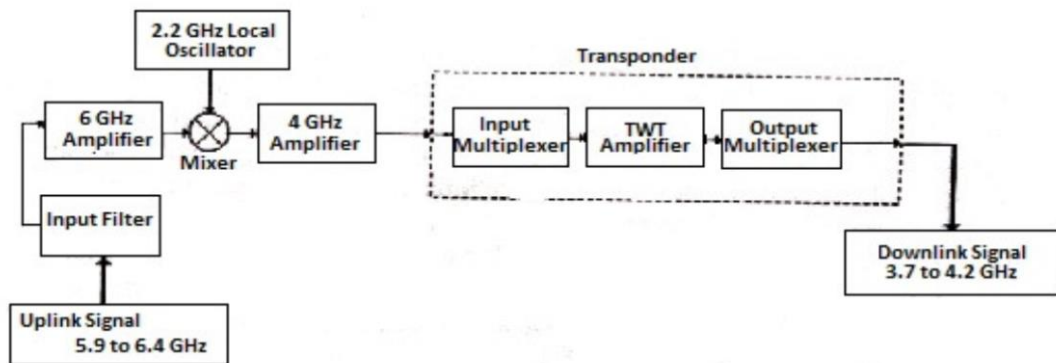
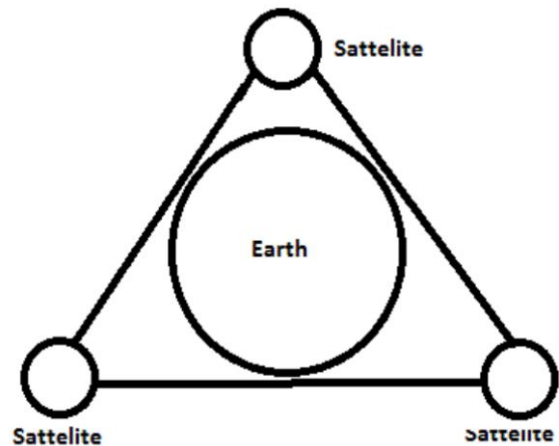


## Satellite Communication

Satellite is powerful long distance and point-to multi point 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.

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  $120^\circ$  in GEO-STATIONARY orbit, they provide 100% coverage from one earth station to anywhere on the earth, this concept is shown below

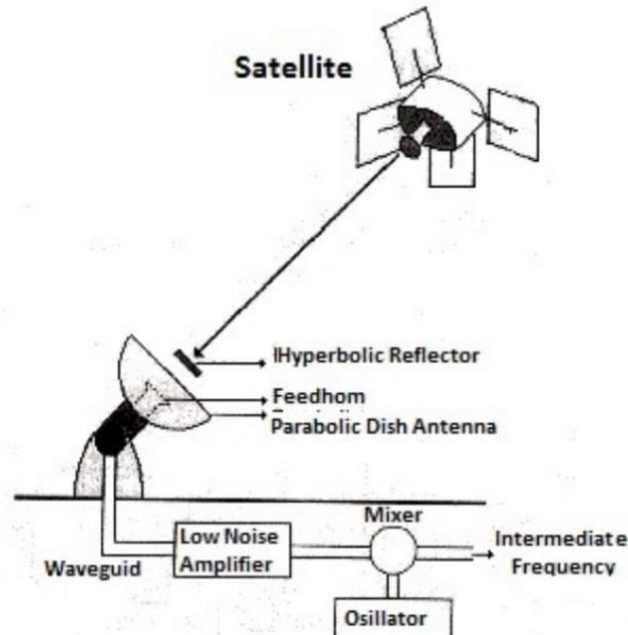


**Fig.33: Block Diagram of Satellite Communication System**

The uplink frequencies (5.9--6.4 GHz) are used for T/N from the earth station to the satellite and down link frequencies (3.7—4.2GHz).

