

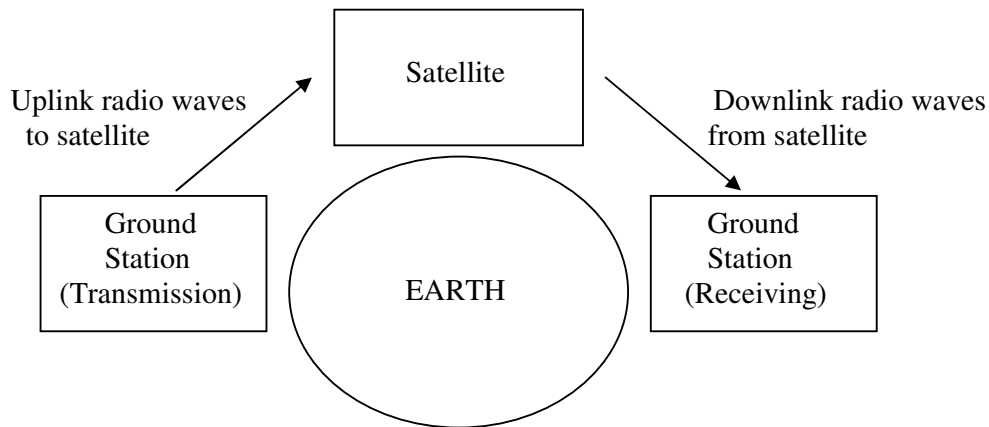
# **ADVANCEMENTS IN** **SATELLITE COMMUNICATION**

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## **ABSTRACT:**

Satellites have evolutionized communication. Satellite communication has served mankind in many ways for instance its is used to predict weather and broadcast storm warnings and also provides a wide range of communication services in the fields of relaying television programs, digital data for a multitude of business services. It might not surprise us if, in near future satellite links are used for voice and fax transmission to aircraft on international routes. Communications satellite systems have entered a period of transition from point-to-point high-capacity trunk communications between large, costly ground terminals to multipoint-to-multipoint communications between small, low-cost stations. As any invention develops with the passage of time, satellite communication has also moved a step ahead from what it was in the past with the use of several techniques such as frequency reuse, interconnecting many ground stations spread over the world, concept of multiple spot beam communications, these days lasers are effectively used for transmission through satellites. The latest development in satellites is the use of networks of small satellites in low earth orbits.

## **INTRODUCTION:**



In this present era, communication plays a vital role. We use a wide range of devices to communicate between two persons placed at different places (irrespective of the distance between them). Any earth-orbiting spacecraft that provides communication over long distances by reflecting or relaying radio-frequency signals. Satellites have revolutionized communication by making worldwide telephone links and live broadcasts common occurrences. A satellite receives a microwave signal from a ground station on the earth (the uplink), then amplifies and retransmits the signal back to a receiving station or stations on earth at a different frequency (the downlink). A communication satellite is in geosynchronous orbit, which means that it is orbiting at the same speed as the earth is revolving. The satellite stays in the same position relative to the surface of the earth, so that the broadcasting station will never lose contact with the receiver.

## **DEVELOPMENT IN SATELLITE COMMUNICATION:**

Some of the first communications satellites were designed to operate in a passive mode. Instead of actively transmitting radio signals, they served merely to reflect signals that were beamed up to them by transmitting stations on the ground. Signals were reflected in all directions, so receiving stations around the world could pick them up. Echo 1, launched by the United States in 1960, consisted of an aluminized plastic balloon 30 m (100 ft) in diameter. Launched in 1964, Echo 2 was 41 m (135 ft) in diameter. The capacity of such systems was severely limited by the need for powerful transmitters and large ground antennas.

Score, launched by the United States in 1958, was the first active communications satellite. It was equipped with a tape recorder that stored messages received while passing over a transmitting ground station. These messages were retransmitted when the satellite passed over a receiving station. Telstar 1, launched by American Telephone and Telegraph Company in 1962, provided direct television transmission between the United States, Europe, and Japan and could also relay several hundred-voice channels. Launched into an elliptical orbit inclined 45° to the equatorial plane, Telstar could only relay signals between two ground stations for a short period during each revolution, when both stations were in its line of sight.

