

**THE NEXT, SMALL, STEP FOR MANKIND:
FIXING THE INADEQUACIES OF THE
INTERNATIONAL SPACE LAW TREATY
REGIME TO ACCOMMODATE THE MODERN
SPACE FLIGHT INDUSTRY**

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ABSTRACT

Since man's first foray into space flight in 1958, the world has greatly changed. Early space law treaties were created for a world where nations looked to travel to the moon and beyond, two hostile superpowers gave rise to the danger of a weaponized outer space, and space travel was too expensive for anyone but the world's richest governments. This article argues that the current space law treaty regime, negotiated in the late 1960s and early 1970s, is inadequate to handle the challenges of space flight in the next decade. These challenges include commercial space flight and its attendant concerns, space tourism, orbital crowding, and most importantly, the proliferation of dangerous orbital debris. The article then critiques proposed solutions to some of these problems, and suggests a direction for future space law developments.

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Sputnik, the world's first man-made satellite, was launched in 1957.² The state of the world has changed greatly since then. In the early days of space flight, the United States and the U.S.S.R. were the major powers in the world, and only those two governments launched spacecraft into orbit.³ This was the state of the world when the series of treaties that govern international law over outer space were negotiated, from 1967 to 1979.⁴ It is not the state of the world today, and the direction of space flight is different than that anticipated by the treaties.

Today, government activities in space are largely limited to unmanned flight in low Earth orbit, with occasional launches of unmanned spacecraft to bodies outside of Earth's orbit. In addition to the United States and Russia, the European Union, China, and Japan now have thriving space programs.⁵ Most importantly, much of the current innovation in the space flight industry is coming from private corporations, some national and some multinational.⁶ The United States first began supporting its private space flight industry only in 1984, when Ronald Reagan signed into law the Commercial Space Launch Act.⁷ The United States has severely cut back on manned space shuttle missions since the Columbia disaster of 2003, launching only seven missions from 2003 to 2008.⁸ While the U.S. shuttle was grounded, a private company, Scaled Composites, won the Ansari X Prize on October 4, 2004 by making two manned suborbital flights within fourteen days.⁹ In the field of unmanned space flight, a number of private corporations provide launch services. In 2005, nearly a third of orbital launches were performed by commercial launch companies.¹⁰

² GLENN H. REYNOLDS & ROBERT P. MERGES, *OUTER SPACE: PROBLEMS OF LAW AND POLICY* 55 (2d ed. 1997).

³ *See id.* at 4, 55–56.

⁴ NATHAN C. GOLDMAN, *AMERICAN SPACE LAW: INTERNATIONAL AND DOMESTIC* vii, 85 (1988).

⁵ *See id.* at 7–8, 18.

⁶ *See* REYNOLDS & MERGES, *supra* note 2, at 246, 275, 279.

⁷ Commercial Space Launch Act, 49 U.S.C. § 2601 *et seq.* (amended 1988); *see* GOLDMAN, *supra* note 4, at 115; REYNOLDS & MERGES, *supra* note 2, at 246.

⁸ *See* NASA Shuttle Mission Archives, http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/list_main.html (last visited Feb. 11, 2009) (showing how the U.S. did not fly any space shuttles in 2003 and 2004 after Columbia, flew one mission in 2005, and flew three in each of 2006 and 2007).

⁹ *See* Michael Coren, *SpaceShipOne Captures X Prize: Privately Funded Craft Reaches Altitude Requirement*, CNN, Oct. 4, 2004, <http://www.cnn.com/2004/TECH/space/10/04/spaceshipone.attemptcnn/index.html>.

¹⁰ *See* Federal Aviation Administration, *Commercial Space Transportation*:

The future holds even greater promise for private space flight, particularly in the area of space tourism. In 2005, Virgin Galactic—an outgrowth of Richard Branson’s Virgin group which includes Virgin Airlines—began selling tickets for flights on their planned SpaceShipTwo, the design for which was unveiled in January 2008, with commercial flights expected to begin sometime in 2009 or 2010.¹¹ Virgin Galactic is not the only company rushing to be first to the space tourism market. Benson Space Company is also trying to carve out a piece of the market; its vehicle uses a technology to limit G-forces on passengers.¹² Bigelow Aerospace is attempting to create a commercial orbital space complex out of its modular Genesis units, two of which have launched successfully.¹³ These are just some of the American companies pursuing commercial manned space flight. While there has already been some limited space tourism through the Russian government, companies are on the verge of making private space tourism a reality.

With the international law of space governed by a series of treaties negotiated in a world where space flight was only done by two large governments, the treaty regime is not capable of properly regulating space flight in the modern world. The treaty regime cannot accommodate a booming private space flight industry, the emerging space tourism market, or launches from the high seas. In this Article, I explore the problems that could result from private space flights under the current treaty regime, and suggest better solutions to international regulation of space flight. In Part I, I lay out the background of international space law, including the basic science behind space flight, the problems of international law that are imposed by the very nature of space flight, and the current treaty regime governing space flight. In Part II, I explore various hypothetical, but quite possible challenges that non-governmental space flight may pose to the

2005 Year In Review 6 (2006) available at http://www.faa.gov/about/office_org/headquarters_offices/ast/media/2005_YIR_FAA_AST_0206.pdf (stating that out of 55 launch events that year, 18 were commercial launches).

¹¹ See Virgin Galactic, *Mothership “Eve” Roll Out*, July 28, 2008, <http://www.virgingalactic.com/htmlsite/news.php> (stating that flight testing is expected to begin in Summer of 2008, and commercial flights are expected to begin after 12-18 months of testing).

¹² See Jeff Foust, *An Experience That Sells Itself*, SPACE REV., July 9, 2007, available at http://www.bensonpace.com/press_details.php?id=1.

¹³ Bigelow Aerospace, *Aerojet Supplies Aft Propulsion for Sundancer*, May 28, 2008, available at <http://www.bigelow aerospace.com/news/>.

current treaty regime. In Part III, I delve into two issues where the current treaty regime has significant adverse effects on outer space development. Finally, in Part IV, I critique some proposals for regulating private space flight, and suggest my own methods for better regulating the international space flight industry. This Note focuses only on Earth's orbit, and is not concerned with private ownership or property rights in celestial bodies such as the moon, Mars, or asteroids. Most importantly, this Note is focused on the near future and problems likely to arise within the next decade or those that have already arisen; it is not focused on issues such as asteroid mining that are decades if not centuries away.

I. BACKGROUND

The very nature of space flight poses unique problems to international law that are not posed by other frontiers of human transportation such as the high seas, atmospheric flight, or polar exploration. Many of these problems are due to the simple fact that outside of a small band of orbits called geosynchronous orbits, satellites will not remain in place above one nation and will always overfly many different nations.¹⁴ The current treaty regime, declaring that outer space is not subject to appropriation by claim of sovereignty, and making outer space "free for exploration and use by all States without discrimination of any kind,"¹⁵ is in part a response to this fact.

A. *Why Space Travel and Space Law are Unique*

The international community must take a different approach to regulating space travel than it has taken in various other related fields, though the approach will be informed by said related fields. The very nature of space flight, the way the science of space flight has developed, and the speed of space flight development differentiate space flight from other forms of transportation, such as aviation and travel on the high seas. The things that can be done in space are sufficiently different from

¹⁴ See REYNOLDS & MERGES, *supra* note 2, at 15; M. Cherif Bassiouni, *The Future of International Criminal Justice*, 11 PACE INT'L L. REV. 309, 310 (1999).

¹⁵ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, U.S.-Russ.-U.K., art. I, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

what can be done on the high seas or in Antarctica to require different rules from these other areas traditionally not subject to national sovereignty. The civilian and trade-focused aspects of space travel require a different approach from other international regimes established to govern private organizations that take the place of state functions, such as the rules governing corporations in human rights law and the rules governing military contractors.

Orbital space flight is a function of basic Newtonian physics. A spaceship in orbit is constantly falling towards the Earth due to the force of gravity, but travels fast enough tangential to the Earth that as it falls it circles the Earth rather than hitting the Earth.¹⁶ The time it takes for an object in orbit to circle the Earth is determined by the average distance.¹⁷ The only way for a satellite to remain stationary with respect to the Earth's surface is to orbit the Earth at the equator at the same speed at which the Earth rotates, once every twenty-four hours.¹⁸ This only happens when a satellite orbits at an altitude of about 35,600 km, called the geosynchronous orbit.¹⁹ In general, any other orbital spacecraft will overfly many different nations, and must cross every longitudinal line on the globe.²⁰ This physical problem makes it impossible to create a sovereignty regime over outer space by simply extending national boundaries upwards, as was done with airspace.

The nature of orbital space flight poses unique issues of sovereignty and regulation that are not present on the high seas. A ship on the high seas, traditionally defined as the parts of the seas or oceans at least twelve miles from the nearest shore, cannot substantially affect inland areas by accident.²¹ Until the advent of advanced sensing technologies such as radar, a ship on

¹⁶ See REYNOLDS & MERGES, *supra* note 2, at 14–15.

¹⁷ See *id.* at 15 (“[S]atellites at low orbits complete a circuit of the earth in ninety minutes, while those higher up may take twenty-four hours or longer.”).

¹⁸ See *id.*

¹⁹ See Adrian Copiz, *Scarcity in Space: The International Regulation of Satellites*, 10 COMM.LAW CONSPECTUS 207, 207, 209 (2002).

²⁰ See JOINT CHIEFS OF STAFF, JOINT DOCTRINE FOR SPACE OPERATIONS I-3 (2002), available at http://www.fas.org.irp/doddir/dod/jp3_14.pdf; European Space Agency, Types of Orbit, http://asimov.esrin.esa.it/esa.it/esaSC/SEMU4QSIVED_index_0.html (last visited Feb. 11, 2009).

