19. By using the transformation $x+y=u$, $y=uv$ show that $\int_0^1 \int_0^{1-x} \frac{x}{\sqrt{1-x-y}}$

Analog Communication

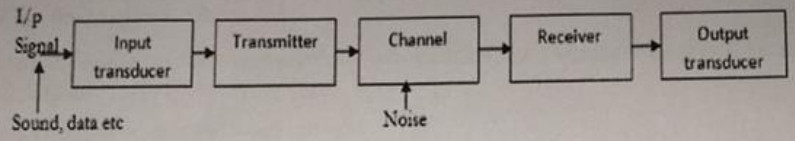


Fig: Basic analog communication system

The elements of basic analog communication system are input signal or information, input transducer, transmitter, channel, Noise, Receiver, Output transducer.

Information or Input signal: The information is transmitted from one place to another.

This information can be in the form of a sound signal like speech, or it can be in the form of pictures or it can be in the form of data information.

Input transducer: The information in the form of sound, picture or data signals cannot be transmitted as it is.

First it has to be converted into a suitable electrical signal.

The input transducer block does this job.

The input transducer commonly used are microphones, TV etc.

Transmitter: The function of the transmitter is to convert the electrical equivalent of the information to a suitable form so that it can transfer over long distance.

Basic block in transmitter are: Amplifier,Oscillator,Mixer.

Channel: The communication channel is the medium used for transmission of electrical signal from one place to other.

The communication medium can be conducting wires, cables, optical fibres or free space.

Depending on the type of communication medium, two types of communication system exists.

Line communication: The line communication systems use the communication medium like the simple wires or cables or optical fibres. Eg: Telephone, Cable TV.

Radio communication: The radio communication systems use the free space as their communication medium. The transmitted signal is in the form of electromagnetic waves. E.g. Mobile communication, satellite communication.

Noise: Noise is an unwanted electrical signal which gets added to the transmitted signal when it is travelling towards the receiver.

Due to noise quality of information gets degrade.

Once added the noise cannot be separated out from the information

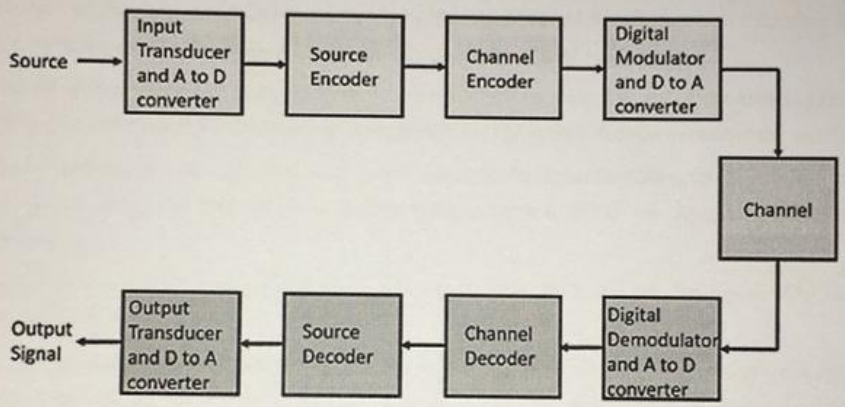
Receiver: The receiver always converts the modulated signal into original signal which consist of Amplifier, Oscillator, Mixer.

Output transducer: Output transducer converts electrical signal into the original form i.e. sound or TV pictures etc.

E.g. Loudspeaker, data and image convertor.

Digital communication

The elements which form a digital communication system is represented by the following block diagram for the ease of understanding.



Basic Elements of a Digital Communication System

Following are the sections of the digital communication system.

Source: The source can be an **analog** signal. **Example**: A Sound signal

Input Transducer: This is a transducer which takes a physical input and converts it to an electrical signal (**Example**: microphone). This block also consists of an **analog to digital** converter where a digital signal is needed for further processes.

A digital signal is generally represented by a binary sequence.

Source Encoder: The source encoder compresses the data into minimum number of bits. This process helps in effective utilization of the bandwidth. It removes the redundant bits (unnecessary excess bits, i.e., zeroes).

