altitude termination of State sovereignty will create the potential for conflict.[158] With space becoming increasingly important – not only to the security of nations, but also in the day-to-day lives of people across the globe – and the looming threat of space terrorism,[159] the need for a clear definition of the extent of State sovereignty has never been more acute.

[158] Reinhardt, *supra* note 7, at 14, 76.

[159] SPACE SECURITY INDEX, *supra* note 44, at 63, 67, 136; REPORT OF THE COMMISSION, *supra* note 91, at 22; Oberst, *supra* note 133.

THE MARCH OF SCIENCE: FOURTH AMENDMENT IMPLICATIONS ON REMOTE SENSING IN CRIMINAL LAW

*Surya Gablin Gunasekara**

The government's use of technology must be weighed in the Fourth Amendment balance not because the Constitution constrains the government to employ antiquated surveillance techniques but because the march of science over the course of this century has time and again laid bare secrets that society had (erroneously) assumed to lie safely beyond the perception of government.[1]

INTRODUCTION

Technology has become entrenched in society and it has permeated through every aspect of our lives. Its application in law enforcement is no exception, and agencies across the United States have consistently developed new and improved ways of fighting crime. In particular, the use of satellite technology, a method of remote sensing,[2] has become a viable law enforcement tool. Satellite sensors can now penetrate through cloud cover and forest canopies, and also have the ability to track human movements on the ground.[3] Currently, the images produced by satellites are being used by law enforcement agencies to identify

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[1] United States v. Cusumano, 83 F. 3d 1247, 1261 (10th Cir. 1996) (McKay, J., dissenting).

[2] For the purposes of the article remote sensing shall be defined as "the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device not in contact with the object, area or phenomenon under investigation." *See* THOMAS LILLES & RALPH KIEFER, REMOTE SENSING AND IMAGE INTERPRETATION 1 (1994).

[3] Robert Block, *U.S. to Expand Domestic Use of Spy Satellites*, WALL ST. J., Aug. 15, 2007, *available at* http://online.wsj.com/article/SB118714764716998275.html.

agricultural fraud,[4] observe environmental infractions,[5] and catch producers of illegal drugs.[6] The potential applications of satellite imaging, however, are virtually unlimited. For example, such uses could include: monitoring suspected criminals, analyzing crime scene patterns, and assessing local natural disaster damage.[7]

The difficulty with the evolution of law enforcement technology is how to apply existing law to new developments, while maintaining an acceptable level of privacy. Although the U.S. Supreme Court has upheld the validity of aerial surveillance of private property by law enforcement aircraft without a warrant, no court has applied these decisions with regard to the use of satellite technology.[8] Furthermore, the Court has restricted law enforcement technology to that which is in general public use, so it is difficult to conclude with any certainty how a court will treat the use of satellite remote sensing by law enforcement.[9]

This article will attempt to resolve the potential constitutional issues that may arise as satellite imaging and remote sensing technologies become a mainstream part of modern law enforcement. Section I examines how the Fourth Amendment has attempted to keep pace with technology. Section II details the application of remote sensing in law enforcement, as well as the constitutionality of employing certain technologies. Section III provides a glimpse into how the Supreme Court of Canada has dealt with remote sensing employed in law enforcement activities. Finally, section IV analyzes the status of the Fourth Amendment today and how it should be applied to the use of remote sensing and satellite technology in criminal law in the future.

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[4] *See* United States v. Fullwood, 342 F.3d 409 (2003).

[5] *See* Dow Chem. Co. v. United States, 476 U.S. 227 (1986).

[6] *See* California v. Ciraolo, 476 U.S. 207 (1986); Florida v. Riley, 488 U.S. 445 (1989); Kyllo v. United States, 533 U.S. 27 (2001); United States v. Garcia, 474 F. 3d 994 (2007).

[7] Block, *supra* note 3.

[8] *Id*.

[9] *Kyllo*, 533 U.S. at 40 ("Where, as here, the Government uses a device that is not in general public use, to explore details of the home that would previously have been unknowable without physical intrusion, the surveillance is a 'search' and is presumptively unreasonable without a warrant.").

I. THE FOURTH AMENDMENT AND TECHNOLOGY

The Fourth Amendment guarantees freedom from unreasonable searches by providing that:

> [t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the person or things to be seized.[10]

More than a century after the ratification of the Bill of Rights the Supreme Court articulated the scope of the Fourth Amendment.[11] Whereas early court decisions relied on a property-based rationale, the Fourth Amendment was only applied where there was a physical invasion of property.[12]

The application of the Fourth Amendment based upon physical intrusion is exemplified by the Supreme Court's decision in *Olmstead v. United States*.[13] In *Olmstead* the defendants were convicted of conspiracy to violate the National Prohibition Act.[14] The evidence, which led to the discovery of the conspiracy, was largely based on wiretapped conversations between the defendants by four government agents.[15] The government agents, without trespassing, inserted small wires along the telephone lines and testified as to the criminal content of the conversations they overheard.[16]

The Supreme Court found that the purpose of the Fourth Amendment "was to prevent the use of governmental force to search a man's house, his person, his paper and his effects; and

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[10] U.S. CONST. amend. IV.

[11] James J. Tomkovicz, *Technology and the Threshold of the Fourth Amendment: A Tale of Two Futures*, 72 MISS. L.J. 317, 327 (2002) (*citing Boyd v. United States*, 116 U.S. 616 (1886)).

[12] Reginald Short, *The Kyllo Conundrum: A New Standard to Address Technology that Represents a Step Backward for the Fourth Amendment Protections*, 80 DENV. U. L. REV. 463, 466 (2002).

[13] 277 U.S. 438 (1928).

[14] *Id*. at 455.

[15] *Id*. at 456.

[16] *Id*. at 456 – 57.

to prevent their seizure against his will."[17] The Court ultimately concluded that the wiretapping did not constitute a search or seizure, since there was no taking of "tangible material effects" or "physical invasion" of a home, property or "curtilage."[18] *Olmstead* marks the first case in a series where the Court's decisions were predicated by government officials' exploitation of advances in technology.[19]

The ruling in *Olmstead,* requiring physical intrusion for a Fourth Amendment violation, prevailed for almost forty years. In 1967, however, the *Olmstead* doctrine was essentially overruled by the Supreme Court in *Katz v. United States*.[20] The Court in *Katz* recognized that privacy was not rooted in physical property but rather the Fourth Amendment protected "people, not places."[21] The petitioner in *Katz* was charged on eight counts of "transmitting wagering information by telephone from Los Angeles to Miami and Boston in violation of a federal statute."[22] At trial the government introduced evidence of telephone conversation, which FBI agents had recorded using a listening device.[23] The eavesdropping machine was attached to the outside of a public phone booth, from which Mr. Katz placed his calls.[24] The Supreme Court declined to address whether the petitioner had a right to privacy in a public phone booth, under the Fourth

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[17] *Id*. at 463.

[18] *Id*. at 466.

[19] Tomkovicz, *supra* note 11, at 334, *see Goldman v. United States*, 316 U.S. 129 (1942) (holding a detectaphone placed against a shared wall to amplify conversations did not constitute a Fourth Amendment search); *On Lee v. United States*, 343 U.S. 747 (1952) (finding that conversations recorded by a wired narcotics agent did were not a Fourth amendment search since there was no physical invasion required by the *Olmstead* doctrine); *but see Silverman v. United States*, 365 U.S. 505 (1961) (concluding that eavesdropping accomplished by means of an electronic device that penetrated the premises occupied by the petitioner was in violation of the Fourth Amendment).

[20] 389 U.S. 347 (1967), *see also id*. at 362 (Harlan, J., concurring) ("[T]oday's decision must be recognized as overruling *Olmstead v. United States*, which essentially rested on the ground that conversations were not subject to the protection of the Fourth Amendment.").

[21] *Id*. at 351.

[22] *Id*. at 348.

[23] *Id*.

[24] *Id*.

Amendment, based upon property rights.[25] Rather, the Court found what a person knowingly exposes to the public is not protected, however, what a person seeks to keep private even in a public area, may be protected.[26] Thus, the Court concluded that a private conversation recorded by government agents constituted a search requiring Fourth Amendment protections.[27] This decision represented a shift in Fourth Amendment jurisprudence away from a protected area towards a protected person.[28]

While the plurality opinion in *Katz* made progress in protecting Fourth Amendment rights in the wake of technology, Justice Harlan's concurrence provided the test for constitutionality. The two-prong test required: "first that a person have exhibited an actual (subjective) expectation of privacy and, second, that expectation be one that society is prepared to recognize as 'reasonable.'"[29] The subjective nature of the first prong has been widely dismissed,[30] however, the second prong "has come to reflect a balancing test between the needs of law enforcement and the importance of the individual interest threatened."[31] For example, if society holds that there is a lower threshold of privacy in a particular area, then the scope of invasiveness may be allowed to increase.[32] The test in *Katz* has been employed by the courts as technology advanced to balance the investigative ne-

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[25] *Id*. at 350 ("In the first place the correct solution of Fourth Amendment problems is not necessarily prompted by incantation of the phrase 'constitutionally protected areas.'").

