Space Policies for Geostationary Spectrum / Orbit Resource
– With Special Reference to Tongasat –

鈴木　實
Minoru Suzuki

Space resources including the geostationary satellite orbit(GSO) should be utilized efficiently and effectively at the global level. With the rapid increase in demand for geostationary satellite slots due to the fast growing satellite projects, particularly in the Asian region and with increasing number of "paper satellite" network, GSO became a very scarce resource, and thus global management for GSO is necessary. The emergence of Tongasat also led to the reconsideration of the existing satellite communication regulatory system. This paper examines the problems of the ITU regulatory system and proposes alternative regulatory measures.

キーワード：トンガサット、国際電気通信連合、ペーパーサテライト
Key Words : Tongasat, ITU, Paper satellite

I. Introduction

Satellite communication has become one of the major communication means since its inception in the 1960's. The demand for spectrum/orbit resources has been increasing rapidly in recent years. Spectrum/orbit resources are finite resources of great value for commercial purposes and other emergency communications as well as military use. These resources are considered as global public goods. Efficient utilization of the spectrum/orbit resource is the major issue for the global satellite business. Tongasat's entry into the world satellite business brought about global concern and disputes over the management and coordination of the spectrum/orbit resources. In managing these scarce resources, principle of efficiency as well as equitable access to spectrum/ orbit resources should be taken into account. The existing ITU regulatory process requires a substantial and lengthy coordination among the satellite agencies and operators concerned. In order to expedite the coordination procedures, the present international regulatory procedures should be improved through a step by step approach. To reduce the number of paper satellites and to raise the efficiency in utilization of the space resources, alternative policies including the introduction of more strict due diligence, and ,if possible, auctioning of orbital slots should be considered.

The following discussion is mostly based on the information available up to September 1997 and doesn't reflect much the results of WRC-97.

II. Rapid development of satellite communication sector

The demand for spectrum/orbit resources has been increasing tremendously in recent years. Since the early 90's, satellite buisiness has become buoyant. One of the major contributing factors in this trend lies in Asia, particularly ASEAN countries and Asian NIEs. Hong Kong's Star TV was epoch-making in the world satellite business. The success of Star TV proved that satellite business is economically viable in the Asia region. A number of ASEAN and Asian NIEs, such as Thailand, Malaysia, Republic of Korea started their own satellite projects.

The sharp increase in the number of satellite projects is attributable to various factors. First, there was a marked progress in the satellite technology including introduction of digital broadcasting services. Larger and more complex satellites are being constructed in less time. Second, the costs of launch vehicle and spacecraft have become relatively inexpensive. Third, per capita income of many Asian countries has grown at a high rate, resulting in the growing number of TV viewers and sponsoring firms. Fourth, private sectors wished to enter into satellite business reflecting the global economic change toward information society. Fifth, in some country like Thailand, the satellite project became a national project, and thus the government concession was provided for it.

In the late 1980's, there still existed vacant Geostatinary orbital slots available for c and ku bands. Since many new satellite networks has been proposed thereafter, geostationary satellite orbit (GSO) has been saturated for the most frequently used c and ku bands by mid-1997. As for the Ka band, where very little commercial service existed even in 1996, the Radiocommunication Bureau of ITU had received 216 AP4 forms, which are the first stage of the ITU procedures, for new geostationary satellite networks , from January 1995 to January 1996.

As shown in Table 1, there are more than one thousand satellite networks file at ITU at present. It is said that Thaicom and Intersputnik have files for 10 times the amount of spectrum they currently use, and moreover, SociÈte EuropÈene des Satellites has filed for over 50 times their current use.

It has been pointed out that there exists an enormous gap between the number of satellites that has been filed with ITU and those in actual use. It is estimated that the overfiling rate for in-orbit satellites has a mean value of about 2, which means 100% overfiling(1). This high overfiling rate is partly due to delay or failure in the satellite projects, and partly to the hoarding with expectations that at least some projects could be fully coordinated among the requested orbital positions , and partly to speculative purposes. Thus, the paper satellites is a vital issue for the efficient use of scarce orbital positions.