Hundreds of active communications satellites are now in orbit. They receive signals from one ground station, amplify them, and then retransmit them at a different frequency to another station. Satellites use ranges of different frequencies, measured in hertz (Hz) or cycles per second, for receiving and transmitting signals. Many satellites use a band of frequencies of about 6 billion hertz, or 6 gigahertz (GHz) for upward, or uplink, transmission and 4 GHz for downward, or downlink, transmission. Another band at 14 GHz (uplink) and 11 or 12 GHz (downlink) is also much in use, mostly with fixed (nonmobile) ground stations. A band at about 1.5 GHz (for both uplink and downlink) is used with small, mobile ground stations (ships, land vehicles, and aircraft). Solar energy cells mounted on large panels attached to the satellite provide power for reception and transmission.

### **GEOSYNCHRONOUS ORBIT:**

A satellite in a geosynchronous orbit follows a circular orbit over the equator at an altitude of 35,800 km (22,300 mi), completing one orbit every 24 hours, in the time that it takes the earth to rotate once. Moving in the same direction as the earth's rotation, the satellite remains in a fixed position over a point on the equator, thereby providing uninterrupted contact between ground stations in its line of sight. The first communications satellite to be placed in this type of orbit was Syncom 2, launched by the National Aeronautics and Space Administration (NASA) in 1963. Most communications satellites that followed were also placed in geosynchronous orbit.

### **COMMERCIAL COMMUNICATIONS SATELLITES:**

Deployment and operation of communications satellites on a commercial basis began with the founding of the Communications Satellite Corporation (COMSAT) in 1963. When the International Telecommunications Satellite Organization (INTELSAT) was formed in 1964, COMSAT became the U.S. member. Based in Washington, D.C., INTELSAT is owned by more than 120 nations. Intelsat 1, known as Early Bird, launched in 1965, provided either 240 voice circuits or one two-way television channel between the United States and Europe. During the 1960s and 1970s, message capacity and transmission power of the Intelsat 2, 3, and 4 generations were progressively increased.

The first of the Intelsat 4s, launched in 1971, provided 4,000 voice circuits. With the Intelsat 5 series (1980), innovations in signal focusing resulted in additional increases in capacity. A satellite's power could now be concentrated on small regions of the earth, making possible smaller-aperture, lower-cost ground stations. An Intelsat 5 satellite can typically carry 12,000 voice circuits. The Intelsat 6 satellites, which entered service in 1989, can carry 24,000 circuits and feature dynamic on-board switching of telephone capacity among six beams, using a technique called SS-TDMA (satellite-switched time division multiple access). In the early 2000s, INTELSAT had 21 satellites in orbit, providing the world's most extensive telecommunications system. Other systems also provide international service in competition with INTELSAT. The growth of international systems has been paralleled by domestic and regional systems, such as the U.S. Telstar, Galaxy, and Spacenet programs and Europe's Eutelsat and Telecom.

## **SERVICES:**

Broadcasters use data from meteorological satellites to predict weather and to broadcast storm warnings when necessary. Satellites such as the Geostationary Operational Environmental Satellite (GOES) collect meteorological and infrared information about the atmosphere and the ocean. A camera on the GOES is continuously pointed at Earth, broadcasting satellite images of cloud patterns both day and night. Here, the GOES-C satellite is being encapsulated inside its payload fairing aboard a Delta rocket.

Commercial satellites provide a wide range of communications services. Television programs are relayed internationally, giving rise to the phenomenon known as the “global village.” Satellites also relay programs to cable television systems as well as to homes equipped with dish antennas. In addition, very small aperture terminals (VSATs) relay digital data for a multitude of business services. Intelsat satellites now carry over 100,000 telephone circuits, with growing use of digital transmission. Digital source coding methods have resulted in a ten-fold reduction in the transmission rate needed to carry a voice channel, thus enhancing the capacity of existing facilities and reducing the size of ground stations that provide telephone service.

