INTERNATIONAL LAW REGARDING OUTER SPACE—AN OVERVIEW

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If the past is our guide to the future, present day outer space activities are only a small fraction of the progress many of us will see in our lifetime. There are people still alive who were living when the Wright brothers made their historic flight and paved the way for aviation as we know it today. It is amazing that the birth of flight and the vast growth of the aviation industry has occurred in only one lifetime. If the use of outer space and space-related activities increases at a similar pace, the extent of progress in a relatively small amount of time will be astounding.

The space age is still in its infancy. The first satellite, Russia’s Sputnik 1, was launched only thirty-one years ago in October, 1957. Early spacecraft were essentially an unreliable bundle of instruments. In the 1960s, competition in the space industry paved the way for the development of lightweight, efficient, and most importantly,

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1 F. Howard, Wilbur and Orville (1987). The Wright brothers' first historic flight occurred only eighty-six years ago near Kitty Hawk, North Carolina on December 17, 1903. Id. at 133-40.

reliable spacecraft. Today, man’s activities in outer space are startling. Compared with two successful launchings in 1957, a total of 129 successful launches were reported in 1984 alone. In 1985, there were a total of 1,573 payloads in orbit and more than 140,000 total crew hours have been logged in outer space to date.

Outer space activities have already begun to inconspicuously pervade and change our lives and values. Several worldwide satellite communication networks are in place providing instantaneous radio, telephone, television, facsimile, and data transmission on a global basis. This revolution has provided global coverage of events and instantaneous transmission of a large volume of data and information worldwide. Earth observation or remote sensing satellites are used today as a routine tool for crop surveys, oil and gas exploration, mineralogy, ocean research, and many other businesses and fields of study. These types of satellites also have military application and can be used for reconnaissance, spying, detection of troop movements, and treaty verification. Meteorological satellites continually monitor weather and give advance warning of thunderstorms, hurricanes and other severe weather. Worldwide teleconferencing and facsimile transmissions are now commonplace. Direct dial passenger telephone services will soon be available for aircraft worldwide. Satellites are also changing labor markets. Airline companies are already using cheap labor in other countries to process millions of airline tickets via satellite. Space research has made valuable contributions to agriculture, communications, education, medicine, and

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3 See generally T. Osman, Space History (1983).
5 Id.
7 Id. at 118-40.
8 Id. at 89-117.
materials processing. Aerospace spinoff technology has also been utilized in many divergent fields with wide-ranging application.\textsuperscript{11} 

The immediate future of space activities is very promising. In addition to the United States, the European Community, and the Soviet Union, a myriad of other countries and private companies are becoming involved in the development and utilization of commercial launch vehicles to take payloads into orbit at competitive prices.\textsuperscript{12} The development and utilization of space stations and orbiting space platforms will lead to commercial applications for materials processing in space. A number of countries, including the United States are conducting research in order to develop a hypersonic aircraft/spaceship known as the "aerospace vehicle" which would be capable of accelerating up to twenty times the speed of sound and capable of attaining low earth orbit.\textsuperscript{13} Dubbed the "Orient Express" by former President Reagan, such a vehicle would be able to take off from New York and fly to Tokyo within two hours.\textsuperscript{14}

Lawyers are and will become an integral part of outer space-related activities. Lawyers are needed for regulating access to outer space and establishing an orderly and safe environment to conduct further space activities. As will be discussed in this article, many countries have already formulated and adopted general principles pertaining to outer space and outer space-related activities.

\textsuperscript{11} See H. SHIPMAN, supra note 6, at 379-80. Once the technology is developed, it can be applied to uses which are different from the original application. Fields in which this technology has been applied include health and medicine, public safety, food and agriculture, and transportation. National Aeronautics and Space Administration, Aerospace Spinoffs - Twenty-Five Years of Technology Transfer (available from Director, Technology Utilization Division, Office of Commercial Programs, NASA Headquarters, Washington, D.C. 20546).

\textsuperscript{12} See generally Dula, Private Sector Activities in Outer Space, 19 INT'L LAW. 159 (1985).

\textsuperscript{13} See Covault, Aero-Space Plane Leading U.S. Hypersonic Research, AVIATION WEEK & SPACE TECH., Feb. 27, 1989, at 18; Le Bourget, Soviets Seek Cooperative Role in Western Hypersonic Programs, AVIATION WEEK & SPACE TECH., June 19, 1989, at 38.

These multilateral treaties form the framework for more specific rules and regulations. Further, international cooperation in space is growing as nations worldwide deal with the high costs and risks associated with many outer space activities. While the Soviet Union and the United States have fostered international cooperation for years, this cooperative effort is currently expanding, and, in addition, cross-cooperation has developed among Western nations, the Soviet-bloc, and the Pacific-rim countries. In the last thirty years, the United States has signed more than 1,000 agreements with a great variety of countries regarding international space activities. The United States' international space station project includes agreements with Japan, Canada, and the European Space Agency (ESA), which encompasses more than a dozen European countries and represents the largest space venture ever attempted. This space station will set new precedents in space law. In addition, the emergence of a private commercial space industry in space-related activities will call for new rules and regulations. Throughout the development of these activities, lawyers versed in both international and national law will play an integral role in the formation of treaties, contracts, and agreements and will also invariably be involved in the filing of claims and resolution of disputes dealing with tort law, corporate law, conflicts of law, licensing and patent law, and many other fields.

I. Existing International Space Law

While the space age officially began with the Soviet launching of the first artificial satellite in 1957, jurists have written on the legal implications of the use of outer space for decades. Formal legal publications on space law have been traced back to as early as 1910. Today, space law is clearly recognized as a separate and distinct field of

16 *Id.*
law, even though many of the legal principles have been
taken from the related areas of aviation and maritime
law. While few countries currently have any formal do-
mestic law in regard to outer space and outer space-re-
lated activities, the majority of countries have adopted
existing international treaties on outer space activities,
mainly through international organizations such as the
United Nations and the International Telecommunication
Union. It is through these organizations that virtually
every nation is now involved in some way in the creation
of international space law. As with other forms of interna-
tional law, sources for international space law include in-
ternational conventions, rules expressly recognized by
countries, international custom as evidence of a general
practice accepted as law, general principles of law recog-
nized by civilized nations, judicial decisions, and teachings
or writings of highly qualified jurists.

Since the advent of the space age, the international
community has been very aware of and receptive to the
need to develop a set of international principles to govern
space activities. In December, 1958, the United Nations
General Assembly approved a resolution regarding the
peaceful use of outer space, the sovereign equality of
countries relating to space activities, and the need for in-
ternational cooperation. The General Assembly also es-

Laude, a Belgian jurist, published an article on the necessity of a specific legal
system as soon as the progress of science made spaceflight possible. Id.

18 See generally J. Fawcett, OUTER SPACE: NEW CHALLENGES TO LAW AND POLICY
1-7 (1984) (discussing the relationship between space law and maritime law);
E.R.C. Van Bogaert, supra note 17, at 9-11 (discussing the relationship between
space law and aviation law).

19 E.R.C. Van Bogaert, supra note 17, at 16. The author notes that “[s]pace
law is a part of international law. By their nature space activities cannot be sub-
jected to the sovereignty of States and the main legal regulations must evidently
have their origin in an international consensus.” Id.

1055, 1061, T.S. No. 903, at 25. For discussions and explanations of the various
sources of international outer space law, see also E.R.C. Van Bogaert, supra note

(1958).
established an ad hoc Committee on the Peaceful Uses of Outer Space (COPUOS). COPUOS, comprised of a legal subcommittee and a scientific and technical subcommittee, eventually became a permanent committee of the United Nations. During its approximately thirty years of existence, COPUOS has drafted several treaties concerning space activities which were submitted to the United Nations General Assembly for approval and eventually adopted or ratified by many countries as binding, multilateral treaties. These multilateral treaties form the legal framework of existing international space law.

