unit-V

Radio

Radio is a very commonly used appliance of reception of audio signals (speech, music etc.) The audio frequencies are in the range of 20Hz to about 20kHz and cannot be transmitted directly by radio waves. Therefore these waves are modulated by High frequency carrier wave through amplitude or frequency modulation. At the radio receiver the carrier is separated and audio signal fed to the Loudspeaker of the receiver. Both in transmitter and receiver the signals have to be amplifi suitably to make them strong.

AM Transmitter:

It is very commonly used for point to point communication using medium, long, or short waves.

1) To generate carrier wave of suitable high frequency
2) To modulate the carrier wave by the audio signal.
3) To amplify the signal to a suitable level.

The modulation may be low level or high level.

In low level modulation the modulation process is carried out when the strength of carrier is low. Then the modulated signal is amplified through one or more stages to make it strong.

In low level modulation is suitable for low power transmitters.

In high level modulation the carrier wave and audio wave are amplified suitably before modulation. After modulation the signal is fed directly to the transmitting antenna without any further amplification. High level modulation ensures a high conversion efficiency and is more commonly used.

1KW or 10KW or so.

The RF crystal oscillator generates high frequency waves. The desirable features of good oscillators

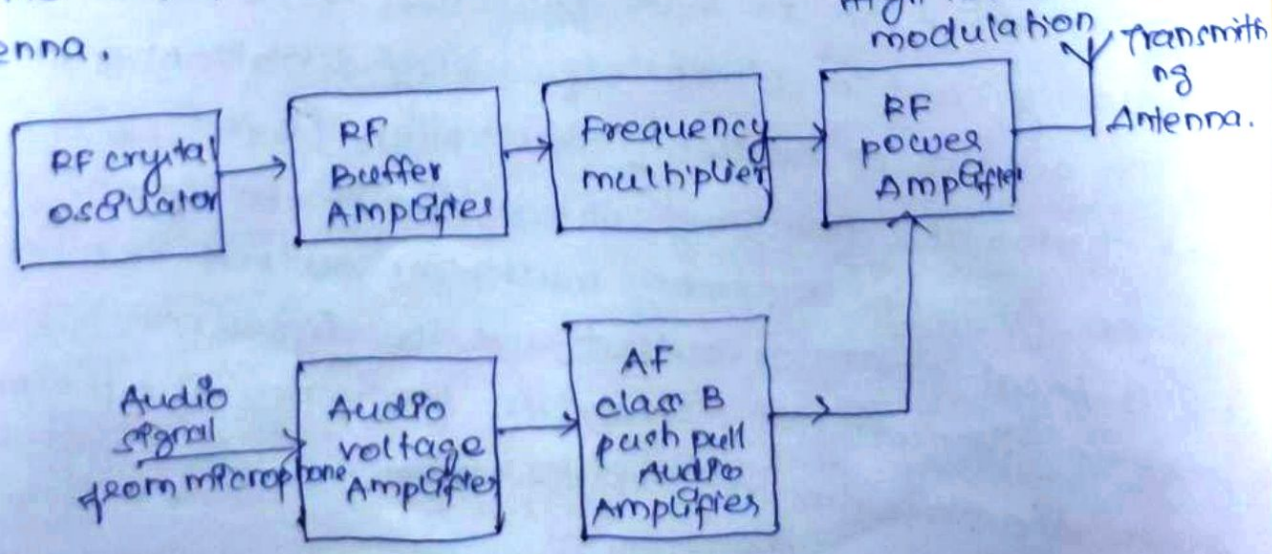
frequency stability
freedom from drift
frequency adjustment

ystal oscillator provides good frequency stability and are more commonly used.

Buffer amplifier provides Isolation between crystal oscillator and RF power amplifier.

The frequency multiplier increases the frequency obtained from crystal oscillator to the desired frequency of the carrier wave. Crystal oscillator has better frequency stability but it output frequency is relatively low. Therefore it is desirable that output frequency of crystal oscillator is increased by frequency multiplier.

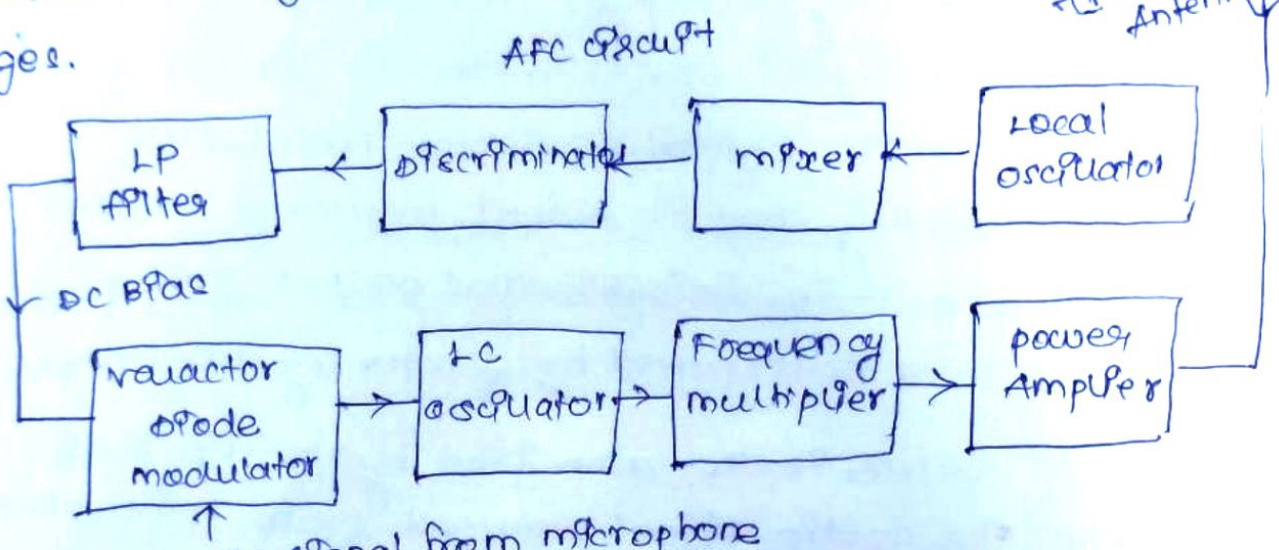
The RF carrier is then amplified by the RF power amplifier. The audio signal obtained from microphone is amplified first by a voltage amplifier and then by a class B push pull power amplifier, operating in audio frequency range. The carrier is amplitude modulated by the amplified audio signal and fed to transmitting antenna.



Block Diagram of AM Transmitter.

FM Transmitter:

Fig 14.14 shows a block diagram of frequency modulated transmitter. The audio signal, from mic is fed to varactor diode modulator. The output of this modulator undergoes a number of frequency multiplier stages.



