
SCARCITY IN SPACE: THE INTERNATIONAL REGULATION OF SATELLITES

Adrian Copiz*

I. INTRODUCTION

A recently identified natural resource—the orbit-spectrum—is at the center of an increasing number of conflicts that have exposed the need to revise the relevant regulatory system in light of international legal principles. In determining what kind of regulatory system is most appropriate, there are three main levels of legal discussion. First, examination of international legal principles reveals a basic framework for an effective regulatory regime. Yet, some principles are contradictory; where contradictions occur—most notably between the principles of efficient utilization and equitable access—this article argues that the principle of efficient utilization ought to be given greatest credence. Second, the discussion focuses on whether an *a posteriori* system or an *a priori* system is best supported by the legal principles. An *a posteriori* system is essentially a first-in-time, first-in-right method based on the publication, coordination and notification procedures of the International Telecommunications Union (“ITU”); an *a priori* system is a planned or engineered system that allocates nominal orbital positions to various countries, whether or not a country has an immediate need or capability to use the position. This article argues that the current *a posteriori* system is the most appropriate. Third, accepting that the *a posteriori* system is appropriate, the discussion then revolves around possible revisions to the *a posteri-*

ori system. In doing so, this article proposes that revisions should focus on the efficient utilization of the orbit-spectrum, as can be best realized through strong enforcement mechanisms and stimulation of technological innovation.

As will be discussed in greater technical depth, the limited orbit-spectrum resource¹ is exploited through the simultaneous use of geostationary orbit (“GSO”) and the electromagnetic spectrum, which are both independently scarce resources.² The orbit-spectrum is one of society’s valuable natural resources. Through orbit-spectrum use, artificial satellites provide numerous services to society through many key functions including: telecommunications, direct broadcasting and remote sensing. The GSO is especially valuable because satellites in GSO, which appear stationary to an observer on Earth, do not need to be tracked, provide a continuous link to Earth stations and are generally less expensive to operate than satellites in other orbits.³ Arthur C. Clarke, a British military officer and science fiction author,⁴ referred to the belief that three satellites placed equidistant in GSO could provide for worldwide communications “as the central nervous system of mankind.”⁵ Not only do satellites perform vital functions for contemporary society, but the satellite industry is a rapidly growing sector of the global economy.⁶

Along with the tremendous growth in the satel-

* Adrian B. Copiz is a telecommunications attorney practicing with the law firm of McGuireWoods LLP.

¹ CHARLES H. KENNEDY & M. VERONICA PASTOR, AN INTRODUCTION TO INTERNATIONAL TELECOMMUNICATIONS LAW 47 (1996) [hereinafter KENNEDY & PASTOR].

² Martin A. Rothblatt, *Satellite Communication and Spectrum Allocation*, 76 AM. J. INT’L L. 56 (1982) [hereinafter Rothblatt]. This is a scientifically derived, functionalist definition that reflects how the dual nature of the resource dictates that orbital-spectrum regulation considers both orbital position and frequency.

³ RACHAEL E. SCHWARTZ, WIRELESS COMMUNICATIONS IN

DEVELOPING COUNTRIES: CELLULAR AND SATELLITE SYSTEMS 130 (1996) [hereinafter SCHWARTZ].

⁴ *Id.* at 129.

⁵ RITA LAURIA WHITE & HAROLD M. WHITE, JR., THE LAW AND REGULATION OF INTERNATIONAL SPACE COMMUNICATION 3 (1988) [hereinafter WHITE & WHITE]. Clarke used the phrase in a speech at the signing of the Definitive Arrangements for INTELSAT in 1971. *Id.*

⁶ *£9 Million Programme to Boost British Satellite Communications Sector*, INTERFORUM NEWS, at <http://www.interforum.org/news%202000/marn3.htm> (Mar. 2, 2000) [hereinafter INTERFORUM]. According to Interforum, it

lite industry, orbit-spectrum conflicts have been on the rise, stemming directly out of the scarce nature of the orbit-spectrum.⁷ For example, PanAmSat Corp's PAS-4 satellite experienced interference⁸ from a Russian Stationary 20 satellite. Although a spokesman for PanAmSat said that the interference did not affect customers, the Russians did not respond to initial requests from PanAmSat to coordinate satellites.⁹ In another instance, APT Satellite of China experienced interference with its Apstar 1A satellite allegedly caused by a Palapa satellite used by Pasifik Satelit Nusantara of Indonesia. Pasifik, however, accused APT of moving a satellite into an orbital slot at 134 degrees E.L., which was already claimed by Pasifik.¹⁰ Another conflict occurred when the Malaysian Measat satellite was designed to operate on a frequency that was already used by an Australian satellite in close orbital proximity. Although the problem was resolved just before launch, the Malaysian owners were in favor of launching the satellite even if the problem was not resolved.¹¹ In another case, Asiasat of Hong Kong had "difficult negotiations with Thailand trying to coordinate satellites located at 77.5 and 78.5 degrees."¹² Because the distance between the satellites was likely to cause "serious interference . . . Asiasat [] tried to negotiate a technical solution even though it claim[ed] first priority to the slot."¹³

is estimated that by 2010 the "global satellite communications market is expected to be worth more than £ 140 billion per year" (\$200 billion based on conversion rate during August of 2001); see also *UK Satellite Companies Receive Aid*, SATELLITE NEWS, Mar. 6, 2000, at Vol. 23 No. 10 (describing the potential growth of the satellite industry).

⁷ Nandasiri Jasentuligara, Director of the U.N. Office for Outer Space Affairs, in a speech given at the McGill University Institute of Air and Space Law, in 22 ANNALS AIR & SPACE L. 359 (1997) ("A problem that is sure to dramatically escalate disputes related to activities in outer space is that of the growing shortage of suitable orbital slot positions for satellites, especially in the GSO."). Lawrence D. Roberts, *A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union*, 15 BERKLEY TECH. L.J. 1095, 1125-29 (2000) [hereinafter Roberts] (analyzing developing nations' efforts to secure greater access to GSO); see also Audrey L. Allison, *Meeting the Challenges of Change: The Reform of the International Telecommunications Union*, 45 FED. COMM. L.J. 491, 495 (1993) [hereinafter Allison] (discussing developing nations' demand for greater access to "ITU resources").

⁸ MARC A. FRANKLIN, CASES AND MATERIALS ON MASS MEDIA LAW 537 (1977) [hereinafter FRANKLIN]. Interference is a distortion of a signal that occurs when satellites using the same frequency are operating too close to each other. See text *infra* pp. 210-11.

⁹ *ITU System of Satellite Coordination Eroding Fast in Asia Pa-*

Many orbit-spectrum conflicts occur because the regulatory system is in need of further improvement. Not only has the current system led to practical problems in orbit-spectrum use, but also the way the system is designed has led to abuse. For example, entities have exploited the current regulatory system to traffic in orbital locations and to file too many applications for limited orbital positions. When this happens under an *a priori* system, in which countries can reserve their own orbital positions, valuable orbit-spectrum goes unused or it may be used, but at a higher cost to the end-user. A notable case of this problem is when the Kingdom of Tonga, a small Pacific island nation, registered for 16 GSO allotments with the ITU.¹⁴ From 1988 to 1990, when Tonga made the filings on behalf of Friendly Islands Communications ("Tongasat"), the ITU system permitted a country¹⁵ to register a position for up to nine years before a satellite was launched.¹⁶ Tonga's action "outraged" the international community because it "lacked a genuine need" for so many orbital allotments in the Pacific Rim portion of the GSO.¹⁷ Tonga eventually withdrew its request for ten of the sixteen allotments, and, in 1991, it acquired six allotments.¹⁸ But, Tongasat further angered the international community by leasing one allotment to Unicom, a Colorado company, and auctioning off the remaining five allotments "for

cific, SPACE BUSINESS NEWS, Apr. 2, 1997, 1997 WL 8214983 [hereinafter *ITU System of Coordination*]. Coordination operates on a nation-to-nation system of espousal in which the U.S. took PanAmSat's complaint to the Russian government. *Id.*

¹⁰ *Id.*; see also *Crowded Orbital Slots Test ITU's Influence*, SPACE NEWS, Jan. 27, 1997, 1997 WL 9051757.

¹¹ *ITU System of Coordination*, *supra* note 9.

¹² *Id.*

¹³ *Id.* In discussing the negotiations, Sabrina Cubbon, of Asiasat, said that Asian operators are becoming increasingly aggressive in disregarding the rules with "no intention of coordinating. They just buy satellites and launch them." *Id.* Also, according to an official of a U.S. satellite firm, "[t]he operators in Asia are thumbing their nose at the ITU." *Id.*

¹⁴ Albert N. Delzeit & Robert F. Beal, *The Vulnerability of the Pacific Rim Orbital Spectrum Under International Space Law*, 9 N.Y. INT'L L. REV. 69, 70 (1996) [hereinafter Delzeit & Beal].

¹⁵ *Id.* Tongasat was owned by Dr. Matt Nilson, an American entrepreneur, who retired in Tonga. *Id.* at 70-71; see also Jannat C. Thompson, *Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing*, 62 J. AIR L. & COM. 279, 280-81 (1996) [hereinafter Thompson].

¹⁶ *ITU Aims for Stiffer Telecommunications Satellite Rules*, NIKKEI ENGLISH NEWS, Apr. 2, 1997, at *1.

¹⁷ Delzeit & Beal, *supra* note 14, at 71.

¹⁸ Thompson, *supra* note 15, at 280-81.

\$2 million per year for each orbit."¹⁹ INTELSAT, "the world's largest satellite operating consortium,"²⁰ claimed that Tongasat was engaging in "financial speculation in the geo-stationary orbit" in violation of ITU regulations.²¹ Columbia Communications filed a petition with the Federal Communications Commission ("FCC"), which "request[ed] that the FCC deny applications for landing rights"²² in the United States by any satellite operated pursuant to an allotment leased from Tongasat.²³ In response, Rimsat, Ltd., a company which had leased one of Tongasat's allotments, accused INTELSAT and Columbia Communications of taking anti-competitive measures.²⁴ The situation was further complicated when Indonesia transferred its Palapa B1 satellite into an allotment already claimed by Tongasat.²⁵ This example of orbit-spectrum conflict reveals the divergent opinions surrounding the regulation of the orbit-spectrum. Because no clear agreement exists among industry stakeholders, reform is particularly challenging. Yet, as this article will demonstrate, international legal principles provide guidance in reforming the orbit-spectrum regulatory system.

As the regulatory system and legal principles are discussed, reference will be made to the coordination problems and the Tonga incident to better illustrate the relevant legal issues. Prior to the legal discussion, Section II describes the orbit-spectrum's physical characteristics, and Section III examines the regulatory system from its early development to current structure. Section IV addresses the main legal issues and then the pro-

posed revisions. These proposed revisions are important for improving the regulation of the orbit-spectrum and have ramifications for space law in general. Solving the current conflicts in the orbit-spectrum by way of the international legal principles may encourage further exploration and commercialization of space by showing that it is possible to establish legal regimes in space and by affirming legal principles that will be applicable to other space ventures.