²¹ See Carol Elizabeth Remy, Note, *U.S. Territorial Sea Extension: Jurisdiction and International Environmental Protection*, 16 FORDHAM INT'L L.J. 1208, 1213–14 (1992). Only with the advent of modern weapons systems such as missiles could a ship on the high seas intentionally harm inland areas.

the high seas could not be used to survey any territory of another nation other than the coast. Similarly, a person in Antarctica will not be close to any other nation's sovereign territory. A satellite, on the other hand, will not only have line-of-sight to a much larger area of the earth than any ship can have due to its altitude, but a satellite not in geosynchronous orbit will traverse most of the Earth within the range of its latitudes.²² While an airplane with advanced sensing technologies traveling over international waters, twelve miles from a nation's border, may be able to collect information about the nation, it is necessarily less than that which can be collected by a satellite. Not only does this mean that a satellite will see a very large portion of the Earth, it also means that a satellite that crashes will spread debris over a larger and much more unpredictable section of the globe than a crashed airplane or sunken ship.

Space flight has developed in a very different manner from other forms of transportation, such as aviation and travel on the seas. Humans have built ships since the beginning of recorded history. Aviation has developed more recently, but early developments in commuter aviation were spurred by individual inventors and investors, not by state actors.²³ Space flight, on the other hand, began with large state actors during the Cold War, and private companies became involved much later.²⁴ This is partly due to the costs involved: the first boat could be made with a dugout tree, the first successful airplane was made by two bicycle mechanics, but the first satellite put into orbit required years of effort on the part of hundreds of Soviet scientists.²⁵

²² A satellite traveling around the Earth will have a maximum and a minimum latitude at which it travels, and will typically traverse every longitude on Earth unless it is in the geosynchronous orbit. See REYNOLDS & MERGES, *supra* note 2, at 15. For example, a satellite may travel between 45° N and 45° S, reaching as far north as the state of Michigan and as far south as the southern end of Argentina, and will, in enough time, cover the entire area of the Earth between those two latitude lines.

²³ See generally Charity Trelease Ryabinkin, *Let There Be Flight: It's Time To Reform the Regulation of Commercial Space Travel*, 69 J. AIR L. & COM. 101, 104 (2004) (discussing the early history of aviation regulation); NASA, Aviation, http://www.nasa.gov/worldbook/aviation_worldbook.html (last visited Feb. 11, 2009).

²⁴ See generally Patrick Collins, *The Regulatory Reform Agenda for the Era of Passenger Space Transportation*, SPACE FUTURE, May 1996, available at http://www.spacefuture.com/archive/the_regulatory_reform_agenda_for_the_era_of_passe; Ryabinkin, *supra* note 23, at 114.

²⁵ See John Crandall, *Dugout Canoes: An Amazing Chapter in the History of Transportation*, Dec. 6, 2006, <http://transportationhistory.suite101.com/article>.

While there are many military applications of space flight, no current space technologies and very few speculative future space technologies can directly and intentionally cause an individual's death on the ground. The primary military uses of space in the current world are for communications and surveillance.²⁶ In their most directly damaging use, modern space technologies act as force multipliers for ground-based weapons, for example by allowing pinpoint targeting of missiles.²⁷ Because the most serious space-based weapons, nuclear devices, have been banned by treaty and international norm,²⁸ the remaining space-based technologies do not have the capacity to directly violate human rights or cause intentional deaths. For all these reasons, space law has had to develop on its own, informed by the concerns of related areas of international law but not as an extension of any of those areas. By this, I do not mean that space law has had to develop in a vacuum, but that it is almost always inappropriate to simply project existing international law on space travel; and the development of space law treaties reflects the field's somewhat independent development.

The most closely related area of international law to space law is international aviation law. The first plane took off from Kitty Hawk, North Carolina in 1903; the first international regulation of aviation came with the Warsaw Convention in 1929.²⁹ The Warsaw Convention instituted a negligence-based limited liability regime for international air travel, with the carrier rather than the state being liable for any injury or property damage.³⁰ There were no new issues of sovereignty introduced by the advent of flight; it was easy to just declare that a nation had sovereignty over the airspace directly above its land, which was

cfm/dugout_canoes; NASA, *supra* note 23; MSN Encarta, Science, http://www.encyclopedia.msn.com/encyclopedia_761557105/Science.html (last visited Feb. 11, 2009).

²⁶ See Major Elizabeth Seebode Waldrop, *Integration of Military and Civilian Space Assets: Legal and National Security Implications*, 55 A.F. L. REV. 157, 160 (2004).

²⁷ See *id.*; *U.S. Uses Satellite Constellation to Guide Missiles in Current War Effort*, SATELLITE WEEK, Oct. 15, 2001, available at <http://www.globalsecurity.org/org/news/2001/011015-attack02.htm>.

²⁸ See *infra* Part I.B (discussing the 1967 Outer Space Treaty between U.S. and Russia prohibiting use of nuclear and other mass-destruction technologies in outer space).

²⁹ See Ryabinkin, *supra* note 23, at 104.

³⁰ See *id.*

done in the Paris Conference of 1919.³¹ The nature of commercial air flight allowed for such a system; airplanes were relatively cheap and privately owned, and they moved in a manner similar to cars or ships in terms of ease of maneuverability. Until transcontinental flight became widely available, airplanes rarely flew outside of sovereign airspace.³²

Maritime law shares an important feature with space law: the vehicles do most of their traveling in regions that are *res communis*, under no nation's sovereignty.³³ However, this is the only significant similarity between the two areas of law. Ships on the high seas typically cannot see or affect areas inland. If ships sink or crash on the high seas, they typically do not do so in such a way that will damage a nation's sovereign territory. Ships move very slowly, and while they are not as maneuverable as a car or plane, they can still make full 360 degree turns. Further, and possibly most importantly for the development of the law, the ship predates the nation-state, so the international norms governing maritime law are formed from millennia of tradition.³⁴

If one of the differences between space flight and aviation or sea travel is the path of scientific development, it may be useful to look to other areas where private organizations have taken up functions traditionally performed only by states. For example, military contractors like those employed by the American government in Iraq today are a relatively new development in the history of warfare. One of the challenges of international law in dealing with these private military contractors is determining their status and rights under the law of war.³⁵ The goals of the law of war, however, are fundamentally different from the goals of laws regulating travel. The law of war is concerned with

³¹ Ved P. Nanda, *Substantial Ownership and Control of International Airlines in the United States*, 50 AM. J. COMP. L. 357, 358 (2002).

³² See generally MSN Encarta, Aviation, http://encarta.msn.com/encyclopedia_761572047/Aviation.html (last visited Feb. 11, 2009) (summarizing the history and the development of aviation before and after the first transcontinental flight in 1911).

³³ See M. J. Peterson, *The Use of Analogies in Developing Outer Space Law*, 51 INT'L ORG. 245, 252 (1997); John Meisel, *Communications in the Space Age: Some Canadian and International Implications*, 7 INT'L POL. SCI. REV. 299, 309 (1986).

³⁴ See Robert R. Stieglitz, *Long-Distance Seafaring in the Ancient Near East*, 47 BIBLICAL ARCHAEOLOGIST 134, 134 (1984); William I. Robinson, *Beyond Nation-State Paradigms: Globalization, Sociology, and the Challenge of Transnational Studies*, 13 SOC. F. 561, 567 (1998).

³⁵ Christopher J. Mandernach, *Warriors Without Law: Embracing a Spectrum of Status for Military Actors*, 7 APPALACHIAN J. L. 137, 138 (2007).

issues such as protecting civilians, ensuring that only hostile actors may be attacked, and ensuring that those who violate the law can be held accountable.³⁶ Law concerning space is concerned with less personal issues: protecting the space environment, encouraging the development of space commerce and technologies, or creating a predictable and just liability scheme for accidents.³⁷ The vastly different goals make private military contractors an inappropriate analog for space law, especially relative to other forms of travel.

The fact is, while space flight shares common features with other forms of travel, it is fundamentally different in a way that requires a wholly different legal regime from other forms of travel or other issues. Problems of sovereignty are more complex than in any Earth-based area of law, as outer space is necessarily *res communis*, but spacecraft can seriously affect any nation's sovereign territory. Problems of liability are different from those of airplanes or ships, due to the cost of space flight and the fact that a failed spacecraft is less controllable and may land in a greater variety of locations on Earth. In simplest terms, what makes space flight unique is that outside of a few particular orbits, a spacecraft cannot take off from the United States and go into orbit without overflying a nation as remote as Thailand at some point. An airplane or ship, on the other hand, can always travel from the United States to Great Britain without, absent a rare emergency situation, having to enter the sovereign territory or airspace of any other nation. Recognizing this fact, the international community established a treaty regime to regulate space flight . . . in some ways.

B. The International Space Law Treaty Regime

International governing bodies began moving to create rules for outer space shortly after the launch of Sputnik in 1957, with the formation of the United Nations Committee on the Peaceful Uses of Outer Space (“UNCOPUOS”).³⁸ UNCOPUOS authored the four treaties that are the core of international space law: the Treaty on Principles Governing the Activities of States in the Exploration and Uses of Outer Space, Including the Moon and Other Celestial Bodies in 1967 (“Outer Space Treaty”); the

³⁶ *Id.*

³⁷ GOLDMAN, *supra* note 4, at 70–72, 75.

³⁸ *Id.* at 27.

Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space in 1968 (“Rescue Agreement”); the Convention on International Liability for Damage Caused by Space Objects in 1972 (“Liability Convention”); and the Convention on Registration of Objects Launched into Outer Space in 1975 (“Registration Convention”).³⁹ UNCOPUOS has since authored only one treaty, the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies in 1979 (“Moon Treaty”), which had only been ratified by seven nations in 1984, and was not ratified by the United States.⁴⁰ In practice, the spacefaring nations have a greater impact on space law for obvious reasons; given the high-tech nature of space flight, a space law treaty will be ineffective without the support of major spacefaring nations, while such treaties will have little effect on nations without space programs.

The first of the four core treaties, the Outer Space Treaty, focuses on outer space exploration as “the common interest of all mankind”⁴¹ Articles I through III of the treaty focus on the international nature of space exploration: forbidding discrimination and claims of sovereignty, and stating that State activities shall be carried out “in the interest of maintaining international peace and security and promoting international cooperation and understanding.”⁴² Article V continues the high-minded internationalist language of the treaty, stating that, “States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space”⁴³ Article IX states this internationalist principle yet again: “[i]n the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance”⁴⁴ The treaty is clearly internationalist in nature in that it rejects almost any concept of state sovereignty over space, but it is important to understand why the treaty is dismissive of state sovereignty and does not mention private space flight.

³⁹ See *id.* at 27, 70–85; Philip R Harris, Space Law and Space Resources, <http://www.belmont.k12.ca.us/ralston/programs/itech/SpaceSettlement/spaceresvol4/spacelaw.html>.

⁴⁰ GOLDMAN, *supra* note 4, at 30.

⁴¹ Outer Space Treaty, *supra* note 15.

⁴² *Id.* arts. I–III.

⁴³ *Id.* art. V.

⁴⁴ *Id.* art IX.

The Outer Space Treaty was negotiated in 1967, in the middle of the “space race” between the U.S. and the U.S.S.R., two hostile nations with large numbers of nuclear weapons pointed at each other.⁴⁵ As such, the need to negotiate a treaty to govern the actions of states in outer space was less prompted by the need to regulate peaceful uses and more by the need to prohibit military uses, particularly on the moon (the treaty was ratified less than two years before the first moon landing, Apollo 11). Paul Dembling and Daniel Arons, the general counsel and an attorney-advisor of the National Aeronautics and Space Administration (“NASA”) at the time, reported on the treaty negotiations, writing, “there was . . . general agreement that a critical need existed to include a provision banning nuclear weapons and other weapons of mass destruction from outer space.”⁴⁶ The sense of urgency came directly from actors such as President Lyndon B. Johnson, who made a statement on May 7, 1966, emphasizing “the need to ‘take action now . . . to insure that explorations of the moon and other celestial bodies will be for peaceful purposes only’”⁴⁷ President Johnson later described the treaty as, “the most important arms control development since the 1963 treaty banning nuclear testing in the atmosphere, in space and under water.”⁴⁸ The Outer Space Treaty did set rules for the regulation of space flight, but it should be seen as motivated more by the need for an arms control agreement anticipating a manned moon landing than by a need to set up a system for regulating peaceful space flight.

Private space flight goes unmentioned in the Outer Space Treaty and in Dembling and Arons’s report for the simple reason that in 1967 there was no significant private space flight, and, indeed, private space flight was not even anticipated in the near future by policymakers. In a 1963 treatise on the law of outer space, McDougal et al. began by stating, “[t]he fact that space exploration is most intimately connected with development of weapons and, in addition, at present extremely costly explains why states constitute the most important category of

⁴⁵ *Id.*; see History Shots, Race to the Moon, <http://historyshots.com/space/timeline.cfm> (last visited Feb. 11, 2009); Science Encyclopedia, Nuclear Age - Mutual Assured Destruction, <http://science.jrank.org/pages/10504/Nuclear-Age-Mutual-Assured-Destruction.html> (last visited Feb. 11, 2009).

⁴⁶ Paul G. Dembling & Daniel M. Arons, *The Evolution of the Outer Space Treaty*, 33 J. AIR L. & COM. 419, 427 (1967).

⁴⁷ *Id.* at 425 (citations omitted).

⁴⁸ *Id.* at 432 (citations omitted).

participants.”⁴⁹ McDougal et al. acknowledges that private entities may be expected to take more part in space ventures in the future, but only mentions one private space initiative, the Telstar experimental telecommunication satellite, that had been active as of the book’s publication.⁵⁰ Combined with the focus on arms control in the treaty negotiations, it is understandable that the Outer Space Treaty focuses on the actions of states, not on the actions of private entities.

The Rescue Agreement was ratified by the United States in 1968, and is concerned with the rescue and return of astronauts and space objects that accidentally land in foreign territory.⁵¹ Article V of the Outer Space Treaty already provided some international rules for the rescue and return of astronauts, but the Rescue Agreement was negotiated “to develop and give further concrete expression to these duties”⁵² The Agreement imposes three types of duties on contracting parties: (1) the duty to extend assistance to spacecraft and astronauts in distress within their jurisdiction, or if on the high seas, where the party is in a position to do so;⁵³ (2) the duty to promptly return personnel of a spacecraft landing in a contracting party’s territory to representatives of the launching authority;⁵⁴ and (3) the duty to, where practical, recover and return parts of space objects that return to Earth within the jurisdiction of the contracting property.⁵⁵ The agreement does go into the particular details of who shall pay for such rescues, and does not provide any exceptions to the requirement for rescue, even where the astronaut rescued wishes to defect or where the astronaut is not of the nationality of the launching state.⁵⁶

The Rescue Agreement, unlike the Outer Space treaty, acknowledges that space launches may be done by international inter-governmental organizations, and allows for return of a rescued astronaut to such an organization if the organization

⁴⁹ MYRES S. MCDUGAL ET AL., *LAW AND PUBLIC ORDER IN SPACE* 5 (Yale Univ. Press 1963).

⁵⁰ *See id.* at 9.

⁵¹ Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, U.S.-Russ.-U.K., Dec. 3, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599 [hereinafter Rescue Agreement].

⁵² *Id.*; Outer Space Treaty, *supra* note 15, art. V.

⁵³ Rescue Agreement, *supra* note 51, arts. II-III.

⁵⁴ *Id.* art. IV.

⁵⁵ *Id.* art. V.

⁵⁶ REYNOLDS & MERGES, *supra* note 2, at 204.

declares its acceptance of the agreement and a majority of members of the organization are contracting parties.⁵⁷ However, as expected for an outer space treaty negotiated in 1968, the Rescue Agreement does not acknowledge the possibility that a private company may be a launching authority.⁵⁸ Indeed, while private unmanned space flight was already in development at the time, the first private manned space flight would not occur until thirty-seven years after the treaty's ratification, with the flight of SpaceShipOne.⁵⁹

The Rescue Agreement has never been applied in the case of astronauts accidentally landing in a foreign jurisdiction because no astronaut has ever survived such a disaster.⁶⁰ The Soviet Union did abide by the terms of the agreement during the Apollo 13 crisis, when they ceased broadcasting in certain frequencies to facilitate American rescue efforts.⁶¹ For space objects, there have also been few applications of the Agreement and no disputes arbitrated by an international judicial body. In 1994, a Russian Soyuz returned to Earth in Khazakh territory, and Khazakh officials did not initially allow the Russians to retrieve the craft until the Russians could document that the "craft had really dropped out of the sky[.]" but did eventually return the craft.⁶²

In 1972, many nations including the United States ratified the Liability Convention, which imposed a regime of strict state liability for space flight accidents affecting the surface of the Earth, and fault-based state liability for space flight accidents affecting space objects.⁶³ In only imposing liabilities on states and not on persons or organizations, the Convention defines a "launching State" as either "[a] State which launches or procures the launching of a space object;" or "[a] State from whose territory or facility a space object is launched[.]"⁶⁴ For launches

⁵⁷ Rescue Agreement, *supra* note 51, art. VI.

⁵⁸ *See id.* (defining "launching authority" without specifying applicability to private entities assuming such roles).

⁵⁹ Coren, *supra* note 9.

⁶⁰ *See, e.g.,* MARCIA S. SMITH, NASA'S SPACE SHUTTLE PROGRAM: THE COLUMBIA TRAGEDY, THE DISCOVERY MISSION, AND THE FUTURE OF THE SHUTTLE, CONGRESSIONAL RESEARCH SERVICE (2006), available at <http://www.fas.org/sgp/crs/space/RS21408.pdf> (discussing previous space flight fatal accidents).

⁶¹ GOLDMAN, *supra* note 4, at 78.

⁶² *Id.* at 79.

⁶³ Convention on International Liability for Damage Caused by Space Objects, U.S.-Russ.-U.K., arts. II-III, Oct. 9, 1973, 24 U.S.T. 2389, T.I.A.S. No. 7762 [hereinafter Liability Convention].

⁶⁴ *Id.* art. I.

by intergovernmental organizations, the treaty imposes joint and several liability on the states who jointly launch a space object.⁶⁵ The Convention does not preclude injured parties from seeking compensation for damage caused by space objects under a state's national law, though if a person pursues a claim under a state's national law, the state may not also present a claim for damages under the Convention.⁶⁶ This is substantially different from the liability regimes in maritime and aviation law, which are fault-based, limit liability, and impose liability on carriers rather than states.⁶⁷

The Liability Convention has so far only been seriously tested once, during the *Cosmos 954* incident.⁶⁸ This particular incident took place in 1978, when the Soviet satellite, *Cosmos 954*, powered by nuclear materials, crashed in Canada, spreading nuclear debris over parts of Northern Canada.⁶⁹ The cleanup cost Canada approximately 14 million Canadian dollars, and the U.S. spent about 2-2.5 million dollars.⁷⁰ Invoking the Liability Convention, Canada billed the Soviet Union for C\$6 million, and the Soviet Union eventually paid Canada C\$3 million in 1981.⁷¹ While the Soviets did not pay the full cost of the cleanup, the United States did not criticize the Soviets for paying too little, and in fact it was not clear if the treaty required any payment.⁷² The Liability Convention may not have applied because the only costs suffered by Canada were the costs of the cleanup; no persons or property were harmed by the satellite's fall.⁷³

The *Cosmos 954* incident appeared to validate an international norm that underlies the Liability Convention: nations have some responsibility to compensate states that are damaged by their fallen spacecraft.⁷⁴ Beyond that, there is very little precedent to apply from the incident, especially in a post-Cold War world. As

⁶⁵ *Id.* art. V.