Block Diagram of FM Transmitter.

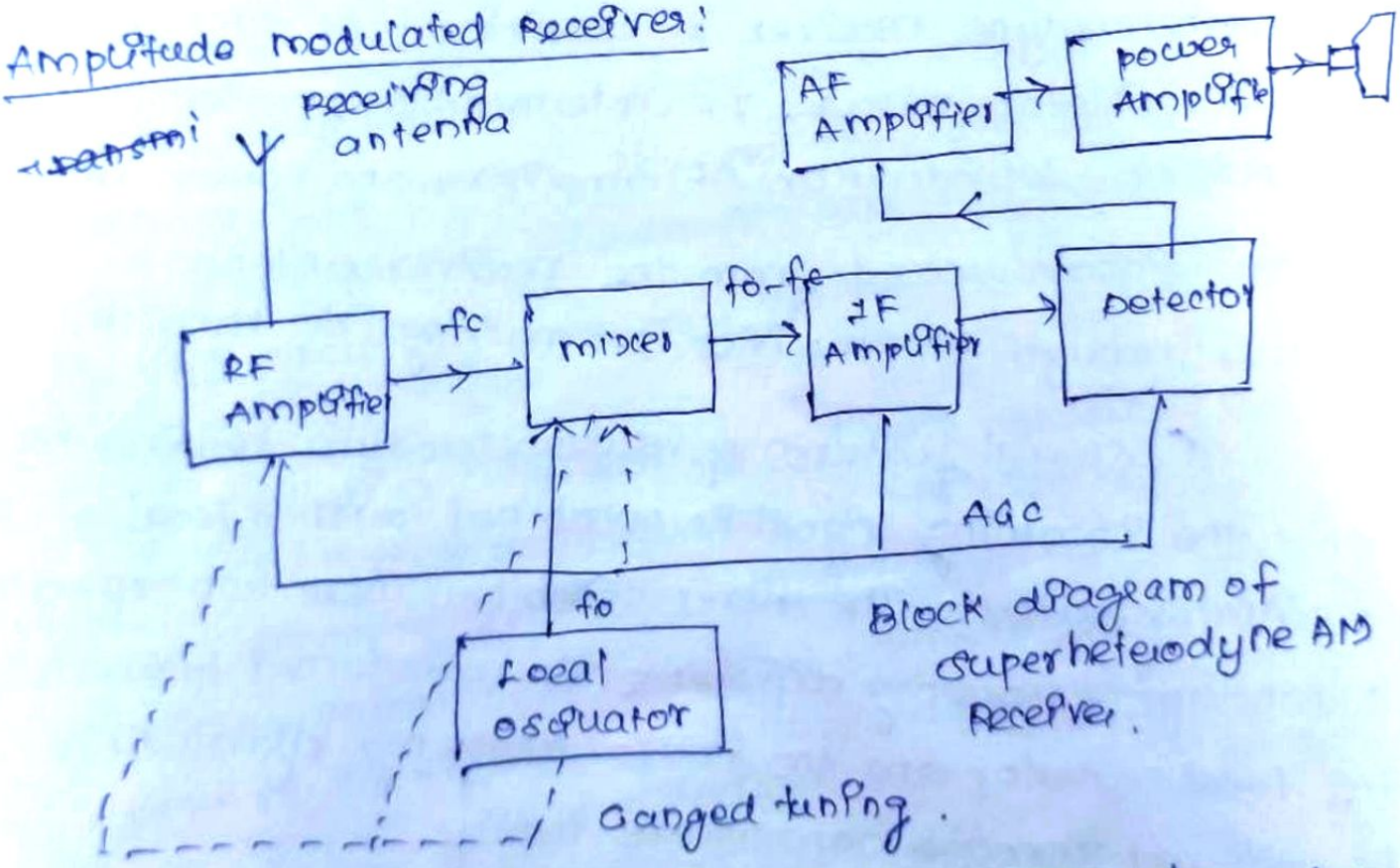
These stages raise the centre frequency of the signal However the frequency deviation also gets multiplied by the same ratio. To make correction in the centre frequency and to eliminate frequency deviation) a part of the output of frequency multiplier is fed to AFC (automatic frequency control) circuit as shown.

In AFC the frequency multiplier output is mixed with local oscillator output and the difference frequency goes to discriminator. When the frequency of o/p signal from discriminator matches the centre frequency the dc bias is zero

however any frequency deviation exists, the filter does not allow this drift to reach varactor diode modulator. LP filter has a cut-off frequency lower than that of signal. Finally the signal is fed to power amplifier and then to transmitted antenna for radiating the signal into space.

Inspite of the presence of AFC, the above

Amplitude modulated Receiver:



Block diagram of superheterodyne AM Receiver.

The present day Radio Receivers are superheterodyne receivers. Earlier to this TRF (tuned Radio frequency) receiver were used. TRF does not have high selectivity Because to this reason TRF receivers were discarded many decades ago and superheterodyne receives were introduced.

superheterodyne receiver has the following advantages

i) Better selectivity and less disturbance from adjacent channels.
ii) Good selectivity over the complete frequency range
iii) High gain
iv) uniform bandwidth.

It shows a simple block diagram of AM superheterodyne receiver. It consists of RF amplifier, Local oscillator, mixer, IF (Intermediate frequency) amplifier, demodulator (AF) amplifier and power amplifier.

The signal received from the receiver antenna pass through RF Amplifier for raising its strength.

A special feature of superheterodyne receiver is that the incoming signal is combined with a Local oscillator output. The mixer combines these two signals. A constant frequency difference is maintained between the local oscillator and the radio frequency signal. This is achieved through capacitance tuning.

All the capacitors are ganged together so that ganged tuning can be done through a single, Knob.

The frequency obtained by mixing of radio frequency and local oscillator frequency is called intermediate frequency.

The RF amplifier is a wideband amplifier having frequency range 540kHz to 1650kHz.