[26] *Id*. at 351 ("What a person knowingly exposes, even in his own home or office, is not a subject of Fourth Amendment protections. But what he seeks to preserve as private, even in an area accessible to the public, may be constitutionally protected.").

[27] *Id*. at 353.

[28] Short, *supra* note 12, at 467.

[29] *Katz*, 389 U.S. at 361 (Harlan, J., concurring).

[30] *See* Short, *supra* note 12, at 468 (Justice Harlan appeared to reject the first prong of his *Katz* test in *United States v. White*). *See also*, *United States v. White,* 401 U.S. 745, 786 (1971) (Harlan, J., dissenting) (explaining that legal analysis must "transcend the search for subjective exceptions or legal attribution of assumptions of risk. Our expectations, and the risks we assume, are in large part reflections of laws that translate into rules the customs and values of the past and present.").

[31] *Id*.

[32] *Id*. at n. 44 (*comparing United States v. Ross*, 465 U.S. 798, 811 (1982) (noting that expectations of privacy in personal luggage and other closed containers must be substantially greater than in the area of an enclosed automobile), *with Arkansas v. Sanders*, 442 U.S. 753 (1979) (noting if the personal luggage is found in a car, the expectation of privacy must correspondingly be less)).

cessity with individual's rights. It would, however, be years until the Forth Amendment and the *Katz* test would be applied to remote sensing.

II. REMOTE SENSING IN LAW ENFORCEMENT

It is undeniable that surveillance technology has vastly improved over the course of this century. These technological improvements have given the government and law enforcement agencies the tools to investigate criminals, but they have also created legal conundrums for courts as they attempt to determine how new technologies should be constrained by the Fourth Amendment.[33] Some of these remote sensing technologies involve devices which allow the government to gather information that would otherwise be impossible to detect.[34] In recent years, the use of aerial surveillance, thermal imaging, and satellite imaging have emerged as methods of modern law enforcement, and the courts have struggled to reconcile these technologies with the sphere of privacy.

A. Aerial Surveillance

In the past three decades law enforcement officials have used warrantless aerial surveillance to identify criminal activities, from drug production[35] to environmental infractions,[36] and the Supreme Court has time and again found these observations to be constitutionally permissible. Beginning with *California v. Ciraolo*, the Court examined a case where police officers, acting on a tip, used a plane to fly over the defendant's home and photograph the defendant's backyard where he was growing marijuana.[37] Police were unable to observe the marijuana from the

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[33] Ric Simmons, *Why 2007 is Not Like 1984: A Broader Perspective on Technology's Effect on Privacy and Fourth Amendment Jurisprudence*, 97 J. CRIM. L. & CRIMINOLOGY 531, 541 (2007).

[34] *Id*. at 541 – 42 (noting that "[i]on scanners can be waved over any surface to detect the presence of drugs or explosives; airplanes fly over our fenced-in fields, allowing law enforcement agents to view our backyards; and satellites in space can take pictures of these backyards with a stunning level of detail.").

[35] *See Ciraolo*, 476 U.S. 207; *see also Riley*, 488 U.S. 445.

[36] *Dow Chem. Co.*, 476 U.S. 227.

[37] *Ciraolo*, 476 U.S. at 209.

ground level, as the backyard was obstructed by a 6-foot high outer fence and a 10-foot high inner fence.[38] Instead the officers procured a private plane to fly in navigable airspace over the defendant's backyard at an altitude of 1,000 feet; the officers readily identified marijuana plants 8 to 10 feet high and photographed the area with a standard 35mm camera.[39] Based upon the officers' observations and the anonymous tip, a warrant was executed and 73 marijuana plants were seized.[40]

Applying the two part test in *Katz*, the Court held that the defendant's Fourth Amendment rights had not been violated by the observations of his curtilage, since the backyard was visible to anyone traveling at such an altitude.[41] Applying the first prong stipulated in *Katz*, the Court was not entirely clear whether the defendant manifested a subjective expectation of privacy from all surveillance of his backyard.[42] Therefore, the Court turned to the second prong and found that because the defendant knowingly exposed his backyard to observation from navigable airspace, he did not have a reasonable expectation of privacy.[43] Specifically, "[t]he Court found it important that the plane was traveling at an altitude that was within navigable airspace and that the marijuana plants could be seen from that altitude with the naked eye."[44] As a result, the Court found that the police observations did not violate the Fourth Amendment.[45] The Court, however, did not address the constitutionality of using the photograph as an exhibit, since the warrant was sup-

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[38] *Id*.

[39] *Id*.

[40] *Id*. at 209 – 10 (It should be noted that the photograph was attached to the officers' affidavit as an exhibit and was not the basis of the warrant.)

[41] *Id*. at 211 -216 (Curtilage is defined as "the area to which extends the intimate activity with the 'sanctity of a man's home and the privacies of life.' ").

[42] *Id*. at 212.

[43] *Id*. at 214 ("[W]e readily conclude that respondent's expectation that his garden was protected from such observation is unreasonable and is not an exception that society is prepared to honor.").

[44] Melissa Deal, *Can Big Brother Watch You? The Implications of the Department of Homeland Security's Proposed National Applications Office for Fourth Amendment Protections*, 73 J. AIR L. & COM. 407, 415 (2008) (citing *Ciraolo*, 476 U.S. at 209, 215).

[45] *Ciraolo*, 476 U.S. at 215.

ported by the officers' observations and not the photograph itself.[46]

Fortunately, it would not be long before the constitutionality of warrantless aerial surveillance was resolved. Decided the same day as *Ciraolo*, the Supreme Court, in *Dow Chemical Co. v. United States,* addressed the issue of whether aerial photography constituted a search without a warrant, thereby violating the Fourth Amendment.[47] In *Dow Chemical Co.*, the Environmental Protection Agency (EPA) acquired consent for an on-site inspection of the petitioner's 2,000 acre chemical manufacturing plant.[48] When the EPA requested a second inspection, Dow refused.[49] Instead of seeking an administrative search warrant, the "EPA employed a commercial aerial photographer, using standard floor-mounted, precision aerial mapping camera, to take photographs of the facility from attitudes of 12,000 ft, 3,000 ft, and 1,200 ft."[50] Upon learning of the EPA's activities, Dow brought suit in District Court alleging that the EPA's actions violated the Fourth Amendment.[51]

The Court examined whether the area of the facility observed fell under the curtilage doctrine[52] or the "open fields" doctrine.[53] The Court acknowledged that the chemical plant had elements of both a curtilage and an open field. However, it decided "such an industrial complex is more comparable to an open field and as such it is open to the view and observation of persons in aircraft lawfully in the public airspace immediately

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[46] *Id*. at 212, n. 1 ("It was the officer's observations, not the photograph, that supported the warrant.").

[47] *Dow Chem. Co.*, 476 U.S. at 234.

[48] *Id*. at 229.

[49] *Id*.

[50] *Id*. ("At all times the aircraft was lawfully within navigable airspace.").

[51] *Id*. at 230.

[52] *Id*. at 235 (citing *Ciraolo*, 476 U.S. at 213) (noting that the "curtilage area immediately surrounding a private house has long been given protection as a place where the occupants have a reasonable and legitimate expectation of privacy that society is prepared to accept" and the curtilage doctrine has "evolved to protect much the same kind of privacy as that covering the interior of a structure.").

[53] *Id*. (citing *Oliver v. United States*, 466 U.S. 170, 179 (1984)) ("[T]he Court has drawn a line as to what expectations are reasonable in open areas beyond the curtilage of a dwelling: 'open fields do not provide the setting for those intimate activities that the [Fourth] Amendment is intended to shelter from governmental interference or surveillance.'").

above or sufficiently near the area for the reach of cameras."[54] In reaching its final ruling, the Court emphasized the fact that the camera was "commonly used in mapmaking," and that the EPA was within navigable airspace when the photographs were taken.[55] While the Court recognized that the camera could distinguish wires that were half an inch in diameter, it was not able to penetrate the walls of the plant.[56] In dicta, the Court explained that surveillance equipment not available to the public, such as satellite technology, may violate the Fourth Amendment absent a warrant because they have the ability to provide highly "intimate details."[57] Ultimately, the Court held that taking aerial photographs of a chemical manufacturing plant was not a search prohibited by the Fourth Amendment.[58]

The most recent Supreme Court case involving aerial surveillance was *Florida v. Riley* in 1989.[59] In *Riley*, law enforcement officers used a helicopter to determine that the defendant was growing marijuana in his greenhouse.[60] The helicopter was flown at an altitude of 400 ft, and the investigating officers were only able to observe the marijuana because two panels of the greenhouse roof were missing.[61] Based upon these observations a warrant was executed, the subsequent search revealed marijuana being grown and the defendant was arrested pursuant to Florida laws.[62]

Again, the Court in a plurality opinion acknowledged that the greenhouse was part of the defendant's curtilage, however, the defendant's expectations that his "crops" were unobservable were unreasonable.[63] The helicopter was within navigable air-

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[54] *Id*. at 239.