The above frequencies are used for T/N from the satellite to the earth station , the uplink frequencies are converted to lower frequencies by the mixer and local Osc, the com satellite acts as a repeater station it receives the signal, amplifiers it and then transmitted over a next frequencies to avoid interference between the uplink signal and down link , the two way communication is established with the help of transponder , a com satellite has multi

transponder per satellite has increased over the year ,a satellite with 2 transponder can support a signal T.V channel or 240 telephone lines , a satellite with 48 transponder can accommodate 4000T.P CKTS and 2 T.V channels now-a-days in satellite using a digital tech , due to which One satellite can handle 120,000 T.P4 channels and more than 500 T.V channels.



**Fig.34: Satellite Communication Earth Station**

The equipment used in satellite earth station are shown in fig , the earth station consist of a dish antenna transmitter which can transmit a high frequencies (5.9—6.4GHZ) micro wave signals, some earth stations also called ground station , which can transmit and receive the signals while others can only receive signals.

A high directive and a high gain antenna is necessary at the earth station , because the losses over the long T/N path is very high , the signals power reaching back to the earth station from satellite

is very small . Therefore at receiving end a parabolic dish antenna with 61m diameter provides a high gain and thus amplify the signal power, it is important to have a low noise amplifier before the mixer stage in the receiver C, K, T at the satellite earth terminal.

## 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 geo stationary satellite.

### Telephone Link via Satellite

The satellite communication can be used for Telephone telecom. Around the world, the block diagram of such a system is shown in fig.31. The block diagram of earth station working with three satellites here, the national long distance Telephone network of a 4 countries (A,B,C,D,) through international switching centre are connected, consider country “A” the O/p of the Telephone exchange is applied to the MUX, the multiplexed signal is send to the micro-wave station and from there to the satellite earth station , at the earth station the signal is multiplexed and directly applied to the modulator stage of earth station where it demodulated with a high frequency signal and transmitted towards the satellite as uplink , in other case the earth station “A” receive three down link signal , the 3 carriers are demodulated and then transmitted toward the micro-wave station and from there international switching centre.

Many earth stations are designed to transmit several carriers from direct communication with other station through one satellite; the other wire (OW) facilities are transmitted for message carriers from the band of 300HZ----12KHZ,

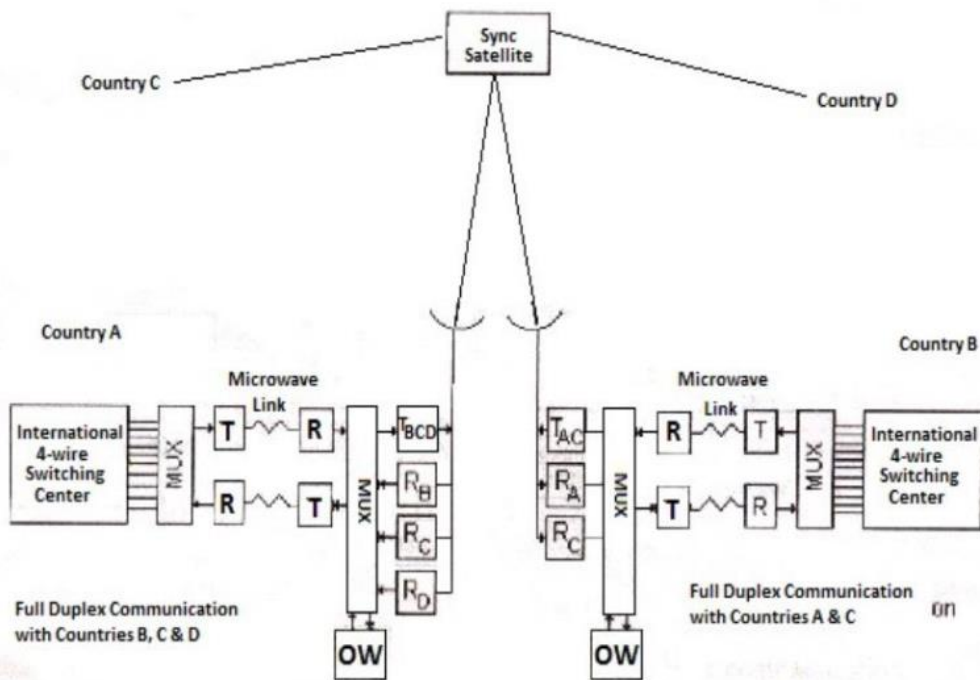


Fig.35: Satellite communication used for telecom

## Merits

1. No tracking is required by Geostationary Satellites.
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 require high power, most sensitive transmitters and large diameter antennas.
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, 300ms) 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.