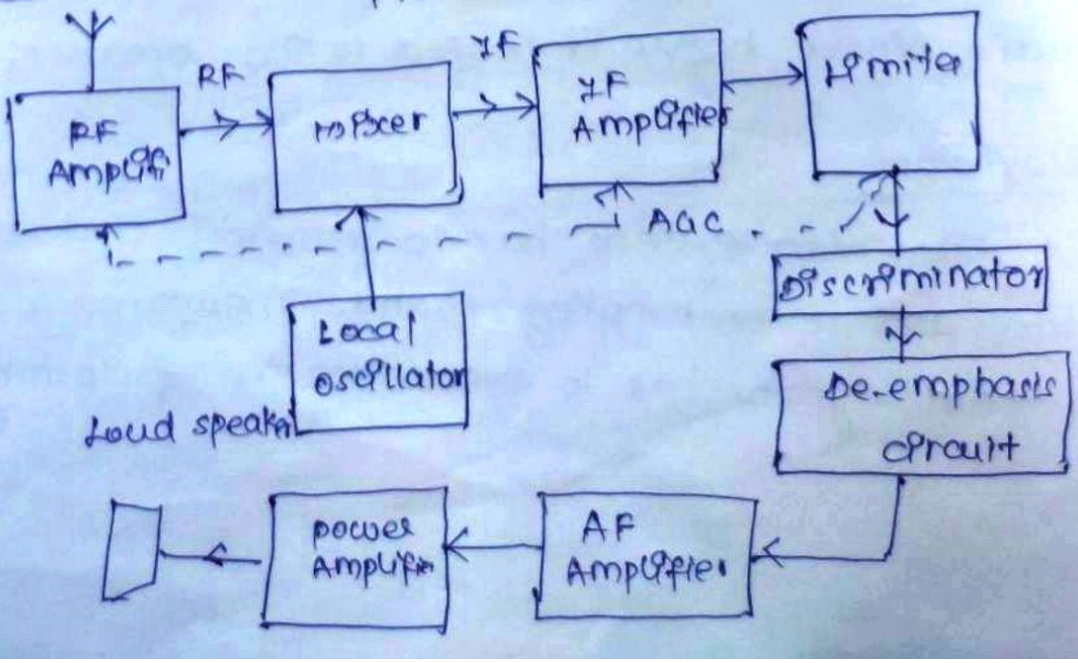
The IF Amplifier output is sent to detector. The detector eliminates one of the sidebands. The RF is filtered to ground and audio signal fed to AF amplifier. then to power amplifier and finally to speaker.

FM Receiver:

Frequency modulated Receiver is also a superheterodyne receiver. However there are some important differences between AM and FM receiver s.

1) The operating frequency in FM is much higher than in AM
2) FM receiver uses limiter and de-emphasis circuit.
3) The method of demodulation in FM receiver is very different from that in AM Receiver.
4) AGC (automatic gain control) methodology in FM receiver is different from that in AM receiver.

FM Radio Receive



The RF amplifier gets the RF signal from antenna. Besides strengthening the signal it also reduces the noise and matches input impedance of receiver to that of ~~mate~~ antenna for maximum power extraction from antenna.

The local oscillator generates a frequency to which is mixed with RF in the mixer to generate I.F. The IF signal is amplified by IF amplifier. The function of limiter is to limit the amplitude changes in the output of IF amplifier.

The discriminator converts IF signal to AF sig It has been found that if higher frequencies in audio signal are boosted at the transmitted and correspondingly cut at receiver, the signal to noise ratio is improved. Thus the de-emphasis circuit cuts the boost given to the higher audio frequencies to restore the audio signal to original form. The AF amplifier and power amplifier strengthen the audio signal before it is fed to the speaker.

Television:

A television system has to transmit and receive pictures and accompanying sound. Therefore a television system has to reproduce the following

shape and size of each object

2) brightness of each object and its contrast.

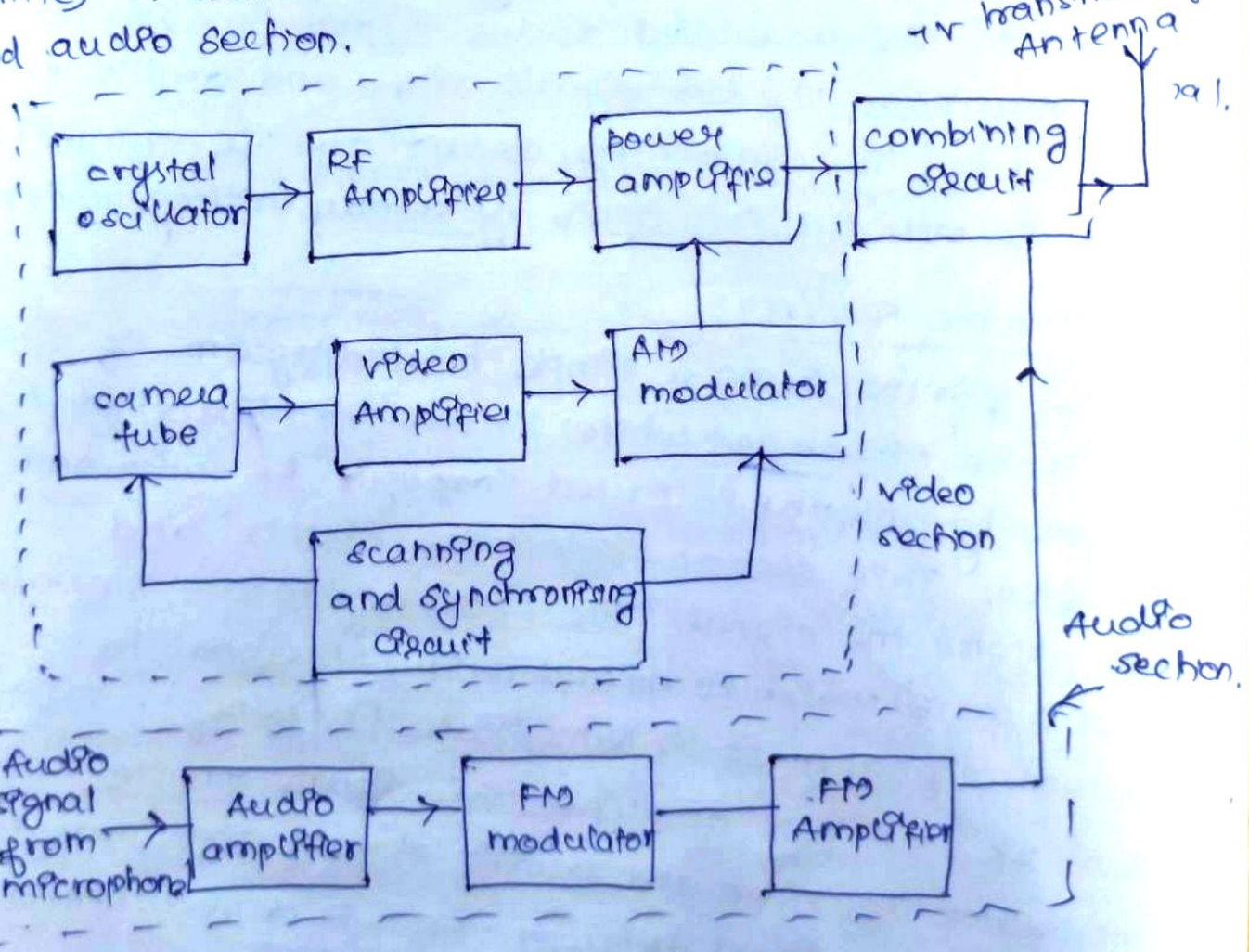
3) Motion of the objects.

