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RECENT CHALLENGES FACING THE MANAGEMENT OF RADIO FREQUENCIES AND ORBITAL RESOURCES USED BY SATELLITES

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ABSTRACT

In October 2009, ProtoStar, a start-up satellite company with a promising business plan, was forced into Chapter 11 bankruptcy proceedings as a direct result of radio frequency-coordination hurdles involving one of its satellites. The company found it easier to raise millions in equity and debt than to gain access to adequate radio frequency and orbital slot resources under the current international legal regime. In addition, an increasing number of instances in which harmful (sometimes intentional) interference with adjacent satellite systems was publicly alleged by reputable satellite companies demonstrate that the management of radio frequencies resources as administered by the International Telecommunication Union (ITU) is becoming extremely challenging and in dire need of practical solutions. Although the Radio Regulations provide for a detailed procedure for allocation and assignment of radio-frequency spectrum at designated orbital slots, in the context of growing demand for frequency and orbital resources and orbital congestion, the practical application of ITU's radio frequency management system, especially with regard to frequency coordination, is in many instances influenced by political and anti-competitive agendas. This paper identifies some of the loopholes in the ITU procedures regarding radio frequencies assignments which allowed for the "paper satellite" phenomenon, the "floater-for-hire" practices and the undermining of the frequency coordination process. Given that the ITU does not, and has no authority to, impose sanctions or otherwise enforce its Radio Regulations or other applicable rules, compliance is ensured through the goodwill, to the extent available, of the member states. In light of the current commercial reality characterized by high demand and scarcity of valuable orbital location and associated radio frequencies, the goodwill of the parties is likely conditioned upon economic interests of their nationals. The paper critically reviews the feasibility of several mechanisms and practical strategies which can be employed to ensure a more efficient management of the use of the spectrum and orbit resource and provide better solutions to the current challenges in administering the scarce orbital location and radio frequency resources.

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I. INTRODUCTION

The satellite industry is a multi-billion dollar business delivering a broad range of essential services such as broadband digital communications,[1] direct-broadcast services,[2] enhanced fixed satellite services,[3] mobile satellite services[4] and environmental monitoring.[5] The satellite industry generated $160.9 billion U.S. dollars in 2009, with an average annual revenue growth of 11.7% for the period from 2004 through 2009.[6] All main industry sectors (*i.e.*, satellite services, satellite manufacturing, launch industry and ground equipment sectors) reported a growth in their revenues..[7]

A healthy and profitable satellite industry depends on the proper functioning of satellites providing commercial services. Interference-free use of radio frequencies is one of the vital conditions for the proper operation of a satellite since it ensures communication with the earth.[8] Inability to use radio frequencies at a certain orbital location may render the satellite a commercial fiasco for its owners and investors. Recent instances of allegations of harmful interference with adjacent satellite systems and lack of cooperation in coordinating the use of frequencies demonstrate that the management of radio frequencies resources is becoming increasingly challenging and in dire need of practical solutions.

The case of ProtoStar stands as an example of the vital importance that orbital and spectrum rights have for a satellite company and the devastating consequences that uncertainties regarding the validity of rights over frequency assignments can have.[9] It also provides an indication of potential issues with the international regime governing the management of orbital and frequency resources.

This paper reviews the international radio spectrum management process as applicable to satellites and identifies challenges facing commercial satellite owners and operators in obtaining and maintaining access to radio frequency resources at the international level. Potential solutions proposed in addressing such challenges are also discussed.

II. ORBITAL CONGESTION

2.1. Limited Nature of the Orbit/Frequency Resource

The orbit location/frequency spectrum resource is the core reservoir of value for the satellite industry. It has been validly noted that, in the context of the geostationary (GEO) orbit, this resources has a dual nature given that its value can necessarily be realized only through the simultaneous use of both the GEO orbital location and electromagnetic spectrum.[10]

The laws of physics dictate that if two different transmissions are made in the same geographic area at the same frequency, they will interfere with each other resulting in deterioration or even loss of signal..[11] As a result, no two satellite systems can operate on the same radio frequency in the same (or immediately adjacent) orbital position(s), without causing interference to one another.[12] Use of different frequencies or frequency coordination between operators of neighboring satellite networks is therefore required to avoid harmful interference.

Regarding the orbital resource, especially in the GEO, demand for "prime real estate", *i.e.*, orbital slots with a footprint covering desirable markets such as the continental United States, Asia or Europe, is significantly greater than supply and as a result very few undeveloped slots remain.[13]

Steady increase in demand for satellite-based telecommunication services during the past 25 years led to increased demand for frequency spectrum/orbit usage. Such upward trend for demand will inevitably continue.[14] In this context, it is understandable that orbital slots and associated radio frequency assignments became scarce (and thus, extremely valuable) resources.[15]

2.2. The International Nature of Frequency Coordination

In most cases, radio frequency interference between satellites involves networks of different nationalities so generally such interference has an international nature and national legislation alone would not be adequate to address international radio interference. An international organization, International Telecommunication Union (ITU), was considered as best positioned to fulfill the role of coordinator of all frequency assignments, including those associated with satellite systems.

