The Innovation of Satcom Industry in China

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ABSTRACT

The paper discusses technical innovation and development in different satcom areas, and then offers some strategic considerations and detailed suggestions for China satcom industry.

Key words: satellite communication, communication satellite, orbit and spectrum resource, satcom network, earth station equipment

I. INTRODUCTION

The satellite communication industry is a slowly developing one, yet it is necessary in modern lives. The reason for claiming the slow developing speed is that the current technologies have not experienced much fundamental changes from what was employed forty years ago; meanwhile its occupancy has decreased gradually due to the rapid development of terrestrial wire and wireless networks. However, because of its unique broadcasting feature, as well as its coverage of remote rural areas, the satcom industry is still irreplaceable.

The satcom industry ran into trouble early this century. Two well-known mobile satcom corporations were close to bankruptcy. Many planned broadband satcom networks were no longer mentioned; and the business by traditional satcom companies were partially replaced by rapidly growing terrestrial communication networks. With the expansion of intercontinental and domestic fiber cables, satcom has left the backbone networks. Now it acts more like a supplement for rural areas or a backup for disaster communication. Fortunately, the satcom industry has recovered with the renaissance of the global economics. The Iridium and the Global Star has revived; and the Loral Space & Communications has emerged from its 28 months' bankruptcy proceedings. The profits of most enterprises in the industry have increased for years. In this situation, Chinese satcom industry, which is still in its tough time, should make more efforts in innovations, and initiate new technologies and new business fields.

II. NO DEVELOPMENT WITHOUT INNOVATION

In the past few years, although the development of

the satcom industry slowed down, the innovation and research for new technologies have never stopped. The United States still dominates satellite and earth station equipment manufacturing, while nations in Europe and Asia also stick to their own technology development. Europe successfully seized the opportunity of the digital satellite broadcasting, and did a lot of work in the establishment of the DVD standard series. By making use of the communications and broadcasting engineering test satellite (COMETS), which did not reach its orbit by a launch failure, Japan also gained much experience in the field of mobile satellite communication and broadcasting in Ka and millimeter-wave band, as well as interorbit communications (relaying communications between LEO observation satellites and ground stations via a GEO relay satellite). Moreover, Japan also conducted lots of research work on highly inclined geosynchronous circular orbit (HIGCO) satellite and high altitude platform station (HAPS). The Israeli GILAT Corporation has occupied certain amount of the satcom ground equipment market by its low cost and high quality. Thailand successfully launched the iPSTAR that provides high capacity IP service by cellular beam. India has persisted in the research of multifunctional communication and earth observation satellite. China has also made some improvements in manufacturing and selling communication and broadcasting satellites.

Research for innovations requires the investment in human resources and finance. There are several leading companies in the industry in the United Sates, which makes it easier to gain lots of investments. In addition to corporation operation, the satcom research and development in EU is also sponsored by Information Society Technology (IST) sector of the 5th and 6th EU-funded four-year R&D programmes. In order to improve the cooperation, Japan incorporated three former space development organizations, Institute of Space and Astronautical Science (ISAS), National Aerospace Laboratory of Japan (NAL), and National Space Development Agency of Japan (NASDA), into Japan Aerospace Exploration Agency (JAXA). The Indian Space Research Organization (ISRO) is also a governmental organization. In such a situation, however, China reformed the government based space organization into state-owned corporations. This would make people doubt whether the company will focus more on profiting, and think little of the fundamental research for the future.

The R&D projects depend on the capital orientation. Chinese research foundation projects are usually decided by scholar-type experts. Although they seem to have a high-level basis, many projects can only imitate some state of the art technologies in the world. Considering their applications, novel technologies such as the Iridium system may not necessarily lead to economical benefits. The outcome of imitation of such technologies with a large amount of fund will likely have no practical benefit but a national award. Therefore, it is recommended that the projects of research foundation should also take into account the practical use and economical benefits.

In the near future, the Chinese satcom industry will surely thrive technically and economically by expanding the industry scale. However, satcom only accounts for a little portion of the communication industry. Thus domestic research parties are not strong enough, the focuses are separated, and the funding is also limited. Since the low-efficient repeating investment cannot have any major breakthrough, it is reasonable to worry that the Chinese satcom industry will be behind the world advanced level. Hence, related administrations should take their moves to concentrate as much resources as possible, so as to make progress in a few potentially economical fields, and keep pace with the advanced technologies in the world.

