Three Decades after Early Bird: Global Communications Satellite Services and Emerging Regulatory Issues

by

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ABSTRACT

Four fundamental principles constitute the basis of international regulations pertaining to the operational aspects of telecommunications, and communications satellites in particular. Firstly, provision of global distress and safety service should be provided globally on a priority basis. Secondly, global telecommunications coverage and connectivity should be achieved. Thirdly, basic telecommunications services should be established within every national jurisdiction, including developing areas, and should be accessible to all individuals. Finally, universal access to telecommunications services on a non-discriminatory basis should be guaranteed.

Similar to the era which introduced the first telephone and radio communications devices over one hundred years ago, the emergence of new communications and information technologies, and global satellite system proposals in particular, are triggering a world-wide socio-economic structural change. Numerous countries currently find themselves in the heart of a major transition period which is leading them into the electronic information age. The dramatically new environment is characterized not only by more effective and reliable communications devices, but also by increased competition, deregulation and privatization of traditionally government owned and operated services.

At the outset, governments have not only chosen to foster and closely regulate the development and operations of communications satellites, but also to maintain management oversight by cooperatively establishing two unique consortia, namely Intelsat and Inmarsat. This international regulatory framework, which currently continues to oversee the operational aspects of global satellite services, is essentially comprised of the Intelsat and Inmarsat Agreements adhered to by numerous member states. This framework was established a few decades ago at the inception of commercial fixed and mobile satellite services, and has not been structurally reviewed despite the changing global environment.

Considering that the prime objective of international agreements is to ensure that the world community adheres to the principles outlined above, this thesis examines the relevance of the current regulatory framework at the dawn of the information age.
A growing number of governments may be rewriting their own role in the operational aspects of communication satellites for the future, as they review this framework to address the challenges of the emerging environment nearly three decades after the launching of the first commercial satellite, Early Bird.

RÉSUMÉ

Quatre principes constituent les fondements du cadre réglementaire international qui régit les aspects opérationnels des télécommunications globales et, plus particulièrement, des communications par satellite. Premièrement, les services de détresse et de sécurité devraient être offerts globalement sur une base prioritaire. Deuxièmement, chaque État devrait être desservi par des services de communications par satellite, lui assurant ainsi une liaison avec tout autre État. Troisièmement, des services de télécommunications essentiels devraient être établis à l'intérieur de chaque juridiction nationale, incluant les régions en voie de développement, et devraient être accessibles à tout individu. Quatrièmement, le réseau mondial des télécommunications devrait être accessible universellement de façon non-discriminatoire.

Avec l'émergence de nouvelles technologies de communication et d'information, et plus particulièrement des systèmes de satellites globaux de communication, de nombreux pays se situent actuellement au coeur d'une période de transition extraordinaire qui les mène vers l'ère de l'information à support électronique. Cette période est caractérisée non seulement par l'invention de moyens de communication plus efficaces et fiables, mais également par un accroissement de la compétitivité, de la déréglementation et de la privatisation de services traditionnellement fournis par les gouvernements.

Dès l'arrivée des télécommunications par satellites, les gouvernements choisirent d'incuber et de réglementer diligemment les aspects opérationnels de ce type de service en créant coopérativement deux consortiums, Intelsat et Inmarsat. Ce cadre réglementaire international, qui assume encore aujourd'hui le contrôle global des aspects opérationnels de la plupart des services de communication par satellite, est essentiellement fondé sur les accords constitutifs de ces deux consortiums auxquels ont adhérés de nombreux États.

Considérant que l'objectif premier des accords internationaux est de promouvoir auprès de la communauté des nations le respect des principes stipulés ci-haut, cette thèse examine la pertinence du cadre réglementaire actuel à l'aube de l'ère de l'information. De nombreux gouvernements ont entamé la révision de leur rôle dans les aspects opérationnels des services de communications par satellite, et analysent actuellement les modifications à apporter à ce cadre réglementaire global afin de mieux répondre aux défis que leur propose le nouveau contexte mondial quelques trente ans après le lancement du premier satellite commercial de communications surnommé Early Bird.

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I would like to thank Dr. Ram Jakhu, my thesis director, for his council and support in helping me prepare this thesis. I would also like to thank the friends and colleagues who have provided the necessary aid in overcoming the obstacles for completing the research for this paper.

I would like to dedicate this thesis to my family and very best friends, as well as to the women and men who, by daring to establish increasingly effective global communications systems, have been helping to create a better environment for us all.

Table of Contents

Introduction

In 1888, telephones had to be linked by a single wire and were only available in sets of pairs; without the advantage of central switching stations or anyone else to talk with except the person at the other end of the line, these first telephones were essentially considered to be expensive toys.[1] In 1901, the first transatlantic radio signal was transmitted from England and received at Signal Hill in St-John's, Newfoundland; this led to tremendous excitement, although commercial exploitation of the invention was not to be undertaken for a few years.

In 1964, the newly created International Telecommunications Organization (Intelsat), consisting of a consortium of eleven countries, launched "Early Bird", the first international communications satellite system later re baptized as "Intelsat I".[2] At that time, Intelsat's project was generally regarded as nothing more than the beginning of another scientific experiment.[3] Few people realized that this launch was actually the start of a rapidly paced information and communications revolution, which would fuel a global economic revolution as well.

Today, three decades after the launch of this satellite which provided only 240 telephone fixed satellite channels, innovative information processing and

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1 Rens, J.G., L'empire invisible: histoire des télécommunications au Canada de 1846 à 1956, Presses de l'Université du Québec, Québec, Canada, 1993, p. 89.

2 The Intelsat Agreement entered into force on August 20, 1964 for 11 countries, although 14 countries had signed the Agreement. The membership had grown to 68 by the time the first Plenipotentiary Conference met in 1969 to consider definitive arrangements, and to 83 by the time the definitive arrangements came into force in 1973. By the end of 1994, 136 States were members of Intelsat.

3 Astrain, S., *Global Overview of Satellite Communications*, The INTELSAT Global Satellite System, Progress in Astronautics and Aeronotics V. 93, American Institute of Aeronotics and Astronautics, New York, New York, 1984, p. 2.

telecommunications technologies are signaling yet another period of profound and unprecedented structural change. These technologies, integrated into terrestrial and space systems, will enable the provision of highly sophisticated and seamless personal and broadcast communications services in the near future.

As stated by the International Maritime Satellite Organization (Inmarsat), which is proposing such a personal communications service , "it is by no means science fiction to predict that before the end of the century we will be offering cheap, reliable, high quality communications between anything that moves and virtually any other point, fixed or mobile, on the face of the Earth"[4]. These versatile communications systems would not only be a welcome convenience to users, but would certainly provide them with a competitive advantage in business applications. These proposed systems, along with other emerging terrestrial communications technologies, are precursors of a profound structural change which will markedly affect the way societies think and live.

The pace of the introduction of such services, however, can be greatly influenced by the framework which regulates the public and private organizations which are planning to deploy new and powerful systems which can deliver these services. Governments, investors and scientists are sufficiently disconcerted with the difficulty of finding and securing the appropriate frequency allocation to deploy a new radio-based service without causing interference to existing systems. Additional operational hurdles imposed by a seemingly dated regulatory framework are difficult to justify in an environment increasingly characterized by more competition leading to more power and sophistication at decreasing costs, as well as changing national policies and business trends. Many traditionally government owned and operated services in world markets are being

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4 Gibson, R., *Nation Shall Speak Unto Nation: The Worldwide Role of Satcoms*, Never Beyond Reach: The World of Mobile Satellite Communications , Inmarsat, 1989, p.15.

deregulated and privatized. The rapid convergence of telecommunications, broadcasting and information processing technologies is leading many countries to the threshold of a new period in history, which is becoming known as "the information age", and within which the new satellite communications infrastructure is bound to play a key role.

This thesis examines the operational aspects of the current international regulatory framework as they impact upon the introduction of a particular satellite service. Indeed, emerging technologies provide the essential blueprint elements of various new mobile satellite communications systems which are currently proposed for launching by several organizations. Some of these systems have been developed by American companies, and are currently being reviewed by the U.S. Federal Communications Commission (FCC) for approval.[5] Although these proposed systems can be distinguished by various levels of quality, bandwidth utilization and types of services provided, much attention has been directed to the service providers which intend to offer global satellite service directly to consumers as an extension of their cellular telephone service. The consumers would access the service with portable hand-held terminals, thereby ensuring full voice and data communications mobility wherever the service would be available. It is important to note that even if the services were technically available on a global basis, they must be authorized within every national jurisdiction to be actually accessible. It is therefore no surprise that the first international mobile telecommunications provided by Inmarsat were available originally only for the maritime community, generally outside national jurisdictions.

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5 By 1993, applications to provide Mobile Satellite Service (MSS) and Radiodetermination satellite service (RDSS) have been filed by the following corporations : Constellation Communications Inc. ("Aries") , Ellipsat Corporation ("Ellipso"), Loral Qualcomm Satellite Services ("Globalstar"), Motorola Satellite Communications Inc. ("Iridium"), TRW Inc.("Odyssey"), and American Mobile Satellite Corporation (MSat). Celsat Inc. ("Celstar") has also indicated an intention to file an application to use MSS/RDSS bands. For further details, see Report of the MSS Above 1 GHz Negotiated Rulemaking Committee, Federal Communications Commission, USA, April 6, 1993.

Since the inception of telecommunications, however, national governments have cooperatively established universal principles which have been further defined with the emergence of newer technologies. These principles constitute the foundation of international telecommunications law. They also serve as a basis for the formulation of the regulatory framework, which oversees the technical and operational aspects of system developments and the provision of global telecommunications services.

The most important technical principle, as briefly refered above, stipulates that every country should take the necessary measures to avoid causing harmful interference to any other radio-based system by a radiocommunications device operating under its jurisdiction . The avoidance of harmful interference essentially requires appropriate world-wide coordination of radio frequency allocation for signal transmission, orbital position management and device standardization, which are the responsibility of the United Nation's International Telecommunications Union (ITU).[6] The technical regulatory framework, which ensures the application of this telecommunications principle, is currently being aggressively reviewed by the international community, and although important to mention, is not included in the scope of this thesis.

This thesis focuses on the operational aspects of the telecommunications regulatory framework which apply to communications satellites in particular. At the outset, it is important to note that this operational framework is based on fundamental principles which

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6 There has been increasing criticism in the later part of the 1980's denouncing the ITU's growing inability to efficiently address certain challenges of changing technology, as well as shifting policy and business requirements around the world. This has led to the decision by ITU members in 1989, to revise its structure and decision making process. The result was the redrafting of the ITU Constitution and the revision of its Convention, which have both been ratified by a number of countries, including Canada. See Warren, G. *The Enhanced Participation of Users in the ITU,* Remarks by the Chairman of the ITU High Level Committee at the Policy Forum of Telecom 92, Acapulco, April 7, 1992; see also Tomorrow's ITU: The Challenges of Change, Report of the High Level Committee to Review the Structure and Functioning of The International Telecommunications Union (ITU), Geneva, April 1991.

are embodied in various international legal instruments, and which in this is defined and grouped for the purpose of this analysis as follows:

a) the provision of distress and safety telecommunications services should be ensured globally;

b) global telecommunications coverage and connectivity between countries should be achieved;

c) basic telecommunications services should be established within every national jurisdiction, including developing areas, and shoud be accessible to all individuals; and

d) universal access to telecommunications services on a non-discriminatory basis should be garanteed.

This thesis analyses the continuing relevance of the regulatory framework which oversees the operational aspects of global satellite communications, and which was cooperatively established by governments a few decades ago during the inception period of commercial fixed and mobile communication satellite services. Considering that the prime objective of the established framework is to ensure the continued achievement of objectives set out in the four principles outlined above, governments not only chose to regulate satellite operations, but also to cooperatively establish the unique global service providers, namely Intelsat and Inmarsat, and to continue to maintain management oversight on the two global consortia. The regulatory framework remains, therefore, comprised essentially of the Intelsat and Inmarsat Agreements, which define the rights and obligations of the numerous country members which are party to these global satellite communications providers.

The main question in this paper addresses the possible adjustments which may be required to the operational aspects of the global regulatory framework in order that governments may continue to fulfill their obligation, pursuant to international law, to ensure the continued adherence to these principles in the future information age environment. This review has become necessary, not only because governments regulate the provision of satellite communications through their membership in these consortia, but more importantly, because other private and public organizations are deploying their own global service systems. Through the Intelsat and Inmarsat consortia, governments are the *de facto* regulators while they oversee the management of the only global systems still nearly forty years after the beginning of commercial satellite communications, in addition to also maintaining, in certain cases, a stake in their ownership. At a time when other public or private organizations are ready to enter the global satellite services market, the regulators, which also own and operate the only current global systems available today, may be seen as impeding upon the fair competitive process.

Chapter 1 presents an overview of the historical milestones of developments in terrestrial and space telecommunications which led to the deployment of global satellite communications, and thereby establishes the general context in which the universal principles noted above have evolved. Chapter 2 reviews these principles which have shaped international satellite communications, with particular attention given to their respective foundations in various elements of international law. Also analyzed are the operational aspects of the current international regulatory framework, which provides the rights and obligations of governments which use the major satellite communications systems - namely Intelsat and Inmarsat. Chapter 3 analyzes the innovative trends in telecommunications technology and system development, as well as the emerging global economic and political context, which define the current transition period and the future environment. Also examined are the emerging issues resulting from the consequences of maintaining the regulatory framework established for the inception period of satellite communications. This regulatory framework is losing its relevance in a structurally different context and certain essential elements should be revised to address the challenges of the future. It is important to determine what changes to the existing Intelsat and Inmarsat structures are necessary or desirable in the light of changing telecommunications and information industry conditions, the increasing competitive environment and the growth in communications satellite services and markets.

This satellite infrastructure which provides global telecommunications is the product of various factors. These include the inventive genius of the scientists who continue to develop the trend setting technologies, the visionary and entrepreneurial spirit of public and private organizations which deploy the systems, as well as the cooperative involvement of governments which formulate the regulatory framework at international and domestic levels in order to foster the continued enhancement of telecommunications systems. As Sir Donald Maitland, Chairman of the 1985 ITU Maitland Commission, recently stated, experience suggests that certain forms of regulation are necessary if the potential benefits of telecommunications are to be fully realized.[7] This thesis assumes that the fundamental principles will continue to be recognized and respected by the international community as the basis of international telecommunications law, as governments review their role by reformulating the international satellite communications regulatory framework to meet the challenges of the future.

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7 The Changing Role of Government in an Era of Deregulation, ITU Colloquium No.1 Briefing report: Options for Regulatory Processes and Procedures in Telecommunications, ITU, Geneva, May 1993, p. viii.

Chapter 1 Satellite Communications: A Historical Overview

The telephone became the first device which enabled ordinary people to communicate instantly with each other beyond the reach of a scream. Although telephones were initially considered to be scientific curiosities or luxury conveniences, it soon became clear that the more the general public would be connected to the telephone network, the more the telephone would become as an essential communications device.

Governments in many countries came to appreciate the critical importance of telecommunications as an enabling technology, making it possible for a wide range of industries to reach high levels of productivity while also serving important non-economic national needs for information and communication.[8] From the outset, regulators established a form of control over telecommunications within their territory. This was essentially motivated by military strategic considerations, national control objectives[9], as well as by the recognition that an adequate telecommunications network could fuel economic growth in regions where telephone services became available. Most governments established publicly owned and operated telecommunications organizations, with the major exception of the United States which opted for private sector service provision under a complex system of regulatory oversight.

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8 The Changing Role of Government in an Era of Deregulation, ITU Colloquium No.1 Briefing report: Options for Regulatory Processes and Procedures in Telecommunications, ITU, Geneva, May 1993, p. viii.

9 For example, television broadcasts could easily be controlled and censored throughout certain Arab states with the deployment of Arabsat. Reeckie, D.H.M., MSAT Program Applications Engineer, Department of Industry Canada, Interview August 15, 1994.

At the international level, governments also held discussions leading to bilateral and multilateral agreements, which were necessary to address prime common concerns such as the avoidance of harmful interference by radio devices. Very early on, the establishment of connectivity between telecommunications systems of every country as well as global coverage became key objectives, which were later carried through by Intelsat and Inmarsat. Governments also established protocols ensuring that the provision of international distress and safety telecommunications services remain an imperative priority. It was only later, in the early 1960s, that the deployment of telecommunications services in developing areas also became a priority for the world community.

This chapter provides a historical overview of the emergence of telecommunications technologies and systems, and establishes the general context in which the fundamental principles reviewed in Chapter 2 have evolved. The first section of this chapter offers a brief overview of the invention and commercial deployment of the telegraph, telephone, and radio systems, as well as other information processing technologies. Automatic switching stations and effective long distance transmission have enabled the integration of local terrestrial networks, which were implemented throughout vast territories. This eventually opened the door to an increasingly universal access to telecommunications for the general public within most industrialized nations, while providing the earthwork for satellite communications. The second section examines the emergence of satellite systems and their contribution to the general telecommunications infrastructure.

1.1 Terrestrial Telecommunications and Information Processing Technologies

This first era in the history of telecommunications, which has provided the necessary base for the successful deployment of satellite communications, can be clearly divided into two different periods, namely the inception of telecommunications, which was followed by the introduction of integrated networks as the basis of universal communications systems.

1.1.1 The Inception Period: The Emergence of Revolutionary Devices (1844-1915)

The true adventure of telecommunications began in 1844 with the invention of the telegraph[10], which was linked to the developments of electricity [11]. Very early on, researchers sought ways to harness electricity to transmit information, but the various devices were highly complex and impractical. It was Samuel Morse who developed a brilliantly simple binary code[12] which bears his name. He also introduced the principle of simplicity to telegraph equipment, which incorporated a single wire to transmit coded information. The first inter-city communication in the world was established by Morse

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10 The concept and word designating the telegraph first appeared towards the end of the XVIIIth century. It referred to systems which would transmit visual signals through semaphore. This communications apparatus was essentially used by ships.

11 In 1801, The Italian physicist Alessandro Volta developed the first electric batery. In 1820, the Danish physicist Hans-Christian Oersted demonstrateed that an electrical current could generate a magnetic field. Telegraphy actually became the first commercial application of electricity - before the electric lamp, the phonograph and the telephone, which were to appear almost simultaneously three decades later. See Rens, J.G., op. cit., p. 9.

12 Certain observers believe that Morse's code may may very well be a distant ancestor of the codes used in the powerful computers of today.

between Baltimore and Washington in 1844. The messages sent that day demonstrated the usefulness of the forefather of our telecommunications infrastructure: grieving family members were advised that a close relative did not die as originally speculated; a bank confirmed that a particular cheque was sufficiently covered with funds; and the US government was first to receive the results of the Democratic Convention in Baltimore. However, the very first transmission that historic day was a quote from the Bible :"What Hath God Wrought!". [13] The telegraph offered essentially fixed point to point communications, and required messengers at each end of the wire to hand-deliver or re-transmit the text to complete the link between correspondents.

The British Empire had established its strength on the power of the written word transmitted over long distances. In 1870, it inaugurated the London-Calcutta line of 11 000 km, which was to remain operational for half a century to the satisfaction of its users.[14] European governments have generally assumed the responsibility of deploying and operating the telegraph infrastructure within their territory. Notwithstanding budgetary considerations, they would claim that telecommunications must remain a public service rather than a commercial one, which was the approach adopted by the United States. This government-operated public service, however, was perceived by certain American observers to be a form of a political instrument.[15] In the USA, Morse had failed his attempts to sell his invention to the government, consequently offering the rights of his inventions to entrepreneurs. From that moment on, the development of

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13 See Bertho, C., Télégraphes et téléphones, de Valmy au microprossesseur, Livre de poche, Paris, 1981, p. 60.