The ITU has established an international legal regime codified through the ITU Constitution and Convention, as well as the Radio Regulations. These instruments contain the main rules governing frequency spectrum allocation to different categories of radiocommunication services; the rights and obligations of member administrations in obtaining access to the spectrum/orbit resources and international recognition of these rights by recording frequency assignments and, as applicable, orbital

positions used or intended to be used in the Master International Frequency Register.[16]

III. ROLE OF THE ITU AND ITS COORDINATION PROCEDURE

3.1. The Goals and Purposes of the ITU

The preamble of the ITU Convention states that the purpose of the ITU is to facilitate "peaceful relations, international cooperation and economic and social development among peoples by means of efficient telecommunication services."[17] In order to achieve this purpose, the ITU Constitution entitles the ITU to:

(1) effect allocation of bands of the radio-frequency spectrum, the allotment of radio frequencies and the registration of radio-frequency assignments and, for space services, of any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits, in order to avoid harmful interference between radio stations of different countries; [18] and

(2) coordinate efforts to eliminate harmful interference between radio stations of different countries and to improve the usage of the radio-frequency spectrum for radio communication services and of the geostationary-satellite and other satellite orbits.[19]

3.2. The Role of the ITU and the National Administrations

The ITU currently has 192 member States. Only States have standing (via their "notifying administrations", typically the domestic postal, telegraph and telephone authority) to act within the ITU as advocates for their respective satellite operators.

The coordination of orbital slots and associated frequencies is conducted by the ITU in accordance with its Radio Regulations.[20] Frequency bands (*i.e.*, "slices" of spectrum) are allocated to different radiocommunication service categories (*e.g.*, fixed, mobile, radionavigation, etc.) either worldwide (worldwide allocation) or regionally (regional allocation). The process of internationally coordinating and registering orbital slots and associated radio frequencies is carried out by notifying administrations, on behalf of their nationals, through the ITU's Radiocommunication Bureau (RB) pursuant to the ITU's Radio Regulations. Within the framework of the Radio Regulations, the notifying administrations designate the orbit/spectrum resources required to satisfy what they determine to be their (ideally) actual requirements.

It then falls on the national administrations to allocates radio-frequency spectrum domestically in accordance with the relevant ITU regional plan, establish related service rules and to promulgate and apply licensing procedures to the space segment and earth stations of their networks (whether governmental or private) and to assume continuing responsibility for their networks under the ITU regime.

3.3. Core Principles of Radio-Frequency Assignments: Equity and Efficiency

The ITU Constitution sets forth the two main principles guiding radio-frequency allocation: the efficient use and equitable access to the spectrum/orbit resources.

First, the ITU requires that its members "endeavor to limit the number of frequencies and the spectrum used to the minimum essential to provide in a satisfactorily manner the necessary services."[21] Second, members are reminded that radio frequencies and any associated orbits, including the GEO, are limited natural resources and that "they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking into account the special needs of developing countries and the geographical situation of particular countries."[22] Lastly, it is provided that satellites are to be operated "in such a manner as not to cause harmful interference" to the radio services or communications of other member states.[23]

3.4. ITU Planning Procedures

There are two types of planning procedures: *a priori* planning for planned services and coordination procedures for unplanned services.

3.4.1. ITU Procedures for Planned Services[24]

The space service plans were developed in order to guarantee to all countries members of the ITU equitable access to the GEO and associated frequency resources for specific future satellite services, namely the fixed satellite service (FSS) and broadcasting-satellite service (BSS), in specific bands.[25] Plans provide for each country a pre-determined orbital position, frequency spectrum and service area (usually country territory) for future uses of FSS and

BSS. The allocation is aimed at preserving a certain amount of frequency spectrum for future uses by all countries, particularly those which are not in a position, at present, to make use of these resources.[26]

It has been noted, however, that, to date, few resources allocated to the Plans have in fact been used for the original purposes, i.e., mainly for national systems.[27]

3.4.2. ITU Unplanned Services Procedure

The principle of efficient, rational and cost-effective utilization was implemented through the unplanned services procedures which are aimed to ensure interference free operation of satellites. The Radio Regulations establish priority of use of defined radio-frequency spectrum at designated orbital slots based on a "first come – first served" procedure. If applied to genuine requirements, the procedure would serve to fill the gaps in the orbit as needs arise and would result, in principle, in a homogeneous orbital distribution of satellites in the GEO.[28]

The relevant procedure involves three basic steps:

(1) Advance Publication Procedure[29]

The aim of the first stage, known as "advance publication information" (API), is to inform all administrations of any planned satellite network and provide its general description. Member administrations are supposed to designate the volume of orbit/spectrum resources that is required to satisfy their actual requirements.[30] This procedure provides a formal mechanism whereby any administration can make a preliminary assessment of whether the planned networks is likely to pose any potential threat to existing terrestrial or satellite systems (including those already under coordination), in terms of orbital position and/or interference, and comment accordingly.[31] The advance information should reach the RB not earlier than five years and preferably not later than two years prior to the planned date of bringing the network into use.[32] When the information is complete it is published by the RB in the International Frequency Information Circular (IFIC) and a copy is sent to all ITU members.