[55] Deal, *supra* note 44, at 416, *see also Dow Chem. Co.*, 476 U.S. at 238.

[56] *Dow Chem. Co.*, 476 U.S. at 238.

[57] *Id*. ("It may well be, as the Government concedes, that surveillance of private property by using highly sophisticated surveillance equipment not generally available to the public, such as satellite technology, might be constitutionally proscribed absent a warrant."); *see also id*. at 239, n. 5 (explaining that "intimate detail" is being able to identify human faces or read documents).

[58] *Id*.

[59] *Riley*, 488 U.S. 445 (plurality opinion).

[60] *Id*. at 448.

[61] *Id*. (noting that 10 percent of the roof area was missing).

[62] *Id*. at 449.

[63] *Id*. at 450.

space, thus the observations were made from a "public vantage point."[64] The plurality opinion established three factors which it deemed essential to invoking Fourth Amendment protection: (1) the surveillance was sufficiently rare; (2) the surveillance interfered with the normal use of the curtilage; or (3) the surveillance detected intimate details connected with the use of the home or curtilage.[65] In the end, the Court determined that the aerial observation in *Riley* did not meet any of the aforementioned factors; as a result, aerial surveillance by helicopter was not considered a search under the Fourth Amendment.[66]

In these three aerial surveillance cases the Supreme Court did not find any of the law enforcement observations to be a search under the Fourth Amendment.[67] This line of cases has validated law enforcement agencies' ability to observe criminal behavior from the public vantage point of navigable airspace.[68] The Supreme Court has also recognized that the use of aircraft and sense-enhancing technology, does not automatically give rise to constitutional problems.[69]

B. Thermal Imaging

Despite giving virtually free reign to law enforcement officers in aerial surveillance, the Supreme Court began to limit the scope of Fourth Amendment protections in regard to sense-enhancing technology. Twelve years after *Riley*, the Court in *Kyllo v. United States* held that the warrantless surveillance of a home using a thermal imaging device was a search under the Fourth Amendment and therefore was an unconstitutional invasion of privacy.[70] In *Kyllo*, Department of Interior (DOI) agents suspected the petitioner of growing marijuana in his Oregon triplex.[71] The agents used the Agema Thermovision

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[64] *Id*. at 450 - 51.
[65] *Id*. at 452; *see also* Deal, *supra* note 44, at 417.
[66] *Id*.
[67] *See id*., *see also Dow Chem. Co*., 476 U.S. at 239; *Ciraolo*, 476 U.S. at 215.
[68] *Id*.
[69] *Dow Chem. Co.*, 476 U.S. at 238 ("The mere fact that human vision is enhanced somewhat, at least to the degree here, does not give rise to constitutional problems.").
[70] *Kyllo*, 533 U.S. at 40.
[71] *Id*. at 29.

210,[72] a thermal imaging device to scan the triplex.[73] This sense-enhancing device detects the infrared spectrum that is invisible to the naked eye.[74] By analyzing the data gathered by this device the agents were able to determine that petitioner's garage roof was substantially hotter than those of his neighbors.[75] The DOI agents believed that the heat was coming from halogen lights typically used in the cultivation of marijuana.[76] "Based on tips from informants, utility bills, and the thermal imaging, a Federal Magistrate Judge issued a warrant authorizing a search of petitioner's home, and the agents found an indoor growing operation involving more than 100 plants."[77]

The Court distinguished *Kyllo* from the aerial surveillance cases by virtue of the thermal imager's ability to observe the inside of the house rather than the outside as in *Riley* and *Ciraolo*.[78] The Government contended that the thermal imager was constitutional because it only detected heat emanating from the outside of the house, and it did not reveal activities in private areas.[79] The majority noted that they rejected the mechanical interpretation of the Fourth Amendment in *Katz*, where the listening device only picked up sounds projected outside the walls of the phone booth.[80] The consequence of this reversed approach would in effect leave the "homeowner at the mercy of advancing technology including imaging technology that could discern all human activities in the home."[81] The Court also concluded that the imaging device did discern intimate details, simply because the details were those within the sanctity of the

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[72] *Id*. at 30 ("The imager converts radiation into images based on relative warmth-black is cool, white is hot, shades of gray connote relative differences; in that respect, it operates somewhat like a video camera showing heat images.").

[73] *Id*.

[74] *Id*. at 29.

[75] *Id*. at 30.

[76] *Id*.

[77] *Id*.

[78] *Id*. at 37 – 38.

[79] *Id*. at 35 – 37.

[80] *Id*. at 35.

[81] *Id*. at 35 – 36; *see also id*. at 36, n. 3 ("The ability to 'see' through walls and other opaque barriers is a clear, and scientifically feasible, goal of law enforcement in research and development.").

home.[82] In this respect, the Court distinguished *Kyllo* from *Dow Chemical Co*., in that the enhanced aerial photography in *Dow* did not involve the heightened Fourth Amendment protections of a home.[83] The final effect of *Kyllo* is to prohibit the warrantless use of devices not in general public use, which have the capability to explore "details of the home that would previously have been unknowable without physical intrusion."[84]

C. Satellite Imaging

While no court has ruled on the warrantless use of satellite surveillance, the Supreme Court, in *Dow Chemical Co.* stated that satellites may pose constitutional problems because of their ability to provide intimate details.[85] This statement, however, was made in dicta over twenty years ago, before satellite were an integral part of society. In 2008, the Department of Homeland Security (DHS) established a new branch called the National Applications Office (NAO), which was chartered to use classified satellite reconnaissance for law enforcement purposes.[86] With the creation of the NAO it was widely speculated that soon the warrantless use of satellite surveillance would come under constitutional scrutiny. In fact, DHS Secretary Janet Napolitano ended the NAO program after little more than a year, citing the need to protect civil liberties and the privacy of the American people.[87] This, however, does not mean that the use of satellite imaging will no longer be prevalent in criminal law. Perhaps one of the largest emerging applications of satellite images is their use in agricultural fraud.

Farming in the United States is no easy task; farmers have to combat the weather, commodity prices, insects and diseases.[88]

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[82] *Id*. at 37 -38.

[83] *Id*.

[84] *Id*. at 40.

[85] *See supra* note 57 and accompanying text.

[86] Deal, *supra* note 44, at 408.

[87] *Secretary Napolitano Announces Decision to End National Applications Office Program*, Department of Homeland Security Press Releases, Jun. 23, 2009, *available at* http://www.dhs.gov/ynews/releases/pr_1245785980174.shtm.

[88] Laura Rocchio, *Fighting Crop Insurance Fraud with Landsat*, 72 PHOTOGRAPHIC ENGINEERING & REMOTE SENSING 725 (2006).

The United States Department of Agriculture (USDA) helps to reduce the perils of farming by allowing farmers to manage their risks through the Federal Crop Insurance Program.[89] Over the years, however, the program has been threatened by a small percentage of fraud leading the USDA to crackdown and step up enforcement.[90]

In order to combat crop insurance fraud the USDA uses *Landsat*[91] satellite images to analyze suspected fraudulent crops insurance claims.[92] *Landsat* imagery is employed when a USDA investigator determines that it is necessary to verify an insurance claim.[93] The image is either examined internally by the USDA's Risk Management Activity (RMA), or contracted out to private remote sensing experts, such as Dr. John Brown.[94] Over the past several years the RMA has used an average of 600 *Landsat* scenes per year covering an area of 7.6 million acres.[95] "Typically, about half of the Landsat Image analyses support a farmer's insurance claim and half indicate fraud."[96] Conservative estimates put the government's savings from the use of *Landsat* images at 100 million dollars annually.[97]

When Dr. Brown is employed to investigate potential fraud, he examines the satellite images to determine whether or not the farmer actually planted or harvested what was claimed.[98] If there is satellite imagery that does not support the farmer's claim, Dr. Brown will testify to that fact.[99] "Brown testifies in

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[89] *Id*.

[90] *Id*. (A study done by the Center for Agribusiness Excellence at Tarleton State University and the RMA's Strategic Data Acquisition and Analysis unit estimates fraudulent activity among 0.18% of insured farmers.).

[91] *Landsat* is the world's oldest civilian land remote sensing satellite system. It is a national program with global functions, providing crop forecasting for national markets and national security. Joanne Irene Gabrynowicz, *The Perils of Landsat from Grassroots to Globalization: A Comprehensive review of US Remote Sensing Law with a Few Thoughts for the Future*, 6 CHI. J. INT'L L. 45, 45-47 (2005).