14 Stumpers, F.L.H.M., *The History, the Development, and the Future of Telecommunications in Europe*, IEEE Communications Magazine, New York, May 1984.

15 Libois, L-J., Genèse et croissance des télécommunications, Masson, Paris, 1983, pp. 25-26.

telecommunications in the United States has remained essentially the work of the private sector.[16]

The telegraph nonetheless became, over a short period, the most effective means of communication of its time throughout North America and Europe. These two continents, however, opted for two very different implementation approaches and both regions also displayed quite different penetration levels of service. North America showed less enthusiasm for the use of the telegraph in comparison to Great Britain and Europe. In 1866, the North American network consisted of 120 000 km of wire, while the European countries and their colonies' telegraph systems sprang to over 500 000 km.[17] It is interesting to note that this discrepancy is not related to North America's misevaluation of the importance of communications, but rather because the telegraph on that continent was confronted with the rapid development of a competing technology - the voice carrying telephone.

Alexander Graham Bell and his collaborators persisted in wanting to make a telegraph wire speak. After tenuous research efforts, they finally discovered the means to send and receive sound transmissions electrically over a wire which linked two telephones.[18] In 1876, driven by a clear vision of how this device could have a global impact on society,[19] Bell was ready to unveil his still primitive technology at the Universal

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16 Sharlin, H I., The Making of the Electrical Age. From the Telegraph to Automation, Abelard-Schuman, London,-New York- Toronto, 1963, pp. 9-17.

17 Rens, J.G., op. cit., p. 65.

18 This was a logical preoccupation for the inventor and third-generation speech therapist who taught elocution and vocal physiology at Boston University. Surtees, L, Pa Bell - The Meteoric Rise of Bell Canada Enterprises, Random House, Toronto, 1992, p. 58.

19 In a letter to his father, Bell wrote: "I think I may have found the solution to a big problem - and the day will come when telegraphic wires will link houses together like water and gas - and where friends will be able to talk with each other without having to leave the house". Letter from Graham Bell to his father, Melville Bell, March 10, 1876, Archives of Bell Canada.

Exhibition in Philadelphia, where the United States centennial was being celebrated. One year later, the world's first experimental one-way long-distance telephone message was made from Brantford to Paris, Ontario, over 14 km of rented telegraph company lines. This further stimulated business interest in Bell's patents. At that time, however, telephones were only available as a pair and had to be linked by a wire. Customers did not have the benefit of central switching stations, and were unable to talk with anyone else than the person at the other end of the line.

As important as the invention of the telephone itself, was the introduction of the first manual telephone switching station in 1878. In New Haven, Connecticut, twenty-one subscribers were linked to a central point where operators ensured that the requested connections were established. This major technological innovation was a catalyst for the telephone, which had suddenly ceased to be a scientific curiosity and was on its way to becoming a popular communications tool. Unlike the telegraph which would require special operators, the telephone was a technology which was going to be used by the general public.

The telephone system was, thereafter, vigorously promoted to a curious world by a new breed of marketers, who had quickly understood the paramount principle of telephone economics: that the value of the telephone (and the price charged for the service) grows in direct proportion to the number of other telephones a subscriber can call. A rapid implementation of these switching stations followed in the next months across North America. The development of switching technology has ever since been the subject of extensive research.[20]

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20 Surtees, L., op. cit., pp.58-103.

The first commercial long-distance link between two large cities was established by the Bell Telephone Company in 1884 between Boston and New York. Realizing that the operation of long-distance services would bring a definite strategic advantage over future competitors, the company created a subsidiary, the American Telephone and Telegraph Company (AT&T), which was to develop the long-distance network. The new company's incorporation statutes clearly express the powerful vision of universal service which epitomized the driving force of its leaders at that time:

> The lines within this association ... will link one or more points in a city, town or locality within the State of New York to points within each city, town or locality in the United States, Canada and Mexico ... as well as link these points by cable or by any other appropriate means to the rest of the known world.[21]

Bell had left the company he helped found in 1880. He continued to help defend his patents, which required his presence in approximately 600 law suits. When he died in 1922, there were 13 million telephones in operation in the world.[22]

While wire telecommunications technologies were being refined, the beginning of the century also witnessed the birth of "wireless" devices.[23] Indeed, a complementing key element to future telecommunications systems was the radio communications experiments, which were initiated by Guglielmo Marconi. The young entrepreneur had become interested in the discoveries of Heinrich Rudolph Hertz, a German physicist, who a few years earlier had created and radiated electromagnetic waves. For the young

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21 AT&T, Incorporation documents, 28 february 1885, translated by Author from a French translation presented in Rens, J.G., op. cit., p. 157.

22 Rens, J.G., op. cit., p.93.

23 The first radio communications devices were refered to as "wireless", as opposed to the more popular telephones which had to be linked together by a wire to ensure communication.

Marconi, this was the germ of an idea: if electromagnetic waves created by a device could also be detected at a distance, could these waves not be used for signaling? He assembled a few electrical components into what became known as a transmitter and a receiver. In 1894, he was successful in transmitting cricket-like sounds so that they could be "heard" by a receiver more than a kilometer away. This experiment marked the beginning of wireless telegraphy.

Once Marconi was capable of transmitting coded signals through the air, he was challenged to overcome what was considered to be a major weakness in wireless telegraphy: how could two or more stations operate at the same time without their signals overlapping and interfering with each other? He invented a tuner which would send signals at different frequencies, thereby eliminating radio interference and clearing the way for many stations to operate simultaneously in the same region. However, if wireless telegraphy was to be a commercial success, a more sensitive and stable means of reception had to be found, as well as appropriate amplifiers and oscillators, in order to help manage the traffic, and thereby ensure that messages would be clearly transmitted to their destination.[24]

By the end of the century, scientists were busy understanding how to harness electromagnetic energy. In 1899, the English Channel was bridged by the successful transmission of messages sent across by the Hertzien radio waves. Marconi was ready for his biggest challenge: transatlantic communications. In 1901, notwithstanding diverging

24 In 1897, J.J. Thompson, an English physicist, demonstrated the true character of the electron as the smallest particle of the electrical structure of the atom. The electron was the key to a new age in electrophysics and, unsuspected by veterans of wireless, it was a key to a vast new world of radio. First, however, some new tool had to be found to generate electrons, liberate them, amplify and control then, and put them to work, thereby creating the science of electronics.

theoretical discussions on how radio waves travel once they have been generated [25], he crackled out the first radio message to span an ocean: the three Morse code dots forming the letter "s". The message, which was flashed from Poldhu, England, was heard in Newfoundland, Canada, 3,000 kilometers away.[26] In 1902, following a full year of experimentation, a commercial transatlantic service was organized between Canada and England. Three months later, the London Times published the first news, which it received by this method from overseas. For the general public, however, nothing had really changed. It would be necessary to wait a few years before sending private messages between Europe and North America.

If dots and dashes could be transmitted over the waves, experimenters wondered if they could also use similar techniques to transmit spoken words and music. Envisioning a wireless telephone system which would primarily ensure point to point communication, Reginald A. Fesenden succeeded in demodulating the first radio-voice transmission in 1900. One year later, he applied for a U.S. patent covering "improvements in apparatus for wireless transmission of electromagnetic waves, said improvements relating more especially to transmission of words and sounds".[27] In 1906, voice messages crossed the Atlantic using an improved wireless telephone transmitter and receiver.[28] In 1927,

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25 Refering here to the science of propagation, at that time, many observers were sceptical with regard to Marconi's proposed experiment. It was considered impossible to transmit signals further than a certain distance on Earth, essentially because of the Earth's curve: waves, after all, travel in a straight line like sound and light, and would ultimately take the direction of Space. Marconi thought that, to the contrary, waves would follow the surface of the Earth. Each of these theories was partially wrong: in reality, radio waves are actually propagated in straight lines, heading towards space, but waves at certain frequencies may be redirected back to Earth thanks to the reflective layers of the ionesphere which envelops the planet.

26 Kites were used to increase the effective height of Marconi's antennas to optimize chances of receiving the telecommunicated message.

27 Surtees, L., op. cit., p.62.

28 In 1906, Fesenden had also invented the true radio broadcast variety show, as we know it today with singing and story telling. Because he had asked people who heard the broadcast to write to him, he had also inadvertedly invented audience ratings. This new technology developed into two distinct industries -radio telephony and radio broadcasting. Radio and television in this paper are examined

transatlantic radio voice telephone service would begin between New York City and London, relying at that time upon conventional amplitude modulation (AM) radio for signal transmission.

Initially, radio communications technology was applied in systems which helped to dramatically improve the safety and distress services at sea. With transmitters and receivers installed on board ships and at coastal locations, mobile communications became established. In the first years, however, system compatibility problems restricted connectivity between all ships and land stations; many deaths at sea could have been averted if common interconnection standards had been in place to ensure that neighboring vessels could receive S.O.S. signals and respond effectively. The most well known example was the sinking of the Titanic, in 1912, where rescuers were not alerted early enough because their equipment was not compatible with the ship in distress. Immediately thereafter, the question of connectivity of radio communications was addressed by political leaders and scientists; they were determined to remedy the situation rapidly.

Like Morse in 1844 and Bell in 1876, Marconi and his contemporaries were driven by a vision. They did not limit themselves to scientific experimentation or technical innovation. They were going to make an impressive mark with the implementation of their new technology, which at the time must have been considered to be absolutely fantastic. The scientific and technological adventure led by researchers would eventually be superseded by the skills of public and private sector entrepreneurs, who ensured that the telecommunications networks became increasingly accessible to the general public. However, during these early years, the numerous manual telephone exchanges were

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from the point of view of radio telecommunications technology exclusively. The history of radio broadcasting is a whole different universe, predominated essentially by programming content.

linked to each other in an artisan fashion, and long distance lines were still the exception, offering poor quality and highly expensive service. Until the First World War, the telephone was still perceived to have primarily a local and community application.

1.1.2 The Beginning of International Connectivity and Universal Access (1915-1960)

As early as 1915, telephones became increasingly available on a routine basis. This inaugurated a period which may be characterized by the development of networks, which conferred to these telephone devices an increasing importance as more people were provided with the ability to communicate with one another.

During this period, the concept of the network was established. This generated fortunes for the telephone service providers, while also providing the general public with the beginnings of universal access to effective local and continental long distance telephone services in a limited number of countries. "It is more the system established in connection with the telephone, than the telephone itself, that makes the value of the telephone". This statement exemplified the entrepreneurial vision of AT&T's President Vail during one of the numerous patent court cases at the turn of the century.[29] This understanding of the economic importance of the network led to the rapid expansion of the industry, particularly in long distance telephony. This expansion was essentially stimulated by the extraordinary improvements in two important areas: the enhancement of quality voice transmission over the wires and radio waves, and the development of automated call routing and billing through improved electronic switching mechanisms.

29 Schlessinger, et al., Chronicles of Corporate Change, p.6, as cited in Surtees, L., op. cit., note 36, Chap 3.

These improvements helped solve the original problem in long distance communications. Indeed, because of the characteristics of signal propagation over wires or radio waves, the transmitted signal would normally fade after a certain distance. This was corrected by key innovations, which include the triode vacuum tube repeater relay, later followed by the highly miniaturized and sturdier transistor, which would reamplify the signal at regular intervals so as to permit transmission over longer distances. The development of coaxial cable and related undersea cable technology, as well as microwave transmission systems which incorporated these relays, were also instrumental in establishing longer links throughout and between continents. In addition, to enable the transmission of numerous messages simultaneously over the same wire or radio signal, a multiplexing process was introduced so that these messages could be modulated and transmitted together so that they may then be retrieved distinctly by different receivers.

These innovations contributed to enhancing the quality and reliability of electronic transmission, as well as augmenting dramatically the transmission capacity of numerous simultaneous conversation channels over the same signal. Finally, in order to allow growing traffic on an increasingly complex network of wires and waves, while still ensuring that messages reached their expected destinations, automatic call routing and billing devices were incorporated into switching systems as an essential element in the development of telecommunications.

Furthermore, network transmission requirements took on a new dimension with the invention of television. Early television signal transmission for wide area broadcast could only be ensured if the signal was distributed to local broadcasters via the telecommunications network. At that time, without the benefits of any signal compression technology, the delivery of a television signal would require a minimum transmission capacity equivalent to many telephone lines transmitted simultaneously over the same system.[30]

Other scientists also made outstanding contributions which helped pave the way for many new services, including satellite systems. Convinced that radio wave technology was too powerful a force to be limited to the carrying of messages, experimenters began to test new applications. For instance, if radio could spread across the world, its beams should be able to reach out like fingers on a long arm and activate remote control apparatus on ships, planes and even certain weapons at any distance. Remote control was born. In 1898, Nikola Tesla had fitfully controlled a model boat in a tank at a distance using a wireless device. As early as 1912, John Hays Hammond established the principles of radio-guided missile control. These technologies would later become essential to ensure the successful launching and orbital positioning of satellites.

Another important contribution to the future information age was mobile telephony for land vehicles, which constituted a significant scientific challenge throughout the first half of the century; cost constraints usually restricted its use to certain specialized activities.[31] At that time, miniaturization became possible with the fairly cumbersome vacuum triode, which permitted mobile telephone terminal size reduction to a certain extent. In 1946, true mobile service made its debut, when mobile radio users in St-Louis, Missouri, were linked to the land-line telephone network. Within a year following the issuance of a FCC license to AT&T for that operation, mobile telephone service was being offered in more than 25 cities. However, it was not until the invention of the transistor, in 1947, that mobile telephone terminals could become both portable and reliable through

30 Television signal transmission required 2,8 million cycles per second (or 2,8 MegaHertz), whereas a telephone line enabling the two-way transmission of voice would require 3400 Hertz.

31 Examples include police, ambulances and journalists.

of the increased miniaturization and sturdiness offered by this new semiconductor technology. Initially, mobile telephones operated on a single frequency.

Following a rapidly growing demand for FM-based service in the post-war era, two-way mobile radio service providers had also appeared. The transmission method employed in mobile communications at that time was a single, high-powered radio transmitter fastened to a tower broadcasting a signal across a large geographic area. A simple scanning system was then introduced, permitting multiple usage over a single network interconnection site. Call set-up was necessarily slow. The only feature on the mobile was an identification for incoming calls.[32] With this method, each call required a separate frequency. Despite refinements to this mobile phone system, technical difficulties persisted. As a two-way communications system, the "one tower - one frequency" approach had serious shortcomings.

Moreover, the concept of cellular telephony had been conceived in the late 1940's, but had not become commercially viable until much later in the 1980's. Technological limitations placed several constraints on a mobile carrier's ability to provide services.[33] The requirement to exchange various network control signals was only implemented in the 1980's, when sophisticated cellular services were introduced,[34] only to grow at an exponential rate.[35]

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32 Reeckie, D.H.M., op. cit.

33 A maximum of 44 channels were allocated by the FCC to mobile service and only allocation of additional radio spectrum could overcome the capacity limits of the system hardware. However, it was not until 1970 that, under pressure from mobile service providers, the FCC allocated 115 MHz to new mobile services, including 50 MHz of spectrum within the 800 MHz ultrahigh frequency (UHF) radio band for telephone common carrier services.

34 The first commercial cellular system in the USA begins operations in Chicago in 1983.

35 The dynamism in the cellular industry has been spurred in large part by subscriber growth. Such rapid growth is expected to continue in the near term as cellular coverage expands across North America and prices go down.

Throughout the first part of the century, the key inventions discussed in this section contributed to the beginning of universal access to public telecommunications networks in certain areas of heavier traffic. Early on, these interconnecting networks rapidly replaced the cluster of community exchanges which had been originally linked together manually .[36]

Although the telephone and the radio communications device did evolve since Bell, Marconi and Fesenden first spelled out their theories, the increasingly integrated network of transmission and switching equipment, which remained the central focus of telephone company activities, would continue to undergo the most profound technological metamorphosis throughout most of the century.

In retrospect, it is now clear that this series of inventions have been developed with the support of innovative marketing and management approaches, as well as with the establishment of the domestic and international regulatory frameworks. These elements have certainly provided a solid foundation without which satellite communications would not have been possible.

1.2 Communications Satellites

This section offers an overview of the first thirty years of satellite communications activities. The basic concepts of satellite systems are briefly described, followed by the

36 A collection of community exchanges does not constitute a true network. To phone far away, one would have to be connected manually through a multitude such exchanges, which would make the establisment of the communication long and problematic. The telephone had originally been conceived as a local technology and a few more years would be necessary before administrative structures of companies actually ajusted to the potential of this new technology.

definition of fixed and mobile services provided in these early decades, which lead to the establishment of Intelsat and Inmarsat. In order to provide satellite communications services, a coordinated and cooperative involvement of governments at domestic and international levels is required. These satellite services are analyzed with a view to presenting the context in which the current global regulatory framework was formulated. Finally, the present satellite communications infrastructure is examined as it appears three decades after the launch of Early Bird, which, as noted, was the first commercial communications satellite. Particular emphasis is given to certain advantages provided by satellite communications services and to the role they play within the present global infrastructure for telecommunications service provision. The question as to whether satellite communications currently provide a complement or competition to terrestrial systems is also addressed.

1.2.1 Emergence of Satellite Communications: Fixed and Mobile Services

The story actually began in 1945, when Arthur C. Clarke, an officer in the Royal Air Force, wrote a paper entitled "Extra Terrestrial Relays", which described an idea for a worldwide communications system using man-made satellites placed at a specific distance from Earth so that it would revolve above the globe in a seemingly stationary position, and would be visible from almost half of the Earth's surface.[37] Three of these satellites at an altitude of 36,000 km in geosynchronous orbit, carrying signal repeaters spaced 120

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37 Clarke, Arthur C., "Extra-Terrestrial Relays", Wireless World, Feb 1948. The original article was published May 25, 1945 under title "The Space-Station, its Radio Applications", reproduced in Telephone Engineer & Management, Chicago, June 1, 1984. Clarke did some calculations to see whether the amount of power required to transmit from the satellite was within the realm of reason. The answer was positive; he figured a transmiter of approximately 50 watts or so could be adequate. He had also calculated the necessary sensitivity of the receiver on the satellite, the directivity of its antenas, and so on. These answers were all available from the radar technology that grew out of World war II-- a technology to which Clarke himself had contributed.

degrees from each other, could supply the planet with all international telephone and television which was at that time carried terrestrially over microwave links.[38]

By the late 1950s, terrestrial-based telecommunications were seen to have certain limitations. Accessible telecommunications services were spreading into vast regions throughout Europe and North America. However, continental[39] and overseas[40] service availability had been irregular despite technological breakthroughs, and had essentially penetrated regions of heavier demand and higher returns on investment. Important to note is the fact that less economically developed areas within the two continents, as well as other large regions in the world, remained generally deprived from access to international communications for many years.

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38 See McLucas J. L., Space Commerce, Harvard University Press, Cambridge Massachusetts, 1991, p. 20. Clarke's paper attracted little attention at that time. The satellites he designed were highly impractical in light of available technologies. His system actually required manned space stations to keep the transmitters operating, and also necessitated large supplies of vacuum tubes, power supplies and tools, not to mention a complete habitat to support the crews for several years at a time. For many reasons, it seemed that the system he describerd could not be put into space any time this century - a situation he did not fail to point out. Little did Clarke know, that just three years later, Bell Laboratories would announce the invention of the transistor, and many hitherto impractical ideas like unattended, long-endurance satellites would eventually become possible.

39 In a continental perspective, by the end of the second world war, transcontinental telephone links had been in place for decades as more people began calling long distance, with microwave towers were installed on hilltops to accomodate the growing traffic. However, terrestrial microwave links provide line of sight communications for up to 30 kms, beyond which repeater or relay stations are required. Because of topological irregularities on the earth's surface, including oceans, mountains and forests, microwaves are not particularly useful for certain long distance links or overseas communications. Once directed through the ionosphere, the information loaded beams pass right through it without being reflected back to earth.