A. The Outer Space Treaty

The first treaty drafted by COPUOS, which embodied a number of United Nations General Assembly resolutions dealing with space law, is the Outer Space Treaty of 1967. This treaty is known as the basic treaty from which all others arose because many of the broad principles set forth in this treaty are the basis for subsequent treaties. The Outer Space Treaty sets forth basic principles regarding outer space. The Treaty provides that outer space, the moon, and other celestial bodies shall be the province of all mankind and shall be free for exploration and use by all States; outer space, the moon and other celestial bodies shall not be subject to national appropriation or claims of sovereignty; activities carried out

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22 Id. at 22-23.
24 See E.R.C. Van Bogaert, supra note 17, at 17.
in the exploration and use of outer space shall be in accordance with international law, including the Charter of the United Nations. The treaty also contains a cleverly drafted article which at first glance appears to be a broad prohibition against the militarization of outer space but in reality is very narrow and ineffective. Further, there are articles recognizing astronauts as envoys of mankind and requiring States to give assistance to astronauts in distress; imposing international responsibility for national activities in outer space, regardless of whether such activities are governmental or nongovernmental; and encouraging cooperation and mutual assistance in conducting space activities.

B. The Rescue Agreement

The next multilateral treaty drafted by COPUOS is known as the Rescue Agreement, and is an agreement regarding the rescue and return of astronauts who have suffered an accident or experienced conditions of distress or emergency, or who have unintentionally landed in another country or on the high seas. The personnel

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28 Outer Space Treaty, supra note 26, arts. I-III. Article I provides that outer space "shall be free for exploration and use by all States without discrimination of any kind." Id. art. I. Article II states that outer space "is not subject to national sovereignty" by any means. Id. art. II. Article III establishes that "States Parties to the Treaty shall carry on activities . . . in accordance with international law, including the Charter of the United Nations . . . ." Id. art. III.

29 Id. art. IV; see infra notes 102-109 and accompanying text for a discussion of Article IV of the Outer Space Treaty.

30 Outer Space Treaty, supra note 26, arts. V, VI, IX. Article V provides that "States . . . shall regard astronauts as envoys of mankind in outer space and shall render to them all assistance possible in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas." Id. art. V. Article VI provides that "States . . . shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or non-governmental entities . . . ." Id. art. VI. Article IX establishes that "States . . . shall be guided by the principle of co-operation and mutual assistance and . . . with due regard to the corresponding interests of all other States Parties to the Treaty." Id. art. IX.


32 Id.
aboard such spacecraft are to be afforded all necessary assistance and returned safely and promptly to representatives of the launching country. Further, upon request, spacecraft and their component parts are to be returned to the launching country.

C. The Liability Convention

The Liability Convention is of practical significance concerning any damages, injuries or death occurring as a result of space activities. This Convention establishes a dual international legal regime for damages, death or injury resulting from space activities and also establishes an international procedural framework assessing liability and compensation. Any potential liability begins at launch or attempted launch. Any damage by a space object which occurs on the earth's surface or to an aircraft while in flight is governed by an absolute liability regime. Damages caused other than on the earth's surface are governed by traditional principles of fault.

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33 Id. arts. 2, 4. Article 2 provides that "if, owing to accident, distress, emergency or unintended landing, the personnel of a spacecraft land in territory under the jurisdiction of a Contract Party, it shall immediately take all possible steps to rescue them and render them all necessary assistance." Id. art. 2. Article 4 states that "personnel of a spacecraft . . . shall be safely and promptly returned to representatives of the launching authority." Id. art. 4.

34 Id. art. 5(2). This article provides that "[e]ach Contracting Party . . . shall, upon the request of the launching authority and with assistance from that authority if requested, take such steps as it finds practicable to recover the object or component part." Id.


36 Id.

37 Id. II, III; see also N. Goldman, supra note 23, at 79-80. The author states that the COPUOS committee "had to decide on the standards for liability, the process for dispute resolution, the limitations on damages, the categories of damages . . . and even the status and the responsibility of international organizations . . . ." N. Goldman, supra note 23, at 79.

38 Liability Convention, supra note 35, art. I(b) (stating that "the term 'launching' includes attempted launching").

39 Id. art. II. Article II provides that "[a] launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight." Id.

40 Id. art. III. Article III provides:
several liability attaches to states which jointly launch a spacecraft or space object. While there are certain exceptions to this imposition of liability and provisions for exoneration, the Liability Convention is a victim-oriented legal instrument. Claims are brought by countries on behalf of their nationals. While the treaty envisions a diplomatically negotiated settlement, should that fail there are provisions for the establishment of an international claims commission to attempt to resolve any disputes. The claims commission's decision, however, shall be final and binding only if the parties so agree.

D. The Registration Convention

Another treaty drafted by COPUOS which has been adopted multilaterally is the Registration Convention, 44

In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.

41 Id. arts. IV, V. Article IV describes joint and several liability in those situations in which one State's space object causes damage to a second State's space object, resulting in damage to a third State. Id. art. IV. The first two States are jointly and severally liable for damage to the third State. Id. Article V provides for joint and several liability when "two or more States jointly launch a space object" causing any damage. Id. art. V.

42 Id. arts. VI, VII. Article VI provides for exoneration when the launching State shows that the damages were caused by the gross negligence or wilful misconduct of the State claiming damages. Id. art. VI. Article VII states that "[t]he Convention does not apply to damages caused . . . to [n]ationals of the launching state" or "[f]oreign nations participating in operation of the space object." Id. art. VII. See generally Bosco, Practical Analysis of International Third Party Liability for Outer Space Activities—A U.S. Perspective, 29 TRIAL LAW. GUIDE 298 (1985) [hereinafter Practical Analysis].

43 Liability Convention, supra note 35, arts. VIII(1), XIV-XX. Article VIII(1) provides that a "State which suffers damage, or whose natural or juridical persons suffer damage, may present to the launching State a claim for compensation for such damage." Id. art. VIII(1). Articles XIV through XX generally provide for the establishment of a Claims Commission to reach a settlement for damages "[i]f no settlement of a claim is arrived at through diplomatic negotiations." Id. art. XIV; see also Practical Analysis, supra note 42, at 347-48.

which provides for a registration system regarding space objects. The Registration Convention requires states to register any objects launched into the earth's orbit or beyond and provides for a centralized international registry to be maintained by the Secretary General of the United Nations which shall remain open for inspection to signatories to this convention. Each object a state launches must be registered, and that state must furnish as soon as practicable the following information: (a) name of launching state or states; (b) appropriate designator of the space object or its registration; (c) date and territory or location of the launch; and (d) basic orbital parameters.

E. The Moon Treaty

The final and most controversial multilateral treaty drafted by COPUOS is referred to as the Moon Treaty. It is of limited legal value, however, because few countries have signed or ratified this treaty at the present time. Neither the Soviet Union nor the United States has expressed any indication of signing or ratifying this treaty in the near future. The main reason for the Moon Treaty's lack of popularity is the presence of a controversial principle known as the "common heritage of mankind."
Aside from this provision and the specific limitations and prohibitions the treaty contains concerning the establishment of military bases, installations or fortifications, the testing of weapons, and the conducting of military exercises on the moon, many of the other provisions are taken directly from the widely accepted Outer Space Treaty.53

Article XI of the Moon Treaty declares that "the moon and its natural resources are the common heritage of mankind."54 This concept entails an "equitable sharing" by all parties in the benefits derived from these natural resources, whereby the interest and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration.55 Further, when exploitation of these resources becomes feasible, the Moon Treaty requires the establishment of an international regime, including appropriate procedures to govern the exploitation of these resources.56 Developing countries argue that the "com-

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53 Moon Treaty, supra note 49, art. III. The Moon Treaty stipulates that the moon and other celestial bodies shall be used exclusively for peaceful purposes. Id. art. III, para. 1. Accordingly, it forbids "[t]he establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the moon." Id. art. III, para. 4; see supra notes 25-30 and accompanying text for a discussion of the Outer Space Treaty.

54 Moon Treaty, supra note 49, art. VI, para. 1.

55 Id. art. XI, para. 7(d). Interestingly, when the "common heritage of mankind" principle was first introduced to the COPUOS Committee, the United States welcomed the principle. C. CHRISTOL, supra note 45, at 315-17. In time, however, the United States changed its position and is now firmly opposed to the concept. Id.

56 Moon Treaty, supra note 49, art. XI, para. 5. The parties to the Moon Treaty established this regime to govern the exploitation of the moon's resources. Id. To do this, the States who are parties to the Moon Treaty "shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of any natural resources they may discover on the moon." Id. art. XI, para 6. Paragraph seven
mon heritage of mankind” principle amounts to a theory of common property for all the nations and peoples of the world. Consequently, if the Moon Treaty were widely accepted, there could be significant legal ramifications regarding the taking of “common heritage of mankind” property, such as mineral resources, without consent of all the “owners.”