III. GEO SATELLITE

Communication satellite is the lifeblood of the Industry. Though Chinese Companies have won contracts to provide communication satellites and relevant techniques to some African and Latin Ameri-

can countries, the old type of DFH-3 platform is still less advanced than overseas ones designed in the 1990's, especially in DC power and RF power per kg of lift weights and the designing and manufacturing cost. According to the statistics, the weight of a communication satellite with the same function and capacity will halve every 8 to 10 years. Thus, it is expected that the modified DFH-3 and the new generation DFH-4 can meet this developing rule.

3.1 Super size or medium size

Most manufacturers in the United States and Europe prefer to produce large communication satellites. However, Russia found that medium sized ones are more suitable for its own technical scale and the market requirement in developing countries. It is said that the cost of every transponder or an average unit of DC power of a medium satellite can be close to large ones. Moreover, the benefits of medium size satellite also include short manufacturing period, low cost in purchase and operation, and separated launch risks. As proposed by Orbital Science Corporation, a US manufacturer of small and mid-size GEO satellites, when a very large satellite with up to about 10kW payload is needed, the customer should even consider whether using two smaller satellites would be better.

Medium sized satellites are more flexible for developing countries. Therefore they have more marketing opportunities there. The satellites designed and manufactured by ISRO (India Space Research Organization) are mid-size ones, so are the Chinese ones ordered by Nigeria and Venezuela. Meanwhile, when Chinese companies order large satellites, the European and American models will still be considered prior to DFH-4 by China. Therefore, it should be noticed that large satellites have less business demands, and Chinese manufacturer would rather focus on medium sized ones. If the performance is improved with higher reliability, higher transponder specifications, variety of payload, more payload power for each kg of launch mass, lower design and manufacturing cost, etc., the Chinese mid-size satellite would possess more confidence in international competition.

3.2 Ka-band and multi-beams

According to the statistics, among the over 40 commercial GEO communications and broadcasting satellites launched in the past three years, about 10 satellites have Ka-band transponders. Obviously, Ka-band satcom application has popularized nowadays. China also needs its own Ka-band satellite resources. If it is difficult or unnecessary to manufacture and launch a Ka-band only satellite, the adoption of some experimental Ka-band transponders should be considered. For example, one 1m or larger antenna can generate 3 spot beams to cover Beijing, Shanghai, and Chengdu/Chongqing along with their surrounding areas. These transponders could be used for experimental operation and equipment research, as well as for orbit and spectrum resource protection.

Broadband satellites seem to be inseparable from on-board exchanging and multi-beam technologies, which are used to improve communication capacity and efficiency. On-board exchanging could also increase the ability of resisting interference and rain fade, because both the up-link and down-link carriers on such satellites are modulated and demodulated individually. However, the system specifications and reliabilities for on-board ATM switches, multi beam antennas, and RF subsystems are extremely strict. The most advanced satcom systems in the world are still under research by the leading companies in Europe and America, and it may not be put into use in the near future. The iPSTAR system of Thailand is another choice. The iPSTAR exploits high density frequency reuse by traditional bend-pipe transponder with cellular beam technique. Its bandwidth is claimed equivalent to 1,000+ transponders of 36 MHz of conventional coding and modulation, or over 20 times of existed large satellite's. Furthermore, the ground terminals and

channel costs of iPSTAR system are also much lower than normal communication satellites. If iPSTAR has successful commercial application, it will be a model of satcom system with high capacity and high efficiency which is based on existed and reliable techniques.

3.3 Deployable reflector and MSS

It seems that mobile satellite service (MSS) is now the hot area of satcom development in developed countries. However, MSS application in China will be restricted by orbit and spectrum resource, marketing requirement, as well as the difficulty in research and development.

The deployable antenna with the aperture of 10 meters or above is often used for mobile satellite communication and broadcasting services. Some officials announced that China will also research the related technologies if some certain conditions are satisfied. Considering the ground antennas in such systems are usually low gain with wide beamwidth, the interference coordination is quite difficult. Thus, the system seems to have rare chance to be installed and operated, and the technology is less promising in marketing. Furthermore, this kind of antenna is really high-tech. It is very difficult to test the deployment mechanism on the ground with gravity effect. In order to prevent the large antenna from being excited by the disturbance force of the thruster firing for station keepings, a low power plasma thruster engine is also required. It is easy to set a project, while it is difficult in R&D and has rare chance in practice. Therefore, the research fund would be better put into the subjects more useful with better benefit.

