A Proposal on the Peaceful and Efficient Use of Space Resources for Meeting Increased Satellite Demand in the Asia-Pacific Region

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Abstract

The orbit and frequency spectrum allocation for the communication and broadcasting satellite services are coordinated between the concerned parties according to the Radio Regulations of International Telecommunication Union (ITU). Currently, the geostationary orbit is filled with too many satellites for the commercial or military uses. In addition, a number of near earth satellite programs are being introduced. As each country claims for the space orbit and spectrum, the limited space resources are being exhausted. In this paper, the current situations in the worldwide

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satellite orbit demand are discussed, and some ideas on the peaceful, efficient and equitable use of space resources are proposed.

I. Introduction

Since 1980, the commercial use of communication and broadcasting satellites has been rapidly increasing. From the end of 1990's, many new projects for communication services using the near earth orbit are being introduced, for instance, ICO, Iridium, Odyssey, Globalstar, etc. Therefore, lots of satellites will be launched into the space in the near future. As the resources of satellite orbit and frequency are limited, each country strives to occupy the available space resources. As a result, the ITU is deluged with many applications for new orbits and frequencies. Moreover, there happen many international conflicts resulted from the frequency interference between the satellites networks. ITU has the limitation to handle such disputes. To date, those problems are resolved mainly by the coordination procedures between the concerned parties according to the Radio Regulations of ITU. Unfortunately, it usually takes long time. Facing this situation and problems, we need to find ways of promoting the efficient and equitable use of space resources rather than competing to pre-occupy them.

II. Current Problems and Situations

1. Increasing Satellite Demands

Presently the orbital space near the earth is already crowded with satellites. About seven percent of more than 8,000 man-made objects in the space are operational satellites, 15 percent are rocket bodies, and the remainder are fragmentation and inactive satellites. The number of all the satellites and debris in space is shown in Table 1. Most of the satellites are owned by U.S., C.I.S., Europe, and Japan. All the satellites, geostationary or non-geostationary, commercial or experimental or military, are included in the Table to show the crowdedness of the space. In the Table, "Satellite" is defined by any payload, operational or non-operational, launched into the earth orbits, and "Debris" is defined by all other man-made objects in the earth orbits. More than 200 active satellites in the geostationary orbit are shown in Fig. 1 as a function of orbital positions. In case there are more than two satellites collocated, they are indicated in the radial direction for clarity.

The number of communication and broadcasting satellites to be launched in the Geostaionary Earth Orbit (GEO) from July 1996 to 2006 is expected to reach approximately 300 as seen in Table 2. The market size will reach up to $28 billion. It is noted that the demand in Asia is remarkable. In this region, the economic growth rates are very high and the communication infra-structures are rapidly being constructed. In particular, this region is composed of lots of islands and sparsely populated area. Thus, the satellite communication network is preferred to ground communication network due to its relatively easier configuration of information infra-structure. In addition, many projects for communication services using LEO are being newly introduced; ICO (10 satellites), Iridium (66 satellites), Odyssey (12 satellites), Globalstar (48 satellites), etc. The number of satellites in the LEO will reach as many as 242 during ten years till 2006. Teledesic Corporation, which is building a global broadband "Internet-in-the-sky", was granted a license in March 1997 by US Federal Communications Commission to provide two-way telecommunications services via a constellation of 840 (reduced to 288 later) LEO satellites (*Table 2 does not reflect this progress).

World satellite market will show high growth especially in 1990's because it falls into the replacement period of previous generation satellites. Among 100 or more satellite contracts until June 1996, more than 40% is for the replacement of old satellites. The exploding demand of satellite communication and broadcasting services in Asia-Pacific, South America, and Africa will boost the satellite market. Furthermore, many small non-geostationary satellites projects such as Iridium, Globalstar, and Teledesic will contribute much to the bull satellite market.

2. Current Situations and Efforts to Resolve the Problem

The radio spectrum is a limited natural resource which should be shared by all types of radio services, be it terrestrial or via satellites. To avoid interference between the various radio systems, the ITU allocates the frequencies and orbits for each communication service on a global and regional basis. The international registration of frequency and orbit assignments for radio telecommunication is managed by the Radiocommunication Bureau of ITU.