F. The Right to Orbit Subjacent Territory Without Prior Authorization or Permission

While the main body of international space law is in multilateral treaty form, customary principles of international law have also evolved. One of the main principles which has evolved is the right to launch satellites or space objects which orbit over the subjacent territory of other sovereign countries without prior permission or authorization. While space exploring nations now take this international right for granted, it is completely opposed to well recognized and established principles of air law. For example, an aircraft has been shot down for allegedly unauthorized aerial intrusions at least once a year during the last twenty years and at least thirty-three times since 1947. As barbarous as these statistics may seem, they all stem from purported breaches of the clearly recognized international air law principle that countries have exclusive sovereignty and control of the airspace over their territory. This principle is embodied in Article 1 of the

of Article XI articulates the main purposes of this international regime. Id. art. XI, para. 7(a)-(d).

57 Smith, supra note 52, at 51. The second of the two primary theories regarding the “common heritage of mankind” principle considers this principle contrary to existing international law. Id.

58 Id. at 53.

59 See G. Zhukov & Y. Kolosov, supra note 2, at 43-44.

Chicago Convention,\textsuperscript{61} which is the most widely adhered to and respected public international air law document.\textsuperscript{62}

Interestingly, this principle has never been extended to outer space. From the first launching of satellites into outer space there have not been any significant objections regarding the right of earth orbiting satellites to pass over the territories of other nations without their consent.\textsuperscript{63} The diametrically opposed legal regimes regarding air and space law can have curious practical results. For example, while spying and other military operations in air-space are absolutely forbidden according to international air law, it is widely recognized and accepted that such activities are conducted in outer space by military satellites which orbit over the subjacent territory of countries. These activities have not met significant protest and have actually been welcomed in recent years by the superpowers as a means of verifying compliance with arms control agreements.\textsuperscript{64}

G. International Telecommunication Law

Telecommunications is by far the most mature and profitable commercial space industry to date. Communi-\textsuperscript{64}
cation satellites are presently providing telephone, telegraph, facsimile, television relay, and a myriad of other services on a regional, national, and global basis.

The International Telecommunication Union (ITU), a specialized agency of the United Nations, is the regulatory body of global telecommunications and is dedicated to the coordination and regulation of the radio spectrum and other facilities utilized for global communications. The ITU has 160 member countries. The main international legal instrument of the ITU is the International Telecommunication Convention, which was amended at Nairobi in 1982 and entered into force January 1, 1984. The ITU's main function is the regulation of the world's telecommunications, including use of the geostationary orbit and associated radio frequencies, and the maintenance of international cooperation among all members for the improvement and rational use of telecommunications. With a view towards meeting these objectives, the Convention requires the ITU to:

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65 E.R.C. Van Bogaert, supra note 17, at 192.
66 Doyle, Regulating the Geostationary Orbit: ITU's WARC-ORB '83-'88, 14 J. Space L. 1, 2 (1987) [hereinafter Doyle I].

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

Id. (emphasis added). The emphasized portion embodies the revisions to the original text. Id. at 104-05.
68 Int'l Telecommunications Convention, supra note 67, art. 4, para. 1. The Convention states that the ITU's purposes are:
a) to maintain and extend international co-operation for the improvement and rational use of telecommunications of all kinds;
b) to promote the development of technical facilities and their most efficient operation with a view to improving the efficiency of tele-
a) effect allocation of the radio frequency spectrum and registration of radio frequency assignments in order to avoid harmful interference between radio stations of different countries;

b) coordinate efforts to eliminate harmful interference between radio stations of different countries and to improve the use made of the radio frequency spectrum;

c) coordinate efforts with a view to harmonizing the development of telecommunications facilities, notably those using space techniques, with a view to full advantage being taken of their possibilities;

d) foster collaboration among its Members with a view to the establishment of rates at levels as low as possible consistent with an efficient service and taking into account the necessity for maintaining independent financial administration of telecommunication on a sound basis;

e) foster the creation, development and improvement of telecommunication equipment and networks in developing countries by every means at its disposal, especially its participation in the appropriate programmes of the United Nations;

f) promote the adoption of measures for ensuring the safety of life through the co-operation of telecommunication services;

g) undertake studies, make regulations, adopt resolutions, formulate recommendations and opinions, and collect and publish information concerning telecommunication matters.\(^69\)

The ITU, through the management of the radio frequency spectrum, ensures that radio, telephone, television, and other means of communications are free from harmful interference by other transmissions. As a result, most countries are willing to abide by the ITU's regulations.

\(^{69}\) Id. art. 4, para. 2.
The ITU regulates the use of radio frequencies. One of its management functions is the allocation of certain radio frequencies to certain services. There are dozens of uses for frequencies (e.g. broadcasting, mobile, telephony, etc.) and the ITU attempts to guarantee that certain bands in the radio frequency spectrum are used as specified for a particular purpose or service.\(^{70}\) The ITU's frequency management function is by “allotment,” which involves allotting particular frequencies to a region or country for a particular service.\(^{71}\) ITU employs two different allotment processes: \textit{a posteriori}, also known as “first come, first served,” and \textit{a priori}, which attempts to formulate an allotment plan based on generally accepted criteria.\(^{72}\) Through the assignment process, countries assigning frequency use distribute frequencies to individual stations.\(^{73}\) The ITU is then notified of these assignments and determines whether that frequency assignment is in conformity with the ITU radio regulations and that there is no harmful interference with other uses of that frequency.

The ITU is also instrumental in regulating communication uses of the geostationary orbit. It regulates the use of frequencies that are utilized by satellites, regardless of what particular orbit the satellite is in (e.g. geostationary, elliptical, solar, etc.). The geostationary orbit, most used by telecommunication satellites, is the circular orbit in the earth’s equatorial plane, which is approximately 22,300 miles above the surface of the earth.\(^{74}\) If an artificial satellite is in the geostationary orbit, it will rotate around the earth in approximately twenty-four hours, the same time it takes the earth to make one rotation. If the satellite is moving the same direction which the earth is moving, the satellite will appear to be stationary when observed from Earth.\(^{75}\) The importance of this orbit is that satellites in

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\(^{70}\) J. Fawcett, supra note 18, at 53.

\(^{71}\) Doyle I, supra note 66, at 15.

\(^{72}\) See generally id.

\(^{73}\) J. Fawcett, supra note 18, at 53.

\(^{74}\) Doyle I, supra note 66, at 4.

\(^{75}\) Id.
this orbit are capable of providing continuous contact with ground stations via a single satellite. Because of potential interference among radio frequencies, however, the geostationary orbit can be occupied by a limited number of satellites at any one time. Separation of the satellites in this orbit have prevented significant problems with interference to date. With the increasing use of these geostationary orbit slots, however, problems with the congestion of and access to these limited positions are growing.

Recently, a World Administrative Radio Conference (WARC), convened in 1985 and 1988, drafted and adopted a dual planning method regarding the use of the geostationary orbit and associated radio frequencies. Traditionally, the practice of occupying a particular geostationary orbital position was done on a "first come, first served" basis. Due to the limited number of these positions and a growing international awareness that the majority of orbital positions and frequencies are used and controlled by a small number of industrialized countries, several less developed countries began protesting that something needed to be done to protect their equitable access to these limited resources. Consequently, the ITU convened a "World Administration Radio Conference (WARC) on the Geostationary Satellite Orbit in the Planning of the Space Services Utilizing It" (WARC-ORB) which convened in 1985 and 1988. As a result of this conference, the ITU now has an "arc allotment plan" which guarantees every nation at least one orbital slot.
The ITU provides the technical framework for satellite communications. Other organizations provide these communications services. A global organization which provides telecommunications worldwide is the International Telecommunications Satellite Organization (INTELSAT), which is an international intergovernmental organization established by treaty for the commercial utilization of satellite communications. Member countries share in the revenues, based on their investment share and utilization of the INTELSAT system.\(^8\) INTELSAT is a non-profit cooperative of 117 countries that owns and operates a global communications satellite system consisting of thirteen satellites in orbit. This system is used by more than 170 countries and territories for international communications.\(^8^4\)

Another organization is the International Organization for a Maritime Satellite Service (INMARSAT), which is designed for the commercial utilization of satellite communication by ships, aircraft, and other mobile services, such as oil rigs, which are based on or move across water.\(^8^5\) INMARSAT operates a system of satellites to provide a range of high-quality mobile telecommunication services for commercial, distress, and safety applications worldwide.\(^8^6\) In 1985, the INMARSAT Assembly adopted amendments which would allow INMARSAT to provide aeronautical satellite communications.\(^8^7\) Belgium recently became the thirtieth country to accept these amendments to the INMARSAT Convention and Operating Agree-

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\(^8^4\) See E.R.C. Van Bogaert, supra note 17, at 196-214.