40 Calling overseas during the pre-satellite period was a different matter altogether. Marconi had established the first radio links between Europe and North America in 1915, but despite many improvements, communications by radio were usually unreliable, noisy and highly expensive. Short waves were not reliable because of their degradation when exposed to sun rays, and were limited as to the quantity of information they could carry. Service was so poor that very few people bothered to try calling overseas unless it became a matter of life and death - or if the investment was justified by the competitive business edge the telecommunications link would provide. Another means of communicating between continents was the underseas cable. The major drawback was its limited capacity. In the early 1950s, the existing cables were designed to handle 36 telephone calls at any one time - and no television at all. See McLucas J. L., op. cit., p. 19.

As traffic grew, with increasing demand for long distance telephone and television signal transmission, the question was how to accommodate the increasing volume. Should more undersea cable be laid and additional microwave transmitters be erected to garnish our landscape, or should satellite systems be seriously considered as radio wave relays installed in space? How to build them, place them into orbit, keep them there and ensure that they would provide clear and reliable signal transmission were quite the challenging questions at that time.

The Space Age truly began with the launch of Sputnik and Explorer satellites by the Soviet Union and the United States, in 1957 and 1958 respectively. These satellites were small crude repeater devices placed in subsynchronous orbit.[41] They carried instrumentation for electromagnetic wave propagation tests and other scientific experiments in space, and had little to do with solving our communications problems. However, these events clearly identified space as a unique environment, opening the door to a whole new field of technology by demonstrating that satellites could be used for practical applications as well as for scientific exploration.

Although certain countries were at first preoccupied with the military significance of the initial launchings of satellites, it soon became apparent that the most important strategic use of space was a place from which to view activities around the globe and gain

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41 The space age began on october 4, 1957, when the Soviet Union surprised the scientific community by launching the world's first artificial satellite into orbit, Spoutnik 1. See Government of Canada, Spacebound, op. cit., p. 9. The first communications satellites launched in the usa were produced for the military. Score was developed by RCA and launched piggyback on an Atlas rocket in december 1958 into a low nongeosynchronous orbit. It contained a receiver and a tape recorder to receive and store a message from the ground during one part of its orbit; it then relayed the taped message via the satellite's transmitter to a ground station below, far removed from the point of origin. Score transmitted a recorded christmas greeting from president eisenhower to the world and lasted two weeks before its batteries died. There was also an immediate retransmission capability, but the store-and-repeat mode was the most useful for military purposes. This experience enabled the US defence department to create a world-wide communications network between 1966 and 1968. See Rens, J.G., op. cit., tome 2, p. 336.

invaluable intelligence, with the support of "eyes in the sky". Because of the overriding strategic importance of military operations during the "Cold War", it was not possible to consider space as just another place to do business - let alone consider developing a communications network as a commercial venture without government national security approval. However, the military organizations conducted successful communications experiments in space, which stimulated the imagination of both governments and the telecommunications industry alike.

The first satellite communications experiments used passive reflectors in orbit, thereby temporarily avoiding the problems of developing electronic relay devices and power supplies that would work reliably in space.[42] Major telecommunications companies joined government agencies to study and tame the behavior of radio waves on the passive satellites. By the early 1960s, space technology had developed sufficiently to permit the design of active satellites carrying power supplies and transponders that could receive signals imbedded in microwave beams from earth stations, amplify them, and relay the information further.[43] These microwave beams carried television signals or tens of thousands of telephone conversations from a fixed earth station to the satellite where they were re-routed to another earth station also in its line of sight. In 1962, an American

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42 Launched in 1960, the US Echo project deployed 30 meter diameter gas inflated aluminum-coated mylar balloons into a low-altitude orbit of 1500 kms. The reflective surface enabled ground stations on opposite sides of the USA and across the ocean to periodically communicate with each other for short intervals when the Echo balloon came within line of sight of two ground stations, allowing their signals to be reflected off its surface back to earth. At about the same time, a somewhat similar approach had been taken in a Canadian experiment in which the moon, a very high-altitude natural satellite, was used as the passive reflector. In this case, the two earth stations remained in line of sight of the moon and could communicate with each other for much longer periods. When the Canadian Prime Minister John Diefenbaker spoke via the moon to American President Dwight Eisenhower in 1959, because of the the moon's distance from Earth there was a delay of 2.5 seconds for each word to reach the moon and return - this prevented any risk of extended discussion! For a historical review of experimental communications satellites, see generally McLucas J.L., op. cit., pp. 16-25; Spacebound op. cit., p. 26.

43 Communication with the satellite are established through microwave links which are similar to frequencies used on ground. This explains why the first earth stations were built outside urban areas not to create interference. See Rens, J.G., op. cit., tome 2, p. 342.

television signal was broadcast for the first time via the Telestar 1 satellite.[44] Following these conclusive experiments, all communications satellites thereafter would carry transponders.

The demand for world-wide communications was so strong that many satellites were launched. During the first decade in space, (1957-1967), the U.S.A. had orbited 500 satellites, accomplished 13 successful moon missions, and logged 1,994 hours of manned flight. The Soviet Union had launched 250 satellites, and was credited with 533 hours of manned flight and 8 lunar successes.[45]

The introduction of satellites had changed the whole scenario for world communications and altered its infrastructure design philosophy. Moving an increasing volume of data and television signals through terrestrial networks which were originally designed for voice traffic has been an often slow and expensive proposition. Most of the satellites at first were conceived to offer "fixed" satellite services, which are defined as a "radio communication service between earth stations at specified fixed points when one or more satellites are used".[46] This service is also referred to as point to point communications. Fixed satellite communications systems, which have essentially remained configured along the same basic design since their inception, consist of the communications satellites themselves, earth stations, and interconnections providing the link between the earth station and the terrestrial network, whether the end-user is accessing the system through a line or local cellular terminal.

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44 The first public impact of satellites on television was launching of Telstar 1 onto a low-altitude elliptical orbit in 1962, carrying an active transponder of a few watts. Developed by Bell Laboratories, it had a rather short operational life, and was used to exchange a large number of television programs between North America and Europe. see McLucas J.L., op. cit., pp. 25-26.

45 McLucas J.L., op. cit., p. 173.

46 ITU, Radio Regulations, 1982, No.22.

However, the advent of "fixed" satellite systems did not solve all communications problems. The maritime shipping industry was still limited in its ability to ensure adequate safety and distress services at sea. This industry was first to require the introduction of a satellite system to ensure that moving earth stations located on the ships could communicate more effectively with anyone on land as they journeyed across the seas, out of reach from shore stations. It rapidly became clear that satellites were ideal to provide wide area coverage "mobile" telecommunications services. Officially defined, "mobile" satellite services are "a radio communication service between mobile earth stations and one or more space stations, or between space stations used by this service, or between mobile earth stations by means of one or more space stations. This service may also include feeder links necessary for its operation."[47]

Very recently, satellites began providing mobile communications service to aircraft passengers, which will eventually replace the current airphone connected to air-to-ground networks. Satellites are also providing basic mobile communications services to moving vehicles. Although not as convenient to manipulate as the current cellular pocket phone, earth stations recently became available in briefcase formats,[48] making them even more portable within any location covered by the satellite footprint. This satellite communications system also solves the problem of limited coverage when using by the cellular system.

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47 ITU, Radio Regulations, 1982, No.27.

48 The Inmarsat-M system, deployed in 1993, provides digital voice and low-speed fax communications through a new generation of small, less expensive terminals. Inmarsat-M briefcase technology models provide portable communications world-wide and models designed for maritime use are also in operation, Some models have multiple-channel capabilies. Data services and vehicule mounted terminals are expected to become available in 1995. Inmarsat, Annual Review and Financial Statements 1994, London, U.K., 1995, p. 3.

1.2.2 International Cooperation

For many years before the conception of satellite systems, the importance of international connectivity between telecommunications systems of different countries, on land as well as on sea and in aircraft, has increasingly attracted the attention of many countries. The need to coordinate telecommunications activities had become even more essential with the arrival of satellites. This necessity to coordinate activities principally manifests itself in three major dimensions, which can be categorized as technical, political and economic.

Technical cooperation has been necessary because radio waves do not respect national borders. Therefore, the very nature of radiocommunications required agreements which would ensure a coordinated use of satellite services so as to avoid signal interference leading to breakdown in transmission. Furthermore, it became obvious, very early on, that without cooperatively developed standards, it would be impossible to provide international connectivity.

The political dimension of connectivity is based on the national sovereignty principle, which provides that every national government controls the telecommunications activities within its jurisdiction. A telecommunications network cannot become global if its access is excluded in certain countries or if discriminatory access conditions on communications systems are imposed on certain countries . International cooperation and direct participation in ownership and operations of international satellite systems, at a time of inception, have helped ensure that these systems be deployed within a mandate to deliver truly global services with access to every country. Moreover, the number of developing countries within the United Nations system attained a numerical majority in the early 1960s.[49] This commanded the attention at the heart of various multilateral discussions in the international community, thereby ensuring that developing countries were also given appropriate consideration.

From an economic perspective, pooling together resources from different countries to share the risk and eventual benefits was certainly a consideration when the idea for international satellite consortiums were initially developed. International discussions, initiated by the United States[50], led to the interim establishment of the Intelsat consortium, founded in 1964, to provide global fixed satellite communications services. Eleven countries had ratified the instruments by the time Early Bird became operational that same year. Membership grew to 136 countries in 1994, with the last members to join being the Kyrgyż Republic, Kazakhstan, Malta and Botswana.[51] The U.S.S.R. created during the same period a separate system of fixed satellite services called Intersputnik , essentially designed for the membership of the so-called "Soviet Bloc" States, but remained rather modest, comparatively to Intelsat, in terms of business volume.

Commercial mobile satellite communications services were established in 1979 with the creation of Inmarsat through its world-wide geostationary satellite system.[52] This form of cooperation was based on a different approach and generated wider international representation; the Soviet and so-called "West Bloc" states, as well as non aligned countries, were brought together into forming the consortium. In offering mobile

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49 Jakhu, R., Interview March 22, 1994.

50 Intelsat stemed from an American initiative based on the 1962 U.S. Communications Satellite Act, which created the Communications Satellite Corporation (Comsat). Comsat was instrumental in the creation of Intelsat.

51 Intelsat, Intelsat Annual Report, Washington D.C., 1995.

52 Inmarsat, op. cit., p. 3.

services, Inmarsat demonstrated that owning and providing satellite service was no longer to be the exclusive right of Intelsat.

Since it took several years for Inmarsat to evolve from a paper based idea to an established organization based in London. By the time Inmarsat officially became operational in 1982, there were 1,000 customers ready to use the service. That number was 11,00 in 1990. Since its establishment, Inmarsat's space segment has used global beam satellites, which are associated with big and expensive terminals. However, the next generation of satellites, Inmarsat-3, will use more powerful spot beam satellites with increased capabilities. The portable Inmarsat-C data terminal, introduced in 1991, provides store-and forward data messaging services through small, portable terminals available for both maritime and land-mobile applications such as vehicle and ship fleet management, distress and safety communications, messaging, remote monitoring and control, and position reporting. These terminals have been joined by the satellite briefcase phone Inmarsat-M, introduced in 1993 as previously noted. A global paging service was designed for Inmarsat-D in 1994 to provide a portable message receiver, using pocket sized equipment to be commercially available in 1995-96.[53]

Presently, the prime carrier for global satellite communications traffic for mobile users remains Inmarsat, with 76 member countries as of 1994, with the most recent countries being Mexico, South Africa, the Bahamas and Senegal, Thailand and Lebanon. The Republic of Georgia left the organization in 1994. [54] Inmarsat has progressively broadened its mandate from initially providing communications services between ships, ship owners and their customers, and services for personal communications for crew members and passengers. The organization awarded itself, with the consent of its

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53 id.

54 ibid., p. 4.

signatories, the right to provide commercial services of every kind of mobile user. Accordingly, in December 1994, the Inmarsat Assembly agreed to change the formal name of the Organization from the International Maritime Satellite Organization to the International Mobile Satellite Organization, which reflects the expansion of Inmarsat's services. [55]

In 1994, Inmarsat operated a satellite system for global mobile communications serving more than 44,000 maritime, aeronautical and land mobile and transportable terminals, while 1993 figures totaled 33, 125 such terminals.[56] Although the major markets continue to be in the maritime sector, land mobile markets in 1994 accounted[57] for more than 34 percent of Inmarsat traffic and terminals. Inmarsat also provides easy solutions for difficult communications requirements in remote locations where there are no effective terrestrial based telecommunications services. Observers say that Inmarsat has made the greatest contribution to safety and efficiency at sea since the invention of radio itself.[58]

More recently, when the appropriate technology became sufficiently refined and affordable, other regional and domestic satellite operators began offering fixed and mobile services. These operators, which are generally headquartered in countries party to the Intelsat and/or Inmarsat agreements, consequently were subject to obligations imposed on them by these agreements. This helped ensure coordination with the global service providers on a technical level. Although the ITU had a mandate to ensure this

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55 id.

56 id.

57 ibid., p. 18.

58 Clarke, A.C., in McLucas J. L., op. cit., p. viii.

coordination, certain technical aspects were more effectively coordinated by the service providers in collaboration with the ITU.

To a certain extent, coordination was also ensured to avoid causing economic harm to Intelsat and Inmarsat. In practice, however, over recent years, the concern for economic harm became less of an issue for the two consortia. As later reviewed in Chapter 3, both Intelsat and Inmarsat no longer tend to invoke the pertinent clauses in their respective agreements to protect themselves against competing service providers. Private organizations have also been successful in deploying satellite systems which offer specialized communications services. However, unlike Intelsat and Inmarsat, this group of public and private organizations does not have a mandate to provide global telecommunications services on behalf of the international community. Although these organizations contribute increasingly to the advancement of satellite communications and to certain aspects of the regulatory framework, they do not constitute the superseding driving force in the establishment of international regulations.

1.2.3 Three Decades after Early Bird

Intelsat's first satellite, Early Bird, launched in 1965 into geostationary orbit, has been followed by increasingly powerful satellites. As noted, Early Bird could handle 240 telephone calls, but these had to be cut off to carry one television program. In 1995, thirty years later, Intelsat 6 uses a sophisticated digital multiplication technique (DCME), thereby enabling its transmission capacity to be raised to 120,000 circuits. Newer technologies and decreasing costs have allowed Intelsat to lower its charges for telephone lines by 95 percent. The price for 20 circuits in 1990 is what was paid for one circuit on Early Bird.[59]

59 McLucas, J.L., op. cit., p.45.

Very early on, satellites demonstrated their advantages over the increasingly complex and expensive terrestrial based systems of intercity microwave relays and undersea cable systems. A few years following the commercial deployment of satellite systems, scientists had addressed the essential weaknesses in quality and reliability of transmission, and new designs rapidly demonstrated the benefits of satellite communications. Most notable was the fact that satellites were distance insensitive in terms of cost, as well as geographic and political barriers. Satellites also provided communication links into countries that otherwise were not considering the expansion of their international public telecommunications service for either economic or political reasons.

This translated into not only more effective telephones, but also extensive broadcast service delivery. Initial satellites were used mostly for telephony, and eventually served for the transmission of news feeds and special event coverage. Although this has evolved over time, and may change with the era of direct broadcast technology, one of the communications satellite systems' major client groups are currently the local broadcasters which require satellites to receive their feeds for local distribution. Satellites provided an additional advantage to the broadcast industry: for the first time live television became possible around the world. The example of the 1988 concert for Mandela in London, which was viewed by 750 million people in 60 countries simultaneously, illustrates how satellites have indeed brought reality closer to the virtual global village.[60] A few years later as this thesis was being researched, in 1994, the final game of the World Cup of Soccer which opposed Italy and Brazil was viewed live by an estimated two billion people.

60 see generally Jakhu,R., Telecommunications Law Course Materials, McGill University Institute of Air and Space Law, , 1992.

In summary, satellites offer quality and reliability in transmission, and research continues in response to consumer demand to offer additional capacity and mobility, irrespective of transmission distance. Advanced multiplexing and signal compression technologies, combined with increasing numbers of transponders on board satellites, have multiplied the capacity of space systems to provide simultaneous transmission of voice, fax, data and television signals to multiple destinations anywhere on earth.

Radiocommunications technology improvements in transponders and in earth stations continue to reduce the size of the devices, and increase their overall power and versatility. This is particularly important when considering the recent advantages offered by new developments in terrestrial communications, which include the increased capacity of fiber optic technology, as well as the mobility offered by the rapidly expanding cellular telephone networks. In high activity areas, it is clear that a portion of the traffic and related revenues may be diverted back from satellite to terrestrial telecommunications systems. With current and emerging these particularly heavy traffic regions are the only markets which can sustain the cost of implementing enhanced terrestrial systems. However, space systems currently offer affordable access to similar advantages to any region or country notwithstanding the region's ability to invest in a sophisticated terrestrial network.

Parallel to the developments in the satellite industry, terrestrial systems have also evolved tremendously over the last thirty years. More effective switching and transmission systems, as well as increasingly versatile terminals, currently enable the transmission of either voice, data, fax or video signals. The most notable innovations include the cellular telephone system, the fax machine, and more recently, the "Internet" type of computer networks. Internet terminals and fax machines simply require regular phone lines and the appropriate terminal equipment which has become affordable. The cellular systems, which are linked to the local and long distance telephone networks, have essentially been implemented in the urban areas of industrialized countries, where heavy traffic provides the required returns to the service providers. While some services are restricted to urban and other heavy traffic areas, this new technology continues to transform the demand for increasingly mobile telecommunications into a mass market.

The question whether satellites are competitors to terrestrial systems or serve as their complement has been argued since the inception of space segments. Many observers note that in areas of heavier traffic served by advanced terrestrial networks, there may currently be some competition between the services. For example, important investments in fiber optic cable technology have resulted in fixed services which are said to be at least as reliable and effective as the equivalent satellite services currently available. Undeniably though, both the terrestrial and space based components make distinct contributions to the global communications system, whereby they complement each other, sometimes even bringing additional business to each other. For example, cellular or other types of local networks may be set up in isolated regions which are linked to other domestic and international networks because of satellite services. [61] Similarly, current satellite communications linking populated areas would be useless without the local terrestrial network completing the connection between the earth station and the user's terminal.

The slow pace of telecommunications development in many areas can be explained by the high costs of implementing terrestrial systems, combined with the still rather expensive satellite services requiring fixed and mobile earth-stations which would be

61 For more detailed analysis of technical and economic benefits of new technologies in developing countries, and political implications, see Mamboundou-M'Boumba, D., Les télécommunications spatiales et les pays en développement, spécifiquement les pays d'Afrique, Thèse présentée en vue de l'obtention du grade de maîtrise en droit, Institut de droit aérien et Spatial, Université McGill, Montréal, 1985, pp. 32-37.

integrated to the terrestrial system. Emerging technologies in terrestrial and space systems, could help accelerate the penetration of telecommunications, thereby reducing telecommunications gaps between regions. However, in practical terms, the pace of the development and introduction of these new systems pertains to the ability to generate revenue through the provision of competing services, which can be, in effect, partially stimulated or impeded by the establishment of a regulatory framework.

Chapter 2 Legal Principles and Regulatory Framework Pertaining to the Provision of Global Satellite Communications Services

The principles at the basis of the body of international law which governs the use of telecommunications, and radiocommunications in particular, have been determined primarily by the nature and physical characteristics of the radio spectrum, as well as by the political philosophy shaped by international relations.[62] Indeed, with the emergence of communications satellites and other new information technologies, international law in this field has evolved with the adherence of a majority of countries to numerous bilateral and multilateral agreements negotiated over the last hundred years. Moreover, these agreements have also helped even further define and entrench the principles analyzed in this chapter.