Before the early 1980's, the demand for the geostationary orbit and frequency was not so high, and as a result such space resources were used by a few countries on the "first come, first served" basis. Recently, many countries joined ITU and argued such allocation system. Consequently, through WARC-85 and WARC-88, reflecting the developing countries' positions, it was decided that at least one orbit and one frequency band shall be allocated to all 165 member nations for their domestic satellite communication. For communication satellites, there is no definite international regulation on the distance between the satellites, but it was recommended by Federal Communications Commission (FCC) that the 2° distance be maintained for the satellites using C or Ku band frequencies. For broadcasting satellites, 6° distance is recommended to be maintained in the region other than North and South America.

Realizing the importance and the value of the space resources, each nation tries to secure as many orbits and frequencies as possible in advance and there are overflowing applications for the orbit and spectrum. This resulted in many paper satellites which occupy orbit and frequency without actual use.

There are several factors which have led to the present unsatisfactory situation in satellite network coordination. In summary, this situation resulted from;

- exploding demand for telecommunications services fuelled by private sector enterprises,
- growing congestion in the use of those orbit/spectrum resources,
- the current ITU procedures that do not discourage the hoarding of the spectrum/orbit resources, and
- increased awareness of the economic value of spectrum/orbit resources.

The present ITU regime for regulating the use of these natural resources was largely established more than a quarter century ago, and is not designed to adequately handle the present situation.

Recently, ITU administrations (i.e., member states) tend to file for much more spectrum/orbit resources than needed. The filings are massive partly because administrations may wish to stake a claim to orbital resources over a long period of time and in a wide variety of circumstances. At the same time, both the existing coordination pipeline of proposed satellites and the Master International Frequency Register (MIFR) are filled with "paper satellites", that is, systems which are not in operation or that will never be brought into operation. There are several causes. First, with the "first come, first served" regime for the unplanned bands, administrations have an incentive to "stake a claim" to the economically valuable orbit/spectrum resources, particularly in the current circumstances where other countries are increasingly doing so. Secondly, there is no financial cost associated with the filing, apart from the minimal cost of preparing the necessary filing and submitting it to the ITU. Third, there is no penalty or sanction subsequently imposed on the notifying administration if the system is not established within the specified period. In sum, the present system provides all benefits and virtually no costs or risks for paper satellites.

Fortunately though, in response to these problems in utilizing space resources, efforts are being made by the global and regional organizations.

There is no single panacea or magic solution to the problem of orbit congestion and paper satellites. In several Radiocommunication sectors and conferences in ITU, recommendations and contributions gathered from the administrations are being discussed and processed to be reflected in the ITU Constitution or in the Radio Regulations, or in the form of World/ Regional Radiocommunication Conferences (WRC) Resolutions. There appears to be a consensus on some actions while not enough views are expressed or no consensus is achieved on others. Some of the recommendations will be addressed in the following.

Due diligence should be adopted as a means of addressing the problem of reservation of capacity without actual use. Two principal approaches have been recognized: a procedural/administrative approach in which ITU administrations must demonstrate the seriousness of their intent to establish a satellite network, and a financial approach comprised of three elements: fees to cover processing costs, registration fees, and deposits returnable when a satellite system is launched. There appears to be a general consensus on the main elements of the procedural approach although many detailed questions remain to be addressed. On the contrary, there is no consensus at this time on the principal elements of the financial approach.

There is another type of problem. As the demand of such resources increases rapidly due to the increased number of satellites, there happen many conflicts between satellite operators. Table 3 shows the list of disputes on satellite orbits and frequencies in Asia-Pacific region during '92~'95 in which satellites have interfered with other satellite transmissions. In this case, it is necessary for some international organization to play a policeman-like role in controlling space resources for commercial satellite. But ITU, basically, is not structured to play that kind of role in doling out satellite space. It has been a general agreement that ITU should not carry out monitoring itself but rather use international monitoring system for space use. The international monitoring stations can provide data to the Bureau when necessary, but under the current regulations such data cannot be employed to remove entries from MIFR without administration's consent. Thus, what we need is self-discipline by satellite operators, and if that is not possible, the satellite operators should have an association or organization that looks after the industry.