\(^8^6\) See generally, E.R.C. Van Bogaert, supra note 17, at 214-23.

ment, which now makes it possible for INMARSAT to provide mobile satellite communications services, including direct-dial passenger telephone services from aircraft worldwide. The amendments, which went into effect on October 13, 1989, allow INMARSAT to provide aeronautical satellite services on a full and unconditional basis.

Until now, airline communications have been dependent upon high frequency (HF) and very high frequency (VHF) radio, which are limited in range, capacity, and reliability. HF radio communications depend on the reflection of HF radio waves from the ionosphere. The density and height of the ionosphere vary a great deal depending on a number of unpredictable factors, including solar activity, making HF communications unreliable. VHF radio waves travel in straight lines, and, consequently, once an aircraft is beyond the horizon, communications are cut off. The INMARSAT satellite system provides virtual global coverage because satellite communications are unaffected by ionospheric propagation conditions. Aircraft can thus be assured of high-quality, reliable communications links, using equipment built to agreed aviation industry international standards. Other intergovernmental organizations which regulate or provide telecommunications include: INTERSPUTNIK, ARABSAT, and EUMETSAT.

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88 Magdelenat, supra note 85, at 269-70.
89 See generally Von Noorden & Dann, supra note 87.
91 Id.
92 See id.
93 Space Activities of the United Nations and International Organizations, U.N. Doc. A/AC.105/358, U.N. Sales No. E.86.I.2 (1986). The International Organization of Space Communications (INTERSPUTNIK) was designed to deliver telephone and telegraph communications, exchange radio and television programs and transmit other types of information via satellite with the purpose of promoting political, economic, scientific, and cultural cooperation between the various countries involved. The Arab Satellite Communication Organization (ARABSAT) was established to promote a regional telecommunications system for the Arab region. The European Organization for the Exploitation of Meteorological Satellites (EUMESTAT) was formed to establish and utilize European systems of operational meteorological satellites.
H. Militarization of Outer Space

It has been estimated that roughly seventy-five percent or more of all satellite launchings are for military or para-military use. It is important to note, however, that while outer space has been "militarized" almost from the beginning of the space age, it has not been significantly "weaponized." Given the pervasiveness of military uses of outer space, it is important to examine existing international law regarding the militarization and weaponization of outer space.

With the advent of the space age, there was a common hope that the space environment would be used exclusively for peaceful purposes. Before the Outer Space Treaty entered into force in 1967, there were few restrictions on the military uses of outer space in international law. The only legal restrictions were those contained in the Limited Nuclear Test Ban Treaty of August 5, 1963, by which the United States, Soviet Union, and United Kingdom agreed to prohibit, prevent, and not conduct any test of nuclear weapons or other nuclear explosions in the atmosphere, outer space, and underwater. The major advantage of the 1963 Test Ban Treaty was the establishment of favorable conditions for the peaceful use of outer space. This result was accomplished by keeping outer space relatively free from the adverse effects of electromagnetic pulse (EMP), which can be created by nuclear explosions in the atmosphere or in outer space. This is

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95 Nuclear Test Ban Treaty, supra note 94.

96 Id.; see also B. Hurwitz, Legality of Space Militarization 108-11 (1986).
significant because in outer space, the EMP is not dissipated by the atmosphere.\textsuperscript{97}

It is possible that the EMP of a single two-megaton bomb exploded fifty kilometers or higher above the earth could damage the electronic circuits in nearly all satellites in the geostationary orbit.\textsuperscript{98} While 112 states are parties to this widely respected treaty, it was the outcome of "selective rapprochement" between the United States and the Soviet Union, which alienated at least two other major space powers, France and China.\textsuperscript{99} As a result, France and China have never become parties to the Treaty and have continued their high altitude nuclear testing. Between 1963 and 1982, France conducted forty-one such tests, and China conducted twenty-two, thus diminishing the significance of the Treaty's prohibitions.\textsuperscript{100} It is important to note that the prohibition in Article I applies only to "nuclear" tests, and not conventional or high energy laser beam weapons. Additionally, the Treaty only regulates nuclear explosions or tests and not the use of nuclear substances as a power source for space objects.\textsuperscript{101}

Article IV of the Outer Space Treaty specifically deals with the militarization of certain aspects of the space environment.\textsuperscript{102} At first reading, this Article appears to be a strong deterrent to any militarization or weaponization. Article IV states:

States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or


\textsuperscript{98} Id.

\textsuperscript{99} Id. at 405.

\textsuperscript{100} Id.

\textsuperscript{101} Nuclear Test Ban Treaty, supra note 94, art. I.

\textsuperscript{102} Outer Space Treaty, supra note 26, art. IV. Article IV gives every member State the right to withdraw from the Treaty as an exercise of its natural sovereignty. Matte, supra note 97, at 404. This withdrawal is only allowed if "'extraordinary events' relating to nuclear explosions have jeopardized its 'supreme interests.'" Id.; see supra notes 25-30 and accompanying text for a discussion of the Outer Space Treaty.
any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited.103

Because of clever draftsmanship, much of the prohibitory force contained in Article IV is weak or nonexistent. This resulted from the division of the space environment into separate legal areas: in orbit around the earth, outer space, the moon, and other celestial bodies. Interestingly, throughout the Treaty, certain words are used regularly together, such as “outer space including the moon and other celestial bodies.” In Article IV, however, these words are used separately, which effectively creates separate legal areas with separate limitations applicable to each area. Professor Matte, a distinguished and respected space law jurist, points out some of the deliberate shortcomings and wilful omissions contained in Article IV:

In the first paragraph, the deliberate omission of the obligation of not sending nuclear arms or weapons of mass destruction into outer space seems designed to permit the use of Intercontinental Ballistic Missiles, which—at least for a short time—would cross outer space. Such a restriction would have forced the two great atomic powers to abandon an important, if not vital, part of their defensive systems. There is no doubt that the United States as well as the Soviet Union use outer space for nuclear missile tests for military purposes. The former United States Secretary of Defence [sic], Mr. Robert MacNamara, an-

103 Outer Space Treaty, supra note 26, art. IV (emphasis added).
104 ld.
nounced at the end of 1967 that the Soviet Union was in the process of perfecting a system of orbital arms, but added that this will not contravene Article IV of the Space Treaty, as it is a question of launching a nuclear missile and not placing it in orbit, the placing in orbit being the only one banned by the Treaty under the provisions of Article IV.

The manner in which the second paragraph of Article IV of the Space Treaty was drawn up practically represents a franchise, if not an invitation to use outer space for military purposes, such as reconnaissance and surveillance via satellites. The establishment of military bases and fortifications, the testing of weapons of all types and the carrying out of military maneuvers on celestial bodies are strictly forbidden. This may also mean that these activities could be carried out on the moon, as the article does not make mention of the moon while enumerating said activities. Thus, with the exception of the placing in orbit of nuclear arms and weapons of mass destruction, countries seem to have the right to carry out all military activities, even the establishment of military bases and fortifications.105

Ironically, the muddled text of Article IV, which was supposed to curb the militarization of outer space, has had the opposite effect. Major space powers have demonstrably been acting on the premise that what is specifically not prohibited under the Treaty is permissible and lawful. Another area of controversy surrounds the meaning of the term "peaceful purposes," which is not defined in the Treaty. As a result, a group of countries led by the United States has consistently espoused the view that the term prohibits only "aggressive" uses of outer space while permitting "non-aggressive" or "defensive" military activities.106 Others assert that all military conduct is potentially aggressive and, hence, non-peaceful.107