The progressive development and codification of international law constitutes one of the principal responsibilities of the United Nations. With the arrival of satellites, the exercise of these responsibilities has extended to include the environment of outer space. For over three decades, outer space has been exploited by a number of states which have, *inter alia*, deployed satellite systems to provide enhanced telecommunications. As it is

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62 Jakhu, R.S., "The Evolution of the ITU's Regulatory Regime Governing Space Radiocommunication Services and the Geostationary Orbit" Annals of Air and Space Law, Vol. VIII, McGill University, Montreal, 1983, 381.

appropriate to an environment whose nature is so extraordinary, the extension of international law to outer space has been gradual and evolutionary.

The formulation of principles is generally achieved in various fora by the international community and then incorporates such principles into general multilateral treaties. These treaties or multilateral agreements directly affect party governments, which incorporate into their respective national legislative frameworks the pursuit of the internationally supported objectives. This ensures, to a certain extent, the tangible application of widely recognized principles within national jurisdictions.

During the inception period of satellite communications, a growing number of countries have cooperatively opted for that the establishment of the Intelsat and Inmarsat consortia, which would own, regulate and operate satellite communications within the framework of multilateral agreements. It is important to note that these consortia provided the world community with a solution for a regulatory framework which would oversee the operational aspects of global satellite communications. The numerous governments party to the Intelsat and Inmarsat agreements, as well as their designated signatories, have adhered to the obligations stipulated in their respective mandates. As demonstrated in this chapter, these obligations include the pursuit of the objectives stipulated in the telecommunications principles.

This chapter outlines the foundation of the four fundamental telecommunications principles at basis of the regulatory framework which oversees the operational aspects of global satellite communications.[63] These principles are the following:

63 An other major fundamental telecommunications principle is the avoidance of any harmful interference to any radio service in other countries. However, this remains essentially a "technical" aspect of satellite regulations (as opposed to "operational"), as mentioned in the introduction, and its analysis does not fall under the scope of this paper.

a) Provision of global distress and safety service on a priority basis;

b) Global telecommunications coverage and connectivity;

c) Basic telecommunications services should be established within every national jurisdiction, including developing areas, and should be accessible to all individuals; and

d) Universal access to telecommunications services on a non-discriminatory basis.

Also analyzed in this chapter are the current roles and obligations of governments with respect to national and international law, as well as the adherence of Intelsat and Inmarsat member States to these principles.

Intelsat and Inmarsat are a unique form of hybrid intergovernmental treaty-based organization. On the one hand, they operate as an international self-regulating public service utility. On the other hand, acting as cooperatives which hold a world-wide dominant position, they provide global telecommunications services on a sound commercial basis.[64] In both consortia, the Convention is signed by governments party to the consortium, setting forth the basic provisions, principles, and structures of the of the organizations. This Convention is supplemented by an Operating Agreement signed by a government or its designated Signatory. A Signatory can either be a private or public telecommunications entity, and is only authorized to participate in the Operating

64 Intelsat Agreement Relating to the International Telecommunications Satellite Organization, Aug. 20, 1971, 23 U.S.T. 3813, T.I.A.S. No. 7532, Article 5 (3).

Agreements.[65] Each consortium has its own legal personality distinct from its member States, and is responsible for its respective acts and obligations.

Intelsat and Inmarsat own and operate their respective space segments of satellites, while their member countries or their designated Signatories own the earth segment or earth stations, but the consortia establish detailed specifications and operating rules for these earth stations. Comsat and Teleglobe are examples of private Signatories which represent respectively the USA and Canada. The members of the consortia are also the users of the system, and in this respect, these organizations are unique international organizations. In addition to owning and operating the satellite network, this allows both Intelsat and Inmarsat to collect working and investment capital from their members, based on their overall needs and their share of ownership, and to derive revenues from the sale or lease of satellite capacity to its members and other users.

Although the success of the global Intelsat and Inmarsat services prompted as early as the 1970s the formation of regional systems,[66] the Intelsat and Inmarsat agreements constitute the key elements of the regulatory framework which oversees the operational aspects of global satellite service provision. International operational matters, as well as certain policy issues, are essentially dealt within the regulatory process of Intelsat and Inmarsat, because these organizations are currently the only truly global providers of overseas services to domestic carriers. The involvement of countries in both consortia

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65 ibid.

66 Regional systems have been deployed, first for domestic purposes in the UAS and then in Europe, Asia, Australia and Canada. Among the most noteable are Eutelsat (founded in 1977 and came into existence in 1984), Arabsat (founded in 1976 by the 21 members af the Arab League), Palapa (1976) and Aussat (1982). see Gibson, R., "Nation Shall Speak Unto Nation: The Worldwide Role of Satcoms", Never Beyond Reach: The World of Mobile Satellite Communications, Inmarsat, 1989, p.15-18.

can vary from direct ownership by governments or their designated Signatories to the ability to access the satellite services without being a member of the organizations.

This framework oversees the operational aspects of most of the world's international satellite communications service provision, from the choice of technology to tariff regulation and the scope of services which they are to provide to national carriers. In the early years of satellite service, this framework was instrumental in coordinating the scarce financial and technological resources available globally, so that satellites and earth stations deployed around the world provided the basic infrastructure which would complement terrestrial-based telecommunications.

At their inception, these organizations operated as *de facto* monopolies. Currently, they continue to hold a dominant position in the global market, thereby imposing their regulatory framework on the world community. It was only a few years ago that both consortia ceased to rigorously enforce that member States comply with a clause forbidding any Party member - which includes most States that could afford to launch their own system - from deploying an independent satellite system which could cause an economic harm to either organization.[67] For example, similar to a provision in the Intelsat Agreement, the Inmarsat Agreement stipulates that a Party member

> notify the Organization in the event that it [...]intends to [...]initiate the use of separate space segment facilities to meet any or all of the purposes of the Inmarsat space segment, to ensure technical compatibility and to avoid significant economic harm to the Inmarsat System.
>
> [...]
>
> The Council shall express its views in the form of a recommendation of a non-binding nature within a period of nine months from the date of commencing the

67 Gagné, P., Interview December 3, 1992.

procedures provided for this Article. An extraordinary meeting of the Assembly may be convened for this purpose.[68]

2.1. Provision of Global Distress and Safety Service on a Priority Basis

It became obvious very early on this century to what extent radiocommunications could be useful in providing distress and safety services, particularly in the maritime sector. With the arrival of telecommunications networks, and radiocommunications in particular, it became possible to introduce new and more effective distress and safety devices. The first fundamental telecommunications principle is that the provision of distress and safety telecommunications services should be ensured globally on a priority basis. This principle has been reflected and further defined in numerous multilateral agreements since the inception of telecommunications systems.

As early as 1912, the London Radiotelegraph Conference convened just three months after the sinking of the Titanic. This tragedy served as a catalyst to reach international agreement on compulsory intercommunication between ships equipped with radio apparatus of various types.[69] These provisions were further elaborated in the 1914 Safety of Life at Sea Convention (SOLAS), which remains a cornerstone of the principle stipulating that safety and distress telecommunications services are to be provided effectively on a priority basis.[70]

68 Inmarsat Agreement, op. cit., Article 8

69 Article 3 of the International Radiotelegraph Convention, Final Protocol and Service Regulations adopted on July 5, 1912; 7, American Journal of International Law (1913), Supp. 229 et seq.

70 Jakhu, R., Interview, op. cit.

Radiocommunications technologies, although rather primitive in their developmental phases, have demonstrated their tremendous effectiveness on countless occasions. With the arrival of satellite technology, and more particularly mobile satellite services, Inmarsat was established to provide maritime distress and safety service on a global basis, thereby further enabling the achievement of the objective set out in this principle.

The Inmarsat system is a necessary part of the Global Maritime Distress and Safety System (GMDSS), which provides a most significant improvement for the safety of life at sea. Until recently, the system for maritime distress and safety communications relied primarily on individual ship-to-ship alerting, whereas GMDSS transmits the distress message directly to safety organizations.[71]

In the context of Inmarsat's current activities, the provision of distress and safety services at sea is a very small part of its overall costs. Nonetheless, satellite GMDSS remains an essential and mandatory public service component to be provided to the international community pursuant to the mandate given to Inmarsat by its members.[72]

The objective of safety at sea has also been significantly advanced by the COSPAS-SARSAT satellite system created by the Soviet Union, France, United States and Canada. This unique system provides for the detection of distress signals and

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71 GDMSS is based on the principle of alerting both shore stations and any vessel in the area which may be in a position to provide assistance. The GMDSS was brought into effect by the 1988 Conference of the IMO and was implemented in 1992. By February 1, 1999, all ships subject to the IMO SOLAS Convention will be required to comply with the provisions of the GDMSS Regulations. St-Arnaud, D., Department of Industry Canada, International Relations Branch, Interview August 12, 1994.

72 Arnaud, D., op. cit.

communicates this information to the appropriate emergency services through various earth stations located at strategic locations around the world. Enhancements to the system are presently being prepared for deployment.[73]

Accordingly, there is no reason to restrict the distress and safety service principle to the limits of the open seas. An increasing number of countries have been incorporating this principle into their local and national policies, particularly because of recently available technologies, making it widely recognized as an objective for sea, ground and air. Moreover, this principle has also been recognized as applicable to the newly explored space environment, as expressed in the Agreement on the Rescue of Astronauts, which in its Preamble notes the great importance 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[74] (The Outer Space Treaty), which calls for the rendering of all possible assistance to astronauts in the event of accident, distress or emergency landing and the prompt and safe return of astronauts.[75] This Agreement also stipulates that its signatories are being prompted by sentiments of humanity[76].

As well, in 1992, the provision of telecommunications global distress and safety service principle was again incorporated in the ITU Constitution, which stipulates that

> International telecommunication services must give absolute priority to all telecommunications concerning safety of life at sea, on land, in the air or in outer

73 Lessard, S., Canadian Space Agency, International Relations, Interview August 24, 1994.

74 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, United Nations, 1967.

75 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, United Nations, 1968, Preamble.

76 id.

space, as well as to epidemiological telecommunications of exceptional urgency of the World Health Organization.[77]

In the last few years, Inmarsat has expanded its mandate to provide service to the aviation community, as stipulated in Inmarsat's Constitution:

> The purpose of the Organization is to make provision for the space segment necessary for improving maritime communications and, as practicable, aeronautical communications, thereby assisting in improving communications for distress and safety of life, [...] [78]

More recently, the consortium has also proposed to its members a modification to its constituting agreement so that it may provide land-mobile service as well.[79] Developments in personal satellite communications systems, reviewed later in Chapter 3, are expected to further enhance the provision of distress and safety services so that they may be conveniently available anywhere on the earth's surface via highly portable devices.

2.2. Global Telecommunications Coverage and Connectivity

The achievement of global telecommunications coverage and connectivity between all countries are closely interdependent. Both technology and international agreements should contribute to ensuring the adherence of all States to this second telecommunications

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77 Constitution of the International Telecommunications Union, 1992, Article 29.

78 Convention on the International Maritime Satellite Organization (Inmarsat), 1976, Article 3.

79 See generally Inmarsat, op. cit.

principle, which aims at establishing truly global telecommunications coverage and effective connectivity between all countries.

The origin of this principle can perhaps be linked to the basic necessity for people to express themselves and to communicate with each other. Over the last few centuries, the need to communicate has become an international prerogative. Although initially a local requirement, this basic necessity to communicate has expanded, over time, beyond local communities.[80] It has strongly contributed to establishing national identities which, even now, continue to result in the formation of countries.

This necessity to communicate has also led to the conclusion of various international legal instruments which include the fundamental human right to communicate.

Even before the inception of electronic telecommunications, the right to communicate has been reflected in the international protocols which were established to ensure that written messages would be transmitted reliably between countries to their destination by the various national mail systems. The Universal Postal Union, a sister organization of the ITU, is based on the fundamental right to communicate.

The freedom to communicate can no longer be fully ensured without the establishment of a worldwide telecommunications system which provides global coverage and enables connectivity between all national jurisdictions. Since their inception, Intelsat and Inmarsat have been committed to the adherence to the principle of global coverage and connectivity.

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80 Ram Jakhu - Interview March 22, 1994.

Indeed, the main aim of Intelsat, as set forth in the Preamble of the its Agreement is:

> [...] to achieve a single global commercial telecommunications satellite system as part of an improved global telecommunications network which will provide expanded telecommunications services to all areas of the world and which will contribute to world peace and understanding [...]; [81]

To achieve these goals, Intelsat is to:

> [...] continue and carry forward on a definitive basis the design, development, construction, establishment, operation and maintenance of the space segment of the global telecommunications satellite system.[82]

The scope of activities to be provided by Intelsat is defined in both functional and geographical terms, and "public telecommunications services". In Article I of the Agreement, Intelsat may provide both types of service... but its basic purpose is "public" telecommunications services, that can be "fixed" or "mobile" and which are available for use by the public, such as telephony, telegraphy, telex, facsimile, data transmission, transmission of radio and television programs for further transmission to the public, as well as leased circuits for all of these purposes.[83]

Inmarsat as well is governed by similar provisions[84] which ensure that the organization's resources be dedicated to the establishment of connectivity and global coverage. Furthermore, without connectivity and global coverage, it would be difficult, if not impossible, to ensure the provision of distress and safety telecommunications services.

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81 Intelsat Agreement, op. cit., Preamble.

82 Intelsat Agreement, op. cit., Article II (a).

83 Intelsat Agreement, op. cit., Article I.

84 Inmarsat Agreement, op. cit., Articles 3 and 7.

2.3. Establishment of Basic Telecommunications Services within Every National Jurisdiction, Including Developing Areas, and accessibility to all individuals.

The third telecommunications principle is that basic telecommunications services should be improved and developed within every national jurisdiction, including developing areas An appropriate service would give access to every individual to a world-wide telecommunications network, thereby enabling him or her to exercise the fundamental right referred to previously.

At the outset, it is important to note that the concept of "essential" or "basic" telecommunications services evolves as the technology changes and becomes readily available to the general public in various parts of the world. Consequently, the concept of "essential" or "basic" telecommunications service evolves with time according to the general availability of specific services, as well as with the changing expectations of the general public which may or may not have become accustomed, for example, to easily accessible mobile personal telecommunications services in many parts of the world.

Ten years after submitting his Commission's Report to the United Nations[85], Sir Donald Maitland recently wrote that:

> Communications is a means by which information can be shared. Information accumulated becomes knowledge. And knowledge is the key that opens the gate to the fields of liberty. Our shared conviction that the denial of access to information

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85 The Missing Link Report, presented to the UN in 1985 by the the Independant commission for World Wide Telecommunications Development, chaired by Sir Donald Maitland.

implicit in the gross imbalance in the distribution of telecommunications throughout the world was intolerable led us to set a clear objective: all mankind should be brought within easy reach of a telephone by the early part of next century.[86]

This statement encapsulates the essence of the third fundamental telecommunications principle. It is important to note that this principle had only been articulated for the first time in the early 1960s, much later than the other principles reviewed in this section. The issue had first attracted the attention of the world community when two trend setting occurrences provoked a serious international debate. Firstly, experimental communications satellite tests for the first time offered a completely innovative and possibly effective solution to the leveling of telecommunications gaps around the world. Secondly, coinciding with these early satellite communications demonstrations, the so-called "developing countries" for the first time obtained the numerical majority in the United Nations system. This principle, by which the availability of basic telecommunications is to be achieved in all under serviced areas within every national jurisdiction, has been receiving increasing support from the international community ever since.

As early as 1961, the General Assembly unanimously invited the UN Special Fund and the UN Expanded Programme of Technical Assistance[87], in consultation with the ITU, "to give sympathetic consideration to requests from Member States for technical and other assistance for the survey of their communication needs and for the development of their domestic communications facilities, so that they may make effective use of space

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86 Maitland, Sir D., 'The Missing Link' Revisited, Transnational Data and Communications Report, Nov/Dec 1992, 15.

87 Merged into the UN Development Programme (UNDP) in 1966.

communications".[88] In 1962, the UN General Assembly expressed the view that "the application of scientific and technological advances in outer space, particularly in the fields of meteorology and communications , can ... contribute to the economic and social progress of the developing countries as envisaged in the United Nations Development Decade Programme."[89] In 1963, The Committee on the Peaceful Uses of Outer Space (COPUOS) again commented on this issue and specifically invited "the Specialized Agencies and other competent international organizations to assist in the development and extension of such terrestrial systems."[90] During the General Assembly debate later in 1963, those recommendations were noted with approval by a number of delegations.[91] Consequently, the efforts by the developing countries to gain international legal recognition for the principle of the equal sharing of benefits provided by space exploration resulted in the insertion into the first Article of the 1967 Outer Space Treaty of the stipulation that:

> The exploration and use of outer space ...shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development.[92]

It is fair enough to say that there was a basic call upon states carrying out space activities to be in some way responsive to the interests of developing countries, and to

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88 Un General Assembly resolution 1721 D (XVI) of December 20, 1961.

89 Un General Assembly resolution 1802 (XVII) of December 14, 1961.

90 Report of the Committee on the Peaceful Uses of Outer Space . UN document A/5549, 24 September 1963

91 Valters, E International Law of Communications Satellites: Scarce Resources in a New Environment. Columbia University, Ph.D., 1970 p.247

92 Outer Space Treaty, op.cit. Article I.

ensure the distribution of benefits derived from such activities.[93] These UN debates, however, had relatively little impact on the overall tangible action which was required to improve telecommunications in under serviced areas, except that service providers had suddenly become more conscious of the vast markets which remained to be served in many regions around the world. Beyond the recognition of the problem of dramatically different levels of accessibility to basic telecommunications, the real challenge then became the search for a solution.

The issue of wide telecommunications gaps between various countries finally became the focus of the ITU, in 1965, during its Plenipotentiary Conference, which followed the inaugural launches of experimental satellites a few years earlier. Later, in 1982, the ITU reformulated its Convention and added to its general purposes *inter alia*, these three objectives:

1) to maintain and extend international cooperation between all Members of the Union for the improvement and rational use of telecommunications of all kinds, as well as to promote and to offer technical assistance to developing countries in the field of telecommunications;

2) to promote the development of technical facilities and their most efficient operation with a view to improving the efficiency of telecommunications services, increasing their usefulness and making them, so far as possible, generally available for the public; and

3) to harmonize the actions of nations in the attainment of those ends.[94]

93 See generally Stoffel, W. Legal Aspects of aeronautical Mobile satellites (unpublished LL.M Thesis), McGill University, Montreal, 1992.

94 ITU International Telecommunications Convention, Nairobi 1982, Article 4. 1.

To accomplish these purposes, ITU has assigned itself certain duties, which are:

... to foster international cooperation in the delivery of technical assistance to the developing countries and the creation, development and improvement of telecommunications equipment and networks in developing countries by every means at its disposal, including through its participation in the relevant programs of the United Nations and the use of its own resources, as appropriate. [95]

Over time, the principle of establishing basic telecommunications services to be available for all individuals in every country was expanded and strengthened with widely publicized studies, such as *The Missing Link* report previously mentioned.[96] This report, which was widely acclaimed by the international community, offered four main conclusions. First, higher priority had to be given to investing in telecommunications. Secondly, the operating efficiency of existing networks in developing countries had to be improved. Thirdly, arrangements for financing had to recognize that in many developing countries foreign exchange was scarce. Finally, the ITU should play a more effective role to achieve these goals.

Maitland believes that the Members of the Independent Commission, "were they to meet again today, would, with only minor modifications, reiterate the substance of the recommendations in 'The Missing Link' with renewed vehemence". The Commission's analysis remains valid: investment in telecommunications as an essential element in economic and social development is even more essential today. No developing country

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95 ibid, Article 4.2. c).