## Numbering plans

The objective of numbering plan is to uniquely identify every subscriber connected to a telecommunication network. In early stages of development a numbering scheme was confined to a single local exchange, and exchanges were identified by the names of the towns in which they were located. This scheme works well as long as there is only one exchange per town. But as the subscriber volume grew, it became necessary to introduce more than one exchange in a town. Generally, a large centrally located exchange called the **main exchange** serving the main business center of the town, and a number of smaller exchanges known as **satellite exchanges** serving different residential localities were used to cope with the growing traffic in a large area. The area containing the complete network of the main exchange, and the satellite is known as **multiexchange area**. A common numbering scheme was then required for the area so that the digits dialed to identify a given terminating exchange do not vary with the exchange originating the call. For call originating from a location outside the multi-exchange area, there is a need to identify the area by a common code. The common numbering scheme is sometimes called as the **linked numbering scheme**. In this scheme, all exchanges in a town were collectively identified by the name of the town. The introduction of subscriber **trunk dialing (STD)** or **direct distance dialing (DDD)** for intercity and intertown long distance connection called for a national numbering plan, where multiexchange areas are identified uniquely by numbers. Subsequent development of **international subscriber dialing (ISD)** makes it necessary to have an international numbering plan and to have the national numbering plan conform to the international one. A numbering plan may be open, semi open, or closed. An **open numbering plan**, also known as **non-uniform numbering scheme**, permit wide variation in the number of digits to be used to identify a subscriber within a multiexchange area or within a country. This plan is used in countries equipped extensively with non-Director Strowger switching systems. In such cases, the numbering scheme is usually an exact image of the network structure and requires to be changed if the network structure changes.

A **semiopen plan** permits number lengths to differ by at most one or two digits. Today the scheme is the most common and is used in many countries including India, Sweden, Switzerland, and the United Kingdom. In **closed numbering plan** the **uniform numbering scheme**, the number of digits in a subscriber number is fixed. This scheme is used by a few countries which include France, Belgium and the countries in the North America(USA,Canada). An **international numbering plan** or **world numbering plan** has been refined by CCITT in its recommendation. For the number of purposes, the world is divided into zones. Each zone is given a single digit code. For the European zone, two codes have been allotted because of the large number of countries within this zone. Every international telephone number consists of two parts.

The country code contains one, two or three digits, the first digit being the zone code in which the country lies. For example France has the country code '33'. In cases where an integrated numbering plan already covers an entire zone, the countries in that zone are identified by the single digit zone code itself. All the countries in the North America zone have the code as '1' and all the countries in the USSR have the code as '7'. It is not clear if this code would change on account of the recent changes in the political setup of the USSR and the formation of the new commonwealth of Independent States (CIS).

The existence of a world numbering plan places restrictions on the national numbering plan of each country. The number of digits in an international subscriber number is limited to an

absolute maximum of 12. In practice, with a few exceptions, world numbers are limited to 11 digits. As a result, the number of digits available for a national numbering plans is  $11-N$  where  $N$  is the number of digits in the country code. In general, a national number consists of three parts. The **area** or **trunk code** identifies a particular numbering area or the multiexchange area of the called subscriber, and thus determines the routing for a trunk call and the charge for it. A numbering area is defined as that area in which any two subscribers use identical dialing procedure to reach any other subscriber in the network. An **exchange code** identifies a particular exchange within a numbering area. It determines the routing for incoming trunk call from another numbering area or for a call originating from one exchange and destined to another in the same numbering area. **Subscriber line number** is used to select the called subscriber line at the terminating exchange. In CCITT terminology, the combination of the exchange code and the subscriber line number is known as the **subscriber number** which is the number listed in the telephone directory. The term 'local call' here implies a call within a numbering area and the term 'national call' a trunk call between two different numbering areas within the same country. Basically there are four possible approaches to dialing procedures:

1. Use a single uniform procedure for all calls, viz. local, national and international calls.
2. Use two different procedures, one for international calls and the other for local and national calls.
3. Use three different procedures, one for international calls, second for national trunk calls, and the third for local calls.
4. Use four different procedures, three procedures same as given in 3 above and a fourth procedure for calls in the adjacent numbering areas.

Approach 1 demands that 11 or 12 digits be dialed uniformly for any number to be obtained. This places an unnecessary burden on the subscriber and the digit processing subsystems of the exchanges and hence the approach is not resorted to. In approach 2, a common procedure of dialing the full national number for both local and national trunk calls is adopted. This is justified

only if the national trunk traffic represents a high proportion of the total traffic which generally is not the case. Hence the approach is also not favored. Approach 3 is commonly adopted by most of the nations. Here a subscriber directory number is dialed for calls within a numbering area, a national number for national trunk calls, and an international number for foreign calls. A need to distinguish one class of numbers from the other now arises. A standard technique that has been adopted for this purpose by most of the countries is the use of a set of one or more **prefix digits**. Since the first digit of the country codes can be any of the digits 1-9, the prefix digit conveniently starts with a zero. Usually, a single digit '0' prefix is used to distinguish between a local call and a national call. A two digit '00' or a three digit, e.g. '010' prefix is used to differentiate between national and international calls. The first prefix digit '0' routes a call to a trunk exchange and the following prefix digit(s), if any, causes the call to be switched to the international gateway exchange. The dialing procedure calls for the required prefix to be dialed followed by the appropriate (national or international number). Approach 4 suggests special short dialing codes for adjacent numbering areas. This approach tends to reduce the number space available to users, hence is not extensively used. Size and delineation of numbering areas require careful consideration. Large numbering areas necessitate long and expensive junctions from satellite exchanges to central trunk switching centers. A numbering plan must make a generous allowance for growth in the number of subscribers for up to 50 years ahead. The numbering area should not be so large that the number of subscribers it will ultimately serve is beyond its

numbering capacity. A large number of subscribers within a numbering area imply long subscriber numbers and cumbersome dialing. A maximum size of seven digits for local numbers appears to be at the acceptable limit. If the numbering area is small, the number of such areas is large and so is the number of trunk switching centers. In such a case, the number of area codes available in the national numbering plan may run out too soon. If the numbering areas are small, nearby exchanges having considerable traffic between them may belong to different numbering areas, thus complicating the dialing procedure and entailing higher charges.

Any special provision in numbering scheme has the effect of reducing the number space available for identifying unique subscribers. Another important aspect of numbering plan is direct inward dialing (DID) with the advancement of electronics switching most of the PABXS provide direct dialing access to the public networks i.e. the direct outward dialing (DOD) from extension. However the incoming calls are routed through the operator. Increasingly the customers now desire that it should be possible to dial a PABX extension directly from a public network without having to go through the operator. The DID facility is desirable particularly in the context of any distance dialing when a caller has to pay for the time that lapses before the operator establishes a connection to the desired extension.

There are basically two approaches to provide DID facility:-

- (i) Use of set suffix digits to the national number to identify PABX extension.
- (ii) Allot national number to a PABX extension.

Under the restriction of maximum 12 digits in the international no. approaches & has the effect of increasing the length of the subscriber no. and thereby reducing the digits available for exchange and area codes and approaches to reduce the no. of subscribers who can be accommodated within the numbering scheme of the local exchange. Both approaches reduce the effective no. space available, approach 1 more severely than approach 2. A better approach would

be to add suffix digits over and above the international, national or local no. This can be exchange or modified in the exchange system. An elegant solution seems to be in the use of DIMF signaling once the connection is established to PABX system. A data invoice answer (DIVA) feature is required in the PABX system for this purpose. Here as soon as PABX is dialed the PABX enables a digit receiver and recorded voice using dialer to dial additional extension digits. These digits are analyzed by the PABX digits receiver and an appropriate connection is established.

