

# Role of Satellite Communication in the Current Era



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**Abstract** Internet is one of the great inventions for human kind. Everyone wants to be connected every time in this era. Real-time news or information is required for the growth of different sectors. Military, government, share-market, etc., require current information of the globe. And, all this is not possible without satellite communication. On the other side, dependency on it may be very harmful. If the frequency is blocked, then the whole system will be affected. As the new technologies may have many disadvantages, similarly satellite communications may create problems. The satellite communication has more applications and useful for the mankind and overall development of society, country, businesses, agriculture, education, health, etc.

**Keywords** Satellite · Satellite communication · Transponder · Mobile communication · Internet · Radio

## 1 Introduction

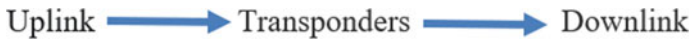
Communication is playing a significant role in the overall advancement of human beings. With the development of Internet, Web and smartphones, the communication method and pattern are changed. Now, the people are not bounded for the limited or traditional methodologies for communication [1]. After, the COVID-19, the role of electronic communication is increased; now the communication is not limited. The

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**Fig. 1** Working of satellite communication

education system is effected after the COVID-19 and their teaching and evaluation also depend on the electronic media [2, 3].

The wireless communication using artificial satellite can be known as satellite communication. Different type of services, e.g., television, voice or video calling, Internet, radio, etc., are provided through satellite communication. In the working method, an artificial satellite is placed on globe between the two more common communication points [4–6].

Broadcast communication, global coverage, mobility, bandwidth facilities, and Internet services made the satellite communication different from other services. Apart from these multiple services, communication services in remote areas for forest or hill areas, aircraft, maritime satellite, crowded areas satellite communication are the best way of fast communication. High-quality networks like broadband, heterogeneous or simple networks can be served with satellite network [7].

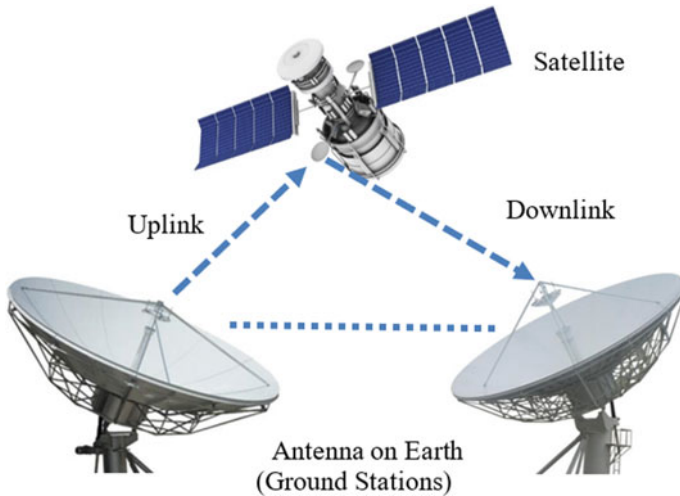
Radio waves are used for satellite communication, big antennas on the earth receives the signals from the satellite and transmit these signals further. Similar to the mirrors, satellite receives the signal like radio, Internet data, etc., from earth and bouncing back on the other side on the earth [8–10]. There are three main stages in satellite communication (Fig. 1).

**Uplink.** In this stage, the information from earth to satellite is sent to transmit the information. For an example, if users want to send TV signals from one face of earth to another face of earth. Then, they need to send signals from first face to satellite.

**Transponder.** It works like transmitters/amplifiers/radio receivers. Transponders boost the incoming signal and modify frequency so maintaining the quality of signals.

**Downlinks.** As the satellite works as mirror, the information is sent through uplink then satellite sends back the signals on other side on globe. For that, antennas are set as receivers on the earth. The working of satellite communication is depicted in Fig. 2 [8–10].

Federal Communications Commission (FCC) initiated the satellite communication by listing some launches of International Telecommunications Satellite Organization (INTELSAT) in 1995 which has currently become an association of more than 130 countries. India is also working rigorously to be the world leader in satellite communication and has developed one of the largest domestic communication satellite structures for Asia–Pacific called Indian National Satellite (INSAT) containing fifteen satellites. It works majorly in the C and Ku-bands [9].



**Fig. 2** Satellite communication

## 2 Literature Survey

The overall growth in any field without electronic media is not possible in the current era [11]. As the use of satellite is increasing in every field, so new requirement and expected possibilities are also increased. In this section, the research work done by renowned researchers in different areas of satellite communication is described:

Authors in [3] focused on the use of Artificial Intelligence (AI) in satellite communication. In their study, different applications of AI are discussed which can be used for communication satellite, e.g., network traffic forecast, beam-hopping, channel modeling, etc. The authors in [6] focused on real users, traffic, both synthetic satellite operational networks used for satellite Internet access and proposed the qualitative results of the basis of real measurements.

According to authors [6], this work is done first time in the literature. In their work, they showed that the performance of new satellite network is much higher than the previous network solutions. The authors in [12] focused on contribution of SatCom. Authors also discussed advanced concepts and future challenges in SatCom.

Authors in [13] discussed various new applications like satellite communication based on laser beams, space situational awareness, reuse of frequency, concept of spot beam, etc., and challenges in the satellite communication. According to them, as the technology is improving and the mode of communication is developing the use and challenges, e.g., high-powered platforms, critical future technologies, new policies issues [9].