The introduction of many new satellite networks under the limited spectrum/orbit resources has caused many interference problems and disputes for space resources operators concerned. In Asia and Pacific region, there have been a number of serious satellite disputes existed in the 1990's; for example,(1) among Apstar 2, Palapa Pacific 1, Tongastar 1, and Express for the same slot 134E, (2) between Asiasat 2(100.5E) and Thaicom1(101E), and (3) among Rimsat G1(130E), Apstar1(131E), and CS 3A(132E). This kind of disputes and conflicts for the limited space resources will become more serious in the near future.

Under the circumstances of increasing number of disputes and overfiling over the limited space resources, the efficient utilization of limited space resources should be one of the goals for space utilization. For this purpose, internationally well managed coordination procedures and more effective global management systems will be needed.

III. Tongasat

The satellite world was shocked when Tonga submitted files for sixteen geostationary orbital slots from 1988 to 90 to the International Frequency Regulation Board(IFRB). IBRD is the agency which coordinates the right to operate satellite services in the Geosynchronus Orbital positions(GEO). Eventually Tonga gained six orbital slots after a compromise by May 1991. This pushed Tonga to the world's sixth-largest user of orbital rights, after the U.S., the UK, the Soviet Union, China and Japan. Needless to say, Tonga is very tiny country in the South-Pacific regions from the point of population of 98,000 in mid-1993 and area of only seven hundred square kilometers.

Tonga's emergence into the satellite world had brought about disputes with the existing global satellite system which had been governed overwhelmingly by the international consortium such as INTELSAT, INMARSAT and a several developed countries. Tonga's satellite project was a challenge to the traditional satellite system, and, as expected, strong negative responses and oppositions were directed to Tonga from the selected rich countries and international organizations concerned.

Tonga like other Pacific island countries doesn't have high-tech industrial base nor indigenous satellite technology. Tongasat project had been utterly initiated by one man, Matt Nilson(2). Tongasat project would never be carried out without the leadership and expertise of Nilson. Nilson, born and raised in Sweden, moved to the U.S. as age of 17. After obtaining two advanced degrees in engineering at the universities of Austria and the U.S., he joined the COMSAT in 1968, which was the U.S. satellite company to provide satellite service, and later became an executive in the early 1970's. During the period from 1977 to 1979, he was the senior officer at the Business Planning of INTELSAT. It seems that Nilson gained every know-how on international telecommunication systems while working at INTELSAT. From 1979, he started to set up his own consulting company named Nilson Research Corporation which has been engaged in satellite businesses. After the death of his wife in 1987, Nilson moved to Tongà to spend quiet retirement time in the same year. There he met King Taufa'ahau Tupou IV, a graduate of Sydney University's law school. The king was interested in satellite project and Nilson convinced the king to create a satellite agency called Tongasat Limited.

Table 1. Number of satellites and geostationary orbital positions

(as of December 1996)

State/Agency	No. of satellites			No. of GSO positions		
	Registered	Planned	Total	Registered	Planned	Total
USA	62	286	348	43	125	168
Russia	28	77	105	22	38	60
INTELSAT(USA)	34	83	117	18	19	37
Japan	15	24	39	12	9	21
Australia	16	15	31	4	2	6
France	8	30	38	5	12	17
ESA(France)	6	17	23	7	10	17
UK	4	80	84	4	44	48
EUTELSAT(France)	11	44	55	7	13	20
INMALSAT(UK)	2	24	26	2	14	16
Brazil	2	26	28	2	11	13
China	8	29	37	6	16	22
Tonga	3	9	12	3	5	8
Canada	4	14	18	4	2	6
Germany	2	16	18	2	12	14
India	6	75	81	3	27	30
Mexico	3	18	21	3	14	17
Thailand	0	23	23	0	12	12
INTERSPUTNIK(Russia)	0	13	13	0	13	13
Indonesia	4	26	30	4	19	23
Rep. of Korea	2	8	10	2	6	8
Pakistan	0	7	7	0	5	5
Malaysia	2	9	11	2	7	9
Singapore	0	6	6	0	6	6
Hong Kong	0	3	3	0	2	2
Philippine	0	6	6	0	6	6
Laos	0	6	6	0	6	6
Others	14	155	169	12	118	130
Total	236	1129	1365	167	573	740

