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NEW SPACE TECHNOLOGY:

REGULATORY CHALLENGES FOR THE

INTERNATIONAL TELECOMMUNICATION UNION.

by

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ABSTRACT

This work examines the effect of three emerging satellite technologies on the use and regulation of what might be called Earth Orbital Space. The three new technologies, Direct Broadcasting Satellites (DBS), Global Mobile Personal Communication Services (GMPCS), and Global Navigation Satellite Services (GNSS), are being implemented in or planned for different portions of Earth Orbital Space: the geostationary orbit, low earth orbits, and medium earth orbits, respectively.

Each technology creates different challenges for the International Telecommunication Union which is the organization charged with their regulation. DBS services were regulated in the 1970s and early 1980s prior to their practical use. That early regulation appears, today, to be overly restrictive in many ways.

GMPCS, on the other hand, is now becoming a reality but lacks a solid legal structure to ensure that its potential for global wireless communication can be achieved.

GNSS provides yet a different challenge: that of providing for the civil utilization of military navigation systems. The deployment of these new technologies add to the increasing problem of congestion in the orbit-spectrum resource.

The final chapter details a number of different proposals aimed at increasing both equity and efficiency in the management of the orbit-spectrum resource.

RÉSUMÉ

Cette thèse examinera les effets de trois nouvelles technologies sur l'utilisation et la règlementation de l'Espace Orbital de la Terre. Ces trois technologies: diffusion directe par satellite (DBS), services de communications mobiles personnels par satellite (GMPCS), navigation globale par satellite (GNSS) se verront établies à trois altitudes orbitales différentes: orbite géostationnaire, orbite de basse altitude et orbite d'altitude moyenne, respectivemment.

Chacune de ces technologies présente des défis différents pour l'Union Internationale des Télécommunications, l'organisation chargée de les régir. La diffusion directe par satellite fût reglementée dans les années 1970 et 1980 avant même leur utilisation pratique. Cette règlementation semble aujourd'hui, à certains égards, excessivement restrictive.

Les services de communications mobiles personnels par satellite, d'un autre côté, sont maintenant au stade de lancement mais il manque une structure juridique solide pour assurer l'épanouissement de leur potentiel.

La navigation globale par satellite engendre un problème différent encore, celui de l'utilisation de systèmes de navigation militaires pour des besoind civils.

La mise en place de ces technologies ajoutera au problème croissant de congestion des ressources spatiales (orbites et fréquences). Le dernier chapitre examinera certaines propositions visant à accroître l'équité et l'éfficacité de la gérance des ressources spatiales.

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PART I. THE INTERNATIONAL TELECOMMUNICATION UNION

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New Space Technology:

Regulatory Challenges to the International Telecommunication Union

Introduction

Born from the demands of a new technology called wireless telegraphy and the need to regulate it to avoid interference, the International Telecommunication Union (ITU) has proven itself to be a useful and adaptable international institution in fulfilling that function, even as new technologies emerged and the radio-spectrum was far more extensively utilized.

Four decades after the launch of Earth's first artificial satellite, Sputnik I, certain sections of the orbit-spectrum resource are heavily exploited. International allotment plans of orbital positions and frequencies have been devised so as to ensure, in practice, equitable access for all countries to certain portions of this limited resource. The saturation of this resource is accelerating while traditional commercial applications of space continue to show growth, even as new applications thrust themselves into an increasingly crowded orbit-spectrum resource.

It is on three new technologies, Direct Satellite Broadcasting, Global Mobile Personal Communication Services, and Global Navigation Satellite Services, and their impact on the regulatory regime of the ITU, which this thesis shall concentrate. The thesis will examine the new technologies and the inevitable conflict between their contribution to orbit-spectrum saturation and the international law governing activities in Outer Space.

In chapter one, the thesis defines the technical and legal terms and concepts relevant to the main topic. It also outlines the current state of the orbit-spectrum resource in relation to congestion. Finally, the new technologies and their estimated impact on congestion, which form the core interest of this paper, will be identified. The focus of the second chapter is on the ITU: it briefly describes its history and importance, outlines its structure, its current regulatory regime and underlines the legal principles governing its resource-allocation process. This chapter shall also examine recent developments within the ITU relative to the new technologies. Reforming the ITU frequency allocation regime to permit more equitable and efficient use of space resources could result in the adoption of an alternative to the existing institutional model, some proposals of alternative regimes shall be explored in the third chapter of this thesis.

CHAPTER I. TECHNICAL AND LEGAL BACKGROUND

This thesis is concerned with the legal implications of technologies of which the most essential component is an artificial space object traveling on an orbital path around the Earth. These space objects[1] are commonly referred to as satellites and perform their functions aided by radio signals. Satellites as well as all space ventures, require interference-free radio links for command, control, telemetry and tracking.[2] Because radio interference can compromise the success of a mission or even endanger human life, the legal rules governing frequency allocation consequently take on additional importance in space law.[3]

PART I. OUTER SPACE- General Observations

A. Definition of Space Law

Many terms have been proposed to define the collection of legal rules governing human activities in space: cosmic law, "droit de l'espace extra-atmospherique", "droit astronautique", and aerospace law, among others.[4] The most widely accepted however, is the English term "space law".[5] There are many

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[1] Satellites are space objects pursuant to Article I (d) of the *Convention on Liability for Damage Caused by Space Objects*, September 1, 1972, (UNGA Res.2777 (XXVI) Annex of Nov.29, 1971) UNTS Vol.961, at 187.

[2] N.M. Matte, *Aerospace Law: Telecommunication Satellites* (Toronto: Butterworth and Co., 1982) at 1.

[3] R.S. Jakhu, "International Regulation of Satellite Communications" in K. Tatsuzawa, ed., *Legal Aspects of Space Commercialization* (Tokyo: CSP Japan, 1992) at 78.

[4] L. Peyrefitte, *Droit de L'Espace* (Paris: Dalloz, 1993) at para 4. See also van Bogaert, infra note 6 at 7.

[5] Ch. Chaumont, *Le Droit de l'Espace* (Paris: Presses Universitaires, 1960) at 5.

definitions for the expression "space law"; a typical definition can be found in Aspects of Space Law:

> "Space Law regulates the relations between States, international organizations and private persons, arising from the exploration and use of outer space."[6]

International space law is a branch of public international law[7] because it regulates transnational activities. However, the last two decades have witnessed increasing private commercial participation in space activities, which has led to the emergence of national laws relating to space use and exploration.[8] Space law finds its source primarily in written international law in the form of treaties prepared by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). COPUOS has drafted five treaties of which four have been ratified by a sufficient number of parties to bind the majority of States, including all space powers.[9] A number of bilateral and multilateral agreements on space related issues, such as the Nuclear Test Ban Treaty and the ITU Constitution and Convention complement those treaties. Although several important rules of customary space law were codified by the Outer Space Treaty,[10] international customary law remains applicable for the determination of those questions of law which have not been written.[11] Furthermore,

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[6] E.R.C. van Bogaert, *Aspects of Space Law* (Deventer, The Netherlands: Kluwer Law and Taxation, 1986) at 6.
[7] N.C. Goldman, *American Space Law*, 2nd ed. (San Diego: Univelt, 1996) at 65.
[8] See R. Oosterlinck, "Private Law Concepts in Space Law" in Tatsuzawa, ed., supra note 3 at 42.
[9] Goldman, supra note 8 at 67 The four treaties are the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space including the Moon and other Celestial Bodies*, 610 UNTS 205; *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, 672 UNTS 119; *Convention on the International Liability for Damage Caused by Space Objects*, 961 UNTS 187; *Convention on Registration of Objects Launched into Outer Space*, 1023 UNTS 15.
[10] Peyrefitte, supra note 4 at 40.
[11] Ibid. at 42.

the rules of customary international law apply also to those States that are not party to the treaties in which those rules have been codified.[12]

National (or "municipal") laws are another, albeit more limited, source of space law.[13] National laws are specific laws regulating particular aspects of space activities on a national level, although some, such as the American "Commercial Space Launch Act" of 30 October 1984, may have extra-territorial application.[14]

B. Legal Delimitation of Airspace and Outer Space

In international law, it is clear that outer space is not subject to national appropriation[15] whereas the air space above the national territory is subject to sovereignty.[16] The conflicting legal regimes of free access and national sovereignty obviously cannot apply to the same area. The determination of which set of legal rules is applicable in which circumstances or at which locations has yet to be resolved with precision.[17]

Few issues in space law have been the source of as much debate as the question of the delimitation of air space and outer space.[18] Numerous learned articles and proposals have preceded and followed the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) background paper entitled "The Question

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[12] As stipulated at Article 38 (1) c) *Statute of the International Court of Justice.*
[13] Oosterlinck, supra note 8 at 42.
[14] Peyrefitte, supra note 4 at 44.
[15] Art. 1 of the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space including the Moon and other Celestial bodies* of January 27, 1967 [Hereinafter Outer Space Treaty].
[16] See Article I para. (1) *Convention on International Civil Aviation*, Chicago, Dec.7, 1944, 61 Stat. 1180, TIAS No. 1591, 15 UNTS 295
[17] H. Qizhi, "The Problem of Definition and Delimitation of Outer Space" (1982) 10 J. Space L. 157 at 158
[18] S.N. Hosenball & J.S. Hofgard, "Delimitation of Air Space and Outer Space: is a Boundary Needed Now?" (1986) 57 U. Colo. L. Rev. 885 at 885

of the Definition and/or Delimitation of Outer Space".[19] While these essays have identified the conflicting arguments relating to this question they have failed to propose an internationally acceptable solution to the problem. Three successive Soviet proposals made in 1979, 1983 and lastly in 1987,[20] have unsuccessfully suggested drawing a line somewhere between 100 and 110 km of altitude, accompanied by a right of innocent passage below that limit.[21] At the thirty-sixth session of the Legal Subcommittee (1-8 April 1997) it was decided that consideration of the question on aerospace objects (agenda item 4)[22], partially discussing the definition and delimitation of outer space (at questions 2 and 4), should be continued at its next session in 1998.[23] It may therefore be stated that the issue is not resolved. Whether the functionalist theory (by which the character of the activities under regulation is held to be determinant) or the spatial theory (which aims at establishing an altitude boundary to state sovereignty) or any other proposal shall provide a solution is not clear at time of writing.

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[19] UN Doc. A/AC.105/C.2/7 (1970) followed by UN Doc. A/AC.105/C.2/7 Add. 1, an addendum from 1977.
[20] UN Doc. A/AC.105/L.112 (20 June 1979); UN Doc. A/AC.105/L.139 (4 April 1983); UN Doc. A/AC.105/L.168 (5 June 1987).
[21] For a detailed study of the legal status of the right of innocent passage see Terekhov, infra note 93.
[22] UN Doc. A/AC.105/674; Agenda item 4 is entitled: "*Matters relating to the definition and delimitation of outer space and to the character and utilization of the geo-stationary orbit, including consideration of ways and means to insure the rational and equitable use of the geo-stationary orbit without prejudice to the role of the International Telecommunication Union*"[Hereinafter Agenda item 4].
[23] UN Doc. A/AC.105/674 at 19.

C. Space debris

There is currently no authoritative definition of the term "space debris",[24] however the first report[25] (of three) of a multi-year study by the Scientific and Technical Subcommittee of COPUOS at paragraph 95 has provided the following guidance:

> "[S]pace debris are inactive man-made objects, such as spent upper stages, spent satellites, fragments or parts generated during launch or mission operations, or fragments from explosions and other breakups"

Some commentators[26] would add spent rocket effluent and other micro-particulate matter to the definition of debris,[27] whereas others would classify such small particles simply as pollution,[28] restricting the term "space debris" to identifiable remnants of inoperational satellites.[29] In 1994 over 7,000 objects in orbit were being tracked by NORAD (North American Aerospace Defense Command), of which roughly 5% provided useful services,[30] the number of untraceable fragments is estimated to be several magnitudes larger.[31]

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[24] G.T. Hacket, *Space Debris and the Corpus Iuris Spatialis* (Gif-sur-Yvette, France: Editions Frontieres, 1994) at 53 ff.
[25] UN Doc. A/AC.105/C.1/L.203 (9 February 1996).
[26] H.A. Baker, *Space Debris: Legal and Policy Implications* (Dordrecht, The Netherlands: Martinus Nijhoff, 1989) at 8.
[27] UN GAOR, COPUOS, *Environmental Effects of space activities* [:] Report submitted by the Committee on Space Research and The International Astronautical Federation, A/AC.105/420 (15 Dec. 1988) at 8 ff.; see also P. Fortin, *Artificial Space Debris and International Law* (LL.M. Thesis, Montreal: Institute of Air and Space Law, McGill University, 1990) at 11.
[28] Hacket, supra note 24 at 19.
[29] G.C.M Reijnen & W. de Graaff, *The Pollution of Outer Space, in Particular of the Geostationary Orbit* (Dordrecht, the Netherlands: Martinus Nijhoff, 1989) at 38.
[30] J.A. Simpson, ed., *Preservation of Near-Earth Space for Future Generations* (New York: Cambridge University Press, 1994) at 17
[31] Space Debris Working Group, *Space Debris: A Report from the ESA Space Debris Working Group* (Noordwijk, The Netherlands: ESA Publications Division, 1988) at 15

Debris, unfortunately, is not restricted to any particular region of outer space. Three-fourths of all debris is estimated to be located in the Low Earth Orbit (LEO) region of space,[32] with the densest accumulations to be found between 800 and 1500 km where the average lifetime of an artificial object is several hundred years.[33] The collision hazard engendered by debris in LEO is estimated to be much greater than in the geostationary orbit (GEO).[34] The remaining one-fourth of debris is spread among the Geo-synchronous Transfer Orbit (GTO), the Geostationary Satellite Orbit (GEO) and beyond the GEO. The orbit of debris located in LEO, below 800 km, is deteriorating by the Earth's gravitational pull as well as by solar winds and other forces, leading to eventual disintegration in the atmosphere.[35] Debris in the GEO is not as susceptible to these forces and will likely continue orbiting within the GEO for approximately 10,000 years.[36]

Space debris cannot but affect the use of the geostationary orbit.[37] One commentator has noted that only a small portion of the geostationary arc permits Canada-wide service with a single satellite; should debris render that small portion unusable it will surely have repercussions on the cost and availability of any such service.[38] Efforts at resolving this problem have not yet resulted in an internationally binding legal instrument. The ITU Radiocommunication Assembly adopted a non-

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[32] Baker, supra note 26 at 22.
[33] There are over 100,000 debris in LEO as small as 1cm in diameter that can cause serious damage to satellites. L. Perek "Space Debris: Discussions in the United Nations in 1996" (1996) 39 Colloquium L. Outer Space at 216.
[34] R.S. Jakhu "Space Debris in the Geostationary orbit: A Major Challenge for Space Law" (1992) 17 Ann. Air & Sp. L. 313 at 315.
[35] Hacket, supra note 24 at 29 and at 40.
[36] Jakhu, supra note 34 at 318.
[37] On July 17, 1997, the European Remote Sensing (ERS-1) satellite was moved just 60 minutes before a projected impact with the abandoned Russian satellite Cosmos 614.
[38] R.S. Jakhu "Space Debris in the Geostationary Orbit: A Matter of Concern for the ITU" (1991) 34 Colloquium L. Outer Space 205.

binding recommendation in 1993[39] regarding debris in the geostationary orbit. The Assembly's recommendation suggested minimizing the release of debris during placement into orbit and transferring satellites nearing the end of their operational life-time to a higher disposal (or "graveyard") orbit in such a way as to not create interference with still operational satellites, among other possible actions. Even without a binding document some space agencies are voluntarily adopting preventive methods which implement the above recommendations, in addition to more comprehensive steps.[40] These measures are only partially responsive to the needs, however, and do not address the existing debris problem. More pro-active solutions are required.[41]

D. Geostationary Orbit

A geo-synchronous satellite is defined in the Radio Regulations[42] as an earth satellite whose period of revolution is equal to the period of rotation of the Earth about its axis. A geostationary satellite[43] is a satellite whose circular and direct orbit lies in the path of the Earth's equator and which thus remains fixed relative to the Earth. Consequently, the geostationary satellite orbit is "the orbit in which a satellite

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[39] Recommendation ITU-R S. 1003; UN Doc. A/AC.105/C.1/CRP.4 of 9 Feb. 1995.
[40] The Iridium and Teledesic LEO constellation proposals plan for de-orbiting their satellites, however significant debris accumulation is still expected from spent upper-stages and other launch related hardware. Steps undertaken by others include the venting of upper stages and the discharging of batteries to prevent explosions. See Perek, supra note 33 at 219; UN Doc. A/AC.105/620 of 21 Nov. 1995. Also see UN Doc. A/AC.105/681 of December 17, 1997.
[41] One possibility is the Autonomous Space Processor for Orbital Debris, a space object which would use advanced robotics to seize, dismantle, and dispose of the largest items of debris (over 1000 pounds). The Department of Aerospace and Mechanical Engineering of the University of Arizona in Tucson have built a one-third-scale model of ASPOD. See P.M. Sterns & L.I. Tennen "The Autonomous Space Processor for Orbital Debris (ASPOD) Project and the Law of Outer Space: Preliminary Jurisprudential Observation" (1995) 38 Colloquium L. Outer Space at 107.
[42] ITU Doc. ISBN 92-61-01221-3 art.1, No. 180 (1982).
[43] Ibid. at No. 181.

must be placed to be a geo-stationary satellite".[44] A geostationary orbit is also a geo-synchronous orbit.

