Radio Wave: An electromagnetic wave of a frequency between about ~~10^{9} and 10^{11} or 10^{12}~~ 2.5KHz to 300GHz Hz, as used for long-distance communication.

Broadcasting: Broadcast - message that is transmitted by radio or television, or the term broadcasting means the transmission of audio or video content using radio-frequency waves. With the recent advancements in digital technology, radio broadcasting now applies to many different types of content distribution.

Broadcasting by radio takes several forms. These include AM and FM stations. There are several subtypes, namely commercial broadcasting, non-commercial educational (NCE) public broadcasting and non-profit varieties as well as community radio, student-run campus radio stations, and hospital radio stations can be found throughout the world. Many stations broadcast on short wave bands using AM technology that can be received over thousands of miles (especially at night). These broadcasts are very sensitive to atmospheric conditions and solar activity.

Radio station

Radio station for the production and transmission of AM or FM radio broadcasts

broadcasting station - a station equipped to broadcast radio or television programs

broadcasting studio - a studio where broadcasts originate.

Analog Radio

Analog radio consists of two main types: ***AM (amplitude modulation) and FM (frequency modulation)***. Analog radio station frequently feeds only one transmitter and referred to as an AM station or an FM station. But it is quite possible for a station to feed both transmitters in a similar area, or to feed more than one transmitter covering different areas. In either case, AM or FM refers only to a particular transmitter and not to the entire station.

AM radio uses the long-wave band in some nations. This long-wave band comes with frequencies that are fairly lower than the FM band, and having slightly different transmission features, better for broadcasting over long distances. Both AM and FM are in use to broadcast audio signals to home, car, and moveable receivers.

Digital Radio

Four standards for digital radio systems exist worldwide: IBOC (In-Band On-Channel), DAB (Digital Audio Broadcasting), ISDB-TSB (Integrated Services Digital Broadcasting-Terrestrial Sound Broadcasting), and DRM (Digital Radio Mondiale). All are different from each other in several respects.

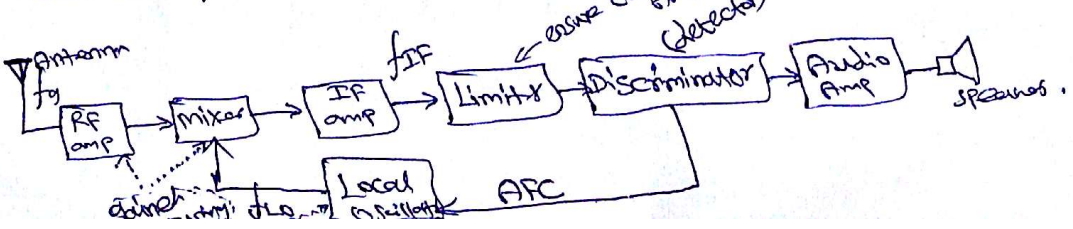
FM Broadcast:

FM refers to frequency modulation, and occurs on VHF air waves. Regular FM broadcasting began in 1939 but did not pose a significant threat to the AM broadcasting industry. It required purchase of a special receiver. The frequencies used, 42 to 50 MHz, were not those used today. The change to the current frequencies, 88 to 108 MHz, (everywhere except Japan and Russia, Japan uses the 76 to 90 MHz frequency band.) began after the end of World War II.

Unicast ⇒ from one source to one destination (one-to-one) ex: Telephone.

Broadcast ⇒ from one source to all possible destination (one-to-all) ex: Radio

Multicast ⇒ from one source to multiple destination (one-to-many) ex: Internet



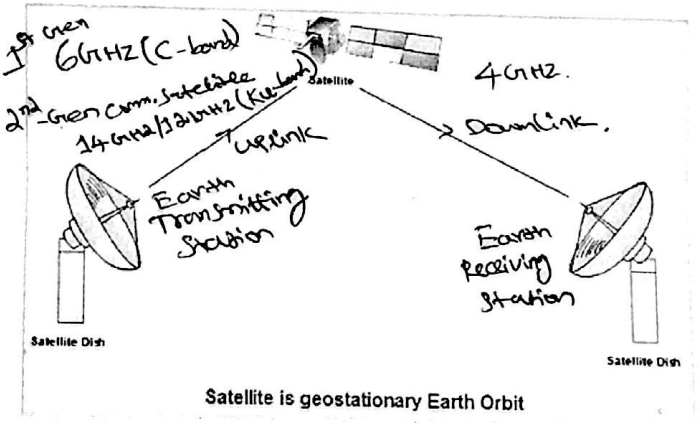
Bandwidth of 200 kHz is not needed to accommodate an audio signal — 20 kHz to 30 kHz is all that is necessary for a narrowband FM signal. The 200 kHz bandwidth allowed room for ±75 kHz signal deviation from the assigned frequency, plus guard bands to reduce or eliminate adjacent channel interference. The larger bandwidth allows for broadcasting a 15 kHz bandwidth audio signal plus a 38 kHz stereo "subcarrier"—a piggyback signal that rides on the main signal.