4) Sound accompanying the object.

5) colour.

Monochrome Transmitter:

shows the block diagram of monochrome (black and white) TV transmitter. It has two sections, video and audio section.



The camera tube contain the circuitry for scanning deflection etc. The video signal produced by camera tube is amplified by video amplifier and then amplitude modulated. The crystal oscillator generates RF carrier wave and RF amplifier strengthen this wave The video signal is amplified by power amplifier.

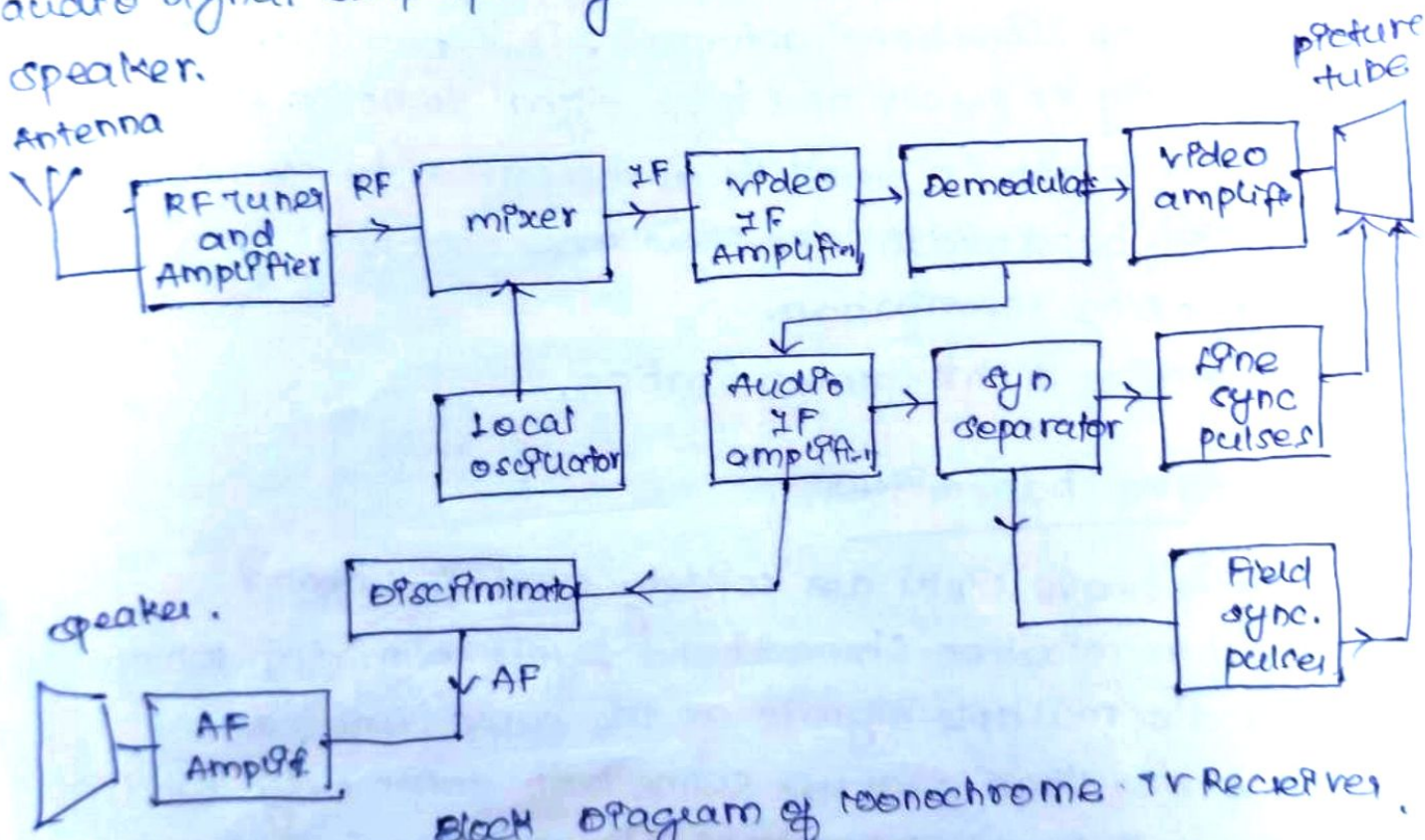
The audio signal from microphone is amplified by audio amplifier and frequency modulated by FM modulator. The modulated audio signal is strengthened by RF amplifier. The two signals video and audio are combined in the combining circuit and the complete signal is radiated into space by tv transmitting antenna.

Monochrome Receiver:

The figure shows a simple block diagram of monochrome (black and white) tv receiver. The signal captured by antenna is passed through RF tuner and amplifier. This section select the channel and strengthens the signal. The local oscillator generates a sine wave which is mixed with RF signal to produce signal at IF (intermediate frequency). The video IF amplifier amplifies this signal. In the demodulator the video and audio signals are separated and the video signal obtained through demodulation.

video signal is amplified in video amplifier section and sent to picture tube.

The audio signal is amplified in Audio IF amplifier. Frequency demodulation takes place in discriminator and audio signal amplified by AF amplifier and sent to speaker.



Block Diagram of monochrome TV Receiver.

It is necessary to synchronise the scanning process at receiver with that at transmitter. The syn. separator separates the synchronising pulses and sends them to line and field sync. pulses section. The output of this section goes to picture tube for synchronisation.

Microwave:

Microwave means waves having frequency in the range of 3GHz to 30 GHz and thus the wavelength is in the range of 10cm to 1cm. Microwave communication has the following special features.

