micromirror device.

Liquid-crystal display => (LCD)

A liquid-crystal display is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit light directly but instead use a backlight or reflector to produce images in color.

Organic Light-Emitting Diode (OLED)

An organic light-emitting diode (OLED) is a solid state light device that makes use of flat light emitting technology with the help of two conductors between which a series of organic thin films are kept. Unlike other display modes, an OLED does not require backlighting. Because of its low powere consumption and great brightness, OLED used as a backlight source in LCD displays, electronic equipment signalling as well as in general lighting.

Quantum Light emitting Diode (QLED)

Quantum Light emitting Diode are a new form of light emitting technology based on nanoparticle, and their structure are similar to the OLED technology.

Principle of operation of LCD display

LCD (Liquid crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer moniters and instrument panels.

LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. Where an LED emits light, the liquid crystals in an LCD produces an image using a backlight. LCDs have begun being replaced by new display technologies such as OLEDs,

HOW LCDs WORK

A display is made up of millions of pixels. The quality of a display commonly refers to the number of pixels; for example a 4K display is made up of 3840X2160 or 4096 x 2160 pixels. A pixel is made up of three subpixels; a red, blue, and green commonly called RGB. When the subpixels in a pixel change color combinations, a different color can be produced. When the pixels are rapidly switched on and off a picture is created. LCDs are lit by a backlight, and pixels are switched on and off electronically while using liquid crystals to rotate polarized light. A polarizing glass filter is placed in front and behind all the pixels, the front filter is placed at 90 degree. In between both filters are the liquid crystals, which can be electronically switched on and off.

LCDs are made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors with pixels on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time.

CATV SYSTEMS

In Cable television commonly known as community antenna television (CATV), these cable systems use a "community antenna" to receive broadcast signals which they then retransmit via cables to homes and establishments in the local area subscribing to the service.

Transmission of digital signal

To transmit the digital signal, it uses quadrature amplitude Modulation (QAM) or vestigial side band (VSB) modulation technique. Where as analog televisions transmits in amplitude modulation (AM) which is uncompressed.

What is the mode of transmission of TV signals?

Transmission of TV signals as analog in which the picture and sound are transmitted by analog signals modulated onto the radio carrier wave, and digital in which the picture and sound are transmitted by digital signals.

UNIT-4: MICROWAVE ENGINEERING

Define Microwave Wave Guides.

A microwave waveguide is an electromagnetic feed line used in microwave communications, broadcasting and radar installations. A waveguide consists of a rectangular or cylindrical metal tube or pipe. The electromagnetic field propagates lengthwise. waveguides are most often used with horn antennas and dish antennas.

Rectangular Wave guide theory

Rectangular wave guide can be constructed from a hollow conducting tube. If the conducting tube is rectangular in shape then it forms a rectangular waveguide.

Advantage of Rectangular Waveguides

- Wide frequency bandwidth for single mode propagation
- low attenuation.
- Excellent mode stability for fundamental propagation modes.

Circular wave guide

A wave guide is a hollow metal tube (rectangular or circular in cross section) that transmits electromagnetic energy from one place to another. A wave guide with a circular cross-section is called as circular waveguide. It supports both transverse electric (TE) and transverse magnetic (TM) modes.

Operational cavity resonator

A cavity resonator can be used as a frequency sensor. It acts as an energy trap because it will siphon off energy from a microwave when the microwave frequency hits the resonance frequency of the cavity resonator. This can be used to determine the frequency of the passing wave.

Types of cavity resonator

=> Regulated cavity Resonator
=> Un-regulated cavity Resonator
=> Wave guide Resonator
=> Capacitive Resonator
=> Inductive Resonator
=> Co-axial cavity Resonator.