Source: Yuseisho-hen, Tsushin hakusho(1997), p-375

Tongasat later closed negotiations with to U.S. based firms namely Rimsat and Unicom to lease some of the satellite slots. The Rimsat system was planned to cover two thirds of world's population . For this purpose, Rimsat had received approval from the Russian Space Agency to lease several satellites from Russian consortium called Informcosmos. As a result, already-orbiting Russian communication satellites had been moved to one of Tongasat's slots. In addition, Tongasat had signed a contract for the use of two of Tongasat's orbital slots with Unicom, a U.S. telecommunication's company. Tongasat project is, in its nature, of multinational characteristics; namely it is the combination of American entreneurship, the U.S. and Malaysian capital, Russian satellites and Tonga's orbital rights. It should be noted that Tongasat itself is not an indigenous national project but a global and multinational project.

Nilson eventually made a victory for Tongasat after the disputes with INTELSAT. The success of Tongasat project owes greatly to his business failure in 1980's in the U.S. In the early 1980's, Nilson founded and took the positions as a president of Advanced Business Communications Inc.(ABCI). ABCI concluded a joint venture with Hughes Communications Satellite Services(HCSS), a Hughes subsidiary, to launch a ku band satellite service project. In the case of this joint venture project, HCSS would design satellite, sell or lease transponders, while ABCI would receive a commission from HCSS and also retain marketing rights for the second satellite launch(3). In this arrangement, ABCI's contribution was very limited, both financially and technologically. The ABCI/Hughes project was criticized based on the lack of funds on the part of ABCI. The Federal Communications Commission(FCC) regulations asked ABCI to certify its financial qualifications prior to the grant for permission for a satellite license and orbital positions. Finally ABCI revoked the authorization previously granted to ABCI in 1985. This means that the due diligence had been applied for satellite projects by FCC. The failure of ABCI surely gave Nilson a precious lesson. In utilizing the similar approach as ABCI, Nilson could find a way to start a satellite business in Tonga.

There are several reasons why Tongasat venture proved to be a successful one. First, Tonga is not a member of INTELSAT. Second, Tongasat project has been carried out under the sovereign country, namely by the kingdom of Tonga, which made it possible for Tonga to directly contact with IFRB. Third, IFRB regulations do not require financial qualifications prior to the grant of orbital positions. As will be discussed later, it became a general consensus at the global level that developing countries, even if they are tiny as Tonga, have an equal right to orbital slots, and thus it is understandable that poor countries should seek funding from external sources to launch expensive satellite projects.

Tongasat's projects as well as overfilings by paper satellites posed a question on how to manage and regulate the limited spectrum/orbit resources effectively and efficiently. Tongasat issue should be analyzed not only from legal and regulatory management aspects, but also from economic and political aspects at the global level.

IV. Dilemma in ITU regulatory system

As mentioned above, there has been increasing demand for spectrum/orbit usage for space radiocommunication services, particularly for fixed-satellite, broadcasting satellite and mobile-satellite, as for the use and management of GSO. There is an urgent need for the global regulatory framework which would bring about the efficient utilization of this limited resource and also the reduction of disputes and conflicts.

At present, ITU is the global agency which deals with the global management issues relating to the regulation of the geostationary spectrum/orbit. Access to the geostationary spectrum/orbit resources is approved by coordination in which the principle of ITU is "first come, first served" bases. The ITU, unlike FCC, does not assign or distribute frequencies and orbital positions to individual satellite operators nor does it decide whether to accept or reject an application for a specific satellite network, since the ITU Constitution recognizes the sovereign right of each state to regulate its telecommunications.

