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SATELLITE COMMUNICATION AND ITS APPLICATIONS

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Abstract: Satellites are generally made for telecommunication purpose. They are used for mobile applications such as TV and radio broadcasting, communication to planes, ships and vehicles. A satellite works more efficiently when the when the transmission are focused on desired area. Multimedia video and internet connectivity, Global telephony, GPS Navigation, Earth imaging through Remote Sensing Satellites for resource monitoring, Telemedicine, Tele-education services, etc. are other feathers in the satellite communication application. Satellite communication system entered transition from point-to-point high cost, high capacity trunks communication to multipoint-to-multipoint communication to low cost. In this paper we discussed that the basics of satellite communication technology and its applications.

Keywords: Space Segment And Ground Segment, Uplink And Downlink, Orbits.

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INTRODUCTION

Satellite communication service industry has grown more rapidly than was forecasted in1992. This growth has been a global phenomenon as the economies of world have increased and improved communication services for both business and consumer market. Satellites orbit around the earth. These orbits can be circular or elliptical depending on its applications. Satellite is also known as space segment, and consists of three units, namely the fuel system, the satellite and the telemetry control, and the transponder. The transponder includes the receiving antenna to pick up signals from ground station, a broad band receiver, an input multiplexer, and a frequency converter which is use to reroute the received signals through a high powered amplifier for downlink. The primary role of satellite is to reflect electronic signals. In the case of satellites primary task is to receive signals from ground station and send them down to another ground station which may away over a distance from the first. This action can be two way, as in case of long distance phone calls. Another use of satellite is in the case of TV and radio broadcast, the ground station's uplink is then downlinked over a wide region. Another use of satellites is observation, in which satellite equipped with cameras and various sensors.

Fig. Artificial Satellite

2 The Ground Station:-

This is the ground segment. The ground station's job is two-fold. In case of an uplink, a data which is in the form of baseband signal is passed through a baseband processor, an uplink processor, a high powered amplifier, and through a parabolic dish antenna up to an orbiting satellite. In the case of downlink, converting signals received through the parabolic antenna to the baseband signal.

Fig. Ground Station

3 Uplink and Downlink:-

When a communication going from satellite to ground is called as downlink and when a communication is going from ground to satellite is called as uplink. When an uplink is received by satellite at the same time downlink is received by earth. This type of communication is called as two ways. If there is only uplink happening, this communication is called as upload. If there is only downlink happening, the communication is called one-way.

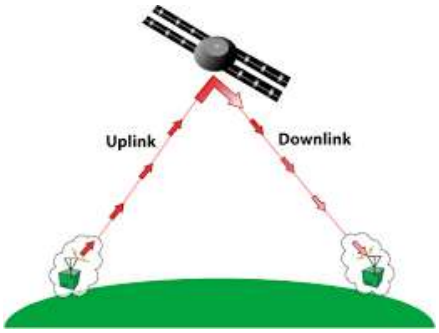

Fig. Uplink and Downlink

4 Orbits:-

GEO

GEO stands for Geostationary Earth Orbit. Geostationary satellites remain stationary from the fix spot of the earth surface. The distance of satellite is nearly 36,000 kilometer from the earth surface. Its angular velocity is equal to that of the earth, it appear to be same point on the earth. In the case of geostationary satellite, the inclination of satellite with respect to earth to earth must be $0^{0.}$ It needs to be uploaded and downloaded over a distance of 72,000 kilometer.

Geostationary Earth Orbit requires total three satellites to cover the complete earth. Generally it is used for communication purpose, so it is also called as Communication Satellite. The transmit power needed is relatively high which causes problem for battery powered devices. Transferring a GEO into orbit is very expensive.

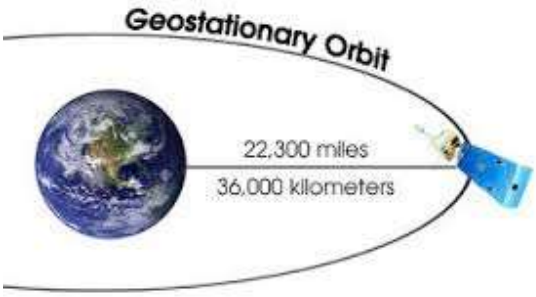

Fig. Geostationary Earth Orbit

LEO

LEO stands for Low Earth Orbit. It refers to satellite in the orbit at less than 22300 miles above the earth surface. It takes approximately 1.5 hrs for a full orbit. A LEO orbit can be used to cover a polar region. Since it is not stationary from the earth station, earth stations need an antenna assembly that will track the motion of the satellite. LEO systems try to ensure a high elevation for every spot on

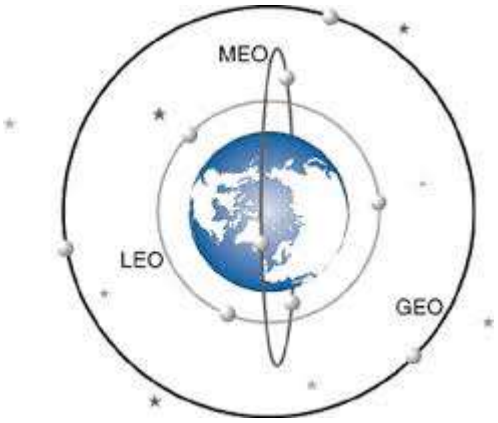

Fig. Satellite Orbits

Earth to provide a high quality communication link. It provides Omni directional antennas using low transmit power in the range of 1W. Due to Proximity to earth, LEO satellites have lower

latency. These satellites are mainly used in remote sensing and providing mobile communication services.