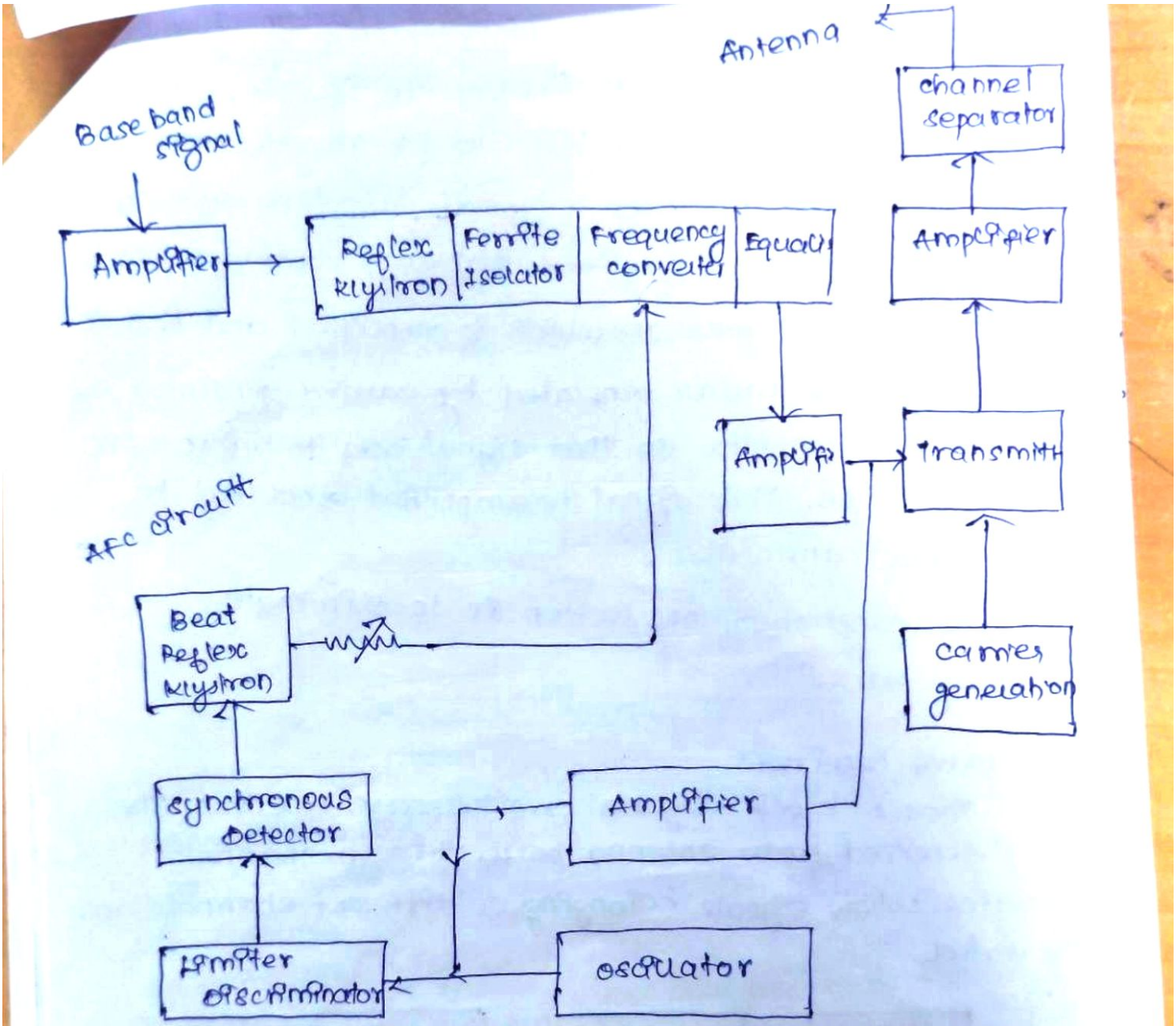
1) use of directional antennas. This feature results in saving in power and high signal to noise ratio.
2) Wavelength is small as compared to size of antenna.
3) High bandwidth and thus more channels for sending information.
4) Line of sight communication.

Microwave transmitter:

Microwave units are widely used for broad band communication (broadband refers to media which can handle multiple signals at the same time. It is much faster than dial up connection commonly used in homes for Internet connection). Propagation is through space waves and limited to line of sight distances.

Repeater stations are spaced about 50 km apart are necessary.

Telephone, data, TV and other signals are combined to give baseband signal. Frequency division multiplexing is used to combine these signals.



Block diagram of microwave transmitter.

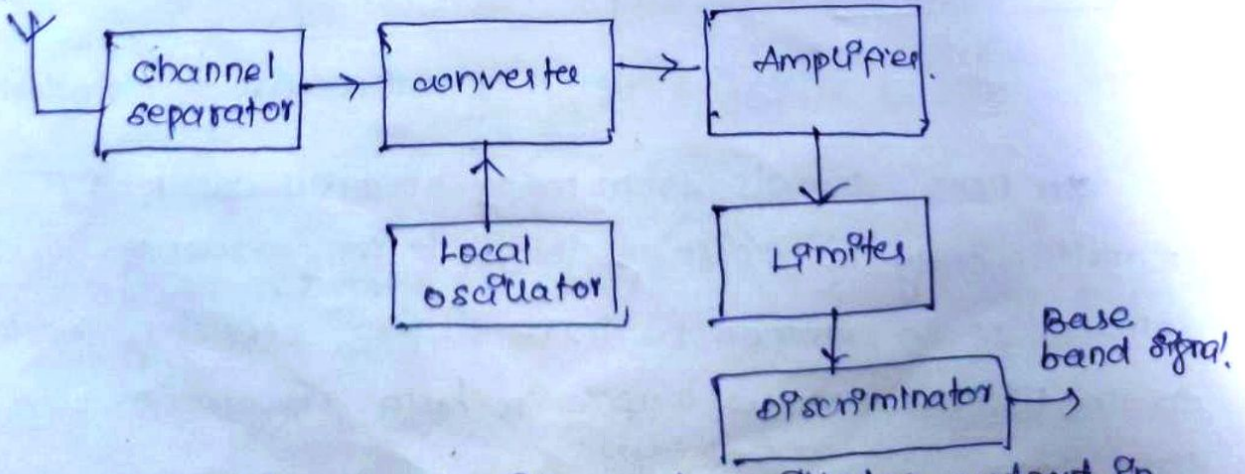
In FDM signals from many channels can be sent simultaneously by shifting them in frequency domain. It is common to have duplex operating mode so that simultaneous traffic in both directions can take place.

The baseband signal is amplified. Reflex klystron causes frequency deviation. The ferrite isolator allows the signals to go forward but not in reverse direction. The beat klystron produces a typical 6100 MHz and the two signals are mixed in ~~diode~~ frequency converter. This mixing produces 70MHz IF which is amplified and fed to transmitter. The carrier generated by carrier generator is also fed to transmitter so that signal goes to microwave frequency range. This signal is amplified and fed to antenna for transmission.

The function of AFC section is to eliminate frequency error.

Microwave Receiver:

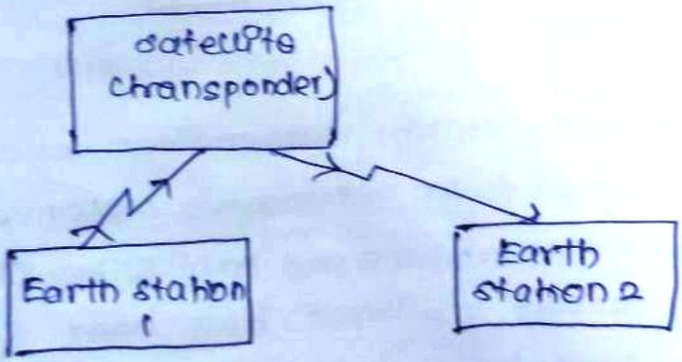
Shows block diagram of microwave receiver. The signal received from antenna pass through channel separator where signals belonging to different channels are separated.