Note that the advance publication process is the mandatory first phase of the ITU registration procedure but it does not give the notifying administration any rights or priority. Its main purpose is to inform all administrations of developments in the use of space radiocommunications.[33] Administrations have four months to comment on the proposed system.[34]

(2) Coordination of Frequency Assignments Procedure[35]

Coordination is the next step in the process leading up to notification of the frequency assignments for recording in the MIFR (Master International Frequency Register). The right to use a satellite position and associated frequency bands in unplanned services is acquired through negotiation with the administrations concerned by actual use of the same portion of the orbital segment and associated spectrum.

The coordination stage can be initiated not earlier than six months after the date of receipt by the RB of the complete information for advance publication[36] but in any case within a period of 24 months after the date of receipt of the API information.[37] This procedure is a mandatory regulatory obligation both for an administration seeking to assign a frequency assignment in its network[38] and for an administration whose existing or planned services may be affected by such assignment. The procedure involves a series of coordination meetings which generally result in adjustment of the technical parameters of the proposed new system to ensure it does not interfere with existing services. The ITU norms require administrations to negotiate in good faith and to make a genuine effort to achieve coordination.

(3) Notification and Recording Procedure[39]

The notification of frequency assignments presents the final regulatory step before recording into the MIRF. At this stage, the ITU perform a final verification that formal coordination has been successfully completed and that the system is still compliant with the Radio Regulations. If a favorable finding is reached, the system is recorded in the MIFR. If not, the notice is returned to the notifying administration which has then the option of continuing negotiations until a favorable outcome is achieved or no objections or complaints are made about the transmission within a four month period.[40] Note that the Radio Regulations allow operation of satellites on a non-interfering basis when all required coordination cannot be completed.[41]

Completion of the registration procedure, including the coordination and recording of frequency assignments in the MIFR establishes the rights and obligations of administrations in the domain of orbit/spectrum management and in particular the

international recognition and protection of their satellite system.[42] As exemplified by the ProtoStar case, lack of international protection can have devastating consequences. It has been noted that the aim of completing the ITU frequency registration process is "to prevent possible loss of investment, customers and revenue by minimizing the capacity that remains unusable due to potential interference."[43]

If a "filing" is not "developed" or "brought into use" within the applicable period (nominal period of 5 years and subject to potential 2-year extension for launch/satellite design problems), then priority is lost to the next "filing" in the queue.[44]

Once assignments have been recorded in the MIFR and actually brought into use, they remain in the MIFR for the "period of validity" of the network, which generally is meant to mean the lifetime of the satellite although some administrations have submitted "periods of validity" as long as 50 years.[45] The assignments can be renewed with the same technical characteristics for a new "period of validity".[46]

Note also that in accordance with RR 11.49, assignments that are not used must be suspended. Such suspension is for a maximum period of two years and if after such period the system is not brought back into use the assignment can be suppressed at the recommendation of the RB. Although this prerogative was seldom used in the past, in the last couple of years the ITU appears to display a more "get tough" approach.[47]

3.5. Resolution of Coordination Disputes

Article 11 of the Radio Regulations provides for an escalation procedure in case of coordination disputes arising between administrations. The administration responsible for the planned network shall first explore all possible means of meeting its requirements without the possibility of adjustment to networks of other administrations. If no such means are found, the administration concerned may request other administrations to mutually help resolve these difficulties. An administration receiving a request for coordination shall explore all possible means of meeting the requirements of the requesting administration by relocating one or more of its own satellites or by changing the frequency usage. If difficulties remain unresolved, the administrations concerned shall together make every possible effort to resolve these difficulties by means of mutually acceptable adjustments.

In the event administrations cannot amicably resolve their differences, the ITU Convention provides that they may settle their dispute by mutually agreed method or by mutually agreeing to arbitration. An administration may request that the dispute be submitted to compulsory arbitration according to the procedures of the Optional Protocol for Compulsory Settlement of Disputes only if the administrations involved in the dispute have ratified the Optional Protocol.[48]

3.6. ITU's (Lack of) Enforcement Authority

The important aspect to note is that the ITU does not, and has no authority to, impose sanctions or otherwise enforce its Radio Regulations or other applicable rules and cannot exercise any real control over how a member State uses its orbit/spectrum assignment.[49] Compliance is ensured through the goodwill, to the extent available, of the member states.[50] Given that ITU lacks an enforcement mechanism, it was rightly noted that it can only legitimize, rather than guarantee, a spectrum use and orbital slot registration.[51]

Although rare, cases of malign, intentional interference do exist. In a recent instance, Iran was accused by Eutelsat of attempting to block broadcasting it did not approve of.[52] The ITU Radio Regulations Board was called to weigh in this matter and it concluded that "the interfering signals appear to be of a nature that is prohibited under Radio Regulations No. 15.1" and urged the Administration of Iran "to continue its effort in locating the source of interference and to eliminate it as a matter of the highest priority."[53] It appears that the issue has been resolved as a result of diplomatic pressure.