II. THE ORBIT-SPECTRUM RESOURCE

A. The GSO

The GSO was first identified by H. Noordwig, an Austrian engineer who, in 1929, determined that a satellite at an altitude of approximately 35,800 km above the equator would appear stationary when viewed from Earth.²⁶ More precisely, a satellite in GSO is located at 35,780 km above the equator, which is 42,164 km from the center of the Earth or a total of 6.61 Earth radii.²⁷ A satellite's velocity in GSO is equal to the Earth's velocity moving in an eastward direction.²⁸ The period of the orbit of a satellite in GSO is one sidereal day, which is 23 hours, 56 minutes and four seconds.²⁹ Any orbit with this period is called a geosynchronous orbit and may be either elliptical or inclined to an arbitrary degree; GSO specifically referred to herein is a special case of geosynchronous orbit because it has a circular orbit and no inclination above the equatorial plane.³⁰ The circumference of the orbit, which is necessary in

¹⁹ *Id.* at 281.

²⁰ *Id.* INTELSAT, a private company as of July 18, 2001, is an international organization with 144 member countries. Formed by treaty, INTELSAT originally provided satellite services on a commercial basis and divided the profits among member countries. In the mid 1990s, INTELSAT provided nearly two-thirds of the world's telecommunications services. *Id.* at 281 n.8; *see also* PanAmSat Corp., Comment, *Market for Satellite Communications and the Role of Intergovernmental Satellite Organizations*, submitted to the National Telecommunications and Information Administration, in Dkt. No. 000410098-0098-01 (May 8, 2000) available at <http://www.ntia.doc.gov/ntiahome/occ/oecd2000/panamsat/panamsat508.htm>; *see generally* INTELSAT.com, at <http://www.intelsat.com> (last visited Jan. 12, 2002) (INTELSAT's affiliate, New Skies Satellites, N.V., currently operates five satellites); www.newskies.com, at <http://www.newskies.com> (last visited Sept. 18, 2001).

²¹ Thompson, *supra* note 15, at 280-81.

²² *Id.* at 281 n.10. Landing rights refer to permission for satellites in certain positions to communicate with Earth sta-

tions located in specific countries.

²³ *Id.* at 281.

²⁴ *Id.* at 282. Rimsat, Ltd. defended Tongasat in part because Rimsat had a financial interest in Tongasat's allotments. Furthermore, at about the same time that Dr. Nilson, the key founder of Tongasat, terminated his association with Tongasat, he purchased more than 11% of Rimsat, Ltd. stock. Tongasat's control of these orbital locations was in Rimsat's and Dr. Nilson's financial interest. *See* Rick Mendosa, *Tongasat's Flawed Genius*, *4-5, at <http://www.mendosa.com/tongasat.html> (Dec. 30, 1996).

²⁵ Thompson, *supra* note 15, at 282.

²⁶ BRUNO PATTAN, *SATELLITE SYSTEMS: PRINCIPLES AND TECHNOLOGIES* 43 (1993) [hereinafter PATTAN].

²⁷ *Id.*

²⁸ *Id.* This translates into a linear velocity of 3 km/s and an angular velocity of 72.9×10^{-6} rad/s. *Id.*

²⁹ *Id.* This is equal to 0.9973 solar days. *Id.*

³⁰ PETER BERLIN, *THE GEOSTATIONARY APPLICATIONS SATELLITE* 54-55 (1988) [hereinafter BERLIN]. The eccentricity and inclination are both zero in which a circle may be con-

determining how many positions are available in GSO, is 264,925 km.³¹ Any satellite in this position has a field of view of 42% of Earth's surface.³²

In practice, however, the reality is never in harmony with the theory of how many satellites can use an orbit because the satellites are subject to various perturbing forces.³³ There are triaxialities, which are long-term, large-scale oscillations in longitude due to longitude-dependent terms.³⁴ There are the solar and lunar gravitational attractions.³⁵ Also, solar radiation pressure exerts an influence on a satellite's motion and position in orbit.³⁶ In order to keep satellites as close as possible to their optimum positions in orbit, there is "station keeping," which provides for corrections at regular intervals.³⁷ With improved station keeping technology, smaller windows—the area in which a satellite operates in orbit—can be maintained.³⁸ The object of station keeping is to keep the satellite in the window while using as little fuel as possible.³⁹ Typically, through the use of telecommands or automatic commands for emergencies, rocket thrusters make north-south corrections every month and east-west corrections twice per month.⁴⁰ Current technology allows satellites to remain in a window of 0.1 degree plus or minus in

sidered as a special form of an ellipse. An ellipse is generally defined as a set of all points in a plane such that the sum of all of the distances from two points in the plane, called the foci, is constant. In the case of a circle, the two foci are in the same position, the center of the circle. The eccentricity refers to how close the foci are to each other. In a circle, the foci are at the same point, and the eccentricity is thus zero. The inclination refers to the angle in degrees as to how far off from the equatorial plane a particular orbit is. GSO satellites have an inclination of zero since they orbit on the equatorial plane, having no angle relative to the equatorial plane. CROSSWHITE ET AL., PRE-CALCULUS MATHEMATICS 262 (1988).

³¹ See PATTAN, *supra* note 26, at 43. Although the various physical characteristics of satellites prevent defining the maximum number of satellites in the GSO, "physical interference between satellites and radio frequency interference between systems" demonstrate that GSO is a limited resource; see also UMBERTO LEANZA, THE FUTURE OF INTERNATIONAL COMMUNICATIONS: THE LEGAL REGIME OF TELECOMMUNICATIONS BY GEOSTATIONARY-ORBIT SATELLITE 2243 (1993) [hereinafter LEANZA].

³² See PATTAN, *supra* note 26, at 43.

³³ CHONG-HUNG ZEE, THEORY OF GEOSTATIONARY SATELLITES 23 (1989).

³⁴ *Id.*

³⁵ *Id.*

³⁶ *Id.*

³⁷ JOHN T. GARNER & MALCOLM JONES, SATELLITE OPERATIONS: SYSTEMS APPROACH TO DESIGN AND CONTROL 82 (1990).

³⁸ *Id.*

longitude and in latitude, respectively.⁴¹

Disregarding for the moment the effect electromagnetic spectrum has on orbit-spectrum, it is estimated that there are approximately 1800 orbital slots of 0.2 degrees width available in GSO.⁴² Generally, satellites are spaced one to two degrees apart, but even if satellites were spaced at only 0.2 degrees, the probability that a collision would occur is extremely small.⁴³ An Advisory Committee for the ITU determined that if ten satellites, each with a 100 square meter cross sectional area, were placed in the same two degree nominal orbital position, the risk of a collision would only be 0.00004% per year.⁴⁴ Yet, despite the low risk of collision with a separation of 0.2 degrees and the trend to place satellites closer together with improved technology and station keeping capabilities, disputes arise over access to GSO because a limited number of satellites can orbit in GSO;⁴⁵ however, demand for access to GSO is increasing.⁴⁶

A greater risk for GSO collisions comes from debris. From the moment a satellite is launched it encounters harsh environments and begins to deteriorate. During the ascent into space there is violent acceleration, vibration, shock and decom-

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ LEANZA, *supra* note 31, at 2243. The 0.1 degree corresponds with an area of space 150 km from north to south and from east to west. The altitude of the satellites will typically only vary within a space of 30 km; WHITE & WHITE, *supra* note 5, at 11.

⁴² See LEANZA, *supra* note 31, at 2243. The circular orbit, 360 degrees, is divided by 0.2 degrees. *Id.* Of course, larger satellites in GSO would cause a reduction in the denominator. Such larger satellites could include manned space stations and solar-collecting satellites. The latter would be a satellite equipped with large solar panels to absorb solar energy. The energy would be collected by photovoltaic cells, converted into electric energy and transformed into microwave power. A microwave beam would be transmitted to Earth, where it would be collected and reconverted to electrical power by an antenna-reflector array. To obtain a useful amount of energy, the solar panels on the satellite would need to measure in square kilometers. The potential amount of energy would be between 2,000 and 15,000 Megawatts.

⁴³ WHITE & WHITE, *supra* note 5, at 12.

⁴⁴ *Id.* That would equal one collision per 400,000 years.

⁴⁵ Milton L. Smith, *Space WARC 1985: The Quest for Equitable Access*, 3 B.U. INT'L L.J. 229 n.13 (1985) [hereinafter Smith] (explaining that GSO is limited by volume, satellites meeting specific orbital parameters, regulatory constraints on frequency use and radio frequency interference).

⁴⁶ Thompson, *supra* note 15, at 284–85 (explaining disputes arising from developing nations' efforts to secure access to GSO); Roberts, *supra* note 7, at 1125–29.

pression.⁴⁷ Once the satellite enters its orbit, different parts of the satellite reach temperature extremes at the same time because there is no temperature exchange through convection; the extreme temperatures can cause structural stress.⁴⁸ Bombardment by cosmic particles causes electrostatic discharges that can “produce short or open circuits and burn[] out electronic components.”⁴⁹ The effective operation of satellites may be threatened by “lubricants evaporat[ing] in vacuum and caus[ing] moving parts to seize up”⁵⁰ and “paints and sealants perspir[ing] and settl[ing] on sensitive optical surfaces.”⁵¹ Micrometeorites, which can strike satellites with tremendous impact, pose a risk to their structural integrity.⁵² A satellite may stop operating earlier than expected for the simple reason that it may run out of fuel. If a satellite does not succumb to these threats, its life span is generally ten to fifteen years.⁵³

If the satellites were merely left in orbit, a serious problem of crowding GSO would occur. But the general practice is to “dispose” of satellites by either using the last bit of fuel to fire the satellite out of orbit or by simply letting it drift out of orbit once the fuel runs out.⁵⁴ A satellite without fuel cannot engage in station keeping, therefore it drifts out of orbit.⁵⁵ The first option of using the remaining fuel to propel the satellite out of orbit is preferred to the possible risks of collision if satellites without fuel are permitted to drift out of orbit.⁵⁶ Yet, under these circumstances, the probability for a collision is very low.⁵⁷ Although debris in GSO poses a very small risk of collision and the total number of orbital slots is currently sufficient to reduce the risk of collision between operating satellites, the fact remains that only a

limited number of positions are available in GSO. This is a real limitation to the GSO as a resource, but the harnessing of the electromagnetic spectrum presents a greater limitation to orbit-spectrum use.