Additionally, most of the current Strategic Defense Ini-

106 Id. at 299-300.
107 Id. The author noted that "the Soviet Union and the Communist Bloc countries considered the expression 'peaceful' as being opposed to military activities . . . ." Id. at 300.
tiative (SDI) or "Star Wars" technology arguably would not be prohibited under the Outer Space Treaty. Most of the technology employed or proposed for SDI either would be in space only a short time and consequently would not be considered placed in orbit\[^{108}\] or would not be considered a weapon of mass destruction.\[^{109}\]

In 1972, the United States and Soviet Union reached another agreement, the Anti-Ballistic Missile (ABM) Treaty.\[^{110}\] Under this Treaty, the United States and the Soviet Union, in order to minimize the destabilizing effect of technological change on the strategic balance, agreed to limit ABM systems including space-based systems.\[^{111}\] The purpose of this Treaty was to sharply limit defenses against missile attacks so that a party contemplating an attack would have no defense against a retaliatory blow.\[^{112}\] The deterrence theory based on a massive retaliators strike has come known as "mutually assured destruction," or MAD.\[^{113}\] Article IX prohibits the deployment outside

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\[^{108}\] Cf. id. at 298 (missiles crossing outer space for a short time seem to be permitted by treaty).

\[^{109}\] Space Treaty, AVIATION WEEK & SPACE TECH., Nov. 14, 1988, at 23. The article notes that:

- Ground-based, nuclear directed energy weapons launched to intercept enemy reentry vehicles probably would be allowed under a liberal interpretation of the Outer Space Treaty, which bans orbiting weapons of mass destruction, according to a report by Los Alamos National Laboratory officials. Lasers, particle beams, pellets and electromagnetic weapons are not considered to be weapons of mass destruction and could be orbited without violating the treaty, in the lab's view.


\[^{111}\] Id. art. V, para. 1. Article V provides that "[e]ach Party undertakes not to develop, test or deploy ABM Systems or components which are sea-based, air-based, space-based, or mobile land-based." Id. The Treaty also establishes that "an ABM System is a system to counter strategic ballistic missiles or their elements in flight trajectory . . . ." Id. art. II, para. 1.

\[^{112}\] See id. at preamble; see also A. COX, THE DYNAMICS OF DETENTE: HOW TO END THE ARMS RACE 85 (1976).

the national territory of the parties of ABM systems covered by the Treaty.\textsuperscript{114}

In 1985, the United States reconsidered the restrictive interpretation of the ABM Treaty that would have completely prohibited the development and testing of non-fixed, land-based systems. Relying on the negotiating history of the Treaty, the United States took the position that a proper interpretation may be broader in order to allow research, development and testing of the SDI program.\textsuperscript{115} Notwithstanding the adoption of a permissive interpretation, the United States administration decided to conduct the SDI program within the parameters of the restrictive interpretation.\textsuperscript{116}

Recently, it has been reported that the testing of the "Brilliant Pebbles" component of the Star Wars system may begin as early as 1990.\textsuperscript{117} "Brilliant Pebbles," developed at the United States Government's Lawrence Livermore National Laboratory in California, would consist of a swarm of thousands of small, computerized rockets deployed in space to locate, track, and destroy enemy missiles.\textsuperscript{118} Each of the interceptors would be about three feet long and one foot in diameter.\textsuperscript{119} While it is believed that initial flight tests will be in compliance with the ABM Treaty, it is predicted that by 1994 or 1995 the program's testing will violate the restrictive interpretation of the

\textsuperscript{114} AMB Treaty, \textit{supra} note 110, art. IX. Article IX provides, in part, that "[t]o assure the viability and effectiveness of this Treaty, each Party undertakes not to transfer to other States, and not to deploy outside its national territory, ABM Systems or their components limited by this Treaty." \textit{Id.}


\textsuperscript{116} \textit{Id.} at 854 ("[a]ccording to the administration, the ABM Treaty places no restrictions, short of actual deployment, on the [SDI] . . . .").

\textsuperscript{117} Foley, \textit{Brilliant Pebbles Testing Proceeds at Rapid Pace, Aviation Week & Space Tech.}, Nov. 14, 1988, at 32 [hereinafter \textit{Brilliant Pebbles Testing}] (SDI Organization already has flight-tested a new Brilliant Pebbles sensor); Foley, \textit{Sharp Rise in Brilliant Pebbles Interceptor Funding Accompanied by New Questions About Technical Feasibility, Aviation Week & Space Tech.}, May 22, 1989, at 20, 21 ("[e]ight suborbital and four orbital tests of Brilliant Pebbles technology are planned before 1993").

\textsuperscript{118} \textit{Brilliant Pebbles Testing, supra} note 117, at 32.

\textsuperscript{119} \textit{Id.} Photographs of hardware prototypes made by Livermore recently were declassified. \textit{Id.}
ABM Treaty.\textsuperscript{120}

Other agreements dealing with the militarization of space include the two "SALT" agreements,\textsuperscript{121} to which the United States and the Soviet Union observe or conform to while awaiting new treaties. These interim agreements contain verification provisions which establish that the contracting parties shall use "national technical means of verification" to monitor adherence to the provisions of the agreements.\textsuperscript{122} These national "means of verification" must not be disturbed or "interfered with."\textsuperscript{123} It is assumed that surveillance satellites are among those means.\textsuperscript{124}

The SALT II agreements\textsuperscript{125} contain a relatively unnoticed expansion of the Outer Space Treaty by forbidding development, testing, and deployment of in-orbit nuclear weapons.\textsuperscript{126} In addition, the SALT II agreement prohib-

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\item[\textsuperscript{120}] Brilliant Pebbles Become Focus of a Strategic Review, AVIATION WEEK & SPACE TECH., Apr. 3, 1989, at 47, 48 (noting that the "Brilliant Pebbles option has serious arms control implications and would force early U.S. abrogation of the [ABM] Treaty with the Soviet Union, if adopted").
\item[\textsuperscript{122}] SALT I, supra note 121, art. V, para. 1.
\item[\textsuperscript{123}] Id. art. V, para. 2.
\item[\textsuperscript{124}] For a discussion of how surveillance satellites gained international acceptance, see B. HURWITZ, supra note 96, at 91-98 (1986). The author notes that "surveillance satellites serve as a means for the verification of arms-control agreements . . . ." Id. at 95.
\item[\textsuperscript{126}] See SALT II, supra note 121, art. IV(1)(c).
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its testing, development, and deployment of Fractional Orbital Bombardment Systems (FOBS). While the SALT agreements appear to protect military surveillance satellites from attack, the legal standing of these agreements is doubtful. The SALT I agreement has expired, even though it is still applied, and the SALT II accords, while signed by the United States, have never been ratified.

The Accident Measures Agreement of 1971 and the Prevention of Nuclear War Agreement of 1973 together obligate the Soviet Union and the United States to refrain from interfering with or attacking early warning systems of either side, which would include satellites that are components of such warnings systems. The Moon Treaty also contains provisions further limiting militarization. As stated previously, however, the Moon Treaty is of limited legal effect given the lack of ratification and adherence to the Treaty among the space powers.

II. FUTURE OF INTERNATIONAL SPACE LAW

A. The Aerospace Vehicle

The viability of a launching system capable of returning to earth after its launch into outer space, reentering the earth's atmosphere using the aerodynamic characteristics of flight, descending and ultimately landing on a runway, and then being reused again has been proven with the "Shuttle" series of outer space launching vehicles. The concept of a spacecraft capable of "flying" within the

\[\text{id}^{127}\]

\[\text{Id.}\]

\[\text{See K. Kaplan, Dubious Specter: A Skeptical Look at the Soviet Nuclear Threat 60 (1980).}\]


\[\text{Moon Treaty, supra note 49, arts. II, para. 2, III.}\]
The earth's atmosphere is under further refinement. Research organizations in the United States, Soviet Union, United Kingdom, Federal Republic of Germany, France and Japan are all currently conducting research aimed towards the development of a new type of aircraft/spacecraft known as the "aerospace plane." It would be capable of taking off horizontally from a runway of an ordinary airport using airbreathing engines through airspace, and then proceeding single stage to outer space. The vehicle would then be able to reenter the earth's atmosphere, "fly" through airspace, and land horizontally at a conventional airport.

The aerospace vehicle is expected to revolutionize long distance intercontinental travel. A flight from New York to Tokyo could take only two hours compared to the current sixteen or more hours, and travel from California to New York could take less than an hour. In addition, such a vehicle could have military applications, such as reconnaissance flights or spying missions where it would be capable of inspecting far more targets than any satellite.