Weather satellites carry cameras and other instruments pointed toward Earth’s atmosphere. They can provide advance warning of severe weather and are a great aid to weather forecasting. NASA launched the first weather satellite, Television Infrared Observation Satellite (TIROS) 1, in 1960. TIROS 1 transmitted almost 23,000 photographs of Earth and its atmosphere. NASA operates the Geostationary Operational Environmental Satellite (GOES) series, which are in geostationary orbit. GOES provides information for weather forecasting, including the tracking of storms. Meteosat 3, a European weather satellite also in geostationary orbit, augments GOES. The National Oceanic and Atmospheric Administration (NOAA) operate three satellites that collect data for long-term weather forecasting.

The International Mobile Satellite Organization (INMARSAT), founded in 1979 as the International Maritime Satellite Organization, is a mobile telecommunications network, providing digital data links, telephone, and facsimile transmission, or fax, service between ships, offshore facilities, and shore-based stations throughout the world. It is also now extending satellite links for voice and fax transmission to aircraft on international routes.

## **RECENT TECHNICAL ADVANCES:**

Launched on October 4, 1957, the Sputnik 1 was the first craft in Earth’s orbit. Named after the Russian word for “traveling companion of the world” (Sputnik Zemli), it was a small satellite measuring only 58 cm (23 in) across. It circled the earth once every 96.2 minutes and transmitted atmospheric information by radio. After three months aloft, it was destroyed while reentering the atmosphere.

Communications satellite systems have entered a period of transition from point-to-point high-capacity trunk communications between large, costly ground terminals to multipoint-to-multipoint communications between small, low-cost stations. The development of multiple access methods has both hastened and facilitated this transition. With TDMA, each ground station is assigned a time slot on the same channel for use in transmitting its communications; all other stations monitor these slots and select the communications directed to them. By amplifying a single carrier frequency in each satellite repeater, TDMA ensures the most efficient use of the satellite's onboard power supply.

A technique called frequency reuse allows satellites to communicate with a number of ground stations using the same frequency by transmitting in narrow beams pointed toward each of the stations. Beam widths can be adjusted to cover areas as large as the entire United States or as small as a state like Maryland. Two stations far enough apart can receive different messages transmitted on the same frequency. Satellite antennas have been designed to transmit several beams in different directions, using the same reflector.

A method for interconnecting many ground stations spread over great distances was demonstrated in 1993 with the launch of NASA's ACTS (Advanced Communications Technology Satellite). The satellite uses what is known as the hopping spot beam technique to combine the advantages of frequency reuse, spot beams, and TDMA. By concentrating the energy of the satellite's transmitted signal, ACTS can use ground stations that have smaller antennas and reduced power requirements.

The concept of multiple spot beam communications was successfully demonstrated in 1991 with the launch of Italsat, developed by the Italian Research Council. With six spot beams operating at 30 GHz (uplink) and 20 GHz (downlink), the satellite interconnects TDMA transmissions between ground stations in all the major economic centers of Italy. It does this by demodulating uplink signals, routing them between up- and downlink beams, and combining and remodulating them for downlink transmission.

Laser beams can also be used to transmit signals between a satellite and the earth, but the rate of transmission is limited because of absorption and scattering by the atmosphere. Lasers operating in the blue-green wavelength, which penetrates water, have been used for communication between satellites and submarines.

The latest development in satellites is the use of networks of small satellites in low earth orbit (2,000 km (1,200 mi) or less) to provide global telephone communication. The Iridium system uses 66 satellites in low earth orbit, while other groups have or are developing similar systems. Special telephones that communicate with these satellites allow users to access the regular telephone network and place calls from anywhere on the globe. Anticipated customers of these systems include international business travelers and people living or working in remote areas.

## **CONCLUSION:**

Looking at the rate of advancement in satellite communication one would foresee the use of satellites in every field where communication is required such as relaying television and radio signals. Special telephones that communicate with these satellites allow users to access the regular telephone network and place calls from anywhere on the globe.

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