

## Development of Satellite Communication

Linjie Yao, Guangxi Xu, Haiqing Yang

Communication and Information Engineering, Changshu University, Jiangsu, China

**Abstract:** Satellite communication refers to the use of artificial earth satellites as a relay station to forward radio waves, between two or more earth stations in the communication. Satellite communications since 1945 development so far, greatly accelerating the process of social information. The research and use of our satellites began in the early 1970s. Satellite communication applications include applications in data transmission services, applications in mobile communication systems, applications in video broadcast services, and applications in interactive services such as telephony. With the advancement of satellite communication technology and the improvement of satellite communication capability, the application of satellite communication is becoming more and more extensive, and the service level is getting higher and higher. In today's rapid development of terrestrial communications, satellite communications in the development of the market despite the great difficulties and risks, and even suffered major setbacks, but because of its irreplaceable characteristics of the decision it is still to develop and application. Therefore, from the overall and long term, the future development prospects of satellite communications is still bright and beautiful. China's satellite communications development goals: good management, make good use of existing satellite communications systems, and actively develop new business, new markets, new systems and adhere to independent construction.

**Keywords:** Satellite Communication; Satellite Data Transmission; Satellite Mobile Communication; Satellite Video Broadcasting; Satellite Telephone Interaction

Satellite communication is a combination of space technology and communication technology, the computer-controlled advanced communication. It is in the microwave communication based on the development of a special form of microwave communication.

Satellite communication refers to the use of artificial earth satellites as a high relay station from the ground, between two or more earth stations forward radio signals, in order to achieve their mutual information exchange and information transmission between the communications.

It uses the radio frequency of microwave frequency band (300MHz - 300GHz). It can be considered that satellite communication is the inheritance

and development of terrestrial microwave relay communication, which is the extension of microwave relay to space. Satellite communication is a form of space communication, which mainly includes satellite fixed communication, satellite mobile communication and satellite direct broadcast three areas. As satellite communication has a large coverage, bandwidth, capacity, suitable for a variety of business, stable and reliable performance, flexible, free from geographical conditions, cost and communication distance has nothing to do with the advantages. Over the years, it has been widely used in international communications, domestic communications, military communications, mobile communications and radio and television. Here we are from the satellite communications development history,

application, trends and other aspects of satellite communications to summarize and review.

## 1. Brief History of Satellite Communication Development

In November 1945, the British scientist Arthur Clark published an article, proposed the use of synchronous satellites for global radio communication scientific vision. 20 years after this idea became a reality. Through continuous research and testing, the third 'Newcombe' satellite launched by the United States in August 1964 was located above the equator at  $155^\circ$  east, through which it successfully conducted telephone, television and facsimile transmission tests, and in the autumn of 1964 Use it to the United States broadcast in Tokyo, Japan Olympic Games live. At this point, the early stages of satellite communications are basically completed. In the mid-1960s, satellite communications entered a practical stage. In April 1965, the 'International Satellite Communications Organization', composed of Western consortiums, launched the first generation of 'International Telecommunications Satellite' (IN-TELSAT-I, IS-I, formerly known as the morning bird) into the west by  $35^\circ$  W The rest of the Atlantic orbit, officially assume the European and American continent between the commercial communications and international communications business. Two weeks later, the former Soviet Union also successfully launched the first non-synchronous communication satellite 'Lightning -1' into the inclination of  $65^\circ$ , the apogee is 40000km, the perigee is 500km quasi-synchronous orbit (12h) Siberia, Central Asia offers television, radio, fax and some telephone services. This marks the beginning of the international communications business of satellite communications. In the early 1970s, satellite communications entered the domestic communications. In 1972, Canada launched the first domestic communications satellite 'ANIK', took the lead in carrying out the domestic satellite communications business, access to significant economies of scale. Earth station began to use 21m, 18m, 10m and other smaller caliber antenna, with a few hundred watts of traveling wave tube emission level, room temperature parametric amplifier receiver to make the earth station to miniaturization, the cost is also

greatly reduced. There is also a maritime satellite communications system, through the large shore earth station transfer, for the shipping vessels to provide communications services. In the 1980s, VSAT (Very Small Aperture Terminal) satellite communications system came out, satellite communications into a breakthrough stage of development. VSAT is a set of communications, electronic computer technology as one of the solid, intelligent small unattended earth station. VSAT technology development, for a large number of professional satellite communication network to create the conditions for the development of satellite communications applications development of a new situation. In the 1990s, the emergence and development of medium and low orbit mobile satellite communications opened up a new era of global personal communication, greatly accelerating the process of social information.