⁶⁶ *Id.* art. XI.

⁶⁷ See generally LARSEN ET AL., AVIATION LAW 267-68 (Transnational Publishers 2006) (discussing the international regulations governing aviation liability); REYNOLDS & MERGES, *supra* note 2, at 37-38, 298-99.

⁶⁸ See REYNOLDS & MERGES, *supra* note 2, at 178-79.

⁶⁹ Alexander F. Cohen, *Cosmos 954 and the International Law of Satellite Accidents*, 10 YALE J. INT'L L. 78, 79 (1984).

⁷⁰ *Id.* at 80.

⁷¹ *Id.*

⁷² See *id.* at 89 (discussing the context of payments made to Canada because of the *Cosmos 954* incident).

⁷³ See *id.* at 89 n. 72.

⁷⁴ See *id.* at 89.

with the Outer Space Treaty, the real story of the *Cosmos 954* incident is one of American-Soviet cooperation in space flight. In Alexander Cohen's summary of the incident, he writes,

[t]he U.S. and the U.S.S.R. apparently recognized that it was in their mutual interest to cooperate rather than to turn the incident into a propaganda battle. The U.S. and the U.S.S.R. thus demonstrated their ability to take joint steps to deal with the dangerous items over which they exercise control.⁷⁵

In a specific disaster situation that could hypothetically take place in 2008, it is difficult to predict how international law will apply based on the *Cosmos 954* incident. Part of the reason the Liability Convention has had so little application is that accidents capable of causing large amounts of damage are generally limited to launch disasters, which tend not to cross borders.⁷⁶

Finally, the Registration Convention, which entered into force in 1975, requires each contracting party to maintain a registry of space objects launched by that party.⁷⁷ The Convention specifically requires the "launching state" to register particular space objects, and defines launching state as either "[a] State which launches or procures the launching of a space object;" or "[a] State from whose territory or facility a space object is launched"⁷⁸ The registration of a space object with a state automatically grants that state jurisdiction and control over the object and any personnel of the object.⁷⁹ However, registration does not automatically make the registering state liable for damage caused by the spacecraft, allowing for a possible odd situation in which a spacecraft is under the jurisdiction of one state while another state is liable for damage caused by the spacecraft.⁸⁰ Still, it has been suggested that the State of registry is most likely to be liable for damage caused by a spacecraft.⁸¹

⁷⁵ *Id.* at 91.

⁷⁶ REYNOLDS & MERGES, *supra* note 2, at 187.

⁷⁷ Convention on Registration of Objects Launched into Outer Space, U.S.-Russ.-U.K., art II, Jan. 14, 1975, 28 U.S.T. 695, T.I.A.S. No. 8460 [hereinafter Registration Convention].

⁷⁸ *Id.* art. I.

⁷⁹ Outer Space Treaty, *supra* note 15, art. VIII.

⁸⁰ See REYNOLDS & MERGES, *supra* note 2, at 205.

⁸¹ See Sompong Sucharitkul, *Liability and Responsibility of the State of Registration or the Flag State in Respect of Sea-Going Vessels, Aircraft and Spacecraft Registered by National Registration Authorities*, 54 AM. J. COMP. L. 409, 440 (2006).

These four treaties make up the backbone of the international law of outer space. They have not been renegotiated since 1975. As we shall see, they are inadequate to deal with potential problems that are likely to arise given the current state of the international commercial space industry.

II. THE DEFICIENCIES OF THE TREATY REGIME

Technology has greatly advanced since the treaties were negotiated from 1967 to 1975. Now, in 2008, we have private companies launching reusable manned spacecraft, multinational private companies launching from the high seas, and so many satellites in orbit that crowding has become an issue.⁸² With these new technologies come new scenarios that will not be adequately regulated by the current treaty regime, and which the international community should consider before such scenarios occur. In particular, each of these scenarios could plausibly happen within the next five to ten years, if not sooner.

A. *The Rescue Agreement and Private Manned Space Flight*

Suppose that a private orbital spacecraft is launched from the United States and registered with the United States in 2011, carrying a pilot from the United States and two passengers from Germany and Great Britain. The ship takes off from Texas, but due to defects in the spacecraft design, lands in Jamaica or in Jamaica's territorial waters, with some debris from the ship falling off the spacecraft, destroying Jamaican buildings and killing at least one Jamaican national. The passengers on the spacecraft land safely and are rescued by the Jamaican government, but Jamaica refuses to return the astronauts until they are tried for manslaughter, believing that the disaster may have been due to the negligence of the astronauts or the corporation. Jamaica plans to imprison any convicted astronauts accordingly.⁸³

⁸² See Colin Woodard, *High-Seas Launch Worries Islanders*, Sept. 22, 1999, available at <http://www.fas.org/news/ukraine/p5s1.htm>; Lt. Col. John E. Hyten, *A Sea of Peace or a Theater of War: Dealing with the Inevitable Conflict in Space 20* (2000), available at <http://www.acdis.uiuc.edu/Research/OPs/Hyten/HytenOP.pdf>; see, e.g., Kimi Yoshino, *You'll Want a Window Seat*, L.A. TIMES, Mar. 3, 2007, available at <http://articles.latimes.com/2007/mar/03/business/fi-space3>.

⁸³ The countries in this example are chosen because all four of them are signatories to the Rescue Agreement. See Rescue Agreement, *supra* note 51.

Such a scenario would present many dilemmas for international law, as the Rescue Agreement was never meant to handle such a scenario. The Rescue Agreement was written at a time when spacecraft were launched by states, states were the parties solely responsible for their operation, and only Americans flew on American spacecraft while only Soviet nationals flew on Soviet spacecraft.

First, there is the question of who is considered an astronaut. The Rescue Agreement uses the term, “personnel of a spacecraft” to describe those who must be returned, which may refer only to the crew of a spacecraft.⁸⁴ Astronauts are accorded a very high status under the Outer Space Treaty; they are considered “envoys of mankind.”⁸⁵ The Outer Space Treaty may even discourage paying passengers on board a spacecraft; Article I states that “[o]uter space . . . shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.”⁸⁶ This language may be interpreted as discouraging an industry that allows the rich easy access to space flight. It is not inconsistent with the language of the treaties for paying passengers to not be considered astronauts covered by the Rescue Agreement, in which case any claim for the return of the passengers would not be covered by the Agreement but would have to fall under other international law norms.

The pilot, meanwhile, while probably a “personnel of a spacecraft,” is also put in a bind. The Rescue Agreement declares an absolute duty to return rescued astronauts to the launching authority if the landing was due to “accident, distress, emergency or unintended landing.”⁸⁷ It is unclear whether a spacecraft crash caused by the pilot’s negligence would be considered a landing due to, “accident, distress, emergency or unintended landing.”⁸⁸ If such a crash is not covered by the Rescue Agreement, then there would be no duty to return the astronauts under the Agreement. On the other hand, if a crash caused by the pilot’s negligence is “owing to accident,” then there would be a duty to return the astronaut under the Rescue Agreement. The

⁸⁴ Rescue Agreement, *supra* note 51, art. IV.

⁸⁵ Outer Space Treaty, *supra* note 15, art. V.

⁸⁶ *Id.* art. I.

⁸⁷ Rescue Agreement, *supra* note 51, art. IV.

⁸⁸ *Id.*

treaty is simply unclear on the issue.

In other areas of transportation law, states whose nationals are victims of a crime of negligence typically have jurisdiction to prosecute the individuals responsible. In maritime law, sailors who have been charged with a form of negligent homicide have been prosecuted by the country offended rather than the state under which their ship was flagged. The Permanent Court of International Justice (“P.C.I.J.”) so held in the S.S. Lotus case in 1927, in which French sailors were prosecuted for manslaughter in Turkey for causing a collision that killed eight Turkish citizens.⁸⁹ Even though the sailors had committed their crime on a French flagged ship, the court held that they were subject to Turkish jurisdiction once they stepped on Turkish soil.⁹⁰ But, the P.C.I.J. in that case did not find a general customary rule upholding a state’s jurisdiction over foreign nationals for crimes committed against that state’s citizens.⁹¹

Our next problem in resolving the presented scenario is who gets to call for the return of the pilot and passengers. As with the issue of whether a nation may hold astronauts for criminal charges related to a spacecraft accident, the Rescue Agreement may override general principles of international law, but rigid application of the Rescue Agreement in its current form leads to absurdities. The Rescue Agreement requires the return of rescued astronauts “to representatives of the launching authority.”⁹² In the presented example, the launching authority is the United States, and if the duty to return applies, then the astronauts would have to be returned to the United States.