96 The Missing Link Report, op. cit.,. The research and drafting of the report was an extensive exercise which ran 14 months by 17 members drawn from every region, mandated to find ways of stimulating the expansion of telecommunications across the world.

hoping to provide a better life for its citizens, wherever they may live and work, can afford not to make this investment. Nor has the common interest of all countries and all continents in the creation of an effective global network diminished the overriding objective of bringing all mankind within easy reach of a telephone by the early part of next century. The wider interests of the international community would not be served if the response to demand in this comparatively new market were to divert investment capital and technical expertise from developing countries".[97]

Since the initial ITU Plenipotentiary Conference addressing development issues, the role of ITU in development actually increased in importance in an ad hoc way until the 1989 Nice Plenipotentiary Conference during which the Telecommunications Development Bureau (BDT) was established. With this institutional change within ITU, issues relating to telecommunications in developing areas now received the same level of priority as the technical issues of radiocommunication and standardization.[98]

Although the ITU contributes to a certain extent with its own structure and activities to help attain the objective spelled out by this fundamental telecommunications principle, the most pertinent contribution towards implementing this principle comes from the telecommunications service providers themselves, as they establish the operational aspects of the regulatory framework which oversees global service delivery. Although the promotion of the development of telecommunications in developing areas and emerging markets is not expressly stated under Intelsat's and Inmarsat's defined purposes, various governments have openly expressed that it is their view as parties to Intelsat or

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97 Maitland, Sir D., 'The Missing Link' Revisited, Transnational Data and Communications Report, Nov/Dec 1992, 15 at 17-18

98 In the following years, there were important milestones. The BDT's organizational structure in 1990 was approved; its first director was elected in 1992; the provisions concerning the Development Sector were integrated in the revised Constitution and Convention and approved at the 1992 Additional Plenipotentiary Conference; and the first series of Regional Development Conferences was completed.

Inmarsat that the realization of this objective is instrumental to the fulfillment of the overall mandate.

The U.S. Satellite Act, which created the Communications Satellite Corporation (COMSAT)[99], provided for "the establishment, ownership, operation and regulation of a commercial communications system", which would serve the U.S. goal of "contributing to world peace and understanding by establishing ...a communications system in conjunction and cooperation with other countries, directing care and attention toward providing services to economically less developed countries."[100] Other key provisions in the Intelsat Agreement clearly invite the participation in the development of satellite communication technology in order to provide communication services on a non-discriminatory basis to all areas of the world.[101] Other key provisions in both Intelsat and Inmarsat Agreements demonstrate to what extent their mandates require that they contribute to the implementation of this principle[102].

In practice, at the outset, certain developing countries were dissatisfied with the policy of Intelsat which in implementing the system chose to rely on low powered satellites requiring elaborate and expensive earth stations. The high cost of the standard

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99 Communications Satellite Act, 1962, Publ. L. No 87-624, 76 Stat. 419 (1962). Comsat was initially the most important stakeholder in Inmarsat, until other countries began increasing their use of the system.

100 Communications Satellite Act, 1962, Publ. L. No 87-624, 76 Stat. 419 (1962)., § 102 (a).

101 Intelsat Agreement, op. cit., Articles II (a) and III (a).

102 The Preamble of the Intelsat Agreement, op. cit., stipulates that Parties to the agreement believe that satellite telecommunications should be organized in such a way as to permit all peoples to have access to the global satellite system, and provides thoughtful consideration of the objective of establishing an improved global telecommunications network which will provide expanded telecommunications services to all areas of the world. To this end, Intelsat: is to provide for the benefit of all mankind, through the most advanced technologies available, the most efficient and economic facilities possible with the best and most equitable use of the radio frequency spectrum and of orbital space.(Agreement Relating to the International Telecommunications Satellite Organization "Intelsat", Signed at Washington, August 20, 1971, Preamble)

Intelsat earth station prevented some developing countries from constructing an earth station while forcing others to charge particularly high rates to users. Nontheless, some countries could still group together and share an earth station which would be linked to their respective terrestrial networks. The effects of this policy were felt at least until the end of the 1970s, as long as the Intelsat IV series remained in use.[103] The following series of Intelsat satellites were equipped with more advanced technology, which enabled them to retransmit more powerful signals to the earth stations. This consequently allowed for the installation and use of less sensitive, less sophisticated and more affordable earth stations which ensured the communications link with the satellite.

Moreover, Inmarsat has also been contributing to the improvement and development of telecommunications in developing and underseviced areas. At its inception, the mobile satellite service consortium had essentially been mandated to provide maritime communications. The aim of achieving global coverage would help ensure that both safety and distress services at sea, and maritime public communications services could be delivered in all regions where the mobile services would be required.[104] With the more recent extensions of Inmarsat's mandate to also provide aviation and land mobile services, combined with a growing number of member states which have adhered to the Inmarsat Agreement, the fundamental principle of making basic telecommunications available on a global basis has been strengthened. With respect to mobile communications, Inmarsat's commitment in the development of telecommunications has been a notable success story over the years and remains in the view of numerous governments as much a priority today as it did back in 1979.[105] Indeed, Inmarsat has

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103 Valters, op. cit. p.260.

104 Inmarsat Agreement, op. cit., Article 3 of the ,

105 St. Arnaud, D. op. cit.

implemented a number of decisions over the years in this regard, notably the inclusion of four representatives to Council "irrespective of their investment shares, in order to ensure that the principle of just geographical representation is taken into account, with due regard to the interests of developing countries".[106]

The development and implementation of an Inmarsat development program and related activities have also contributed to the expansion of telecommunications in emerging markets. On the one hand, the involvement of developing countries in these activities and their ability to access Inmarsat's support for the expansion of telecommunications has enabled a certain level of transfer of technology and additional penetration of basic telecommunications in these countries. On the other hand, the active participation in Inmarsat leads to a better understanding of policy implications, as well as skills and techniques learned within the organization that enable the developing countries to bring changes to their own domestic policies. For example, certain countries are accepting the idea that mobile satellite communications can also be applied to other conventional terrestrial systems on an affordable basis.[107]

This section has addressed the importance of providing essential telecommunications services throughout developing areas in both developing and industrialized countries. This principle paves the way for increased involvement and participation on the part of developing countries in formulating or modifying the international telecommunications policies and regulatory framework. In brief, it can be said that this principle though lacking precise legal value, strongly influences the policies,

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106 See generally Wright, D., Mobile Satellite Communications in Developing Countries (non-published paper), Inmarsat contribution to International Astronautical Federation, 1993.

107 Wright, D., op. cit., p. 8.

the development of legal frameworks as well as operations and activities both at national and international levels.

2.4. Universal Access to Telecommunications Services on a Non-Discriminatory Basis

Telecommunications services should be made available to every country on a non-discriminatory basis. The principle is also a premise for the achievement of global coverage and connectivity, as well as the provision of distress and safety telecommunications services and the enhancement of national telecommunications networks, particularly in developing areas.

Since space-based telecommunications first became available, it had become evident that scientific and developmental satellite programs were to physically enable universal access to international telecommunications on a non-discriminatory basis. At that time, the United Nations had also begun to establish norms of behavior for the exploration and use of outer space - this included its basic policy with regard to the desirable features of global space telecommunications. In 1961, the UN General Assembly unanimously expressed the belief that "communications by means of satellites should be available to the nations of the world as soon as practicable on a global and non-discriminatory basis".[108] The UN also stated that it "was convinced of the need to prepare the way for the establishment of effective operational satellite communication". [109] A year later, the Assembly again unanimously emphasized "the importance of international

108 Un General Assembly resolution 1721 D (XVI) of December 20, 1961.

109 id.

co-operation to achieve effective satellite communications which will be available on a world-wide basis".[110] Although the precise legal effect of UN General Assembly resolutions may be unsettled, the resolutions nevertheless have significant political importance at the very least.[111]

The *Magna Carta* of space was embodied in 1963 by a UN resolution entitled, "Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies".[112] This resolution provides that:

> ... the exploration and use of outer space shall be carried out for the benefit and in the interests of all mankind, that outer space and celestial bodies shall be free for exploration and use by all States on a basis of equality, not subject to national appropriation and in accordance with international law including the Charter of the United Nations.

This declaration was followed, on January 22, 1967 by the signature of the Outer Space Treaty [full name].[113] Its text mainly reproduces the principles enunciated in the 1963 Declaration. One of the Treaty's most relevant provisions stipulates that:

> Outer Space shall be used for the benefit and in the interests of all countries. regardless of the degree of their economic and scientific development.[114]

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110 Un General Assembly resolution 1802 (XVIII) of December 14, 1962.

111 See generally Mateesco Matte, N., Aerospace Law: Telecommunications Satellites, Institute and Centre of Air and Space Law, McGill University, Montreal, and Butterworth (Canada) Ltd., 1982.

112 Un General Assembly resolution 1962 (XVIII) of December 31. 1963.

113 Un General Assembly resolution 1962 (XVIII) of December 19, 1966; for further historical context, see Mateesco Matte. N., Space Policy: Today and Tomorrow - the Vanishing Duopole, Annals of Air and Space Law, op. cit., p 567- 616.

114 Outer Space Treaty, op. cit., Preamble.

With the rapid expansion of communications satellite services, coordination was required to ensure the prompt implementation of this principle at both technical and operational levels. The technical aspects of avoidance of interference and coordination of standards which foster universal access to global telecommunications, remain one of the principle functions of the ITU. For example, in 1963, the ITU allocated certain radio frequencies for use in the communications satellite service and for experimental purposes. These actions helped greatly to set the stage for the introduction of commercial communications satellite services around the world, while also ensuring that the three other telecommunications principles reviewed previously may continue to be respected as the technology and its management by the world community evolves into the next millennium.

The ITU has also been instrumental in setting the pace in certain operational aspects throughout its conventions since 1865. The 1992 ITU instruments again confirmed the world community's commitment to the principle of universal access on a non-discriminatory basis to international telecommunications. The ITU Constitution stipulates one of the essential purposes of the Union is to:

> [...] promote the extension of the benefits of the new telecommunication technologies to all the world's inhabitants; [...][115]

These UN declarations and subsequent treaties regarding space activities, as well as the more specific ITU framework, have spelled out a general legal basis for certain aspects of telecommunications activities. In practice, however, the ability to provide

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115 Constitution of the International Telecommunications Union, 1992, Article 1.

universally accessible telecommunications services on a non-discriminatory basis for all countries is only possible with adequate satellite systems which offer effective and reliable communications.

Consequently, the task of implementing the UN Assembly's overall directive was left to initiatives undertaken outside the UN framework[116]. The foremost among these initiatives was the establishment on a cooperative basis of the Intelsat consortium. In 1965, the United States, which lead the Intelsat initiative, described the consortium to the UN General Assembly as "a giant step toward fulfillment" of the 1961 resolution, referring to the General Assembly's resolution concerning the need to make satellite communications available on a global and non-discriminatory basis.[117] At the end of the debate during which this statement was made, the General Assembly noted "with satisfaction the growing measure of co-operation among many Member States in the peaceful exploration and use of outer space.[118]

In 1968, there was a revival of interest within the UN General Assembly in the more practical arrangements that were being established outside the UN framework for global satellite communications. This renewed interest was stimulated by both by the submission of the Soviet sponsored Intersputnik proposal, and by the approach of the 1969 Intelsat Conference which was going to formulate its definitive arrangements.[119] In the resolution unanimously adopted by the UN at the conclusion of its 1968 debate:

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116 Valters, E., op. cit., p.188.

117 Un General Assembly Resolution 2222 (XXI) of December 19, 1966.

118 Un General Assembly Resolution 2260 (XXII) of November 3, 1967, and Resolution 2601 (XXIV) of December 16, 1969.

119 Valters, E., op. cit., p.188.

the Assembly reaffirms its belief, as expressed in General Assembly resolution 1721 D (XVI) of 20 December, 1961, that communication by means of satellites should be available to the nations of the world as soon as practicable on a global and non-discriminatory basis, and recommends that parties to negotiations regarding international arrangements in the fields of satellite communication should constantly bear this principle in mind so that its ultimate realization may not be impaired[120].

To respond to the world-wide demand for telecommunications, Intelsat has been working since its inception to make available the space segment for fixed satellite communications with a growing number of countries. It is important to note that these countries, which are also responsible for the implementation of the earth stations within their territory.

Since a country's jurisdiction also extends to its registered ships which travel around the world, the maritime community has expressed, through the IMO, the necessity for ships to also take advantage of satellite communications. When mobile satellite communications technology became sufficiently developed to warrant the establishment of an international consortium which would operate the service globally, Inmarsat was formed.

As mentioned earlier in this chapter, adherence to the Intelsat and Inmarsat agreements by a growing number of countries has *de facto* established a regulatory framework to oversee the operational aspects of satellite communications, with the objective of ensuring the provision of universal service on a non-discriminatory basis. Both organizations currently have dominant positions in the world. As noted, they

120 Un General Assembly resolution 2453 B (XXXIII) of December 20, 1968.

provide satellite telecommunications services on a global basis in fulfillment of their mission of public service on behalf of the member states, pursuant to the mandates formulated in their constituting multilateral agreements. The application of this fourth principle has consequently also become one of the important responsibilities of Intelsat and Inmarsat.

Chapter 3 Emerging Trends and Issues

"There is nothing permanent but change" was a statement made by the Greek philosopher Heraclitus, some 2,500 years ago. In 1979, when Professor Nicolas Mateesco-Matte referred to this adage[121] - an often neglected dimension of reality, the very first cellular phones and fax machines were being marketed at prohibitive prices, and Inmarsat was inaugurating its services with the first international mobile satellite communications system.

These and other emerging technologies presented the first signs of the current transition period. Innovative telecommunications and information technologies would modify economic, political, social and regulatory structures at an unprecedented exponential pace in many nations around the world.[122] This structural change is dramatically different from most notable changes that have occurred in history, essentially because it is affecting the transmission, process and storage of information, which is the universal fuel for economic engines, as well as the major influence in an individual's thinking and behavior. In this sense, Garfield, the well respected humanist cat, may have been absolutely right in recently declaring that "the future is no longer what it used to be".[123]

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121 Mateesco Matte, N., Space Policy: Today and Tomorrow, Annals of Air and Space Law, Institute of Air and Space Law, McGill Univers.ty, Montreal, Vol. IV, 1979, p. 567.

122 See generally World Telecommunications Advisory Council (WTAC), Telecommunications Visions of the Future, ITU, February 1993.

123 Garfield. the cat, in a famous poster depicting the times Source: Barcelo, Yan, Télécommunications et turbulences, Les Affaires, 6 mai 1989, p.16.

The phenomenal growth of technological developments in the telecommunications and information processing industries have fostered an increasing free flow of information. As a result, more effective telecommunications and information tools and increasingly shorter technology life cycles, in turn, have generated innovative technologies and systems universally accessible at increasingly affordable prices. This has also stimulated growing global demand and competition to provide better products and services in all sectors. As a consequence, both private sector and government organizations have been forced to restructure their activities domestically as well as internationally.

The technological, socio-economic and regulatory trendlines have now clearly emerged during the present transition period. These trends, which are all highly interdependent at both national and international levels, are the focus of the first section in this chapter. The second section presents the issues which result from the emergence of these new trends, as they forge an environment increasingly difficult to manage in the regulatory framework which had been originally established to foster the inception of the satellite industry. Particular emphasis throughout this analysis will be given to the continued achievement of objectives set out in the four principles regarding the operational aspects of telecommunications.

3.1. Emerging Trends

This section reviews recent key developments in terrestrial and satellite telecommunications, as well as the structural socio-economic and regulatory changes which have recently occurred concurrently with the emerging technology and system developments.

3.1.1 Technological Innovation and resulting competitive advantages

The initial catalyst for change was undoutedtly the massive technological movement which, since the early 1980s, was fueled notably by digitalization, software development for terminal and switching devices, component miniaturization, but also by sharply decreasing transmission unit costs. Advanced microelectronics and electromagnetic wave propagation instrumentation, fiber optic cable, as well as data and signal compression technologies have been integrated into all forms of electronic information transmission systems, including data, voice, and video. These advances in hardware and software are being incorporated into current and future terrestrial and space communications system designs.

Although these various technologies had originally been developed independently from each other, as described in Chapter 1, this transition period, which is characterized by the world-wide transformation of paper-based organizations to electronically managed activities, has witnessed the convergence of a diversity of technologies and systems.

For example, although the first computers had originally been created specifically for tabulating purposes, they have increasingly contributed to the development of telecommunications,[124] thereby making unrecognizable the traditional passive telephone device which was used throughout most of this century. Telephones are becoming sophisticated terminals equipped with increasingly powerful, miniaturized and inexpensive

124 Certain observers evaluate that approximately 80% of the world's computing power is dedicated to telecommunications systems.

intelligence, which allows the user to process, transmit and store all types of information. Moreover, the information processing power of computers is augmented manyfold when computers are linked in a network to other data banks via telecommunications. The most outstanding illustration of this phenomenon is perhaps the growing number of users connected to various private networks or the expanding Internet [125].

Organizations in the telecommunications, broadcasting and information industries have operated traditionally in separate markets, with little synergy occurring by way of either competition or collaboration. As a result of the technical changes already observed, telecommunications have progressively become less stand-alone as an industry. The computer, broadcasting and telecommunications industries have overlapped and converged with each other by sharing synergetic technologies while recognizing mutual dependencies.

In the long term, computers, broadcasting and telecommunications systems will have joined forces to provide an integrated global information infrastructure with interactive capabilities, otherwise referred to as the information highway. This single open architecture network would integrate currently distinct and often parallel systems to provide high-speed transmission for all telecommunications services. The integrated network would ideally allow the local and long distance transmission of digitalized information for all contemporary telecommunications needs, which would be delivered to multiple destinations for various uses by a single universal system comprised of terrestrial and space segments. The consumer would access this universal broad-band communications network through a single ubiquitous multi-purpose terminal, which would provide a wide range of services. These would include classic fixed and mobile

125 Internet, for example, is a network of networks, which currently enables approximately twenty-five to thirty million users to exchange data. This number is growing exponentially.

telephony, advanced telephone call management, faxing, teleconferencing, satellite and cable television, banking and money management, global positioning, remote control, access to medical files, word processing and numerous other software applications, as well as automated billing. These and many other services may become accessible for professional and personal use within regions where this information highway is made available to users who have access to a telecommunications dial tone.

This concept of the future integrated communications environment contrasts with the current information transmission infrastructure. An analogy may be helpful to illustrate the necessity to implement the information highway. The current infrastructure is comparable to a highway system that would provide separate roads for each form of transport - cars, motorcycles, buses, trucks, bicycles and rollerbladers. Another powerful analogy can be made by imagining the unnecessary complexity of an aqueduct system which would transport dedicated water supplies in individual lines for each specific use, as opposed to transporting all of the water in a main line for different uses at its various destinations - whether drinking, cleaning, irrigating fields or supplying an electric generation plant. In this sense, digital bits of information are similar to water, which could be transported simultaneously over the same system, and then distributed to suit user demand.[126]

This growing convergence between industries has fostered the development of common standards in information processing devices to facilitate data transmission. At the very least, a minimal form of open system interface protocols are expected to allow an increasing number of different designs in terminal devices to operate while guaranteeing a minimal level of international connectivity. Technologies based on digitalization and data

126 Ahmed, N., Director General, Spectrum Management, Department of Communications Canada, Interview, September 5, 1992.

compression will continue to blur traditional distinctions between telecommunications, information processing and broadcasting services, which will even further lower the costs of telecommunications services, while facilitating the entry of new competing service providers into all three markets.[127]

Another notable trend is that the introduction and proliferation of these innovative telecommunications technologies are also expected to have shorter life cycles because of their relative effectiveness in comparison to newer and more powerful technologies that will follow. The industry is attempting to produce new equipment in modular design. This not only permits faster repairs to defective devices, but also enables the modular replacement of improved design.[128] This contrasts with the longer life cycles of technology that the world has been accustomed to for centuries where, from time to time, completely revolutionary concepts would be introduced in the marketplace with a promise to achieve similar results at decreased costs and increased effectiveness. The implementation of such revolutionary concepts, such as the proposed hand-held mobile satellite terminal reviewed in the following paragraphs, is increasingly difficult to achieve because the phenomenal investments are not always fully justified when other systems provide an adequate level of similar service as well as a satisfactory rate of return on investment - capital and dividends.