B. The Electromagnetic Spectrum

Electromagnetic spectrum refers to radiant energy waves resulting from periodic oscillations of charged subatomic particles.⁵⁸ The electromagnetic wave comprises an electric field and a magnetic field, where each field is at a right angle to the direction of propagation.⁵⁹ Electromagnetic waves are distinguished by frequency; frequency refers to how many waves occur during a given period of time and is measured in terms of cycles per second or hertz.⁶⁰ The radio spectrum spans from 10 KHz to 3000 GHz.⁶¹ Yet, the most use of the radio spectrum is confined to spectrum in the 10 KHz up to 40 GHz range.⁶² Even at lower frequencies, starting at around 15 GHz, there is significant technical difficulty because of attenuation—the weakening of a signal—due to rain or the constituent gases of the atmosphere.⁶³

The radio spectrum, as a resource, “has three dimensions: space, time, and frequency.”⁶⁴ Two spectrum users can transmit in the same space and at the same time if one is using a frequency different from what the other is using.⁶⁵ If, however, two spectrum users occupy the same frequency, these users must either transmit at various times or in various spaces.⁶⁶ Transmission with the same frequency in the same space and at the same time causes interference.⁶⁷ Interference is the superposing⁶⁸ of one wave onto another;⁶⁹ often, it disrupts information that is carried on

⁴⁷ BERLIN, *supra* note 30, at 65.

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

⁵¹ *Id.*

⁵² *Id.*

⁵³ *Id.*

⁵⁴ *Id.*

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ FRANKLIN, *supra* note 8, at 536.

⁵⁹ FREDERICK E. TRINKLEIN, MODERN PHYSICS 286 (Teacher's ed. 1992) [hereinafter TRINKLEIN].

⁶⁰ FRANKLIN, *supra* note 8, at 536; TRINKLEIN, *supra* note 59, at 287 (“One thousand cycles per second equals one kilocycle per second (1 KHz); 1,000 kilocycles per second equals

one Megacycle per second (1 MHz); and 1,000 Megacycles per second equals one Gigacycle per second (1GHz).”). Heinrich Hertz, a German experimental physicist whom the Hertz is named after, in 1885, provided the experimental evidence of the electromagnetic waves predicted by James Maxwell, a Scottish physicist, in 1865.

⁶¹ FRANKLIN, *supra* note 8, at 536.

⁶² *Id.*

⁶³ WHITE & WHITE, *supra* note 5, at 15.

⁶⁴ FRANKLIN, *supra* note 8, at 536.

⁶⁵ Thompson, *supra* note 15, at 311.

⁶⁶ FRANKLIN, *supra* note 8, at 537.

⁶⁷ *See id.*

⁶⁸ The Superposition Principle states that:

when two or more waves travel simultaneously through the same medium 1) each wave proceeds independently as though no other waves were present and 2) the resul-

both waves.⁷⁰ Some interference can occur with adjacent frequencies, but the greatest interference problems occur with the use of the same frequency.⁷¹ The extent to which interference will occur primarily depends on the distance between same-frequency transmissions and signal strength.⁷²

The orbit-spectrum is a technology bound resource.⁷³ Yet, the technology is not predictably bound by the resource; that is, even though there are limits as to how much can be done with the technology, room exists for further development. The availability of this resource can be increased through strategies and improved technology. For example, technological developments allow satellites to transmit far more information at a given frequency than they could in the past.⁷⁴ In addition, technological advancements allow use of V-band frequencies.⁷⁵ Also, for the better utilization of the radio spectrum in light of its unique limitations, several strategies have been undertaken in operating satellites in GSO. GSO satellite frequencies are divided into three main bands: the C-band, the Ku-band, and the Ka-band.⁷⁶ Within each band, the range of frequencies used for up-link is different from the range used for down-link communications, which ensures that a satellite does not create interference with itself.⁷⁷ When two or more satellites operate on the same band, sufficient distance between the satellites is necessary to prevent their respective frequencies from causing interference. Typically, satellites operating on the C-band have been spaced in increments of three to five degrees.⁷⁸ With the advent

of improved antenna design, however, satellites operating in the C-band are being spaced as close together as two degrees.⁷⁹ Satellite service providers favor use of C-band because the technology for this band is the most tested, least expensive and least susceptible to rain and atmospheric attenuation.⁸⁰ Improvements in the technology for the higher frequency bands, including the Ku- and Ka-bands, allow service providers to use these bands more than they have in the past.⁸¹ Satellites using the Ku-band are usually placed in between C-band satellites, so as to make use of the space necessarily left vacant for avoiding interference between C-band satellites. Increasingly, though, there are more hybrid satellites, which operate on both C- and Ku-band frequencies.⁸² Frequency band distribution and decisions on satellite signal strength involve unilateral actions of nations and corporations, bilateral and regional agreements and, most importantly, the ITU's regulatory system. This regulatory system and its interplay with other stakeholders shape the legal debate surrounding the use of the orbit-spectrum resource.

III. THE REGULATORY SYSTEM

A. History

The ITU plays the central role in regulating the use of the orbit-spectrum resource. From its roots in 1865, as the International Telegraph Union ("Telegraph Union"), the ITU has undergone numerous transformations as the technological and political landscapes have evolved.⁸³ Twenty Euro-

tant displacement of any particle at a given time is the vector sum of the displacements that the individual waves acting alone would give it.

TRINKLEIN, *supra* note 59, at 244.

⁶⁹ *Id.* at 691.

⁷⁰ See FRANKLIN, *supra* note 8, at 537.

⁷¹ *Id.*

⁷² *Id.*

⁷³ Although technology can improve the quality of water and facilitate extraction and transportation of it, water, unlike spectrum, is inherently a resource that can be exploited without advanced technology.

⁷⁴ WHITE & WHITE, *supra* note 5, at 15.

⁷⁵ FCC Adopts V-Band Spectrum Plan, COMM. TODAY, Dec. 18, 1998, LEXIS, Communications News Stories. In the United States, frequencies designated to the V-band are at 36.0–51.4 GHz. *Id.*

⁷⁶ Rothblatt, *supra* note 2, at 57 & n.6.

⁷⁷ *Id.* Up-links are signals from the Earth station to the satellite; down-links are signals from the satellite to the Earth station. For the C-band, 5.925–6.425 GHz is the up-link, and

3.7–4.2 GHz is the down-link; for the Ku-band, 14.0–14.5 GHz is the up-link, and 11.7–12.7 GHz is the down-link; and, for the Ka-band, 27.5–31.0 GHz is the up-link, and 17.7–21.2 GHz is the down-link. *Id.* at 57 n.6.

⁷⁸ See WHITE & WHITE, *supra* note 5, at 15.

⁷⁹ *Id.*

⁸⁰ *Id.*

⁸¹ *Id.* Broadband satellite service providers, such as EchoStar and DirecTV, are using these higher frequencies. Armand Musey, *Dollars and Sense: Broadband: The Next Big Thing?*, VIA SATELLITE, June 10, 2001, LEXIS, Communications News Stories; Theresa Foley, *The World's Hottest Real Estate: Orbital Slots Are Prime Property*, VIA SATELLITE, Sept. 10, 2001, LEXIS, Communications News Stories.

⁸² See, e.g., PANAMASAT.COM, GALAXY XI, at http://www.panamsat.com/global_network/galaxy_11.asp (last visited Feb. 3, 2002). For example, PanAmSat has a number of operational hybrid C/Ku-Band satellites, such as the Galaxy XI at 91 degrees W.L. *Id.*

⁸³ WHITE & WHITE, *supra* note 5, at 51 & tbl.2.1.

pean nations established the Telegraph Union to universalize their telegraph services.⁸⁴ The Telegraph Union did not immediately regulate developing communications technologies. For example, even though the telephone was invented in the 1870s, the Telegraph Union did not do serious work on issues relating to telephone service until 1903.⁸⁵ In that same year, the Preliminary Radio Conference set in motion the framework for what would later become the International Radiotelegraph Union ("Radio Union"). Established in 1927, the Radio Union's early work focused on allocating radio frequencies.⁸⁶

In 1932, the Telegraph Union and the Radio Union merged into the ITU, at which point the debate over radio frequency allocation⁸⁷ and interference was already substantial.⁸⁸ In 1947, the ITU underwent a major reorganization of its structure, including an affiliation with United Nations as a specialized agency.⁸⁹ Shortly thereafter, with the launch of Sputnik on Oct. 4, 1957, the ITU began to work on issues relating to satellite communications. Commemorating this historic event, the United Nations issued a General Assembly Resolution that emphasized, among other things, that outer space exploration and use ought to further the common interest of mankind and peace.⁹⁰ In 1992, the ITU approved an internal reorganization plan to keep pace with rapid international communications technology development; the changes became official on July 1, 1994.⁹¹ Currently, the ITU has 189 members⁹² and all ITU decisions are binding on member states.

⁸⁴ *Id.*

⁸⁵ *Id.*

⁸⁶ *Id.*

⁸⁷ *Id.* at 52. Allocation refers to the designation of specific frequencies to particular services. See *infra* Part III, C.

⁸⁸ *Id.* at 47-49.

⁸⁹ *Id.* at 53 & tbl.2.1.

⁹⁰ Richard A. Morgan, *Military Use of Commercial Communication Satellites: A New Look at the Outer Space Treaty and "Purposeful Purposes"*, 60 J AIR L. & COM. 237, 301, 326 n.340 (quoting from Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962 U.N. GAOR, 18th Sess., (1963)).

⁹¹ See KENNEDY & PASTOR, *supra* note 1, at 31. Changes include creating permanent "sectors" that periodically meet to discuss matters and make changes within their respective fields. The following are some of the sectors: radiocommunication, telecommunications and telecommunications development. *Id.* at 32. During the reorganization, the former In-

B. The ITU Infrastructure

The ITU is governed by a constitution, which is supplemented by the International Telecommunications Convention ("ITC").⁹³ Both documents, which define the rights and obligations of member states, are binding on the ITU.⁹⁴ Every four years, the Plenipotentiary Conference meets to establish "longterm policy, elect[] officers, set[] the budget, amend[] the Convention, and elect[] the 41 members of the Council," which then meets every year for policymaking.⁹⁵ The Office of the Secretary-General, which is led by the Secretary-General, performs ITU's daily administrative work.⁹⁶ In addition, various sectors carry out more detailed work in specific issue areas. One important sector is the ITU-Radiocommunication sector, which is supervised by the World Radiocommunication Conference ("WRC"). Meeting every two years, the WRC oversees technical work on radio spectrum use and makes important decisions on how orbital positions and frequencies are allocated.⁹⁷ The various sectors implement the ITU's Administrative Regulations, which include the Radio Regulations. The Radio Regulations, established in 1963, provide for the allocation of radio frequencies, maintenance of a Table of Frequency Allocations, and "assignment of orbital positions and radio frequencies for satellites."⁹⁸ The basic structure of the Radio Regulations for space services is similar to terrestrial radio regulations; however, the space regulations are "more complex" than their terrestrial counterpart.⁹⁹ Since their initial promulgation, the Radio

International Frequency Registration Board was changed to the Radio Communications Service. Thompson, *supra* note 15, at 289.

⁹² ITU.INT, OVERVIEW, at <http://www.itu.int/members/index.html> (last visited Feb. 3, 2002).

⁹³ KENNEDY & PASTOR, *supra* note 1, at 32.

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ *Id.* The current Secretary-General is Mr. Yoshio Utsumi, who was elected to the position on Oct. 20, 1998. The Secretary-General takes a leadership role in administering the ITU's duties and guiding policy. The Secretary General's duties are defined in Article 11 of the ITU Constitution and Article 5 of the ITU Convention. ITU.INT, OFFICE OF THE SECRETARY GENERAL, at <http://www.itu.int/osg/> (last visited Feb. 3, 2002).