IV. DEFICIENCIES IN THE CURRENT INTERNATIONAL SATELLITE SPECTRUM MANAGEMENT REGIME

The current regulatory procedures were developed in the 1970s. As the occupancy of the orbits increased and demand for satellite services grew, various types of abnormal behavior emerged in international satellite network registration[54] as discussed below.

4.1. The Overfiling Problem

This phenomenon consists of registering unneeded uses and has the effect of foreclosing others, who have near-term needs, from achieving conflict-free registrations. A recent survey of the ITU Space Radiocommunication Stations (SRS) database which contains information relating to satellite networks

submitted to the RB indicated that less than 20% of networks at the advance publication information (API) stage will successfully complete the notification and recording procedures.[55]

The strong demand for satellite-based services combined with a lengthy international coordination procedure has led to deliberate and routine filing of requests for coordination for orbital positions and frequencies that are not actually needed with a view of "reserving" (and thus "freezing") those positions and frequency bands for possible future uses or for commercial resale to another user at a later date.[56] Filing for the registration of orbital slots for satellites with no realistic probability of launch is sometimes referred to as the "paper satellite" phenomenon. Warehousing of spectrum and filing "paper satellite" registration have a double harmful effect: on the one hand they block productive use by others with near-term needs and on the other hand they thwart later-in-time registration by developing nations whose requirements and ability to finance usage typically arise after developed countries have already enjoyed first choice opportunities.[57] The existence of a large number of "paper satellites" hinders the speedy coordination of legitimate satellite networks and can add significantly to the costs associated with such coordination.[58] Since "paper satellites" which have completed the coordination process are listed in the MIFR just as if they were real systems, their operating parameters and requirements need to be taken into account when coordinating new real-life systems, generating unnecessary work and triggering technical problems for genuine networks.[59]

Sources within the ITU have acknowledged that there is no real incentive to give up unused or underused spectrum/orbit resources or update their satellite network parameters at the stage of notification and recording of assignments in the MIFR in order to accurately reflect the intended satellite operations.[60] Also, the ITU cannot readily discipline its members for "papering" the registration system with spectrum registrations designed to foreclose uses by operators in other countries.[61] When exercise of goodwill is linked to negative financial consequences, enforcing mechanisms based on such goodwill tend to be disregarded.[62]

4.3. Undermining the coordination process

Independent information available today on the real use of the spectrum/orbit resource shows that administrations that file the request for coordination and subsequently the request for notification information to the ITU do not necessarily provide actual operational parameters, but file for the worst case sharing scenario of their satellite networks, *i.e.*, maximum and minimum values which in practice are never utilized.[63] This results in impractical maximum and minimum operating margins, unspecific coverage, and wide range of unused frequency bands' data of planned/operating satellite networks submitted in the request for coordination and notification processes.[64] This leads sometimes to absurd coordination requirements since each planned network needs to take into account the frequencies and positioning requirements of all other systems registered in MIFR, including "paper satellites".[65]

Coordination of radio frequencies is an inherently political process often akin to bilateral trade negotiations. Concerns were expressed regarding extensive reliance on negotiation as a form of dispute resolution given the potential for inconsistent results across similar disputes and the tendency for negotiation power to supersede reasoned outcomes.[66] Severe difficulties arise if the responding administration wishes to secure full flexibility for its own operator(s) by insisting on significantly high transmission levels – as against low transmission levels for the requesting administration's operator – all across the relevant frequency band. The discrepancy between high power levels for one operator and low power levels for the other would practically prevent the requesting administration's operator from providing any services in the filed bands and service area: it would simply not be able to operate.[67] Thus, sometimes, this allows for the responding administration to secure anti-competitive advantages for its satellite operators.[68]

4.4. Bypassing "Bring into Use" Deadlines by Using In-Orbit Satellites

It is becoming relatively standard practice to use an existing in-orbit satellite (usually called a "floater") to "bring into use" assignments of a filing about to expire in case in which due to extended delays the satellite cannot be launched within the 7-year timeframe allowed under the Radio Regulations.[69] This practice raised questions regarding what type of in-orbit satellite can be used, to what extent should the technical characteristics of such satellite reflect the filed characteristics of the network whose assignments are being brought into use and how long should such "floater" be left in location? "floater". The RB clarified to a certain extent some applicable requirements by specifying that the date of bringing into use denotes the date at which the frequency assignment is brought into "regular operation" to provide the published

radiocommunication service with the technical parameters within the technical characteristics notified to the RB.[70]

4.5. Growing Secondary Markets for Orbital Rights

Given the scarcity of available orbital slots and associated frequencies, many new comers approach administrations of States other than those of their country of incorporation or other licensees (operators who have valid assignments of rights from their governments) to acquire orbital rights. Some of the countries who received planned allotments under Appendix 30B *a priori* procedure and have no immediate space capabilities are getting into this secondary market of licenses. The regime governing the transfer or assignment of licenses varies from country to country. For example, the FCC in the US (and most other sophisticated licensing regimes) involve "personal" licenses granted to specific entities and license transfer/assignment requires prior FCC consent.