However, if only the launching authority has rights in this scenario, then we have an odd situation where the German and British passengers can only demand return to the United States and not to their home countries, while Germany and Great Britain would have no right under the treaty to demand the return of their nationals. This state of affairs appears to conflict with basic human rights law. The Universal Declaration of Human Rights establishes an explicit right of a person to return to his or her own country. Obviously, this right can be overridden for reasons such as criminal prosecution, but it is a

⁸⁹ S.S. Lotus (Fr. v. Turk.), 1927 P.C.I.J. (ser. A) No. 10, at 27 (Sept. 7).

⁹⁰ *Id.* at 19.

⁹¹ *Id.* at 18, 22.

⁹² Rescue Agreement, *supra* note 51, art. IV.

basic right nonetheless.⁹³ It is possible to imagine a scenario here where the launching authority insists on the return of its nationals, but is unwilling to demand the return of passengers who are not citizens of the launching authority, in which case the status of the passengers becomes vague. Once again, it is a scenario where the treaty regime needs to be clarified so that private space companies can know how their personnel and passengers will be treated under international law.

Absent the space law treaties, surviving passengers and pilots in the Jamaica hypothetical would be treated like any other person in the wrong country under basic international law, but it is unclear that spacefaring nations wish for astronauts to be treated like any other person. The space law treaties treat astronauts “as envoys of mankind,” unique explorers deserving of special treatment from the nations of the world.⁹⁴ Even without this noble language, a spacecraft passenger is in less control of his landing spot in the event of an accident than an airplane passenger, and perhaps should therefore not be subject to the landing nation’s whim. There are substantial arguments for treating astronauts differently from airplane pilots and airplane passengers, and for treating space explorers differently from space tourism pilots and from space tourists, and those arguments should be resolved before space tourism becomes a reality.

This scenario could occur as soon as private companies begin manned orbital launches. One company, SpaceX, is on track to begin testing its manned orbital vehicle, the Dragon, in 2009.⁹⁵ The Dragon capsule is intended to be able to fly seven passengers into orbit and dock with the International Space Station.⁹⁶ One hopes that the legal situation of the passengers under international law will be resolved before a launch, and certainly before a disaster happens.

B. The Liability Convention and Passengers’ Rights

In this hypothetical, consider a private manned spacecraft that

⁹³ Universal Declaration of Human Rights, G.A. Res. 217A, art. XIII, U.N. GAOR, 3d Sess., 1st plen. mtg., U.N. Doc A/810 (Dec. 12 1948), available at <http://www1.umn.edu/humanrts/instree/b1udhr.htm>.

⁹⁴ Outer Space Treaty, *supra* note 15, art. V.

⁹⁵ See SpaceX, Dragon Overview, <http://www.spacex.com/dragon.php> (last visited Feb. 11, 2009).

⁹⁶ See *id.*

disintegrates on the launch pad or on landing like the Challenger and Columbia disasters, leaving no survivors. The spacecraft's failure is due to the negligence of the spacecraft company. The passengers' estates wish to be compensated for their losses. Under the current treaty regime, what rights do the passengers' estates have?

Under the Liability Convention, the answer appears to be that passengers cannot receive compensation for injuries caused due to spacecraft negligence. The Liability Convention is built on the principle of state liability; that only states are liable for damage caused by spacecraft.⁹⁷ The Convention has no provision that allows any entity other than a state or a multistate organization (such as the European Space Agency) to make a claim for compensation under the statute.⁹⁸ The Convention has a provision that prevents participants in a launch from claiming compensation for damages caused by the launch. Article VII states that the Convention:

shall not apply to damage caused by a space object of a launching State to:

- (a) Nationals of that launching State;
- (b) Foreign nationals during such time as they are participating in the operation of that space object from the time of its launching or at any stage thereafter until its descent.⁹⁹

The treaty uses the term "participating in" rather than "personnel of the spacecraft[,]" implying that passengers and ground control may be covered by Article VII, though some have argued otherwise.¹⁰⁰ They appear to have no rights under the Liability Convention.

This does not mean that passengers have no rights to compensation, just that they cannot base their claim on the Liability Convention or make the claim internationally. If, for example, German passengers aboard a private American-registered spacecraft were killed in a launch accident, the passengers' estates would not be able to present a claim under the Convention, but may still seek relief in a domestic court, specifically, an American court. Article XI states, "[n]othing in

⁹⁷ Liability Convention, *supra* note 63, art. II.

⁹⁸ *See id.* art. VIII.

⁹⁹ *Id.* art. VII.

¹⁰⁰ *See* Steven Freeland, *Up, Up and . . . Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space*, 6 *CHI. J. INT'L L.* 1, 10 (2005).

this Convention shall prevent a State, or natural or juridical persons it might represent, from pursuing a claim in the courts or administrative tribunals or agencies of a launching State.”¹⁰¹ Because the business of space travel is inherently international, this state of matters poses problems.

One author has noted some of the facets of this liability problem in space tourism. Steven Freeland writes in the *Chicago Journal of International Law*, “[w]hile there may be scope to institute legal proceedings under national laws, there are limitations—such as sovereign immunity protections—that may represent a bar to a claim for compensation.”¹⁰² This problem has already had the potential to arise, as Russia has already begun allowing tourists into space on state spacecraft. In 2001, Dennis Tito, an American businessman, traveled into space aboard a Russian Soyuz rocket and spent a few days on the International Space Station, reportedly paying 20 million dollars for the privilege.¹⁰³ Had the spaceship crashed, injuring or killing Tito, it appears his estate may have had no recourse, as it could not claim compensation from Russia under the Liability Convention, and its ability to sue the Russian government in Russian courts would be entirely dependent on Russian domestic law.

Domestic law is also not a reliable solution for dealing with individual liability in the hypothetical type of situation. Some commentators have suggested that, comparable to aviation regulation, space travel may be regulated by domestic law. For example, Collins and Yamamoto suggested in 1998 that space tourism should be regulated as an extension of aviation.¹⁰⁴ However, unlike the advent of civil aviation, space travel is a much more international proposition. As already discussed, a spacecraft does not necessarily remain over a particular nation’s territory and travels in a region which is necessarily considered *res communis*. Space travel combines the problems of the fast development of air travel with the lack of sovereignty in travel on the high seas, and domestic law is thus insufficient to resolve issues that may arise when things go wrong.

¹⁰¹ Liability Convention, *supra* note 63, art. XI.

¹⁰² Freeland, *supra* note 100, at 16.

¹⁰³ See BBC News, *Profile: Tito the Spaceman*, Apr. 28, 2001, <http://news.bbc.co.uk/1/hi/sci/tech/1297924.stm>.

¹⁰⁴ See Patrick Collins & Koichi Yonemoto, *Legal and Regulatory Issues for Passenger Space Travel*, Proceedings of International Symposium on Space Law, 49th IAF Congress (1998), available at http://www.spacefuture.com/archive/legal_and_regulatory_issues_for_passenger_space_travel.shtml.

We can expect to see private space tourism in the immediate future, with suborbital passenger flights taking place within the next three years and orbital passenger flights within the next decade. As noted above, SpaceX plans to begin testing an orbital passenger vehicle in 2009.¹⁰⁵ Also noted above, Virgin Galactic plans to begin suborbital passenger flights in 2009 or 2010.¹⁰⁶ Issues of liability for accidents in space flight should be resolved before these businesses become prevalent.

C. The Outer Space Convention and Jurisdiction Over Activities on Private Space Stations

The next hypothetical concerns a tortious act on board a private space station. A private company incorporated in Country A launches a space station registered to Country B, a country with no significant domestic space law. On board the space station, one passenger does not appropriately control his movement, and crashes into another passenger, causing a broken limb that does not heal properly. How does the injured passenger get compensation from either the company or from the passenger who injured him?

The Liability Convention does not cover such a situation. Article IV of the Convention concerns damage caused elsewhere, other than on the surface of the Earth, for example in orbit, to space objects, or persons or cargo on board space objects.¹⁰⁷ However, the language of Article IV requires the damage to be caused “by a space object of another launching State”¹⁰⁸ Injuries caused in the hypothetical situation, or indeed by the negligence of a crew member, would not be covered by the Liability Convention.

If international law does not prescribe a remedy, then an injured party in the hypothetical situation would have to determine which country’s domestic law controls the situation. Article VIII states that, “[a] State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body.”¹⁰⁹

¹⁰⁵ See SpaceX, *supra* note 95.

¹⁰⁶ See Virgin Galactic, *supra* note 11.

¹⁰⁷ Liability Convention, *supra* note 63, art. IV.

¹⁰⁸ *Id.*

¹⁰⁹ Outer Space Treaty, *supra* note 15, art. VIII.

Because the Registration Convention has its problems in defining which state can be a registry in the case of a launch from international waters, and allows unscrupulous companies to register in nations that are not members of the treaty, this poses jurisdictional problems.¹¹⁰ Also, the Outer Space Treaty does not appear to allow for a contractual choice of law provision in a spacecraft passenger contract; it simply says that the nation of registry has jurisdiction over the spacecraft.¹¹¹ In addition, a contractual jurisdiction provision between the owner of the space station and a passenger would not be binding in the event of a dispute between two passengers.

The problem here is not merely one of liability for clumsy orbital hotel passengers. Outer space is a very hazardous environment. Passengers on board orbital spacecraft travel in zero gravity due to the fact that the spacecraft is always falling towards Earth.¹¹² Over time, zero-gravity conditions have significant physiological effects on astronauts, including a loss of muscle mass and bone atrophy; the bone loss may never be replaced.¹¹³ Space sickness is also an immediate concern for astronauts.¹¹⁴ Other dangers for tourists include radiation exposure and problems with treating ordinary medical emergencies in space.¹¹⁵ So far, astronauts have had rigorous medical screenings, but eventually, as space tourism becomes more common, there will likely be a serious medical emergency.¹¹⁶

Space station building standards is another area that poses a danger to orbital space tourists. Space station design is quite complicated, and the space environment poses three major risks to tourists: vacuum, microgravity, and high energy radiation.¹¹⁷

¹¹⁰ See generally Registration Convention, *supra* note 77 (lacking a definition covering launches from international waters, nor mentioning consequences a state would face for allowing a company incorporated within them to launch from a nonmember state).