Channel Encoder: The channel encoder, does the coding for error correction. During the transmission of the signal, due to the noise in the channel, the signal may get altered and hence to avoid this, the channel encoder adds some redundant bits to the transmitted data. These are the error correcting bits.

Digital Modulator: The signal to be transmitted is modulated here by a carrier. The signal is also converted to analog from the digital sequence, in order to make it travel through the channel or medium.

Channel: The channel or a medium, allows the analog signal to transmit from the transmitter end to the receiver end.

Digital Demodulator: This is the first step at the receiver end. The received signal is demodulated as well as converted again from analog to digital. The signal gets reconstructed here.

Channel Decoder: The channel decoder, after detecting the sequence, does some error corrections. The distortions which might occur during the transmission, are corrected by adding some redundant bits. This addition of bits helps in the complete recovery of the original signal.

Source Decoder: The resultant signal is once again digitized by sampling and quantizing so that the pure digital output is obtained without the loss of information. The source decoder recreates the source output.

Output Transducer: This is the last block which converts the signal into the original physical form, which was at the input of the transmitter. It converts the electrical signal into physical output (**Example**: loud speaker).

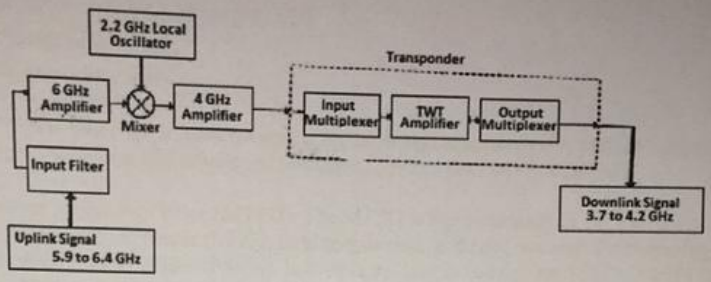
Output Signal: This is the output which is produced after the whole process. **Example** – The sound signal received.

This unit has dealt with the introduction, the digitization of signals, the advantages and the elements of digital communications. In the coming chapters, we will learn about the concepts of Digital communications, in detail.

Digital system is not immune to noise but the effect can be reduced. The main advantage of digital system is the use of multiplexing and switching. Time division multiplexing is used to multiplex different signals together on the same channel the bottleneck of this system is the complexity of the system and larger bandwidth requirement.

Satellite Communication

Satellite is a powerful long distance and point to multipoint communication system. A satellite is a radio frequency repeater. The disadvantages offered by the line of sight communications overcome by the satellite communication. The function of satellite is to communicate between different earth stations over thousands of kilometers.



The signal path from the earth station transmitter to the satellite receiver is called the Uplink, and the path from the satellite to the earth is known as the downlink. Usually Geosynchronous orbit is chosen to place the satellite. This obit is such that occupies a circular orbit above the equator at a distance of 35 thousand kilometer above earth surface. The satellite period in this orbit is same as that of earth rotational period. If the satellite is rotating in the same direction as that of earth's rotation, the satellite will appear as almost stagnant with respect to earth surface hence these satellites are called as Geostationary satellites and the orbit is termed as geostationary orbits.

Signals obtained from satellites are at different frequencies. These signals are amplified and then moved to another frequency for transmission by an equipment called Transponder. Two way communications is established with the help of Transponder. Satellites equipped with two transponders are capable of TV signals and 240 telephone lines. These transmitting and receiving signal frequencies are widely separated to avoid interferences.

Designs of the earth stations depend on whether they are used for sending the signals to satellite or used for receiving the signals from them. The design also varies on types signals (TV, data…) communicated between them. There satellites which are capable of covering nearly half of the earth surface like Intelsat and there ones which employ spot beam capable of covering small are like a country. The earth station consists of dish antenna capable of transmitting at high frequency. These antennas have high directivity and gain.

Satellite can also be placed in Low and medium earth orbits to avoid the use of high gain antennas and high powered transmitters. But they are accompanied with fare share disadvantages like i) they are not stagnant with respect to earth station, ii) they tend to disappear below the horizon, iii) Doppler effect.