The Geostationary Satellite Orbit (GEO) is a ring-like natural phenomenon approximately 30 km wide and 150 km thick[45] at an average distance of roughly 35,785-km above the Earth's equator.[46] Because satellites placed in this orbit move with the same speed and direction as that of the Earth's rotation they appear to be stationary in relation to a given point on the surface of the Earth, and are able to provide 24-hour service to approximately a third of the globe. It should be noted that satellites placed in lower orbit travel more rapidly than those in the GEO; inversely satellites located above GEO revolve slower. There is only one GEO, and it has been declared a "limited natural resource" pursuant to Art. 44 of the International Telecommunications Convention.[47]

The geostationary orbit offers significant advantages for the satellites placed within it. A satellite in this orbit can have line-of-sight communication with roughly a third of the globe; thus a system of three can provide almost global coverage,[48] of great value in telecommunications. Geostationary satellites offer significant cost advantages over those located elsewhere because a single satellite can provide continuous service to a given service area where a system of several would otherwise

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[44] Ibid. at No. 182.
[45] Physical forces and limitations in positioning precision result in deviations from the nominal position of satellites, these deviations which correspond to the dimensions of the GEO "ring". M.L. Smith "The Orbit Spectrum Resource and the Technology of Satellite Telecommunications: An Overview" (1986) 12 Rutgers Computer and Tech. L. J. 286.
[46] Reijnen & de Graaff, supra note 29 at 3.
[47] Final Acts of the Additional Plenipotentiary Conference (Geneva, 1992): Constitution and Convention of the International Telecommunication Union; Optional Protocol; Resolutions; Recommendation (Geneva, 1993)
[48] Reijnen & de Graff, supra note 29 at 14.

be necessary. Also, when satellites do not maintain a fixed position relative to the earth station, more elaborate and expensive earth stations with steerable antennas are required. The life expectancy of a satellite placed in the GEO is greater than in some other orbit and therefore the revenues created are higher. There are, however, certain drawbacks to utilizing the GEO: the satellites involved in its use are large and expensive; the launch vehicle also is comparatively expensive; and transmissions suffer a 0.6 second delay making two-way phone conversations difficult.[49]

The total potential capacity of the GEO is subject to endless debate and at this time impossible to know.[50] The GEO is a ring of 270,000 km circumference and assuming it is divided into standard +/- 0.1 degree slots[51] it might accommodate 1800 satellites,[52] although others claim only 180[53] satellites is realistic. Regardless, some positions are more desirable than others are and while the current GEO satellite population is in the 160-satellite range, already over America, Europe/Africa, and East Asia it is increasingly difficult to be assured a desired position.[54] While the risk of collision in these areas remains low,[55] congestion of the radio spectrum and

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[49] W. Pritchard "Satellites in Non-geostationary orbits: Coming Technical and Policy Issues of the 1990s" (1993) 9 Space Policy 199 at 200.

[50] See *Physical Nature and Technical Attributes of the Geostationary-Satellite Orbit*, U.N. Doc A/AC.105/203 (1977).

[51] Radio Regulations Appendix 30, para.3.11.; Radio Regulations, (International Telecommunication Union, Geneva, 1990)

[52] M. Benko & K-U. Schrogl, *International Space Law in the Making: Current Issues in the UNCOPUOS* (Gif-sur-Yvette: Nouvelles Frontières, 1993) at 156.

[53] P. Achilleas, *La Television par Satellite: Aspects juridiques internationaux* (Paris: Montchrestien, 1995) at 24; A study by the ITU estimates that there are between 240 and 600 "satellite coverage areas" available from GEO, see ITU, CCIR Report to the Second Session of the World Administrative Radio Conference on the use of the Geo-stationary Satellite Orbit and the Planning of the Space Services Utilizing it (WARC-ORB (2)) Executive Summary at pp. 61-63.

[54] The crowding of GEO slots resulted, in 1996, in the jamming (by PT Pasifik Satelit Nusantara of Indonesia) of a communication satellite located in a orbital slot claimed by Indonesia. Also see M.L. Smith, *International Regulation of Satellite Communications* (Dordrecht, The Netherlands: Martinus Nijhoff, 1990) at 13.

[55] Benko & Schrogl, supra note 52 at 156.

resulting radio-interference suggest restrictions are necessary with respect to orbital slots.[56] GEO is best suited for applications such as Fixed Satellite Services and Broadcast Satellite Services that require continuous service to specific service areas.

E. Low Earth Orbit

Different definitions of what constitutes "Low Earth Orbit" (LEO) abound. NORAD (North American Aerospace Defense Command), the prime source of information relating to space debris, considers orbits at altitudes below 5,875 kilometers to be in LEO.[57] Others claim that LEO does not include any orbit above 2,000 kilometers, which appears to be the prevailing view.[58] Regardless of the definition one gives to the term Low Earth Orbit, a physical fact remains: the Van Allen radiation belts restrict its use to certain altitudes. The two Van Allen belts are the result of solar radiation particles trapped by the Earth's magnetic field. The high levels of destructive radiation within these belts severely curtail satellite lifetimes. Thus, it is best to place a satellite either below 1,500 km, or between 8,000 and 12,000 km or, to be above both belts, higher than 20,000 km. Satellites placed in LEO are neither geo-synchronous nor geostationary; their main advantages derive primarily from their proximity to the Earth, because of reduced launch costs and

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[56] Smith, supra note 54 at 10.

[57] N.L. Johnson "The Earth Satellite Population: official growth and constituents", in *Preservation of Near-Earth Space for Future Generations*, ed. J.A. Simpson (New York: Cambridge University Press, 1994) at 17. The altitude of a satellite's orbit may be referred to in terms of the amount of time a satellite's orbit of the planet is achieved. The altitude of 5,875 kilometers corresponds to an orbital period of 225 minutes.

[58] Ibid. See also D. J. Kessler "The current and future space environment: an overall assessment" in *Preservation of Near-Earth Space for Future Generations*, ed. J.A. Simpson (New York: Cambridge University Press, 1994) at 19.

because of operational benefits,[59] such as imperceptible signal delay and complete global coverage.[60] Furthermore, the satellites launched in LEO are cheaper, smaller and several may share a single launch vehicle. With respect to land-based mobile phones, LEO based communication satellites have low-power requirements permitting the use of smaller, hand-held units.[61]

LEO is best suited for application such as Global Mobile Personal Communication Services and Mobile Satellite Services that operate via low-power units on the ground.

F. Medium Earth Orbit

The Medium Earth Orbit (MEO), located above 2,000 km and below GEO, offers compromise characteristics between the respective benefits and disadvantages of GEO and LEO. Two examples illustrate this: a MEO constellation providing global service will comprise more than the three GEO satellites required for that same task, but still fewer than would be necessary for such coverage by a LEO constellation. Similarly, the power levels necessary for signals to reach and be received from MEO permit portable, but not hand-held, units; the power demands to send or receive signals from GEO currently imply the use of a fixed ground station.

MEO is the ideal orbit for global navigation by satellite services as it permits global coverage with a reasonably limited number of satellites.

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[59] Higher data transmission rates and receiver antennas, which do not require accurate pointing, are two operational benefits derived from use of LEO. See E. Yug "Low Earth Orbit Constellations of Communication Satellites" (LL.M. Thesis, Montreal: Institute of Air and Space Law, McGill University, 1995).

[60] Pritchard, infra note 49 at 201ff.

[61] Ibid. at 204.

PART II:RADIO FREQUENCY SPECTRUM

This thesis is concerned primarily with the legal regime governing the allocation and use of radio spectrum frequencies by the ITU. It is therefore necessary to understand the scientific fundamentals and the technical terminology of this natural resource.[62] As noted earlier, the exploration and use of space could never have taken place without radio communications.[63]

This part begins with a description of the radio frequency spectrum and its properties, particularly in earth-space communications. Next the concept of interference will be explained, followed by a brief description of the ITU system of division of the spectrum by services.

A. Definition and characteristics of the radio frequency spectrum

Electromagnetic radiation is a form of electrical and magnetic energy traversing space at the speed of light without the benefit of physical interactions.[64] The electromagnetic spectrum comprises the entire range of rates at which the electrical waves of electromagnetic radiation travel through space,[65] and includes the radio frequency spectrum. The radio frequency spectrum is the range of frequencies

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[62] According to the US Government the GSO is essentially a regime of space flight and not a physical resource. See C.Q. Christol, *The Modern International Law of Outer Space*, (Elmford, NY: Pergamon Press, 1982) at 456.
[63] Matte, supra note 2 at 1.
[64] Reijnen & de Graaff, supra note 29 at 29.
[65] The electro-magnetic frequency spectrum ranges from 0 Hz to 3000 GHz. The radio frequency spectrum ranges from 30 Hz to 300 GHz but the V-band (37.5-50.2 GHz) for broadband services is the upper end of the radio spectrum made usable by technological advances. See C.A. Herter, jr., "The Electromagnetic Spectrum: A Critical Natural Resource" (1985) 26 Nat. Resources Jl. at 652.

that can be exploited for radio communications purposes by superposing information (audio, video or digital) on the waves.[66]

It was Heinrich Hertz who first discovered that electromagnetic waves move outward from an electrical stimulus at the speed of light.[67] These waves, produced by an oscillator, are transmitted into space through an emitting antenna at a particular frequency for reception by the satellite. The satellite then retransmits the signal to ground stations.

Explanations of this natural phenomenon often resort to illustrative analogies with fluids.[68] The signal source can be likened to the point of disturbance of a calm pool of water (a pebble hitting the surface). A signal emanates, much as the surface of the pool is rippled. These ripples have a wavelength defined as the distance between its crests. The notion of wavelength is related to distance whereas the other unit used for identifying waves, the frequency, is a measure of the number crests that pass a particular point in one second. Signals are identified either by the number of cycles per second (one Hertz equals one cycle per second) or by the length of the wave (wavelength). Just as the wave created by the pebble dissipates with distance, so too does a radio signal; increasing the transmitting power (or dropping a larger pebble) increases the distance a signal will travel intelligibly. The analogy cannot be pushed further: a radio signal does not require a medium (such as water or air) to travel in[69] and is subject to the same properties as light: absorption, diffraction, reflection, etc.... Furthermore, the fluid wave expands concentrically whereas electromagnetic waves

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[66] Ibid.
[67] Ibid.
[68] Ibid.
[69] It was thought, before Einstein's theories were accepted, that there must be an "ether" in space in which the signals were carried. Matte, supra note 2 at 9.

Table 1 The radio spectrum

Wavelength	Frequency	Band	Band Designation	Uses
100 km to	3 kHz	4	Very Low Freq. (VLF)	Very long point-to-point communications (over 1800 km)
10 km to	30 kHz	5	Low Freq. (LF)	Long, medium point-to-point communication; Radionavigation aids; aeronautical mobile
1 km to	300 kHz	6	Medium Freq. (MF)	Medium-short range communication; AM broadcasting; aeronautical mobile; radio navigation.
100 m to	3 MHz	7	High Freq. (HF)	Medium and long range communication; international broadcasting; space research;
10 m to	30 MHz	8	Very High Freq. (VHF)	Short line of sight communications; satellites; land mobile; FM radio; television; space tracking and telemetry.
1 m to	300 MHz	9	Ultra High Freq. (UHF)	Short range communication; land mobile; weather satellites; space tracking and telemetry
10 cm to	3 GHz	10	Super High Freq. (SHF)	Communication satellites; aeronautical radio navigation.
1 cm to 0.1 cm	30 GHz	11	Extremely High Freq. (EHF)	Radio navigation; space research; broadcast satellites

Table 1 is reproduced, with slight modifications, from Herter, supra note 65 at 564.

Table 2 Band names used in satellite communications

1-2 GHz	2-3 GHz	4-6 GHz	7-8 GHz	11-18 GHz	20-30 GHz	37.5-50.2 GHz
L-band	S-band	C-band	X-band	Ku-band	Ka-band	V-band

Table 2 is reproduced from Blonstein, with slight modifications, infra note 72 at 72.

B. Radio signal interference

While each portion of the radio spectrum has unique characteristics that restrict that portion's potential applications, there is another limitation common to all frequencies: interference.[74] Two or more emitters sending signals on the same frequency, in proximity of each other, results in an unintelligible confusion of all signals. For a signal to be intelligible it must be free of any harmful interference. As radio waves cannot be sent in a direct line to the receiver, due to the natural dispersion of the signal, the signal sources must be kept sufficiently separate so as to avoid interference. The task of ensuring interference-free use of the radio-frequency spectrum falls within the ITU's jurisdiction, as is detailed in the following chapter. The ITU Radio Regulations define "harmful interference" as follows:

> "Any emission, radiation or induction which endangers the functioning of a radio-navigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service in accordance with these Regulations."[75]

Generally speaking, interference can be avoided by employing any of the following methods: two physically proximate stations must broadcast on different frequencies, or two stations must broadcast from different geographical locations, or the two proximate stations must broadcast to geographically separate areas.[76] Given the importance of radio communications in space use, it should come as no surprise that these requirements are given much thought and care in the planning of a space venture. Because geostationary satellites are "stationary" relative to each other, their

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[74] Ibid. at 655.
[75] Article 1 section III Radio Regulations also Art. 35, ITU Convention, Geneva (1992).
[76] Herter, supra note 65 at 655.

mutual interference is continuous and not in a transitory manner as is the case in other orbits.[77] Interference-free use of a frequency does not imply exclusive use. The same frequency, carefully allocated, may be assigned to several different and sufficiently separated units without risk of the signals interfering with each other. Moreover, various methods such as frequency reuse, beam shaping and higher frequency cultivation (the development of technologies capable of utilizing higher frequencies) have permitted greater use of the spectrum.[78]

C. Orbit-Spectrum Resource

Given the unique advantages of the GEO and the relative scarcity[79] of optimal radio frequencies for the use of telecommunication satellites, it was noted early that the capacity of the GEO in relation to certain frequencies and locations was nearing saturation. The combination of orbital position occupied in the GEO and the frequencies utilized by a given satellite, has been called the orbit-spectrum resource because of their inter-relationship.[80] The value of the GEO spurred a number of countries[81] to stress the importance of equitable sharing of the resource. In 1976 several of these countries re-invigorated the debate concerning the definition and/or delimitation of outer space by postulating that the GEO[82] was not a part of outer space due to its allegedly "exclusive" relationship to the Earth's gravitational field and

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[77] Reijnen & de Graaff, supra note 29 at 21.
[78] M.A. Rothblatt "The Impact of International Satellite Communication Law upon Access to the Geostationary orbit and the Electromagnetic Spectrum" (1981) 16 Texas Int'l L. J. 207 at 211.
[79] Herter, supra note 65 at 655.
[80] Jakhu in Tatsuzawa, ed., supra note 3 at 78.
[81] Including the signatories of the Bogota Declaration: Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda and Zaire.
[82] GEO is located at roughly 36,000 kilometers of altitude.

therefore could be subject to claims of national sovereignty. The Bogota Declaration was intended to protect the interests of less developed equatorial countries who feared exclusion from the GEO due to its eventual saturation by the industrialized states. Although neither the Bogota Declaration nor any of its weaker re-iterations ever gained widespread international support, they did bring the concerns of the non space-faring states to the fore, and succeeded in ensuring a more equitable allocation of the orbit-spectrum resource in relation to specific radio services.[83]

PART III-LEGAL STATUS OF OUTER SPACE

A. Outer Space Treaty of 1967

The cornerstone[84] of the international legal regime governing Outer Space is the *"Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space including the Moon and other Celestial Bodies"* (the Outer Space Treaty) of January 27, 1967.[85] This treaty embodies a number of provisions pertaining to the legal status of Outer Space and establishes a framework which subsequent treaties complement.[86] It was in many ways the codification of customary international law.[87]

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[83] The *a priori* planning procedures ensuring equitable access to certain portions of the orbit-spectrum resource shall be examined below in Chapter II.
[84] B.G. Dudakov "The Outer Space Treaty and Subsequent Scientific Developments of International Space Law" (1974) 17 Colloquium L. Outer Space at 107.
[85] The Outer Space Treaty is also referred to as the "Principles Treaty" or as the "Magna Carta of Outer Space". Christol, supra note 62 at 12.
[86] For a detailed examination of the development of the Outer Space Treaty within COPUOS see P. G. Dembling "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies" in N. Jasentuliyana & R.S.K. Lee, *Manual on Space Law* (Dobbs Ferry, NY: Oceana Publications, 1979) at 1.
[87] Goldman, supra note 9 at 67.

A number of articles in the Outer Space Treaty contain only general principles,[88] a reflection of the geo-political circumstances of the time. Both the US and the USSR wanted urgently certain basic principles established so as to protect their activities, and to prevent a legally chaotic future.[89] This desire for order was, on both sides of the "iron curtain", tempered by an equally strong desire to draft a broadly worded treaty to maintain flexibility with regards to future needs and technical innovations. In the words of the American representative to the United Nations General Assembly, Arthur J. Goldberg: "The provisions of the Treaty are drafted in general terms but they grant a series of commonly accepted principles by which future bilateral, multilateral conventions and space practice will be inspired." Essentially, the Outer Space Treaty was envisioned as the constitutional document establishing a basic legal regime governing space activities to be later followed by more specific agreements.[90] Three main principles of the Treaty are of special concern to this thesis: a) that the space environment is free to be explored and used for the benefit of mankind; b) that outer space is not subject to national appropriation by any means; c) that the rules of international law and the UN Charter apply in outer space.

a) The Principle of Freedom of Outer Space

A fundamental feature of the legal regime governing Outer Space can be found in Article I para. 2:[91]

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[88] Van Bogaert, supra note 6 at 51.
[89] Dembling, supra note 86 at 8.
[90] In fact, COPUOS was already working on drafts of the liability and rescue agreements.
[91] C.Q. Christol, "The *Jus Cogens* Principle and International Space Law" (1983) 26 Colloquium L. Outer Space at 7. The concept of the "Common Heritage of Mankind" is an extension of this principle and, arguably, is distinct from the expression "province of all mankind" at art. I para. 1 OST; see also Hacket, supra note 24 at 62.

> "*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. (Italics mine)

It should be noted that "freedom of use" is understood to include the notion of exploitation.[92] It has been suggested that there is a possibly emerging customary rule of international law permitting innocent passage through foreign airspace for space objects, during ascent and descent.[93]

b) Ban on National Appropriation

The free access language of Article I is reinforced by the ban on national appropriation of outer space including celestial bodies enunciated in Art. II.[94] This ban on "national appropriation" would not, assert some jurists, include the acts of appropriation of natural resources by private entities or international organizations.[95] Sovereign acts, such as the regulation of national space objects or of personnel in outer space, are not prohibited.[96] Indeed, Article VIII stipulates that states shall retain jurisdiction and control over objects launched into outer space, while in outer space, if that object figures on its registry.

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[92] Van Bogaert, supra note 6 at 41.
[93] For a detailed study of the nature of such a right see A. Terekhov "Passage of Space Objects through Foreign Airspace: International Custom?" (1997) 25 J. Space L. at 1.
[94] Dembling, supra note 86 at 1.
[95] S. Gorove "Interpreting Article II of the Outer Space" (1969) 37 Ford. L. Rev. 351.
[96] M. G. Marcoff, *Traite de Droit international public de l'espace* (Fribourg, Switzerland: Editions Universitaires, 1973) at 336; see also Art. VIII Outer Space Treaty.

for any meaningful application by the parties themselves; secondly, there is no competent, authoritative body appointed to resolve those ambiguities by rendering workable decisions.[101] As a consequence, parties to the treaty have largely disregarded this principle. It is generally considered that "The notion of 'Mankind' is (...) used to clarify the general spirit of the Outer Space Treaty, but without constituting a legal notion in itself".[102]

The United Nations General Assembly resolution adopted on 13 December 1996[103] is the most recent development with regard to the community orientation of space law. The UN Declaration on Benefits emphasizes the importance of international co-operation and elaborates on the concept of international co-operation incorporated in the third paragraph of Article I of the Outer Space Treaty.[104] The Declaration attempts to provide an internationally acceptable legal framework within which the principles of Article I could be developed and the benefits of outer space activities shared with all countries "irrespective of their degree of economic or scientific development".[105]

Even though the Declaration on Benefits was adopted unanimously by the General Assembly, its authority remains unclear. Without entering into a detailed analysis of the document, it is clear that the resolution does not have "binding force".