III. A Proposal for Peaceful and Efficient Use of Space Resources

As already mentioned, there are too many satellites in orbit and future satellites planned. The proposal is, basically, to reduce the number of satellites to be launched. Presently each country try to possess its own satellite constellation and thus the space is becoming more and more crowded. But it should be noted that, by nature, a satellite has wide range of coverage. Using this characteristics of wide coverage, some adjacent countries can construct a regional satellite system together and share it. An example program will be introduced in the following.

Korea, China, Japan, and other Asian countries can cooperate together to carry out an Asia-Pacific regional satellite project. In particular, three countries in the Far East Asia are geographically very close and have some common cultural heritage. If realized, this satellite project can help cultural exchange and mutual understanding between the peoples. This regional satellite system can provide the communication services and high speed data transmission between the countries, help exchange TV programs, and directly provide TV broadcasting services (DTH : direct-to-home). This is also to cope with the changing market situations affected by international satellite systems such as INTELSAT, PanAmSat, and Orionsat, etc. A regional satellite communication organization like EUTELSAT or a subsidiary of INTELSAT may be devised in this area. A joint venture company can be established as a consortium composed of companies from these countries for the regional satellite program.

One of the most important thing in this project is how to acquire the required orbit and frequency. First of all, those resources can be requested from ITU. It should be emphasized that ITU should give a priority in the orbit assignment to such regional organizations than individual applications. On this matter, a rule of priority is suggested as follows; the domestic satellite networks by individual nations should be given the highest priority, the next priority is for the regional satellite networks by regional organizations, the third priory for the global satellite networks. Additionally, we had better restrict the regional satellite business to the regional organizations or bodies since such businesses by many individual nations would cause the overlaps in the beam coverage and the orbit/spectrum consumption. Furthermore, regional satellite operators and services provider shall be requested to submit proper approval of the nations under the beam coverage at the time of orbit and frequency application (AP 4) in ITU.

IV. Conclusion

Since the orbital space near the earth is already crowded and space resources are being exhausted, it is necessary for us to develop the ways how to use the resources efficiently and peacefully. These days, there are a lot of paper satellites which occupies orbit and frequency spectrum but are not in operation or will never be brought into operation. Nevertheless, ITU administrations (i.e., member states) and satellite service organizations tend to file much more orbit/spectrum resources than needed to stake a claim to such valuable resources. As a result, there happen frequency interferences between the satellite networks and disputes between the satellites operators. In response to these problems, many recommendations and contributions are proposed by ITU administrations. The procedural and financial measures should be seriously discussed and adopted in the ITU Constitutions or in the Radio Regulations. It is desirable that ITU is restructured to have an authority to resolve these problems. As ITU has a limitation to play a policeman-like role in controlling space resources, other international or regional organizations may be able to monitor the satellite networks and recommend a solution to ITU when necessary. It is proposed that we need to develop more regional satellite projects covering the wide area or several countries with the reduced number of orbits and frequency spectrums. The participating nations will save the natural resources and, satellite cost and other expenses. In addition, people in these nations can share and appreciate cultures of neighboring countries, and therefore understand better each other. To encourage such regional satellite programs, ITU should give a priority in the assignment of orbit and frequency spectrum to the joint venture of regional operators than the individual applications for the multinational satellite coverage.

Table 1. Satellites in orbit owned by states and organizations

(as of Apr. 2, 1997; US Space Command)

Country	Satellites	Earth Orbiting Debris	Total
Argentina	5	0	5
Australia	6	2	8
Brazil	6	0	6
Canada	15	0	15
China	16	96	112
CIS	1,318	2,521	3,839
Czechoslovakia	4	0	4
France	29	16	45
France / Germany	2	0	2
Germany	12	1	13
Hong Kong	3	0	3
India	14	3	17
Indonesia	8	0	8
Israel	2	0	2
Italy	7	3	10
Japan	56	58	114
Korea (South)	4	0	4
Luxemburg	6	0	6
Malaysia	2	0	2
Mexico	5	0	5
Norway	1	0	1
Portugal	1	0	1
Saudi Arabia	3	0	3
Spain	4	0	4
Sweden	5	0	5
Thailand	2	0	2
Turkey	2	0	2
United Kingdom	15	1	16
United States	658	3,349	4,007
Arab States	7	0	7
Europe	19	183	202
INTELSAT	51	0	51
EUTELSAT	10	0	10
INMARSAT	7	0	7
NATO	8	0	8
Total	2,313	6,233	8,546