[92] Rocchio, *supra* note 88, at 725.

[93] *Id*.

[94] *Id*.

[95] *Id*.

[96] *Id*.

[97] *Id*. at 725 ("A conservative estimate would be that Landsat save the U.S. government $100 million per year.").

[98] *Id*.

[99] *Id*.

cases across the nation involving cotton, sorghum, tomato, soybean, and corn crops among others."[100] In many cases the *Landsat* data explained by Dr. Brown is challenged on the basis of admissibility.

For instance, in the Fifth Circuit Court of Appeals case *United States v. Fullwood*,[101] the defendant, Fullwood, argued that the expert testimony of Dr. Brown should not have been admitted by the district court.[102] In *Fullwood*, the defendant participated in farm assistance programs administered by the federal Farm Service Agency (FSA).[103] During the 1999 season, the defendant farmed cotton and grain sorghum, however, he did not plant all the acreage that he certified with the FSA, nor that which he insured.[104] Fullwood proceeded to make fraudulent insurance claims, maintaining that hail and excess precipitation had damaged his cotton crops. Ultimately, the defendant requested more than $310,000 and received more than $235, 000.[105]

At trial, Dr. Brown testified that based upon the satellite images of Fullwood's farm, it was clear that the defendant did not plant the crops on the dates that were certified with the FSA.[106] Fullwood claimed that the district court abused its discretion by allowing Dr. Brown's testimony.[107] Federal Rule of Evidence 702 sets the standard for the admission of expert testimony:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is

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[100] *Id*. at 725 – 26.

[101] 342 F.3d 409 (5th Cir. 2003) (holding that the government expert's testimony, based on satellite imagery, which demonstrated that the defendant did not plant crops that he submitted insurance claims for, was properly admitted).

[102] *Id*. at 411 – 12.

[103] *Id*. at 410.

[104] *Id*. at 411 ("In connection with these claims, he executed various cotton appraisals and production worksheets.").

[105] *Id*. (A substantial portion of the funds were withheld because Fullwood was under investigation).

[106] *Id*. at 412.

[107] *Id*. at 411.

> based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.[108]

Even though Fullwood conceded that Dr. Brown was a highly qualified expert,[109] the defendant still contended that "there was too great a gap between the premise of satellite imagery, as it relates to crop cultivation," and the conclusion reached by the testimony that certain crops were not planted.[110]

The court dismissed Fullwood's contentions as "conclusory and without merit."[111] The Fifth Circuit noted that the Eight Circuit had already upheld the admission of satellite image-based testimony.[112] The court also acknowledged that remote sensing technology has been around for decades, and that the techniques used in Dr. Brown's testimony were used every day by science, industry, and government.[113] In short, the court concluded that the use of satellite images supported by expert testimony was methodologically sound, and the district court by no means abused its discretion by admitting the evidence.[114]

Agricultural fraud is one of the few areas of criminal law where satellite imaging is being used with great success to put

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[108] Fed. R. Evid. 702.

[109] Dr. Brown's credentials include a Ph.D. in horticulture and numerous publications. *Fullwood*, 342 F.3d at 412. "During his dissertation, Brown worked extensively with Magnetic Resonance Imaging (MRI), and imaging technique used extensively in the medical field, to investigate plant water relationships and root hydrodynamics. After earning his Ph.D., Brown applied his experience with imaging science to aerial analysis and in 1993 started Agricultural Investigation and Research Corporation (AIR Corp.)." AIR specializes in analysis of both aerial photography and satellite imagery for crop insurance fraud investigations, but also uses Landsat to help farmers do crop analysis, property damage assessments, and establish water rights. Rocchio, *supra* note 88, at 725.

[110] *Fullwood*, 342 F.3d at 412.

[111] *Id*.

[112] *Id.*; *see also United Stated v. Larry Reed & Sons P'ship*, 280 F.3d 1212, 1215 (8th Cir. 2002) (holding that the district court did not abuse its discretion in admitting reliable evidence expert testimony about soil preparation of an agricultural partnership's farmland, which based on the computer analysis of satellite images demonstrated the submission of false cotton crop insurance claims).

[113] *Id*.

[114] *Id*.

people behind bars, and save taxpayers money.[115] Courts have clearly established that expert testimony aided by satellite imagery is an acceptable practice.[116] However, as remote sensing and satellite imaging technology becomes increasingly available and accessible for all levels of law enforcement, courts will be forced to address potential constitutional violations. By examining how other jurisdictions have handled advances in technology with privacy rights, one can begin to grasp how U.S. courts may reconcile warrantless satellite surveillance and remote sensing with the Fourth Amendment.

III. AERIAL SURVEILLANCE, THERMAL IMAGING AND CANADA

A. Comparative Constitutional Rights

In both the United States and Canada citizens enjoy the same reasonable expectation of privacy and are afforded constitutional protections against government intrusions.[117] Individuals are protected by the Fourth Amendment, and Section 8 of the Charter of Rights and Freedoms, in the United States and Canada respectively.[118] These two constitutional provisions are nearly identical in scope, both protecting the right to be secure against unreasonable searches and seizures.[119] In both countries, when a court determines that there is no reasonable expectation of privacy in relation to a surveillance technique, there is no

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[115] In *Fullwood* alone the defendant was convicted of: conspiracy to commit mail fraud, violating the False Claims Act, making false statements to the Government, in violation of 18 U.S.C. §§ 371 & 2; making false statements to agencies of the United States, in violation of 18 U.S.C. § 287; mail fraud, in violation of 18 U.S.C. § 1341; and, making false statements in a matter with the jurisdiction of an agency of the United States, in violation of 18 U.S.C. § 1001. He was sentence to nearly three and a half years in prison an ordered to pay $235,000 in restitution. 342 F.3d at 411.

[116] *Id.* at 412; *see also Larry Reed & Sons P'ship*, 280 F.3d 1212.

[117] Steven Penney, *Reasonable Expectations of Privacy and Novel Search Technologies: An Economic Approach*, 97 J. CRIM. L. & CRIMINOLOGY 477, 478 (2007).

[118] *Id*.

[119] *Compare* U.S. CONST. amend. IV ("The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the person or things to be seized."), *with* CANADIAN CHARTER OF RIGHTS AND FREEDOMS § 8 ("Everyone has the right to be secure against unreasonable search or seizure.").

constitutional protection.[120] In such cases, law enforcement officers are free to exploit the technique without first obtaining a warrant. Conversely, when there is a reasonable expectation of privacy, law enforcement must generally obtain a warrant based upon probable cause before conducting a search.[121]

Despite the similarities in constitutional protections, the U.S. and Canadian courts often do not agree on what constitutes a reasonable expectation of privacy. Although the Supreme Court of Canada has never dealt with traditional aerial surveillance, the lower courts have typically rejected the American approach and found a reasonable expectation of privacy.[122] In direct contrast, however, the Supreme Court of Canada moved in the other direction, with regards to warrantless aerial surveillance using an infrared camera, ushering in a new era in law enforcement surveillance capabilities.[123]

B. R. v. Tessling

In 2004, the Supreme Court of Canada examined whether the use of Forward Looking Infra-Red (FLIR) violated the defendant's constitutional right to be free from unreasonable searches.[124] In *R. v. Tessling*, the Royal Canadian Mounted Police (RCMP) began to investigate the defendant in 1999. Based upon information provided by two informants, the RCMP believed that the defendant, Tessling, was producing and trafficking large amounts of marijuana.[125] The indoor production of marijuana typically requires the use of high energy halide lamps, which generate a significant amount of heat.[126] The RCMP contacted the electrical company, but found that the en-

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[120] Penney, *supra* note 117, at 478.

[121] *Id*. at n.4 (noting that in Canada "probable cause" is know as "reasonable and probable grounds.").

[122] *Id*. at 489; *see also R. v. Cook*, [1999] A.B.Q.B. 351 ¶¶55-62 (Alta. Q.B.) (Can.) (holding that unaided visual surveillance of a residential lot from 50 -100 (but not 1,000) feet invades a reasonable expectation of privacy); *R. v. Kelly*, [1999] 169 D.L.R. (4th) 720, 735 – 37 (N.B. C.A.) (Can.) (ruling that unaided aerial surveillance of a residential garden from any altitude invades a reasonable expectation of privacy).

[123] *R. v. Tessling*, [2004] 3 S.C.R. 432 (Can.).

[124] *Id*. ¶3.

[125] *Id*. ¶4.