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[101] Ibid. at 58

[102] Ibid. at 63; See also Van Bogaert, supra note 6 at 56.

[103] The resolution is entitled "*Declaration on International Co-operation in the Exploration and Use of Outer Space for the Benefit and in the Interest of all States, Taking into Particular Account the Needs of Developing Countries*" [Hereinafter *UN Declaration on Benefits*]

[104] Art. I para. 3 Outer Space Treaty reads as follows:

> "There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation".

[105] See Art. I para. 1. Outer Space Treaty.

In fact, the Declaration is not drafted in "precise legal language", and its provisions do not establish obligatory legal norms, finally the resolution affirms more rights than obligations.[106] Ultimately, state practice will be the determining factor regarding the authority of this resolution.[107]

The aforementioned principles establish the main characteristics of the legal status of outer space. The geo-stationary orbit, however, has been given a particular status by the ITU, which is examined in the following chapter.

PART IV- New Technologies

The new technologies examined in this thesis are Direct Broadcast Satellites (DBS), Global Mobile Personal Communication Satellites (GMPCS), and Global Navigation Satellite Systems (GNSS). While these satellite technologies provide very different services, they share certain characteristics. These characteristics are the commercial nature and applications of these technologies, the hitherto rarely utilized, LEO[108] and MEO orbits they shall occupy, and their inherently global nature.

Before passing to a technical description of these services, a preliminary comment is necessary: the technologies are experiencing convergence.[109] For instance, INMARSAT's GMPCS system to be launched in MEO is being designed to also provide GNSS augmentation services. Similarly, Argentina's Nahuel-1 satellite,

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[106] For an analysis of the elaboration of the UN Declaration on Benefits see J.S. Thaker "The Development of the Outer Space Benefits Declaration" (1997) 22 Part.I Ann. Air & S. L. at 555.
[107] Ibid.
[108] LEO has, until recently, been used primarily for military remote sensing.
[109] The convergence of space technologies is most evident in the DBS and FSS services. See M. Hoskova "Convergence of Telecommunication Technologies- Some Legal Aspects" (1990) 33 Colloquium L. Outer Space at 215.

primarily designed for DBS, may also provide teleconferencing and other space-based services.

A. Direct Broadcast Satellites (DBS)

a) Service classification

Direct Broadcast Satellites are a specialized type of the Broadcast Satellite Service (BSS).[110] The Broadcast Satellite Service is a service by which the satellite signal is intended by the sender to be received by earth stations for distribution to the general public, via individual or community receivers.[111] DBS signals are intended for reception by the general public without an intermediary earth station.[112] Advances in satellite technology have made it feasible to place transponders in orbit emitting at the power levels necessary to enable the use of small (typically 18-inch diameter) parabolic antennas.

b) Orbital characteristics

All DBS satellites are currently located in GEO in order to provide continuous service to specific markets and for that reason the geostationary orbit is likely to remain the orbit of choice for DBS satellites. It is noteworthy that the last GEO slot permitting full DBS coverage of continental US was auctioned by the Federal Communication Commission in 1996; the winning bidder, MCI, paid 682.5 million

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[110] S.F. Luther, *The United States and the Direct Broadcast Satellite*, (New York: Oxford University Press, 1988) at 5.

[111] Radio Regulations Article 1, Section I.

[112] A footnote to the legal definition of DBS specifies that "[in] the broadcasting service, the term direct reception shall encompass both individual and community reception", Final Acts of the World Administrative Radio Conference for Space Telecommunications, Geneva, 1971, Para 84AP.1 Spa 2 in White & White, infra note 126 at 243

dollars for use of that position.[113] At the World Radiocommunication Conference of 1997 (WRC-97) it was agreed that studies should be undertaken to consider the possibility of approximately doubling the number of channels assigned to each country.[114] This type of space telecommunications service is placing increasing demands on the finite geostationary orbit-spectrum resource.

c) Participants

The first DBS satellite, Yuri-2A, was launched by Japan, in 1984.[115] Until the mid-nineteen-eighties international television broadcasting, not specifically DBS, was monopolized by states and international organizations (such as INTELSAT).[116] The liberalization and deregulation of this industry in Europe and North America[117] has since resulted in the dynamic growth of commercial entities, such as DirecTV (3 million subscribers), providing DBS services to North America, Japan and Europe.[118] These participants increasingly provide programs, such as Music Television, aimed at a transnational public sharing common tastes.[119] State procured DBS satellites are also being launched but at a lesser rate.

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[113] See "Highlights in Space 1996" UN Doc. A/AC.105/566.
[114] ITU press release of 21 November, 1997 at pp. 5-10 available on the internet at http://www.itu.ch/newsroom/press/WRC97/pressnote4.html
[115] D.I. Fisher, *Prior Consent to International Direct Satellite Broadcasting* (Dordrecht, The Netherlands: Martinus Nijhoff, 1990) at 1.
[116] Achilleas, supra note 53 at 44.
[117] Ibid. at 49.
[118] Ibid.
[119] Ibid. at 50.

d) International Law relating to DBS

While it is clear that broadcasting by satellite is an outer space use and activity[120] in the meaning of Article I of the Outer Space Treaty, there are no explicit references to space communications, let alone direct broadcasting, in that Treaty.[121] However, Article VI of the Outer Space Treaty provides that states party to that Treaty bear responsibility for the activities of private entities having their nationality. In addition, it should be mentioned that the United Nations General Assembly resolution 110(II) of 3 November 1947 (condemning propaganda inciting hatred or war) is also applicable to outer space.

The position of most western countries is that states cannot be held responsible for the contents[122] of private broadcasts, pursuant to the principle of freedom of information.[123] Similarly, the Liability Convention of 1972 does not seem to encompass non-material damages that might be alleged in connection with programs broadcast by DBS.[124] There is no international consensus on the applicability of that Convention to non-material harms.

The DBS Principles Declaration,[125] attempting to regulate the use of DBS, was first adopted by a divided vote within the Special Political Committee of the General Assembly. The Principles were later adopted as General Assembly Resolution 37/92 on Dec. 10, 1982, again by a divided vote (107 for, 13 against, 13

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[120] M.L. Stewart, *To See the World: The Global Dimension in International Direct Television Broadcasting by Satellite* (Dordrecht, The Netherlands: Martinus Nijhoff, 1991) at 13.
[121] Ibid.
[122] Fisher, supra note 115 at 43.
[123] See U.N. Doc. A/AC.105/PV. 207 pp 46-47 (Federal Republic of Germany).
[124] Ibid. at 44.
[125] UNGA Resolution 37/92 (1987) "*Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting*" UN Doc. A/37/646 (1982).

The lack of international consensus is due to the conflict between the alleged sovereign right of every state to control information or programs that enter its territory, and the basic human right of each person to receive and impart information irrespective of national borders.[133] Three main points of contention have made compromise on DBS regulation impossible in the past. Firstly, the issue of prior consent to transnational broadcasting opposed developing and socialist countries against western countries; secondly, the question of acceptable program content also complicated matters; thirdly, the question of reasonable signal over-spill further added to the complexities of the debate.

The ITUs role relative to Direct Broadcasting Services has been one of technical coordination and planning procedures involving "something close to a *de facto* form of prior consent".[134] The role of the ITU with respect to DBS is examined at greater length in Chapter 2.

B. Global Mobile Personal Communication Services (GMPCS)

a) Service Classification

GMPCS systems, depending on their design, are either part of the Mobile Satellite Services (MSS) or the Fixed Satellite Services (FSS). MSS differs from Fixed Satellite Services in that the latter, also referred to as "point-to-point" telecommunication services, involve the reception of the signal from a fixed or

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[133] Ibid. at 186, *International Covenant on Civil and Political Rights*, UNGA reso. No.2200 (XXI) 1966, art.19; *European Convention for the protection of Human Rights and Fundamental Freedoms*, (1950) art.10, 231, UNTS 221(1955); art. 13 of the *American Convention on Human Rights* (see Organization of American States Serie Sobre Tratados, no.36, OEA Documentos Officiales OEA/Ser.A/16, SEPE).

[134] White & White, supra note 126 at 251; see also Matte, supra note 2 at 194.

mobile ground station by a telecommunications satellite for re-transmission to a fixed ground station. The Mobile Satellite Services provided by GMPCS involve, as the title would indicate, reception from and re-transmission to mobile units. The Radio Regulations Art.1, Section 4.9 defines an earth station within the mobile satellite service as one "intended to be used while in motion or during halts at unspecified points"; this definition further applies to hand-held communication devices.[135] Some GMPCS systems are designed to operate either directly from the land-based mobile unit to the satellite, whereas others are designed to be compatible with the existing cellular networks;[136] the latter so-called "dual-mode" units are still in their development phase.[137]

Projected GMPCS systems in LEO are categorized as "Little" systems or "Big" systems, depending on the frequencies employed. "Little" LEO systems operate below 1 GHz and provide positioning, messaging and data transmission services; "Big" LEO systems, on the other hand, offer voice transmission in addition to those supplied by "Little" LEO systems and operate on frequencies above 1 GHz. The allocations made to Non-Geostationary Mobile Satellite Services have recently been extended by the WRC-97[138] to accommodate the needs of these new systems.

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[135] W.D. van Noorden & P. Dann "Land Mobile Satellite Communications: Further Development in International Space Law (Part I)" (1989) 17 J. Space L. at 3.
[136] One of the proposed dual-mode systems is Iridium.
[137] S. LeGoueff "Licensing Global Mobile Communications by Satellite: The Quest for the Holy Grail" (1997) 22 Part 1 Ann. Air & S. L. at 418.
[138] ITU Press release, 21 November, 1997 available at http://www.itu.ch/newsroom/press/WRC97/pressnote4.html

b) Orbital Characteristics

The GMPCS systems ready for launch between the present[139] and the year 2002, are planned for LEO, MEO and GEO. The majority of proposals consist of LEO constellations of many small satellites, in certain cases accompanied by satellites in GEO.[140] "Little" and "Big" LEO satellites[141] and "broadband"[142] satellites are all planned for LEO. Other systems, such as INMARSAT-M, are planned for MEO. The most ambitious GMPCS proposal is Teledesic (projected cost: US$ 9 billion), originally conceived as an 840-satellite constellation in LEO, now scaled back to a still impressive 288 satellites with 36 additional spares, it received an operating license from the Federal Communication Commission (FCC), 14 March, 1997. The small satellites planned for GMPCS systems in LEO typically permit the launching of several satellites on the same launch vehicle. It merits emphasis that the lower the orbit, the more satellites required to achieve global coverage.

c) Participants

The prime carrier for global satellite communications traffic for mobile users has been, and remains, the International Mobile Satellite Organization

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[139] As of July 24, 1998, Iridium had successfully launched all its satellites (72) see FLORIDA TODAY Space Online available at http://www.flatoday.com/space/explore/stories/1998b/072498h.htm

[140] Iridium operating on the Ka-Band should include 9 GEO satellites and 63 in LEO. Celestri is another LEO satellite constellation that should include GEO satellites for broadcast and multicast applications, although their FCC filing makes no mention of the GEO component. See J. Anselmo, Aviation Week and Space Technology, June 23, 1997 at 66. More recently it has been announced that Celestri and Teledesic will merge, the implications on either proposal is unclear at this time, see http://www.wired.com/news/news/technology/story/12456.html

[141] LeGoueff, supra note 137 at 418. "Little" LEOs weigh 40-100kg whereas Big LEOs weigh 450-700kg.

[142] Broadband satellites permit the transmission of high volumes of data for applications such as internet access; direct-to-home video, desktop-to-desktop videoconferencing, telemedecine, etc. See J. Montgomery "The Orbiting Internet: Fiber in the Sky" BYTE, Nov. 1997, at pp. 58-72.

(INMARSAT).[143] Its dominance will be challenged by the many different commercial initiatives currently being undertaken, the great majority of which are American-led.[144] The commercialization of space activities is most evident in this telecommunications sector.

d) International law relating to GMPCS

There are no legal texts specifically regulating the proposed GMPCS systems. Many political and economic questions have been advanced concerning this technology.[145] Because of the private nature of these ventures, questions relating to national sovereignty and security have been raised; countries fear they will not have control or input over the operation of the systems within their borders, or over the calls entering and exiting their country via satellite.[146] They feel they must be given the right, under special circumstances, to intercept communications made for criminal, subversive or terrorist purposes.[147] These concerns are exacerbated by the fact that some countries will be served by an earth-station "gateway" located in another country.[148]

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[143] Inmarsat broadened its mandate, with the consent of its signatories, to include the right to provide commercial services of every kind to the mobile user. This is reflected in its change of designation from the International Maritime Satellite Organization, as of December 94. See Berdnikoff "Global Communication Satellite Services" (LL.M. Thesis, Montreal: Institute of Air and Space Law, McGill University, 1995) at 32.

[144] E-Sat, Final Analysis Communication, Leo One, Orbcomm and VITA have all submitted to a FCC band-sharing plan adopted on Oct. 9, 1997. http://WWW.lta.com/high/litlel.htm.

[145] D. Leive & M. Tyler, *Report to the World Telecommunication Advisory Council*, (World Telecommunication Advisory Council, Geneva, 18 Jan. 1996 [unpublished] summarized in LeGoueff, supra note 137 at 422-23.

[146] LeGoueff, supra note 137 at 422.

[147] Ibid. at 423.

[148] Ibid.

Economic concerns also dominate the issue of GMPCS. In most countries of the world the main supplier of telecommunication services is the state-owned monopoly, most often called the Post, Telephone and Telegraph (PTT).[149] Many countries fear the loss of direct revenues occurring as a result of users "by-passing" the PTT by using GMPCS.[150] To ensure economic fallback for their country many would like to ensure the participation of government agencies or of local companies, possibly by negotiating joint ventures or stipulating local sub-contracting requirements. Similarly, the question of reciprocal market access between countries backing different service providers is an issue that will have to be negotiated on a bilateral or multilateral basis. Developing countries believe the affordability of the services and terminals should be resolved by structuring the costs so as to be affordable to the local populations of the least developed countries, a belief which private entities, responsible for a return on investment to shareholders, do not share. Nor are private entities necessarily interested in the transfer of technologies which developing countries might request. Added to these are various safety, health and technical concerns related to GMPCS.[151]

The proponents of these systems have publicly suggested and initiated the type of institutional relationships they would like established for the delivery of their services.[152] The most common arrangement is one involving an exchange of "landing rights" (permission to operate) in counterpart of an investment, generally assumed to reflect the current economic development of the investing country, which

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[149] R.L. Anglin "Alternative Legal Regimes to Enable Universal Telecommunication Roaming" (1992) 35 Colloquium L. Outer Space at 207.
[150] Ibid at 207; also see LeGoueff, supra note 137 at 423.
[151] LeGoueff, supra note 137 at 424.
[152] Anglin, supra note 149 at 207.

rendered redundant by the adoption of foreign satellite navigation systems would provide enormous bargaining power for the provider-state at the end of the 10-15 year "free" operating periods.[158] These concerns impede the rapid adoption of this technology world-wide even though the advantages of GNSS over traditional ground-based navigation systems have been clearly demonstrated.[159]

b) Orbital characteristics

The space segment of U.S.-operated GPS comprises 25 satellites, with three considered spares, in six orbital planes at 55 degrees of inclination respective to the equator. The GPS satellites orbit the Earth at an altitude of 20,200 km. (MEO) and their configuration ensures that at least four satellites are above the horizon at any given time. The GLONASS constellation is designed to include 21 satellites in three orbital planes, with three spares, at an altitude of 19,100 km, also in MEO. GLONASS achieved full operational status in 1995 but its long-term future remains uncertain.[160]

c) Participants

At the present time there are only two systems currently operational. A new network of four geostationary communication satellites, the INMARSAT-3 series, carry transponders broadcasting GPS-compatible signals to complement both GPS

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[158] S. Kaiser "Aeronautical Satellite Navigation: Civil Aviation's Needs and Institutional Alternatives" (1994) 37 Colloquium L. Outer Space at 27.

[159] The Russian government has proposed new polar routes, enabled by GNSS) which would reduce flight time by three hours. "Russians Propose New Polar Routes" Aviation Week and Space Technology, 1 September, 1997

[160] See http://www.oso.chalmers.se/~geo/glonass.html see also the official web site at http://www.rssi.ru/SFCSIC/glonass.html

and GLONASS signals for additional precision and reliability. However, the INMARSAT-3 series cannot operate independently. The costs incurred establishing GPS are estimated at US$ 10 billion, and annual maintenance costs at US$ 400 million; by general consensus, the economic benefits of the system outweigh the costs.[161]

Future participants in this service are the European Space Agency (ESA) whose European Geo-stationary Navigational Overlay System (EGNOS), as well as the Japanese project MTSAT, are both counterparts to the US Wide Area Augmentation System. These projected systems plan to offer regional differential service permitting greater precision in specific augmented regions. The future Augmentation Systems are, from a European perspective, part of a three-step transition to a civil satellite-based navigation system dubbed "GNSS-2". The first step is the existing framework created by GPS and GLONASS to be followed by supplementing the basic framework with EGNOS, which is useless without GPS or GLONASS. The third step, GNSS-2 (intended as an integral part of the "Trans-European Networks") will be centered on the European Navigation Satellite System (ENSS), a constellation of nine to twelve satellites in inclined geo-synchronous orbits a self-standing navigation infrastructure compatible with both other systems.[162] Already certain receivers, capable of combining signals from both the American and

[161] P.B. Larsen "Positioning Satellites: Current Institutional Issues" (1994) 37 Colloquium L. Outer Space at 32.
[162] P. Hartl & M. Wlaka "The European Contribution to Global Civil Navigation Satellite System" (1996) 12 Space Policy at 171.