Satellite Communication:

Satellite radio, quite simply, is a non-terrestrial microwave transmission system utilizing a space relay station. Satellites have proved extending the reach of voice, data, and video communications around the globe and into the most remote regions of the world.

Introduction to Satellite Communication

Satellite is powerful long distance and point-to multipoint communication system. A communication satellite is an R.F (Radio Frequency) repeater. To overcome disadvantage of Line of sight communication which is only 45 - 55 km, the transmitting antenna is placed on the satellite and the satellite is placed in the orbit high above the earth. The function of satellite is to communicate between different earth stations around the earth, thus with the help of satellite, it is easy to communicate over thousands of km, a com-satellite is a combination of ROCKET to put the satellite in the orbit, micro wave electronic devices for the communication, solar cells are used to convert the solar energy into a power supply (ELECTRICAL ENERGY) for the electronic equipment.



Satellite is geostationary Earth Orbit

Satellites used in satellite communications are usually in geostationary orbit. Some of them are placed in highly elliptical orbits.

Satellite communications can provide global availability. It can not only land masses but also maritime areas as well. Large distances can thus be covered quiet easily.

One of the **main advantages** provided by satellite communication is the superior reliability unlike other forms of communication. It does not need terrestrial infrastructure for operation.

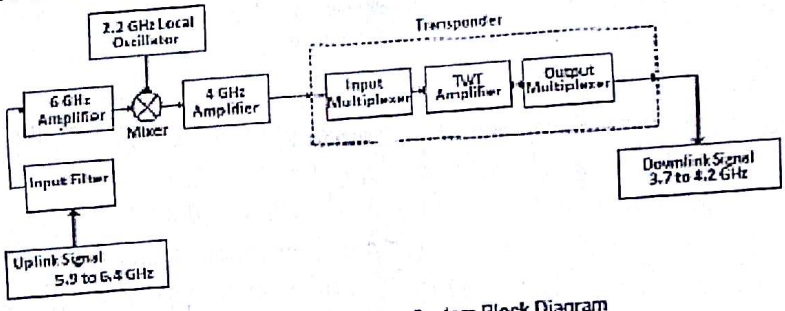
Satellite communication could provide superior performance as uniformity and speed are much more pronounced than other forms of communication.

Scalability is higher in case of satellite communications.

Deployment cost is higher than most forms of communications in case of satellite communications.
As it is less vulnerable than other forms of communication, it is highly used in defense departments.
Satellite communications also provide weather information.
It can be helpful during times of disasters as the services rarely fail.
High amount of data can be transmitted with the help of satellites.