In the last few years, Radiocommunication Bureau of ITU has been experiencing and exploding demand for its services related to space communication services and their assosiate requirements for spectrum/orbit resources. With limited human and financial resources within the Radiocommunication Bureau, it became very difficult to coordinate satellite systems which would satisfy ITU member as administrations and satellite operators. One of the fundamental difficulty in coordinating satellite communication systems lies in the globally accepted principle on space resource utilizations.

The most fundamental and important principles of the spectrum/slot utilization are "efficient use" and "equitable access". This is laid down in No.196 of the ITU Constitution(Article 4) which stipulates that "radio frequencies and the geostationary orbit are limited natural resources and they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or group of countries may have equitable access to both, taking into account in the special needs of the developing countries and the geographical situation of particular countries." Another important principle is laid down in No.195 of the same constitution which stipulates that "Members shall endeavour to limit the number of frequencies and the spectrum used to the minimum essential to provide in a satisfactory manner the necessary services."

These principles mentioned above reflects the United Nations treaties on outer space. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies(in short Outer Space Treaty) in 1967 states that "the exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development and shall be the province of all mankind." Thus, every small developing country like Tonga could have equal access to the space resources.

Another major U.N. agreement which is closely related to the use of space resources is the Agreement of Activities of States on the Moon and Other Celestial Bodies, which entered into force in 1984. Although this Moon Treaty does not contain any provisions regarding geostationary orbit, it does, however, refer to the general access to outer space by describing that "the moon and its natural resources are the common heritage of all mankind." The phrase "common heritage" means that space resource is the public goods which belong to not only developed countries but also developing countries. Thus, nobody could own any orbital positions, but anybody can use this common space resources provided that international regulations and procedures were applied to. In addition, under the U.N. regulations, each state is responsible for her space activities, and thus obliged to establish appropriate control and supervision mechanisms over her space activities.

The rights and obligations of countries and applicable procedures were contained in the ITU radio regulations. Two major mechanisms of sharing the spectrum/orbit resources has been established; namely planned bands procedures to meet requirements for equitable access to spectrum/orbit resources, and coordination procedures with the aim of satisfying efficiency of spectrum/orbit use through the application of a "first come first served" principle(4). The question arises whether "efficient use" and "equitable access" could co-exist or not.

The ITU Plenipotentiary Conference in Kyoto in 1994 adopted Resolusion 18 which called for a review of the existing ITU coordination and planning framework(5). The main objectives of the review in this Resolusion are to ensure : (i) equitable access to the radio-frequency spectrum and the geostationay-satellite orbit, and the efficient establishment and development of satellite networks, and (ii) that international coordination procedures meet the needs of all administrations in establishing their satellite networks, while at the same time safeguarding the interests of other radio services, and (iii) that technological advances examine in relation to the allotment plans with the aim of determining whether they foster the flexible and efficient use of the radio-frequency spectrum and the geostationary-satellite orbit.

Resolusion 18 also instructed the Director of the Radiocommunicatoin Bureau of ITU to initiate a review of some important issues concerning international satellite network coordination, including (i) linkages between ITU procedures and commitments to take up notified frequencies and orbital positions, (ii) the ongoing need for the ITU's frequency coordination and planning framework for satellite networks to continue to be relevant to rapidly advancing technological possibilities in order, for example, to faciliate the establishment of multiservice satellite systems. Resolusion 18 further requested the Director of the Radiocommunication Bureau not only to initiate the review but also to submit a preliminary report to WRC-95 and to submit a final report to WRC-97.

Resolution 18 was indeed the very important decision whereby the agreement had been reached at the global level to find out acceptable pocicy measures to manage and coodinate spectrum/orbit. As a follow-up of this Resolusion, various conferences and meetings were held at the regional as well as global level. Taking into account of the recomendations of these meetings, the Director's report to WRC-97 contained various recomendations, including (i)"due diligence" for administrative and procedual aspects and financial aspects, (ii) filing for multiple orbit positions, (iii) regulatory time limits for bringing a satellite network into use, (iv) streamline and simplify the advance publication stage, (v)operational lifetime and (vi) role of space monitoring.