[126] *Id*.

ergy meter indicated a normal level of usage, and the use of traditional visual surveillance also did not suggest a large scale growing operation.[127]

On April 29, 1999, the investigating police used an RCMP airplane equipped with a FLIR camera to conduct aerial surveillance over the area where the defendant lived.[128] A FLIR camera can measure and record the amount of heat that escapes from a building; it cannot, however see through the external surfaces of a building.[129] The FLIR image only shows a distribution of heat that escapes from a home, which is not discernible to the naked eye.[130] In this case, there was a large amount of heat escaping from the defendant's home, which was believed to be the result of a marijuana growing operation.[131] Based upon the aerial images generated by the FLIR camera and the information provided by the informants, the RCMP obtained a warrant.[132] Upon entering the home, the law enforcement officers found a "large quantity of marijuana, two sets of scales, freezer bags, and several guns."[133] The defendant was charged with several offenses. Tessling contended that the warrantless FLIR overflight constituted an illegal search in violation of his constitutional rights.[134] The defendant further argued that absent a valid warrant for the FLIR images, the evidence obtained inside the house must

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[127] *Id*.

[128] *Id*. ¶5. ("FLIR technology records images of thermal energy or heat radiating from a building. Once a baseline is calibrated, cooler areas show up as darker, and warmer areas are lighter. FLIR imaging cannot, at this stage of its development, determine the nature of the source of heat within the building. It cannot distinguish between heat diffused over an external wall that came originally from a sauna or a potter kiln, or between heat that originated in an overheated toaster or heat from a halide lamp.")

[129] *Id*. (In the U.S. this distinction is know as "off-the-wall" opposed to "through-the-wall" technology.); *see also Kyllo*, 553 U.S. at 41 (Stevens, J., dissenting) (arguing there is a constitutional distinction between "through-the-wall" surveillance that gives the observer direct access to information in a private area and "off-the-wall" surveillance which merely involves indirect deductions from information emanating from the exterior of a home).

[130] *Id*. ¶5.

[131] *Id*.

[132] *Id*. ¶6.

[133] *Id*. ("The street value of the marijuana was between $15,000 and $22,500.").

[134] *Id*.

be excluded, thereby, resulting in insufficient evidence to support a conviction.[135]

At trial the judge found that the use of the FLIR technology was unobjectionable, although even if there was a constitutional problem the evidence ought to be admitted because its exclusion would bring the administration of justice into disrepute.[136] The defendant was convicted and sentenced to six months imprisonment for the possession of marijuana for the purposes of trafficking, six months concurrent for the related drug offenses, and another twelve months for the weapons charge.

Tessling appealed his conviction, contending that the protected privacy interest in the home extends to heat generated inside the home, which is reflected on the outside.[137] The Ontario Court of Appeals noted that the defendant had a reasonable expectation of privacy within his home and the only reasons the RCMP conducted the FLIR overflight was to determine what was happening inside the residence. The court concluded that:

> The FLIR represents a search because it reveals what cannot otherwise be seen and detects activities inside the home that would be undetectable without the aid of sophisticated technology. Since what is being technologically tracked is the heat generated by activity inside the home, albeit reflected externally, tracking information through FLIR technology is a search within the meaning of s. 8 of the *Charter*.[138]

Since the court found that that the FLIR overflight was a serious intrusion into the home, consequently, the evidence found inside the home had to be excluded and the defendant was entitled to acquittal.[139]

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[135] *Id*.

[136] *Id*. ¶7.

[137] *Id*. ¶8; *see also R. v. Tessling*, [2003], 63 O.R. (3d) 1, at ¶33 (Can.).

[138] *Id*. ¶11 (quoting *Tessling*, 63 O.R. (3d) 1, at ¶68); *see also Kyllo*, 533 U.S. at 40 (holding that where the Government uses a device that is not in general public use, to explore the details of the home that would have been unknowable without physical intrusion, the surveillance is a "search and is presumptively unreasonable without a warrant).

[139] *Id*. ¶11.

In review, the Canadian Supreme Court acknowledged that within the home there is no greater expectation of privacy.[140] In addressing where the line of a reasonable expectation of privacy should be drawn, the Court examined whether the technology revealed intimate details of the lifestyle and personal choices of the individual.[141] Since the information generated by the FLIR overflight did not reveal any intimate details, the Court found that, "external patterns of heat distribution on the external surfaces of a house is not information in which the respondent had a reasonable expectation of privacy."[142] While FLIR has the ability to show some of the activities in the house that generate heat that was not enough to reach the constitutional threshold.[143] In concluding that the FILR overflight was a permissible surveillance technique, the Supreme Court of Canada noted that technology must be evaluated according to its current capability, and that courts must deal with technology step by step as it evolves.[144]

IV. THE FUTURE OF REMOTE SENSING IN CRIMINAL LAW

There is no doubt that as technology progresses, courts will be forced to reconcile constitutional privacy rights with the continued advance of law enforcement technology. Recall the Supreme Court's decisions in *Kyllo* and the Canadian Supreme Court's decision in *Tessling*, both of these cases involved the use of infrared imaging, and like many other search technologies the uses and capabilities are developing rapidly.[145] These two cases provide a glimpse into the contrasting approaches courts

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[140] *Id*. ¶22.

[141] *Id*. ¶¶59 – 61 (The reasonableness line must be determined by focusing on the nature and quality of the information which FLIR can actually provide, and then examining the impacts on privacy).

[142] *Id*. at ¶¶62 – 63 (Everything shown in the FLIR images exists on the external surfaces of the building and in that sense FLIR only records information that is expose to the public. Although the information is not available to the public by way of the naked eye, FLIR does not expose the intimate details of the home).

[143] *Id*. ¶62.

[144] *Id*. ¶¶55-66 ("FLIR technology at this stage in its development is non-intrusive in its operations ability and mundane in the data it can produce").

[145] Penney, *supra* note 116, at 511.

have taken to address new technology and constitutional privacy.

A. The Bright-line Rule Approach

The majority opinion in *Kyllo* illustrates how in the United States, the Court has attempted to create a "bright-line rule capable of anticipating future technological developments."[146] The majority explained their rule stating that "obtaining by sense-enhancing technology any information regarding the interior of the home that could not otherwise have been obtained without physical 'intrusion into a constitutionally protected area,' constitutes a search-at least where (as here) the technology in question is not in general public use."[147] The phrase "general public use" is left undefined by the majority, leaving a considerable amount of room for interpretation.[148] In the years since *Kyllo* was decided, infrared cameras have become more affordable and available, and are in use throughout "law enforcement, immigration, military, and civilian applications, including construction, manufacturing, testing and inspection."[149] This leads to the inevitable question of how exactly are courts supposed to determine what sense-enhancing technologies are in general public use?

Some scholars have commented that if a majority of Justices were to ever conclude that satellite technology was generally available to the public, then its use for government surveillance would not constitute a search regulated by the Fourth Amendment.[150] Others have argued that now the Fourth Amendment is "defined solely by the degree of sophistication

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[146] *Id*. at 512; *see also Kyllo*, 533 U.S. at 36 ("While the technology used in the present case was relatively crude, the rule we adopt must take account of more sophisticated systems that are already in use or development.").

[147] *Kyllo*, 533 U.S. at 34 (quoting *Silverman*, 365 U.S. at 512) (citation omitted).

[148] *Id*. at 47, n. 5 (J., Stevens dissenting) (citation omitted) (The dissent in *Kyllo* even argues that the thermal imager used was "readily available to the public for commercial, personal or law enforcement purposes, and is just an 800-number away from being rented from 'half a dozen national companies' by anyone who wants one.").

[149] Penney, *supra* note 116, at 512.

[150] Morgan Cloud, *Pragmatism, Positivism, and Principles in Fourth Amendment Theory*, 41 UCLA L. REV. 199, 262 (1993).

used in the surveillance and the speed by which technological advances become generally disseminated and available to the public."[151] In application, however, lower courts do not merely dwell upon determining whether or not a technology is in general public use; rather the courts also look to whether the technology substitutes for an activity traditionally considered a search under the Fourth Amendment.[152]

A recent Seventh Circuit case, *United Sates v. Garcia*,[153] demonstrates how courts are balancing technological advances and privacy rights in the wake of *Kyllo*. In this case, law enforcement officers placed a global positioning system (GPS)[154] memory tracking unit beneath the rear bumper of the defendant's vehicle.[155] Using the information provided by the GPS device, police were eventually led to the location where the defendant manufactured methamphetamines.[156] Since the police had not obtained a warrant to place the GPS device on the vehicle, the defendant moved to suppress the evidence gained as a result of the GPS tracking device, arguing that it was an unconstitutional search and seizure.[157] The court quickly dismissed the defendant's contention that attaching the GPS device constituted a prohibited Fourth Amendment seizure, because "[t]he device did not affect the car's driving qualities, did not draw power form the car's engine or battery, did not take up room that might otherwise have been occupied by passengers or packages, did not even alter the car's appearance, and in short did not 'seize' the car in any intelligible sense of the word."[158]

The court then determined whether the GPS tracking device constituted a search under the Fourth Amendment. While

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[151] Melvin Gutterman, *A Formulation of the Value and Means of the Fourth Amendment in the Age of Technologically Enhanced Surveillance*, 39 SYRACUSE L. REV. 647, 720 (1988).