V. POSSIBLE REMEDIAL ACTIONS

Several mechanisms and practical strategies to ensure efficient use of the spectrum/orbit resource and to improve the current international satellite spectrum management systems have been proposed in various fora.

5.1. Technical options

Various technical proposals have been advanced by the industry, such as assisting the ITU in defining realistic operating parameters for satellite services, including the typical maximum and minimum operating parameters for different types of services, which would result in administrations filing for more realistic operating parameters within these margins.[71] In turn, this would allow for a more realistic examination of the aggregate interference among adjacent satellite networks and thus, a more efficient sharing of overlapping frequency bands between satellite networks would be possible.[72]

5.2. Regulatory Options

5.2.1. Simplifying the Radio Regulations

One proposal is to simplify the existing Radio Regulations procedure, *e.g.*, to eliminate the six-month regulatory period between the submission of advance publication information and the coordination request.

5.2.2. Establishing an International Satellite Monitoring System

Another suggestion was to establish an international satellite monitoring system to assist administrations in resolving interference and orbit occupancy issues. Satellite operators with monitoring systems in place could be invited to provide the ITU, for example, monitoring service for a fee.[73] It was also suggested that the ITU maintain in the RB's database updated records of satellite launches and changes in longitude of the GEO satellites.[74]

Such a system will likely constitute a deterrent for filing of "paper satellites" and also allow for a clean up of the filings already submitted. In addition, the monitoring system would be useful in resolving satellite interference disputes between administrations in cases raised before the RB.

5.2.3. Introduction of Additional Due-Diligence Milestones

The ITU already made an attempt to address the problem of reservation of orbit and spectrum capacity without actual use by adopting its Resolution 49. This resolution asks an administration to send to the RB due diligence information relating to the identity of the satellite network and the spacecraft manufacturer; delivery date of satellite, launch provider and launch date; this information is to be submitted as early as possible before bringing into use.[75]

However, it has been noted that this Resolution does not provide sufficient guarantees that the "paper satellite" phenomenon will be effectively discouraged.[76] Therefore, additional milestones have been suggested to provide clear evidence of satellite construction, completion of critical design review and successful launch and in-orbit deployment of satellites.[77]

VI. THE FUTURE ROLE OF INTERNATIONAL COOPERATION IN FREQUENCY SPECTRUM USAGE

It is widely recognized that the frequency spectrum is a highly valuable resource for the satellite industry. We are faced with the problem for spectrum/orbit congestion, therefore the coordination of non-planned services is extremely complicated. Radio-interference affects all parties involved, thus appears to be a practical motivation to attempt to cooperate in avoiding harmful interference. Also, finding the right balance between ensuring efficient use of the spectrum while allowing for an equitable distribution

of the resources appears to be a tremendous challenge.[78]

Nations collectively and individually have rejected a market-driven model for allocating, registering and coordinating frequency usage and they entrusted the ITU with establishing and administering mechanisms for achieving an interference-free – or more precisely interference-controlled - environment for satellite operation. The current regime seems to be out-of-date and inadequate to a certain extent. However, mechanisms and practical strategies have been suggested and can be employed to improve the current international satellite spectrum management system.

One aspect that appears to be central to many critics of the current regime is ITU's lack of enforcement powers. It has been proposed to introduce in the Radio Regulations more deterrent enforcement mechanisms and administrative measures particularly against the use of orbit and spectrum resource that is not in compliance with the Radio Regulations. However, it is likely that national administrations will be reluctant to relinquish further their sovereign rights and confer more rights to the ITU.

Given the lack of realistic prospect of allowing the ITU enforcement powers, the essential element to consider is that the ITU provides the necessary forum for international cooperation among its members which can allow parties to ensure that frequencies and orbital positions are compatible and do not result in harmful radio interference. Within this forum, genuine international cooperation is always the key element. The importance of operating within a framework of trust and goodwill cannot be stressed enough.[79]

Undoubtedly, the role that the ITU will play in addressing various regulatory challenges arising from increasing satellite operations will likely have to adapt to the future needs of the industry and may involve playing an enhanced role in the frequency allocation and registration/coordination of orbit/spectrum use and in the development of improved global technical standards and operational practices. Given its expertise and credentials, the ITU appears to be the best suited forum within which national administrations and satellite industry are encouraged to consult and cooperate in ensuring the adoption of consistent and efficient coordination regimes, licensing policies and standardization processes.