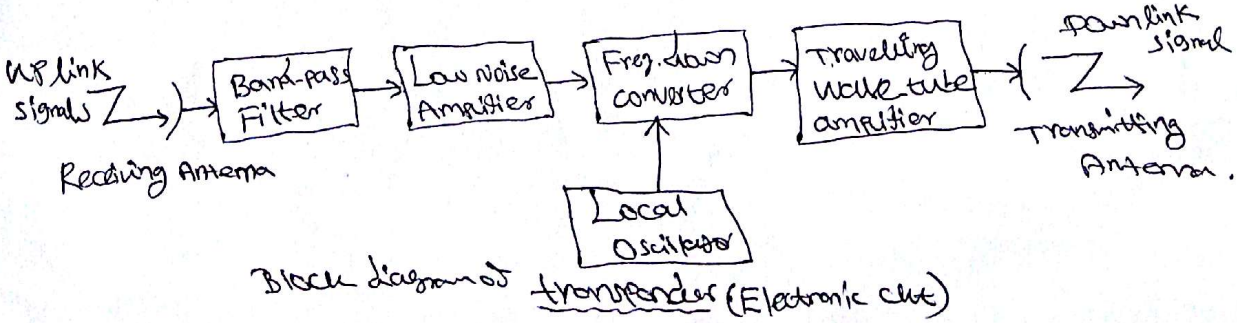
Geostationary Satellite

The satellites were placed in low earth orbit. as a result the satellite at a such high speed that it visible to the ground only for a short time at each day , the satellite appeared below the horizon and dies appear below the opposite horizon , the ground station was cut-off for long time in day , to maintain the communication link another station had to be activated , this problem was solved by placing the satellite in circular orbit of approximately 22300 miles or 35900 km radius, as the satellite height increases from the earth surface , the speed of satellite decreases by the same manner , at that height the angular velocity of satellite will be proportional to the angular velocity of earth , the satellite rotates with the same speed as that of the earth due to which the satellite will always be at the same place where it has been fixed , this type of satellite is called geostationary satellite.
The satellite placed in GEO- STATIONARY and placed at an altitude of 22300 miles or 35900 km above the ground level. The satellite travels at the same speed at which the earth rotates around the sun. The rotation of satellite is synchronized with earth rotation as a result satellite appears to be stationary in the sky w.r.t the earth station is constant. There are 3 satellites are placed at angle 120° in GEO-STATIONARY orbit, they provide 100% coverage from one earth station to anywhere on the earth, this concept



Satellite Communication System Block Diagram

In case of satellite communication two different frequencies are used as carrier frequencies to avoid interference between incoming and outgoing signals. These are:
Uplink frequency: It is the frequency used to transmit signal from earth station to satellite. The uplink signal can be made stronger to cope better with atmospheric distortion. The antenna at transmitting side is centered in a concave, reflective dish that serves to focus the radio beam, with maximum effect, on the receiving satellite antenna. The receiving antenna, similarly, is



Block diagram of transponder (Electronic ckt)

centered in a concave metal dish, which serves to collect the maximum amount of incoming signal.

Downlink frequency: It is the frequency used to transmit the signal from satellite to earth station. In other words, the downlink transmission is focused on a particular footprint, or area of coverage. The lower frequency, used for the downlink; can better penetrate the earth's atmosphere and electromagnetic field, which can act to bend the incoming signal much as light bends when entering a pool of water.

Broadcast: The wide footprint of a satellite radio system allows a signal to be broadcast over a wide range Thereby; any number (theoretically an infinite number) of terrestrial antennae can receive the signal, more or less simultaneously. In this manner, satellites can serve a point-to-multipoint network requirement through a single uplink station and multiple downlink stations,

Communication satellite comprises of a transponder, antenna, communication payload, switching systems, command, and control system.

Merits

1. No tracking is required by Geostationary Satel.ites.
2. Multiple access points are available in Satellite communication.
3. 24 hour communication can be achieved with the help of satellite.
4. The signal quality of Satellite communication is higher.
5. To put more information on the carrier a broad band can be used.
6. Satellite Communication is used for long distance communication or across oceans.
7. Low transmitting Power and low receiver sensitivity is required by the Satellite in close elliptical orbits.

Demerits

1. The transmitter and receiver used in satellite communication requires high power, most sensitive transmitters and large diameter antenna's.
2. Satellite communication is disturbed by solar activities and cyclones in the space.
3. Due to ageing effect the efficiency of Satellite components decreases.
4. The longer propagation times (APPOX, 300 ms) is one of a disadvantage of satellite communication.
5. The cost for Initial design and launching of the satellite in the orbit results in extremely high.

Telephone System: A phone system comprises multiple telephones used in an interconnected fashion that allows for advanced telephony features such as call handling and transferring, conference calling, call metering and accounting, private and shared voice message boxes, and so on.

Mobile Telephony

Introduction- As we look around, in markets, on trains and buses, people crossing streets, we can see many individuals talking on cell phones or mobile phones. Mobile phones have changed the way we live and communicate. With advancement of technology, look and utility of mobile phone has also undergone change.

In latest mobile phones, along with making and receiving phone calls one can also:

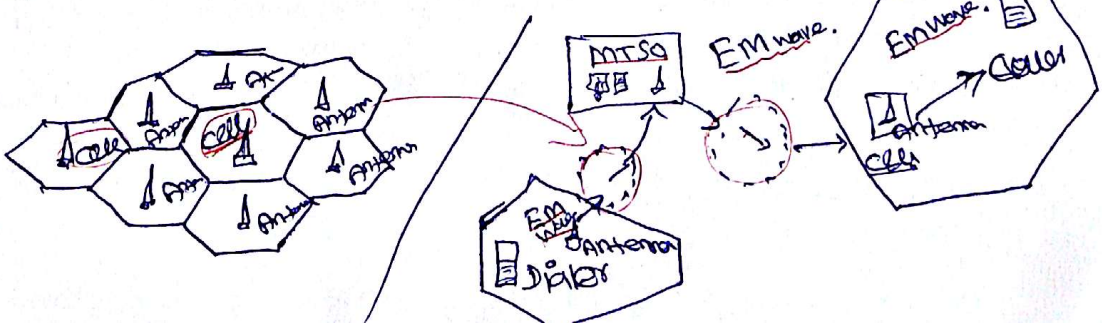
- Store contact information
- Make task or to-do lists
- Keep track of appointments and set reminders
- Use the built-in calculator for simple math
- Send or receive e-mail
- Get information (news, entertainment, stock quotes) from the Internet
- Play games
- Listen radio/music and watch TV
- Send text messages
- Take photos and videos etc.