Russian systems, have demonstrated high precision.[163] The commercial applications of GNSS hold great promise with regard to all modes of transportation.

d) International law relating to GNSS

As far as its uses of outer space are concerned, the global navigation by satellite technology is governed by the Outer Space Treaty and any other authoritative texts that may be enacted in the future. So far, the Legal Subcommittee of COPUOS has not dealt with this problem.

The International Civil Aviation Organization (ICAO) is the most active international governmental organization in the development of a legal framework relative to GNSS. ICAO is a competent forum to discuss global air navigation services because it has jurisdiction to establish minimum standards and recommended practices (SARPs) for the use of positioning satellites by aircraft.[164] ICAO has accepted offers by both the American and Russian governments[165] to use their systems as part of its Communication, Navigation and Surveillance/ Air Traffic Management (CNS/ATM) reform. ICAO is examining this technology within the framework of "Future Air Navigation System" (FANS). However, the constitutional competence of ICAO with regards to regulating GNSS[166] has been questioned as implied by the ICAO Council on 9 March 1994.[167] The International Maritime

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[163] See Aviation Week & Space Technology, Oct. 14, 1996, also see http://www.ashtech.com/Pages/prodoem.html

[164] Larsen, supra note 161 at 34.

[165] http://www.rssi.ru/SFCSIC/icaolett.txt

[166] M. Milde " 'Solutions in Search of a Problem?'- Legal Problems of the GNSS" (1998) 23 Ann. Air & S. L [unpublished at time of writing]

[167] "Statement of ICAO policy on CNS/ATM Systems Implementation and Operation" Doc L/C29-WP/3-2.

Organization (IMO) has an equivalent jurisdiction in providing for maritime navigational standards. The INMARSAT inter-governmental agency was negotiated within the IMO and, as stated previously, provides positioning service by satellite.

U.S.A. Vice President Al Gore announced the current policy governing GPS on March 29, 1996. The policy seeks to "support and enhance" the economic benefits of increased competitiveness and productivity derived from GPS use while assuring the protection of US national security and foreign policy. The intentional degradation of the signal available to civilian users, called "coarse acquisition", will be discontinued within a period of 4-10 years (at the earliest, in spring 2000). Meanwhile, public access to GPS for peaceful, civil, commercial and scientific uses will remain available on a "continuous worldwide basis, free of direct user fees."[168] A similar position has been decreed by the Russian government.[169]

[168] S. Pace "The Global Positioning System: Policy Issues for an Information Technology" (1996) 12 Space Policy at 274-75.
[169] The russian decree is available at http://www.rssi.ru/SFCSIC/decree.txt

CHAPTER II. INTERNATIONAL TELECOMMUNICATION UNION

Because radio links are vulnerable to interference and because the radio spectrum is a limited renewable natural resource, the equitable, efficient, economical and rational use of the radio frequency spectrum is of paramount importance. This chapter examines the international organization responsible for managing the orbit-spectrum resource in such a way as to meet these requirements.

Following a brief historical description, the structure of the International Telecommunication Union and its regulatory regime as well as the legal principles guiding the Union in frequency and orbital position allocation are outlined. The new technologies and the challenges they represent are of particular interest to this thesis and are treated in light of recent developments within the ITU.

PART I. THE INTERNATIONAL TELECOMMUNICATION UNION

A. Historical Origins of the ITU

The history of the International Telecommunication Union (ITU) can be traced back even before 1865 the year when twenty-one European states sent representatives to Paris in order to organize the international telegraph network.[170] Telephony, various other communications uses, technical standards for facilities, and tariffs are some subject matters that were added to the agendas of subsequent

[170] G.A. Codding, Jr., "The International Telecommunications Union: 130 years of Telecommunications Regulation" (1995) 23 Denver Journal of Int'l Law and Pol'y at 502.

Conferences.[171] Following the simultaneous International Telegraph and International Radiotelegraph Conferences held at Madrid, in 1932, the International Telegraph Union was merged with the International Radiotelegraph Union (which regulated "wireless" communications) to form the International Telecommunication Union, on January 1, 1934.[172] The Atlantic City Conference of 1947 saw an important re-organization of the Union, and it created the International Frequency Registration Board (IFRB)[173] as an independent body mandated to record frequency assignments and provide advice to members and associate members on allocation issues.[174] That same year the ITU became a specialized agency of the United Nations.[175] While space needs were first considered and the competence of the Union relative to space radiocommunications recognized in 1959, it took an Extraordinary Administrative Radio Conference, in 1963, to address the issue of allocation of a portion of the radio spectrum for space services.[176] In 1971, the World Administrative Radio Conference on Space Telecommunication (WARC-ST) introduced the concept of management of the geostationary satellite orbit without endorsing the suggestion to convene a special WARC to prepare a "World Plan" for its use. At WARC-ST the members first specifically recognized that

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[171] F. Lyall, *Law and Space Telecommunications* (Aldershot, England: Dortmouth Publishing, 1989) at 313 ff.
[172] Codding, supra note 170 at 503.
[173] Since renamed Radio Regulations Board (RRB).
[174] J.G. Savage, *The Politics of International Telecommunications Regulation* (Boulder, Col: Westview Press, 1989) at 39.
[175] The ITU is a specialized agency of the United Nations having legal capacity. Articles I (i)(ii) and II of the *Convention on Rights and Immunities of Specialized Agencies* (UNGA 21 Nov. 1947). The Secretary-General of the ITU acts as it's legal representative (ITU Constitution art. 11.1(4)); see also *Agreement between the United Nations and the International Telecommunication Union*, Annex 5, The International Telecommunication Convention, in *Final Acts of the International Telecommunication and Radio Conferences*, Atlantic City, 1947, 80-E.
[176] R.S. Jakhu "Legal Regime of the Geostationary Orbit" (DCL Thesis, Montreal: Institute of Air and Space Law, McGill University, 1983) at 204 [hereinafter Legal Regime of the GEO]

geostationary orbital positions and the radio-frequency spectrum are limited resources and that all countries had equal rights in the use of those resources. Since the 1960s the membership of the ITU has grown considerably and currently includes 185 member states.[177] The new members, mostly from the Third World,[178] were instrumental in introducing the notions of "equitable access"[179] and "the special needs of developing countries"[180] to the organization.

The most recent important changes to the ITU were initiated at the Plenipotentiary Conference held in Nice in 1989.[181] At that conference most members of the Union recognized that the ITU needed to evolve if it was to remain abreast of the accelerating pace of technological change. A High Level Committee of twenty-one members was established in order to review the structure and functioning of the organization; the Committee's report[182] was accepted by the Administrative Council of the ITU in 1991 which then decided to convene an Additional Plenipotentiary Conference in Geneva in 1992. The Geneva Conference of 1992 was pivotal in that it created a Constitution and a Convention[183] and also re-structured the organization. While some of the changes were implemented

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[177] A current list of ITU members is available at the ITU web site on the Internet at http://www.itu.ch/aboutitu/bigm.html

[178] B.E. Harris, "The New Telecommunications Development Bureau of the International Telecommunication Union", (1991) 7 Am. J. of Int'l Law and Policy at 88.

[179] This concept was first incorporated into the ITU Convention at the 1973 Malaga-Torremolinos Plenipotentiary Conference. M.L. Smith "The Role of the International Telecommunication Union in Space Law" (1992) 17 Ann. Air & S. L. at 159.

[180] The notion of the "special needs of developing countries" was added by the 1982 Plenipotentiary Conference, held in Nairobi.

[181] F. Lyall, "The International Telecommunication Union Reconstructed" (1993) 36 Colloquium L. Outer Space at 79 [hereinafter ITU Reconstructed]; Codding, supra note 170, at 501, refers to the reorganization of the Union since the 1989 Nice Plenipotentiary as the "fourth major period" of the ITUs history.

[182] International Telecommunication Union, High Level Committee to Review the Structure and Functioning of the ITU, *Tomorrow's ITU: the Challenges of Change*, ITU Doc. No. 145-E (1991)

[183] Provisions cited from the Constitution and Convention shall be referred to as (CS) and (CV) respectively.

following the Geneva Conference, the new structure was to be fully established after the 1994 Kyoto Conference and is now applicable in its entirety.

B. The ITU's "raison d'être"

International telecommunications are not possible without compatible equipment and procedures. International agreements relative to the use of the radio spectrum must be respected lest mutual interference impede the communications of all.[184] The principal reason underlying the longevity and effectiveness of the ITU resides in the fact that "its major sanctions are not legal procedures but physical facts and physical laws".[185] Indeed, It is against the interest of any state not to abide by the international rules established by the organization. Three main principles have guided the Union's work since its inception: firstly that certain frequencies are allocated to certain services; secondly that equipment shall be operated as efficiently as possible; thirdly that the minimum signal strength required for adequate reception shall be employed.[186]

The ITU is a technical body that exercises regulatory functions.[187] The purposes of the Union are stated in Article 1 of its Constitution. The ITU can be described as the international organization in charge of frequency management: it establishes technical and operational standards (CS 1.2.c)[188], it allocates portions of

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[184] F. Lyall "The International Telecommunication Union: A World Communications Commission?" (1994) 37 Colloquium L. Outer Space, at 42 [hereinafter A World Communications Commission?]
[185] A World Communications Commission?, supra note 184 at 42.
[186] Ibid.
[187] J.G. Starke, *Introduction to International Law*, 10th ed. (London: Butterworths, 1989) at 624
[188] Hereinafter the abbreviations CS and CV shall refer to provisions of the 1994 Kyoto Constitution and Convention respectively.

the radio-frequency spectrum for particular uses (CS 1.2.a), and it offers protection from harmful interference. The ITU is also concerned with setting telecommunication rates (CS 1.2.f). The Union exercises a regulatory function by adopting Radio Regulations for service allocations of the radio-frequency spectrum (CS 1.2.h). More recently, as a result of pressure from increasingly numerous "Less Developed Countries" (LDC) members of the ITU,[189] the organization has also been given clearer responsibilities to help in the development of telecommunications in countries less able to achieve that development themselves (CS 1.2.d). The ITU has also been recognized an implied jurisdiction in relation to the regulation of orbital positions on the geo-stationary orbit for space services.[190] The extension of the ITUs primary mandate concerning space services to govern the GEO was justified because of the indivisible relationship between radio frequencies and geostationary orbital positions.[191] Indeed,

> "The proper and effective regulation of the radio spectrum for space services implies that orbital positions of space stations should be notified to, and registered with the ITU; hence regulated by the ITU".[192]

C. The ITU structure

As noted previously, the revisions that were finalized at the Additional Plenipotentiary Conference at Geneva in 1992 are now applicable; they were

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[189] Smith, supra note 179 at 159

[190] Since the Plenipotentiary Conference at Malaga-Torremolinos, 1973, in M. Bourély, "Quelques Réflexions au sujet de L'Orbit Géostationnaire", (1988) 13 Ann. Air & S. L. at 236; see also N.M. Matte, " The Common Heritage of Mankind and Outer Space: toward for survival" (1987) 12 Ann. Air & S. L. at 334, see also V.M. Postyshev "WARC-ORB '85 and the Common Heritage of Mankind concept in Outer Space" (1986) 29 Colloquium L. Outer Space at 135.

[191] Legal Regime of the GEO, supra note 176 at 210

[192] Ibid at 211

structural changes and did not comprise a substantive review of the law.[193] The single document formerly governing the ITU, in the form of the various incarnations of the International Telecommunications Convention as re-adopted at each Plenipotentiary Conference, was separated into a Constitution and a Convention.

The Constitution includes the provisions less susceptible to frequent amendments whereas the Convention comprises the other governmental provisions more likely to change. It is believed that this separation of principle and detail allows for a more structured and coherent discussion of change at Conferences.[194] There are three legal instruments of the Union (CS 4.1): the Constitution, the Convention, and the Administrative Regulations. The Administrative Regulations complement the Convention and Constitution and may be either International Telecommunication Regulations or Radio Regulations.[195] The hierarchy of legal norms pertaining to these documents is established at Article 4.4 of the Constitution: in case of conflict between a provision of the Constitution and a provision of the Convention or of the Administrative Regulations the former shall prevail; conflicts between provisions of the Convention and of the Administrative Regulations are resolved by application of the Convention's provisions. Administrative Regulations are binding international instruments (CS 54.1).

The Constitution, at Article 7, stipulates that there are seven different organs of the ITU:

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[193] ITU Reconstructed, supra note 181 at 79
[194] Ibid. at 82.
[195] The Radio Regulations comprise detailed and highly technical provisions developed to regulate use of the radio frequency spectrum and geostationary orbit.

a) The Plenipotentiary Conferences
b) The ITU Council
c) The World Conferences on international telecommunication
d) The Radiocommunication Sector
e) The Telecommunications Standardization Sector
f) The Telecommunications Development Sector; and
g) The General Secretariat

The ITU structure can be described as "federal".[196] Five permanent organs (the General Secretariat, the Radio Regulations Board, the Radiocommunication Sector, the Telecommunication Standardization Sector and the Telecommunication Development Sector) and three periodically convened bodies (the Plenipotentiary Conferences, the Administrative Council, and the World Conferences on International Telecommunication) comprise the Union.[197]

a) The Plenipotentiary Conferences

The Plenipotentiary Conferences are the supreme organ, the "General Assembly",[198] of the Union (CS 7.a). They are composed of delegations representing each Member State and are convened every four years (CS 8.1). Their duration is of four weeks in the course of which fundamental policies are adopted and decisions are taken on the organization and activities of the Union, these are adopted in a treaty known as the International Telecommunication Constitution and Convention. One of the most important functions of these Conferences is their competence to revise the Constitution and Convention; these conferences have residual powers to deal with all questions relating to telecommunications (CS

[196] Savage, supra note 174, at 14.
[197] Harris, supra note 178, at 86.
[198] G.D. Wallenstein, *International Telecommunication Agreements*, (Dobbs Ferry, N.Y.: Oceana Publications, 1982) at 35.

8.2.k); the other organs of the ITU may only function within the limits expressly delegated to them.[199] Plenipotentiary Conference resolutions and proposals are voted on a "one-country, one-vote" basis (CS 3.2.b).

The Plenipotentiary Conferences concern themselves with long-term policy issues (CS 8.2.a); decisions are taken relative to draft Strategic Plans. The Strategic Plans comprise the objectives, work programs and the expected outcome of each constituent of the Union until the next Plenipotentiary Conference and are submitted by the Council. These Conferences are open to the ITU member countries, the UN and its specialized agencies. The International Atomic Energy Agency, regional telecommunications organizations and inter-governmental satellite operators may also participate.

b) The ITU Council

The ITU Council, similar to councils of other UN agencies,[200] acts, within the limits delegated to it by the Plenipotentiary Conference, as the governing body of the ITU (CS 10.3). It considers broad policy issues in the interval between two Plenipotentiary Conferences in order to ensure that the policies and general strategy of the Union fully respond to changes in the telecommunications environment. It is also among the Council's responsibilities to ensure the efficient coordination of the work of the Union and for exercising effective financial control over the General Secretariat and the three Sectors (CS 10.4.3). The Council also aids in the

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[199] D. St-Arnaud, "La mise-en-oeuvre en Droit Canadien des Reglementations et Conventions Internationales en Matière de Télécommunications Spatiales" (LLM Thesis, Montreal: Institute of Air and Space Law, McGill University, 1991) at 25.
[200] ITU Reconstructed, supra note 181 at 83.

implementation by Members of the provisions of the Constitution, the Convention and the decisions and regulations of the Conferences (CS 10.4.1). The Council is composed of forty-six Members of the Union elected by the Plenipotentiary Conference. The Council is to be elected with "due regard for the need for equitable distribution of the seats among all five regions of the world" (CS 9.1.a). The five regions are Region A, the Americas (8 seats); Region B, Western Europe (8); Region C, Eastern Europe (5); Region D, Africa (13); Region E, Asia and Australasia (12).[201] These five regions are not to be confused with the three Regions of the World for Radiocommunication purposes: Region 1 Europe/Africa; Region 2 The Americas; Region 3 Asia.

c) World Conferences on International Telecommunication

These conferences establish general principles relating to the provision and operation of international telecommunications services offered to the public, they put into place the international means required for the provision of such services. The Conferences also establish the rules applicable to the administrations and operators with regards to international telecommunication matters.[202] These decisions are implemented by the World Conferences on International Telecommunication through revision of the Telecommunications Regulations (CS 25.1). These Conferences are open to all those groups permitted to be present at Plenipotentiary Conferences.

[201] The member countries are listed on the Internet at http://www.itu.ch/aboutitu/council.html
[202] See http://www.itu.ch/aboutitu/orgchart/structure/govbody/wconf.htm

The ITU Sectors

The three Sectors of the ITU are representative of the three main functions of the organization.[203] The Radiocommunication Sector regulates the frequency spectrum; the Telecommunication Standardization Sector establishes technical norms, and the Telecommunication Development Sector promotes development of telecommunications. All three sectors share similar administrative structures: they each comprise Conferences and Assemblies, advisory groups, and bureaus headed by Directors.

d) Radiocommunication Sector (RS)

The Radiocommunication Sector (RS) fulfills the regulatory function of the organization with respect to use of the radio frequency spectrum by all Radiocommunication services (CS 12.1.1) including those using the geostationary orbit[204]. The RS ensures the "rational, equitable, efficient and economical use" of the resource by all Radiocommunication services (CS 12.1.1).

This Sector operates through Radio Conferences (CS 12.2.a), and Radiocommunication Assemblies supported by study groups (CS 12.2.d). The Conferences revise the Radio Regulations (CS 13.1). The Advisory Group, which provides strategic advice, and the Bureau, headed by a Director in charge of administrative tasks, complete the structure of the RS.

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[203] D.J. Maclean "Global Partnerships for Global Communications: Challenging the New ITU" (ITU, Geneva, Switzerland) in (1995) 2 Telecommunications and Space Journal (Ed: L. Rapp, Serdi Publishing, Paris) at 290; see also ITU Reconstructed, supra note 181 at 80.

[204] International Telecommunication Union, Final Acts of the Additional Plenipotentiary Conference 11 (1992).

World and Regional Radio Conferences are ordinarily convened every two years; they review and revise the Radio Regulations (RR). An agenda, established in its generalities four years in advance (CV 7.2.2), is refined into a Final Agenda by the Council by a majority of the Members of the Union two years prior to Radio Conferences. This agenda serves as the basis for the review (CV 7.1). The Radio Conference may make recommendations for the forthcoming conference's agenda. Radiocommunication Assemblies provide the technical basis for the work of the World Radio Conferences and they approve the program of work of the Radio Conference study groups (CV 8.2.h) and decide on the priority, urgency and time-scale for the completion of their study (CV 8.2.2).