⁹⁷ KENNEDY & PASTOR, *supra* note 1, at 32.

⁹⁸ *Id.* at 33.

⁹⁹ See WHITE & WHITE, *supra* note 5, at 97.

Regulations for space have undergone many changes.¹⁰⁰ While some ITU Administrative Regulations are not binding on member states, all the Radio Regulations “are treaty undertakings” binding on member states.¹⁰¹

Creating the International Frequency Registration Board was one of the most important steps in the ITU’s efforts to manage radio frequency use. The Board’s functions have remained the same since its establishment in 1947; however, its name was changed to the Radio Regulations Board (“RRB”). Although the RRB does not have judicial power, it is characterized as a quasi-judicial body.¹⁰² RRB is quasi-judicial in that it authoritatively interprets the Radio Regulations and their application to specific assignments.¹⁰³ Beyond this role, however, the RRB does not have enforcement power. Nevertheless, RRB decisions are considered “persuasive evidence of the international law embodied in the [binding] Radio Regulations.”¹⁰⁴ The RRB comprises of five “technically trained” individuals who are experienced with the particular region they represent.¹⁰⁵ RRB members are elected by the Plenipotentiary, which also appoints the RRB Director.¹⁰⁶

C. Regulatory Substance and Procedure

The current regulatory system employs a two-track approach. The first track, an *a posteriori* system, is used for orbit-spectrum use in the C- and Ku-bands. The second track uses an *a priori* system, which was designed for the emerging Ka-band and Broadcasting Satellite Services. Although coordination problems certainly occur in using the C- and Ku-bands, the significant concerns surrounding the use of an *a priori* system stem from the ITU’s regulation of the Ka-band and Broadcasting Satellite Services. At the same time, neither the *a posteriori* nor the *a priori* track

raises entirely distinct issues surrounding use of the orbit-spectrum because the same international legal principles apply to both systems.

Whether an applicant follows the *a posteriori* or the *a priori* track, the frequencies of the radio spectrum must first be allocated. This complex process involves dividing radio spectrum into blocks of frequencies that ultimately are used by specific services.¹⁰⁷ For example, the ITU has allocated certain frequencies for radio broadcasting, maritime navigation, radar, satellite communications and radio astronomy.¹⁰⁸ More specifically, the ITU has allocated the C-, Ku- and Ka-bands, a frequency block ranging from 3.7 GHz to 31.0 GHz, for satellite communications.¹⁰⁹

Once the spectrum has been allocated, the next step, identification of the entity that will provide the services for the allocations, is where the ITU’s and the RRB’s tasks become more complex and more controversial. After allocation, the frequency is either allotted or assigned.¹¹⁰ Allotment describes the process where a block of frequencies or orbital positions¹¹¹ is dedicated to a specific country or geographical region.¹¹² Assignment, on the other hand, refers to a nation, regional organization or the ITU deciding which company or country can use a certain frequency for the allotted service. Allotment, and the subsequent national assignment, works well for localized services. Direct international allotment and assignment by the ITU, however, are better suited for international services.¹¹³ For example, the ITU has allocated a specific portion of the spectrum for commercial radio services. This allocated block of frequencies is then allotted to countries, and the countries assign specific frequencies to individual radio stations. International allotment, on the other hand, requires the international organization, the ITU in this case, to directly allot and assign frequency and orbital positions to the

¹⁰⁰ KENNEDY & PASTOR, *supra* note 1, 32.

¹⁰¹ *Id.* at 33.

¹⁰² WHITE & WHITE, *supra* note 5, at 86.

¹⁰³ *Id.*

¹⁰⁴ *Id.* (explaining that RRB interpretations are given such weight because nations are required to cooperate and they “prefer to resolve disputes without primary reliance upon binding arbitral or judicial processes”).

¹⁰⁵ *Id.*

¹⁰⁶ *Id.* at 96; see also ITU.INT, ELECTED OFFICIALS, at <http://www.itu.int/officials/jones/index.html> (last visited on Feb. 3, 2002) (stating that the current Director of the RRB is Mr. Robert Jones, who was elected to the position in September

of 1994).

¹⁰⁷ FRANKLIN, *supra* note 8, at 540.

¹⁰⁸ KENNEDY & PASTOR, *supra* note 1, at 48. Although allocated categories have been established, much overlap occurs among users of popular frequencies. *Id.* Additionally, countries may record their reservations with the ITU to make exceptions for use within certain frequencies. *Id.*

¹⁰⁹ Rothblatt, *supra* note 2, at 57 & n.6.

¹¹⁰ KENNEDY & PASTOR, *supra* note 1, at 48.

¹¹¹ *Id.*

¹¹² *Id.* at 48–49.

¹¹³ *Id.* at 49.

requesting country or company.¹¹⁴

Prior to 1988, the ITU used an *a posteriori* system,¹¹⁵ but, as of 1988, the ITU has used a two-track system, where the satellite service provider either acquires an assignment directly from the ITU or from a country that has received an allotment.¹¹⁶ The frequency the provider hopes to operate on defines whether assignment is acquired from the ITU or a country. The first track, which was used exclusively until 1988, is an *a posteriori* system applicable to the C- and Ku-bands.¹¹⁷ It is, essentially, a first-come-first-served system, in which the ITU officially recognizes the use of a specific orbit and frequency so long as the provider complies with applicable ITU requirements.¹¹⁸ When a provider seeks rights to operate on a frequency pursuant to the *a posteriori* track (assignment from the ITU), it must fulfill three necessary steps established in Radio Regulations, Articles 11 and 13: advance publication, coordination and notification.¹¹⁹

Advance publication entails the service provider submitting technical information on the satellite system to the ITU.¹²⁰ This information is supplemented by "due diligence" information, which includes identification of the satellite network and operator and evidence of contracts providing for the manufacturing of the satellite and launch services.¹²¹ At this time, the ITU does not have the authority to verify the information provided.¹²² Advance publication must be provided at least two years before the beginning of the satellite service and, at the earliest, five years before the implementation of the satellite service.¹²³ The ITU may grant a two-year extension if the provider timely submits the due diligence information and justifies the extension on any of the following grounds: launch failure or a delay beyond the provider's control; delays caused by design modifications that are required by coordination agreements; problems in meeting design specifications;

delays in establishing coordination; or, financial circumstances that are beyond the provider's control.¹²⁴ If the service provider satisfies these requirements, the ITU then provides advance publication of the assignment in a weekly bulletin, which notifies other providers and leads to the next step in the *a posteriori* track.¹²⁵

The second and most difficult step is coordination. During coordination, providers of existing satellite systems and the provider of the new system must ensure that no interference will occur between the systems. But for coordination to take place, providers of existing service must contact the new provider within four months after advance publication.¹²⁶ If the provider does not expect any interference, no coordination is required.¹²⁷ This process often requires a tremendous amount of negotiation and technical adjustments, and it may take several years.¹²⁸

The third step, notification, occurs after advanced publication and coordination. So long as the ITU does not find any technical problems in the providers' agreements, it will register—or officially list—the orbital slot and frequency assignment in the Master International Frequency Register.¹²⁹ This provides the operator with the legal rights to use the orbital location and frequencies when the satellite system becomes operational. If, however, the satellite system is not registered or even if it is registered but not operational within the required time periods the whole process is cancelled and the orbital location becomes available to other providers.¹³⁰ Once notification occurs and the system is operational, the assignment is entitled to "international recognition" and legal protection.¹³¹

The second track, the *a priori* system, is applicable to fixed satellite services in the Ka-band.¹³² An *a priori* system is a planned, or engineered, system in which the ITU allots a "nominal" orbital slot with a certain arc or a portion of the GSO to each

¹¹⁴ Thompson, *supra* note 15, at n.48.

¹¹⁵ *Id.* at 295.

¹¹⁶ KENNEDY & PASTOR, *supra* note 1, at 49.

¹¹⁷ Thompson, *supra* note 15, at 294–95, 297–98 & n.136.

¹¹⁸ KENNEDY & PASTOR, *supra* note 1, at 49.

¹¹⁹ *Id.* at 58.

¹²⁰ Thompson, *supra* note 15, at 298.

¹²¹ Roberts, *supra* note 7, at 1121, 1130–31. The new due diligence requirement is aimed at dissuading actions similar to Tonga's creation of "paper satellites."

¹²² *Id.*

¹²³ *Id.*

¹²⁴ *Id.* Previously, the time periods were six and three years, which totals nine years. The new time requirements are also meant to combat the creation of "paper satellites."

¹²⁵ See Thompson, *supra* note 15, at 298.

¹²⁶ *Id.*

¹²⁷ *Id.*

¹²⁸ See KENNEDY & PASTOR, *supra* note 1, at 58.

¹²⁹ Thompson, *supra* note 15, at 298.

¹³⁰ *Id.*

¹³¹ *Id.*

¹³² See *id.* at 297, 311 & n.136.

member state.¹³³ When a provider wishes to use a nominal slot, it must seek assignment from the member country.¹³⁴ If the country makes the assignment to the service provider, the nominal position may be adjusted to a real position within the arc.¹³⁵ When the *a priori* system was implemented, however, providers generally did not use the Ka-band because the technology for commercial use was not readily available.¹³⁶ Recently an increasing number of satellites using the Ka-band have been launched, and the FCC has granted additional licenses for Ka-band satellites to satellite companies.¹³⁷

Despite these efforts to use spectrum assigned pursuant to the *a priori* track, service providers have used the *a posteriori* track far more than the *a priori* track.¹³⁸ The primary reason for this action is that service providers are accustomed to using the C- and Ku-bands, which are assigned pursuant to the *a posteriori* track, and their technology was developed for use of these bands. Yet, the *a priori* track cannot be viewed merely as a theoretical matter; it is the track used for a numerous emerging services, making it a critical concern with respect to the debate on applying international legal principles to the regulation of satellites.

IV. THE LEGAL PROBLEM

In order to better comply with the legal framework of the orbit-spectrum while considering the unique nature of the orbit-spectrum resource, further revision to ITU regulations is necessary. The controversy—and need for revision—may be ex-

amined at three main levels. First, there are tensions between various legal principles. Second, in light of the legal principles there is the debate on whether to move toward a regulatory system primarily based on the *a posteriori* track (“an *a posteriori* system”) or move to a system based on the *a priori* track (“an *a priori* system”). Third, if the ITU should move towards an *a posteriori* system, as this article argues, what steps can be taken to improve it? In the following pages, the tensions between legal principles will be explained to underscore why these principles support an *a posteriori* system, particularly based on efficient utilization, while paying due regard to the other principles, most notably equitable access. Finally, Section V recommends revisions for the current *a posteriori* system, some of which hint toward a future hybrid system.