Principle of operation of Mobile phone

Traditional mobile service was structured in a fashion similar to television broadcasting: One very powerful transmitter located at the highest spot in an area would broadcast in a radius of up to 50 kilometers. The cellular concept structured the mobile telephone network in a different way. Instead of using one powerful transmitter, many low-power transmitters were placed throughout a coverage area.

The cellular communications system consists of the following four major components that work together to provide mobile service to subscribers.

- public switched telephone network (PSTN)

Links cellular network with other networks like PSTN through fiber networks, microwave or copper cable.

HLR (Home location register): database maintained by the service provider containing the data about each subscriber (like location, activity status, call forwarding preferences)

VLR (Visitor location register): data base that store temporary data about a subscriber
It is kept in the MSC of the area that the subscriber is located in
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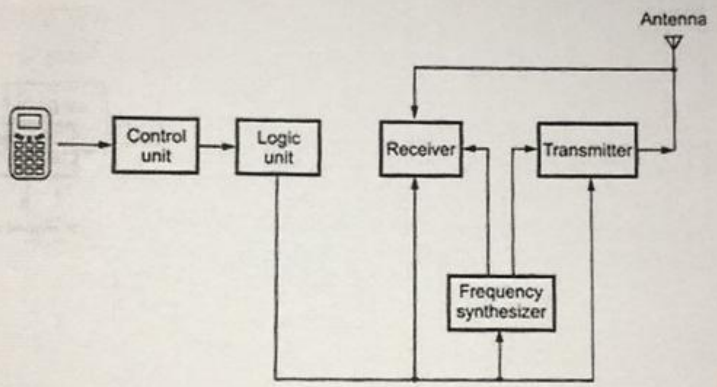
Cellular telephone unit



The diagram shows a cellular mobile unit. It consists of transmitters, receivers, synthesizer, logic unit and control unit. The mobile unit contains built-in rechargeable batteries to Provide operating power. The transmitter and receiver in the unit share the common antenna.

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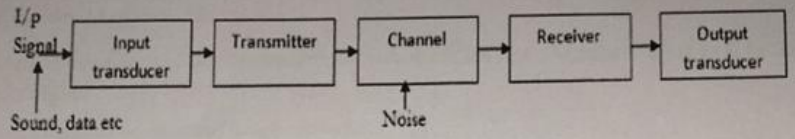

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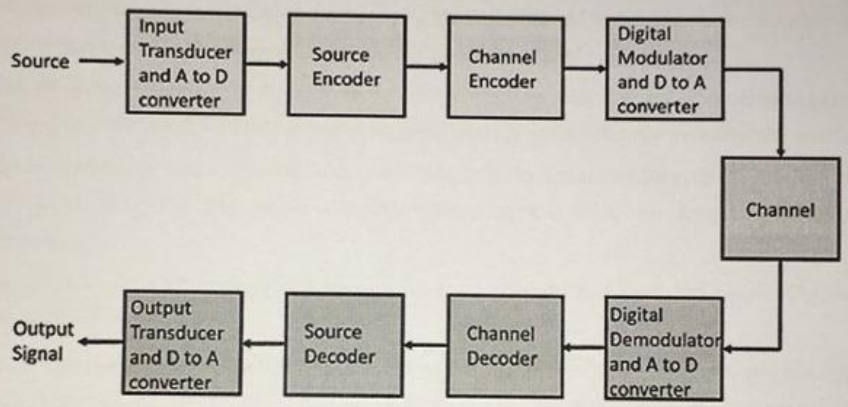

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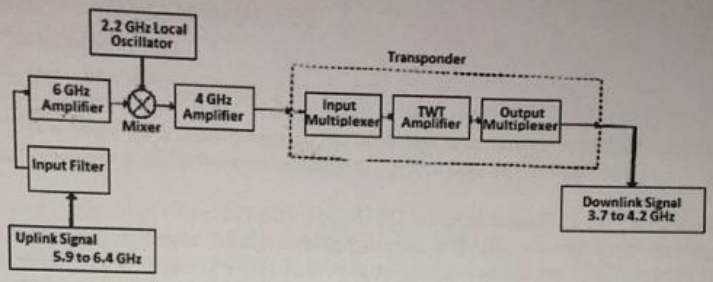