[152] *Deal*, supra note 44, at 425.

[153] 474 F.3d 994 (2007).

[154] *Id*. at 995 (These tracking devices receive and store satellite signals that indicate the vehicles location. GPS is a form of navigation, and not sense enhancing technology. This case, however, sheds light on how courts address advancing technology).

[155] *Id*.

[156] *Id*.

[157] *Id*. at 996.

[158] *Id*.

the Seventh Circuit did not specifically address the issue of general public use, the court did note that the tracking device utility was "commercially available for a couple hundred dollars."[159] The court compared the use of the GPS device to the less sophisticated tracking mechanism (a beeper), which the Supreme Court held was not a search.[160] The court even likened the tracking of the vehicle by GPS to observing the route by means of cameras mounted on lamp posts or satellite images, stating that such observances would not be a search under the Fourth Amendment.[161] The court noted the difference between GPS tracking and satellite imaging, but found that this technology was on the same side, "and if what they do is not searching in Fourth Amendment terms, neither is GPS tracking."[162]

The Seventh Circuit, however, made an important distinction between GPS tracking and the thermal imaging device used in *Kyllo*.[163] The court explained that in *Kyllo*, the technology provided a substitute for a form of search plainly governed by the Fourth Amendment, by revealing details of the interior of a home that would not be discovered without physical entry.[164] However, the substitute technology in the *Garcia* case, specifically, following a car on a public street, is explicitly not a search within the meaning of the Fourth Amendment.[165] Finally, the court concluded that GPS tracking was not a search, and that the Fourth Amendment "cannot sensibly be read to mean that

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[159] *Id*. at 995.

[160] *Id*. at 996 (*citing United States v. Knotts*, 460 U.S. 276, 284 – 85 (1983)).

[161] *Id*. at 997 ("If a listening device is attached to a person's phone, or to the phone line outside the premises on which the phone is located, and phone conversations are recorded, there is a search (and it is irrelevant that there is a trespass in the first case but not in the second), and a warrant is required. But if the police follow a car around, or observe its route by means of cameras mounted on lampposts or of satellite imaging as in Google Earth, there is no search. Well, but the tracking in this case was by satellite. Instead of transmitting images, the satellite transmitted geophysical coordinates. The only difference is that in the imaging case nothing touches the vehicle, while in the case at hand the tracking device does. But it is a distinction without any practical difference.").

[162] *Id*.

[163] Deal, *supra* note 44, at 425.

[164] *Garcia*, 474 F.3d at 997.

[165] *Id*.

police shall be no more efficient in the twenty-first century than they were in the eighteenth."[166]

In essence the rule emerging from *Kyllo,* as interpreted by the Seventh Circuit in *Garcia*, is that sense-enhancing technology, which is in general public use, can be employed by law enforcement to substitute for activities traditionally not subject to Fourth Amendment scrutiny. Applying this test to advanced law enforcement activities demonstrates the usefulness of a bright-line rule.

For instance, if a court were faced with determining the constitutionality of satellite surveillance over an individual's property, this rule would provide some level of guidance. First, the court would have to determine if satellite technology is in general public use. Over the years, satellite technology has become quite common.[167] While in *Dow Chemical Co. v. United States,* the Supreme Court, in dicta, stated that satellite surveillance technology not generally available to the public might be constitutionally prohibited, note that this decision was rendered more than two decades ago.[168] Since *Dow*, however, the availability of satellite imaging has grown exponentially, is used every day by millions of people, and could be considered in general public use under *Garcia v. United States*.[169] Therefore, it is possible that satellite imaging could be considered in general public use, thus, fulfilling the first prong of the test.

The second prong of the rule would require the courts to determine if the technology was a substitute for an activity which would traditionally be constitutional.[170] Determining constitutionality under this prong requires a more fact specific analysis. Courts would almost certainly allow satellite imaging to be used over an "open field" because there is a lower expectation of privacy.[171] Moreover, courts have already allowed such images to be admitted into evidence during agricultural fraud cases.[172] If,

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[166] *Id*. at 998.
[167] Deal, *supra* note 44, at 430.
[168] *See supra* note 57, and accompanying text.
[169] *See supra* note 160, and accompanying text.
[170] *Garcia*, 474 F.3d at 997.
[171] *See supra* note 53, and accompanying text.
[172] *See Fullwood*, 342 F.3d at 412.

however, the area under satellite surveillance was a home, there would be a heightened expectation of privacy.[173] Thus, if the satellite imagery revealed any "intimate details"[174] of a home or curtilage, the surveillance would constitute an unconstitutional search.[175] Yet, if the same surveillance was conducted on the curtilage of a home the courts might not find a Fourth Amendment violation.[176] Currently, the available satellite imaging only has a resolution of six inches, and in *Dow,* the aerial mapping camera had a resolution as high as half an inch.[177] Based upon the Supreme Courts definition of "intimate details" articulated in *Dow* and *Kyllo*, it is unlikely that data gathered by satellites could render their use unconstitutional.[178]

Certainly the bright-line rule approach has some benefits in that it provides guidance for courts as they address advances in technology. As the above example demonstrated, it is plain to see how a court might address technology and Fourth Amendment issues. This rule, however, does not provide all the answers in reconciling advancements in law enforcement technology with privacy rights. One particularly troubling issue is the term "general public use," which is both vague and ambiguous. As technology progresses, certain surveillance tools may become more affordable and available to the public; therefore, what was once an unconstitutional search could become constitutional with the passage of time.[179] This type of logic seems to be at odds with the fundamental expectation of privacy, which the Supreme Court had long interpreted as the foundation of Fourth Amendment rights.

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[173] *Kyllo*, 533 U.S. at 33 (*quoting Dow Chemical Co*., 476 U.S. at 237).

[174] In a footnote the Supreme Court defined intimate details as the ability to make out human faces or read documents. *Dow Chemical Co.*, 476 U.S. at 238 n.5 ("[N]or are there any identifiable human faces or secret documents captured in such a fashion as to implicate more serious privacy concerns."). However, this definition was expanded in *Kyllo* to include details which would otherwise be unknowable without physical entry. *See supra* note 9, and accompanying text.

[175] *See supra* note 9, and accompanying text.

[176] *See Riley*, 488 U.S. at 452; *see also Ciraolo*, 476 U.S. at 215.

[177] Deal, *supra* note 44, at 429 ("In fact, the mapping camera used in *Dow* could distinguish widths a low as half an inch, whereas the satellite imagery may only have a resolution of six inches.").

[178] *Id*.

[179] Penney, *supra* note 117, at 512.

B. Evolutionary Approach

In direct contrast to the majority's decision in *Kyllo*, the Supreme Court of Canada ruled unanimously in *Tessling* that the warrantless use of a thermal imaging device was not a search under the meaning of Section 8 of the Canadian Charter of Rights and Freedoms.[180] The Court in *Tessling* distinguished its decision from *Kyllo*, by stating that the issues were not whether the technology was in general public use, or if the police gained information about the inside of the home, "but rather the nature and quality of the information about activities in the home that the police are able to obtain."[181] The Court found that information displayed by the thermal imager showed activities in the home which generated heat but that did not reveal intimate details of the defendant.[182] Since Section 8 protects people not places, there was no reasonable expectation of privacy requiring constitutional protection.[183] The Court concluded that technology must be evaluated by its present capabilities, and that any development in the future must be addressed by the courts, on a case-by-case basis.[184]

The evolutionary approach taken by the Canadian Supreme Court echoes back to the U.S. Supreme Court case *Katz*, where the Court stated that the Fourth Amendment protects people, not places.[185] This approach relies on the deeply rooted common law precept of a reasonable expectation of privacy. In regards to the heat emanating from an individual's home, the Canadian Supreme Court found no reasonable expectation of privacy with the current level of technology.[186] As technology advances, however, the Court acknowledged that "[c]oncerns should be addressed as they truly arise." [187] If one day, thermal imaging has the ability to detect bodies through walls, a court may deem

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[180] *Tessling*, 3 S.R.C. at ¶62.
[181] *Id*. ¶58.
[182] *Id*. ¶62.
[183] *Id*.
[184] *Id*. ¶55.
[185] *Katz*, 389 U.S. at 351.
[186] *Tessling*, 3 S.R.C. at ¶¶55 - 65.
[187] *Id*. ¶55.

that to be an unconstitutional search. The advantage of the evolutionary approach is its ability to adapt to developing technologies.