* Satellite: Any payload (operational or non-operational) launched into Earth orbit
* Debris: All other man-made objects in Earth orbit

Table 2. World Communication and Broadcasting Satellites Markets

('96.7.~2006)

		Contracts Made	Contracts Expected		Total
			Minimum	Maximum	
GEO	INTELSAT, INMARSAT	10	14	14	24
	Private International Satellite Operators	5	9	9	14
	North America	21	29	33	50~54
	West Europe	16	20	22	36~38
	Africa/Middle East	6	15	17	21~23
	Middle and East Europe	14	6	19	20~33
	South Asia	3	10	15	13~18
	Asia-Pacific	28	30	47	58~75
	South America	5	9	14	14~19
	Subtotal	108	142	190	250~298
	Relaunch	-	-	-	12~15
	Total	-	-	-	262~313
	Market Size ($ billion)	-	-	-	23.8~28.7
LEO	Big LEO	140	12	12	152
	Little LEO	16	56	74	72~90

* GEO = Geostationary Orbit
* LEO = Low Earth Orbit
(from World Satellite Comm. and Broadcasting Markets Survey by Euroconsult, 1996)

Table 3. Orbit Disputes in Asia-Pacific Region

Orbit	Satellite (Country/Operator)	Launch Date	Coordinated Results and Status
69° E 70° E	INTELSAT 505 (INTELSAT) Unicom F2 (US/Unicomsat)	'82.9.29 -	o Unicom F2 program cancelled
76.5° E 78.5° E	Apstar 2 (Hong Kong/APT) Thaicom 2 (Thailand/SCC)	'95.1.26 '94.10.8	o Unresolved (Apstar 2 launch failure)
91.5° E 91.5° E	Meatsat 1 (Malaysia/Binariang) INTELSAT 501 (INTELSAT)	'96.1.12 '81.5.23	o INTELSAT 501:orbit change or stop operation before Meatsat 1 launch
93° E 93.5° E	Apstar 2 (Hong Kong/APT) Insat 2B (India/DOS)	'95.1.26 '93.7.23	o Apstar 2: withdrawal of orbit plan (Launch failure to 76.5° E)
100.5° E 101° E	Asiasat 2 (Hong Kong/Asiasat) Thaicom 1 (Thailand/SCC)	'95.11.28 '93.12.18	o Asiasat: giving up 77.5° E o Thaicom1,2:placed in 78.5° E
105.5° E 105.9° E	Asiasat 2 (Hong Kong/Asiasat) Indosat 1 (Indonesia/Indostar)	'90.4.8 '96. .	o Unresolved
114.9° E 115.5° E	Indostar 2 (Indonesia/Indostar) Chinasat 5 (China/Chinasat)	Unfixed Orbit ch.	o Unresolved
115.5° E 116° E	Chinasat 5 (China/Chinasat) Koreasat 1 (Korea/KT)	Orbit ch. '95.8.5	o Chinasat 5: Ku band not to be used
130° E 131° E 132° E	Rimsat G1 (US/Rimsat) Apstar 1 (Hong Kong/APT) CS 3A (Japan/NTT)	'93.11.18 '94.7.21 '88.2.19	o Apstar 1 moved to 138° E
134° E 134° E 134° E 134° E	Apstar 2 (Hong Kong/APT) PalapaPacific 1 (Indonesia/PSN) Tongastar 1 (US/Rimsat) Rimsat Express (US/Rimsat)	'95.1.26 Orbit ch. '89.1.26 '95.12.	o Apstar 2: withdrawal of orbit plan (Launch failure to 76.5° E) o PalapaPacific 1 used till EOL o Tongastar 1 moved to130° E, transferred to Rimsat Express
138° E 139° E	Apstar 1 (Hong Kong/APT) Palapa Pacific2 (Indonesia/PSN)	'94.7.21 Orbit ch.	o Unresolved
167.4° E 168° E	Pacstar 1 (US/PSI) PAS 2 (US/PanAmSat)	- '94.7.8	o Pacstar 1 program cancelled
170.2° E 172° E	Unicom F1 (US/Unicomsat) Pacificom 1 (US/TRW)	- -	o Both programs cancelled

Fig. 1 Active Satellites in Geostationary Orbit