The numerous technological innovations described above are providing increasing system efficiency, terminal size reduction and mobility. The emerging environment is currently characterized by a proliferation of more powerful and versatile terminals, whether wired or mobile, as well as by increasingly effective transmission systems, which

127 Gagné, P., Director, International Relations, Department of Communications Canada, Interview, December 3, 1992.

128 Reeckie, H. op.cit.

can carry more information to a variety of destinations in different forms including voice, video and data. The design of future telecommunications services will no longer be based on the provision of a few mass-produced devices imposed by a particular organization protected by a regulated monopoly, but rather by a growing number of providers tailoring services to user requirements.

The telecommunications infrastructure, particularly in certain industrialized countries, is expected to be enhanced tremendously from these technical and system developments. Perhaps the most apparent difference with the previous basic telephone service era will be the volume of information which can be transmitted between multiple users because of the availability of a more powerful transmission infrastructure and advanced switching devices. The increasing versatility and mobility [129] of innovative terminals provided to a growing number of consumers are also key characteristics in developing terrestrial telecommunications trends.

Also expected is a growth in service penetration levels where the deployment of interconnecting networks are financially justified. The network would thereby generally continue to expand to regions where users have the ability to purchase the services. Although the implementation costs of the new services are decreasing, it is expected that there will remain vast regional discrepancies in accessibility to the latest terrestrial telecommunications services. Unless anticipated by governments and corrected by a global regulatory framework, the gap is not expected to become narrower in a natural manner. At the risk of over-simplifying, this may be explained by simple economics: since the access to efficient telecommunications increases the users' competitive edge and

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129 The mobile terminals have proliferated, particularly since the spectacular penetration rate of cellular phones in certain areas, which is starting to offer similar processing capabilities as land lines for data and voice storing and transmission. More recently, experiments with personal communicators have also been conducted in Europe, North America and Asia. Reeckie, H. op.cit.

revenue generating ability, the users of advanced terrestrial telecommunications in particular regions will generate the necessary resources to purchase even more empowering technologies, while the revenue and purchasing ability of users not accessing similar services decreases.

Space-based telecommunications have also undergone profound changes which are indicative of the type of systems and services to be expected in the future. As noted in Chapter 1, satellites have been providing fixed and mobile communications services on a distinct basis, which originally justified the establishment of two separate consortia each providing one of the global services. The new technologies mentioned above are expected to transform the configuration and performance of fixed and mobile satellite systems, thereby affecting the design of earth stations as well, which in turn could offer world-wide accessibility to satellite communications.

Currently, the general public can only access fixed satellite communications through a terminal which is connected to a terrestrial communications network.[130] This network then relays the signals to and from a local fixed earth station, which transmits them via satellite to another earth station.[131] This type of routing has not posed a problem in areas where wired or cellular telephony systems are readily available, making satellite communications as simple as communication within a local loop. However, there remains a communications problem in the many areas where these earth stations have not been installed. This makes satellite communications unavailable in those particular areas which remain isolated from the global network. Furthermore, it is difficult to justify establishing a rather sophisticated and costly earth station in areas which have not implemented a

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130 VSATS can make satellite communications directly available to certain small business users who use special earth stations, but currently this system has not been adopted widely by the general public.

131 This portion of the signal transmission is often referred to as the space segment.

terrestrial communications system to make the space segment available to a sufficient number of users who will share its cost. Areas which currently do not have access to these types of earth stations are found in isolated regions of industrialized countries, as well as in many developing countries.

Emerging technologies are expected to provide a solution to this current inaccessibility. Improvements in both power and signal transmission capacity in satellites will provide telecommunications services to existing and newly constructed fixed earth stations connected to local terrestrial networks, as well as to mobile stations. Accordingly, both fixed and mobile earth stations would become smaller, increasingly mobile and affordable to the extent that consumers would be able to communicate directly via satellite from anywhere in the world, as long as an operational satellite remains in the consumer's line of sight. Future terminals are expected to enable consumers to directly access satellite voice and data two-way communications, as well as receive-only video signals delivered by direct broadcast satellites.

Perhaps the most remarkable improvements are occurring in the mobile satellite communications services, which have already made considerable progress over the last twenty years. The most recently deployed satellite system[132] provides consumers with miniaturized earth stations no larger than a briefcase, which enable communication directly with the space station thanks to more powerful and miniaturized technologies integrated in both the transponders and the terminal earth stations. This system offers users the ability to move anywhere within the satellite's visibility, anywhere between 78^{o}N to 78^{o}S.[133]

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132 Inmarsat-M , introduced in 1993, provides digital voice and low-speed fax communications through a new generation of small, less expensive terminals. The briefcase models provide portable communications world-wide and models designed for maritime use are also now in operation. Inmarsat, op. cit., p.3.

133 Reeckie, H. op.cit.

New technologies have also been tested, which include advanced satellite tracking, automated remote switching, and multiplexing, as well as satellite to satellite signal relay capabilities. Spot beam technology allows a more effective use of satellite channels in the retransmission of an increasing number of signals. Dynamic beam hopping directs the spectrum resource to the time-variant high traffic areas, hence not tying up the spectrum in places where demand is low. On-board processing eliminates the need for links between the satellite and the center where the switching and routing of calls are processed.[134] These emerging technologies are currently being incorporated into innovative global and regional system designs, which would provide ubiquitous service to a growing number of mobile communications users anywhere on land, over the sea and in the air. Proponents of future systems are considering the delivery of voice and data transmission service directly to and from hand-held terminals, while significantly reducing again the size and weight of the earth station. Various system designs are being proposed, with configurations ranging from a simple system comprised of few powerful geosynchronous satellites to complex satellite constellations revolving in non-geostationary orbits.

The provision of such services are currently being envisaged by international consortia as well as by private organizations. These systems could significantly contribute to providing an essential link which would technically enable true global communications for individuals in regions where, as noted above, public access to communications satellites is currently not available.

In 1993, the FCC received half a dozen competing proposals for mobile personal voice and data communications systems, which ideally would operate at frequencies above

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134 Ahmed, N. , Is Spectrum Scarcity Real?, unpublished essay produced for the Canadian Minister of Communications, March 1992.

1 GHz.[135] For example, some of the proposed systems require the deployment of a constellation of satellites which would revolve in either low-earth orbit (LEO) or Mid Earth Orbit (MEO), at altitudes which vary between 750 and 1500 km.[136] Also proposed are various Highly Elliptical Orbit (HEO) satellite system, which have a more regional vocation. It should be noted that all of these designations are unofficial and imprecise, but they do indicate some variant of non-geostationary operations, and they share many of the same characteristics.[137]

The developments in fixed and mobile satellite telecommunications are, therefore, in the process of eroding the distinction between domestic and international service. Furthermore, the distinctions between fixed and mobile services, as well as between terrestrial and space systems are expected to eventually become academic, because each of these systems is rapidly evolving into a segment of an increasingly integrated seamless global telecommunications infrastructure. Certain observers note that this shift towards integrating various modes of transmission is the fastest growing trend in the telecommunications industry, and that it is not solely the work of corporate strategists, but rather testifies to the growing strength of consumers and their ability to chose from an increasing array of services and service providers. [138] The consumer will eventually

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135 For further information concerning the exact configuration of these proposed systems, see The Report of the MSS Above 1 GHz Negociated Rulemaking Committee, presented to the FCC April 6, 1993. Also see Use of Low Earth Orbit Satellites for Voice Communications, Committee on the Peaceful Uses of Outer Space, Scientific and Technical Sub-Committee, Thirty-first session, Vienna, United Nations A/AC.105/564 21 December.

136 Reeckie, H. op.cit.

137 These systems can, at the outset, be characterized as heavy consumers of frequency spectrum users, because they are expected to operate on similar frequencies within the whole service area, without partial exceptions because a specific region is using the same frequency for another type of service, therefore creating possible interference. These systems are also similar in that they require extensive capital investment to deploy and operate the satellite constellations.

138 See generally Mario, R.J., The Satellite Communications Marketplace: Taking our cue from the Customer, COMSAT Mobile Communications, London, December 7, 1993.

want to use a single terminal which will have the ability, no matter where, to search for the most effective and inexpensive transmission route to deliver information digitally in various formats.

The emerging technologies and systems carry with them potential positive and negative consequences, which can be measured in terms of achieving the objectives spelled out in the fundamental telecommunications principles enunciated in Chapter 2. Besides providing the obvious convenience of added-value services to people in industrialized areas where basic telecommunications are already taken for granted, these emerging space and terrestrial systems certainly have the potential - if appropriately managed - to bring the world community closer to achieving universal access to an integrated global communications network; such networks would enable more people than ever to communicate together either locally, nationally or internationally no matter where they may be in the world. These positive effects would be welcome indeed in industrialized countries as well as in developing areas.

The general direction guiding the development of these technologies and systems can be characterized by the objective of providing highly mobile, more powerful and versatile interactive services which enable activities such as virtual conferencing with multimedia support for individuals wherever they may be located. A full range of services would be available, as previously mentioned in this chapter. The integration of various communications tools into one terminal would enable the user to process, store and transmit various forms of information on demand. In summary, the general trend is to recreate the natural personal communications process in a distance-insensitive manner within the global environment.

Emerging satellite technologies would further contribute to creating a global seamless communications network which would incorporate both mobile and fixed communications. Proposed hand-held mobile terminals, directly linked to a global satellite system, would operate in dual-mode, with terrestrial/satellite options providing the most cost-effective mode of transmission. In other words, such a terminal could be operated as a normal cellular phone when within a range of a terrestrial cellular system, or otherwise as a satellite phone. Essentially, this type of global system would allow world-wide roaming for individuals anywhere. The new "personal communications " concept is gaining interest, where an individual and no longer a place or a vehicle may be reached anywhere by dialing a unique number. This future trend may well be on its way to becoming a reality, especially when people on the move want to avoid being cluttered with different cumbersome pieces of equipment.

Isolated areas in industrialized countries, as well as developing countries, where current public access to global and national telecommunications is either difficult or non-existent, will also benefit from the reduction in costs and the simplification of both terrestrial and space systems. However, converging fixed and mobile satellite communications are expected to provide the unique benefit to consumers which makes them insensitive to distance in terms of the service availability and transmission costs that even sophisticated terrestrial networks cannot provide. Satellites could either provide domestic and international telecommunications service to regions away from the cities and major highways where a cellular or wired local loop system could not be established to operate economically. Satellites can also link these terrestrial systems which otherwise could not intercommunicate.[139] The configuration of satellite systems allows the

139 Gibson, R., Nation shall Speak onto Nation: The Worldwide Role of Satcoms, in Never Beyond Reach, (INMARSAT publication, 198921. See also Callendar, M., "Future Deployments in Personnal Computers, Transitions spectrum conference, 1992, p.1.3.4.

provision of wide area telecommunications coverage which is not impeded upon by geographical or topological barriers, such as spans of ocean and mountain ranges, which generally limit the expansion of terrestrial based communications to high traffic areas. Nor are satellite communications quite so vulnerable to natural disasters or sabotage, to the same extent as terrestrial long-distance links particularly in developing areas where a diversity of linkages to support heavy traffic routing have not yet been established.

Proponents of the proposed non-geostationary satellite systems noted above are suggesting that they are the new answer to high quality "anytime, anyplace" satellite communication in the twenty first century in both industrialized and developing countries. Many consumers of the current terrestrial and satellite telecommunications services, particularly those used for mobile telephony, have naturally been brought to expect that these services will be made available not just through fixed installations, but also through mobile satellite terminals anywhere on the sea, in the air and on land. This would ensure that where ever the users of the new technology find themselves, they would never be out of reach.

3.1.2. Socio-economic and Regulatory Trends

Technological innovations have been enabling a restructuring of telecommunications and information systems which, in turn, have increasingly fostered a change in socio economic and regulatory trends in the public and private sectors, both nationally and internationally. These trends are creating a new global environment essentially characterized by competition, deregulation and privatization.

This section offers a review of socio-economic and national regulatory trends which are increasingly characterizing the new information-based societies world-wide. Also examined are the influences of these trends on the restructuring that is expected of both terrestrial and space telecommunications service providers, which must respond to increasing consumer demand. Indeed, better informed consumers use telecommunications and information systems to organize themselves as user groups, thereby acquiring the ability to access the best telecommunications service choices and lowest prices available globally . The following demonstrates that both the competing telecommunications providers as well as the regulating authorities which oversee terrestrial and satellite communications have no choice but to readjust in response to this consumer-led demand. After all, consumers do have a legitimate reason in requiring this access because they can no longer afford to pay more for less performing telecommunications tools which are needed if they are to survive in a highly competitive globalized economy.[140]

3.1.2.1. Socio-Economic Dimensions

It is important to note that these socio-economic changes are continuing to influence trends in the development of emerging national regulatory processes. There have been many recent instances of governments privatizing or commercializing previously state-owned telecommunications services, while at the same time formulating more liberalized national regulatory frameworks which invite competitive organizations to provide telecommunications services to accommodate consumer requirements.

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140 For examp:e, an international call from most Caribbean islands to Canada currently costs 6-8 dollars a minute, with the complements of the foreign monopolies which are providing the service there. By contrast, a call covering the same distance placed in the United States costs perhaps 50 cents, 1/16th of the price. It is therefore understandable why businesses are more attracted to the USA than to the Caribbean, and why consequently this may imp[act on the rate of development which is much slower in the Islands.

These movements, in turn, create pressures domestically and internationally, not only on the traditional telecommunications service providers, but also on their new competitors to modify dramatically in their business approaches if they are to survive and prosper in the emerging marketplace. The traditionally monopolistic telecommunications service providers must rationalize to protect continuing returns on their investments while also competing with new highly aggressive service providers, many of whom are well accustomed to responding to client demand. On the other hand, the new competitors have to face the strength of the incumbent service providers by establishing themselves and demonstrating that they can supply the wide range of services in a reliable and acceptable manner.

Telecommunications have a unique ability to capture and disseminate all types of information; this creates structural shifts at both micro and macro-economic levels. The new systems described in the previous section are affecting the way in which both people and societies think and behave, as well as how goods and services are provided domestically and internationally. This is due, in part, to the fact that technology developments are providing pertinent information to both business and individual consumers of telecommunications about services available world-wide.

In a micro-economic and social perspective, developments in communications and information technologies are transforming the way people interact and do business in almost every field of endeavor, opening up new opportunities and challenges in both domestic and international markets. Whether accessing basic telephone service for a first time in a developing area, or implementing advanced telecommunications in a highly industrialized zone, the use of new technologies influences where and how people work, play and study, how they do research, design and manufacture products, and distribute goods and services. These technologies are modifying the way banking, bill payment and tax collection is conducted. and how people learn about what is going on in the world, educate children and retrain for changing jobs. The new telecommunications services which are available at decreasing costs are also changing how people interact with friends and family, as well as how they spend leisure hours.[141]

Most importantly, individual consumers will increasingly access devices and services which provide the ability to make more informed purchasing decisions. These capabilities have become essential for economic growth and social well-being in an information based economy which actually requires that people have the ability to generate, access, analyze and use information. Many consumers of advanced telecommunications are the businesses which are rapidly developing new services to respond to the vast market demand, particularly in information management areas. This is contributing to a shift in job growth from the manufactured goods sector of the economy to the services sector; this trend that will likely continue at an increased pace.

At a macro-economic-level, public and private organizations, as well as societies in general, are structurally changing because of increasingly affordable telecommunications services. As previously noted, these new technologies are a catalyst to growing competition, which in turn fosters a world-wide integration of markets. This is the steady, indeed relentless globalization of economic activity. Cross-border mergers and acquisitions, international joint-ventures, cooperative research and development projects are all becoming familiar features of the landscape. The creation of electronic networks has revolutionized the way in which markets operate. International business, which

141 The Canadian Information Highway: Building Canada's Information and communications Infrastructure, Spectrum, Information Technologies and Telecommunications Sector, Industry Canada, April 1994, p. 3.

depends more than ever on the possession and transfer of information rather than goods, has been conducted increasingly without regard to national boundaries. Indeed, the use of electronic links for financial, industrial and commercial purposes provides the infrastructure for what is fast becoming the global economy.[142]

In an increasingly competitive environment, many types of organizations are searching for ways to reduce costs. Characteristics of this global integration manifest themselves through businesses which, with the support of advanced telecommunications, are becoming location-insensitive, thereby establishing their operations in any region of the world where costs and more flexible regulatory environments provide them certain competitive advantages. Furthermore, businesses are forced to expand their market base beyond traditionally domestic borders to ensure their survival.

Another factor which fosters world competition and integration of business organizations is the regional and global trade agreements. These intergovernmental agreements reduce barriers and facilitate the expansion abroad for organizations capable of providing competitive services and prices.

Moreover, as noted in the case of the individual consumer, organized telecommunications consumers are also becoming increasingly informed and demanding, which in turn impacts upon the development of the very telecommunications system that has enabled the consumers to develop this clout. This new reality contrasts with the way telecommunications have been provided since their inception, where monopolies or oligarchies would simply impose mass-produced telecommunications, broadcast and

142 Maitland, Sir D., 'The Missing Link' Revisited", Transnational Data and Communications Report, Nov/Dec 1992, p. 15 at 17.; see alsoMaitland, D., "Forging the Missing Link", Reforming the Global Network, International Institute of Telecommunications Report on the 1989 ITU Plenipotentiary Conference, p. 66.

information products. It is to bc expected that organized consumer groups are to have an increasing influence on service providers as well as on domestic telecommunications regulators. The growing consumer demand will require the establishment of mechanisms which will foster the speedy availability of telecommunications services, so that consumers at the very least find themselves in a level playing field where they can compete globally. The most productive consumers of telecommunications are less apt to maintain their operations in an area which does not provide services that are available elsewhere at competitive prices, particularly if these services constitute critical input which will provide them a competitive edge.

3.1.2.2. Regulatory Dimensions

In many industrialized countries, and a growing number of developing countries, governments are realizing that irreversible technological and socio-economic trends are creating pressures to privatize their state owned and operated telecommunications services. Governments also realize that to respond to the phenomenal consumer demand, the key is to establish a regulatory framework which allows competition domestically in the provision of telecommunications services. Increasingly, it appears that policy objectives of numerous countries to ensure the provision of telecommunications as a public service can be achieved through innovative means like privatization and competition, which are more suitable for the emerging information-based environment. This section examines how the national and international satellite communications regulatory trends are no exception to the general trends affecting telecommunications.

Since the beginning of telecommunications, most countries have exercised control over communications in their jurisdiction through the ownership and operation of their telecommunications. This approach may have been effective in times when resources and technological innovations were scarce, thereby ensuring that the telecommunications system, which was already considered to be a public service, was implemented according to government policy. Over the last few years, however, powerful influences on governments to privatize or commercialize their telecommunications have been gaining importance. Some of these important influences are enumerated in the Hansen Report ,[143] in which it is stated that:

> analysts predict that the traditional monolithic state-owned monopoly is disappearing as a general model for telecommunication sector organization, in developing as well as in industrialized countries. This results mainly from five factors:
>
> a) growing and increasingly heterogeneous demands for telecommunication services, especially from large users;
>
> b) the sustained inability of [state-owned] telecommunication enterprises to meet these demands;
>
> c) the availability of technology that allows needs to be met independently from the established telecommunications enterprises, and often at lower costs;

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143 Hansen, The Changing Telecommunications Environment: Policy Considerastions for the Members of the ITU, BDT/ITU, 1989, (Chapter 1, pages 8-9, paragraphs 8.4-8.7.

d) the emergence of enterprises seeking telecommunications investment opportunities outside their own countries; and

e) the experience of a growing number of industrialized countries and a few developing countries in liberalization and privatization of telecommunication.