The signal is mixed with Local oscillator output in convertor, and IF signal goes to amplifier. It is amplitude limited in limiter and fed to discriminator to give base band signal.

Satellite communication:

A satellite is a radio repeater, also called transponder placed in the sky. A satellite system consists of a transponder and a minimum of two earth stations one for transmission and another for reception. The transponder receives the signal from the transmitting earth station, frequency converts amplifies and retransmits the signal towards the receiving earth station.



satellite system:

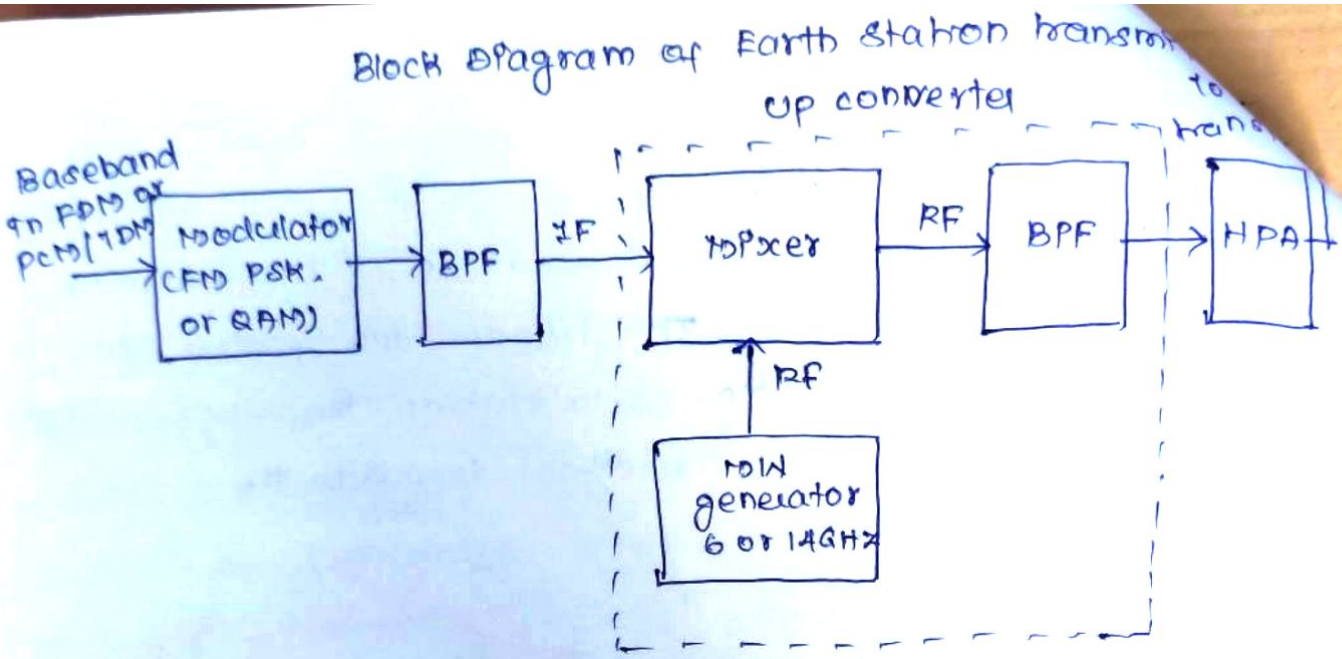
A satellite system consists of three basic sections
uplink (transmitting earth station)
the satellite transponder
downlink (receiving earth station)

Typical frequencies for telecommunication services in a satellite system are 6/4 GHz and 14/12 GHz, where 6 GHz and 14 GHz represent uplink frequencies and 4 GHz and 12 GHz the downlink frequencies.

uplink model:

The primary component of the uplink section of a satellite system is the earth station transmitter.

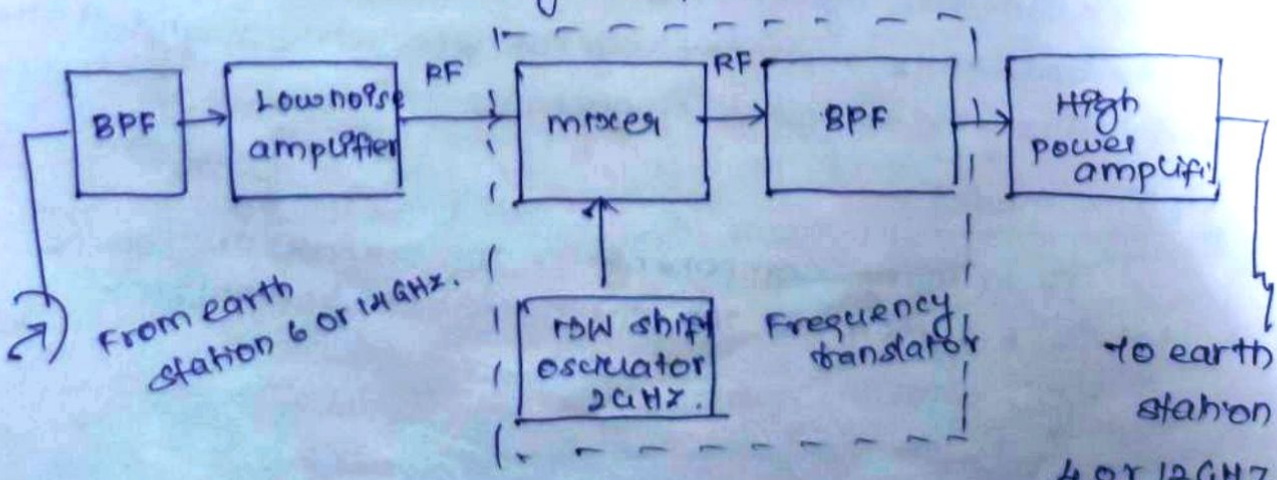
Block Diagram of Earth station transm



A typical earth station transmitter consists of an IF modulator, an IF to RF microwave upconverter, a high power amplifier (HPA) and a band pass filter (BPF). The IF modulator convert the input base band signals to either an FM or a PSK modulated Intermediate Frequency.