¹¹¹ Outer Space Treaty, *supra* note 15, art. VIII.

¹¹² See National Air & Space Museum, How Things Fly: Is There Gravity in Orbit?, <http://www.nasm.si.edu/exhibitions/gal109/NEWHTF/HTF611.HTM> (last visited Feb. 11, 2009).

¹¹³ Karen Miller, *The Zero G Battle: How Astronauts and Cosmonauts Cope*, Aug. 31, 2001, http://www.space.com/scienceastronomy/generalscience/gravity_adapt_010831-1.html.

¹¹⁴ Marilyn Larkin, *Health Checks Before Facing Tourism's Final Frontier*, 359 LANCET 588 (2002).

¹¹⁵ See *id.*

¹¹⁶ See *id.*

¹¹⁷ Uwe Apel, *Human Factors and Health in Space Tourism*, 2d International

Space station design has to protect tourists from these dangers and provide redundant systems. Some commentators have suggested that an “orbital building code” may be useful at this point in spacecraft development before companies begin building space hotels.¹¹⁸ However, there is no provision for such a code in international law, and given the international nature of space flight and the ability for companies to easily choose their nation of registry, domestic law is unlikely to be sufficient. Some international solution is necessary.

III. HOW THE TREATY REGIME IMPEDES SPACE DEVELOPMENT

A. *The Outer Space Treaty and Property Rights in Space*

Taking a different turn from our previous hypothetical disaster scenarios, this time suppose that Company A wishes to enter the communications market with a new type of satellite that will run at the geosynchronous orbit, but the geosynchronous orbit is too crowded to launch another communications satellite, either out of concerns about collisions or issues of signal overlap. Company B owns communications satellites in geosynchronous orbit, but is not running a profitable company and would like to leave. B wishes to sell to A its orbital space, planning to decommission its satellites and let A launch replacement satellites. Can B establish any property right in its orbit that will be protected under international law?

Though it may seem odd to talk about scarcity in the vast reaches of outer space, the fact is that orbital crowding has become a problem, most notably in the geostationary orbit. The geostationary orbit is particularly valuable for telecommunications, as a satellite in geostationary orbit remains stationary with respect to the Earth, and so can stably cover an area of the Earth’s surface.¹¹⁹ NASA launched the first telecommunications satellite, the NASA Syncom, into geostationary orbit in 1963.¹²⁰ With current technology, satellites in geostationary orbit are stable to plus or minus 0.1 degrees of arc, which requires satellites to remain 0.2 degrees of arc apart, allowing for a total of 1,800 satellite slots in geostationary

Symposium on Space Tourism (1999), available at http://www.spacefuture.com/archive/human_factors_and_health_in_space_tourism.shtml.

¹¹⁸ See Collins, *supra* note 24.

¹¹⁹ See REYNOLDS & MERGES, *supra* note 2, at 215.

¹²⁰ *Id.*

orbit.¹²¹ However, some slots are more useful than others; a geostationary satellite that mostly covers the ocean is not very valuable. In addition, while satellites are not at significant risk of physical collision at 0.2 degrees of separation, satellite signals will interfere with each other at separations of less than three degrees in the most commonly used frequency band, which would allow for only 120 total slots.¹²²

Because geostationary orbits are limited, both by physical orbital location and signal conflicts, the allocation of orbits is a highly contested issue. The Outer Space Treaty prohibits national appropriation of outer space by any means.¹²³ However, in 1976, a group of eight equatorial countries signed a declaration that attempted to declare these nations' sovereignty over the portions of the geostationary orbit over their territory.¹²⁴ The International Telecommunications Union ("ITU") currently regulates telecommunications satellites, and appears to apply a "first-in-time, first-in-right" system to orbital allocation.¹²⁵ This system favors private companies over developing nations that are typically on the equator, but does not grant those private companies a property right either.¹²⁶

The geostationary orbit is not the only orbit with crowding problems. Polar orbits, which are orbits that are oriented to travel over the Earth's poles, are also used for communication because a satellite in polar orbit will travel over every latitude on each revolution.¹²⁷ They are often used by particularly northern or southern nations that are at points inaccessible from the geostationary orbit.¹²⁸ They are also used for Earth observation satellites that need to be able to scan all latitudes.¹²⁹

The Outer Space Treaty does not allow for allocating orbital

¹²¹ Copiz, *supra* note 19, at 210.

¹²² *Id.* at 210, 212.

¹²³ Outer Space Treaty, *supra* note 15, art. II.

¹²⁴ Declaration of the First Meeting of Equatorial Countries, Dec. 3, 1976, available at http://www.jaxa.jp/library/space_law/chapter_2/2-2-1-2_e.html.

The eight countries were Brazil, Columbia, Congo, Ecuador, Indonesia, Kenya, Uganda, and Zaire. *Id.*

¹²⁵ Copiz, *supra* note 19, at 218.

¹²⁶ *Id.* at 219.

¹²⁷ See DAVID WRIGHT ET AL., THE PHYSICS OF SPACE SECURITY: A REFERENCE MANUAL 13, 40–41 (2005).

¹²⁸ See generally *id.* at 13–14, 33, 41, 43 (explaining that polar orbits cover the entire earth, whereas geostationary orbits only cover the equator, thus implicating that countries outside the coverage of a geostationary orbit would make use of polar orbits to compensate).

¹²⁹ See *id.* at 40–41.

slots either as a property right or through appropriation by national sovereignty. Article II of the Outer Space Treaty is very clear on the question of sovereignty: “[o]uter space . . . is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”¹³⁰ The Bogota Declaration can be seen as a direct challenge to the Outer Space Treaty, but as the developed, spacefaring nations of the world generally agree that nations cannot claim sovereignty over satellites in geostationary orbit over their territory, such a challenge is unlikely to have much effect.¹³¹ The treaty, by prohibiting national appropriation “by any other means”, also appears to prevent companies from establishing recognizable property rights over the geostationary orbit, including a right to sell the orbit.¹³² Under the current treaty regime, the geostationary orbit is a scarce resource that no nation or individual can claim a legal right to beyond that of a squatter, which does not work to allocate the orbital space either efficiently or equitably.

B. The Outer Space Treaty, Decommissioned Satellites, and Other Space Debris

Even if a company wants to decommission its satellites without attempting to sell its orbital space, the current treaty regime provides neither an incentive for removing dead satellites from orbit nor any penalty for littering in orbital space.¹³³ The current treaty regime thus leads to a classic tragedy of the commons situation, where the *res communis* area of outer space becomes a dumping ground; but unlike the high seas, orbital space is actually scarce, especially in the geosynchronous and polar orbits.¹³⁴ This has caused an immediate problem of space debris that cannot be handled by the current treaty regime.

“Space debris . . . consists of natural or human made particles that circle the Earth.”¹³⁵ Since 1961, over 140 satellites have exploded and over 1,000 inactive payloads circle the Earth,

¹³⁰ Outer Space Treaty, *supra* note 15, art. II.

¹³¹ See Michael J. Finch, Comment, *Limited Space: Allocating the Geostationary Orbit*, 7 NW. J. INT'L L. & BUS. 788, 790, 793–94 (1986).

¹³² Copiz, *supra* note 19, at 218.

¹³³ See Robert C. Bird, *Procedural Challenges to Environmental Regulation of Space Debris*, 40 AM. BUS. L.J. 635, 673, 681–82 (2003).

¹³⁴ See Copiz, *supra* note 19, at 210, 222.

¹³⁵ Bird, *supra* note 133, at 637.

spreading debris all over space.¹³⁶ Debris travels at extremely high speeds, on the order of 11,000 to 35,000 kilometers per hour, and “[a] collision with a fragment measuring a tenth of an inch could do more damage than a bowling ball flying at sixty miles per hour.”¹³⁷ There have been a number of incidents where manmade space debris has caused damage to satellites or manned spacecraft. “In 1983, a paint chip struck the space shuttle Challenger[,]” causing \$50,000 in damages.¹³⁸ “In 1997, a Japanese climate observation satellite was disabled for an unknown reason, but space debris” is presumed to be the cause.¹³⁹ More seriously, “[a] piece of debris one centimeter in diameter striking a space station could penetrate the pressurized crew module . . . and kill the crew.”¹⁴⁰ Debris in geostationary orbit can remain there for millions of years, as there is no significant atmospheric drag to pull debris out of orbit.¹⁴¹

The treaty regime provides no regulation or incentive for launching states or companies to limit space debris. The Liability Convention does impose liability on a launching state for damage caused by its space object to another nation’s space object, but only if the launching state is at fault.¹⁴² When damage is caused by space debris, it is often impossible to discover which space object the debris comes from, making any liability difficult to discover.¹⁴³ If a piece of debris one centimeter in diameter destroys a space station, it would be nearly impossible to find that piece of debris after the disaster and identify it. This makes the Liability Convention, along with any other sort of tort-like system, a poor way of reducing the dangers of space debris.

In early 2007, China tested an anti-satellite missile;¹⁴⁴ such tests could present a major challenge to the question of liability

¹³⁶ *Id.* at 638–39.

¹³⁷ *Id.* at 640.

¹³⁸ *Id.*

¹³⁹ *Id.* at 641.