The Radio Regulations Board (RRB) is a board of nine part-time "custodians of international public trust"[205] whose duty it is to oversee the routine administration of radio-frequency allocations and of space systems. This entails the verification of proposals in order to ascertain their conformity with ITU standards as well as their coordination with prior notifications by other members. Besides those functions, the history of the IFRB shows that the root justification of the RRB is that it instills and maintains confidence in the international regulatory system.[206] The part-time nature of the posts combined with the requirement of expertise and requirement of regional representation detracts from the apparent independence of

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[205] F. Lyall, "The International Frequency Registration Board" (1992) 35 Colloquium L. Outer Space at 394-399 [hereinafter The IFRB]. Also see CS 8.2.h and CV 10.1

[206] Ibid. at 395. At the 1965 Montreux ITU Plenipotentiary Conference the IFRB was saved from abolition because developing countries perceived it to be an "impartial voice" and a source of "disinterested advice" relating to frequency allocation.

the Board, in the opinion of at least one critic,[207] although specific provisions are included to safeguard the Boards impartiality (CS 14.3.1, 2, and 3).

e) The Telecommunication Standardization Sector (TSS)

The TSS studies technical, operating, and tariff matters (CS 17.1.1). It also formulates recommendations after such studies, with the goal of creating worldwide standards. It operates through World Telecommunication Standardization Conferences, study groups and the Telecommunication Standardization Bureau. It is organized and coordinated by its Director, elected by the Plenipotentiary Conference. Every four years a World Telecommunications Standardization Conference is held (CS 18.2) although additional conferences for this sector may be scheduled. In contrast with other Sectors, there are no Regional Conferences. Matters discussed at World Standardization Conferences must be specific and related to telecommunication; those matters can be referred to it by the Plenipotentiary Conference, the Council, other Conferences, or generated from within the Sector.

The precise division of responsibilities between the TSS and the RS with regard to matters of common interest to both is a subject of continuing review (CS 17.2 and CV 11.5 and 14.2). Failure to reach timely and effective agreement on the jurisdictional division concerning a certain question results in reference of the matter to the Plenipotentiary Conference via the Council. This jurisdictional overlap

[207] ITU Reconstructed, supra note 181 at 86.

has been criticized for its potential to recreate problems that haunted the previous structure: the duplication of effort and conflict of interest between two Sectors.[208] The ITU has a reputation for pragmatism and a division for the "purpose of intellectual satisfaction or sterile neatness"[209] might detract from that quality.

f) The Telecommunications Development Sector

By creating the Telecommunications Development Sector, the Additional Plenipotentiary Conference of Geneva 1992 recognized the importance of the development of telecommunications in less developed countries. This new sector reorganizes in a single entity many projects already underway in different areas of the previous structure. This reorganization laid down a much more coherent basis for work in telecommunications development and gave the objective of development far greater prominence within the ITU than it had previously.[210] The composition of the TDS resembles that of the other two sectors: Conferences on World or Regional levels, an Advisory group and a bureau headed by a Director.

g) The General Secretariat

The General Secretariat handles all administrative and financial aspects of the Unions activities. The General Secretariat is charged with the dissemination of information, the organization of conferences, the coordination of its own work with

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[208] Ibid. at 82.
[209] Ibid.
[210] Harris, supra note 178 at pp. 86 and 90.

single body of regulations to all members. The inclusiveness of the ITU membership is obvious since members of the Union are "all States parties to *any version* of the ITU Convention prior to the Nice Constitution and Convention" (italics mine). The Nice Plenipotentiary Conference replaced a complex legal regime of different forms and versions of the ITU. It did this by stipulating that "ratification, acceptance or approval of or accession to the Convention or Constitution *also* constitute consent to be bound by competent World Administrative Regulations adopted by the World Administrative Conferences prior to Nice"[214]. Moreover, the concept of provisional application (CS 54.3) aids in creating uniformity in international radio regulations. Under the new rules, provisional application of a regulation lasts 36 months, within this period a member's intention not to be bound must be notified, otherwise consent shall be deemed to have been given. This "silence means consent" rule is a mechanism aimed at maintaining legal uniformity between members of the Union; it is found at article 54.5 of the Constitution. The obligation to provisionally apply the future revisions of the regulations is subject to the extent permitted by the domestic law of ITU members.[215]

Some commentators have suggested to broaden ITU membership to include international organizations which have operational capability, such as INTELSAT.[216] Although private sector participation is more visible and welcome as evidenced in paragraph 54 of the Strategic Plan (1995-1999):

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[214] Art. 40(2) Nice, this provision has now been incorporated in the new Constitution at article 54.2
[215] 1989 Nice, supra note 213 at 10.
[216] Legal Regime of the GEO, supra note 176 at 221 and ff.; also see Lyall, supra note 171 at 330.

> "The ITU's role (...) and the achievement of its purposes (...) fundamentally depend on the enhanced participation of non-administration entities and organizations. This in turn requires continued consultation with industry participants to ensure that their contributions are rewarded by effective results. The need to enhance the ITU's character as a partnership between the public and private sectors is therefore a strategic premise"[217]

it seems probable that the ITU will remain an inter-governmental organization for some time to come.

PART. II THE RIGHT TO INTERFERENCE-FREE USE OF RADIO FREQUENCIES

The most important element of the international regulatory regime governing the orbit-spectrum resource is the principle of avoidance of harmful interference. Generally, legal protection from harmful interference from other radio stations is acquired through the completion of a regulatory filing procedure involving advance publication, coordination with other systems, notification and, finally, registration of the frequencies to be used in the Master Registry. Plans or alternative procedures with regards to certain specific services have supplanted this generally applicable regulatory framework.

[217] International Telecommunication Union, Final Acts of the Additional Plenipotentiary Conference 54 (1994)

A. General Regulatory Regime

a) Advance publication[218]

The first step in the regulatory filing procedure, the "start of the regulatory clock", is advance publication of information relating to the technical characteristics of a proposed satellite system. The purpose of advance publication is to ascertain, at the early stages of planning, any major system incompatibilities.[219] Advance publication contains certain basic technical information (RR 1041-1044) and must be sent to the Radio Regulations Board no earlier than six and no later than two years prior to the date of bringing into service of the proposed system.[220] The RRB reviews the information in accordance with the standards established in the Radio Regulations and publishes the "advance publication information"[221] in a Weekly Circular[222] sent to all members of the Union. If no Administration comments are received within four months of the date of the Weekly Circular detailing the proposed system it is assumed that there are no basic objections to the proposal (RR 1047). Alternatively, if a problem has been identified by the advance publication procedure, the proposing

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[218] During consideration of the need to streamline and simplify the regulatory procedures in the framework of Resolution 18, some Administrations and the RRB favored the merging, into one combined procedure, of the Advance Publication and Coordination phases of the regime, this concept did not achieve consensus, however.

[219] S.D. White "International Regulation of the Radio-Frequency Spectrum and Orbital Positions" (1995) 2 Tel. & Space Jl. at 334 ff.

[220] As part of the process of streamlining and simplifying the Radio Regulations, WRC-97 reduced the period between advance publication and the date of bringing into use by one year (from 6 to 5). The current automatic extension period of three years is also reduced to two and granted for specific reasons and decided upon following well defined procedures. The new regulatory time frame is now at most seven instead of nine years.

[221] Recommendation D of the Report on Resolution 18 suggests that the information required under advance publication should be simplified and restricted to: notifying administration; satellite name; orbital characteristics; frequency ranges to be used; description of service area, type of service; and planned date of bringing into use. Report on Resolution 18, infra note 233.

[222] WRC-97 operated a change in the frequency of the Weekly Circular, which shall now appear every two weeks; the Weekly Circular will also be making a transition from paper, microfiche and diskette publication to CD-ROM format.

administration must explore all possible solutions without considering the possibility of adjusting other satellite systems (RR 1051). Only after that process is completed can a request be extended to the Administration of the satellite system likely to be affected to examine any potential adjustment of the other system which might resolve the problem (1052). It should be noted that since the February 26, 1993 date of issue of rule no. H40 by the RRB, no administration gains any particular priority based on date of advance publication or request for coordination.[223]

Difficulties in compatibility of systems are initially resolved by applying the technical information and criteria in Appendix 29 of the Radio Regulations. While it is also possible to seek the assistance of the RRB to facilitate the coordination of systems, coordination is most often a matter of bilateral negotiation, partially because the RRB may only play an advisory role (RR 1054-1054D).[224] There is no obligation on the part of the "first-comers" with previously registered assignments to accommodate the new entrants' system although they are expected to negotiate in good faith.[225] The results of the advance publication procedure are published in the Weekly Circular and, if all the necessary agreements have been obtained, the Administration may proceed with the coordination of the frequency assignments pertaining to the network. However if subsequent modifications to the proposed system significantly alter the character of such system there is an obligation to repeat the advance publication procedure (RR 1043).

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[223] White, supra note 219 at 338.
[224] See below at page 58, for recent developments regarding dispute resolution within the ITU
[225] Jakhu, supra note 176 at 276

b) Coordination

If the frequency assignment sought is in the same frequency band and belongs to the same service (or to another service with equal rights or a higher category allocation) as existing legitimate assignments recorded in the Master International Frequency Register, then coordination procedures must be applied. Once the Administrations with which coordination will be required have been identified,[226] the Administration planning the proposed system must forward all relevant information to the RRB, which in turn sends the information and its own conclusions to the concerned Administrations. This information is published in the Special Section of the Weekly Circular. Again, if changes are made to the proposed system after publication, it will be necessary to recommence the coordination procedure if such changes significantly alter the systems character.[227]

If, within four months of publication of the Circular, any administration has objections regarding the specifications of the proposal it must forward them to the Administration making the proposal. The objecting Administration must also identify the technical details at the heart of the objection and provide the RRB with any solutions to the problem (RR 1084). The affected Administrations must make "all possible mutual efforts to overcome the difficulties in a manner acceptable to the parties" (RR 1085A).[228] Once coordination has been initiated after the four months

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[226] The Report on Resolution 18, under the heading 12.2 New Coordination Methods/Concepts, focuses on reducing the number of administrations with which coordination is required. Under study is a concept of a 'coordination arc' of +/-X° from the proposed orbital position, satellites positioned outside the arc would not necessitate being coordinated with. Another suggestion was to obligate satellite designers to accept standard, homogeneous characteristics in order to alleviate coordination difficulties.

[227] White, supra note 219 at 339

[228] Ibid. at 343

time period, the Administration proposing the new satellite network informs the RRB of Administrations with which agreement has been reached, followed by reports every six months on the status of negotiations with other Administrations (RR 1087). The assistance of the RRB can be requested in the case of disagreements that cannot be resolved. Once the RRB involves itself in aiding resolution, it takes all the necessary steps to facilitate negotiations and evaluates the extent of harmful interference and the technical basis of objection. A thirty-day "cure period" follows during which Administrations give indication of their being affected by the proposal. It is deemed that no complaint will be made and that the stations will not cause harmful interference to the proposed system if no complaint is made within that period of time.[229]

The RRB is not a quasi-judicial tribunal as it lacks any powers of sanction and can only aid in the resolution of disagreements. An objecting Administration may continue to stall coordination by simply supplying unhelpful responses during the "cure period".[230] The RRB proposed, in the framework of Resolution 18,[231] that the ITU should be empowered to settle disputes arising from unsuccessful satellite coordination exercises by giving formal responsibility concerning dispute resolution to an "appropriate organ" of the ITU.[232] The prevailing opinion of the other participants, was that it was not necessary to make any such changes to the scope of the ITU's jurisdiction as there already exists a mechanism for such dispute resolution for signatories to the *Optional Protocol on the Compulsory Settlement of*

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[229] Ibid. at 344
[230] Ibid.
[231] Resolution 18 of the Plenipotentiary Conference, Kyoto 1994 is entitled "*Review of the ITU's Frequency Coordination and Planning Framework for Satellite Networks*"
[232] The Radio Regulations Board itself might be such an "appropriate organ" of the ITU.

Disputes Relating to the Constitution and Convention of the International Telecommunication Union and the Administrative Regulations.[233]

c) Notification

Notification is required for new systems or for modifications to an assignment that has already been recorded. In the case of a previously recorded assignment a new notification is required if the modification includes a) a request seeking international protection or b) the assignment is to be used for international services or c) the use is likely to cause harmful interference to the services of another country (RR 1488-1491).

Notices must contain the information required by Appendix 3 of the Radio Regulations and are examined by the Radio Regulations Board for conformity with the ITU Convention and Radio Regulations. The Radio Regulations Board also verifies the notice for conformity with provisions relating to previous notifications. Finally the RRB evaluates the probability of harmful interference when coordination has not been successfully achieved. The RRB must publish the notification in the Weekly Circular within 40 days of reception of the notice.

d) Registration

Recording of the assignment in the Master Register follows favorable evaluation by the RRB. Any registration may also indicate that its operation is on a non-interference basis (in accordance with RR 342) in which case, should harmful

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[233] Director Radiocommunication Bureau, "*Report on Resolution 18 of the Plenipotentiary Conference Kyoto, 1994*" (ITU, Geneva, 1997)

interference be caused to a service operating in accordance with the Radio Regulations, the interference must cease.[234]

If the RRB makes an unfavorable finding, and an Administration resubmits a notice with insufficient changes, rule H40 permits recording the notice "provisionally" (RR 1544 and 1556) if an earlier notified assignment at the origin of the unfavorable finding is not in operation. If both the earlier notified assignment and the newly notified assignment have been in operation for at least four months without any reports of harmful interference, then the notice may be recorded "definitely".

However, should a country not respect an unfavorable review of its assignment and decides to maintain use of such assignment, the ITU has no recourse and can do nothing.

This describes the generally applicable regulatory framework. As noted previously, certain space services have been planned and involve the successful completion of different procedures to obtain international protection for the use of those services.

This regulatory framework can be described as a "time sensitive registration scheme" by which the first person to register their use of a frequency is afforded protection from harmful interference. Those who register subsequently must coordinate their systems with the "first-comer(s)" and possibly implement modifications to their system to avoid creating harmful interference.

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[234] White, supra note 219 at 345

B. Other Approaches to Regulation of the Orbit-spectrum Resource

a) Background

The generally applicable regulatory system described above is also referred to as "first come, first served" because the first member to register an assignment has no obligation to accommodate those who notify assignments subsequently. The term "first come, first served" reflects the principal criticism directed at the ITU's right-vesting mechanism: because it favors early entrants and penalizes latecomers. This criticism was given prominence by the experiences of India and Indonesia in the mid-1970s.[235] India, as a member of INTELSAT, was obliged pursuant to the coordination procedures of article XIV of the INTELSAT Agreement to renounce the orbital position for which they had designed a telecommunications satellite and to accept a less optimal position[236]. Because article XIV required India to respect INTELSAT's "first come, first served" coordination guidelines derived from ITU-CCIR (Comité Consultatif International de Radio) Recommendations the full "burden" of coordination changes fell upon India as later entrant. Indonesia also had to make operational concessions because of INTELSAT coordination requirements. Indonesia had further difficulties extracting detailed information about the Soviet systems with which it had to coordinate.

An important counterpoint to these criticisms should be noted: neither of these incidents directly concerned the ITU right-vesting procedures which, in the

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[235] S.E. Doyle "Space Law and the Geostationary Orbit: The International Telecommunication Union's WARC-ORB 85-88" (1990) 18 J. Space L. 13

[236] India had to accept a) a shift from its preferred orbital position by 5°, b) restrictions on satellite power resulting in higher earth station costs, c)some restrictions on India's television operations. However, India made no advance study of the problems which might arise with other satellite systems. See S.E. Doyle "Regulating the Geostationary Orbit: ITU's WARC-ORB '85-'88" (1987) 15 J. Space L. at 8

opinion of some commentators, is a "first come, last served"[237] system that has never failed to accommodate a satellite system. However, the experiences of these two countries did serve to highlight the fact that the "first come" status of INTELSAT and the USSR space segments required concessions on the part of latecomers via the coordination process. Those incidents served to encourage "Less Developed Countries" to seek the development of the concepts of equity and equitability in space law. More specifically, they reinforced the promotion of a more equitable means of spectrum management.[238] The desire common to the LDC's for more equitable allocation of resources met resistance from the developed countries that feared that allocation along the lines of developing countries demands was at odds with the efficient use of the resources. The central dilemma is "one of efficient versus equitable use of the radio frequency spectrum".[239] The attempts to balance principles of equity and equitability against those of efficiency and economy through alternatives to the general regulatory framework have been blamed for the politicization of the ITU, traditionally perceived as a technical body.[240]

The notion that all ITU members have an interest in and right to equitable use of the radio spectrum allocated to space services was first formulated at the 1963 Extraordinary Administrative Radio Conference as a non-binding recommendation.[241] The concept was later reiterated at WARC-Space

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[237] S.E. Doyle "Equitable Aspects of Access to and Use of the Geostationary Orbit" (1988) 17 Acta Astronautica at 637

[238] Savage, supra note 174 at 63; see also E.D. DuCharme et al., infra note 246 at 262.

[239] Savage, supra note 174 at 65.

[240] Savage points out, however, that "radio frequency spectrum management (...) has always featured political and economic motives behind the technical decisions" Ibid.

[241] Recommendation No. 10 (No. 700); Legal Regime of the GEO, supra note 176 at 268

Telecommunication, held in 1971,[242] and in WARC-BS 1977, WARC 1979, and WARC-88 (as resolution Com 6/3), under the terms that the use of such resources should be available to "all countries with equal rights".

The notion of equitable access, originally added to the ITU Convention by the 1973 Plenipotentiary Conference at Malaga-Torremolinos, is now stated in the ITU Constitution, article 44 (2):

> In using frequency bands for radio services, Members shall bear in mind that radio frequencies and the geostationary-satellite orbit are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have *equitable access* to both, taking into account the special needs of the developing countries and the geographical situation of particular countries.[243] (italics mine)

The generality of the concepts of equity and equitability refuse specification precisely because what is equitable must be evaluated with reference to the specifics of each situation. No definition of equitable access is supplied by any of the ITU legal instruments, but it is clear that countries may have equitable access to the orbit-spectrum resource only in conformity with the Radio Regulations.[244] Ultimately, the most specific implementation of those principles is to be found in the alternative regulatory regimes applicable to the Broadcasting Satellite Service and portions of the Fixed Satellite Service. The plans seeking to establish more equitable sharing of the orbit-spectrum resource are commonly referred to as the 1977 WARC-BS and 1983 RARC, and the WARC-ORB '85-'88.