The upconverter translates the IF to an appropriate RF carrier frequency. The HPA provide adequate output power to propagate the signal to the satellite transponder. Most widely used HPA's and klystrons and travelling wave tube Amplifiers (TWTAs)

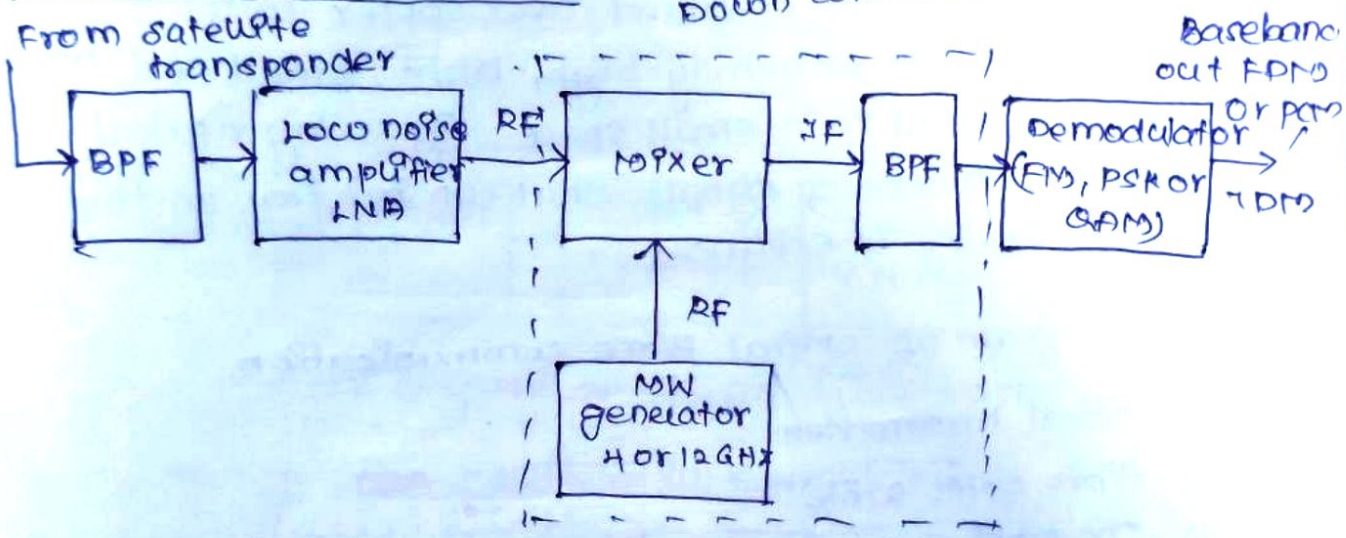
Block Diagram of satellite transponder.



The Transponder:

A satellite transponder shown in fig consists of a Band pass filter, an input low noise amplifier (LNA), a frequency translator and a high power amplifier. The transponder is an RF to RF Repeater.

Satellite Downlink Model:



Block Diagram of Earth station Receiver.

An earth station receiver includes an input BPF an LNA and an RF to IF Down converter. The input BPF restricts the input noise power to the LNA. The LNA normally used is a tunnel diode amplifier or a parametric amplifier. The RF to IF down converter is a mixer BPF combination which converts the Received RF signal to an IF Frequency.

In a satellite system where three or more earth stations wish to communicate with each other, any of the three methods of multiple accessing called Frequency Division Multiple Access (FDMA), Time Division multiple Access (TDMA) and code Division Multiple Access are required.

optical fibre communication.

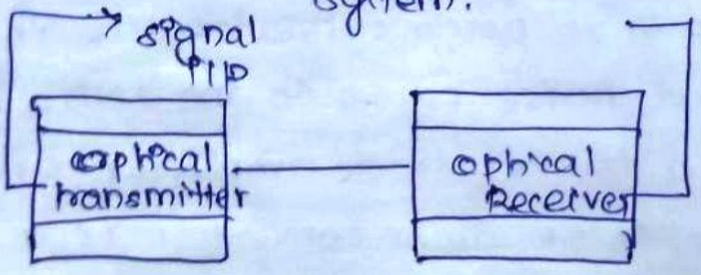
1) Fibre optics deal with the transmission of light through fibres of glass, plastic or other transparent materials and works on the principle of total internal Reflection.

2) optical fibres are preferred over copper wires because they are extremely ~~high~~, light, small and can be accomodated in a small space. By using optical fibres, the number of signals, that can be transmitted simultaneously is enhanced.

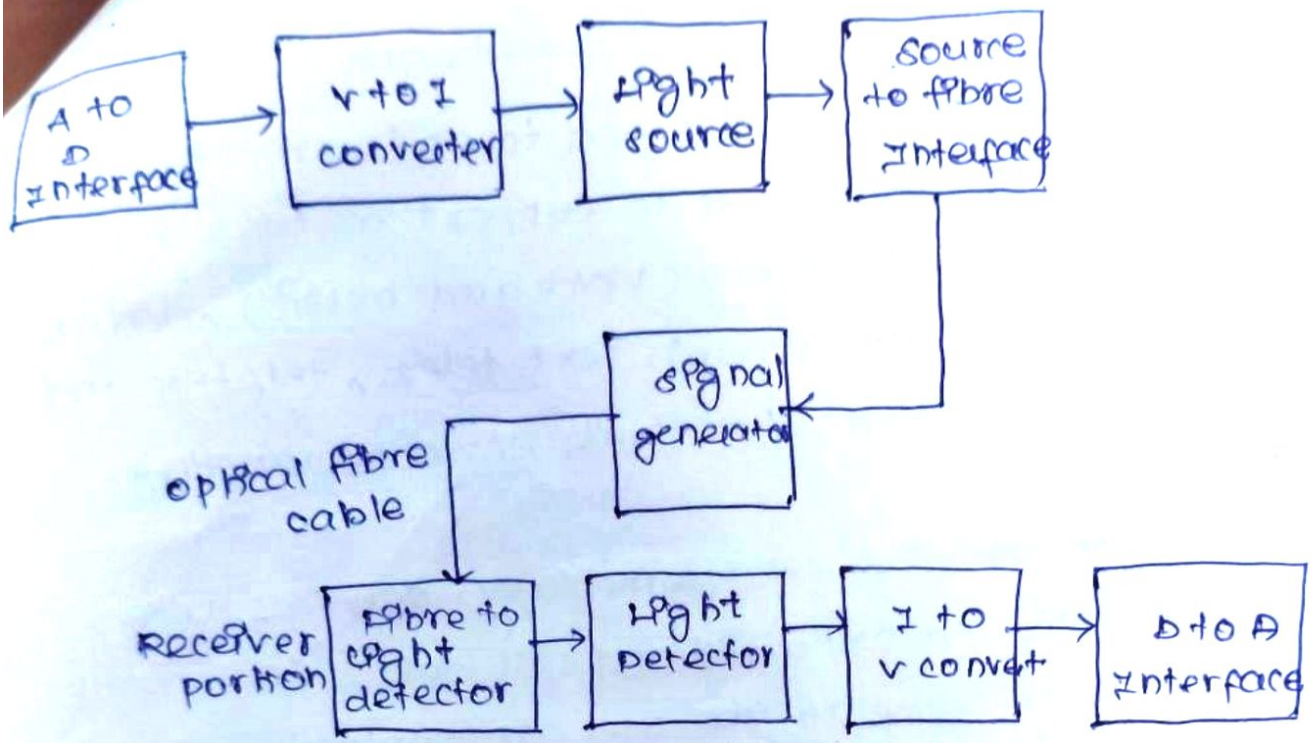
Block diagram of optical fibre communication,

1) optical transmitter
2) fibre optic cable
3) the optical receiver.