MEO

MEO stands for Medium Earth Orbit. These satellites positioned between LEOs and GEOs. The distance of satellite is nearly 10,000 kilometer. This system requires a dozen satellites which is more than a GEO system but less than LEO system. Depending on its inclination, a MEO can cover large population so it requires less handovers. The MEO satellites need higher transmit power and more antennas for smaller footprints. Typically it travels in an elliptical orbit over the North and South Pole or in an equatorial orbit. These satellites are generally used for GPS navigation system and sometimes it is used by satellite operator for voice and data communication.

5 Advantages of Satellite Communication:-

- It is easy to regenerate.
- It occurs less distortion and interference.
- There are low error rates in the case of Satellite Communication.
- Multiple streams can be easily multiplexed into single stream.
- It is secure.
- It is drift free, miniature, and low power hardware.

6 Critical Future Technologies:-

Critical technologies for future satellite communications are:

- Devices and structure phased
- Array and Multiple spot beam antennas on the ground and in space
- Fuel combustion structures for launch vehicles
- High frequency (>20 GHz) devices
- Solar cell material and structures
- Network technology for high data rate

- Strong and light-weight material

7 Applications of Satellite:-

Traditional Telecommunication

Telecommunication trend that are interest in satellite system are direct to home television or Direct Broadcast satellite, the growth in wireless hand held phone usage, the growth in number of personal computers are being used interconnect with internet, maritime and aeronautical telephony, fleet broadcast communication. .

Weather forecasting

Certain satellites are designed to monitor climatic condition on earth. They continuously monitor the assign areas of earth and predict the weather conditions. This is done by taking images of earth by satellite. These images are transferred by assign radio frequency to the earth station. Earth station is a radio station on the earth and used for relaying signals from satellite. These satellites are used in predicting disasters like hurricanes, and monitor the changes in the Earth's navigation, sea state, ocean color, and ice fields.

Radio and TV Broadcast

These satellites are responsible for making 100s of channels across the globe available for everyone. They are also responsible for broadcast live matches, news, world-wide radio services.

Military Satellites

These satellites are for military purposes, or military weapons. A satellite itself is neither military nor civil. It is a kind of payload it carries that enables one to arrive at decision regarding its military or civilian charter.

Navigation Satellites

The system allows for precise localization world-wide, and some additional techniques, the precision in the range of some meters. Ships and aircrafts rely on Global Positioning System (GPS) as an addition to tradition navigation system. Many vehicles come with installed GPS receivers.

Globe Telephone

One of the applications of the satellite for communication was establishment of international telephone backbone. It was sometimes faster to launch a new satellite instead of using cables. Using satellites, to typically cover a distance nearly 10,000 kilometers away, the signal needs to travel almost 72,000 kilometers, that is, sending data from ground to satellite and from satellite to another location of earth. This cause's substantial amount of delay and this delay becomes more prominent for users during voice calls.

Connecting Remote Areas

Many places all over the world do not have direct wired connections to the telephone network or the internet because of their geographical area or because of the current state of infrastructure of the country. Here the satellite provides a complete coverage to earth.

Global Mobile Communication

The basic purpose of satellites for mobile communication is to cover maximum area of the earth surface. This area is termed as footprint of that satellite. Within the footprint, communication with that satellite is possible for mobile users. These users can communicate by a Mobile-User-Link. The base-station can communicate with satellites using a Gate-Way-Link. Sometimes it becomes necessary for satellite to create a communication link between users belonging to two different footprints. Here the satellite sends signal to each other and this is done by using Inter-Satellite- Link.

India's Mars Orbiter Mission

It has been a year since India's space probe arrived into Mars orbit. It was launch aboard PSLV C-25, which was an XL variant of PSLV, one of world's most reliable launch vehicle. The XL variant was earlier used to launch Chandrayaan (2008), GSAT-12 (2011), and RISAT-1 (2012). It is the 25th flight of PSLV. The challenging PSLV C-25 mission is optimized for launch of Mars Orbiter Mission spacecraft into a highly elliptical Earth orbit. The nearest point at 250 kilometer and the farthest point are at 23,500 kilometer from the earth.

Fig. Mars Orbiter Mission

8 Future Applications:-

- Frequency reuses applications
- Use of spot beam concept and its applications
- Laser beam based satellite communication
- Space Situational Awareness uses

9 Conclusions:-

In this paper we have shown basics of satellite communication and discussed about its applications. We discussed about Orbits of satellites in which they are placed. Also discussed about Advantages, Future technology and Future applications. It is lone attempt to bring brief sketch about India's Mars Orbit Mission. The detail study of applications is still to carry out at length. Details study of Satellite Applications is matter of research in our future works.

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