CONCLUSION

New technologies are being developed and implemented everyday. The improvements that they have made throughout society are immeasurable, from the industrial age to the information age. Sense-enhancing technology has rapidly emerged as an excellent means of law enforcement. Currently, aerial surveillance, thermal imaging and satellite imagery all play a vital role in criminal law. Yet, this technological progress poses a serious threat to privacy, by enabling law enforcement with probative abilities not imagined when the Constitution was ratified.

Over the years the Fourth Amendment has evolved to meet the challenges of advancing technology. The bright-line rule created by the majority in *Kyllo*, has halted the adaptability of the Amendment. By making technologies in general public use constitutional, the Supreme Court has in effect eroded the historical interpretation of privacy under the Fourth Amendment. The fact of the matter is that, even the most advanced technologies will inevitability wind up in the hands of the general public. By attempting to draw a line in the sand, the Court has tied its hands and opened the door for new technologies to strike at the very core of the Fourth Amendment.

Using an evolutionary approach towards advancing technology the Supreme Court could have continued to determine constitutionality based upon a reasonable expectation of privacy. This line of reasoning would have granted the Court the ability to determine the constitutionality of surveillance techniques instead of attempting to predetermine the fate of future technologies with ambiguous terminology. By adopting an evolutionary approach to remote sensing in criminal law the United States courts will allow the Fourth Amendment to "keep pace with the march of science."[188]

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[188] *Garcia*, 474 F.3d at 997.

PROMETHEUS UNBOUND? PROPOSAL FOR A NEW LEGAL PARADIGM FOR AIR LAW AND SPACE LAW: ORBIT LAW

C. Brandon Halstead[*]

I. INTRODUCTION[1]

Despite the "common bond" of flight shared by both air and space travel, these two realms of transit are governed by separate and distinct legal regimes. Since the late 1950's, the boundary between where air flight ends and space flight begins has been much debated, but has yet to be determined. For flights which occur solely within the airspace atmosphere, aviation law or air law has emerged to govern such travel; should those flights cross international boundaries or the high seas, international air law applies. However, missions and vehicles intended for outer space launches are governed by what can be collectively referred to as space law.

Two schools of thought have therefore emerged to distinguish between airspace and outer space. Although there is no scientifically-measurable line of demarcation between these two realms, spatialists wish to establish a clear boundary between State-sovereign airspace and unencumbered outer space. With two separate and distinct legal regimes currently in existence for each region, delimitation and clear establishment of borders should be accomplished once and for all.

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[1] C. Brandon Halstead, *Hybrid Hops On (and Over) the Horizon: The Future Has Arrived, and Requires a New Look at Air and Space Law*, 34 ANNALS AIR & SP. L. 775 (2009) [hereinafter *Hybrid Hops*]. This article takes many of the questions posed in the *Hybrid Hops* cite and provides additional details and solutions to the proposals in the earlier text.

A second school of thought sees airspace and outer space as a continuum where the activity taking place within that realm governs the applicable law. These functionalists believe if the activity is aeronautical, then air law should apply; if the activity is a space-based mission, then space law should apply. In the absence of a clear break point between one region and the other, functionalists believe that the endeavor rather than a random border should determine the appropriate law.

Although air and space transit were inventions of the 20th century, State apprehension over sovereignty and liability are longstanding and deeply-rooted concerns. International air law has only recently modernized[2] its methods for holding air carriers accountable for accidents, whereas space law continues to struggle with inconsistent determinations of liability for damage on Earth versus outer space. Air law also adheres to strict protection of a State's airspace as sovereign territory, while space law emphatically proclaims freedom of outer space as *jus cogens*.

In the early days of space flight, the limited capabilities of space craft and few launching States effectively ignored the academic questions of liability and sovereignty during launch or descent through the air-space realm. However, the recent growth of space commerce is making space more accessible. Modern "hybrid" craft have increased the altitudes and decreased the orbits at which air-space flight is possible, yet defy a clear answer as to which legal regime should apply to them. Accordingly, the questions of liability and sovereignty remain unanswered for flights which operate in both legal realms of air and space. Given the differences in aviation liability and potential State responsibility for public and private space actions, and the conflict between State sovereign airspace and the freedom of outer space, these issues remain at the forefront of State concern.

Rapidly advancing technology and improvements in flight components have brought the worlds of air and space travel closer together than ever before. The historical development of

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[2] Convention for the Unification of Certain Rules Relating to International Transportation by Air, *opened for signature* May 28, 1999, ICAO Doc. 9740 [hereinafter Montreal Convention].

space flight limited such activity to a few State powers. However, technological advancements and an increase in private commerce have brought outer space within reach of businesses, local municipalities, multinational consortiums, and former "non-space-faring States." Commercial enterprise now leads the way in development of new launch and flight systems, often uniting with international conglomerates to create a truly multinational partnership. The evolution in public and private space ventures has seen rapid growth and development of hybrid craft which are able to function both within and beyond Earth's orbit, combining the properties of both air travel and space transport. For example, even older equipment such as the U.S. *Space Shuttle*, and recent inventions such as *SpaceShipOne*,[3] are able to bridge the gap between both airspace and outer space. During much of its ascent and/or descent, such vessels perform like an aircraft, but the ability to ascend above atmospheric limitations and extend flight into outer space appears to qualify as a spacecraft. As these craft combine both air and space transit into one mission, it is uncertain whether air or space legal principles (or both) should apply to the craft, the mission, and its personnel. Accordingly, the increased prevalence of air-space flight systems amplifies the longstanding legal dilemma: how to differentiate between these two mediums of flight, and how to apply the current differing legal regimes to such flights.

Given the growing prevalence and capabilities of hybrid craft, spatialist attempts to establish a boundary line are premature. On the other hand, the buffer between air and space has not only met, but overlapped, thereby defying a functionalist distinction of the mission. It is this dysfunctional and obsolete attempt to bifurcate flights as solely air or space without recognizing that the realms have now been blended, and the corresponding unanswered concerns over liability and sovereignty, which necessitate consideration of a new legal regime for all flights.

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[3] Scaled Composites, LLC, *SpaceShipOne Captures X-Prize*, http://www.scaled.com/projects/tierone/041004_spaceshipone_x-prize_flight_2.html (last visited Dec. 23, 2009).

Because air law and space law have been unsuccessful in distinguishing such hybrid craft as "air" or "space," or in determining which rule(s) of law should be applied throughout its flight, this article introduces a new legal approach to bridge the uncertain gap between airspace and outer space. This new legal paradigm, collectively known as "Orbit Law," proposes to synergize the functional/spatial demarcation of flight and recommend new legal guidelines blended from existing air law and space law. Relying on *orbital status* rather than air-space segregation to determine the applicable legal principles applied to such flight, Orbit Law seems to be the logical moniker for such a regime.

The first premise of Orbit Law begins with the application of existing public and private international air law tenants to suborbital flights only. The next premise of Orbit Law includes the application of current space law treaties to all orbital and inter-orbital flights. Although Orbit Law's maturation will eventually generate its own *corpus juris spatialis internationalis* founded in air law and space law precedence, its genesis must begin from these existing legal foundations before such an evolution may occur.

The need for uniformity across the boundaries of airspace and outer space, with innovative solutions to the longstanding problems of air and space sovereignty and liability will be suggested as a model for the merger of air and space legal systems. This newly-suggested legal paradigm called Orbit Law proposes to distill the best applications from existing air and space treaties and jurisprudence, and slowly siphon these relevant components away from the bifurcated air law and space law regimes into a blended Orbit Law system.

II. CHAPTER I: HISTORY OF AIR & SPACE LAW AND THE "GREAT DEBATES"

"To use an analogy, this notion of Orbit Law might serve as a 'zincir'[4] to unite and strengthen the tapestry of international

[4] A "zincir" is a weaving along the end of a carpet between the warp and the fringes which serves to strengthen the carpet and prevent the pile knots from shifting or drop-

air law and space law, and weave these separate strands of law into one artful composition that covers all forms of flight – a 'magic carpet'," so to speak.[5] However, one divergent segment of this composition which must somehow be harmonized includes the notion of absolute State sovereignty above its territory.[6] Legal scholars have advocated that it was not logical or desirable to extend State sovereignty beyond its airspace, even before the launch of the first satellite on October 4, 1957.[7] Over time, the absence of State protests after satellites crossed over their territory came to be considered "tacit or implied consent or agreement" and the emergence of "free passage"[8] through outer space, which was later incorporated into the 1967 Outer Space Treaty:[9] "Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law . . . ."[10] However, it is also noteworthy that throughout the years of space launches, a number of satellites have passed through other States' *airspace* while going to or coming from space without State protest.[11]

A second major gap in the legal tapestry of aero-space law revolves around the uncertainty of public and private-party responsibility, and the crucial item of liability for space activities. Although the Montreal Convention has provided recent solutions to issues of aviation liability, the twin concepts of overall State *responsibility* for any deviations from the corpus of space

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ping out of the warp. MEHMET ATEŞ, TURKISH CARPETS, THE LANGUAGE OF MOTIFS AND SYMBOLS 20-22 (1995). Literally translated, zincir (pronounced "zin-jer") is a chain, or fetters. H.-J. KORNRUMPH, LANGENSCHEIDT'S UNIVERSAL DICTIONARY, TURKISH-ENGLISH, ENGLISH-TURKISH 196 (Resuhi Akdikmen ed., 1998).