Two sources establish the legal framework for regulation of the orbit-spectrum: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (“Space Treaty”) and the ITC.¹³⁹ Both the Space Treaty and the ITC are binding on member countries, which include all developed countries and many developing countries. The two treaties create a foundation for the international law of the orbit-spectrum resource.¹⁴⁰

The Space Treaty became effective in 1967 and contains many broad principles, which guided the development of subsequent instruments of space law and provided grounds for resolving conflicts.¹⁴¹ Because of the broad nature of the principles promulgated in the Space Treaty, the im-

¹³³ KENNEDY & PASTOR, *supra* note 1, at 58. Although under development since 1947, the *a priori* system in 1988 was still only practically implemented for a brief time and for a few services. *See id.* at 49; *see also* WHITE & WHITE, *supra* note 5, at 90.

¹³⁴ KENNEDY & PASTOR, *supra* note 1, at 58.

¹³⁵ *Id.*

¹³⁶ *See* Thompson, *supra* note 15, at 295, 311 & n.117. Creating an *a priori* system for the Ka-band may be viewed as a political gesture to appease the developing countries because they had little chance to develop the capabilities to use the Ka band. *Id.* at 295–96 & n.118. Operation at the C band, the most popular, uses a cheap and developed technology, but is subject to the *a posteriori* system. *Id.*

¹³⁷ *Milestones Loom for Winners of Ka-band Spectrum in Long-Delayed Second Round*, SATELLITE NEWS, Aug. 6, 2001, LEXIS, Communications News Stories. In Aug. 2001, the FCC released the second round assignments for orbital locations and Ka-band frequencies. *Id.*

¹³⁸ Thompson, *supra* note 15, at 297.

¹³⁹ Rothblatt, *supra* note 2, at 61.

¹⁴⁰ *Libya v. Malta*, 1985 I.C.J. 13, 29–30 (stating “multilateral conventions may have an important role to play in recording and defining rule from custom, or indeed in developing them”); *see also* RESTATEMENT (THIRD) OF FOREIGN RELATIONS OF THE UNITED STATES §102(1) (1987) (providing that “international law is one that has been accepted as such by” custom, international agreement or derivation from general principles). Of the three sources, conventions and custom are the most widely recognized sources because the general principles derived from them have been absorbed into customary international law. Although the conventions cannot directly bind nonmember parties, they aid the development of customary international law, which could then bind non-member parties. THOMAS BUERGENTHAL & HAROLD G. MAIER, PUBLIC INTERNATIONAL LAW 16, 25–26 (1989) [hereinafter BUERGENTHAL & MAIER]. Conventions, including the Space Treaty and the ITC, are honored “*pacta sunt servanda*” by the member parties. Delzeit & Beal, *supra* note 14, at 75.

¹⁴¹ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18

plementation of these principles operates as both a blessing and curse. The breadth of these principles provides for tremendous flexibility, which has been both beneficial and frustrating, depending on which side of the technological divide one is situated. Nonetheless, the Space Treaty¹⁴² provisions relevant to the legal dispute and regulatory debate over use of the orbit-spectrum are Articles I, II and IX.¹⁴³ The activities of signatories to the Space Treaty are constrained by it and the ITC.¹⁴⁴ The ITC contains the stated goals of the ITU and specifies what measures ought to be taken to achieve those goals.¹⁴⁵ If similar principles are consolidated, the following legal duties—some of which overlap—guide the use of the orbit-spectrum: restriction on national appropriation; equitable access while considering the special needs of developing countries; cooperation with due regard for corresponding interests; and efficient and economic operation.

As may already be evident, contradictions exist between the legal principles set forth in the Space Treaty and the ITC. These contradictions are practically manifested in the regulatory system of

the orbit-spectrum resource. Most noticeably, the debate is strongest between the developed and developing countries. The developed countries generally advocate the principle of efficient and economic operation (efficient utilization), whereas the developing countries are most supportive of the principle of equitable access. Subsequently, as will be discussed, the way the principles are interpreted determine what system they support; consequently, this leads to what type of system the countries will support, depending on their level of development. The actual debate between countries operates primarily at a political level that conveniently uses the various principles to promote the respective interests of the developed and developing countries, including their constituents. Yet, the debate on the regulatory system's future will not become mired in political and legal wrangling so long as stakeholders keep in mind that orbit-spectrum is a delicately balanced resource, that the operation of two nearby satellites on the same frequency will result in interference for both parties and that an increasing number of satellites are launched into GSO. The care-

U.S.T. 2410, 610 U.N.T.S. 201, *reprinted in* 6 I.L.M. 386 (1967) [hereinafter Space Treaty]. Subsequent conventions include: Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119; Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 197; Convention on the Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies; U.N. GAOR, 34th Sess., Supp. No. 20, U.N. Doc. A/34/20 (1979); see generally Heidi Keefe, *Making the Final Frontier Feasible: A Critical Look at the Current Body of Outer Space Law*, 11 SANTA CLARA COMPUTER & HIGH TECH. L.J. 345, 345 (1995) [hereinafter Keefe].

¹⁴² Eric Husby, *Sovereignty and Property Rights in Outer Space*, 3 J. INT'L L. & PRAC. 359, 361-65 (1994) [hereinafter Husby]. The Space Treaty developed from two earlier treaties, the Antarctic Treaty and the Test Ban Treaty. *Id.* at 362.

¹⁴³ Space Treaty, *supra* note 141, at art. I, II, IX.

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. Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

Id. at art. I. "Outer Space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by

any other means." *Id.* at art. II.

In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty.

Id. at art. IX.

¹⁴⁴ GLENN H. REYNOLDS & ROBERT P. MERGES, *OUTER SPACE: PROBLEMS OF LAW AND POLICY* 200 (1989) [hereinafter REYNOLDS & MERGES] (explaining that the ITC, originally enacted at the 1932 Madrid Conferences, is periodically amended); WHITE & WHITE, *supra* note 5, at 47.

¹⁴⁵ Allison, *supra* note 7, at 504, 514 & n.48. ITC art. 1 provides that ITU's purpose is "[t]o promote the development of technical facilities and their most efficient operation;" "to harmonize the actions of the nations in the attainment of those ends," "[t]o maintain and extend international cooperation between all Members of the Union for the improvement and rational use of telecommunications of all kinds, as well as to promote and offer technical assistance to developing countries." To achieve these goals, ITC art. 4 calls on the ITU "to coordinate efforts to eliminate harmful interference between radio stations of different countries and to improve the use made of the radio frequency spectrum." ITC art. 12 establishes ITU's duty "to effect allocation of the radio frequency spectrum and registration of radio frequency assignments in order to avoid harmful interference. . . ." Finally, ITC art. 33, as amended in 1989, directs the ITC to "take into account the special needs of the developing countries" in providing for "efficient[] and economic[]" orbit-spectrum use.

fully constructed language of each instrument should not be considered as a mere tool for political and pecuniary gain, but, more importantly, as the ideals from which rational solutions will develop.¹⁴⁶ With the unique nature of the orbit-spectrum resource and the established legal principles in mind, it is possible to construct a workable system that looks towards the future. The next section demonstrates that the most relevant legal principles give more support to an *a posteriori* system than an *a priori* system. The next section will also demonstrate that the equitable access principles do not necessitate an *a priori* system because these principles can be reflected in an *a posteriori* system. The following section concludes by arguing that, even though an *a posteriori* system is preferred, this system needs revision.

A. Restriction on National Appropriation

A fundamental goal of the Space Treaty is the elimination of "sovereignty" claims in outer space.¹⁴⁷ However, a strict reading of the Space Treaty's text reveals some ambiguity as to the signatories' intent on this issue. Although the Space Treaty prevents national sovereignty claims, it does not unequivocally preclude appropriation by private individuals, companies or international organizations. Article 2 only provides that outer space is "not subject to national appropriation."¹⁴⁸ The Space Treaty can be interpreted as allowing private appropriation because where the signatories intended to bar appropriation, they clearly did so. Thus, it can be inferred from the absence of such a bar, with respect to private appropriation, that the signatories were not opposed to the private appropriation of outer space. However, Article 2 refutes this argument, stating that national appropriation "shall not" be served "by any

other means."¹⁴⁹ This argument advanced by Article 2 provides that every individual or company that makes use of the orbit-spectrum is a nationality of a given country.¹⁵⁰ Thus, a private ownership claim is viewed as an extension of national sovereignty. If that country in any way recognizes or supports the actions of a private company or its claims, state action may be found.¹⁵¹ Moreover, barring private ownership claims precludes a nation from intentionally using a private entity to affect an appropriation.

Although strong legal grounds exist for recognizing that outer space is not subject to traditional property rights, it also may be forcefully argued that traditional property rights should be recognized in outer space. If property rights in outer space remain unrecognized, fewer incentives may exist to explore and exploit the resources of outer space. The need to create incentives in outer space is analogous to grants of property rights to promote the development of the American West.¹⁵² Nonetheless, until such policies are translated into new international agreements or customary international law, outer space will be viewed in terms of *res communis* in which nations cannot appropriate a given area in space, but nations or private parties may fully exploit the resources in that given area.¹⁵³ As on the high seas, where no exclusive property rights attach to fishing concerns, orbit-spectrum use within the GSO does not create an ownership right to the area of space. Instead, application of *res communis* allows for the exclusive exploitation of natural resources at that location and at that time.¹⁵⁴

In regulating the orbit-spectrum, the *a posteriori* system better complies with the legal principle of *res communis* by recognizing the ancient "first-in-time, first-in-right" principle,¹⁵⁵ which is analogous to *res communis* application to the high

¹⁴⁶ Smith, *supra* note 45, at 247-54 (analyzing the policy implications of ambiguity in defining the terms "planned" and "plan" in the ITC's equitable access provisions).

¹⁴⁷ Husby, *supra* note 142, at 359, 361-62.

¹⁴⁸ Keefe, *supra* note 141, at 358-59 (quoting Professor S. Gorove, Vice President of the International Space Institute, that "[a]t present, an individual acting on his own behalf or on behalf of another individual or a private association or an international organization could lawfully appropriate any part of outer space"); see also Glenn H. Reynolds, *Space Law in the 1990s: An Agenda for Research*, 31 JURIMETERICS J. 1, 5 (1990) (explaining that Professors Reynolds and White's argument that appropriation by private parties is lawful).

¹⁴⁹ Husby, *supra* note 142, at 362.

¹⁵⁰ Delzeit & Beal, *supra* note 14, *passim* (analyzing Tonga incident in terms of both Tonga's and Tongasat's conduct).

¹⁵¹ John Doe I v. Unocal Corp., 110 F. Supp.2d 1294, 1305 (C.D. Cal. 2001) (explaining that a court will look to various factors to determine whether state action is implicated: public function, state compulsion, nexus and joint action).

¹⁵² REYNOLDS & MERGES, *supra* note 144, at 164.

¹⁵³ See Husby, *supra* note 142, at 365.

¹⁵⁴ Rothblatt, *supra* note 2, at 68 & n.81.