The research and use of our satellites began in the early 1970s. In 1972, China leased the international 4th generation satellite (IS-IV), introduced foreign equipment, established four large earth stations in Beijing and Shanghai, and carried out commercial international satellite communication business for the first time. On 8 April 1984, China successfully launched the first pilot communications satellite (STW-1), which was fixed at  $125^\circ$  Above the equator. On March 7 and December 22, 1988, China successfully launched two improved practical communications satellites, which were fixed at  $87.5^\circ$  and  $110.50^\circ$  equator, respectively. February 4, 1990, China successfully launched the first five satellites, fixed at  $98^\circ$  east longitude over the same year the same year the Asian satellite (24 transponders) into the scheduled orbit. On May 12, 1997, China successfully launched the 3rd generation communications satellite 'Dongfanghong No.3 (DFH-3)' satellite, mainly for television transmission, telephone, telegraph, fax, broadcasting and data transmission and other business<sup>[4]</sup> The At present, the country has nearly 400 cities and counties through the satellite with more than 180 countries and regions for remote communications. Each provincial television station has 1 to 2 sets of satellite TV programs. The future will also launch more transponders of the satellite, so that the

level of China's satellite communications into a new stage.

## **2. Application of Satellite Communication**

### **2.1 Data transmission business applications**

Foreign early rise of the VSAT system, mainly used in the main station and the remote station between the data communication. Specific application has two aspects: First, multinational companies or industry-specific data network for headquarters and the chain (branch) between the data communication; Second, the hierarchical management of the computer network for the host and the extension (or Personal computer) between the data communication.

VSAT is a solid, intelligent small unattended earth station integrating communication and electronic computer technology. The antenna band of the C-band VSAT station is 3m, the aperture of the Ku-band is 1.8m, 1.2m or less, You can put this small station built on the roof or near the place and directly for the user service. VSAT technology development, for a large number of professional satellite communication network to create the conditions for the development of satellite communications applications to create a new situation.

Satellite system is also very suitable for different regions of the large computer systems or computer LAN to provide interconnection between the data transmission rate is generally  $N * 64\text{ kbit/s}$ .

### **2.2 Application in Mobile Communication System**

Since the 1990s, in the communications, electronics, aerospace and other high-tech development driven by the development of mobile satellite communications is very rapid. In addition to the INMARSAT system, there are several systems available to provide commercial or recent commercial availability. These systems can be divided into three categories: the first is the orbiting mobile satellite communications system, such as the United States Motorola's 'iridium' system and the United States Loral Qualcomm company's 'global star' system; the second category is the orbital mobile satellite Communications systems, such as the International Personal Satellite Communications System proposed by

the global personal satellite communications company; the third category is the geostationary mobile satellite communication system, such as the Canadian TMI and the United States AMSC developed the North American MSAT system and the Asian cellular system. Among them, the low-orbit mobile satellite communication delay is small, easy to achieve mobile communication, can achieve global coverage, but need more than a dozen, dozens of pieces, or even hundreds of satellites, so the larger investment, mainly for global mobile satellite Communication.

At present, typical commercial satellite communication systems include: geostationary satellite communication system, INMARST system, medium rail satellite mobile communication system ICO system (international maritime satellite communication organization), low-orbit satellite mobile communication system Iridium system (US Motorola company), GlobalStar system (American Loral and Qualcomm).

### **2.3 Application of video broadcasting service**

At present, two thirds of the world's GEO satellite transponders are used for television and video broadcasting. There are three forms of transmission of digitized video signals using satellite broadcasting systems.

A point-to-multipoint TV program assignment: The digital video signal is transmitted from the studio via the satellite system to the regional radio station or the regional cable TV system receiving station to complete the distribution of the program. Usually the transmitted signal is a broadband multiplexed data stream.