Because telecommunications permits international communications virtually at the speed of light, and because it remains one of the prime factors in the transformation of national and regional economies into one global economy, there is additional pressure to ensure that domestic telecommunications policies and regulatory environments adjust to improve the nation's international competitive position.[144] This is being facilitated by a turn toward market-driven political ideals in many countries. This increased competition in telecommunications, in turn, generates more choice and decreasing costs, thereby completing the circle by making the consumer even more demanding.

Consequently, a growing number of governments are transferring power to the marketplace[145] as they have started to transform government corporations or intergovernmental organizations into private sector business entities. The drive towards privatizing the industry has been a global trend which has had its most dramatic impact in the more industrialized nations.

These technological and socio-economic trends, as well as wider spreading privatization are leading to the establishment of new national regulatory frameworks,

144 See generally Telecommunications in Canada: An Overview of the Carriage Industry, Department of Communications Canada , 1992.

145 Tarjanne, P., Multilateral Organizations and the Global Information Society, speech presented to the International Institute of Communications Annual Conference, Montreal, 10 September 1992, p. 2.

which include the promotion of new entry and competition into the previously guarded monopolistic markets.[146] The progression down this path also varies between countries, but the movement seems inevitable, and most carriers assume that any monopoly powers will be eroded. The strategic assumption is that they will face, sooner or later, a completely new regulatory environment.[147] Although many authors refer to this phenomenon as a process of "deregulation", it is important to note that it would appear more appropriate to view the reformulating of regulatory frameworks as a process of "re-regulation", which is designed to establish a balance between allowing competition and ensuring consumer protection .[148]

Many countries are expected to adopt a critical aspect of regulatory reform which accompanies the introduction of competition: the necessary separation of the regulatory and operating bodies, which provides an equitable approach for both existing and newly established telecommunications service providers, otherwise refered as a level playing field. It thereby avoids a situation whereby the incumbents are perceived to be "judge and party". This also helps ensure that public policy will be applied evenly to all service providers for the benefit of the general public, thereby reducing possible service interruptions which may result from casualties of competition. A well balanced regulatory framework which fosters the provision of wide choice and competitive prices will reduce the risks of consumers and service providers having to ignore the regulatory framework to access more attractive foreign services with the support of technology because of too restrictive regulations.

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146 St-Arnaud, D., op. cit.

147 See generally WTAC, op. cit.

148 Jakhu, R., Interview op. cit.

Two other basic influences have contributed to the changes occurring in domestic telecommunications industry policies. First, there has been the increase in general regulatory processes such as those associated with general consumer protection or with anti-competitive practices. Secondly, the evolution of general trade policies, which although originally designed to regulate trade in goods, have progressively been applied to the service sector, and includes telecommunications. [149] The dual role of telecommunications as a sector of economic activity in its own right and as a means of transport for other economic activities has been recognized by the Uruguay Round of trade negotiations. These winds of change will undoubtedly affect national regulations. This in turn will greatly modify the multilateral debates on the formulation of the international telecommunications regulatory framework, particularly those operational aspects which require oversight by the international community.

3.2 Emerging Issues

The satellite business, which traditionally has been even more tightly regulated than certain terrestrial telecommunications services, such as long distance international underseas cables, is also affected by trends of privatization, competition and newly regulated national frameworks. Pressures for bringing structural change to the Intelsat and Inmarsat agreements, which essentially regulate the operational aspects of global satellite communications, are subject to pressures for structural change which are coming from several directions.

149 See generally WTAC, op. cit.

It is important to note that a major force to readjust to the new competitive environment comes from the Signatories themselves. Certain Parties to the Intelsat and Inmarsat agreements are launching domestic and regional communications satellite systems which directly compete with the international consortia. Furthermore, many Signatories have been undergoing radical changes, as noted above, whereby the old state monopolies have been corporatized and privatized. When Intelsat and Inmarsat were created, almost all signatories (Comsat is the notable exception) were government owned and controlled post and telecommunications entities (PTTs). More than half of Inmarsat's funding, however, now comes from privatized Signatories. The percentage is approximately the same for Intelsat. Of all of Inmarsat's member countries, many have privatized or are at some stage in the privatization process.

As mentioned, business users have realized the strategic significance of telecommunications to their business competitiveness. With the end of virtual monopolies, both terrestrial and space telecommunications service providers must be more competitive in providing the ultimate product and service choices at the right prices to respond to the more sophisticated consumer demand. To be more competitive, they also have to rationalize their operations and increase productivity.

In delivering their services within the emerging environment, telecommunications organizations will be competing with other operators of global and regional services for customers, capital, professional staff, access to spectrum, regulatory access (permission to provide service), providers of terrestrial and space segment equipment and systems, orbital slots, terminal providers, cellular and personal communications providers, and distribution channels, to name a few.[150] A successful telecommunications service provider must be fast in responding to consumer needs, nimble by investing profits wisely

150 St-Arnaud, D., op. cit.

to anticipate demand, and adaptable to new situations and priorities. Organizations providing telecommunications services in general need freedom and flexibility to operate effectively in better serving the customer who can chose from a growing variety of available options. In summary, changing customer demand and growing competition impose the need for a strong, entrepreneurial approach to the telecommunications business, and more particularly to the satellite communications business.

In order to be competitive in the emerging environment, telecommunications service providers must rationalize their operations like most of their clients. Industry rationalization is all the more imperative because of shortened innovation cycles, increased product development costs (particularly in software), and global market integration. The restructuring of activities of many domestic and international telecommunications organizations will dramatically contrast with the previous era, which encouraged a mandate of exclusive universal service provision, cross-subsidies, technical priorities, and minimal marketing innovation. The set of priorities is changing, with the effect being that productivity and world's best practice are becoming key drivers, and pressure is mounting for cost-based tariffing to remove internal cross-subsidies.

For most domestic telecommunications service providers driven by productivity, there is an additional challenge, which is the shift towards globalization; this globalization is motivated by the search for the best products at minimal costs, as well as to ensure market expansion abroad. A major feature to be considered by national regulators is the transition of industrialized country carriers from an almost totally domestic orientation to a multi-domestic role or even global role. This trend for offshore expansion is to be expected from carriers, which operate in a domestic market where saturation of basic service is encountered and limits their growth potential.[151] Certain observers predict that in the long term, globalization may even change the basic structure of the telecommunications industry so that it is dominated by a small number of global actors or alliances which extend beyond national boundaries.[152]

Satellite communications operators have a particularly challenging task in the information age. The issue of competition seemed rather academic when Intelsat and Inmarsat were created respectively in 1964 and 1979. After all, what global consortium member would spend resources to create a competitive system when Intelsat and Inmarsat themselves had not yet shown there viability?[153] But more recently, as satellites have proved their worth, a number of countries and a few private entities have thought it advantageous to establish systems more or less competitive with the global consortia. The recent deployment of the various space communications systems is eroding the distinction between fixed and mobile satellite services, as well as international and domestic satellite communications. As is the case with terrestrial systems, satellite communications which can often complement each other in an integrated network, have at times also become competitors.

On the one hand, Intelsat and Inmarsat, as well as other regional international consortia such as Eutelsat and Intersputnik, find themselves pressured by the increased privatization and competition established by many of their Parties. This provides strong incentive for the consortia to review certain fundamental aspects of their operations. Decisions will have to be made in key areas in the near future. Technologies will have to

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151 See generally WTAC, op. cit.

152 Tarjanne, P., op. cit.

153 McLucas, op. cit., p42

be selected for the future systems. As technology continues to provide enhanced service opportunities, satellite service providers will have to chose between either gambling on the latest invention or benefiting from the economies of scale on earlier developments and buried investments in their bid to remain competitive. Innovative investment partnerships with manufacturers and other players will also have to be considered to support the massive growth required to respond to the increasing demand for services.

The issue of improved access to the global system is currently being addressed in the various consortia, so that investment in their operations by non-Signatories can be facilitated with a view to reducing to a certain degree the necessity of establishing privately operated parallel systems. Structural changes to the organizations are already being envisaged to develop a more effective and responsive decision making processes. For example, Inmarsat is considering the establishment of an affiliate company which would implement the satellite system and earth infrastructure for Inmarsat-P. This affiliate company would be a limited company which would provide investment and commercial flexibility to deploy and operate the new system.[154] Furthermore, both Intelsat and Inmarsat are considering changes to their amendment and decision making processes to respond to the challenges of change.

An important trend besides the direct advantages offered to the consumers of these telecommunications and information technologies is the compounded effect in the development rate of even more innovative and powerful technologies produced by telecommunications providers. This potential output is important to appreciate when designing a regulatory framework which is to foster innovations in all areas of telecommunications. If satellite communications service providers can continue to offer certain comparative advantages in effectiveness, price, diversity, quality, and mobility,

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154 Satellite Communications,"Inmarsat to Establish Affiliate Company" July 94, pp. 10-13.

they will survive in the new information-based environment . Otherwise, satellite communications will be limited to playing a more marginal role, and consequently will have more difficulty in attracting the necessary capital to develop and deploy the systems which reflect the full potential of the technologies. The appropriate regulatory environment will have an important impact on the ability for satellite systems to successfully compete both among each other and with terrestrial telecommunications in higher traffic areas, while complementing other systems in other areas; this would thereby clearly establish their position as an essential link in the seamless communications network, which increasingly will become accessible to more individuals on a non-discriminatory basis. This design of the regulatory framework, which oversees all forms of telecommunications equitably, is consequently instrumental in achieving the objectives stipulated in the fundamental principles.

Perhaps the most important issue is that newly established satellite communications service providers are aggressively approaching the marketplace with attractive services and prices, while pressuring governments to establish an equitable international framework which will allow them to provide consumers in many countries with the full benefits of competition.

Finally, it is clear that Intelsat and Inmarsat have reached an important point in their evolution. These organizations have been enormously successful since their inception, in part due to having maintained a dominant position without threatening competition. With the recent emergence of competitive international regional and domestic mobile satellite systems, such as Iridium, certain Signatories are seeking to structurally review the intergovernmental character of Intelsat and Inmarsat. It is against this backdrop that some of these Signatories are pushing for a wide range of significant changes to the organization's mandate, corporate structure and financial arrangements. The role of governments in the future of these organizations is also being seriously questioned.

Governments will want to consider the anticipated consequences of the emerging technological, socio-economic and regulatory trends as they review the operational aspects of the global telecommunications regulatory framework. The major negative consequences, which are of a technical or operational nature, are particularly important to note. Technical consequences include spectrum over-congestion[155] and an increase in space debris[156], which can both harm satellite communications, and which must continue to be addressed by both the ITU and national regulatory authorities which register launched spacecrafts.

In Arthur C. Clarke's words, "communications satellites may have added to the cacophony of the airwaves, but they have also demonstrated their ability to improve the quality of life on earth and to make a profit for their investors".[157] Indeed, it may be

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155 The number of voice circuits which can be accommodated within the same spectrum space has experienced multi-fold increases. This impressive reduction in channel bandwidth increases the number of users per given channel that can be accomodated, and hence, the information carrying capability of the spectrum. This, however, also fosters the introduction of new applications of radio services. Historically, the land mobile service has undergone a 10 to 20-fold reduction in channel bandwidth from the initial 200 kHz frequency modulation channel in the early 1950s to the present 12.5 kHz. Ahmed, N. , Is Spectrum Scarcity Real?, op. cit.; see also generally Towards a Spectrum Policy Framework for the Twenty-First Century, Department of Communications Discussion Paper, Telecommunications Policy Branch, Spectrum and Orbit Policy Directorate, September 1990.

156 U.S. Space Command, Denver, was tracking about 7,000 man-made objects as of Oct. 10, 1992, fewer than 7% of them active satellites. The rest are debris (spent rocket stages, dead satellites, fragments from exploded rockets. It is estimated that Space Command's radar and optics network isn't detecting about 7,000 grapefruit sized particles, or 100,000-200,000 marble sized objects, and billions of tiny, synthetic particles such as paint flecks. In geostationary orbit, where everything travels at approximately 27,000 km/hour, even paint chips can be dangerous. Impact of every kilogram in orbit is equivalent to 15 kilograms of TNT. In Space, that one kilogram can demolish the Space Shuttle as easily as a 2,000 kilogram rocket hulk. See Space Commerce Week, "Geostationary Orbit Cluttered: US, Russia to Work Together to Clean Up Space", November 9, 1992, Vol 9, No 43, Warren Publishing, p.2. Also see Mobile Satellite Report, "International Experts to Seek to Combat Growing Space Debris", Vol.7, No 6, March 29 , 1993, Warren Publishing, p. 4.; see also Baker, H. A., Space Debris: Legal and Policy Implications (unpublished LL.M.. Thesis), McGill University, Montreal, 1988.

157 Clarke, Arthur C., forward to McLucas John L., op.cit. p.vii

generally assumed that both the developing technology and positive market study results warrant the deployment of at least one of the proposed global mobile telecommunications systems which would use a constellation of satellites revolving around the globe in non-geostationary orbits, as well as other innovative improvements which would enhance global telecommunications abilities. Deciding which of the technologies will be deployed is not only debatable in technical terms, but is also decided in political and economic arenas which will have an important influence on this selection.

These issues may well become problematic, particularly if governments do not take the appropriate measures, both domestically and globally, to ensure that the objectives expressed in the fundamental principles remain achievable in the emerging environment. It is important to remember that these fundamental principles are expressed as an objective expression of a dynamic equilibrium - not to say compromise - between the interests of three major groups concerned by telecommunications: the consumers of telecommunications services, the service providers, and the governments. Accordingly, each of these groups have certain requirements which are to considered in a structural revision of the regulatory framework. In this chapter, these are reviewed, as well as the issues raised regarding the achievement of goals expressed in the fundamental principles. This sets the scene for the conclusion of this discussion, which proposes certain recommendations to address these issues in both the transitional period and the long term.

Conclusion

Despite all the benefits that the satellite and terrestrial telecommunications industry has to offer in both industrialized and developing areas, and despite the current level of pre-competitive cooperation between countries, which has been establishing the foundation for a truly global seamless telecommunications system, the world community remains far from having achieved the objectives it had set out for itself in the telecommunications principles. Universal access on a non-discriminatory basis is far from being achieved. In refering to the global situation, Canada's Communications Minister Perrin Beatty stated: "I believe that the industry is up to the challenge just as it had been since the days when Alexander Graham Bell invented the telephone, or when Reginald Aubrey Fesenden made the world's first radio broadcast of voice and music. We have come a long way, but there may be miles to go. If I may humbly add: those miles can be covered rapidly if the appropriate telecommunications tools become available to everyone.[158]

Many regions of the globe remain under-serviced, with little or no access to national or global telecommunications, although recently developed technologies could make smaller earth stations available to bridge the gaps between service levels. Global satellite coverage is provided to most regions, except for the less populated polar areas, and a reasonable level of connectivity between countries has been achieved. Distress and safety services are continuing to be refined as well. However, the individual access to global telecommunications networks remains to be improved significantly. As previously

[158] Beatty, P., Speech given to the Financial Post Conference on Telecommunications, Toronto, October 8, 1992.

noted, technology can help achieve these goals, but the regulators will first have to establish a framework where all telecommunications service providers are treated equitably, whether they are providing satellite or terrestrial international telecommunications. Thirty years after the launching of the first commercial communications satellite, because of the growing convergence of various technologies and integration of systems, attempting to make academic distinctions when revising the regulatory framework between terrestrial and space communications has not only become futile, but can be counter-productive as well. Indeed, with the various telecommunications alternatives increasingly available world-wide to help fuel socio-economic activity, users will pay for the most cost effective transmission service, whether provided via a space or terrestrial segment. Regulating the operational aspects of a particular segment differently by imposing specific constraints will only drive consumers away to an alternative solution. Moreover, bygone is the era where a regulator, even a *de facto* self-regulator such as Intelsat or Inmarsat, is also a service provider amongst other competitors.

Understandably, the government members of ITU did not have a great deal of experience in satellite communications when the regulatory provisions concerning satellite communications system were adopted. In 1963, the technical blueprints for global fixed service were barely sketched when the Intelsat Agreement was finalized. At that time, not a single country had an operational satellite - not even the United States. Since then, domestic regulations have had to be adapted continuously to accommodate technological developments.[159] In the first few years, the international regulatory framework, comprised of the Intelsat and Inmarsat agreements, was formulated to help achieve the goals expressed in the fundamental principles which had been developed since the inception of telecommunications, as reviewed in Chapter 2. More recently, an increasing

159 See generally St-Arnaud, D. Droit canadien et international des telecommunications spatiales. Thèse présentée en vue de l'obtention du grade de maîtrise en droit, Institut de droit aérien et Spatial, Université McGill, Montréal, 1991.

number of countries have supported the trend towards privatization and competition in the telecommunications industry. At the international level, however, the regulatory framework which oversees the operational aspects of global satellite communications has remained relatively unchanged since it was originally established.[160]

Emerging satellite communications systems can supply the segments which provide the missing link, making these "basic" and "essential" services available to all individuals, whether for safety purposes or any other applications of interactive telecommunications, no matter where consumers may be. As noted in the previous chapter, this technology has the ability to further the achievement of goals established in the fundamental principles, while addressing the consumer concerns. It is important to note that the development of these new systems can be either fostered or impeded by the national and collective choices that governments make in regulating the operational aspects of satellite and terrestrial telecommunications.

Since nearly a decade ago, the United States have initiated a world-wide trend with a revision of their national licensing policy for global satellite service delivery, with a view to liberalize the domestic and international telecommunications market.[161] Systems independent from Intelsat or Inmarsat would be allowed to compete with the two self-regulating world-wide service providers. Nontheless, until only a few years ago, many Intelsat and Inmarsat member States, which maintained control on their state monopoly telecommunications, displayed a severe resistance towards such a trend.

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160 The regulatory framework which oversees global satellite communications service, as noted in Chapter 2, consists essentially of the Intelsat and Inmarsat Agreements.

161 Israel, M., Téléglobe Canada, Interview June 23, 1995.

In 1994, however, a remarkable phenomenon clearly started to appear within the world community, whereby a growing consensus by States increasingly supported a major restructuring of the international regulatory framework which governs the operational aspects of international satellite communications.

Today, the dilemma remains as to what type of structural change would be required or most appropriate to allow satellite communications to develop in an environment characterized by competition, deregulation and privatization, while ensuring that the fundamental principles noted above would remain strongly adhered to in every region of the globe. The ultimate solution lies in a global system of networks which would provide services competitively while continuing to ensure that satellite communications be available to every country on a non-discriminatory basis through a cooperatively established network; that global telecommunications coverage and connectivity between countries continue to be increased; that the provision of distress and safety telecommunications services is to be ensured globally; and that telecommunications services be improved and developed within every national jurisdiction, including developing areas, so as to allow every individual to have access to basic or essential services.

Long gone are the traditional business approaches to telecommunications service provision, as well as the approaches with which the world markets have been divided over the last decades since the launch of Early Bird. The East and West Blocks have disintegrated, and the categorization of developing and developed countries is also being replaced by the distinction between countries or areas which have competing telecommunications service alternatives available to them, and those which do not. This distinction essentially results from political and legislative directions taken within every national jurisdiction. Those countries which have only one alternative available to them remain dependent on the system's technical and economic success to ensure the delivery of world-standard international and local telecommunications services. These are the countries which may need garnets that a globally operated service provider will continue to respect the principles summarized above even if these services - such as ensuring the availability of distress and safety telecommunications, are less lucrative to provide in certain areas.