Working of directional couplere

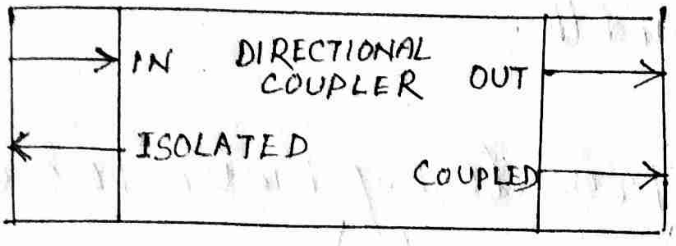
⇒ Directional couplers are devices that will pass signal across one path while passing a much smaller signal along another path.

⇒ One of the most common uses of the directional coupler is to sample a RF power signal either for controlling transmitter output power level or for measurement.

⇒ An example of the latter use is to connect a digital frequency counter to the low-level port and the transmitter and antenna to the straight-through (high power) ports.

⇒ The circuit symbol for a directional coupler is shown in fig. below. Note that there are three outputs and one input.

⇒ The IN OUT path is Low-loss and is the principal path between the signal source and the load. The coupled output is a sample of the forward path while the isolated showed very low signal. If the IN and OUT are reversed then the roles of the coupled and isolated ports also reversed.



CIRCUIT SYMBOL FOR DIRECTIONAL COUPLER

Travelling Wave Tube (TWT)

A travelling wave tube is a high power amplifier used for the amplification of microwave signals up to a wide range. It is a special type of vacuum tube that offers an operating frequency ranging between 300 MHz to 50 GHz.

Travelling wave tubes are non-resonant structures that offer continuous interaction of applied RF field with the electron beam over the entire length of the tube. Due to this reason, it provides wider operating bandwidth.

Working of Travelling Wave Tube

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Working of Travelling wave Tube =>

The applied RF signal produces an electric field inside the tube. Due to the applied positive half, the moving electron beam experiences accelerative force. Howevere, the negative half of the input applies a de-accelerative force on the moving electrons. This is said to be velocity modulation because the electrons of the beam are experiencing different velocity inside the tube. However, the slowly travelling wave inside the tube exhibits continuous inter-action with the electron beam. Due to continuous interaction, the electrons moving with high velocity transfer their energy to the wave inside the tube and thus slow down. So with rise in the amplitude of the wave the velocity of electrons reduces and thus causes bunching of electrons inside the tube. The growing amplitude of the wave resultantly causes more bunching of electrons while reaching the end from the begining. There by causing further amplification of the RF wave inside the tube. The positive potential at the other end causes collection of electron bunch at the collector.

However, as the TWT is a bidirectional device. Therefore, the reflected signal causes oscillations inside the tube. But as we have already discussed earlier that the presence of attenuators reduces the generation of oscillations due to reflected back wave.

Application of TWT

1 => Travelling wave tubes are highly used in continuous wave radar systems.

2 => It is used for broadband receivers for RF amplification.

Working principle of cyclotron

A cyclotron accelerates a charged particle beam using a high frequency alternating voltage which is applied between two hollow "D" shaped sheet metal electrodes known as the "dees" inside a vacuum chamber.

=> The dees are placed face to face with a narrow gap between them, creating a cylindrical space within them for particles to move. particles are injected into the center of this space.

Due to this reason, it provides wider operating bandwidth.

Working of Travelling Wave Tube

⇒ Dees are located between the poles of electromagnet which applies a static magnetic field B perpendicular to the electrode plane.

⇒ The magnetic field causes the path of the particle to bend in a circle due to the Lorentz force perpendicular to their direction of motion.

⇒ An alternating voltage of several thousand volts is applied between the dees. The voltage creates the oscillating electric field in the gap between the dees that accelerates the particles.

⇒ The frequency of the voltage is set so that particles make one circuit during a single cycle of the voltage. To achieve this condition, the frequency must be set to the particle's cyclotron frequency.

Expression for cyclotron frequency

$$f = \frac{qB}{2\pi m}$$

B is magnetic field strength

q is the electric charge of the particle

m is the relativistic mass of the charged particle.

UNIT-5: Broadband communication

Basics of communication system

Information can be sent over a communication system from either a person or a machine. A transmitter is positioned at one location and a receiver is located at another location with the channel serving as a medium between the two locations. It is the message signal that originates from the source and it is this signal that is fed into the transmitter.