¹⁵⁵ Richard A. Epstein, *Stranahan Lecture: Property Rights Claims of Indigenous Populations: The View from the Common Law*, 31 U. TOL. L. REV. 1, 4 (1999) (explaining the literal and common translation of "qui prior est tempore potior est

seas.¹⁵⁶ Thus, the party that first exploits the orbit-spectrum is entitled to use it. Moreover, ITU regulations support this entitlement by requiring the providers of a new satellite to coordinate with the providers of operational satellites in nearby positions.¹⁵⁷

An *a priori* system, in contrast to the *a posteriori* system, would allow for regulations that resemble national appropriation. In the *a priori* system, nominal assignments of orbital positions would essentially give each country exclusive property rights to the GSO without the actual exploitation of the resource, which is necessary under *res communis*. Countries would be permitted to follow Tonga's actions in leasing GSO allotments for profit as if they had property rights in the allotments. Although Tonga's actions occurred under the current *a posteriori* regulations, such practices are likely to proliferate under an *a priori* system. Furthermore, Tonga's exploitation of the GSO, as if it had an ownership interest, contravenes international legal principles and highlights the need to further revise the regulatory system of the orbit spectrum.

B. Balancing Equitable Access With the Particular Needs of Developing Countries'

Although equitable access principles provide for "fairness and justice [by] taking all relevant circumstances into consideration," equitable access does not mandate equal results.¹⁵⁸ At the urging of developing countries, equitable access considerations were incorporated into the ITC in 1973.¹⁵⁹ Developing countries were concerned that the existing *a posteriori* system operated to their detriment because developed nations saturated the more desirable C-band and a developing country's deployment of its own satellite system was "prohibitively expensive."¹⁶⁰ These concerns

over C-band saturation and the increasing costs for developing other bands are legitimate.¹⁶¹ However, ameliorating these concerns does not demand implementation of an *a priori* system.

The principle of equitable access is generally agreed to be a concept of "equal legal opportunity."¹⁶² Under the current *a posteriori* system every country has an equal right and opportunity to use orbit-spectrum. If a particular country does not have the financial and technological resources immediately available to use the orbit-spectrum, it is not necessarily the responsibility of the developed countries to provide enhanced opportunity.¹⁶³ Indeed, the idea of equal legal opportunity arises only when a country is ready to use orbit-spectrum.¹⁶⁴ When the country is ready to use orbit-spectrum, the issue that arises is whether to recognize the special needs of developing countries in their use of the orbit-spectrum. These special needs may include the acceptance that a developing country's use of orbit-spectrum may not be as efficient or economic as use by a developed country.¹⁶⁵ Thus, the principle of equitable access certainly does not require reservation of positions for developing countries through an *a priori* system; it only requires recognition and acceptance that developing countries may use orbit-spectrum less efficiently.

In addition, the Space Treaty's "benefit for all countries" clause does not require the creation of an *a priori* system or the direct sharing of benefits on a regulated basis in order to create equitable access. When the Space Treaty was signed and ratified, there was some concern as to the meaning of this declaration. When the United States Senate ratified the treaty, the Committee on Foreign Relations stated "that nothing in Article 1 . . . diminishes or alters the right of the United States to determine how . . . it shares the benefits and re-

jure").

¹⁵⁶ See *Ghen v. Rich*, 8 F. 159, 162 (D. Mass. 1881) (holding that the party which first marked a whale for capture had a priority right to the whale).

¹⁵⁷ *Malaysia's Binariang Worried INTELSAT Satellite Too Close*, ASIA PULSE, July 8, 1997, LEXIS, Communications News Stories. Regarding a conflict over orbit-spectrum use, Haniff Omar, chairman of Binariang Sdn Bhd, owner of the Measat-1 satellite, said, "We already have that slot . . . it is up to the newcomer to discuss with the incumbent. When a newcomer comes into the scene, it has to take the matter up with the ITU and coordinate with all owners of satellites in the surrounding areas." *Id.*

¹⁵⁸ Smith, *supra* note 45, at 237 (arguing that equitable

access "implies fairness and justice, taking all relevant circumstances into consideration").

¹⁵⁹ *Id.*

¹⁶⁰ *Id.* at 232-34.

¹⁶¹ *Id.* at 232-33 & n.14-15. Predictions on when the C-band will be saturated have varied from it already having occurred to "beyond" the 1990s.

¹⁶² Delzeit & Beal, *supra* note 14, at 75.

¹⁶³ Thompson, *supra* note 15, at 300.

¹⁶⁴ Smith, *supra* note 45, at 237-38.

¹⁶⁵ Thompson, *supra* note 15, at 300. Dedicating use of the orbit-spectrum to developing countries, which is less efficient and economical, contravenes the principle of efficient and economic use. *Id.* See discussion *infra* Part D.

sults of its space activities.”¹⁶⁶ The former Soviet Union expressed the opinion that the “mankind provisions [in Article 1] have no precise definition” and that countries’ outer space activities entirely “depended on their will.”¹⁶⁷ Although the statements accompanying ratification by developed countries essentially are made for political value, these statements show a lack of support for interpreting the equitable access clause to require sharing. Edwin Paxson concurs in stating that nations “are under no definite obligation to share anything beyond what they think is reasonable.”¹⁶⁸

Many developed countries and private entities put forward tremendous effort and expense to establish satellite systems. However, this does not automatically mean that they have no responsibility to underdeveloped countries. Concepts of fairness and justice underlying the principle of equitable access require addressing the concerns of developing countries.¹⁶⁹ For one thing, developed countries must not act to deprive developing countries of access to orbit-spectrum, so long as, developing countries are ready to exploit the resource. Furthermore, the ITU affirmatively places the burden on developed countries to support the growth of the developing countries’ telecommunications capabilities.¹⁷⁰ One way developed countries can provide positive support is through the World Bank, which assists developing countries with improving telecommunications capabilities. For example, in 1994 the World Bank assisted Uganda in acquiring a national cellular license.¹⁷¹

Despite the apparent lack of special provisions to allow developing countries to acquire access to the orbit-spectrum, which may fuel a quest for an *a priori* system, plenty of opportunities exist for de-

veloping countries to access orbit spectrum. Until recently, one opportunity was membership in INTELSAT, a multinational organization created for the purpose of developing the orbit-spectrum and making it available to all countries.¹⁷² INTELSAT membership was open to all ITU members,¹⁷³ which comprised 144 member nations as of its privatization on July 18, 2001.¹⁷⁴ INTELSAT “provide[d] two-thirds of the world’s public satellite telecommunications services” in the mid 1990s.¹⁷⁵ Each member country contributed “at least 0.05% of the valuation of the organization upon joining.”¹⁷⁶ Thereafter, each country “must make regular contributions” depending on its amount of orbit-spectrum use.¹⁷⁷ When a country, or a private entity applying through its country, sought access to INTELSAT’s network, INTELSAT assessed various technical factors in determining how best to provide for the needs of the applying country. INTELSAT’s network provides an affordable alternative for developing countries to access orbit spectrum and fulfill their telecommunications needs.¹⁷⁸ Although INTELSAT has been privatized, it still strives to provide access to satellite services for all countries.¹⁷⁹ In fact, the International Telecommunications Satellite Organization, a separate and independent intergovernmental agency, monitors how well INTELSAT is fulfilling its public service goals.¹⁸⁰ Arrangements with INTELSAT, however, do not provide a developing country the independence and prestige afforded by a national satellite system. Yet, INTELSAT remains an option until a country is financially and technically ready to operate its own system. Another option for developing countries is to subscribe to the services of other private providers.¹⁸¹

¹⁶⁶ Husby, *supra* note 142, at 364.

¹⁶⁷ *Id.*

¹⁶⁸ Edwin W. Paxson, III, *Sharing the Benefits of Outer Space Exploration: Space Law and Economic Development*, 14 MICH. J. INT’L L. 487, 491–92 (1993).

¹⁶⁹ See Smith, *supra* note 45, at 245.

¹⁷⁰ See KENNEDY & PASTOR, *supra* note 1, at 32.

¹⁷¹ SCHWARTZ, *supra* note 3, at 10.

¹⁷² INTELSAT, Agreement and Operating Agreement Relating to the International Telecommunications Satellite Organization “INTELSAT”, Sept. 17, 1971, 10 I.L.M. The preamble of the INTELSAT Agreement indicates that the organization was formed under the principle that “outer space shall be used for the benefit and in the interest of all countries.” *Id.*

¹⁷³ KENNEDY & PASTOR, *supra* note 1, at 63.

¹⁷⁴ INTELSAT Approves Privatization Plan,

SPACEANDTECH.COM, at <http://www.spaceandtech.com/digest/sd2000-36/sd2000-36-003.shtml> (May 28, 2001) [hereinafter *Privatization Plan*].

¹⁷⁵ Delzeit & Beal, *supra* note 14, at 78. Currently, INTELSAT operates 21 satellites. INTELSAT, FLEET, at <http://www.intelsat.com/satellites.asp> (last visited Sept. 8, 2001). Its affiliate, New Skies Satellites, N.V., operates five satellites. NEW SKIES SATELLITES N.V., ABOUT NEW SKIES FLEET, at http://www.newskies.com/PBFleet/fleet_front.asp (last visited on Sept. 19, 2001).

¹⁷⁶ KENNEDY & PASTOR, *supra* note 1, at 71.

¹⁷⁷ *Id.* at 72.

¹⁷⁸ REYNOLDS & MERGES, *supra* note 144, at 215.

¹⁷⁹ *Privatization Plan*, *supra* note 174.

¹⁸⁰ *Id.*

¹⁸¹ Mike Mills, *Ready to Launch a Global Radio Network*, WASH. POST, Mar. 23, 1998, at F5-7. WorldSpace, a satellite

C. Cooperation With Due Regard for Corresponding Interests

The Space Treaty's requirements for cooperation and mutual assistance among countries and the ITC's requirements for harmonization and the coordination ensure cooperation with due regard for corresponding interests are a critical component of the ITU's regulatory system. Although it may be argued that an *a priori* system could fulfill this principle through planning, it is now fulfilled by the current *a posteriori* system, which has the critical coordination procedure to prevent interference. An *a posteriori* system's coordination process directly requires cooperation and mutual assistance among countries to prevent interference. A central authority that dictates courses of action would contradict the spirit of cooperation and mutual assistance in the *a posteriori* system. Furthermore, an *a priori* system is a more authoritative method that could result in arbitrary evaluations. Certain types of activities, such as international aviation regulation, may require a more authoritative approach because of significant safety issues, complex flight procedures and numerous actors' involvement. On the other hand, satellite use does not raise significant safety issues and usually only two parties are involved in any dispute. When the dispute arises from interference, it is directly within the interest of those two parties to find a solution, and it is a waste of resources for others to support what is primarily in the interest of the two parties. The recent conflicts involving interference demonstrate how important it is for countries to cooperate and coordinate their frequencies.¹⁸² The conflicts also demonstrate that revisions to the regulatory system are needed, particularly enforcement options, which are explored in Section V.