A hybrid architecture of LPWAN-satellite communication network for IoT and protocols is proposed in [14] to implement IoT system in isolated zones. To optimize data transfer, authors proposed changes in the presentation layer. Focusing on data

transfer optimization, we proposed a data format change on the presentation layer that can be implemented using packaging algorithm.

Simulated annealing and Monte Carlo based on uplink transmission forecast algorithm for IoT applications proposed in [15]. For comparing objectivity and throughput of various scheduling algorithms, Second-Order Deviation (SOD) metric is used. And, the results showed that the proposed algorithm SA-MC is better than Maximal Throughput scheduling (MAxTh) and Round Robin Scheduling (RRS) algorithms [15].

The authors in [13] proposed a novel architecture named as Coordinated Satellite-Terrestrial Networks (CSTNs). In CSTN, satellite is used for handling broadcast and to manage multiple nodes and to cover the nodes afar from satellite reach, terrestrial network is used. The results showed that in case of large size network, efficiency of blockchain increased [16].

Fourati and Alouini in [17] presented a comprehensive literature survey on the artificial intelligence and its use in satellite communication. The major challenges of satellite communication and their problems are also given in [17]. Alam et al. in [18] have proposed a novel antenna design for CubeSat communication using metamaterial-based patch antenna which consists of two separate layers working in the frequency band of 443.5–455 MHz. The size of the antenna proposed in [18] is  $80 \times 40 \times 3.35 \text{ mm}^3$ .

### 3 Types of Satellite Communication Services

Following are the diverse satellite communications services as proposed by the International Telecommunication Union (ITU) [12] (Table 1):

**Table 1** Services of satellite communications

Fixed satellite	Mobile satellite	Broadcasting satellite
In fixed satellite, as the name suggests, the communication application is employed in between the satellite and a ground station having a fixed location	Contrary to fixed satellite, the mobile satellites work for moving earth stations/users	For the broadcasting satellites, the signal transmitted by such a satellite is proposed to be received by all the receivers in its receiving range
Power signals are very low	Data communication and two-way voice calls are possible	One-way communication
This type of services provide links for networks like telephone and also works as a transmitter for TV signals	Connecting ships, airplanes at remote places	Television broadcasting, radio, etc., are the applications
Large antennas are used to receive signals	Small antenna is required	Parabolic antenna is used to receive the signals

## 4 Applications of Satellites

The technology is upgrading day by day. The world seems to have shrunk with the use of different communication methods. Also, as the need and uses of new technologies are increasing, the need of satellites for communications is also increasing, and with the broad benefits of satellites, the applications of satellites are also increasing. Following are the few common applications of satellites [10, 13, 19]:

**Weather Forecasting.** Forecasting and predictions are more important in the developing world. Weather forecasting is more important for agriculture-dominated countries. Weather forecasting is not only helpful for the farmers but it is equally helpful for the government, society, industry, health, etc. For example, the INSAT-3A, KALPANA-1 and INSAT-3C are some of the exemplary missions used for weather forecasting.

**Military.** The real-time information of any geographical area is important for military of any country. And, with the help of new technologies, it became easier for army to know about the current location or geographical condition of enemies. Also, they can set the targets and positions of missiles from their own country to their enemies. For example, the early warning system under the Defense Support Program (DSP) of the USA is utilized for only military purposes.

**Radio and TV Broadcast.** New/information broadcast among country or on remote areas is one of the big achievements in past development with satellite. TV and radios not only helpful to broadcast the information of news but these are also useful for entertainment for long time. INSAT 3E mission is one such example of TV broadcasting satellites.

**Internet Access.** Life without Internet is cannot be imagined in the current era. Everyone wants to be online. Fast communication, real-time information.

**Connecting Remote Areas.** Geographical and remote areas are big obstacles in the growth of country, society and mankind. Countries such as India whose geography is not only big but also different. Like where there is a mountain, somewhere a desert, forest, river, rocky place and field. Following are the challenges in remote areas:

- To send or receive messages
- To educate people
- To learn about their culture
- To reach on the right place

All such problems can be solved with the help of satellite communications. And, the government of such countries is working in this direction.

**Telephone/mobile communication on Globe.** All the globe is connected with each other with telephonic connection. And, this is also one of the services of satellite.

**Transportation.** Transport facilities like aircraft, marine, ship, Trans, buses, cars and radio are in the moving form. For such kind of facilities, navigational facility is

required for communication. Navigational satellites are playing a vital role for such kind of facilities.

## **5 Impact of Satellite Communication in the Current Era**

Satellites have changed the entire way of communication. The way, how the people transmit and receive messages has evolved. As a result of satellite communication, the speed of communication became very fast which directly or indirectly impacted on government, education, society in the current era. More and better communication services are available, e.g., telephone, Internet, video call, etc. More interactive with high-resolution data transfer and processing has become possible. The fast communication system provides the better facilities to understand about the other countries, states and people on the globe, which also effect on the daily life, economic, politics, culture and society. The world seems to be shrinking with new technologies and fast communication. These communication systems are beneficial for the growth of the society though it is affecting the era in negatively and positively.

## **6 Conclusion**

The use of satellite communication is increased in the current era. Though, it is very costly to set and install satellite. But, the cost does not matter in this fast world. Every country wants to be connected at its all remote areas. In this work, a detailed overview of satellite communication is presented. The advantages and drawbacks of satellite communication along with various missions and applications are presented. In the countries like India, where the geographical area is large with different diversities, communication became more critical without use of satellite communications. This is the time of technology, and it is growing very fast. And, use of satellite communication is increasing day by day. It is very difficult to handle different situations without satellite communication.

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