From a legal point of view, the classification of and the law applicable to such a vehicle has not yet been determined. When the aerospace vehicle does become operational, the international community will have to determine whether such a vehicle is to be governed by air law, space law, a combination of the two, or a sui generis legal regime.

While existing law has been applied previously to newly developed systems, the aerospace vehicle will have to hurdle special legal problems not yet encountered by even its close counterpart, the Shuttle. The aerospace vehicle has many similarities to the flight characteristics of the current

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132 See generally Gorove, supra note 14, at 147.
133 Id. at 148.
134 Id.
135 Id. at 147. The author notes that "[t]he utility associated with the aerospace plane technologies could be gauged from the vehicle's capability of global unrefueled operation and of reaching any point on the earth in two hours or less." Id. at 148.
Shuttle series of launch vehicles, but it will also have distinct differences. During certain phases of the Shuttle's mission, it can be considered an "aircraft" and in other phases a "spacecraft." Current United States interpretation and practice leads to the conclusion that the space Shuttle is to be classified as a "spacecraft," however, and not as an aircraft. Current international law, as evidenced by the practice of states, also regards the Shuttle as a "spacecraft" even though it functions as an aircraft during the landing phase. Further, the Shuttle is launched and lands within the United States, and suborbital flight is mostly over international waters and United States territory. Unlike the Shuttle, however, the aerospace vehicle will be capable of purely suborbital flights in airspace and will be used in international travel between countries.

A host of legal issues will be in need of revision. Should such a vehicle be governed by recognized principles of international air law or space law? Related to this issue is a myriad of sub-issues. Would such a vehicle be accorded freedom of overflight/orbital flight over subjacent territories, or would prior authorization be required? According to recognized public international air law, such permission may be required. While the Chicago Convention grants civil aircraft the right to make flights into or in transit non-stop across other contracting State's territory for nonscheduled civil flights, and the International Air

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136 Commonly accepted definitions of aircraft do encompass some of the Shuttle's flight characteristics. For example, the International Civil Aviation Organization definition of aircraft is any machine that can derive support in the atmosphere from the reactions of the air other than reactions of the air against the earth's surface.

137 Gorove, supra note 14, at 149. The author notes that "the relevant legislative history as well as NASA practice and an authoritative statement of the Chief Counsel of the Federal Aeronautics Administration came to the now well accepted conclusion that space law had to be applied to the Shuttle." Id.

138 Id.; see also E.R.C. VAN BOGAERT, supra note 17, at 137.

139 E.R.C. VAN BOGAERT, supra note 17, at 143.

140 Gorove, supra note 14, at 149-50.

141 Id. at 151-56.

142 Chicago Convention, supra note 61, art. 5.
Services Transit Agreement extends this privilege to fly across adherent’s territory without landing to scheduled international air services,\textsuperscript{143} the question remains whether the aerospace vehicle would be granted these privileges. Further, such privileges are granted only to \textit{civilian} aircraft. State or military aircraft are not granted these privileges.\textsuperscript{144}

It is possible that the applicability of air and space law will vary during the different phases of the vehicle’s mission or depending upon the vehicle’s overall mission. For example, if the aerospace vehicle is used for civilian/military purposes on a flight from New York to Tokyo, it is possible that any flight over subjacent territories will be performed while the vehicle is in outer space, not airspace. In such a scenario, any take-off or landing will be done in the United States or Japan, subject to bilateral agreements between these nations and the national law of each country. Thus, according to recognized principles of space law, should any overflight take place in outer space, prior permission or authorization by subjacent countries will not be required.\textsuperscript{145} If such a flight is conducted exclusively in airspace, however, air law would probably be applicable and prior authorization or permission may be required by subjacent countries.

Further complicating this scenario is the lack of defined boundaries between airspace and outer space. While it is generally accepted that aircraft fly in airspace and orbiting spacecraft are in outer space, there is no universally accepted definition of where airspace ends and outer space begins. This is known as the “definition/delimitation issue” and has been debated for over twenty years in the United Nations COPUOS Committee with no resolution.


\textsuperscript{144} \textit{Id.} art. I, para. 1; see also Chicago Convention, \textit{supra} note 61, art. 3.

\textsuperscript{145} See C. CHRISTOL, \textit{supra} note 45, at 829 (the question of whether the vehicle achieves orbital height before overflight of a subjacent country is a crucial distinction).
yet in sight. The absence of a recognized definition has not yet led to any practical difficulties. Given the developing nature of the aerospace vehicle, however, a resolution of this problem may soon be necessary. The difference between an aerospace vehicle being in spaceflight or flying in airspace over a subjacent state may be the difference between customarily recognized spaceflight over subjacent territories or unauthorized flight into territorial airspace.

Another unresolved issue of practical importance will be liability for torts. Under the Liability Convention, any injuries, damages or death caused to unrelated third-parties on the surface of the earth or to aircraft in flight would be governed by absolute liability. If the damage, injury, or death is caused elsewhere than on the surface of the earth to a space object of another launching state, then fault principles are applicable. The question becomes whether the Liability Convention is applicable to the aerospace vehicle at all times the vehicle is traveling in airspace and outer space, or whether the function of the particular flight is to be examined in determining the Convention’s applicability. For example, if the aerospace vehicle was involved in a collision with a satellite in outer space, it is probable that the Liability Convention would apply. What if, instead, the aerospace vehicle was engaged in suborbital flight at the time of collision with an aircraft and the flight manifest of the aerospace vehicle never called for outer space flight for that particular mission? Would absolute liability attach under the Liability Convention or would another body of law, such as a national law, be applicable? Another area of inquiry is the possible limitation of potential liability of the aerospace vehicle’s operator to persons aboard such a flight. Assume an aerospace vehicle is engaged in regularly scheduled

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146 See generally, M. Benko, W. de Graaff & G. Reijnen, supra note 27, at 121-46.
147 See Liability Convention, supra note 35; supra notes 35-43 and accompanying text for a discussion of the Liability Convention.
148 Liability Convention, supra note 35, arts. III, IV.
services between New York and Tokyo, and there are fare-paying passengers aboard such flight. Would such a flight be considered “international transportation” under Article I of the Warsaw Convention, and, consequently, could the operator then be able to limit any potential liability for damages, death or injuries to his passengers to a mere $8,291 as described by the Warsaw Convention; $16,528 as prescribed by the Hague Protocol; or $75,000 as prescribed by the Montreal Interim Agreement? The $75,000 limitation applies if the air passenger’s flight commences or terminates in the United States or if the ticketed itinerary calls for a stop at any airport in the United States. In some instances, however, liability may be limited, even for American passengers, to the Warsaw or Hague amounts if, for example, they purchase their tickets and fly exclusively outside the United States.

While the above limitations are applicable exclusively to international air travel by aircraft, it is possible that

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150 Id.


153 Id.

154 See generally Kennelly, When Will International Air Travelers Get Their Rights, CBA REC., Jan. 1989, at 22.

155 Warsaw Convention, supra note 149, art. I. Article I provides that:

1. This convention shall apply to all transportation of persons, baggage, or goods performed by aircraft for hire. It shall apply equally to gratuitous transportation by aircraft performed by an air transportation enterprise.

2. For the purposes of this convention the expression “international transportation” shall mean any transportation in which, according to the contract made by the parties, the place of departure and the place of destination, whether or not there be a break in the transportation or a transshipment, are situated either within the territories of two High Contracting Parties or within the territory of a single High Contracting Party, if there is an agreed stopping place within a territory subject to the sovereignty, suzerainty, mandate or
these treaties may be applicable to injuries or deaths to passengers aboard an aerospace vehicle. The Warsaw Convention applies to "aircraft for hire." The issue thus becomes whether the aerospace vehicle which carries paying passengers is considered an "aircraft for hire." In making this determination, it may be relevant that the aerospace vehicle does take-off, fly, and land as an aircraft.

B. The Space Environment: Space Debris And Nuclear Contamination

As of January 11, 1989, the United States Air Force Space Command in Colorado Springs, Colorado, was tracking 7,087 pieces of space junk. Of these, it is reported that 3,142 were put into orbit by the United States, and 3,302 were put there by the Soviet Union. These objects include a glove which floated out of the Gemini Four spacecraft in 1965, a screwdriver dropped by a spacewalking astronaut aboard the Soviet Mir space station, spent rocket engines, and thousands of whirling fragments of equipment and miscellaneous spacecraft parts. The more than 7,000 pieces of space junk currently being tracked are those objects which are at least approximately four inches in diameter. Another 20,000 to 60,000 pieces of debris having a diameter of less than four inches are estimated to be orbiting space.