D. Efficient and Economic Operation

The principle of efficient and economic operation is closely related to the principle of coopera-

tion because coordination of the orbit-spectrum promotes efficient and economic orbit-spectrum use. For example, two satellites in close proximity transmitting on the same frequencies may cause each other harmful interference, potentially preventing successful operation of each satellite system. Lack of coordination would not only result in the inefficient use of the orbit-spectrum by effectively leaving precious orbital positions unused, but could even entirely prevent use of the orbit-spectrum as fully debilitating interference may result. Therefore, whether or not an *a priori* or *a posteriori* system is used, the principle of cooperation is necessary both in theory and practice. The principles of efficient and economic operation, however, are distinguished from the principle of cooperation in that these sometimes contradictory principles assist in defining what type of regulatory system should be used for the orbit-spectrum. A regulatory system, based on efficient and economic principles, focuses on obtaining the most use out of the resource at the lowest possible cost. In other words, preventing orbit-spectrum from remaining fallow while demand and technology make use possible.

Advocates of an *a priori* system might suggest that an *a priori* system would be more efficient since it requires careful planning of how orbit-spectrum is utilized; such planning could seek to optimize the spacing of satellites and the assignment of frequencies. To the extent that planning could benefit utilization of the orbit-spectrum by maximizing the number of satellites in GSO while making the greatest use of the spectrum through technical analysis, these arguments may have some merit. However, with such a large presence already in GSO, however, an *a priori* system as advocated for the benefit of the developing countries, in which positions are reserved for individual countries, fails to promote efficiency and economy. Most developing countries use of the GSO is or would be less efficient than developed countries' use of it.¹⁸³ Furthermore, a

service provider, was formed with the specific intent of marketing to developing countries, especially Africa, India, China and the Americas. The company offers broadcasting services, not just interactive telecommunications services. WorldSpace's current satellite fleet serves Africa and Asia; it plans to launch the "AmeriStar" satellite to serve the United States. This service provides an example of developing countries fulfilling their satellite communication needs by leasing a channel. See, e.g., WorldSpace.com at www.worldspace.com

(last visited Sept. 3, 2001).

¹⁸² See *infra* pp. 207-09.

¹⁸³ Many developing countries do not have the technology or cannot afford the improved antennas and transmitters that allow smaller distances among satellites. Many developing countries with large rural areas favor use of small, inexpensive antennas, even though these antenna types require a stronger signal from the satellite. But stronger signals require more space among satellites; the result is a less efficient use

jurimetric¹⁸⁴ analysis of channel depth for transmission at various frequencies demonstrates that an *a posteriori* system, and not an *a priori* system, provides for the most efficient and economic use of the orbit-spectrum.¹⁸⁵ Moreover, proponents of a *a posteriori* system contend that this system provides a market solution to the orbit-spectrum, which will yield the most efficient and economic use.¹⁸⁶

It might be contested that the free market actually supports the actions of Tonga in leasing out the allotments because through market mechanisms Tonga has merely transferred rights to a different user, while not diminishing the efficiency of the resource. In fact, the FCC has been advocating and developing rules for secondary markets for domestic use of the radio spectrum in the United States. This effort is aimed at encouraging the maximum use of spectrum that has been licensed, yet remains unused.¹⁸⁷ To the extent that there is value in advocating the free market and encouraging the use of fallow spectrum, it must also be noted that, first, leasing allotments clearly contradicts the non-appropriation principle. Second, a practice of leasing would decrease the overall efficiency of the market in terms of cost to the end-user. The increased costs associated with deploying a satellite system by paying an additional \$2 million, for example, is a burden that will be shifted to those who gain access to the system (just as the massive auction costs yielding billions of dollars for wireless spectrums in Europe and the United States will be passed on to end-users, particularly if costs increase from acquiring profit margins by leasing radio spectrum rights to another provider). The foreseeable result with re-

spect to satellite service is that unrestrained market mechanisms will create inefficiencies and decrease equitable access for the developing countries.¹⁸⁸ If a developing country sought to deploy its own satellite system, additional costs would be incurred from lease agreements, impeding the system's deployment. Or, if the developing country purchased services from an implemented system, which incorporated a leased allotment, the price would be higher than it would have been without a lease.

Although the principle of efficient and economic operation and the principle of equitable access may not be in harmony, of the two principles, greater force ought to be given to the principles of efficient and economic operation. As discussed above, there are various options for the developing countries seeking to gain access to the orbit-spectrum. On the other hand, there are very limited means for accomplishing the efficient and economic operation of the orbit-spectrum. Because orbit-spectrum is such a scarce resource and demand is increasing, it is critical to harness as much of this resource as possible. Deference to the principle of efficient and economic operation will best lead to an adequate supply of satellite service without unduly limiting developing nations' access to orbit-spectrum.

E. Additional Support for the *A Posteriori* System

International law, as established by custom, supports the continuation of the *a posteriori* system for regulating orbit-spectrum use.¹⁸⁹ Additionally, the customary international law of a *a posteriori* regula-

of the orbit spectrum. See Smith, *supra* note 45, at 241 & n.62.

¹⁸⁴ Jurimetrics is the application of quantitative methods to legal decision-making. Rothblatt, *supra* note 2, at 70; see generally AndrewLaw.com, at <http://www.andrewlaw.com/jurimetrics.htm> (last visited Jan. 12, 2002).

¹⁸⁵ Maximum channel dispersion is an international legal principle based on economic and efficient operation of the orbit-spectrum pursuant to the Space Treaty and the ITC. Channel dispersion is a function of three dimensions: depth, distribution and directionality. Applying a formal quantitative analysis to each dimension demonstrates that maximum channel dispersion is achieved with an *a posteriori* system, not with the *a priori* system. With respect to depth, the *a posteriori* track allows 500 MHz per orbital position, whereas the *a priori* system allows only 2.3 MHz per orbital position. With respect to distribution, the *a posteriori* system provides "about twice as much" as the *a priori* system. It is only with respect to directionality where the *a priori* system is comparable to the *a posteriori* system because the value is the same for both. Roth-

blatt, *supra* note 2, at 72.

¹⁸⁶ D. da Empoli, *Market Versus Non-market Decisions for the Global Commons: The Case of the Orbit-Spectrum Resource*, THE FUTURE OF INTERNATIONAL COMMUNICATIONS 2337, 2339 (UMBERTO LEANZA ed., 1993).

¹⁸⁷ *In re Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, Notice of Proposed Rulemaking*, 15 FCC Rcd. 24203, para 18 (2000) (proposing regulations for "the development of more robust secondary markets in radio spectrum usage rights").

¹⁸⁸ Thompson, *supra* note 15, at 308-09.

¹⁸⁹ *North Sea Continental Shelf (F.R.G. v. Den.; F.R.G. v. Neth.)*, 1969 I.C.J. 3, 175 (Feb. 20, 1969) (dissenting opinion of Judge Tanaka). Judge Tanaka explained that two elements, corpus and animus, must be fulfilled for a particular practice to constitute customary international law. The corpus, a "quantitative factor, . . . constitutes a usage or a continuous repetition of the same kinds of acts." The animus is a

tion may also be binding on nations that are not signatories to the Space Treaty or ITU members.¹⁹⁰ From the U.S. perspective, the 1984 Commercial Space Launch Act ("Launch Act") supports implementation of an *a posteriori* system more than an *a priori* system.¹⁹¹ The Launch Act's purpose is to "promote economic growth and entrepreneurial activity through utilization of the space environment for peaceful purposes."¹⁹² Because an *a priori* system would limit access to the orbit-spectrum, its implementation would not promote outer space use; rather, the *a posteriori* system would allow for greater access, flexibility, and opportunity for entrepreneurial activity.

V. REFORMATION OF THE REGULATORY SYSTEM

The increase in conflicts over the orbit-spectrum has led observers to call for revisions to the regulatory system.¹⁹³ Recent demands have not been for a shift towards an *a priori* system, but have been for changes to the current *a posteriori* system. How successful revisions to the *a posteriori* system are will depend on resolving critical issues, such as the creation of paper satellites, interference problems and administrative costs.

Recent changes in the *a posteriori* system addressed the problems of paper satellites and administrative costs.¹⁹⁴ To address the problem of paper satellites, the ITU decreased the maximum amount of time that an orbital position can be re-

served through advanced publication before actual implementation of the satellite from nine years to seven years.¹⁹⁵ Moreover, the ITU developed the due diligence requirements to increase the likelihood that the applicant has contracted for the manufacturing of a satellite for the publicized orbital slot. At the WRC 2000 in Istanbul, Turkey, satellite industry stakeholders reviewed administrative and financial due diligence requirements.¹⁹⁶ Financial due diligence has met significant resistance because it may impose high costs; thus impeding the ability of developing nations to deploy a satellite system. As these changes for dealing with paper satellites have been recently implemented, it may be too early to fully assess the success of these revisions; yet, early indications from the WRC 2000 are that administrative due diligence has limited the number of frivolous filings. Although a good step, the changes do not go far enough. Paper satellites infringe on the restriction against national appropriation in space and on the efficient and economic use of space by unnecessarily reserving positions that could be immediately used by another party. Paper satellites need to be further curtailed; to accomplish this, more stringent regulations are necessary. For example, the seven-year period is still too long, it should be shorter. The appropriate length of satellite deployment depends on what is reasonably necessary to complete the coordination process, assuming all states cooperate.¹⁹⁷ Assuming a cooperative coordination process, with the industry's

"qualitative factor" that looks to the subjective, motivating force behind state action, which reflects a binding legal obligation—"opinion juris sive." Subjective intent may be identified from numerous signatories to the Space Treaty and the ITC recognizing a binding legal obligation to the principles articulated in therein. Utilization of the *a posteriori* system has certainly been a continuing, prevalent practice in the international community. Also, the *a posteriori* system was utilized from the beginning, prior to any regulatory system, when Sputnik was placed into orbit without any planning of the use of the orbit-spectrum.

¹⁹⁰ See BUERGENTHAL & MAIER, *supra* note 140, at 24. Customary international law will not be binding on a nation if that nation consistently rejected the practice embodied in the custom or formally "contracts out of customary international law." *Id.*

¹⁹¹ 98 Stat. 3055 (1984).

¹⁹² 49 U.S.C. §70101(b)(1) (1994).

¹⁹³ Roberts, *supra* note 7, at 1136 (summarizing proposed reforms); Jennifer A. Manner, *A Survey: WRC-2000 & IMT-2000 the Search for Global Spectrum*, 9 COMM'LAW CON-SPECTUS 5, 9-22 (2001) (analyzing various points of view advocated at the World Radiocommunications Conference in 2000).

¹⁹⁴ Roberts, *supra* note 7, at 1130.

¹⁹⁵ *Id.*

¹⁹⁶ Administrative due diligence "information includes identity of the satellite network, name of the administration, country symbol, frequency band(s), name of operator, name of satellite, orbital characteristics, name of the satellite manufacturer, date of execution of the contract, contractual delivery date, number of satellites procured, name of the launch vehicle provider, date of execution of the contract for launch services, a launch or in-orbit delivery window, name of the launch vehicle and name and location of the launch facility." *WRC2000 Highlights*, No. 11, May 19, 2000 at <http://www.itu.int/newsarchive/wrc2000/releases/22may.html> (last visited Feb. 3, 2002). Financial due diligence could require payment of "deposit of one percent of the cost of building and launching a satellite" so as to "deter frivolous filings." *WRC2000 Highlights*, No. 3, May 9, 2000 at <http://www.itu.int/newsarchive/wrc2000/releases/10may.html> (last visited Feb 3, 2002).