IV. LOW RATE DATA AND GPS RELATIVE SERVICES

The integrated GPS (Global Positioning System) and GPRS (General Packet Radio Service) technologies are better resolutions for paging, monitoring, controlling, and tracking services of fixed and mobile equipments. Satcom technology can then be used outside of the coverage of the terrestrial mobile service. In China, there are two such systems in practice: GPS with Ku-band satcom facility, and the BeiDou navigation system with L-band. Both of these systems rely on GEO satellites, thus their terminal and channel costs are not acceptable for the clients.

GEO satellites are blind in the high latitude areas surrounding the poles. However, by proper orbit design, LEO micro satellite constellations such as Orbcomm system can cover the globe. LEO systems require less transmission power for the shorter propagation distance and lower free space loss. Besides, VHF antennas are quite simple in structure, and the system design is emphasized in short message service. Hence, both the equipment and channel costs in LEO systems can be much lower than in GEO systems.

China is also developing its own micro satellite project. It is expected that the system could turn into practice as soon as possible and integrate with BeiDou navigation system. The integration of the low rate micro satellite system with the positioning and navigation system should be widely applied in the services such as managing vehicles, vessels and cargos, monitoring and commanding remote equipments, transmitting short messages in wilderness areas, etc.

In addition to positioning, GPS and similar systems can provide cheap but highly accurate frequency standard for the receivers. There are already some imported satcom equipments based on GPS frequency standard. Considering GPS belongs to the U.S. Department of Defense, its civil operation would be possibly interrupted under some particular conditions. Once it happened, the performance of the equipments relying on GPS reference frequency would decrease. Users depending on satcom system should prepare for such risks. In fact, this also brings an opportunity: it is perhaps worthwhile to develop some external frequency source based on BeiDou Navigation System to provide low cost 5 or 10MHz standard frequency for the

equipments requiring highly accurate frequency at an uncertainty less than 1 x 10-10.

V. THE EXPANSION OF SATCOM TECHNOLOGY

When the rising parties do not have the technical and economical strength to compete with the industry leaders, it ought to find new paths by technical innovation. The new paths should be based on technical foresight. It cannot last long in marketing competitions if one simply imitates an advanced system in low technical level. The new paths may also need relative spectrum resources. The administration should support and coordinate with the research organizations, to strive for the rights from ITU and other international organizations. Japan has expanded satcom technology in the areas of HIGCO (Highly Inclined Geosynchronous Circular Orbit) satellite and HAPS (High Altitude Platform Station). The United States has several business research plans on HAPS as well. While in China, there are only a few papers discussing HAPS, and fewer about HIGCO satellite.

5.1 HIGCO satellites

A HIGCO satellite has the same orbital altitude and period as a GEO satellite. Because its orbital plane is highly inclined with the equator plane, its track projected on the ground looks like the figure 8; so it is also known as the figure-8 satellite. The latitude of the south and north peaks of the figure-8 track is equal to the inclined angle, so the satellite is running far from the equator plane in most time of the day. Therefore, this kind of satellite can offer communication and broadcast services to mid and high latitude regions by high elevation angle in the ground, with no interference to GEO satellites. This is why it is also called quasi-zenithal satellite in Japan. By the proper orbit design, a constellation of 3 inclined satellites could operate at the same figure-8 track at equal time intervals. Auto tracking earth stations can operate on the three satellites one by one, with the same period of 8 hours.

In addition to the auto tracking ground antennas, HIGCO satellite system could also employ low-gain non-tracking antennas that points approximately to the zenith. Japanese researchers once did the test by S-band conical cup microstrip antennas. For the antennas located in Japan with the latitude between 30 to 40 degrees north, the elevation angle pointing to quasi-zenithal satellite is around 70 degrees, while the elevation to GEO satellite is lower than 45 degrees. If the peak antenna gain is 11dBi, the gain to quasi-zenithal satellite will be 7dBi, and the gain to GEO will be only 1dBi. The test result shows that some interference isolation existed between GEO satellites and the inclined ones, even though low-gain non-tracking antennas are used.

5.2 HAPS

HAPS is another kind of platform for radio communications. The platform is installed on an airship or airplane, which floats or flies in the stratosphere (20km above the sea level), and operates at a relatively fixed location from the ground stations. HAPS can be used as a wireless metropolitan area network (MAN) or a base station for IMT-2000 on air. If necessary, the platform can also carry some remote sensors.