It is estimated that there are already four million pounds of debris in low earth orbit and that the accumula-

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authority of another power, even though that power is not a party to this convention. Transportation without such an agreed stopping place between territories subject to the sovereignty, suzerainty, mandate, or authority of the same High Contracting Party shall not be deemed to be international for the purpose of this convention.

Id. N.Y. Times, Jan. 24, 1989, § C (Science), at 8.

Id.

Broad, Orbiting Debris Threatens Space Missions, N.Y. Times, Aug. 4, 1987, at C1, col. 1. The United States Space Command now tracks nearly 7000 orbiting objects the size of a baseball or larger. Id.

Id. at C1, col. 3.
tion of small debris increases at a rate in excess of ten percent per year. While the design of early satellite launchers exacerbated the debris problem due to a launch stage that exploded after use, even today, the probability of yet more space junk being left behind in orbit increases with each spacecraft launch. As more and more nations launch an ever growing number of satellites into an increasingly polluted orbit, experts worry that the probability of damages, loss of spacecraft, and death of astronauts will increase. These worries are not unfounded. Three years ago, a tiny crater was found in a space Shuttle after it returned from earth orbit. Careful analysis revealed that the Shuttle had collided with a speck of paint about the size of the period at the end of this sentence. The speck of paint, which was probably from another spacecraft, had been orbiting at about 4,000 miles per hour when it collided with the Shuttle.

Complicating the present situation is the fact that space debris is self-generating, in that debris collides with other debris to cause even more debris. Joseph Mahon, NASA’s deputy associate administrator for space flight, has stated that because of their erratic orbits, pieces of debris can smash into satellites at speeds of up to 32,000 miles per hour. A typical collision could have a speed of 21,000 miles per hour. At such a speed, a piece of debris the size of a period can disable sensitive equipment; a piece the size of a pencil eraser could have the explosive impact of a hand grenade; a piece the size of a baseball could have the destructive effect of a bomb. The amount of orbiting debris has grown steadily since the beginning of the space age. In 1981, the level of debris increased

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162 Id.
163 Id. supra note 158, at C1, col. 3.
165 Id.
166 Id.
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sharply as a result of the explosion of an American Delta rocket and the subsequent mysterious breakup of a Soviet satellite.\textsuperscript{167} Some experts suspect that debris from the Delta breakup may have destroyed the Soviet satellite.\textsuperscript{168}

In addition to national awareness and regulation, this problem requires the development of international standards. NASA and the European Space Agency (ESA) have established working groups to discuss and explore the space debris problem, and in January, 1988, the two agencies presented the first report on space debris to the United Nations.\textsuperscript{169} While this topic has been met with great interest, it is not yet an agenda item for the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS).\textsuperscript{170} At a COPUOS legal subcommittee meeting, the problem of space debris was considered as a topic to be discussed further.\textsuperscript{171}

One proposed solution would be for spacefaring nations to reach some type of international agreement outside of the COPUOS framework in an attempt to prevent further space debris pollution. An agreement regarding debris removal would also be beneficial. Most of the existing debris can be traced to either the United States or the Soviet Union.\textsuperscript{172} It is doubtful, however, that these countries would agree to a cleanup proposition, especially given the inevitably high cost of such an operation.

The so-called "killer satellites" proposed in recent years in conjunction with or as part of the SDI program will only add to the space debris problem.\textsuperscript{173} Some pro-

\begin{footnotes}
\item[167] Broad, supra note 158, at C1, col. 1.
\item[168] Id. The author noted that "[e]xperts say a fast-moving object the size of a pea could easily shatter a $100 million satellite." Id.
\item[169] See generally H. Baker, supra note 161, at 108.
\item[170] Id.
\item[172] See generally Qizhi, Towards a New Legal Regime for the Use of Nuclear Power Sources in Outer Space, 14 J. SPACE L. 95 (1986).
\item[173] See generally Radioactive Space Debris Study Cites Hazards to Satellites, Earth, AVIA-
posed prototypes would be designed to seek out and destroy other satellites and launch vehicles. Any such destruction in near earth orbits would contribute significantly to the space debris problem.

Another area in need of international resolution is the problem of radioactive space debris. There is potential for radiation pollution to the earth’s environment from satellites reentering the earth’s atmosphere and disseminating radioactive waste. According to recent studies, the potential for nuclear pollution from radioactive satellites is a threat not only to spacecraft but also to the purity of the earth’s atmosphere.

The United States has launched more than twenty-two satellites with radioisotope thermoelectric generators and one reactor-powered spacecraft, whereas the Soviets have launched more than thirty reactor-powered radar ocean reconnaissance satellites and several satellites powered by radioisotope fuel. Malfunctions and unscheduled, uncontrolled reentries of these satellites are not new. As many as six nuclear powered satellites have fallen back to earth. Some of these satellites have fallen, intact, into the Pacific Ocean, and at least two of these are known to still contain dangerous radioactive material.

Other satellites have disintegrated upon reentry, releasing their dangerous materials into the atmosphere. In April, 1964, a United States satellite vaporized over the Indian Ocean, releasing some 17,000 curies of plutonium-

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174 Id.
175 Id. (discussing a report by N. Johnson of Teledyne Brown Engineering for the United States Air Force and NASA).
177 Radioactive Space Debris, supra note 173, at 20. A 1968 Nimbus launch in California also resulted in a radioisotope system falling into the Pacific, but it was recovered. Id. The Apollo 13 lunar experiment radioisotope generator burned upon reentry in 1970, although no radiation from that incident has ever been detected. Id.
238 into the upper atmosphere.\textsuperscript{178} High altitude samples indicated a worldwide release of radiation.\textsuperscript{179} A nuclear reactor from another United States' satellite reentered the earth’s atmosphere over the South Pacific Ocean, and the nuclear fuel case sank 20,000 feet into the ocean where it still remains.\textsuperscript{180} In 1978, a Soviet satellite, Cosmos 954, malfunctioned and reentered the earth’s atmosphere above Canada’s Northwest Territories where it broke apart and partially disintegrated, spewing radioactive material over a wide area of the Northwest Territories.\textsuperscript{181} After this incident, the Soviets redesigned their reactors so that the fuel core could be separated from the reactor.\textsuperscript{182} This design enables both parts of the spacecraft to burn up in the atmosphere. During 1982, another Soviet satellite, Cosmos 1402, with a newly designed nuclear reactor, reentered the earth’s atmosphere, but the design allowed both the fuel and reactors to be consumed during reentry.\textsuperscript{183} It has been estimated that four dozen potentially hazardous satellites presently orbiting the earth carry over one metric ton of highly enriched uranium-235, plutonium-239, and assorted fission products.\textsuperscript{184}

The potential hazards posed as a result of the uncontrolled reentry of a nuclear powered satellite (NPS) has raised international concern. As a result, international regulation of these space vehicles through rudimentary principles has begun in the United Nations COPUOS

\textsuperscript{178} M. Straubel, The International Regulation of Nuclear Power Sources in Outer Space—A Survey of the Legal Fallout (1985) (unpublished term paper submitted to the McGill University Institute of Air & Space Law); see also Qizhi, supra note 172, at 96.

\textsuperscript{179} M. Straubel, supra note 178.

\textsuperscript{180} Id. This incident involved the aborted 1970 Apollo 13 Mission. Id.; see supra note 177 and accompanying text.

\textsuperscript{181} M. Straubel, supra 178. The area was sparsely populated, and no personal injuries were reported. Id. The cleanup was extensive, requiring removal of contaminated soil and plant life, at a cost of almost $14 million. Id.

\textsuperscript{182} Radioactive Space Debris, supra note 173, at 19.

\textsuperscript{183} Id. Because the redesign increases the radioactive elements boosted when no failure occurs, thirty-nine radioactive Soviet Satellites are now in storage orbit. Id.