Second, point-to-point transmission: for digital video signals from the live broadcast site to the studio, or from one studio to another studio satellite transmission.

Third, point to multipoint direct home broadcast mode: In the satellite live system, the home user receiver with about 0.5m antenna, can accept 5 to 8 video signals.

In addition, the distance education system is an important branch of the interactive video broadcasting system.

China's satellite radio and television programs are collectively accepted, satellite-transmitted television programs through thousands of city-based cable television to accept, and then through the cable or microwave into the family, in the C band in this satellite

TV antenna generally need 3m - 6m, in the Ku band to receive antenna technology needs 2.4m - 4.2m, hotels, restaurants and cable networks can not cover the area can be 2.4m - 4.2m (C band) or 1.5m - 2.4m (Ku band) antenna Collectively receive home. The individual users of the remote mountain area can also receive the 1.5m - 3m (C band) or 0.8m - 1.2m (Ku band) antenna.

With technological advances, the world is set off a satellite TV revolution, mainly the use of direct broadcast satellite TV and digital band compression technology. For example, users use a 0.45m diameter wire to receive satellite-directed TV programs. A set of TV programs only needs to take 7MHZ satellite transponders to save transponder bandwidth and broadcast costs.

### **3. Telephone and other interactive business transmission applications**

The telephone service is one of the important services supported by the satellite communication system, but its economy is the key to the problem compared with the PSTN telephone network supported by the terrestrial cable. Satellite channel capacity is small, high cost, only in the ground network cannot cover (or the establishment of the corresponding high investment in the land is very low benefit) of the rural areas of the user to use satellite phone.

GEO satellite from the ground high, the signal transmission delay time (about 250ms). If the system is used to support the telephone service, the meeting will have a sense of disengagement. In addition, the long communication delay of the satellite communication system will bring the problem of echo interference.

With the growth of a variety of business needs, the satellite communications system has the ability to support broadband multimedia services, including the ability to support high data rates (155Mbit / s or even higher), multi-channel channels, Video conferencing and video telephony services; can transmit high-resolution color images; in the Internet environment, providing voice / data / video integrated services.

### **4. Development trend of satellite communication and the**

## **development goal of satellite communication in China**

### **4.1 Development trend of satellite communications**

With the advancement of satellite communication technology and the improvement of satellite communication capability, the application of satellite communication is becoming more and more extensive, and the service level is getting higher and higher. In today's rapid development of terrestrial communications, satellite communications in the development of the market despite the great difficulties and risks, and even suffered major setbacks, but because of its irreplaceable characteristics of the decision it is still to develop and application. Therefore, from the overall and long term, the future development prospects of satellite communications is still bright and beautiful.

Terrestrial telecommunications network is usually composed of switching networks, transmission networks and access networks, modern satellite communications technology can achieve the above functions. Technical satellite communication system has been able to do not rely on terrestrial telecommunications network independent network, directly to the public to provide a variety of communications services. This is important for areas where there is communication demand but no ground communication facilities or the establishment of terrestrial communications facilities are not economically viable. These areas are the main markets for the development of satellite communications.

With the further miniaturization and mobility of satellite fixed communications services and satellite direct broadcast service subscriber terminals, the difference from satellite mobile communication service subscriber terminals will be reduced; similarly, as satellite direct broadcast services are transmitted by unidirectional television and voice broadcasting To the two-way multimedia communications business development, satellite direct broadcast services and satellite fixed communications business will also reduce the difference; In addition, these three services are to broadband multimedia communications business development. These three kinds of business identity increase, the trend of reducing each other, reflecting the

three kinds of business is to the direction of integration, this development will be more appropriate to meet the needs of people to carry out various activities.

Various satellite communication network and a variety of terrestrial service transmission network will be further interconnected, as terrestrial service transmission network indispensable complement and extension, and with the ground communication network together to form a global seamless coverage of land, sea and air three-dimensional communication network.

Ground telecommunications network, computer network and cable television network will continue to triple the direction of integration. Naturally, as a terrestrial three-network supplement and extension of the satellite communications network also participated in the integration. Its steps are different performance and use of satellite communication network first access to a variety of ground communication network to play their role, and then with the ground triple play is naturally a four-network integration.