The antenna pointing from a ground station to a HAPS is quite stable in direction and high in elevation. The communication distance, transmission loss and time delay in a HAPS system are all much lower than that in satellite communications.

5.3 Frequency band

Compared with a communication satellite, a HIGCO satellite uses almost the same technique in platform and communication. Japanese scholars have analyzed the mutual interference between a HIGCO satellite and GEO satellites by

means of the same method used for estimating the interference between LEOs and GEOs. The result is that both the Ka and Ku band can use spectrum spread technique to develop broadcast and communication services for non-tracking ground antennas.

The platform technique of HAPS is still immature in practice. The frequency band assigned by ITU is also too high, and thus not suitable for the application in strong rainfall areas.

In order to effectively utilize the spectrum resources, one of the authors of the paper once suggested to operate HIGCO satellite systems at C-band and HAPS systems at reversed C-band (4GHz for up-link and 6GHz for down-link). If the proper procedures for the frequency assignment in ITU could be passed by effective international cooperation, these two kinds of satcom-like systems in C-band are capable to be researched out independently or cooperatively by Chinese manufacturers based on the existed technologies, to approach the advanced systems in the world.

VI. ORBIT AND SPECTRUM RESOURCE

The orbit slot and spectrum resource is necessary to launch a satellite. In terms of the national economy and population scale, the orbit and spectrum resources belonging to China are far from enough. However, the current available Chinese resources have not been utilized adequately. Both the administration and the satellite companies should make more effort in orbital resource application and protection, as well as in sufficient utilization.

All the orbital positions used by satcom companies in mainland are applied directly from the administration by the companies. As easy as it was, sometimes it is not used with great care. Because of the use is limited in the operation band with the lifetime of the spacecraft, the user has less consideration in pursuit of long term benefits, and does less modification and amendment for the coordination filings. According to the market economy rules, the user should pay reasonable expense for the orbital resource, and the resource should be assigned by auction or by selection. The selected user should also pay some rents, to avoid the resource being abused.

6.1 Fixed satellite service

Due to the problem of export license of ChinaSat-8 and the launch failure of ChinaSat-7, both the traditional orbital slots at 115.5E and 125E have been unused for years. In order to save the rights, some temporary satellites should be migrated to these two orbital positions, till new ordered satellites occupy the relevant slots.

By means of multi-beam antennas, the restricted spectrum resource can be iteratively used. Therefore, some European or American satellites can carry 30, 40 or more Ku-band transponders. Chinese satellites are usually designed for large coverage, namely all visible landmass from the spacecraft for C-band, and the whole China area for Ku-band. Actually, there are also some regional services in China, such as the regional telephone and data networks, as well as the local language TV programs in Tibet and Xingjiang municipality. If there are some proper designed regional beams which meet the market requirement, the power resource onboard can be saved, and the spectrum resource can also be reused. Considering the antenna size onboard is normally 2m or more, and the HPA output power is only 100W or more, Ka-band satellite is unable to offer a China beam with satisfactory specifications, so Ka-band satellite service can be only designed as multi spot beams or cellular beams.

Ka-band is the preferred band for the broadband communication satellites of new generation, because the usable bandwidth in Ka-band is much wider than that in C and Ku-band. To meet the requirement of increasing broadband applications, the ground terminals should decrease its antenna size and lower its cost, and the space segment should increase its power density and lower its channel fee. This kind of space segment which

offers high density frequency reuse by multi-beam technology is called HD-FSS (High Density Fixed Satellite Service) system, and it is assigned to some Ka-band bandwidth (1000MHz for up-link and 500MHz for down-link) in WAC-2000. Actually, the new launched iPSTAR of Thailand is a kind of HD-FSS. In this system, all the remote terminals operate in Ku-band, and all the gateway stations operate in Ka-band. Ka-band is still not a popular band in China, because in this high frequency band, domestic companies have less experience and equipments, and the applications are limited in the economic and population centers in south-eastern China due to the high rain fade. However, in order to protect and occupy the orbital resources, the administration and satellite operators should also make proper efforts on modification, amendment and coordination works for the Ka-band filings applied before WRC-97, and plan to launch new satellite with Ka-band transponders.