\textsuperscript{184} Id.
At the conclusion of a COPUOS legal subcommittee meeting, the subcommittee again considered this subject and is in the process of completing a draft treaty designed to regulate NPS satellites. The revised working paper contains eleven proposed principles.\footnote{U.N. Doc. A/AC.105/C.2/L.154/Rev. 5, reproduced in Annex III.A.3 of the Report of the Legal Sub-Committee of COPUOS on the Work of its Twenty-eighth Session (A/AC.105/430).}

The first principle deals with applicability of international law and states that the activities involving the use of nuclear power sources in outer space shall be carried out in accordance with international law, including the Charter of the United Nations and the 1967 Outer Space Treaty.\footnote{Id.} The second principle deals with the obligation of the state of registry to notify the Secretary General of the United Nations, as soon as possible after launching, of the presence of a nuclear power source aboard a space object and its generic classification.\footnote{Id.} There is disagreement, however, on exactly when notification needs to be furnished: should notification be made before the launch, immediately after the launch, or as soon as practicable?

Principle three deals with the guidelines and criteria for safe use of nuclear power sources.\footnote{Id.} It is the most detailed of all provisions and certainly one of the most important provisions. It also appears to be one of the more controversial provisions. States launching space objects with nuclear power sources aboard shall ensure that the design and construction of such space objects will meet accepted international guidelines for radiological protection in all phases of their mission. In particular, countries shall ensure that space objects comply with the requirements of the Industrial Commission on Radiological Protection. Further, this principle deals with the type of fuel allowed aboard, the activation of the nuclear power source, the design of the nuclear reactor, and other de-
sign criteria, including safety measures to be taken into account to mitigate uncontrolled reentry.

Principle four requires a thorough safety assessment prior to launching. Principle five deals with notification of reentry of a malfunctioning space object with a nuclear power source on board. It provides that any state launching a space object with a nuclear power source on board must timely inform states concerned in the event this object is malfunctioning with the risk of reentry of radioactive materials to the earth. Principle six requires, as far as reasonably practicable, that states providing information in regard to a malfunctioning satellite reentering the earth's atmosphere to respond promptly to requests for further information or consultations sought by other states.

Principle seven deals with assistance to states. It requires that upon the notification of an expected reentry in the earth's atmosphere of a space object containing a nuclear power source on board, all States possessing space monitoring and tracking facilities, in the spirit of international cooperation, shall communicate, as promptly as possible, the relevant information that they may have available on this malfunctioning space object to the Secretary General of the United Nations and other states concerned. This will allow states that might be affected time to assess the situation and take any precautionary measures they deem necessary. After reentry, the launching state shall promptly offer, and if requested by the affected state, promptly provide the necessary assistance to eliminate actual and possible harmful results.

Principle eight deals with the responsibility of states and calls for international responsibility of national activities in outer space whether carried out by governmental
or non-governmental entities.\textsuperscript{194} Principle nine deals with the issue of compensation. International liability is imposed upon states launching space objects with nuclear power sources on board for any damages caused.\textsuperscript{195} This provision is made in accordance with Article VII of the Outer Space Treaty,\textsuperscript{196} which deals with international liability, and the Liability Convention,\textsuperscript{197} which provides a legal framework for determining and presenting the issue of liability for damages caused by space objects. Principle ten deals with resolution of disputes resulting from application of these principles and calls for resolution through negotiations or other established procedures, in accordance with the Charter of the United Nations.\textsuperscript{198} Principle eleven deals with the relation of these principles with other international treaties.\textsuperscript{199}

While the above mentioned principles are not in final form, and will certainly be further revised, these drafts, if adopted, will provide a legal framework of regulations for this potentially hazardous component of some outer space satellites. While formulation of draft principles in COPUOS is facilitated through the consensus method, which is often burdensome and time consuming, the consensus method is desired for the simple reason that any draft leaving COPUOS which was reached through a consensus method is more likely to be adopted and ratified by member nations in the form of a multilateral treaty.

On the national level, the Bush Administration has recently been asked to make an early decision on United States' policy on nuclear reactors in outer space.\textsuperscript{200} Supporters of the Strategic Defense Initiative (SDI) or "Star

\textsuperscript{194} Id.

\textsuperscript{195} Id.

\textsuperscript{196} Outer Space Treaty, supra note 26, art. VII; see supra notes 25-30 and accompanying text for a discussion of the Outer Space Treaty.

\textsuperscript{197} Liability Convention, supra note 35; see supra notes 35-43 and accompanying text for a discussion of the Liability Convention.


\textsuperscript{199} Id.

\textsuperscript{200} O'Lone, Scientists Call for Policy on Space Nuclear Reactors, AVIATION WEEK & SPACE TECH., Jan. 23, 1989, at 23.
Wars" programs state that United States' needs for compact high power and long lasting power sources, such as nuclear reactors, are essential for their programs. In a joint proposal last year by the Federation of American Scientists and the Committee of Soviet Scientists Against the Nuclear Threat, however, it was proposed that nuclear power sources be banned in earth's orbit even though it is recognized that nuclear power sources have a legitimate role in deep space missions.

In addition to the hazards that such nuclear power sources pose to the earth's environment, United States' scientists have been frustrated recently by radiation emitted from Soviet satellites orbiting with nuclear power sources on board. These scientists claim that current experiments have been adversely affected by radiation from Soviet orbital tests of their nuclear reactors. Further, these scientists claim that the only real need that exists for nuclear power source satellites in near earth orbit, as opposed to deep space missions, is entirely military. They call any further United States deployment of such satellites potentially destabilizing and state that "development would unravel decades of arms control progress."

International and national monitoring and regulation of the near earth space environment is essential to prevent the increasing probability of collisions caused by the spread of space debris and to prevent harmful effects of radioactive contamination to the earth's environment from errant nuclear power sources falling earthward and

201 Id.
202 Id. The "Working Group on Space Nuclear Power" of the Federation of American Scientists (FAS) reaffirmed their commitment to this joint proposal at a January, 1989 meeting where university scientists and SDI officials debated the proper role of nuclear reactors in space. Id.
203 Id.
205 O'Lone, supra note 200, at 23. The United States scientists claimed that "the primary uses of such devices in orbit, as opposed to deep space missions are military, and provocatively so." Id.
206 Id.
spewing their harmful radiation. It is ironic that while it has taken hundreds of years to adversely affect the earth’s environment with the harmful effects of pollution, with technological progress the near earth space environment has only taken a few decades to become adversely affected by man-made pollution.

III. Conclusion

International laws regarding outer space and space related activities are now firmly in place and recognized throughout the world by the vast majority of nations through such international organizations as the United Nations and its General Assembly and the COPUOS committee and the International Telecommunications Union. While most space laws generally accepted by the majority of nations deal with broad principles, these broad but widely recognized principles form the framework upon which further international clarification will develop, as the need arises. In the field of telecommunications, the most mature space industry, in addition to the broad principles the need has already arisen for specific regulation of this aspect of the space environment, and as a result, there are extremely detailed and comprehensive specifications dealing with the regulation of the radio frequency spectrum in order to prevent harmful interference. Other similar international rules and regulations will be adopted as the needs arise, such as the applicable legal principles to govern the aerospace vehicle. Currently, there is a great need for regulation of the space environment to prevent further harmful pollution by debris and radioactive substances. It is hoped that international principles of law will soon be developed in this area, and, further, that the draft principles concerning the regulation of nuclear power source satellites will soon be completed by COPUOS and adopted as a multilateral treaty widely adhered to and ratified by nations.

In addition to international law, there are already comprehensive laws dealing with specific aspects of space ac-
tivity on the national level and other national laws under consideration in regard to new and developing space activities. For example, while the ITU regulates the radio frequency spectrum on the international level, the Communications Satellite Act and the Federal Communications Commission regulates radio frequency on a national level in the United States in conformity with ITU regulations. Other nations have similar national laws regarding the regulation of the radio frequency spectrum. In addition, in the United States the National Aeronautics and Space Act of 1958 lays the foundation for United States domestic space law.\textsuperscript{207} There are also many federal statutes regulating space activities such as crimes committed\textsuperscript{208} and taxation.\textsuperscript{209} The conduct of launch activities by private entities in the United States is regulated by the Commercial Space Law Act of 1984.\textsuperscript{210}

Space law is the next legal frontier on both the international and national level. The laws pertaining to outer-space and space activities must keep up with the rapidly expanding technology in this broad area.

\textsuperscript{208} 18 U.S.C. § 7161 (1982).