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[242] at Resolution No.Spa 2-1.
[243] Canada, France, and the United States among other industrialized countries, have made reservations relative to the term "geographical situation of particular countries."
[244] Legal Regime of the GEO, supra note 176 at 267 The second "proviso" no longer applies as the "needs and technical facilities" requirement was abrogated by the 1982 Nairobi Plenipotentiary Conference.

It is necessary to mention the Bogota Declaration of December 3, 1976, as it asserted a sovereign right of equatorial countries over the section of the GEO above their territories, partly on the basis of an alleged "unique relationship between gravity and the GEO" and partly on the basis of a lack of defined delimitation between airspace and outer space.[245] Despite the efforts of Colombia and some other equatorial countries, the substance of the Declaration was not recognized by the ITU, either at the 1977 WARC-BS nor at the 1979 General WARC. The ITU has taken the position that the issue is a matter for COPUOS and its legal subcommittee.[246] While these assertions continue to linger within COPUOS, the "real" purpose of the Declaration being the application of political pressure on the few "space-faring" countries monopolizing the GSO, was achieved.[247] Concerns regarding saturation of the orbit-spectrum resource were shared by many other developing, and some industrialized countries, comprising a voting majority in the ITU on this question. In fact, their voting majority was sufficient to secure passage of Resolution no.3 at the 1979 WARC resulting in the decision to hold the two session WARC-ORB '85-'88 with the objective to "guarantee in practice" access to the geostationary orbit and to the frequency bands allocated to the space service utilizing it.[248] The intentions of the developing countries were tempered by the realization that any plan selected to achieve this goal would require the participation

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[245] R.S. Jakhu, "The Legal Status of the Geostationary Orbit" (1982) 7 Ann. Air & S. L. at 334 ff.
[246] DuCharme, R.R. Bowen, M.J.R. Irwin "The Genesisof the 1985/87 ITU WARC on the Use of the Geostationary Satellite Orbit and the Planning of the Space Services Utilizing it" (1982) 7 Ann. Air & S. L. at 272
[247] Jakhu, supra note 245 at 341
[248] Doyle, supra note 236 at 8

of the majority of developed countries. From that perspective it was clear that compromises would be necessary.[249]

b) 1977 WARC-BS and 1983 RARC

Resolution Spa. 2-2, passed at the World Administrative Radio Conference for Space Telecommunications (WARC-ST) held in 1971, called upon the Administrative Council to convene a WARC to plan the frequency bands allocated to the Broadcasting Satellite Service and use of GEO for such service. Similarly, a request from a number of developed and the developing countries to convene preferably a World or, alternatively, Regional Conferences, to enable planning was considered at the 28th Session of the Administrative Council. The 1973 PC in Malaga-Torremolinos finally set the stage for the WARC for the Planning of the Broadcast Satellite Service to be held in 1977. The 1977 WARC-BS was the first attempt at preparing an *a priori* plan for a space service. The political nature and social impact of satellite broadcasting compounded by the issue of inevitable signal overspill were factors that prompted planning of the service, even though no broadcast satellite systems existed at the time.[250] The WARC-BS of 1977 is unique in that it was developed prior to the establishment of any BSS service.[251]

Most delegates to the 1977 WARC would have preferred a World Plan involving all three Regions, but because Region 2 (the Americas) could not reach agreement on a plan and elected to postpone planning until 1983, when a Regional Administrative

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[249] M. L. Smith "International Regulation of Satellite Telecommunications after the Space WARC" (DCL thesis, Montreal: Institute of Air and Space Law, McGill University, 1989) at 161 [hereinafter After the Space WARC].
[250] Ducharme et al., supra note 246 at 270
[251] Ibid. at 267

Radio Conference could be convened. The planning of the BSS was thus achieved in two steps.

WARC-BS Regions 1 and 3

The plan devised in 1977 for Regions 1 and 3 provides roughly the same number of television channels (on average four or five) and orbital positions to all countries large or small,[252] and specifies the technical parameters which must be respected for use of the orbital slots. The frequency bands planned were for downlink only, but a plan for feeder links (uplink) was subsequently formulated and adopted for Regions 1 and 3 at the first session of WARC-ORB '85-'88. The 1977 WARC-BS plan entered in force on January 1st 1979, and was to remain so for "at least" fifteen years.[253]

The right vesting mechanism to be followed under the plan is much simpler than the general regulatory regime because the positions and related radio frequencies are allotted prior to their use, coordination is guaranteed thus *a priori* by the plan. The Administration which plans to implement a satellite system files a notice with the IFRB (now RRB) and if it is found to comply with the technical parameters established, the assignment is recorded. A notice subject to an unfavorable finding is sent back to the Administration which must render it compatible with the required parameters. If the notice still does not conform it cannot be recorded or used unless it has the agreement of affected Administrations in which case such use must be for a specified period of time.[254] Because the orbital positions and related radio frequencies

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[252] Though some large countries with greater demand received more, the USSR and Australia for example received 65 and 36 television channels respectively.

[253] Ducharme et al., supra note 246 at 272.

[254] Article 4 Appendix 30.The interim procedure, similar to the art 11 and 13 procedures, still applies because no other plans have been implemented. Reso. 507 requires the establishment of international agreements and associated plans for BSS in all frequency bands allocated for the service.

are predetermined for each country under this plan, the date of notification is irrelevant. No variations to the plan were permitted, even on a non-interference basis,[255] though it is possible to make modifications to the plan with the accord of all affected Administrations. This plan is particularly rigid in light of the subsequent *a priori* plans detailed below.

RARC-BS Region 2

At the 1977 WARC-BS discussions between Region 2 members were deadlocked when difficulties arose between the U.S., which did not favor planning at all, and those countries that insisted on planning Region 2 with Regions 1 and 3. In the middle were Canada and some other countries whose approach was to agree to planning, but defer it until a later date. In the end the compromise was chosen and it was decided to reschedule planning of the BSS until 1982, later delayed until 1983. No broadcasting satellite systems were implemented in the interim between the WARC-BS and the RARC.

The 1983 Regional Administrative Radio Conference (1983 RARC) is a plan that utilizes the resource more efficiently and provides more technical flexibility than the earlier 1977 WARC-BS plan. It is also more complete as it planned both the downlink and the uplink frequencies. The notion of "arc segmentation"[256] was introduced for the interim period from 1977 until 1983 but ultimately was not retained because it was not satisfactory to either space service since neither could use the

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[255] M.L. Smith "Space WARC 1985 Legal Issues and Implications" (LL.M. Thesis, Montreal: Institute of Air and Space Law, McGill University, 1985) At 127.

[256] Originally suggested in art. 12(6) established the essential provisions governing the establishment of a detailed plan: BSS operation restricted between 75° West and 100° West Longitude and 140° and 170° Longitude, while the FSS would utilize the remainder.

entire orbit visible from countries in the Region.[257] The Regional Broadcast Satellite Conference instead opted for a division of the frequency bands (or frequency segmentation) by allocating 12.1-12.2 GHz to FSS and 12.2-12.3 to BSS. More interesting from a legal perspective was the adoption of regulatory procedures characterized by flexibility. This made it possible to implement first-generation or interim BSS satellite systems without having to fully comply with the technical specifications of the plan.[258] It was also made possible to establish a system differing from the plan with the agreement of the affected administrations. Procedures for the permanent modification of the plan as necessary to accommodate additional requirements were established. Adding to the flexibility of the RARC-83 plan was the notion of flexibility with respect to orbital position: a system can be implemented within 0.4° of the nominal position indicated in the plan.

The timeline of validity of the plan for Regions 1 and 3 was taken into account by specifying that the plan for Region 2 would be valid until at least 1994. The Region 2 BSS plan was incorporated into the Radio Regulations as a revised Appendix 30 resulting in the full recognition of the plans by the admission of Regions 1 and 3 at the first session of 1985-1988 WARC-ORB.

c) WARC-ORB 1985-1988

Prompted by Resolution No.3 of the 1979 WARC, which sought the establishment of a future WARC to guarantee "in practice" equitable access for all countries to the GEO and the frequency bands allocated to space services, WARC-

[257] Ducharme et al., supra note 246 at 275
[258] Ibid. at 279

ORB was convened to take place in two sessions, in 1985 and 1988. Despite the wide scope envisioned in Resolution No.3, the WARC-ORB '85-'88 concerned only the Fixed Satellite Service.[259] The first session was the scene of conflict between the different aims of developing and developed countries. Indeed, developing countries initially asserted that most, if not all, of the frequency bands allocated to FSS should be planned on a long term basis and the orbit-spectrum resource be partitioned among all nations regardless of their current need or ability to use the portion allotted to them. Developed countries, on the other hand, while willing to compromise and agree to the planning of "expansion bands", did not consider planning of the "conventional" bands to be acceptable. This deadlock was not resolved until almost the end of the conference and might have resulted in its complete failure were it not for the decision by the conference Chairman to create an *ad hoc* group to seek a consensus decision.[260]

The consensus decision reached by the *ad hoc* group was to adopt a "dual planning method approach"[261] to the FSS bands, a combination of proposals initially fielded before the leader of Working Group 5A. This approach involved two different planning methods depending on whether the frequencies belong to the group of "conventional bands" or to "expansion bands". Conventional bands are those which had been allocated to the Fixed Satellite Service before the 1979 WARC and in 1985 already many sectors of the GSO were intensely used for this

[259] The FSS was, and remains, the most important civil use of space services.
[260] After the Space WARC, supra note 249 at 155.
[261] Ibid. at 161.

procedures[264] and it also contains a separate MPM procedure that applies to certain frequency bands in "exceptional cases".

The fundamental regulatory scheme was therefore kept: advance publication is to be sent to the RRB not earlier than six years; affected administrations have four months to send comments or objections relating to the proposal to which the later entrant must seek solutions. Coordination remains a question of bilateral or multilateral negotiation.

The most notable change from the general regulatory regime is at the level of coordination: the affected Administrations, those with previously vested rights may also be requested to seek solutions to interference. This is an important modification as coordination, under these procedures, is therefore a shared responsibility:[265] "all possible mutual efforts to resolve differences in a manner acceptable to both parties" must be made in the coordination process. This is also referred to as "burden sharing." The possibility of notifying one or more typical earth stations and associated service areas is the main modification made to Article 13 of the general regulatory framework. This means that the notification of individual typical earth stations is no longer required except in limited circumstances.

iii) Multilateral Planning Meetings

Most provisions concerning MPMs are included in Resolution Com 6/3, since incorporated by reference into the Radio Regulations. The results of MPMs have status of coordination agreements but do not prejudice the rights of non-

[264] After the Space WARC, supra note 249 at 279.
[265] Ibid. at 286.

participants. No specific rules of conduct are established for MPMs as the nature of the proceedings is left to the parties involved.[266] No enforcement mechanisms were established, a factor which might undermine the effectiveness of MPMs.

C. Use or abuse of the regulatory regime? The case of Tongasat

It can be argued that the term "first come, first served" is not only pejorative but also misleading and incorrect. Some authors point out that the generally applicable regulatory regime has never failed to accommodate a proposed system, and have coined the term "first come, last served" to underscore their point. The actions of the Pacific island Kingdom of Tonga serve as an example of how a tiny state may use the general regulatory structure to its advantage.[267] Between 1988 and 1990 Tonga, a sovereign country member of the Union but without a satellite industry nor any space related regulatory agencies, applied for sixteen[268] orbital slots on the geostationary arc over the Pacific by publishing specification for the use of those slots with the International Frequency Registration Board (IFRB). Because Tonga is not a party to the INTELSAT Agreement it is not bound by the obligation to avoid causing "significant economic harm" to INTELSAT through alternative satellite enterprises.[269] INTELSAT, therefore, could not oppose a "violation" of Article XIV of the INTELSAT Agreement to a satellite system planned by a non-member. Nevertheless, it could complain to the body that does have such

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[266] Ibid. at 288.
[267] J. I. Ezor, "Costs Overhead: Tonga's Claiming of Sixteen Geostationary Orbital Sites and the Implications for the US Space Policy" (1993) 24 Law & Policy in Int'l Business 915.
[268] Initially, Tonga filed for 31positions.
[269] Intelsat Agreement art. 14.

jurisdiction, then the International Frequency Registration Board.[270] INTELSAT claimed that Tongasat was engaged in "orbit speculation for profit" which was, in INTELSAT's opinion, an abuse of the ITU Radio Regulations.[271] The RRB did not have to pronounce itself on the issue since Tonga subsequently volunteered a reduction in its claims from sixteen to six orbital sites, a reduction that was accepted by the IFRB.

It has been argued that even though Tonga may not have violated the letter of the ITU regulations, the warehousing, leasing or auctioning of orbital positions and associated frequencies violate the spirit of the ITU rules, and indeed possibly even the concept of the Common Heritage of Mankind.[272]

It would appear that in the future it will be more difficult to file for orbital positions without any specific intention of use in light of the recently adopted "administrative due diligence" measures aimed at reducing the number of frivolous filings.[273]

D. Nature of the right to interference-free use

The right to interference-free use of radio frequencies and orbital positions may be acquired by successfully accomplishing the regulatory procedures as detailed above. Regardless of the procedure required for obtaining protection from interference, the nature of the vested right remains the same.

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[270] Ezor, supra note 267 at 915.
[271] Ibid. at 927.
[272] J.C. Thompson "Space for Rent: The ITU, Space Law and Orbit/spectrum Leasing" (1997) 62 J. Air L. and Commerce 279
[273] See below at p. 78 for details concerning "administrative due diligence"

The nature of the interference-free use of a geostationary orbital position and the radio frequencies recorded for use in conjunction with that position is not equivalent to the concept of ownership; it is not a title to outer-space property.[274] It is appropriate at this point to restate that a national claim of ownership of a geostationary position would be contrary to international law as stipulated in the Outer Space Treaty, Article II. The right to interference-free use of recorded assignments is characterized by certain particularities that deserve mention at this point.

a) Right to use perpetually

Under the general regulatory regime the ITU assignments are not subject to any limitation in time. So long as no "basic characteristics" of the assignment are modified, the notifying country is entitled to use it continuously and perpetually.[275] An attempt was made to correct this situation by the adoption of Resolution 4 at the 1979 World Administrative Radio Conference. Resolution 4 attempts to restrict the duration of the assignments by declaring that the radio frequencies and geostationary position assignment are to be deemed "definitely discontinued after expiry of the period of operation shown on the assignment notice." The Radio Regulation Board must invite the notifying country to take steps to cancel the assignment at the end of the design life of the satellite network. If the country wishes to continue use of its recorded assignments it may do so with the

[274] Legal Regime of the GEO, supra note 176 at 288
[275] Ibid. at 289

concurrence of the RRB by informing the RRB of its intention at least three years prior to the end of the recorded period of operation.[276]

The review of the radio regulations pursuant to Resolution 18 of the 1994 Kyoto Plenipotentiary Conference identified some "unrealistically long operational lifetimes" of up to 50 years filed for satellite networks. It was decided to consider the issue of operational lifetimes at an upcoming competent WRC, as experience is still being acquired from application of Resolution 4.[277]

The *a priori* plans are designed to meet the requirements of concerned countries for specified periods of time, and can be modified by a competent WARC. Nonetheless, the legal right to continuous use of a recorded assignment remains so long as no such modification is undertaken.

b) The Right to Replace a Dead Satellite

It is possible to replace an old or non-functioning satellite with one bearing identical basic characteristics while retaining the protection vested in the original recording of the assigned frequency in the Master Register because the right to use is perpetual so long as no basic characteristics are changed, and because a change in either the name of a space station or in the date of bringing into use of an assigned frequency are expressly excluded from comprising "basic characteristics". It is also possible to modify and replace the ground segment of the space network, as long as the technical character of use of the assigned frequencies are not affected.[278] Again,

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[276] Ibid. at 290
[277] Report on Resolution 18, supra note 233 at p. 11 (section III. 9)
[278] Legal Regime of the GEO, supra note 176 at 295

Resolution 4 of the 1979 WARC can be perceived as a mitigated limitation to this right since it limits the validity of frequency assignments to the period of operation of the satellite network. However, as seen above, it is relatively easy for the notifying country to extend the period of validity of the recorded assignment.

c) Right to Sell or Barter Geostationary Positions

As a general rule, the right to interference free use is a non-transferable right.[279] No doubt prompted by the actions of Tonga, the question of whether or not there is any need to restrict the transfer of rights and obligations resulting from the transfer of a satellite filing from one Administration to another was raised but not resolved in the framework of Resolution 18. The lack of an appropriate definition of the scope of the problem (one which would address any abuses without restricting commercial flexibility) and a lack of specific proposals were the reasons for which no recommendations were made other than to suggest that the issue be discussed at WRC-97.[280]

Under the *a priori* plans, use must be exercised in accordance with the plans, and may not be used by any other country even on a non-interference basis.[281] It could be possible to transfer the right, however, by successfully following the modification procedure specified in the plan, but only in certain circumstances

[279] D.M. Leive "Regulating the Use of the Radio Spectrum" (1970) 5 Stanford J. of Int'l Studies at 35
[280] Report on Resolution 18, supra note 233, at p.18 (section III 15.2)
[281] Legal Regime of the GEO, supra note 176 at 292

because of the inter-dependence of the technical parameters within an allotment plan.[282]

d) The Right to More Assignments than Satellites

It is possible for a country or international organization to have more recorded orbital positions and associated radio frequencies than the actual number of satellites in orbit. Two principal reasons may motivate this behavior: the first is that having more assignments than satellites permits operational flexibility.[283] This is permissible because it is the orbital position and associated frequencies that are afforded international protection and not the space stations as such.[284] The second reason is the desire to "hoard" orbital slots for the future use, even if there are not any plans to use them in the short-term. This second reason has led to the problem of "paper satellites":[285] the abusive filing of requests with the ITU of orbital positions and associated frequencies for systems which may never be realized.[286] One commentator observes that there are five variants of the fundamental problem of abusive filing.[287] Indeed, states with a more fully planned system have had to

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[282] The possibilities of operating such transfers is limited to countries which are "closely adjacent" see G.O. Robinson "Regulating International Airwaves: the 1979 WARC" (1980) 21 Virginia J. of Int'l L. at 43

[283] A satellite operator might, for example, want to move a satellite from a low traffic position to another, under-served, orbital position.