The world community has come to the realization that the regulatory framework must be revised in order to satisfy both types of areas, whether they do or do not have access to alternative communications services. Realizing that there is a need for change is a giant step in the right direction, and solves the major problem which has characterized the last few years. This indeed clearly cuts out the work for regulators and service providers for the next few years. Members and signatories of the Intelsat and Inmarsat consortia, as well as the new service providers, will now want to keep in mind a double objective in restructuring the regulatory framework. They will want to ensure that, on the one hand, the four fundamental telecommunications principles be maintained while, on the other hand, an environment be established within which public and private telecommunications providers may compete on a level playing field for the privilege to deploy the most cost effective global satellite communications systems for the next century for the benefit of all users.

Will this regulatory framework be discussed and agreed to by the turn of the millennium? If a few individuals such as Bell, Vail, Fesenden and Marconi were good enough to dedicate their technological and marketing geniuses to helping human beings better communicate with each other, it is hoped that a few other leaders will inspire and spearhead the appropriate world-wide restructuring of a regulatory framework which will allow the positive effects of the information revolution to benefit everyone.

Bibliography

Books

Bertho, C., Télégraphes et téléphones, de Valmy au microprossesseur, Livre de poche, Paris, 1981, p. 60.

Brownlie, I, Principles of Public International Law, Clarendon Press-Oxford, London,1979.

Clark, M.P., Networks and Telecommunications: Design and Operation, John Wiley and Sons Ltd., Chichester, West Sussex, England, 1991.

Dunlap, O.E., Communications in Space: From Marconi to Man on the Moon, Harper and Row Publishers Inc., New York, 1962.

Hudson, H.E., Communications Satellites: Their Development and Impact, The Free Press, Ca., Division of Macmillan, Inc., New York, 1990.

Libois, L-J., Genèse et croissance des télécommunications, Masson, Paris,1983.

Mateesco Matte, N., Aerospace Law: Telecommunications Satellites, Institute and Centre of Air and Space Law, McGill University, Montreal, and Butterworth (Canada) Ltd., 1982.

Mateesco Matte, N. Aerospace Law: from Scientific Exploration to Commercial Utilization, The Carswell Company limited and Éditions Pedone, 1977.

McLucas J. L., Space Commerce, Harvard University Press, Cambridge Massachusetts, 1991.

Rens, J.G., L'empire invisible: histoire des télécommunications au Canada de 1846 à 1956, Presses de l'Université du Québec, Québec, Canada, 1993.

Sharlin, H I., The Making of the Electrical Age, From the Telegraph to Automation, Abelard-Schuman, London,-New York- Toronto, 1963.

Snow, M.S., International Commercial Satellite Communications, Economic and Political Issues of the First Decade of Intelsat, Nomos Verlagsgesellschaft, Baden-Baden, 1979.

Surtees, L, Pa Bell - The Meteoric Rise of Bell Canada Enterprises, Random House, Toronto, 1992.

Tritt, R.W., The International Telecommunjications Satellite Organization (INTELSAT): A Case Study in the Evolution of an International Operating Agency, (unpublished thesis) School of International Affairs, Carleton University, Ottawa, October 1971.

Williams, F., The New Telecommunications: Infrastructure for the Information Age, The Free Press, a Division of Macmillan, Inc., New York, 1991.

Theses, Studies and Reports

American Institute of Aeronautics and Astronautics, The International Global satellite System: Progress in Astronautics and Aeronautics, Volume 93, edited by Arper, J. and Pelton, J.N.New York, 1984.

Baker, H. A., Space Debris: Legal and Policy Implications (unpublished LL.M.. Thesis), McGill University, Montreal, 1988.

Bosco, J.A., Liability for Outer Space activities - A United States Perspective (unpublished LL.M.. Thesis), McGill University, Montreal, 1986.

Bourgeois, M., Carriage of Goods in Space (unpublished LL.M. Thesis), McGill University, Montreal, 1986.

Bunker, D. Space Risk and Liability (unpublished LL.M. Thesis), McGill University, Montreal, 1985.

Cooper, B., Satellite Telecommunications Law: The Canadian Perspective (unpublished LL.M. Thesis), McGill University, Montreal, 1985.

Department of Communications Discussion Paper, Telecommunications Policy Branch, Spectrum and Orbit Policy Directorate, Towards a Spectrum Policy Framework for the Twenty-First Century, , September 1990.

Department of Communications Canada, Telecommunications in Canada: An Overview of the Carriage Industry, 1992.

Department of Industry Canada, Spectrum, Information Technologies and Telecommunications Sector, The Canadian Information Highway: Building Canada's Information and communications Infrastructure , April 1994, p. 3.

Federal Communications Commission, Report of the MSS Above 1 GHz Negotiated Rulemaking Committee, USA, April 6, 1993.

Fortin, P. Artificial Space Debris and International Law (unpublished LL.M Thesis) McGill University, Montreal, November1990.

Hill, S.M., The Launch and Insurance of Spacecraft: Business in Space (unpublished LL.M. Thesis), McGill University, Montreal, 1983.

Inmarsat, Annual Review and Financial Statements 1994, London, U.K., 1995.

Intelsat, Intelsat Annual Report (1994), Washington D.C., 1995.

ITU Colloquium No.1 Briefing report: "Options for Regulatory Processes and Procedures in Telecommunications", The Changing Role of Government in an Era of Deregulation, , ITU, Geneva, May 1993.

ITU, Tomorrow's ITU: The Challenges of Change, Report of the High Level Committee to Review the Structure and Functioning of The International Telecommunications Union, chaired by Warren, G., Geneva, April 1991.

ITU, World Telecommunications Advisory Council (WTAC), Telecommunications Visions of the Future, ITU, February 1993.

Jakhu, R., The Legal Regime of the Geostationary Orbit (unpublished D.C.L. Thesis), McGill University, Montreal, 1983.

Jakhu, Ram, "Some Legal Aspects of Commercialization of Telecommunications Activities" A privately sponsored study by Consultants Northam, Montreal, Canada, November 1991.

Lowe, S. Responsibility and Liability in General Public International Law and in the Law of Outer Space (unpublished LL.M Thesis) McGill University, Montreal, July 1991.

Maitland, D., "The Missing Link" - Report of the Independant commission for World Wide Telecommunications Development, presented to the UN, 1985.

Mamboundou M'Boumba, D., Les télécommunications spatiales et les pays en développement, spécifiquement les pays d'Afrique, (unpublished LL.M. Thesis), McGill University, Montreal, 1985.

Marty, H., Legal Aspects of Space Business from the Point of View of Manufacturers (unpublished LL.M. Thesis), McGill University, Montreal, 1993.

Mazowita, G., Private Enterprise and the industrialization of Space: Opportunities for Participation and Attendant Legal Issues (unpublished LL.M. Thesis), McGill University, Montreal, 1983.

Nesgos, P.D., National Law and Commercial Activities in Outer space: Specific aspects of United States Law Applicable to Space Industrialization with Particular emphasis on the Commercialization of Launch Vehicule Transportation (unpublished D.C.L. Thesis), McGill University, Montreal, 1984.

Nordlund, F., Le régime juridique des activités industrielles et commerciales conduites dans l'espace extra-atmosphérique: nouvelles orientations (unpublished LL.M Thesis), McGill University, Montreal, Octobre 1989.

Ospina,S., Project Condor: An Analysis of the Feasibility of a regional Satellite System for the Andean Pact countries (unpublished LL.M.. Thesis), McGill University, Montreal, February 1988.

Rathi, K.L., The Role of ITU in Establishing Legal control in Outer Space (unpublished LL.M. Thesis), McGill University, Montreal, 1983.

Stoffel, W. Legal Aspects of aeronautical Mobile satellites (unpublished LL.M Thesis), McGill University, Montreal, 1992.

St-Arnaud,D., La Mise en oeuvre en droit canadien des réglementations et conventions internationales en matière de télécommunications (unpublished LL.M Thesis) McGill University, Montreal, January 1991.

Smith, M. L., Space WARC 1985 - Legal Issues and Omplications (unpublished LL.M. Thesis) McGill University, Montreal, March 1984.

Smith, M. L., International Regulation of Satellite Telecommunications after the Space WARC (unpublished D.C.L. Thesis), McGill University, Montreal, March 1989.

Straubel, M. S., United States' Regulation of Commercial Space Activity (unpublished LL.M.. Thesis), McGill University, Montreal, March 1989.

Stuyt, M. L. J. M., Legal Aspects of Commercial Activities of Private Enterprise in Outer Space (unpublished LL.M.. Thesis) McGill University, Montreal, September 1985.

Schwetje, K., Managing Outer Space Traffic in the Future: A Challenge to Legal and Technical experts (unpublished LL.M.. Thesis), McGill University, Montreal, August 1985.

UN Report of the Committee on the Peaceful Uses of Outer Space , UN document A/5549, 24 September, 1963.

UN Report of the Committee on the Peaceful Uses of Outer Space , "Use of Low Earth Orbit Satellites for Voice Communications", UN document A/AC.105/564, 21 December, 1993.

Valters, E.N., International Law of Communications Satellites: Scarce Resources in a New Environment (unpublished Degree of Doctor of Philosophy.Thesis), Faculty of Political Science, Columbia University,1970.

Statutes, Regulations and Treaties

Agreement on the Establishment of the Intersputnik International System and Organization of Space Communications, Nov 15, 1971, U.N.T.S. 862:3.

Agreement Relating to The International Telecommunjications Satellite Organization (Intelsat), August 20, 1971, 23 U.S.T. 3813, T.I.A.S. No. 7532.

Convention of the International Maritime Satellite Organization (Inmarsat), September 1976, 31 U.S.T. 1, T.I.A.S. No. 9605, 15 ILM 1052.

International Radiotelegraph Convention, Final Protocol and Service Regulations adopted on July 5, 1912; 7, American Journal of International Law (1913), pp. 229 et seq.

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, United Nations, 1967.

Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, United Nations, 1968.

Constitution of the International Telecommunications Union, 1992.

Convention on the International Maritime Satellite Organization (Inmarsat), 1976.

Operating Agreement Relating to The International Telecommunications Satellite Organization (Intelsat), August 20, 1971, T.I.A.S. No. 7532.

ITU, International Telecommunications Convention, Nairobi 1982.

ITU, Constitution of the International Telecommunications Union, (Geneva) 1992

ITU, Radio Regulations, 1982, No.22.

ITU, Radio Regulations, 1982, No.27.

Proposed Policy for the Provision of Mobile Satellite Services via Regional and Global Satellite Systems in the Canadian Market, Communications Canada, Radio Communications Act, Notice No. DGTP-006-93, May 1993.

Communications Satellite Act, USA,1962, Publ. L. No 87-624, 76 Stat. 419 (1962)

UN General Assembly resolution 1802 (XVII) of December 14, 1961.

UN General Assembly resolution 1721 D (XVI) of December 20, 1961.

UN General Assembly resolution 1802 (XVIII) of December 14, 1962.

Un General Assembly resolution 1962 (XVIII) of December 31, 1963

UN General Assembly resolution 2222 (XXI) of December 19, 1966.

UN General Assembly resolution 2260 (XXII) of November 3, 1967.

UN General Assembly resolution 2601 (XXIV) of December 16, 1969.

UN General Assembly resolution 2453 B (XXXIII) of December 20, 1968.

Articles (Periodicals), Keynote Addresses and Other Documents

Ahmed, N. , Is Spectrum Scarcity Real?, unpublished essay produced for the Canadian Minister of Communications, March 1992.

Anglin, R.L.,"International Organizations to Enable World-wide Mobile Satellite Services", International Mobile Satellite Conference (IMSC '93), Session 3 (Regulatory and Policy Issues), June 16-18, 1993, Pasadena, California, pp. 73-78.

Astrain, S., "Global Overview of Satellite Communications", The INTELSAT Global Satellite System, Progress in Astronautics and Aeronotics V. 93, American Institute of Aeronotics and Astronautics, New York, New York, 1984, p. 2.

Beatty, P., Speech given to the Financial Post Conference on Telecommunications, Toronto, October 8, 1992.

Bell, A.G., Letter from Graham Bell to his father, Melville Bell, March 10, 1876, Archives of Bell Canada.

Binder M., Deputy Minister of the Canadian Department of Communications, opening speech at the "Transitions" Symposyum, Spectrum 20/20, Montreal, September 24, 1992.

Booker, Ellis, "The Whole World in Your Pocket: Looking for Power in the Sky", Computerworld, Vol 26, Iss36, Sept 7, 1992, p. 24.

Callendar, M., "Future Deployments in Personnal Computers", Transitions spectrum conference, 1992, pp.1.3.4 ss.

Clarke, Arthur C., "Extra-Terrestrial Relays", Wireless World, Feb 1948. The original article was published May 25, 1945 under title "The Space-Station, its Radio Applications", reproduced in Telephone Engineer & Management, Chicago, June 1, 1984.

Colino, "Global Stellite Communications and International Organization: a Forum on Intelsat", Proceedings of the tenth Colloquuium of the Law of Outer Space, 1967, pp. 80 - 88.

Department of Industry Canada, A Canadian Perspective on Telecommunications Development, presented to the World Telecommunications Development Conference, Buenos Aeres, Argentina, March 21-29, 1994.

Garfield, the cat., as quoted in a poster depicting the times, by Barcelo, Yan, Télécommunications et turbulences, Les Affaires, 6 mai 1989, p.16

Gibson, R., "Nation Shall Speak Unto Nation: The Worldwide Role of Satcoms", Never Beyond Reach: The World of Mobile Satellite Communications , Inmarsat, 1989, p.15-30.

Inmarsat, Never Beyond Reach - the World of Mobile Satellite Communications, INMARSAT publication, edited by Brendan Gallagher, 1989.

Hansen, The Changing Telecommunications Environment: Policy Considerastions for the Members of the ITU, BDT/ITU, 1989, (Chapter 1, pages 8-9, paragraphs 8.4-8.7.

Howitt, P., "Endogenous Growth Theory: Taming the Winds of Change, or Tweaking Neoclassical Economics?", presented to the Bell Canada Conference, "Stabilization, Growth and Distribution Linkages in the Knowledge Area", Queens University, Kingston, October 15-16, 1993.

Jakhu, R.S., "The Evolution of the ITU's Regulatory Regime Governing Space Radiocommunication Services and the Geostationary Orbit" Annals of Air and Space Law, Vol. VIII, McGill University, Montreal, 1983, p. 381-392.

Jakhu, R.S., International Regulation of Satellite Telecommunications (unpublished paper /course materials), Institute of Air and Space Law, McGill University, 1991.

Klass P.J. , "WARC-92 Approves Satellites for Small Cellular Phones", Aviation Week &Space Technology, March 1992, No.10, p. 31.

Klass P.J. , "Low-Earth Orbit Communications Satellites Compete for Investors and U.S. Approval" Aviation Week &Space Technology, May 18, 1992, pp. 60-61.

Lenorovitz, Jeffrey, M., "Steady Growth seen for Commercial Space Projects", Aviation Week &Space Technology, vol 138, Iss 11, March 15,1993, pp. 83-87.

Levin, L.C., U.S. "Domestic and International Regulatory Issues", International Mobile Satellite Conference (IMSC '93), Session 3 (Regulatory and Policy Issues), June 16-18, 1993, Pasadena, California, pp. 67-71.

Maitland, D., "Forging the Missing Link", Reforming the Global Network, International Institute of Telecommunications Report on the 1989 ITU Plenipotentiary Conference, p. 66.

Maitland, D., 'The Missing Link' Revisited, Transnational Data and Communications Report, Nov/Dec 1992, USA, p. 15.

Mario, R.J., "The Satellite Communications Marketplace: Taking our cue from the Customer", COMSAT Mobile Communications, London, December 7, 1993.

Mateesco Matte, N, "Space Policy: Today and Tomorrow - the Vanishing Duopole", Annals of Air and Space Law, Vol IV- 1979, McGill University, Montreal, pp. 567- 616.

Mobile Satellite Report, "International Experts to Seek to Combat Growing Space Debris", Vol.7, No 6, March 29 , 1993, Warren Publishing, p. 4.

Mobile Satellite Report,"Panamsat and Motorola Butt Heads with Comsat over Latter's 'Immunities' " , Vol.7, No 10, May 24 , 1993, Warren Publishing, p. 2 .

Mobile Satellite Report, "LEO Competitors Balk at Sharing Spectrum", Vol.6, No 14, July 3, 1992, Warren Publishing, p. 3.

Mobile Satellite Report, "Negotiating Agreements Said to Cost Global Cellular Applicants Dearly: Organizational and Structure Needed", Vol.6, No 17, september 14, 1992, Warren Publishing, p. 2.

Mobile Satellite Report, "EC to Release Study on U.S. LEO Systems" ,Vol.6, No 25, December 6, 1992, Warren Publishing, p. 1.

Mobile Satellite Report, "Leos Big and Small: Ubiquitous Cellular Systems Raise Ubiquitous Doubts at Satellite Communications Users Conference (SCUC)",Vol.6, No 24, November 23 , 1992, Warren Publishing, p. 1.

Phillips, R.O., Wright, D., "Complementarity between Terrestrial and Satellite Mobile Radio System" DMR-III, September 1988, Copenhagen Denmark, pp.12-15.

Reinhart, E.E., "Mobile Communications" WARC-92 Special Report, IEEE Spectrum, February 1992, pp. 27-29.

Satellite Communications,"Inmarsat to Establish Affiliate Company" July 94, pp. 10-13.

Smith, M. "A New Era for the International Regulation of Satellite Communications", Annals of Air and Space Law, Institute of Air and Space Law, McGill University, vol. XIV, 1989, pp. 449-459.

Space Commerce Week, "Geostationary Orbit Cluttered: US, Russia to Work Together to Clean Up Space", November 9, Vol 9, No 43, Warren Publishing, 1992, p.2.

Spar Aerospace, "Service Delivery to Rural and Remote Locations: Satellite Solutions" presented to the World Telecommunications Development Conference, Buenos Aeres, Argentina, March 21-29, 1994.

Stumpers, F.L.H.M., "The History, the Development, and the Future of Telecommunications in Europe", IEEE Communications Magazine, New York, May 1984.

Tarjanne, P., Multilateral Organizations and the Global Information Society, speech presented to the International Institute of Communications Annual Conference, Montreal, 10 September 1992, p. 2.

UN Committee on the Peaceful Uses of Outer Space, Scientific and Technical Sub-Committee, Use of Low Earth Orbit Satellites for Voice Communications, Thirty-first session, Vienna, United Nations A/AC.105/564 21 December.

Warren, G. "The Enhanced Participation of Users in the ITU", Remarks by the Chairman of the ITU High Level Committee at the Policy Forum of Telecom 92, Acapulco, April 7, 1992.

Wright, D., Mobile Satellite Communications in Developing Countries (non-published paper), Inmarsat contribution to International Astronautical Federation, 1993.

Interviews

Ahmed, N., Director General, Spectrum Management, Department of Communications Canada, Ottawa, Canada, September 5, 1992.

Gagné, P., Director, International Relations, Department of Communications Canada, Ottawa, Canada, December 3, 1992.

Jakhu, R., Montreal, Canada, March 22, 1994.

Israel, M., Téléglobe Canada, Montréal, Canada, June 23, 1995.

Lessard, S., Canadian Space Agency, International Relations, Ile des Soeurs, Canada, August 24, 1994.

Reeckie, D.H.M., MSAT Program Applications Engineer, Department of Industry Canada, Ottawa, Canada, August 15, 1994.

St-Arnaud, D., Department of Industry Canada, International Relations Branch, Ottawa, Canada, August 12, 1994.