¹⁹⁷ See *infra* Part III.B. The amount of time should be relatively short because cooperation and mutual assistance are international law; it should be assumed that nations would abide by it.

increasingly proficient technical and manufacturing capabilities, five years would be sufficient time to deploy a satellite into an orbital location. Additionally, the ITU should be given the power to investigate whether submitted due diligence information is true and accurate. If it is determined that the information was both material and misleading, a special multinational panel should determine whether to automatically void the registration/reservation. Another possibility for deterring paper satellites is to require applicants to file a deposit equal to a percentage¹⁹⁸ of the satellite's value or a set fee.¹⁹⁹ This might be criticized, however, as discriminatory against developing nations and small companies that do not have readily available capital. This could be partly solved by smaller companies offering collateral in the satellite or in company assets as a good faith gesture, but this may prove terribly complex to administer. Furthermore, it may discourage developing countries and small companies that are willing enter into a risky venture, but are unwilling to lose corporate assets in case a good-faith effort to launch a satellite fails. This, in turn, could be put under the scrutiny of a multinational panel to make a good-faith determination, yet such a determination could lead to a complex and undesirable administrative task. In any case, the shorter waiting period and due diligence enforcement are fair and effective means for destroying paper satellites.

The concern for administrative costs arose from developing countries' view that their ITU fees subsidized developed nations' satellite programs, not developing nations' efforts to launch satellites.²⁰⁰ Requiring each country that files an advanced publication for an orbital slot to pay a set fee will rectify this concern. Although this fee might have some effect on slowing the creation of paper satellites, the ITU clearly stated that the fee is required only to address the needs of administrative costs and to avoid the subsidization complained of by developing countries. The value of this new regulation has not yet been traced, but it appears to be a good step in the direction of continuing to fund

the ITU's increasingly complex tasks and to address developing nations' complaints. If there continue to be fiscal problems, the ITU could raise general fees as well as the case-by-case registration fees.

One of the greatest concerns that remains unresolved is a coordination problem between satellite providers. In part there is no need for increased regulation of the coordination process because it is clearly in the best interest of two individual satellite providers to coordinate, for without coordination, both will experience interference. It is only through coordination of frequencies that both providers can achieve interference free signals. Yet, what about the cases where a provider purposefully jams the signal of another provider or where one provider places a satellite into an orbital position before the provider registered for that position launches its own satellite into the position?

These are problems that even the new regulations are likely to fail to properly resolve. Instead a meaningful enforcement mechanism is necessary to achieve satisfactory results. Unfortunately, the ITU lacks any enforcement power. At least two options are possible, one currently existing and the other is not. The existing option is for the nation, which espoused on behalf of the aggrieved party during the registration process, to bring the case before the International Court of Justice.²⁰¹ The other, not yet existing option is for the ITU to establish a judicial body with enforcement powers. The decisions of this judicial body would be binding on the nations that espoused on behalf of the parties during the registration process. The situation in either an International Court of Justice case or in an ITU judicial case becomes more difficult to resolve if the accused party did not use the national channel to register, but simply launched without any kind of contact with the ITU. Recall, a number of countries that are not ITU members, therefore, are not bound by the ITC's requirements.²⁰² Yet, it could be argued that a combination of the treaties and customary international law developed through the

¹⁹⁸ Proposed percentages range from 1% to 2%. *Crowded Orbital Slots Test ITU's Influence*, SPACE NEWS, Jan. 27, 1997, 1997 WL 9051757.

¹⁹⁹ Roberts, *supra* note 7, at 1132-34. The chances for a financial solution are slim because the ITU determined not to take such an approach at the 1997 WRC meeting. Individual nations, however, are likely to raise the issue at future

conferences.

²⁰⁰ *ITU to Charge Satellite Operators For System Modification Services*, SATELLITE WEEK, July 14, 1997, 1997 WL 8577890.

²⁰¹ Richard Berkley, *Space Law Versus Space Utilization: The Inhibition of Private Industry in Outer Space*, 15 WIS. INT'L L.J. 421, 435, (1997).

²⁰² See *infra* pp. 212-14.

repeated practice of following ITU procedures is binding on ITU nonmember states. Despite this potential complication, all major satellite powers are ITU members. Thus, an internal ITU judicial body could, in effect, operate within the satellite community.

There are some substantial adjustments that could be made to the *a posteriori* system, which incorporate an *a priori* system's planning characteristic, hinting at the evolution of a hybrid system. The primary aim of such adjustments is to ensure efficient and economic operation of the orbit-spectrum through competitive innovation. At the same time, equitable access would be ensured, allowing companies or countries that do not presently have the capability of launching satellites into GSO to develop such capabilities.

At the heart of the proposed adjustments is a transparent competitive bidding procedure similar to that used for public procurements. As positions in the GSO become increasingly scarce, a newly formed ITU technical body would assess and identify the frequency potential for a given slot. Rather than using the current system where the first provider to launch a satellite into that position acquires rights to that position, the suggested approach would permit several providers interested in the same position to submit competitive bids. The ITU would review bids under two circumstances: when the applicants seek an open position and when they seek a position that has been permanently abandoned. The bids would be accepted and reviewed by the newly formed ITU technical body. A precise and publicized scoring system for the various factors would be used to avoid accusations of discrimination. The following are some factors that may be considered: which provider could get a satellite into that position at the earliest date; which satellite would have the longest life span; which provider would maximize channel dispersion at that particular position; which satellite would cause the least risk for interference with the surrounding satellites; which satellite would potentially benefit the largest number of end-users; and which proposal would contrib-

ute the most to a large satellite network. This is a non-exhaustive list; the primary object of using a bidding system is to squeeze as much out of the orbit-spectrum as possible for the benefit of the greatest number of people during a given time period.

A more difficult challenge is to determine a response to a provider that plans to continue operations in a position with a new satellite replacing a disposed satellite when other providers wish to use that slot. Because the original provider may have incurred great expense in developing its satellite service and that particular position may be critical for networking with other satellites, it would be both unfair and wasteful to open that position to bidding. Furthermore, it is highly unlikely that a proposition to open such positions to bidding would be supported by the telecommunications community and developed countries. It is developing countries that might be more supportive of the opportunity to bid on positions under assignment. But the simple wish of one country to use what is already being used by another country is insufficient to pass the right of use. There might be one opportunity, under an adjusted system, for countries to acquire such positions. The ITU should assess a temporarily vacated position and establish minimum technical requirements regarding frequency use, interference and channel dispersion for the particular use of that position. If the original provider fails to meet the minimum requirements for its new satellite, then, under the principle of efficient and economic operation, the ITU should open the position for bidding, at which point both developed and developing countries could bid to provide the most efficient and innovative satellite service for the available position.

There may be some concern about putting such a strong emphasis on technology. As mentioned, the orbit-spectrum is a technology-bound resource with no predetermined limits to define how technology will allow providers to harness the orbit-spectrum resource.²⁰³ Also, the power of technology with respect to issues on the interna-

²⁰³ See, e.g., Teledesic.com, at <http://www.teledesic.com> (last visited Feb. 3, 2002). Where technology reaches its limit with respect to use of orbit-spectrum, new opportunities will arise. For example, Teledesic utilizes low-Earth-orbit (LEO) satellites to establish a communications network. LEO satellites operate at low altitudes and are not in geosynchronous orbit. They are typically integrated into a multi-satellite net-

work, or constellation, so as to provide wide coverage and consistent service. *Id.*; see also Mike Mills, *Haig Floats a High-Tech Trial Balloon: Firm Looks Skyward to Different Satellite*, WASH. POST, Apr. 13, 1998, at F5. Another alternative, involving former Secretary of State Alexander Haig, is Sky Station International, which is planning to launch huge, robotic, high-altitude, zeppelins (High Altitude Platform Systems,

tional scale has gained increased recognition.²⁰⁴ Article 9 of the Rio Declaration on Environment and Development states: "States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies."²⁰⁵

Regulation via technology can both operate to preserve—or better utilize—the environment, and it can operate as a "technology-forcing" mechanism.²⁰⁶ In regard to preserving or better utilizing the environment, a minimal technological standard that is already achievable, but not yet uniformly implemented, could operate to achieve a minimum standard of efficiency.²⁰⁷ A technology forcing approach can stimulate research and development by setting a standard that has not yet been achieved. For example, the 1970 Amendments to the Clean Air Act required automobile manufacturers to meet certain numerical standards for fuel efficiency and auto emissions, however, the auto industry had not developed the technology to meet those standards and maintain market prices for cars.²⁰⁸ This mandate compelled intensive research to develop such technol-

ogy until the standards were reached and surpassed. Likewise, setting standards and promoting competition for the orbit-spectrum will stimulate research and development in the satellite field. This innovation in technology will lead to more efficient orbit-spectrum use, potentially benefiting a large number of people.

VI. CONCLUSION

Since the launch of Sputnik in 1957, utilization of the orbit-spectrum with satellites has been growing and evolving rapidly. Currently, the international satellite community is faced with new challenges without obvious solutions, but familiar legal principles offer guidance. It is critical to not only deal with the current problems quickly, but to do so with a view toward future challenges. Because access to the orbit-spectrum is likely to become scarcer and satellite technology more sophisticated, efficient utilization and emerging technologies are good starting points for evaluating and revising the current regulatory system. Not only will this benefit the satellite community, but it will contribute to the growth of space law in general, which will become increasingly relied upon as we reach toward the stars.

"HAPS") over major cities. Sky Station plans to transmit signals for Internet data transmission, telephone calls and video transmission. Mr. Haig's partners include Harry Darlington, the president of the Ozone Society, and Martine Rothblatt, whose work is referred to herein. It is expected that as many as 250 HAPS will be deployed, with initial deployment planned for 2002. *See generally*, SkyStation.com, at <http://www.skystation.com> (last visited Feb. 3, 2002).

²⁰⁴ DAVID HUNTER ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND POLICY 65–81 (1998) [hereinafter DAVID HUNTER] (discussing technological development with respect to sustainable world growth).

²⁰⁵ *Id.* at 308.

²⁰⁶ *Id.* at 73–74.

²⁰⁷ This raises a problem of quantity versus quality. The

orbit-spectrum has different types of satellites. Some are built to transmit massive amounts of information; others, such as U.S. military remote-sensing satellites, transmit relatively small amounts of specialized data. Not surprisingly, developed countries with specialized satellites performing national security tasks are unlikely to abandon these positions for satellites that merely transmit huge amounts of raw data, even if it is done efficiently. No obvious solution exists to this problem in the context of a revised, technologically-guided bidding system. A possible approach is to defer to the first-in-time, first-in-right principle for non-commercial satellites that provide a critical service, including national security, geological/oceanographic remote-sensing and weather data.

²⁰⁸ DAVID HUNTER, *supra* note 204, at 74; *see also* Clean Air Act, 42 U.S.C. § 7401 (1994).