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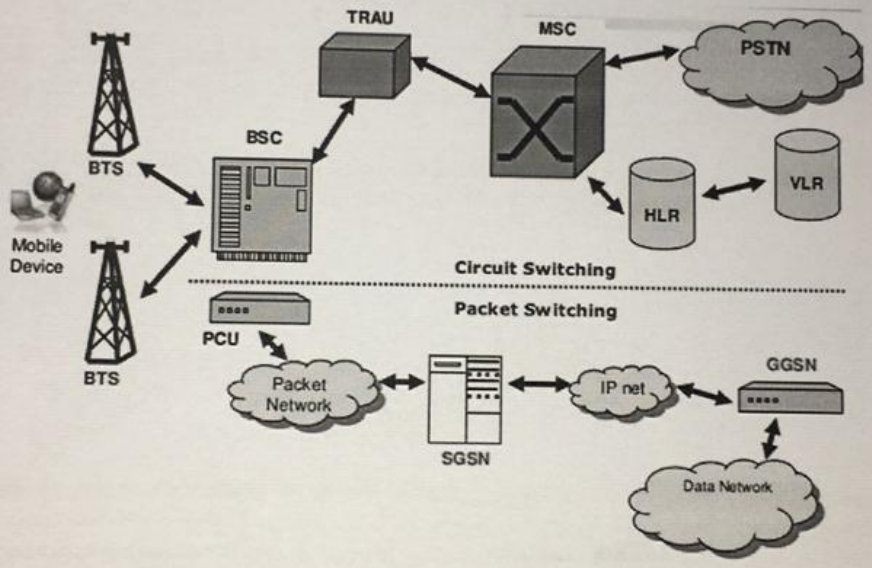
- public switched telephone network (PSTN)

- mobile telephone switching office (MTSO)
- cell site with antenna system
- mobile subscriber unit (MSU)

PSTN: The PSTN is made up of local networks, the exchange area networks, and the long-haul network that interconnect telephones and other communication devices on a worldwide basis.

Mobile Telephone Switching Office (MTSO): The MTSO is the central office for mobile switching. It houses the mobile switching center (MSC), field monitoring, and relay stations for switching calls from cell sites to wireline central offices (PSTN). In analog cellular networks, the MSC controls the system operation. The MSC controls calls, tracks billing information, and locates cellular subscribers.

The Cell Site: The term cell site is used to refer to the physical location of radio equipment that provides coverage within a cell. A list of hardware located at a cell site includes power sources, interface equipment, radio frequency transmitters and receivers, and antenna systems.



BTS (Base Transceiver Station): main component of a cell and it connects the subscriber to the cellular network. For transmission and reception of information it uses several antennas.

BSC (Base Station Controller): it is an interface between BTSs and it is linked to BTS by cable or microwave links.
It routes calls between BTSs
It is also connected to MSC

MSC (Mobile Switching Center): It coordinates all the activities in a cellular network as it is connected to several BSCs
It routes calls between BSCs

Links cellular network with other networks like PSTN through fiber networks, microwave or copper cable.

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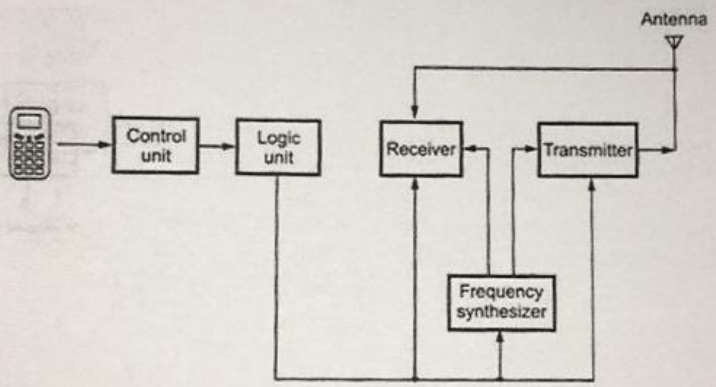

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