Basic fibre optic communication system.



The transmitter converts an electrical analog or digital signal into a corresponding optical signal. The source of optical signal can be either a Light Emitting Diode or a laser diode. The block diagram of optical fibre communication is given



Block Diagram of optical Fibre communication.

The transmission medium in optical fibre communication system is an optical fibre cable. It is very thin and flexible medium that guides light from an optical transmitter to an optical receiver. The cable consists of one or more glass fibres, which acts as waveguides for the optical signal.

The receiver converts optical signals back into a replica of the original electrical signal. The detector of the optical signal is either a PIN type photodiode or avalanche type photodiode.

ISDN

Integeated services digital Network (ISDN)

A network that provides end to end digital connectivity between users to support a wide range of services including telephony (voice and music), data (telemetry, Email and alarm), text telex, teletex and videotex) and image (Fascimile, TV conferencing, videophone).

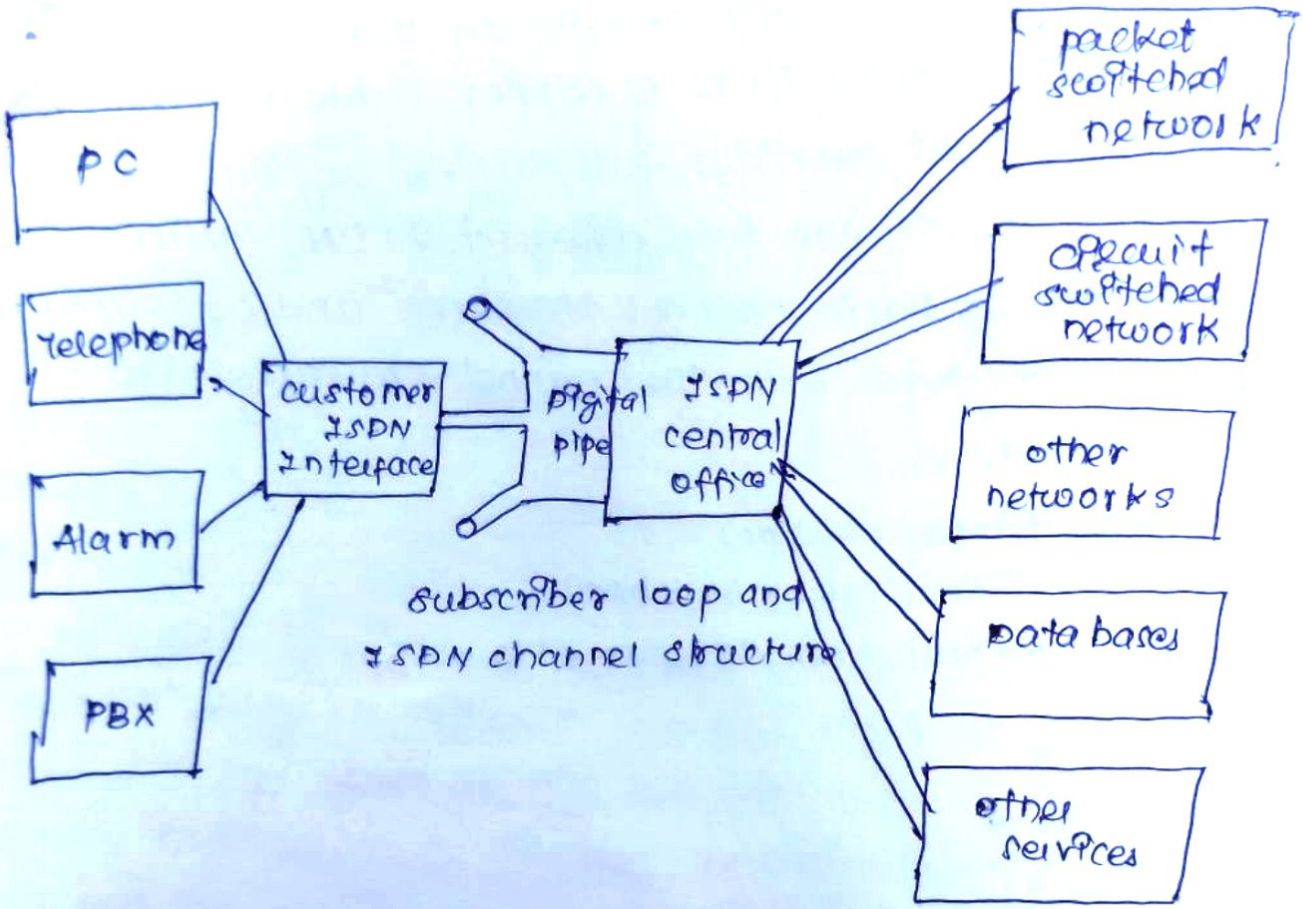
It also provides supplementary services like direct dialing in, call wait and call Hold. In direct dialing office In, the user can contact a person directly in an office by dialing the extension number without the operator's intervention when the called person is connected to private Branch Exchange.

Evolution of ISDN.

1) Digital transmission
2) Digital switching

Architecture of ISDN:

Figure shows the basic block diagram of ISDN architecture. It consists of common physical interface ISDN central office, digital subscriber Loop, ISDN channels and integeated digital network that are explained as follows.



subscriber loop and ISDN channel structure

Common physical Interface : In an ISDN, all devices such as digital telephone, Alarm, computer terminal, videotex, Facsimile, PBX and even a Local Area Network can be connected to the transmission line using the common physical interface.

central office : It connects the numerous ISDN subscriber loop signals to the Integrated digital network (IDN). It provides subscribers the access to circuit switched networks, packet switched networks, databases and other services.

digital subscriber loop and ISDN channels :

The digital subscriber loop is the connection between common physical Interface

and the ISDN central office. In ISDN, this is one or two twisted pairs of copper cable or a fibre optic link that provides full duplex digital transmission. It has two different ISDN channel structures i) Basic channel structure and ii) primary channel structure, Both the channel structures are constructed.

i) B-channel (64kbps)
ii) D-channel (16 or 64 kbps)
iii) H-channel (384, 1536 and 1920 kbps)