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[1] Broadband satellites transmit high-speed data and video directly to consumers and business. Markets for broadband applications also include interactive TV, wholesale telecommunications, telephony and point-of-sale communications, such as credit card transactions and inventory control.

[2] Direct-broadcast services (DBS) transmit signals for direct reception by the general public, such as satellite television and radio.

[3] Satellites providing Fixed-Satellite Services (FSS) transmit radio communications between ground Earth stations at fixed locations.

[4] Mobile Satellite Services (MSS) use a single geostationary or a constellation of lower earth orbit satellites that provide communications services to mobile and portable wireless devices, such as cellular phones and global positioning systems.

[5] Environmental monitoring satellites carry highly sensitive imagers and sounders to monitor the Earth's environment, including the vertical thermal structure of the atmosphere, the movement and formation of clouds, ocean temperatures, snow levels, glacial movement and volcanic activity.

[6] Futron Corporation, *State of the Satellite Industry Report*, June 2010. Online: Futron <http://www.futron.com/upload/wysiwyg/Resources/Reports/SSIR_2010.pdf> (date accessed: 3 September 2010) [hereinafter *Futron Report*].

[7] Despite a worldwide economic slowdown and slightly slower growth in subscriptions for consumer services, satellite services revenues, led by satellite TV growth, grew 11% from 2008 to 2009. Other types of satellite services, such as satellite radio, broadband satellite internet revenues mobile satellite services and remote sensing, also recorded growth. *Futron Report*, *supra* note 6.

[8] Milton L. Smith, III, "The Orbit/Spectrum Resource and the Technology of Satellite Telecommunications: An Overview", 12 Rutgers Computer & Tech. L. J. 285 (1987) at 289.

[9] ProtoStar, a Bermuda corporation with US operations in San Francisco and Asian operations headquartered in Singapore., acquired and was planning on operating high-power GEO satellites to provide direct-to-home satellite television in the Asia-Pacific region. After losing the support

of the Singapore administration in securing orbital rights over the 98.5°E orbital location for its ProtoStar-1 satellite under the current international regime (described below), ProtoStar decided to go ahead with the scheduled launch of its satellite without completing the required coordination procedure. Opposition to ProtoStar 1's filing came most forcefully from China. The 98.5°E is immediately adjacent to AsiaSat's 100.5°E slot where AsiaSat-2 operates. Subsequent allegations of interference with a Chinese satellite and an unfavorable environment for negotiation resulted in ProtoStar's beams being shut down as a result of international pressure. This prevented the company from generating more revenue, which in turn caused it to default on some of its bond payments and eventually forced the company into Chapter 11 bankruptcy proceedings.

[10] Martin A. Rothblatt, "Satellite Communication and Spectrum Allocation" (1982) 76(1) Am. J. of Int'l. L. 56 at 56.

[11] Roscoe M. Moore, "Business-Driven Negotiations for Satellite System Coordination: Reforming the International Telecommunication Union to Increase Commercially Oriented Negotiations over Scarce Frequency Spectrum" (1999) 65 J. Air L. & Com. 51 at 56.

[12] There are different levels of interference but the threshold in the radiocommunication world is set but what is called "harmful interference", term referring to interference between two operating radio frequencies that seriously degrades, obstructs or repeatedly interrupts either or both services. Hamadoun I. Touré, ITU Secretary-General, "Towards a Norm of No Harmful Interference", Speech at UNIDIR-Space Security 2009: Moving towards a Safer Space Environment (Geneva, Switzerland, 15 June 2009). Online: International Telecommunication Union < http://www.unidir.ch/pdf/conferences/pdf-conf99.pdf> (date accessed: 3 September 2010).

[13] In 1980s, six degrees of orbital separation between GEO satellites was considered crowded. Today, the ITU is dealing with spatial separation of as little as 0.5° in the so called "high quality" slots that position satellites to reach the largest number of potential users. *Ibid.*

[14] As an indicator, in 2009, 41 commercial GEO satellites were ordered for future delivery, almost double the orders announced in 2008. *Futron Report*, *supra* note 6.

[15] It has been widely acknowledged that in recent years it has become increasingly difficult for administrations to obtain suitable new GEO positions and frequency assignments and fully coordinate them in accordance with applicable international regulations. Attila Matas, ITU Radiocommunication Bureau, Presentation at the ITU Radiocommunication Bureau Workshop on the Efficient Use of the Spectrum/Orbit Resource (Geneva, 6 May 2009). Online: The International Telecommunication Union <http://groups.itu.int/br-ssd> (date accessed: 3 September 2010).

[16] Yvon Henri, "Orbit/Spectrum Allocation Procedures Registration Mechanism", 19th International Wroclaw Symposium on Electromagnetic Compability 2008 (Wroclaw, Poland, 12 June 2008). Online <http://www.emc.wroc.pl/files/WroclawEMC2008_Ses_ITU1_1.pdf> (date accessed: 3 September 2010).