Broadband multimedia satellite communications will be a major development, will become an important part of the ground information highway. It will be the arrival of the information society to provide a variety of services.

Satellite mobile communications business will be from small to large gradually developed, will become an indispensable part of personal communication business. The third generation mobile communication service developed on the basis of the second generation terrestrial mobile communication service will include satellite mobile communication service. The opening and further development of the third generation mobile communication business will enable people to enter the real personal communication era.

## **4.2 China's satellite communications development goals**

In the fixed-satellite communication: good management, make good use of existing satellite communication system, and actively develop new business, new markets, new systems; independent construction and operation of VSAT equipment as the main coverage of the national satellite public communications network; vigorously develop domestic satellites and Earth station, and gradually increase the

market share of domestic equipment; independent construction and operation of a new generation of regional satellite broadband communications system; 2010 timely launch of domestic satellite processing satellites, the initial completion of a new generation of broadband satellite communications system.

In the field of satellite mobile communication: the use of existing satellite mobile communication system, and vigorously develop new business, new markets; independent construction and operation of handheld user terminal-based regional satellite mobile communication system, 2010, timely launch first Pilot satellite, the initial establishment of regional satellite mobile communication system; actively participate in international organizations, global coverage of satellite communications system planning, design, construction and business activities.

In the satellite video broadcast: the use of the existing 'Asian Star', opening and development of L-band voice broadcast business; the use of existing communications satellites, continue to develop Ku-band DTH TV live business; independent construction and operation of China's L-band domestic satellite figures Voice broadcast system; independent construction and operation of our Ku-BSS band domestic radio and television satellite digital broadcast system, the development of my main user terminal, in 2010 the domestic user terminal equipment to become the leading product; good broadcast satellite broadcasting business to promote the use of Work, for 2010 with 3000 pages of households.

Building a global seamless integration of heaven and earth integrated information network: satellite communications with a large coverage, seamless coverage, and terrain and distance is not sensitive and so on, it has become an integral part of the global seamless coverage of integrated information network; terrestrial communications Network and satellite communication network only together, in order to effectively form a global seamless coverage of the sea, land and air three-dimensional service area. China's regional and other regional construction and transformation of the global synchronization; satellite communications and terrestrial communications construction and transformation of synchronization; is expected in 2020 the whole network take shape and benefit.

Space-based integrated information network: space-based integrated information network in a certain sense can be seen as satellite communication network expansion and extension. It also contains satellite communications systems and satellite and satellite communications areas of tracking and data relay satellite systems. In the construction of the space-based integrated information network, before 2010, breaking the key technology of the network system, launching two tracking and data relay satellites, the initial establishment of spatial data transmission system for some applications to provide experimental services satellite; Launch improved tracking and data relay satellites, improve the performance of space data transmission system; in 2020 the initial completion of space-based integrated information network for a variety of applications satellites and manned spacecraft and other spacecraft to provide long-term stable operation of the world integration information application network system.

## 5. Conclusion

This paper summarizes the development of satellite communications, and on this basis, elaborated the

development of satellite communications in China goals, it can be expected that the 21st century satellite communications will be significant development, especially in the world of new technologies such as optical switches, optical information Processing, intelligent star online control, superconductivity, new launch tools and the realization of new orbital technology, satellite communications will make a revolutionary change, satellite communications will be China's national economic development, industrial information generated a huge enhancement.

## References

---

1. Hu Qing, Tian Zengshan, Yao Yukun. Telecommunication transmission principle and application [M]. Beijing: People's Posts and Telecommunications Press, 2009.
2. Wang Bingjun, Wang Shaoyong, Tian Baoyu, *et al.* Modern satellite communication system [M]. Beijing: Electronic Industry Press, 2004.
3. Guo Qing, Wang Zhenyong, Gu Xuemai, *et al.* Satellite communication system [M]. Beijing: Electronic Industry Press, 2010.
4. Zhang Yue, Li Gang, Yu Yong. Global star system overview [J]. Digital Communications World, 2007, (12): 82-85.