Types of communication systems

Communication systems are divided into two categories: analog and digital.

Analog ⇒ Analog technologies transmit data between people or machine as electronic signals of various frequencies or amplitude. Telephone and radio transmission are the most common examples of analog technology.

Digital ⇒ In digital technology, information is generated and processed in two states: high and low. Digital technology stores and transmits the data in the form of 0s and 1s.

There are two types of communication channel.

1) Wired Communication, also known as line communication is of four types:
1. parallel wires communication
2. Twisted wire communication
3. coaxial cable communication
4. optical fibre communication.

2) Wireless, also known as space communication is of four types:
1. Ground wave communication
2. Skywave communication
3. Space wave communication
4. Satellite communication

Communication system examples
1. Internet
2. public switched Telephone network
3. Intranet and Extranet
4. Television.

The fundamental parts of a communication system are sources, input transducers, transmitters, communication channel, receivers and output transducers.

Cable Internet access

In telecommunications, cable internet is a form of broadband internet access which uses the same infrastructure as a cable television. Like digital subscriber line and fiber to the premises services, cable internet access provides network edge connectivity from the internet service provider to an end user. It is integrated into the cable television infrastructure analogously to DSL which uses the existing telephone network. Cable TV networks and telecommunications networks are the two predominant forms of residential internet access. Recently, both have seen increased competition from fiber deployments, wireless, and mobile networks.

Importance of Broadband

⇒ Broadband service provides a higher-speed of data transmission.

⇒ Broadband provides access to the highest quality internet services, such as video conferencing for telehealth, that require large amounts of data transmission.

⇒ Broadband access is constant, it does not block phone lines, and there is no need to reconnect each time you need to use the internet.

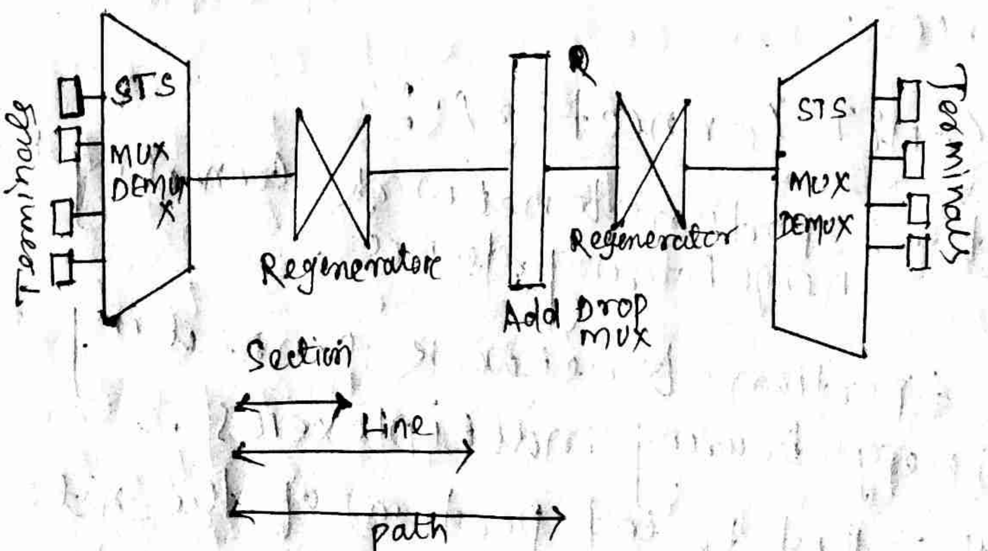
Synchronous optical Network (SONET).

SONET stands for Synchronous optical Network. SONET is a communication protocal, developed by Bellcore - that is used to transmit a large amount of data over relatively large distance using optical fibre. With SONET, multiple digital data streams are transferred at the same time over the optical fibre.

Why SONET is called a Synchronous Network?

A single clock (primary Reference clock, PRC) handles the timing of transmission of signals and equipments across the entire network.