[17] *Convention of the International Telecommunication Union* (Geneva, 1992) as amended by subsequent plenipotentiary conferences [hereinafter *ITU Convention*].

[18] *Constitution of the International Telecommunication Union* (Geneva, 1992) as amended by subsequent plenipotentiary conferences [hereinafter *ITU Constitution*], Article 1.

[19] *ITU Constitution*, Article 1.

[20] In general terms, the *Radio Regulations* distinguish between geostationary and non-geostationary satellite networks and makes them subject to different regulatory regimes in many instances. This paper deals only with the rules applicable to the GEO networks unless specifically specified otherwise.

[21] No. 195 of the *ITU Convention*, Article 44.

[22] No. 196 of the *ITU Convention*, Article 44.

[23] No. 197 of the *ITU Convention*, Article 44.

[24] Appendices 30, 30A and 30B of the *Radio Regulations*.

[25] The Allotment Plan for the fixed-satellite service using part of the 4/6 and 10-11/12-13 GHz frequency bands is contained in Appendix S30B. The Plan for the broadcasting-satellite service in the frequency band 11.7-12.7 GHz (Appendix S30) and the associated Plan for feeder links in the 14 GHz and 17 GHz frequency bands (Appendix S30A).

[26] Henri, *supra* note 16.

[27] Yvon Henri, "Background Paper", ITU Radiocommunication Bureau Workshop on the Efficient Use of the Spectrum/Orbit Resource (Geneva, 6 May 2009). Online: The International Telecommunication Union

<http://groups.itu.int/br-ssd> (date accessed: 3 September 2010).

[28] Henri, *supra* note 16.

[29] Section I, Article 9, *Radio Regulations*.

[30] The administration responsible for the planned satellite network must submit to the Radiocommunication Bureau, for publication, the information stipulated in Appendix 4 to the *Radio Regulations*.

[31] Yvon Henri, *supra* note 16.

[32] No. 9.1, Article 9, *Radio Regulations*.

[33] No. 9.5A, Article 9, *Radio Regulations*.

[34] No. 9.3, Article 9, *Radio Regulations*.

[35] Section II, Article 9, *Radio Regulations*.

[36] No. 9.1, Article 9, *Radio Regulations*.

[37] No. 9.5D, Article 9, *Radio Regulations*.

[38] The proposing administration must complete a form providing detailed system characteristics, including the characteristics of earth stations and their proposed location. Appendix 4 of the *Radio Regulations*.

[39] Article 11, *Radio Regulations*.

[40] Nos. 11.36-11.38, Article 11, *Radio Regulations*.

[41] No. 11.41, Article 11, *Radio Regulations*.

[42] Touré, *supra* note 12.

[43] Yvon Henri, "Long-Term Efficiency of the Space Regulatory Framework". Online: The International Telecommunication Union < http://www.itu.int/ITU-R/information/promotion/e-flash/2/article6.html> (date accessed: 3 September 2010).

[44] Note that Articles 9 and 11 of the *Radio Regulations* do not make reference to monitored information for satellite networks and thus monitored information has no regulatory status. The RB takes the word of an administration at face value as to whether or not an assignment has been brought into use.

[45] Jorn Christensen, Yat Hung Chan, Rui Zhang, "Regulatory Factors Affecting the Efficient Use of the Orbit/Spectrum Resource". Online: The International Telecommunication Union <http://www.itu.int/en/ITU-R/space/workshopEfficientUseGeneva/wseffuse09014.pdf> (date accessed: 3 September 2010).

[46] ITU *Resolution 4*.

[47] Gerry Oberst, "Efficient Use of Satellite Slots", Via Satellite (1 July 2009). Online: Satellite Today <http://www.satellitetoday.com/via/globalreg/Efficient-Use-of-Satellite-Slots_31298.html> (date accessed: 3 September 2010). For example, in 2009 the BR proposed to cancel registrations filed by France for Eutelsat covering satellites (that apparently did not exist) at orbital slots of 44, 48 and 76 degrees East longitude. The BR action was prompted by claims from Malaysia and Belarus according to which there has been no Eutelsat satellites at those orbital locations for four or five years preceding the notification.

[48] *Optional Protocol on the Compulsory Settlement of Disputes Relating to the Constitution of the International Telecommunication Union, to the Convention of the International Telecommunication Union, and the Administrative Regulations* (Geneva, 1992), text available online: The International Telecommunication Union <http://www.itu.int/net/about/basic-texts/optional-protocol.aspx> (date accessed: 3 September 2010). Roughly, half of the ITU members are signatories to the Optional Protocol.

[49] Steven A. Levy, "Institutional Perspectives on the Allocation of Space Orbital Resources: The ITU, Common User Satellite Systems and Beyond" (1984) 16 Case W. Res. J. Int'l L. 171 at 186.