6.2 Broadcast satellite service

To improve the system reliability, the Chinese BSS (Broadcast Satellite Service) system plans to use two in-orbit satellites at the same slot to offer 1:1 back-up. This plan is too extravagant and inefficient. It is suggested that the back-up one should better occupy the secondary BSS slot to protect its rights and to offer less important service there. The back-up one will migrate to the major slot only if it is necessary. Of course, the following issues should be estimated in advance: how long time and how much fuel is needed for shifting the back-up one to the primary slot, and the compatibility of the antenna pointing and the beam coverage in the different orbital positions.

6.3 Non-GEO service

Just like the MEO and LEO constellations, inclined orbit satellites and HAPS can also utilize the limited spectrum resources out of the GEO orbits. It is quite complicated and difficult to apply for a new system in frequency assignment procedures in ITU, so the international cooperation is required and it should be strengthened.

C-band has the advantage of no rain fade in propagation, and no technical difficulties to domestic manufacturers. It may be possible to operate HIGCO satellites in C-band and to operate HAPS in reversed C-band. The mutual interference between these two platforms and GEO satellites are not serious. The most outstanding interference which needs to be calculated and analyzed is existed between the ground stations in reversed C-band HAPS systems and the earth stations in C-band GEO systems. Like C-band fixed satellite service, there are also mutual interference existed between the two new systems and the terrestrial microwave communication systems. As the coordination area of the latter interference is mainly located in the same country, and the digital microwave can be replaced by the fibers, it can also be hopefully resolved.

VII. SATCOM NETWORK AND EARTH STATION EQUIPMENT

Except for the antennas, the market of satcom networks and earth station equipments in China has almost become a proving ground for foreign brands. After the development for more than two decades, Chinese manufacturers have obtained the capability to manufacture optical communication and mobile communication equipments. If supported by proper policies, local manufacturers can also turn into the research and development for satcom equipments.

7.1 Earth station equipments

In the past, China has gained certain technologies and experiences of VSAT equipments and systems. Although the research fund in planned economy paid more attention to project validation than to the market, some technology imitation and innovation were accomplished. However, after enterprise-ori-

ented reform, research institutes are forced to seek more profit by decreasing long term research investment. Intercommunication of practitioners and their knowledge is one of the necessities for technology development. For example, because of the PBX researchers' participation, Chinese mobile communication technology has developed obviously. On the contrary, satcom practitioners did not sufficiently communicate with other communication areas, which is partially because its small market brings its closure to the outside. The administration may want to offer policy and fund to support satcom innovation enterprises, and introduce practitioners of related areas to take part in the development of satcom equipments. Meanwhile, the R&D departments should pay more attention to the corresponding research in ITU-R, and eventually take part in it. After all, the acquaintance of the satcom standards helps to catch up with the advanced, while taking part in the establishment and modification of satcom standards is another way to protect our future benefits.

At present, there are still many PSK/FEC modems which can only transmit and receive inefficient preassigned SCPC carriers. All these modems have MAC ports providing remote computer monitoring and controlling. If the corresponding network management software is developed, which modifies the point-to-point SCPC carriers into a star network with TDM for out-route and SCPC/DAMA for in-route, the advantage of satcom in multicast and broadcast will be taken of, and the goal of saving bandwidth and decreasing the channel cost will be fulfilled consequently. In such way, users can also change their payment measure from bandwidth to data quantity, while the satcom operators can decrease the transponder cost, and the satcom itself can become more competitive.

7.2 Satellite DTH receivers

In Europe, satellite DTH (Direct to Home) service occupies about half of the revenue in civil satellite industry. European manufactures also profit greatly by selling the standards and equipments of DVB-S, DVB-RCS, DVB-S2, etc. Meanwhile, Chinese DTH plan will also activate the receiver market in the coming years.

The officials of broadcasting and television industry once introduced that the planned satellite DTH system will adopt CA (Conditioning Access) technology. CA is an obstacle that may lead to monopoly. In order to make sure that all domestic enterprises have the equal opportunity to participate, the bidding requirement should be publicized beforehand. Actually, satellite broadcasting should be divided into free programs and charging programs. Some consumers may be interested in free ones only. Thus the receivers without CA modules or functions should be designed for these customers, so as to lower the costs and the retail price.

7.3 Satcom networks

Compared to the huge bandwidth of optical communication, satcom is restricted by its orbit and frequency resource. Therefore, satcom network must enhance its bandwidth utilization ratio. To increase the network efficiency reasonably as possible, transmitting data by one hop in a mesh network and utilizing bandwidth effectively by demand assignment may be more important than shortening some header length such as address code in package, or adopting efficiently modulation and coding mode.