¹⁴⁰ *Id.*

¹⁴¹ See Space.com, *Russian Researchers Warn of Space Debris*, May 14, 2001, http://www.space.com/news/space_junk_010514.html; Steven A. Mirmina, Note, *Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument*, 99 AM. J. INT’L L. 649, 650 (2005).

¹⁴² Liability Convention, *supra* note 63, art. III.

¹⁴³ Delbert D. Smith, *The Technical, Legal, and Business Risks of Orbital Debris*, 6 N.Y.U. ENVTL. L.J. 50, 70–71 (1997).

¹⁴⁴ CNN.com, *U.S. Official: Chinese Test Missile Obliterates Satellite*, Jan. 19, 2007, <http://www.cnn.com/2007/TECH/space/01/18/china.missile/index.html>.

for damage caused by space debris. On January 19, 2007, a U.S. National Security Council spokesman reported that China had, using a medium-ranged ballistic missile, destroyed one of its weather satellites in orbit.¹⁴⁵ The explosion created “hundreds of pieces of debris” of significant size, which were then tracked by U.S. satellites.¹⁴⁶ As of today, these pieces have not damaged other spacecraft, and China has not launched another anti-satellite missile test.¹⁴⁷ However, had such an incident occurred, it would be unclear how the incident would be resolved under the Liability Convention.

In fact, the first satellite-destroying collision occurred on February 10, 2009, when a no longer functioning Russian Cosmos satellite collided with a privately owned Iridium satellite.¹⁴⁸ Fortunately, Iridium’s communications network has significant redundancy, and the collision therefore had “minimal impact” on their communication services.¹⁴⁹ As of this writing, it is unclear how the Liability Convention will apply, and whether Iridium’s insurer, the United States, or Russia will have to pay some form of compensation under the Convention.¹⁵⁰

Any solution to the orbital debris problem would require new international treaty negotiation. Property-based solutions that might encourage states and companies to keep their orbital slots clean are prohibited by the Outer Space Treaty.¹⁵¹ The Liability Convention can only target states, and can only do so for damages that can be traced back by causation.

IV. POSSIBLE SOLUTIONS

The evolution of space technology has led to a number of problems that UNCOPUOS did not take into account when drafting the space treaty regime in the late 1960s and early

¹⁴⁵ *Id.*

¹⁴⁶ *Id.*

¹⁴⁷ See *U.S. Satellites Dodge Chinese Missile Debris*, WASH. TIMES, Jan. 11, 2008, available at <http://www.washingtontimes.com/news/2008/jan/11/us-satellites-dodge-chinese-missile-debris/>.

¹⁴⁸ Andy Pasztor, *Satellites Destroyed in Orbital Collision*, WALL ST. J., Feb. 12, 2009, at A1, available at <http://online.wsj.com/article/SB123438921888374497.html>.

¹⁴⁹ *Id.*

¹⁵⁰ Stacy Shapiro, *Satellite Collision Raises Coverage Questions*, BUS. INS., Feb. 23, 2009, available at http://www.businessinsurance.com/cgi-bin/article.pl?article_id=27183.

¹⁵¹ See *supra* Part III.A.

1970s. The three general areas discussed in this paper are private space launch companies, space tourism, and orbital debris. A number of authors have provided possible ways for the international community to deal with these issues and many have recommended renegotiating one or more of the space treaties to deal with the particular problems discussed in this paper.

The various solutions can be roughly divided as following one of two approaches: a free market approach and a regulatory approach.

A. *Regulating Private Space Industry*

As we have seen, the treaties are mostly silent on the issues of liability between individuals or corporations in space, focusing instead on state liability.¹⁵² In an area that is inherently international in nature as outer space travel, it is unacceptable to expect domestic tort laws to control issues of liability and regulation over commercial spacecraft. Some authors have suggested that the current liability system for spacecraft be scrapped and replaced by a limited liability system comparable to the Warsaw Convention on Aviation. The Warsaw Convention established negligence-based liability of international air carriers for damages to passengers or luggage occurring in the course of an international flight, and limited liability to “\$10,000 for injury to passengers and \$9.07 per pound for damage to baggage.”¹⁵³

One author, Van Ernest, suggested rewriting the Liability Convention using the Warsaw Convention as a model in 1991.¹⁵⁴ His proposal allowed for two ways a limited liability system for commercial space companies could come into being. One, parallel to the method of the Warsaw Convention, would allow member countries to develop their own laws and interpretations to implement a future commercial space liability convention.¹⁵⁵ The other would establish an international tribunal patterned off other specialized courts to hear disputes over liability arising out

¹⁵² See *supra* Part I.B.

¹⁵³ Van C. Ernest, Note, *Third Party Liability of the Private Space Industry: To Pay What No One Has Paid Before*, 41 CASE W. RES. L. REV. 503, 536–37 (1991). The Convention has been revised at various times to raise the damage caps, but the principle of limited liability remains in place. See Allan I. Mendelsohn, *The United States and the European Union in International Aviation*, 55 FED. LAW 36, 36 (2008).

¹⁵⁴ See Ernest, *supra* note 153, at 537.

¹⁵⁵ *Id.* at 537–38.

of outer space incidents.¹⁵⁶

Because of the nature of space flight in contrast to the nature of aviation, states should not be given control of interpreting such a convention. An airplane typically flies through airspace that is the sovereign territory of a state, and by and large the purpose of an airplane flight is to transport passengers from one sovereign territory to another. The purpose of space flight is to transport passengers and cargo from the Earth, either from a launch pad in a state's sovereign territory or from the high seas, to sovereignless territory above the atmosphere. As the final destination is sovereignless and the launch location can often be anywhere on the Earth, space companies can engage in a sort of spurious registration that allows them to choose their jurisdiction based on the quantity of regulation, or lack thereof. In this respect, space flight is more comparable to the internet—where physical location tends to be irrelevant and companies can choose their base of operations based primarily on the permissiveness of the local law—rather than to aviation, which is always tied to locations and existing sovereignty.¹⁵⁷

An international tribunal would have the advantage of not allowing unscrupulous space companies to avoid liability through choice of registry, but has its own problems with implementation. Ernest notes that an international tribunal's new procedures and added complexity would cause problems for litigants and would likely increase the cost of bringing a claim.¹⁵⁸ Also, there is the difficulty of getting nations to sign on to such a tribunal, particularly nations like the U.S. that have been wary of permanent international courts.¹⁵⁹ The nations of the world, particularly the nations with active space programs, will have to decide which concern is greater. The only thing that is clear is that the current treaty regime is insufficient.

¹⁵⁶ *Id.* at 539.

¹⁵⁷ See, e.g., Jacob J. Kramer, Comment, *Waive Goodbye: Choice Clauses, the Internet, Consumer Protection, and Other Issues Concerning the Unwary Investor*, 16 EMORY INT'L L. REV. 227, 240–41 (2002) (describing how internet businesses will choose offshore places of business to avoid compliance with certain laws).

¹⁵⁸ Ernest, *supra* note 153, at 540.

¹⁵⁹ See e.g., Global Policy Forum, *US Opposition to the International Criminal Court*, <http://www.globalpolicy.org/intljustice/icc/usindex.htm> (“The United States government has consistently opposed an international [criminal] court that could hold US military and political leaders to a uniform global standard of justice.”).

B. Regulating Space Tourism

As with issues surrounding the liability regime, the basic choice for the international community in issues surrounding space tourism is whether to adopt international regulations on the business or to leave the issues largely in the hands of states' domestic laws.

There are numerous issues with space tourism that need to be resolved. Among them are the liability of commercial space ventures as carriers, insurance requirements for commercial space ventures, vehicle and space station safety standards, jurisdictional issues on board space stations, and the status of passengers on spacecraft. A possible model for the international community to work off of, should it decide to impose uniform standards on the budding space tourism industry, is the United States Commercial Space Launch Act ("CSLA").¹⁶⁰ The CSLA imposes many requirements on space launch activities in the United States, including: sufficient liability insurance,¹⁶¹ any requirement necessary to protect public health and safety,¹⁶² any requirement necessary to protect the safety of crew or space flight participants,¹⁶³ and government monitoring of all commercial space launches.¹⁶⁴ United States domestic law allows the Secretary of Transportation to issue a variety of regulations to protect the safety of space tourists and properly regulate the industry.¹⁶⁵ However, without an international regulatory regime, the net effect may end up being that commercial space ventures just move outside of the United States or other nations with strong restrictions.

One author, Charity Ryabinkin, has argued for deregulation of commercial space travel in the United States.¹⁶⁶ Ryabinkin's basic argument that deregulation will not cause safety issues is based in the CLSA's imposition of liability on commercial space ventures in excess of 2 billion dollars and the fact that we need not expect near perfect levels of safety from the space transportation industry.¹⁶⁷ However, comparisons of space travel

¹⁶⁰ Commercial Space Launch Act, Pub. L. No. 98-575, 98 Stat 3055 (1984).

¹⁶¹ *Id.* § 70112(a).

¹⁶² *Id.* § 70105(b)(2)(B).

¹⁶³ *Id.* § 70105(a)(2).

¹⁶⁴ *Id.* § 70106(a).

¹⁶⁵ *Id.* § 70120(a).

¹⁶⁶ Ryabinkin, *supra* note 23, at 133-36.

¹⁶⁷ *See id.* at 134.

to air or automotive travel fail, as space travel poses so many more risks. Space travel also greatly differs from air and automotive travel in the way it developed. Automotive and air travel were primarily developed by private inventors in the commercial marketplace, while space travel has primarily been developed by governments. Where the government has greater expertise with safety issues in manned space travel, it may make more sense to have the government closely monitor and regulate space tourism, at least in the early years of the industry.