In a way, today's mobile phone is a handy computer equipped with Internet. In ordinary landline phones, phone instruments are connected to a telephone exchange through electric wires, which in turn connect our phone calls to the other phones. However, wire connections limit the mobility of a landline phone. Mobile phone technology has successfully overcome this limitation. Mobile phone is a low power operated device (transmitter), which can wirelessly send and receive radio frequency signals. Before this, walkie-talkie was also a wireless system of communication. You must have seen a policeman talking on his wireless set. After completing one sentence, he says "Over" and then listens. This was because the same radio frequency is used for both sending and receiving the audio signal. However, in a mobile phone, the outgoing and incoming signals use different frequencies, so the two individuals can talk and listen at the same time.

Working principle of Mobile phone

In a mobile phone, it is possible to talk while moving. This becomes possible because of a cellular radio network technology (a replacement of telephone exchange system). Under a cellular radio network a given physical area is divided into smaller parts call cells (or cell zones). To completely cover a given area use of hexagonal cells is a best possible way as shown in the figure.

In every hexagonal cell a radio antenna is installed to receive and send radio signals to and from mobile phones physically present within the cell. All cell antennas present within an area are connected to each other through a network (the way computers are connected in internet). All network related works including handling of all the incoming and outgoing calls are managed by a central control room called Mobile Telephone Switching Office (MTSO). i.e. MTSO is basically a telephone exchange for mobile phone calls. Every cell antenna has a working range of minimum 1.5 to 2 km and maximum up to 48 to 56 or more km area around it. When a mobile



phone is switched on, MTSO records its location by identifying the cell in which it is present. When a mobile phone user moves from one cell zone to another cell zone, MTSO of its own switches mobile phone link to new cell antenna. This way, user gets an uninterrupted link to talk while on move. Also, mobile phones use high frequency radio waves for conversation. Audio signals of these waves are better. As mobile phones works on cell division of physical areas they are also referred as cell phones.

Scientific process of a mobile phone call

When we dial a mobile number from your mobile phone, an oscillator circuit (frequency generator) inside the mobile generates a particular frequency electromagnetic wave. This electromagnetic wave carrying called number's information is transmitted through antenna of your mobile to the antenna of the cell in which we are present. The cell antenna in turn transfers this signal to MTSO. The MTSO computer system identifies the location (cell) of the mobile phone you have dialed and connects you to that phone. The caller mobile on receiving your signal generates again through an oscillator circuit your ID (mobile number) and displays it. This whole process happens within a few seconds as all the signals are transferred through electromagnetic waves, which travel at the speed of light. Here, it is important to note that mobile phone call is transferred from dialer cell antenna to MTSO and MTSO to caller cell antenna only through cell antenna lying in between. That is why mobile phone network is also called terrestrial cellular network.

Mobile phone numbering system

Due to mobility of a mobile phone it is necessary to identify every mobile phone. For this, a SIM (Subscriber Identity Module) card in inserted in every mobile phone. SIM card is like an identity card of its user. It is a small IC (Integrated circuit) chip with a unique SIM number and a mobile phone number. A typical SIM card is shown in the figure. All SIM cards are issued by mobile operator companies and their information is provided to MTSO. After SIM verification, MTSO activates the mobile number of the user. This makes a mobile phone usable. Every mobile number in India is of 10 digits. All mobile numbers in India have the prefix 9,8 or 7. As per National Numbering Plan 2003, the way to split mobile numbers is as XXXX-NNNNNN where XXXX is Network operator digits and NNNNNN is\ the subscriber number digits. To regulate the use of mobile phones system in India a Telecom Regulatory Authority of India (TRAI) was established in 1997 by an act of Parliament.

Mobile network Generations (1G, 2G, 3G & 4G)

With increasing use of mobile phones and advancement of technology, it is pertinent to make the mobile phone networks more efficient. The efficiency of mobile networks is mentioned by word 'Generation' and abbreviation 'G'. 1G were first generation of mobile networks, which were based on analogue radio signals. 2G were narrow band digital signal based networks with good quality of calls.

They provided world over connectivity. 3G networks increased the data transfer speed for efficient use of Internet on mobile phone. 4G networks are going to provide a high-speed internet facility on mobile phones for surfing net, chatting, viewing television, listening music etc.