V. Alternative policies

As mentioned above, demand for spectrum/orbit resources for the space communication service has increased dramatically since the early 1990's. However, the available spectrum/orbit resources are so limited that GSO became scarce and seems to be saturated. The overfiling became a critical issue to be solved for the efficient and equitable use of these limited space resources. Alternative policies should be taken up ,or acceptable step by step approach should be proposed to mitigate the overcrowded space problems.

First of all, more strict "due diligence" should be introduced to reduce the number of paper satellite filings. WRC-97 endorsed that administrative "due diligence" procedure should be applied from 22 November 1997 for satellite network or satellite system of the fixed-satellite service, mobile-satellite service or broadcasting-satellite service. The administrative "due diligence" requires regular disclosure of implimentation data for satellite systems, including a name of spacecraft manufacturer and the satellite operater, the contractual date of delivery and a number of satellites procured, and name of the launch vehicle provider. Unfortunately, financial "due diligence", which would require measures such as filing fee for satellite systems, an anual resistration fee, and a refundable deposit system for new satellite systems, was not endorsed by the Conference. It is necessary to adopt the financial "due diligence" at the global level as soon as possible. It may be appropriate to consider fines for paper satellite projects. In applying financial "due diligence", special consideration should be paid to the satellite network projects proposed by poor developing countries.

Second, there is an urgent need to reduce the time period required for coordination of planed space systems. The present ITU procedures requires three basic steps namely advance publication, coordination and notification. As for the regulatory time limits for bringing a satellite network into use, the total regulatory time-frame between the starting point of the application and the operation of satellite was 9 years in total, comporising of initial period of 6 years between the advanced publication and the date of bringing into use, authorized by the provision RR1042, plus 3 years of extension period under RR1550. The WRC/97 decided to shorten this period to 7 years in total (5 years plus 2 years). With this slight modification, it seems that this period is still too lengthy considering the technological developments, time-frames for launching satellite networks and fast changing economic environment.

Third, there is a possibility of auctioning of orbital slots for the efficient utilization of the space resources. Each orbital slot has defferent economic value. Most valuable spectrum/orbit, which will yield the highest revenue, would tag the highest prices at the auction. In this case, auctioning procedures seem to be not so complicated and time consuming. The question, however, arises who collects the fees for spectrum/orbit use like a rent and how do they spend these fees. There may be several alternative ways to distribute these fees. First, the fees should be given to ITU to support it's regulatory activities. Second, the fees could be used for the funds to develop satellite technology at grobal level. Third, the fees should be directed to assist developping countries to enhance their technological capabilities in the field of satellite communications.

The auctioning system could be applied to the commercial use of spectrum/slot by the developed countries and international agencies. However, satellites for emergency, military and scientfic use could not be treated as the same manner as commercial satellites. Besides, the poor countries, most likely, cannot participate in the auctioning of spectrum/slots of high value. The minimum requirement of the orbital spectrum/slot for the poor countries should be guaranteed as much as possible, based on the principle of equitable participation.

Fourth, ITU Telecommunication Bureau is facing acute manpower and funds shortage due to the explosion of filings. The developed countries including Japan should assist ITU further to expedite the administrative work for coordinating various satellite projects.

Fifth, there is a need for the proper management of the GSO environment. Since the first GSO launch in1963, there have been 657 objects placed in the GSO region as of Janually 1, 1966 (5). As the population objects has grown there would be a probability of colllision among objects in GSO. In order to avoid possible collision, the displacement of the kinetic energy of spacecraft and rocket bodies to a burial region, and removal of all the stored chemical energy would be needed. It is desirable to take appropriate actions by global space community to protect the GSO environment.

Lastly, the disputes on orbital spectrum/slots are also related to service trade issues which could be discussed at WTO. At present, ITU is not in a position to coordinate a number of satellite disputes. It is the responsibilities of countries concerned to solve disputes after lengthy negotiations. There might be a need for the third party or agency which could handle disputes with discipline. In addition, so far various meetings and conferences touching on spectrum/orbital issues have been attended by mostly government administrators and private operators with the background of engineering science. Unfortunately, not much discussion and analysis have been done by economists towards the efficient utiliztion of limited space resources. More reasonable and scientific approach could be sought through the participation of diversified experts potentially existing.