[50] It was noted that if the ITU can be "compared to a traffic officer, it is an officer unable to adequately measure the traffic, whose 'tickets' for violations are often ignored and who lacks not only a jail but also a court for offenders." David M. Leive, *International Telecommunications and International Law: The Regulation of the Radio Spectrum* (1970) at 22 n. 8 cited in Jannat C. Thompson, "Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing" (August-September, 1996) Journal of Air Law and Commerce 279 at 290.

[51] Rob Frieden, "Balancing Equity and Efficiency Issues in the Management of Shared Global Communication Resources", 24 U. Pa. J. Int'l Econ. L. 289 (Summer, 2003) at 303.

[52] Eutelsat, Eutelsat Statement on Transmission of BBC Persian, Deutsche Welle and Voice of America Persian (22 March 2009). Online: Eutelsat <http://www.eutelsat.com/news/compress/en/2010/pdf/PR1310_BBCPersian_VOA-update.pdf> (date accessed: 3 September 2010).

[53] Eutelsat, "ITU Radio Regulations Board Urges Iran to End Interference Hampering EUTELSAT Satellite Operations". Online: Eutelsat <http://www.eutelsat.com/news/compress/en/201

0/pdf/PR1310-statement-BBC-Persian.pdf> (date accessed: 3 September 2010).

[54] Henri, *supra* note 43.

[55] Henri, *supra* note 27.

[56] *Ibid.*

[57] Frieden, *supra* note 51 at 297.

[58] The International Telecommunication Union, "Paper Tigers: The Scramble for Space Spectrum". Online: The International Telecommunication Union, <http://www.itu.int/newsarchive/pp02/media_information/feature_satellite.html> (date accessed: 3 September 2010).

[59] *Ibid.*

[60] Henri, *supra* note 27.

[61] Frieden, *supra* note 51 at 303-304.

[62] Henri, *supra* note 43.

[63] Teh Chin Eng, Presentation at the BR Workshop on the Efficient Use of the Spectrum/Orbit Resource, Geneva, (6 may 2009). Online: The International Telecommunication Union < http://www.itu.int/en/ITU-R/space/workshopEfficientUseGeneva/wseffuse09017.pdf> (date accessed: 3 September 2010).

[64] *Ibid.*

[65] For example, for a particular satellite network received by the ITU in June 2007, the coordination requirement consisted of 40 administrations and 600 networks. Completion of coordination for such requirements is extremely difficult. Henri, *supra* note 27.

[66] Lawrence D. Roberts, "A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union" (Fall 2000) Berkeley Technology Law Journal 1095 at 1121.

[67] Omri Arnon & Yizhar Tal, AMOS-Spacecom, Israel, "Frequency Coordination and the Role of the Responding Administration: Mere Goodwill or Regulatory Obligation?", presentation at the BR Workshop on the Efficient Use of the Spectrum/Orbit Resource, Geneva, (6 May 2009). Online: The International Telecommunication Union <http://www.itu.int/en/ITU-R/space/workshopEfficientUseGeneva/wseffuse09017.pdf> (date accessed: 3 September 2010).

[68] It has been noted that space spectrum resources tend now to be considered as an administration or company share value and might increasingly be used, to a certain extent, to impede competition. Henri, *supra* note 27.

[69] Christensen et al., *supra* note 45.

[70] WRC-2000.

[71] Based on practical experience, it appears that satellites providing a particular type of satellite service (*e.g.*, FSS, BSS or MSS) and within particular frequency bands (C-band or Ku-band) tend to have homogenous operating parameters. Eng, *supra* note 53.

[72] *Ibid.*

[73] *Ibid.* Note that several major satellite operators, including Intelsat, SES and Inmarsat, joined forces to create a database to combat interference. Peter B. de Selding, "Satellite Operators to create Database to combat Interference", *Space News* (2 November 2009) at 20.

[74] Henri, *supra* note 27.

[75] Note also BR Circular Letter CR/301 (1 May 2009) regarding removal of unused frequency assignments (space services) from the Master Register.

[76] It has been noted, for example, that Resolution 49 instead of asking what frequency assignments have been brought into use, it asks what frequency bands have been brought into use and this procedure leaves room for abuse. Christensen et al., *supra* note 45.

[77] Radiocommunication Bureau Workshop on the Efficient Use of the Spectrum/Orbit Resource (Geneva, 6 May 2009). Online: The International Telecommunication Union <http://groups.itu.int/br-ssd> (date accessed: 3 September 2010).

[78] It was noted that the "task of ensuring equitable access while guaranteeing the efficient use of the orbit/spectrum resource requires a delicate balance of politics, the observation of relevant international law, the protection of current users from harmful interference, adaptation to new technology and above all, maximization of efficiency in order to best utilize a limited resource." Jannat C. Thompson, "Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing" (August-September, 1996) Journal of Air Law and Commerce 279 at 310.

[79] See for example, the positive example of efficient cooperation between Intelsat and SES in avoiding interference posed by the Galaxy 15 satellite that started drifting out of control in April of 2010 while still having the C-band payload fully functional.