Another facility demanded by the customer is likely to have a major impact on numbering scheme.

## Charging Plan

- Providing a telecommunication service calls for investment in capital items as well as meeting operational expenses. The capital cost includes that of line plant, switching systems, buildings and land. Operating costs include staff salaries, maintenance cost, water and electricity charges and miscellaneous expenses.
- A telecommunication system administration receives its income from its subscribers. A charging plan provides for recovering both the capital costs and the operating costs from subscribers.
- The cost of shared resources like the switching equipment is amortized among a large number of subscribers over a period of time.
- The cost of dedicated resources like telephone instrument and the subscriber line must be recovered from individual customers. The operating cost must be worked out depending on the quantum of resources used in providing a service and the duration for which these resources are used.
- Taking all these factors in account a charging plan for a telecommunication service levies three different charges on subscriber:
  - (1) An initial charge for providing a network connection
  - (2) A rental or leasing charge
  - (3) Charges for individual calls made
- A subscriber's share of the capital costs of the common resources is generally covered in the initial connection charge and the rental component.
- The rental may be levied on monthly, bimonthly, quarterly, half yearly or annual basis. Certain operating costs are incurred even if the network carries no traffic. These are covered by the rental.
- The charges for the individual calls include the operating costs in establishing and maintaining the calls and a component for capital resources used. There are also other factors like market policy and government regulation. For example: often government regulations demand that the revenue from a trunk network be used to subsidize the cost of local networks. So the local networks still continue to be expensive.
- By feeding revenue from one service to another the subscribers are given reasonable tariff structures for both local and long distance services.

Charging for individual calls is accounted for by using either a metering instrument connected to each subscriber line or metering register assigned to each subscriber in the case of electronic exchanges. The term 'meter' is used to denote the instrument or the register. The account in the meter represents the number of charging units. A bill is raised by assigning a rate to the charging unit. The count is incremented by sending a pulse to the meter. Charging methods for individual calls falls under two categories:

- (1) Duration independent charging
- (2) Duration dependent charging

Local calls within a numbering area are usually charged on a duration independent basis .the charging meter is incremented once for every successful call, i.e. whenever the called party answers.

In the past, some systems made a distinction between the calls within an exchange and the calls across the exchanges within a numbering area. Depending upon the number of exchanges involved in setting of a call, more than one pulse for one call is sent to the charging meter. The scheme of sending more than one pulse for a call is known as multimetering. Today it is more usual to apply one unit charge to all the calls within a numbering area irrespective of the number of exchanges involved.

- To avoid the capital cost of providing meters and operating costs of reading them at regular intervals and preparing the bills some administrations have adopted a flat rate tariff system where some fixed charges for an estimated average number of local calls are included in the rental and this scheme is advantageous to subscribers who make a large number of calls but unfair to sparing users.
- To reduce the disparity, business subscribers are charged a higher flat rate compared to domestic subscribers. When flat rate charging is used, the subscribers naturally tend to make more calls. This necessitates local exchanges to be designed for a higher traffic level. Some administrations combine both flat rate and call rate charging.
- The rental covers a certain number of free calls per rental period and only calls above this number are charged for. India uses this scheme .this method is usually adopted from the marketing angle but this scheme doesn't provide any particular advantage in terms of reducing the capital or operating costs.
- With the introduction of STD and ISD automatic charging demands that the subscriber meters be installed. Moreover with the advancement of data transmission, local calls tend to be longer in duration and due to these reasons flat charges are going to be discarded soon.
- In case of duration dependent charging a periodic train of pulses from a common pulse generator operates the calling subscribers meter at appropriate intervals. This method is called periodic pulse metering. In this case the charge for a call is proportion to its duration.

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