[284] Legal Regime of the GEO, supra note 176 at 298

[285] F. Lyall "Paralysis by Phantom: Problems of the ITU Filing Procedures:" (1996) 39 Colloquium L. Outer Space at 189 [hereinafter Paralysis]

[286] The problem of overfiling is related to three root causes: a) the 'first come, first served' regime provides an incentive to 'stake a claim' to the orbit-spectrum resource, more so when other Administrations are doing the same; b) there is no cost associated with filing; c) there is no penalty if the system filed is not established within the specified period of time, if ever. Special Committee on Regulatory/Procedural Matters devoted to Resolution 18 (Kyoto, 1994) Rapporteur Group SC-4, "Report to the Special Committee", 25 November, 1996. ITU document file name:054_e_43.doc at 14.

[287] Paralysis, supra note 285 at 189

coordinate with systems that exist only on paper. The quasi-spurious nature of a filing is not always obvious and thus acts as an unfair deterrent to others who may think their ventures impracticable because of the filing for fictitious use. The result of coordination negotiations could be a false compromise in which the earlier fictitious system is "modified" in exchange for a real concession by the other Administration. The filing and coordination procedures have become congested by the administrative procedures triggered by frivolous filings. Systems once established do not always conform to the parameters indicated in the notification filed.

The filing of multiple orbit positions per satellite creates an excessive burden for both the administrations and the RRB and adds to the complexity of coordination making it sometimes impossible to complete. An interesting proposal (made as part of the Resolution 18 review but which was not adopted as it did not achieve unanimity)[288] suggested that administrations should be required to submit a single filing with specific alternative positions for each satellite. Following launch the positions not occupied would be relinquished.

The issue of overfiling was addressed at the World Radiocommunication Conference (WRC) 1997 and a concept of administrative due diligence was adopted. The concept of administrative due diligence aims at reducing the number of 'paper satellites' by requiring the disclosure of information that becomes available as the system approaches completion, inter alia: the names of the spacecraft manufacturer and satellite operator, the name of the launch vehicle

[288] Some Administrations felt that the proposal would lead to an increase in multiple filings and that the due diligence procedures would be a better way of resolving the issue.

provider, the contractual date of delivery and the number of satellites procured, and the contractual launch date.[289] The concept of financial due diligence was also explored without being endorsed at WRC-97 and the matter is sure to be raised by some delegations at the next Plenipotentiary Conference.

PART III. RECENT DEVELOPMENTS WITHIN THE ITU

A. Direct Broadcast Satellites

The World Radiocommunication Conference held in 1997 (WRC-97) was concerned with a replanning of the Broadcast Satellite Service. The 1977 WARC-BS plan for Regions 1 and 3 was widely perceived to be obsolete due to the changes in the use and nature of the services offered today.[290] The associated technical criteria for the new plan have not, however, yet been agreed. An "Inter-conference representative group" is undertaking studies to consider the possibility of nearly doubling the number of channels reserved per country to a minimum of 10 analogue channels, based on national coverage. Should this expansion be feasible a conference will be convened before 2001 to replan on that basis. Capacity for future sub-regional systems should also be taken into account and allocated the necessary amount of spectrum. The results of these studies will be submitted at WRC-99 where it will be decided whether a replanning conference should be convened.[291]

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[289] http://www.itu.ch/newsroom/press/releases/1997/itu-20.html
[290] http://www.itu.ch/newsroom/press/releases/1997/itu-20.html
[291] If the delegates at WRC-99 decide that a replanning conference should be held, it should be convened "no later than 2001."

The notion of 'prior consent' was not incorporated. The need for the Administrations originating the broadcasting services to obtain the agreement of the Administrations receiving the services was affirmed, but not made mandatory.

The use of the Fixed Satellite Service bands for Direct-to-Home television broadcasting has raised some conflicting opinions. When the two services FSS and BSS were defined as separate services, there were large technical and operational differences between the two services. Today, as a result of technological convergence, the differences are very small. Some observers wonder if the present distinction between the services is still required. The Report on Resolution 18 concluded that "[While] from a technical viewpoint, the BSS and FSS are often difficult to be distinguished, administrations generally have different regulatory provisions for these services, therefore the present distinction between the two services should be maintained."[292]

B. Global Mobile Personal Communication Services

The decision to allocate a segment of spectrum to the Mobile Satellite Services, taken at WRC-92, spurred serious development of little and big LEO satellite systems.[293] This initial impetus was followed in 1995 by more substantial allocations to these services. The WRC-95 provided additional spectrum to little LEOs below 1 GHz. The Big LEO systems also received encouragement as the date of entry into service of their systems was brought forward from 1 January 2005 to 1 January 2000. Appropriate transitional procedures are to be implemented in order to

[292] Report on Resolution 18, supra note 233 at 13 (section III 11.2)
[293] http://www.itu.ch/newsroom/press/releases/1995/itu-95-31.html

facilitate the move to alternative frequencies while protecting existing systems. Feeder links for the MSS were allocated 400 MHz of band to be shared with the Fixed Satellite Services on a basis of equality. 'Broadband' satellites that shall operate in the band designated for Non-Geostationary Satellite Orbit Fixed Satellite Services (NGSO FSS), received 400 MHz of spectrum in the 19 and 29 GHz bands.

This trend continued at WRC-97, which allocated new spectrum bandwidth for the Mobile Satellite Services, while taking into account the rights of existing services. The little LEOs operating below 1GHz gained 1-3 MHz to the allocation of these services on a Regional basis. Additional spectrum was also allocated to the 'Non-Geostationary Fixed Satellite Service' (NGSO FSS) in the Ku (12-18 GHz) and Ka (27-40 GHz) bands. This will allow three NGSO FSS systems, Teledesic, SkyBridge and Celestri, [294] to begin system construction and deployment. Teledesic and Celestri, for whom the 400 MHz of spectrum previously allocated at WRC-95 was deemed insufficient, sought this additional spectrum allocation. SkyBridge's needs for spectrum allocation in the Ku band were also satisfied at WRC-97. Finally, the date of entry into use of spectrum allocation to NGSO FSS was brought forward so that these systems may now begin operation on 1 January 2002 instead of 2005. The NGSO FSS allocations are subject to strict power limits so as not to compromise other services operating in those bands.

GMPCS-Memorandum of Understanding

On 18 July 1997, the signatories and potential signatories of the Memorandum of Understanding on GMPCS (GMPCS-MoU) agreed on the first set of

[294] The status of Celestri's project is unclear since Motorola has decided to join the Teledesic venture.

arrangements relative to Global Mobile Personal Communication Services.[295] The *Arrangements Pursuant to the GMPCS MoU to Facilitate the Introduction and Development of Global Mobile Personal Communications by Satellite (GMPCS)* (hereafter referred to as the "Arrangements"), agreed upon at the Third Meeting of Signatories and Potential Signatories of the GMPCS-MoU, 6-7 October 1997, have a four-fold objective.[296] The Arrangements provide the framework for the facilitation of mutual recognition of type approvals[297] of GMPCS Terminals[298] (Article VI.A[299].6 of the Arrangements). The Arrangements also provide for simplified licensing of GMPCS Terminals (Article VI.B of the Arrangements)[300] as well as the identification (marking) of GMPCS Terminals (Articles VI.A.5, 6 and VI.B.3). The fourth objective of the Arrangements concerns access to traffic data by authorized national authorities;[301] the data is to be provided 'within a reasonable period of time' to any authorized national authorities. The traffic data to be provided to such authorities does not include confidential customer information, except as provided by national laws and regulations (Article VI.C.4). Article VI.D[302] of the Arrangements is a request for administrations to recommend to their

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[295] ITU Press Release of 25 July 1997, "Landmark decision adopted to translate the promises of future global mobile personal communications by satellite (GMPCS) into reality", available on the Internet at http://www.itu.ch/ne wsroom/press/releases/1997/np-05.html

[296] Ibid. at 1

[297] Type Approval is the process by which conformity of GMPCS Terminals with regulatory technical requirements is assessed (see Article IV.12)

[298] A GMPCS Terminal is defined as the user terminal intended to be operated with a GMPCS system (see article IV.8 Arrangements); it thus refers to the handset or briefcase format device used by the consumer.

[299] GMPCS-MoU articles 1 and 3

[300] GMPCS-MoU Article 2

[301] GMPCS-MoU Article 5

[302] GMPCS MoU Article 4

competent national authorities to implement customs procedures aimed at facilitating unrestricted trans-border movement of GMPCS terminals.

The role of the ITU in relation to the GMPCS-MoU

The Union is the depositary of the Arrangements, (Art. VII.3) and is to maintain a list of the standards and specifications used for type approval, keep track of how the Arrangements have been implemented by signatories, and other entities that have notified the ITU that they have implemented these Arrangements (Art. VII.4). The ITU shall publish a list of all entities that have implemented the Arrangements in full or in part, the GMPCS systems authorized in each country and a list of the GMPCS that have been granted type approval indicating the granting countries.

C. Global Navigation Satellite Services

The World Radiocommunication Conference of 1997 did not permit the expansion of the MSS bands in the bands currently allocated to aeronautical and maritime navigation systems. Expansion was opposed by the civil aviation and maritime communities and thus it was decided that further studies into sharing possibilities between the two services are to be undertaken.[303] The future deployment of the Global Navigation Satellite System that will operate in these bands and safety implications were also considered. The studies will set the technical criteria as well as the operational and safety requirements to determine

[303] ITU press release of 21 November, 1997 available at http://www.itu.ch/PPI/press/releases/1997/itu-20.html

whether sharing a portion of the band with MSS is feasible for consideration by a future WRC to be held before 2000.

CHAPTER III. POSSIBILITIES FOR THE FUTURE

PART I. CRITIQUE OF CURRENT REGIMES

The need for an international authority for spectrum and orbital management is clear; without institutionalized international coordination and control international communications would doubtless "soon descend into chaos".[304] The structure and functions of the ITU and the regulatory regime governing allocation of the orbit-spectrum resources have been given in the previous chapter. This chapter reviews some of the major criticisms of the current regime regulating the orbit-spectrum resource and also examines some suggested alternatives to the existing regime.

A. General Regulatory Regime.

As detailed in chapter II, a direct result of criticism of the "first come, first served" general regulatory regime and corresponding demands for equitable access was planning of the orbit-spectrum resource in the BSS and FSS "expansion bands".[305] Despite valid criticism, the time sensitive registration scheme does present certain advantages over planning of the orbit-spectrum resource. One clear advantage, for the users of the resource, is that the general regulatory regime is flexible.[306] Indeed, the only constraints limiting freedom of use are guidelines on interference and coordination; in all other respects the satellite operator is free to choose the orbital

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[304] D.M. Leive, International Telecommunications and International Law: the Regulation of the Radio Spectrum, (Dobbs Ferry, N.Y.: Oceana Publications, 1970) at 284

[305] J.C. Thompson, "Space for Rent: The International Telecommunications Union, Space Law, and Orbit/Spectrum Leasing" (1996) 62 J. Air L. & Comm. at 293

[306] F. Kosmo "The Commercialization of Space: a Regulatory Scheme that Promotes Commercial Ventures and International Responsibility" (1988) 61 Southern California L.R. at 1062

position and associated frequencies which best suits its purpose within the appropriate service allocation.[307] This scheme is also characterized by efficient use of the orbit-spectrum resource since the latter is exploited only according to existing and real needs.[308] Plans, in contrast, either allot or assign non-transferable positions and associated bandwidth to individual countries regardless of their ability to use them; these reserved satellite positions are then left vacant (or warehoused), leading to waste and inefficiency in the management of the resources.[309]

The general regulatory regime also encourages development of new technology whereas plans, especially inflexible plans such as WARC-BS 1977, lock the use of the assigned positions into inherently dated and obsolete technical parameters.[310]

Finally, the pragmatic scheme permits exploitation of the orbit-spectrum resource at no cost to those who utilize it. While this last observation may be seen as an advantage, it has also been criticized because it is argued that a resource with a clear economic value is being given away for free with the rent being "captured" by the user.[311] It is also argued that free access to outer space resources is likely to lead to inefficient use of the space resources.[312]

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[307] M.L. Stern "Communications Satellites and the Geostationary Orbit: Reconciling Equitable Access with Efficient Use" (1982) 14 L. & Pol'y Int'l Business at 865.
[308] It may no longer be realistic to claim that the number of filings reflects true need, given the number of "frivolous filings" since 1994. See Report on Resolution 18, supra note 233.
[309] The orbit-spectrum resource is a non-depleting resource and when it is not used it is wasted, see Wiessner, infra note 322 at 150
[310] Stern, supra note 307 at 871
[311] E. Steinberg & J. Yager, *New Means of Financing International Needs* (Washington, D.C.: Brookings Institution, 1978) at 27
[312] A.G. Vicas "Efficiency, Equity and the Optimum Utilization of Outer Space as a Common Resource" (1980) 5 Ann. Air & S. L. at 590; see also Wihlborg & Wijkman, infra note 336 at 38.

The principal drawbacks of the general regulatory regime have been detailed in chapter II, namely the fact that the "first come, first served" regime favors early entrants while penalizing late entrants, and risks the monopolization of the orbit-spectrum resource by industrialized nations.[313] The right of all countries to equitable access to the orbit-spectrum resource, as stipulated in Article 44 of the ITU Constitution, is not perceived as being adequately protected by the general regulatory regime. However, the burden-sharing requirements, incorporated in the "improved procedures planning" of WARC-ORB '85-'88, removes the responsibility for coordination from resting solely on late-comers.[314]

B. Planning

Planning of the orbit-spectrum resource can be effected through a gradation of flexibility, from rigid to flexible planning, as is observed by comparing the existing plans. Planning may consist of a rigid plan assigning specific orbital positions, bandwidth, and service areas to individual countries, on a basis of non-transferability. The WARC-BS plan of 1977 is such a plan, and has been criticized for its inflexibility.[315]

A number of concepts may be used to introduce flexibility to *a priori* plans. Flexibility, from a technical perspective, may be achieved by granting permission to choose an orbital position within a "pre-determined arc". The concept of pre-determined arc allows more flexibility than the stricter assignment of specific

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[313] Kosmo, supra note 306 at 1063
[314] After the Space WARC, supra note 249 at 260
[315] See Report on Resolution 18 and After the Space WARC, supra note 249 at 112. It should be noted that the use of the pre-determined arc concept makes the WARC-ORB an allotment plan as opposed to an assignment plan.

positions.[316] Technical flexibility may also be realized through the concept of "generalized parameters" which permits a range of systems which, as long as they respect the generalized parameters, can be introduced without requiring coordination.[317] *A priori* plans may also be designed to provide for procedures allowing flexibility by permitting uses other than those specified in the plan on a non-interference basis. RARC-BS 1983 introduced flexibility by allowing systems not conforming to the plan to operate on an "interim basis". These are allowed to operate only with the accord of Administrations whose assignments would be affected.

The main advantage of planning portions of the orbit-spectrum resource is that it achieves the guarantee of equitable access in practice.[318] This guarantee comes at the price of efficiency in use of the resources, as it does not necessarily lead to economical multi-service satellites.[319] Smaller countries may find that it is not viable to consider systems for national coverage only, and the existing plans make the creation of regional or sub-regional systems difficult. Indeed the Report on Resolution 18 states that "[Most] of the broadcasting by satellite today is done using the FSS bands with the BSS bands largely unused". This occurred because the economic viability of broadcasting increases with the size of the service area and bandwidth available and the BSS plan modification procedures make it more difficult to achieve than by simply using FSS bands.[320] Moreover, as planning reserves portions of the resources for future use to guarantee equitable access, the portions of

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[316] After the Space WARC, supra note 249 at pp. 235 and 298
[317] Ibid. at 316. Both the concept of pre-determined arc and that of generalized parameters are present in the RARC-BS of 1983.
[318] Report on Resolution 18, supra note 233 at 5.
[319] Ibid. at 13.
[320] Ibid.

the resource reserved for those without space-faring capability are wasted until the assignments are exercised.[321] Plans that reserve portions of the orbit-spectrum resource are thus a source of inefficiency since a precious resource that could otherwise be used is unavailable.[322] Finally, any *a priori* plan risks obsolescence even before its entry into force, although it is possible to mitigate this weakness by creating flexible procedures that allow for the introduction of new systems and also by establishing generalized parameters.

C. Need for Change

The use of outer space and outer space resources is intensifying, not only for services relying on the geostationary orbit, but for all services and many orbits. The requirement for more spectrum space to accommodate this explosion in demand was evident at WRC-97. While it is true that technological advances permit the use of an ever-greater portion of the radio frequency spectrum, it is not evident that such advances alone will be sufficient to accommodate future needs.[323] Moreover such technology is affordable only to the richest of the space-faring nations.

There is, therefore, a need to identify a means by which greater efficiency in use of the orbit-spectrum resource may be achieved while respecting the principle of equitable access. As observed previously, two principal methods of orbit-spectrum management have been employed in the past: the time sensitive registration scheme (*a posteriori*) and planning (*a priori*). Those methods, as outlined above, favour

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[321] This is also referred to as the "warehousing" of frequencies.

[322] S. Wiessner "Access to a Res Publica: the Case of the Geostationary Orbit" (1986) 29 Colloquium L. Outer Space at 150

[323] Report on Resolution 18, supra note 233 at 5, reports that calculations indicate that the theoretical capacity of the orbit and the spectrum is greater than the number of transponders currently in orbit.

efficiency over equity or equity over efficiency, as the case may be, without achieving both goals equally. A number of proposals aimed at achieving both objectives have been advanced and are discussed in the following part.

PART II. ALTERNATIVE REGIMES OF OUTER SPACE RESOURCE MANAGEMENT

A. *A priori* planning with transferable rights

One proposal to achieve greater efficiency while respecting the goal of equitable access calls for the establishment of a "pre-assigned slot system" (i.e.: *a priori* planning) to guarantee access to orbital positions and frequencies for all countries. Countries which could not yet utilize their designated portion of the resource could "rent" the assignment and thereby fund their own space technology development, or use the funds for other purposes.[324] This scheme would create transferable property rights in outer space resources. A situation similar to this proposal could result if other countries follow the actions of Tonga and also lease national assignments.

This scheme would present the advantages of permitting greater efficiency in the use of the geostationary orbit and associated radio resources while at the same time guaranteeing access.[325] By creating a transferable right, this scheme avoids the

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[324] T.A. Hart "A Review of WARC-79 and its Implications for the Development of Satellite Communications Services" (1980) 12 Lawyer of the Americas at 457. Robinson, supra note 282 at 51, observes that while an initial auction would be preferable to an "equitable" (negotiated) distribution between countries, the "more important efficiency of allowing subsequent sale or exchange of rights" in such a system justifies the sacrificing the efficiency of auctions.