Meanwhile, some issues surrounding space travel must be dealt with internationally. The status of space passengers under international law, issues of jurisdiction on board private space stations, and third party liability for accidents in space tourism cannot be handled by domestic law; they are fundamentally international issues that the current treaty regime does not address. The first passengers on board private space vehicles should be able to know the legal situation they will be getting into when they board, say, SpaceShipTwo in the next two years.

C. *Dealing With Orbital Debris and Orbital Scarcity*

Of all of the problems noted by this paper, orbital debris is the most serious problem for the international community and one that cannot be merely left to individual states to deal with. It is in the interest of every country to take up as much orbital space as it can while a system of “first come, first served” exists in outer space. It is also in the interest of each individual country to not impose the cost of cleaning up space debris on its own citizens; like many environmental problems in a *res communis* territory, space debris is a classic tragedy of the commons situation. Only through collective action can spacefaring nations set up a regime to limit space debris, or at least to internalize the costs of space debris.

Mirmina’s article suggests three major ways to deal with the space debris problem. One way is a voluntary adherence regime, comparable to the Missile Technology Control Regime signed by the Group of Seven nations to limit the spread of intercontinental missile technology.¹⁶⁸ The second is a U.N. based approach, such as agreeing to a treaty on the subject drafted by COPUOS.¹⁶⁹ The third is a code of conduct which could be created with

¹⁶⁸ Mirmina, *supra* note 141, at 654.

¹⁶⁹ *Id.* at 657.

significant input from private space ventures as well as states and multinational space agencies.¹⁷⁰

A voluntary adherence regime appears inappropriate for dealing with the problem of space debris. Mirmina's comparison to the Missile Technology Control Regime does not work; the dangers from missile proliferation are much more serious than the dangers from space debris. A small piece of space debris could kill a full crew of astronauts if it pierces a space station's pressurized module; a missile carrying a weapon of mass destruction could kill millions. The greater danger gives nations a much greater incentive to comply with the voluntary regime in the case of missile technology control. Because the danger from an individual space debris-related incident is relatively low, nations are much less likely to comply with a voluntary regime. It would be better than nothing, but it would not be ideal.

A U.N. based approach is much more likely to have the necessary teeth to deal with the problem. The UNCOPUOS has drafted a set of guidelines for space debris mitigation in 2007 that was set out as voluntary.¹⁷¹ These guidelines are fairly general, though, and include such provisions as: "[l]imit debris released during normal operations[;]" "[m]inimize the potential for break-ups during operational phases[;]" and "[l]imit the probability of accidental collision in orbit[.]"¹⁷² Even if they were to be adopted as part of a binding treaty, it is hard to see how they would be enforceable in a way so as to limit orbital debris. This is part of a problem that Mirmina notes with a U.N. approach: the negotiation between so many nations is likely to lead to watered down, ineffective treaties.¹⁷³

Mirmina argues that a code of conduct is likely to be the most successful method of limiting orbital debris.¹⁷⁴ A number of European agencies have already signed the European Code of

¹⁷⁰ *Id.* at 659.

¹⁷¹ Press Release, Outer Space Scientific and Technical Subcommittee, Discusses Space-System-Based Disaster Management, Nuclear Power Sources in Outer Space and Space Debris, U.N. Doc. OS/348 (Feb. 26, 2007), available at <http://www.unis.unvienna.org/unis/pressrels/2007/unisos348.html>.

¹⁷² United Nations Committee on the Peaceful Uses of Outer Space [COPUOS], Outer Space Scientific and Technical Subcommittee, *Report of the Scientific and Technical Subcommittee on its Forty-Fourth Session*, 42–46, U.N. Doc A/AC.105/890 (Mar. 6, 2007), available at http://www.unoosa.org/pdf/reports/ac105/AC105_890E.pdf.

¹⁷³ Mirmina, *supra* note 141, at 658.

¹⁷⁴ *Id.* at 660.

Conduct for Space Debris Mitigation.¹⁷⁵ This code is far more specific and detailed than the U.N. guidelines on space debris mitigation and requires specific design and end-of-life measures for space objects.¹⁷⁶ It remains to be seen how effective the European Code of Conduct will be, but it certainly looks to be a more effective way of mitigating space debris than the U.N. approach. Another advantage to a code of conduct is that if commercial space ventures take part in negotiating such codes, they are more likely to comply with the codes. The major disadvantage, as Mirmina notes, is that unless adopted in domestic law, there is nothing requiring private space ventures to comply with a code of conduct.¹⁷⁷ A code of conduct could also lead to an international treaty on space debris mitigation, providing the advantages of the negotiating process for a code of conduct along with the enforceability of an international treaty.¹⁷⁸

Other proposed solutions focus on creating incentives for launching entities to mitigate their own space debris. Mark J. Sundahl argues for a market-share liability regime for unidentified orbital debris.¹⁷⁹ Such a regime would impose liability for damage caused by unidentified orbital debris on nations in proportion to the amount of space debris each is responsible for.¹⁸⁰ While theoretically a fair way of apportioning liability for such incidents, this approach is impractical because it is very difficult to determine a nation's "market share" in orbital space debris. Unlike in the pharmaceutical product liability cases Sundahl analogizes to, the percentage of space debris a state is responsible for cannot be determined from a simple number such as the percentage of space objects that state has launched. Sundahl suggests that the measure for determining the percentage of liability for a state could be the

¹⁷⁵ European Code of Conduct for Space Debris Mitigation (June 28, 2004), available at <http://www.stimson.org/wos/pdf/eurocode.pdf> (showing that the signatories were the Spanish, Italian, British, and German space agencies as well as the multinational European Space Agency).

¹⁷⁶ See generally *id.* at 5–10 (detailing and laying out design and end-of-life measures).

¹⁷⁷ See Mirmina, *supra* note 141, at 660 (observing that the government would not domestically regulate unless the code was adopted).

¹⁷⁸ See *id.*

¹⁷⁹ Mark J. Sundahl, Note, *Unidentified Orbital Debris: The Case for a Market-Share Liability Regime*, 24 HASTINGS INT'L & COMP. L. REV. 125, 126–27 (2000).

¹⁸⁰ *Id.* at 143.

percentage of identified debris the state is responsible for.¹⁸¹ However, identified debris is identifiable and easily tracked because it is large. Such a system would create an incentive for states not to mitigate their debris, but merely to make sure large debris is broken down into smaller parts that cannot be tracked or identified. Because a small piece of space debris can do a large amount of damage, this is not a good incentive to create. Sundahl does note that such a system would encourage debris removal technologies, though, which is a worthy goal.¹⁸² Adopting such a proposal would require renegotiating the Liability Convention.

For allocating orbits, Lawrence Roberts has suggested a market solution to allocate slots in the geostationary orbit.¹⁸³ Under Roberts's proposal, frequency bands along with "designated orbital positions would be auctioned to the highest bidder."¹⁸⁴ Such a system would allow easier resale of geostationary orbit slots and provide an incentive for entities to boost their satellites and debris out of their geostationary orbit slots when their owner decides to leave the business. There are two problems with such an approach. The first is that the international community may want to reserve some orbital slots for public services such as weather and military communication satellites.¹⁸⁵ The second is that it may not be allowed under the current treaty regime, as property rights in space conflict with the "nonappropriation provisions of the Outer Space Treaty."¹⁸⁶

The issues of space debris and orbital allocation are, unlike those involved with space tourism, already concerns for the international community, and some of the most promising solutions are blocked by the current treaty regime.

V. CONCLUSION

The international space treaty regime served its original purpose well. The United States and the Soviet Union never undertook any significant militarization of space, the few issues

¹⁸¹ *Id.* at 145–46.

¹⁸² *Id.* at 148.

¹⁸³ Lawrence D. Roberts, *A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union*, 15 BERKELEY TECH L.J. 1095, 1098, 1135 (2000).

¹⁸⁴ *Id.* at 1136.

¹⁸⁵ *Id.* at 1139.

¹⁸⁶ *Id.* at 1140; *see also supra* Part III.A-B (describing the prohibitions on national appropriation of outer space).

of liability and return were dealt with smoothly, and spacecraft were registered properly with the United Nations. Most importantly, no nation ever put nuclear weapons in orbit, tested nuclear weapons above the atmosphere, or even made serious threats to put an offensive technology into space.¹⁸⁷ As a series of arms control treaties in a world where only two states had significant space programs, it worked well.

However, in 2009, the world has changed, and the space treaty regime must change with it. The Liability Convention's complete failure to hold private entities accountable poses problems for all commercial space developments. The Outer Space Convention's principles of nonappropriation prevent some methods of mitigating the problems of space debris and determining how orbital positions are allocated. The unclear provisions regarding jurisdiction in space and liability for passengers on board space craft create unwelcome uncertainty for the budding space tourism industry.

Now is the appropriate time to address the deficiencies of the treaty regime. None of the problems addressed in this paper are far future science-fiction technologies such as asteroid mining. They are all problems that have either already arisen or will arise within the next five to ten years. Before commercial space ventures can take the giant leap into making space travel available for the common man, the international community has to take the small step of clarifying the rules for those ventures.

¹⁸⁷ Ronald Reagan threatened to implement a space based missile defense system in the 1980s, but this system was defensive and was intended to combat ballistic missiles that would fly above the atmosphere. See Larry Gilman, *Strategic Defense Initiative and National Missile Defense*, <http://www.espionage.info/Sp-Te/Strategic-Defense-Initiative-and-National-Missile-Defense.html> (last visited Feb. 11, 2009); Rebecca Johnson, *Safeguarding Space Security: Missile Defence and the Challenge for Europe*, Sept. 14, 2005, <http://www.acronym.org.uk/space/safeguard.htm>.