VI. Conclusions

We have discussed the rapid increase in the demand for geostationary satellite spectrum/slots which is attributable to various factors such as cease of cold war, globalization, rapid economic growth of Asian countries, and technological progress in satellite commnication. The existing ITU system in managing orbital slots and spectrum is in a difficult position to solve the overfiling issues. In order to utilize these space resources efficiently, the more drastic measures to reduce paper satellites should be taken up, and introduction of alternative policies including auctioning system should be examined more extensively. These spectrum/orbit issues are deeply related service trade issues. Thus, economic analysis should be more applied toward the efficient and equitable use of the limited space resources.

Acknowledgment

The author has been benefited greatly from Dr. Mats C. Nilson (Nilson Research Corporation), Mr. John A. Lewis (ITU) and Prof. William E. Steslicke (Kwansei Gakuin University) for their helpful suggestions and comments. Any remaining errors are the sole responsibility of the author.

Notes

(1)Lewis, 1996, p.6
(2)Interview with Matt Nilson on 7 Feb. 1997
(3)Ezor, pp.920 - 921
(4)Lewis, March, 1996, p.4
(5)ITU, pp.154 - 156
(6) Loftus, p.2

References

Ezor, Jonathan Ira, "Cost Overhead : Tonga's Caiming of Sixteen Geostationary Orbital Sites and The Implications for U.S. Space Policy," "*Law and Policy in International Business*," The International Law Journal of Georgetown University Law Center, Vol. 24, No.3, Spring 1993, pp.915 - 941.

Chasia, Henry, "The Future of Global Telecommunication and The Role of International Organizations," (IAA.-96-IAA.7.1.02), a paper presented at the 47th International Astronautical Congress in Beijing in October 1996.

Christensen, Jorn, "Tonga Fever - A Proposed Cure," "*Via Satellite*," June 1995, pp.30 - 36.

Christensen, Jorn, "The Great Paper Chase - The Rush for Satellite Frequencies Is On," "*Via Satellite*," February 1996, pp.42 - 48.

Garrido-Lecca, Hernan Montanes, "*The Economics and Politics of Slot and Frequency Allocation in the Geostationary Orbit*," a thesis submitted to the Department of Political Science in Partial Fulfillment of the Requirements for the Degree of Master of Science. Massachusetts Institute of Technology, September 1990.

International Telecommunication Union, *Final Acts of the Plenipotentiary Conference (Kyoto, 1994)*, ITU Geneva, 1995

Lewis, John A., "ITU Policy for Space Resources Utilization and Progress Status of The Resolution 18 Process," a paper presented at APSCC 1996 Conference in Seoul from 6 to 8 November 1996.

Lewis, John A., "Access To The Spectrum/orbit Resource - Review of The International Telecommunication Union Procedures," a paper presented at Asia Space Communications Programme in Singapore from 20 to 22 March 1996.

Lewis, John A., "Recent Developments and Future Perspectives in Orbit and Spectrum Resource Utilization," a paper presented at Asia Space Communications Programme II in Singapore from 26 to 28 August 1997.

Loftus Jr., Joseph P., and Reynolds, Robert C., "Issues in the Management of the Geostationary Orbit," (IAF - 96 - V. 6. 09), a paper presented at the 47th International Astronautical Congress in Beijing in October 1996.

Nilison, Mats C., and Aguilar-Nilson, Raquel, "The Sale of Communications Satellite Orbital Positions," (IAF - 94 - M. 1. 794), a paper presented at the 45th International Astronautical Congress in Jerusalem in October 1994.

Prichard, Wilbur, "The Communications Spectrum: Frequency Allocations and Auctions," (IAF-96-M.1.01), a paper presented at the 47th International Astronautical Congress in Beijing in October 1996.

Yuseisho-hen, "*Tsushin hakusho(1997)*," Okurasho Insatsukyoku.