[325] Ibid. at 458

main drawback of planning, specifically the problem of "warehoused" slots would be reduced as they could be utilized, albeit at a price. It is further argued that equitable access is achieved not only through the apportionment of the resource to countries but also through the rents collected, since the revenues from leasing would permit funding for development in telecommunications aiding those countries in their quest to access and utilize the resources.[326]

A priori planning with transferable property rights has been criticized on several points. The principal objection is that it would create in effect sovereign claims over portions of the geostationary orbit contrary to the prohibition of Article II of the Outer Space Treaty.[327] By identifying and granting rights of use to orbital positions, including the right to lease such positions, a permanent property right is created and some initial international allocation of the resource on a "fair" basis would have to be negotiated.[328] This would therefore lead to a political struggle over the apportionment of the resource.

M.L. Stern notes that there would be difficulties in its implementation, as the existing planning regimes link orbital position and associated frequencies to particular service areas. Under the current structure the country could rent its assigned position only for transmission to its own territory which is often an unviable market.[329] This does not appear to be an insurmountable obstacle as it could be possible to create a plan which does not link the orbit-spectrum with restricted service areas.[330] It is also possible to

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[326] Ibid.
[327] The Outer Space Treaty is discussed in Chapter I.
[328] Stern, supra note 307 at 882.
[329] Ibid. at 881
[330] Ibid.

allow for greater flexibility in *a priori* planning, as illustrated by WARC-ORB 1985-1988 and the RARC 1983.

B. *A priori* planning with international leasing

This model is similar to that previously described in that it envisions prior planning of the outer space resources. This model specifically attempts to marry efficiency with equity by calling for an initial allotment, on a consensus basis, of options to use orbital positions and associated bandwidth to each country.[331] This allotment would be periodically revised to respond to technological changes, demand and territorial configurations. An option would be exercised through actual use of the assignment for which the option was held. Unexercised options would remain with the international community to be leased through an auction process conducted by the RRB or some other designated competent organization.[332] During the period of the lease the right to exercise the option would be suspended. Revenues from leasing the unexercised options would accrue to the international community and could be used to promote transfers of technology.

This proposal presents many advantages over the previous model: the problem of extending national sovereignty into outer space through permanent *a priori* planning is reduced because an appropriately mandated international organization, not countries, is vested with the ownership of the resource. The sovereignty problem is

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[331] Ibid.

[332] Here, again, where the author has suggested that the old IFRB be given the mandate to hold such auctions, its newer counterpart the RRB could be similarly charged with such a function.

further reduced because the options to use the resources are subject to periodic reviews, which, as internationally negotiated arrangements, should safeguard the principle of equitable access. The options to use do not constitue unexercised property rights as the object of the option is not a specific slot but a right to access guaranteed by modifiable plans. By providing for specific "option-allotments" to countries this scheme satisfies equitable access *de jure*, and by providing for technology transfers it will hopefully lead to equal access *de facto*.[333]

The *a priori* planning with international leasing model also solves the problem of warehousing frequencies and positions by allowing for a mechanism by which all the resource can be used without creating a system that would introduce national sovereignty to outer space.

This regime may be criticized for creating the potential for continued, even institutionalized, international political struggle over the division of the outer space resources through the mechanism of periodic revision of the plan.

C. International Fee and Taxation Schemes

Another scheme proposed to ensure greater efficiency in the use of the orbit-spectrum resource is that of charging a fee for licenses granted.[334] Alternatively, a taxation scheme based on the amount of spectrum used has been suggested. Ownership of the resources would be vested in the international community, either under the umbrella of an existing organization such as the ITU or under the

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[333] Wiessner, supra note 322 at 151.

[334] Brown, Cornell, Fabian, Weiss, "Regimes for the Ocean, Outer Space and Weather" (Washington, D.C.: Brookings Institution, 1977) at 194.

jurisdiction of a new organization similar to the International Maritime Organization in its governing of the exploitation of deep-sea resources. The user fees could take the form of a flat licensing fee or else be established through competitive bidding system (auctions).

Whatever the method of revenue collection, these revenues could be used to reduce international inequities through projects coordinated by the ITU Telecommunication Development Sector,[335] primarily to help poorer countries bid for spectrum resource needed for their projects. This, it is argued, would promote greater efficiency by encouraging some telecommunication operators to switch to alternative technologies such as cable or fibre optics.[336] This is based on the assumption that satellite operators currently have the free use of a valuable commodity, and consequently invest more in satellite communications than if they had to pay for their use as they do for the real estate needed for ground-based telecommunications.

The proponents recognize that this scheme would "significantly increase the cost of operating satellite systems" and it would therefore be difficult to gain the support of space-faring nations.[337] Moreover, without a market mechanism, there is no objective way to calculate the value of the resource on which the fee or tax would be based.[338] A tax or user fee established at an arbitrary level might unduly discourage space ventures by being placed too high, inversely a tax set too low would not maximize the "free-rent" revenues captured.[339] Moreover, asks Robinson, how

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[335] As the original concept was outlined before the creation of the Telecommunication Development Sector, it suggested the creation of a similar international development fund.
[336] C.G. Wihlborg & P.M. Wijkman "Outer Space Resources and Equitable Use: New Frontiers for Old Principles" (1981) 24 J. Law and Econ. at 24
[337] Brown et al, supra note 334 at 195.
[338] Robinson, supra note 282 at 41; see also Wiessner, supra note 322 at 150.
[339] Wiessner,.supra note 322 at 150

would the tax mechanism itself be established and controlled? Would all countries have equal voting rights, or would the voting rights be weighted as they are in INTELSAT? The authors postulating this type of regime of international ownership do not provide answers to these questions. Finally, this proposal does not address the real goal of the concept of equitable access: actual access to space resources. It is legitimately argued that the term equitable access refers to actual access to and use of outer space resources and not just the international redistribution of wealth envisioned by this scheme.[340]

D. Market models

A number of jurists have identified and described various possibilities of introducing "market-based allocation schemes" to govern the allocation of orbit-spectrum resources. It is posited that the application of the general principles of market economy to the allocation of orbital positions, frequencies and service areas results in greater efficiency.[341] In fact, proponents of market models suggest that "[Any] effort to impose frequency management must be built on a recognition that the frequency spectrum is an economic resource in no significant way different from the mass of other resources available to society."[342] And the best way to achieve efficiency is by using market value as the important criterion in deciding how the spectrum should be used.[343] Though it is recognized that operation of markets is not

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[340] Ibid.
[341] R.H. Coase "The Federal Communications Commission" (1959) 2 J. Law & Econ. at 18. While this article was concerned with American national regulation of the spectrum, the arguments made are generally applicable with respect to the international regime of spectrum allocation.
[342] W.H. Meckling "Management of the Frequency Spectrum" (1968) Wash. U.L.Q. 26
[343] Ibid. at 28;

without cost nothing indicates that it would be more expensive than the current regime of allocation by administration.[344]

Another proposal resembles the "*a priori* planning with international leasing" model examined above. It envisions the creation of an international condominium in which each country would have a stake and a share of the revenues. However the market proposal envisions the creation of transferable property rights in the orbit-spectrum resource on a more comprehensive scale. While the second proposal would cover only certain designated bandwidths or radio services, Wihlborg and Wijkman insist that a market system can be efficient "only if it includes all the resources that substitute, or complement, each other."[345] The authors argue that as there is close substitutability between different parts of the spectrum, a "total allocation regime" including the ground segment frequencies should be implemented, subjecting the whole spectrum to market forces. Further, they argue against any planning, pointing out that "the number combinations among all these variables[346] is immense" and to restrict choice through an *a priori* plan is to limit the possibilities of use. This argument also supports their call for the divisibility of tranferable rights, in terms of frequency and geographic divisibility.[347]

Their argument for definite term leases lasting a period equivalent to the satellites operational life is well based. It would be difficult, however, to obtain

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[344] Coase, supra note 341 at 18
[345] Wihlborg & Wijkman, supra note 343 at 30
[346] The variables come into play when choosing the space resources for utilization by a space venture are signal strength, size of antennae, weight of satellite, precision in direction of signal, precision in use of frequencies, the length of time a frequency is used, and choice of orbit.
[347] Wihlborg & Wijkman, supra note 343 at 30-31

international support for indefinite leasing even though it might lead to a more effective market mechanisms. Indefinite leasing would effectively convey a title of ownership to the lessee.[348] An innovative suggestion is to do away with the existing regulatory constraints relating to interference, and replace them with a "well defined and enforced regime of liability for damages caused by interference."[349]

Under this proposal resources are put to most efficient use and rents are maximized by the use of auctions, an impartial way of gaining access to outer space resources, for those who can afford to participate in them.

The main advantage of this proposal resides in the distinction made between the allocation of user rights and the distribution of rents, with only the distributive (rent) aspects being subject to political negotiations. The user rights to the resources would be distributed efficiently via market mechanisms, while all countries would receive their "share" and benefits through their stake in the condominium. This scheme would not provide for true equitable access in the sense of guaranteeing a right of future use, but would instead allow for transfer of wealth. There would be an international political struggle at the initial apportioning of condominium shares, resulting in a distribution of rents designed to conform to the principle of equitable access.[350]

One drawback of market models is that the flexibility and efficiency they offer risk engendering a loss of global, or even regional, standardization and uniformity in

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[348] Wihlborg & Wijkman, supra note 343 at 31
[349] Ibid. at 33
[350] Stern, supra note 307 at 881

the use of the orbit-spectrum. For this reason market models advocate the continued regulation of services for safety and "public good services".[351]

E. ITU Stock Market

The most ambitious proposal to introduce elements of market economy to the allocation of orbit-spectrum resources envisions the creation of an "ITU stock market" on orbital slots.[352] This scheme advocates the distribution of the orbit-spectrum shares currently in use to all existing satellite operators. Orbit-spectrum shares not currently in use would be sold by the ITU as a privatization action. By the author's count there are approximately 600 orbital slots, each slot consisting of an orbital position, related frequencies and service area.[353] The role of the ITU would be to serve as a clearing-house for the unrestricted sale and purchase of orbit-spectrum rights, after accomplishing this "privatization" of the outer space resource. The "clearing-house" would receive a fee on transactions which could be applied to telecommunications development.

The creation of such an ITU stock market would permit an easier flow of capital to the "capital starved satellite industry".[354] The ultimate result, argues Rothblatt, would be greater practical utilization of slots to the benefit of the consumers. The fees or "value tax" which ITU could claim in its role as clearing-

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[351] Wihlborg & Wijkman, supra note 343 at 39
[352] M.A. Rothblatt "New Regulatory Ideas and Concepts in Space Telecommunications" (1992) 20 J.Space L. at 27
[353] Ibid.
[354] Ibid.

house would be used to support the ITU and global telecommunications development.[355]

This proposal does not, aside from supporting global telecommunications development, make any provisions to safeguard equitable access. It would permanently entrench the advantage industrialized countries have by distributing the resources to those who already have rights of use and "privatizing" those not in use; for that reason alone, it is unlikely to be acceptable to the international community. This plan, like other market models, would not maintain international uniformity in the use of the frequency-spectrum.

PART III. NEW TECHNOLOGIES

A. DBS

The Broadcast Satellite Service plans are currently in the process of being re-planned, following WRC-97. Studies are under way to determine the feasibility of nearly doubling the minimum number of channels available to most countries. This expansion appears somewhat paradoxical in light of the fact that the BSS plans are largely unused. As stated earlier, the reason underlying the use of FSS bands for direct satellite broadcasting, instead of the planned BSS, is that the BSS plan modification procedures make it difficult to obtain the increases in bandwidth and service area necessary for economic viability of broadcast satellite ventures.[356]

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[355] Ibid.
[356] Report on Resolution 18, supra note 233 at 13.

A possibility of correcting this problem of unused spectrum could be to retain the planning regime while introducing elements of flexibility to it. In addition to the concepts of flexibility introduced in past plans, such as the notions of pre-determined arc, interim systems and use on a non-interference basis, other concepts of flexibility might prove useful. In particular the plan could be designed so as to more easily allow for regional broadcasting systems by permitting transferability of allocations. Given that direct broadcasting satellites have coverage of roughly a third of the globe, plans linking frequency bands and orbital positions to specific service areas (national territories) cause inefficiency. The inefficiency is the result of the satellites signal illuminating an area larger than the country or territory that it is intended to serve, the inefficiency is thus entrenched. Satellite operators have so far avoided this problem through the use of FSS bands for direct broadcasting services.

A mechanism facilitating assignments for multinational direct broadcasting ventures is required. The mechanism, or mechanisms, should permit either inter-governmental ventures or purely commercial ventures. What is most important is the possibility to accumulate the necessary outer space resources (i.e. bandwidth) and allow for broadcasting to a number of different countries. Perhaps changes in the global political environment since the end of the Cold War have reduced fears of DBS being used for "propaganda" purposes, weakening resistance to international broadcasting.

Drawing upon the alternative regimes previously described, One could envisage the creation of "space options" as described by Wiessner. Options to use BSS positions established by the forthcoming replanning could either be exercised, or

auctioned by the ITU. Successful bidders could accumulate the necessary outer space resources necessary for their ventures and thus reap the benefits of serving larger, multinational markets. The proceeds from the auctions could be allocated to programs of the Telecommunications Development Sector.

B. GMPCS

The issues presented by GMPCS systems are different from those presented by DBS. Low Earth Orbit and Medium Earth Orbit GMPCS systems are inherently global in nature. The challenge is to permit these systems to fulfill their potential as global systems through a coherent international legal structure. The GMPCS-Memorandum of Understanding is a step in the right direction. It will allow for global roaming (movement between different service areas), internationally recognized standards and set in place a basic framework for use and standardization world-wide if it is accepted and respected by the majority of States.[357]

Curiously, there has been no international outcry for guaranteeing equitable access in practice to MEO or LEO as there was for the geostationary orbit. Perhaps this is because there are, as yet, no operational GMPCS systems.[358] Or perhaps the commercial nature of the proposed systems operators does not arouse as much apprehension as state sponsored ventures.

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[357] There are currently 77 signatories to the GMPCS-MoU, the list is available on the Internet at http://www.itu.int/GMPCS/gmpcs-mou/final/sign/

[358] Iridium launched 72 satellites and commercial services should be provided according to plan, as of September 23, 1998.

C. GNSS

Though the USA and Russia have both offered to provide satellite navigation services free for 10 and 15 years respectively, a number of concerns continue to stall acceptance of these offers. There are fears that use of these systems would lead to dependence on the provider-states and that, following the shut-down of domestic terrestrial navigational equipment, the end of the "free-use" periods would give the provider states great bargaining power. Also, the systems are owned, controlled and managed by the defense administrations of each country. Further, the services can be interrupted, or in the case of GPS downgraded, at the discretion of the provider state, without prior warning.[359]

These concerns have led, within the International Civil Aviation Organization's Future Air Navigation System (FANS) II Committee, to discussions about the institutional aspects of such a future navigation system. In particular, elements of ownership, control and management of the system and its components have been discussed.[360] The FANS committee views positively an international navigation system owned, controlled and managed by an international organization similar to INMARSAT.[361] And politically such an organization must be seen as ideal as ownership would be held internationally and there would be no need to implement institutional elements for the control of national air traffic services. It has been suggested that the only organization with a broad enough mandate to encompass all

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[359] S.A. Kaiser, "Aeronautical Satellite Navigation: Civil Aviation's Needs and Institutional Alternatives" (1994) 37 Colloquium L. Outer Space at 8.
[360] H.K. Shin & S.K. Hong "Legal Aspects of Space Activities of ICAO in Implementing FANS" (1993) 36 Colloquium L. Outer Space at 98 ff.
[361] Kaiser, supra note 359 at 29.

GNSS uses is COPUOS.[362] However, ICAO is the most active international organization involved in discussions concerning GNSS. The central role of ICAO towards the implementation of long term GNSS was recently endorsed at the first CNS/ATM Systems Implementation Conference held at Rio de Janeiro in May 1998. That same conference underlined its support for the adoption of the draft Charter on the Rights and Obligations of States relating to Global Navigation Satellite System Services as an interim legal framework for CNS/ATM systems, as well as its intention to consider development of a draft international convention for the purpose of a long-term legal framework.[363]

[362] Larsen, supra note 161 at 36.
[363] http://www.icao.int/icao/en/nr/pio9803.htm

CONCLUSION

The technologies of concern to this thesis remain, at the time of writing (1998), in their incipient stages of development. Direct Broadcasting by Satellite is the most advanced of the three technologies yet remains governed by a legal regime established over two decades ago. It can be argued that the Cold War circumstances of that period gave strength to arguments for the alleged sovereign right of each state to control information entering its territory. Those circumstances having changed; the time is right to press for greater freedom of international information exchange. In this era of globalization of trade and commerce, it makes sense to promote more flexible frequency and orbital position plans either along the lines of the proposals highlighted in the final chapter or simply through more flexible *a priori* plans. This would allow broadcasting by a single satellite operator to several countries.

The first Global Mobile Personal Communication by Satellite system, Iridium, remains on schedule for commercial operation beginning September 23, 1998. More similar systems will soon follow. While the GMPCS-Memorandum of Understanding attempts to establish conditions conducive to realizing the potential of this technology, for the moment it remains a work in progress. What is required is an international agreement to all states. It is also likely that GMPCS technology will give rise to unforeseen legal problems that fall outside the scope of the GMPCS-MoU and that additional regulation shall be necessary. Furthermore, while the GMPCS-MoU has garnered impressive international support and interest by 77 countries, this

number still falls short of the ultimate goal: the creation of truly global mobile wireless communications.

Of the three technologies discussed, perhaps the one with the most far-reaching potential and possibilities is Global Navigation Satellite Systems. The establishment of GNSS would revolutionize all modes of transportation by air, sea, and on land. The gains offered in terms of economic efficiency, navigational precision and, most importantly, in terms of safety, are already clear. However, the fact that the current satellite systems used to provide such services are operated by the defense administrations of two countries is an enormous hindrance to the acceptance of either as a global system. The enormous cost involved in launching and operating GNSS systems means it shall be some time before a civil GNSS is exclusively installed. An appropriate legal and economic framework for civil and commercial uses of GNSS is also required.

The International Telecommunication Union will continue to play an increasingly important role in the regulation of the three technologies. The orbit-spectrum resource is not yet saturated but there are portions of it which have been under pressure for over a decade. As more diverse space applications emerge, and consequently use of the radio spectrum is increasing, technological advances alone may no longer be able to accommodate global radio-communication needs. It will then be necessary to modify the current legal regime governing spectrum and orbital slot allocation to provide more efficient use of these limited resources by adopting an

international regime resembling one of the proposals outlined in the third chapter of this thesis.

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