SONET Network Elements



1. STS multiplexer

=> performs multiplexing of signals
=> converts electrical signal to optical signal.

2. STS Demultiplexer

=> performs demultiplexing of signals
=> Converts optical signal to electrical signal.

3. Regenerator

It is a repeater, that takes an optical signal and regenerates it.

4. Add/Drop multiplexer

It allows to add signals coming from different sources onto a given path or remove a signal.

Why SONET is used?

SONET is used to convert an electrical signal into an optical signal so that it can travel longer distances.

SONET Connections:

=> section: Portion of network connecting two neighbouring devices.

=> Line: portion of network connecting two neighbouring multiplexers.

=> path: End to End portion of the network

Advantages of SONET:

=> Transmits data to large distances.
=> Low electromagnetic interference.
=> High data rates.
=> Large Bandwidth.

Application of SONET

1=> SONET is designed for public telephone network.
2=> SONET is used for multipoint configuration, enhanced performance, monitoring, and enhanced and integrated OAM.

What is ISDN?

ISDN stands for integrated Services Digital Network. It is a set of communication standards that uses digital transmission to make phone calls, video calls, transmit data and other network services over the circuits of the traditional PSTN (public switched Telephone Network)

How does ISDN work?

ISDN splits the traditional copper telephone line into multiple digital channels. These channels operate concurrently on a single copper line, allowing multiple phones to make and receive calls simultaneously using one physical line.

ISDN Interfaces

There are various kinds of interfaces defined by ISDN such as Basic Rate Interface (BRI), Primary Rate Interface (PRI) and Broadband (B-ISDN)

Basic Rate Interface (BRI)

Basic Rate Interface of ISDN contains two 64-B channel and one D-channel for broadcasting control information.
Basic Rate interface is very popular in Europe but much les common in North America. In Japan it is known as INS64.

Primary Rate Interface (PRI) of ISDN

ISDN Primary Rate Interface (PRI) contains 23 B-channel and one D-channel in US and in Europe. It contains 30 B-channel and one D-channel. Primary Rate interface is very well liked all over the world particularly PSTN circuits to PBXs. Many networks all through the world use the term ISDN to refere low bandwidth circuits.

Broadband (B-ISDN)

Broadband ISDN make use of broadband communications. Broadband is capable to carry broadcasting rate of 1.5 Mbps. Mainly B-ISDN need of fiber optic cables. Most broadband channel carries 64 Kbit/s signals.

What are the services provided by ISDN ?

ISDN provides simultaneous voice, video and text transmission between individual desktop video conferencing systems and group video conferencing systems.

ISDN Architecture

ISDN stands for Integrated Services Digital Network. It can be used to bridge the central office's local loop and the premise connection (home). It is a network in which digital switching links are used to connect digital signals.

ISDN applications

It is used in video conferencing in which we have used the various devices like camera, microphone, speakers, TV etc for carrying our communications with various users for formal purposes.

BISDN (Broadband integrated services digital network)

BISDN is a virtual circuit-switched network that can use high-speed packet switching services. The B-ISDN will use a flexible multiplexing format called ATM (asynchronous transfer mode)

BISDN interface

BISDN is a dial-on-demand service that provides fast call setup, low latency, and the ability to carry high quality voice, data, and video transmissions. BISDN is also a circuit switched service that can be used on both multi-point and point-to-point connections.

BISDN Services

An integrated Digital Network is a network in which digital switching connections are used to transmit digital signals. Integrated Services refers to BISDN ability to deliver two simultaneous connections, in any merging of data, voice, video and fax over an individual line.

What is differene between ISDN and Broad Band ?

ISDN technology, or integrated services Digital network, uses a single optical fibere to transmit a single, While broad band uses a high-speed digital connection; typically with a digital signal. ISDN has multiple channels, While broadband offers a dedicated, constant connection.

Broadband refers to any type of high speed connection to the internet, so this could be either DSL or cable technology. ISDN is always a wired connection, with two channels which separate phone lines to provide one line for a computere or data and one line for a telephone.