Almost all of the existing types of satcom network structures are inefficient in bandwidth utilization. In star networks, communication between remote stations needs two hops. In pure TDMA networks, the system resource will be inevitably wasted by the headers and the guard bands of burst carriers. Even when DAMA is adopted, the narrow band SCPC is far less than IDR in bandwidth utilization. Actually, ATM, which adds a header with address information to a package and provides a selection to the receiving station, is also a flexible and efficient networking mode.

On-board switch is not necessary to satcom ATM.

When the scheduled transmitting data rates are fixed to the earth stations respectively, each station can only transmit an uplink carrier, while it still receives several downlink carriers by relative downlink demodulators for every remote station in the network. Data to different stations are recognized by the address information in the headers. Every received ATM package in the downlink carriers will be retransmitted or discarded according to its address. In this way, by sending only one carrier, every station can communicate with all of the others in the network.

VIII. SYSTEM OPERATION AND RESOURCE INNOVATION

Due to the resource surplus and competition, transponder bandwidth in Asia and Pacific region is probably the cheapest in the world. The demand of VSAT voice and data is decreasing due to more stable performance and lower price of the terrestrial networks'. Digital compression makes the renting bandwidth of satellite broadcasting not increase with the television channels' increase. The emerging services such as distant learning based on IP over DVB did not bring much profit to the operators either.

The small scale and large number of Chinese satcom operators makes them unable to benefit from large-scale effect. On the other hand, some international operators fulfilled several merges in the past years. SES Global merged Americom and some other companies, which makes its current satellite fleet up to 40. After Intelsat's merging Panamsat, its fleet even becomes 53 satellites. The latest news is that SES Global has consented to purchase New Skies which possesses 5 operating satellites and a planned one. Comparing to these, four Chinese satellite corporations together have only 8 satellites in orbit and 2 in plan. (Among them, 3 satellites belonging to Asiasat are also statistically considered in the fleet of SES Global, the share holder of Asiasat). Small-scale satellite corporations have higher average operation cost, and the competition among them results in lower transponder price. Eventually, these corporations have to bear the disadvantage in profiting and competing. Therefore, cooperation and mergence can make for developing together.

Domestic satcom networks also have the drawbacks such as large number of networks, small scale and low efficiency. Considering the public service and poverty alleviation such as telecommunication, broadcasting, distant learning and telemedicine in the outlying poverty-stricken areas, if all these sectors have their own networks, every village has to establish several antennas, which makes it harder to manage the network and save resource. These kinds of government-oriented projects should be integrated together to make full use of the resources from the beginning. If the network security can be guaranteed, and current private networks can be converted into virtual networks in a certain general platform; the bandwidth utilization ratio will be improved remarkably and the operation cost will decrease as well. Network operators are also suggested to expend communication platforms through mergence and cooperation, so as to increase their efficiency and profit.

Satcom network operators can integrate resource via mergence. This can help to enhance efficiency, decrease cost, increase users and enlarge profit ultimately. The ideal operation model may be as follows: a professional satcom network provider manages a multifunctional satcom platform; several engineering service providers in different regions in the country take charge of the installation and maintenance for some earth stations respectively; all the service and content providers of IP access, distant learning, telemedicine, and internal networks of departments and enterprises rent parts of the resource and capacity of the public platform in the form of virtual private networks. Providing the common platform and channels to more clients can lower communication provider's operating cost. Meanwhile, every engineering provider of one

certain region can guarantee the professional service, as well as save the costs on business trips. Released from the network management and earth station maintenance, the content and service providers can also focus on the expansion of clients and the quality of service.

IX. CONCLUSION

For its higher equipment investment and service cost, Satcom is inferior to optical communication in bandwidth capacity and transmission quality, and is inferior to mobile communication in popularization and portability. On the other hand, compared with the terrestrial communication systems, satcom has advantage in broadcasting. It can provide public service to outlying areas with wide coverage, and it also possesses irreplaceable functions during disaster and emergency. As long as we insist on innovation to meet the demands of varying market and to decrease costs by saving resources, the satcom industry will develop in the wake of the increasing information service requirement. In comparison with the developed countries, the Chinese satcom industry lags behind in technology, and is also restricted in resource. With respect to technology innovation and resource exploitation, the limited investment should be used to the projects which can bring technology innovation and market application. Then, we should strive to increase the market occupation of domestic satellites and equipments gradually, and eventually accelerate the development of the Chinese satcom industry.

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