[5] *Hybrid Hops*, *supra* note 1, at 780-81.

[6] Convention Relating to the Regulation of Aerial Navigation, art. 1, Oct. 13, 1919, 11 L.N.T.S. 173 [hereinafter Paris Convention].

[7] *See* Ram S. Jakhu, *International Law Governing the Acquisition and Dissemination of Satellite Imagery*, 29 J. SPACE L. 65, 73 (2003) [hereinafter *Satellite Imagery*].

[8] *Id*.

[9] Treaty of Principles Governing the activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[10] *Id*. at art. 1.

[11] *See* MYRES S. MCDOUGAL, ET AL., LAW AND PUBLIC ORDER IN SPACE 203 (1963) (emphasis added).

law, and ultimate State *liability* for any damage caused by space objects, are likely the most significant and fundamental issues of space transit during this increasing era of public and private space activities.[12] Therefore, for these space endeavors the topic of primary State interest, as well as private enterprise, is liability.[13]

Rapidly evolving technology should not degrade the fundamental protocols of the Outer Space Treaty and other air and space treaties designed to preserve international cooperation.[14] This article will therefore examine the interconnectivity between technological advancements and air-space flight, and the concerns over liability which stem from such progress. Orbit Law's methods for assignment of boundary, responsibility, and liability for all flights, should alleviate much of the apprehension that both States and private entities share regarding transportation between airspace and outer space. Therefore, in order to gain a broader understanding of this synthesis of two separate legal regimes of air and space into one overarching new system, it is necessary to conduct an overview of the fundamental historical premises which form the foundation for Orbit Law.

A. Debate Over the Boundary Between Airspace & Outer Space

The debate on how to distinguish airspace from outer space is as old as the space age itself. The problems emerging from space exploration first entered the agenda of the United Nations in 1957, and were later placed on the agenda before the General Assembly through the establishment of an *Ad Hoc* Committee on the Peaceful Uses of Outer Space (COPUOS) in 1958.[15] Although this Committee initially focused on the debate of disarmament, its status was later made permanent in 1961 while its

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[12] *See generally* FRANS G. VON DER DUNK, PRIVATE ENTERPRISE AND PUBLIC INTEREST IN THE EUROPEAN 'SPACESCAPE' – TOWARDS HARMONIZED NATIONAL SPACE LEGISLATION FOR PRIVATE SPACE ACTIVITIES IN EUROPE 25 (1998).

[13] *Id*. at 24.

[14] *See* Eilene Galloway, *Space Law in the 21st Century*, 26 (2) J. SPACE L. 187, 190-91 (1998).

[15] *See generally* MANFRED LACHS, THE LAW OF OUTER SPACE – AN EXPERIENCE IN CONTEMPORARY LAW-MAKING 30 (1972).

charter was expanded to include examination of all issues relating to the field of exploration and use of outer space by governmental and non-governmental organizations.[16] In 1962 the Scientific and Technical Sub-Committee and Legal Sub-Committee began their true substantive work and became the main center of international cooperation and coordination for exploration of peaceful uses of outer space.[17] Successive sessions focused on general and specific issues of space law, including the establishment of a frontier between outer space and atmospheric space.[18]

However, one of the early problems encountered by these Committees emerged from the fact that there "exist no physical bases which might be used as a sound[scientific] reason for defining a boundary between air space and outer space."[19] Although a great variety of various physical phenomena have been analyzed over the years, including "state of matter," "gravitational field," "electromagnetic," "geometrical/geographical," "biological/environmental," and "technological" bases for demarcation, no scientifically based boundary has been discovered.[20] Arguments for a "physical boundary" versus a "functional boundary" therefore emerged to address the legal status of various space activities.[21]

However, COPUOS did not initially believe that the boundary problem deserved a priority consideration at that time because the absence of such demarcation did not create any serious problems.[22] Both space powers (the U.S. and U.S.S.R.) did not believe it was in their interest to establish boundaries which might restrict their freedom to operate in space, whether for

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[16] *Id*. at 30-31.

[17] *Id*. at 30.

[18] General Assembly, *Report of the Legal Subcommittee*, pp. 3-9, U.N. Doc. A/AC.105/6 (July 9, 1962) (28 May – 20 June 1962).

[19] *See generally* S. Mishra & T. Pavlasek, *On the Lack of Physical Bases for Defining a Boundary Between Air Space and Outer Space*, 7 ANNALS AIR & SPACE L. 399, 412 (1982).

[20] *Id*.

[21] *Id*.

[22] *See* Ram S. Jakhu, *The Legal Status of the Geostationary Orbit*, 7 ANNALS AIR & SPACE L. 333, 336 (1982) [hereinafter *Geostationary Orbit*].

peaceful or military purposes.[23] At the other end of the spectrum, though, early scholars noted that even a UN resolution urging free use of outer space did not infer "a legal right for any State to propel its spacecraft through the national airspace of . . . other State[s] merely to ascend or descend from free outer space . . . ."[24] "International law has never accepted the view" that a right of transit passage through one medium automatically carries with it the same right through other areas as well.[25] Therefore, the debate over a boundary between airspace and outer space was not simply theoretical, but embodied a conflict between exclusive State sovereignty over airspace, and freedom of outer space.[26] The height of any upper boundary of national airspace would be a limiting factor in the development of orbital flight, and unless the boundary was established fairly close to Earth's surface, few States would be able to launch or receive a satellite in its national territory without passing through the national airspace of other States.[27] Thus with the advent of the space age, the stage was also set for a conflict between traditional international law, which was developed by a relatively small number of countries on the basis of strict observation of sovereignty, versus international space law, which was developed by the international community as a whole on the basis of international cooperation and co-sharing of international resources.[28]

B. Examination of the Spatial Approach

Different and inconsistent legal regimes therefore emerged over the boundary between air space and outer space, which

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[23] *Id*.

[24] John Cobb Cooper, *Legal Problems of Spacecraft in Airspace, reprinted in* EXPLORATIONS IN AEROSPACE LAW – SELECTED ESSAYS BY JOHN COBB COOPER 1946-1966 305, 310 (Ivan A. Vlasic ed., McGill University Press 1968) (1964).

[25] *Id*. at 310.

[26] Ram S. Jakhu, *Application and Implementation of the 1967 Outer Space Treaty, in* PROCEEDINGS OF THE FORTIETH COLLOQUIUM ON THE LAW OF OUTER SPACE 442, 443 (1997) [hereinafter *1967 Outer Space Treaty*].

[27] Cooper, *supra* note 24, at 311.

[28] *See* Ram S. Jakhu, *Developing Countries and the Fundamental Principles of International Space Law, in* NEW DIRECTIONS IN INTERNATIONAL LAW 351, at 363 (R. G. Girardot, et al. eds., 1982) [hereinafter *Developing Countries*].

still represents the longest unresolved legal problem of the UN COPUOS Legal Subcommittee.[29] One school of thought stressed the need for a clear internationally agreed upon boundary between the two regions, thereby regulating activities according to the place where they occurred – the so-called "spatial" approach to standardization.[30] "Spatialists stress[ed] the need for clear demarcation between airspace and outer space," as each country exercised complete and exclusive sovereignty over its territory, while outer space remained "free for exploration and use by all States."[31] Delimitation remains necessary to provide and facilitate application and development of outer space law, to define the upper limit of State sovereignty and safeguard national air space, and avoid State disputes over such boundaries.[32]

Some scholars proposed a "new international convention fixing the height of the upper boundary of national territorial airspace."[33] Forty kilometers was originally estimated to be the maximum height to which normal aircraft could be flown, while 80 kilometers represented the approximate upper limit of aerodynamic lift.[34] One hundred twenty kilometers was also proposed as an early estimate of "the lowest practical altitude of free orbital flight."[35] This later notion gained support in 1968 from the International Law Association, who proposed that the term "outer space" should include "all space at and above the lowest perigee achieved" by any satellite put into orbit as of 27 January 1967 (the date when the Outer Space Treaty was opened for signature).[36] This same association later recognized that an altitude of 100 km had been "growingly acknowledged by States" and space experts as "outer space."[37]

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[29] *1967 Outer Space Treaty, supra* note 26, at 443.

[30] *Id*.

[31] *Geostationary Orbit, supra* note 22, at 338.

[32] *Id*.

[33] Cooper, *supra* note 24, at 311.

[34] *Id.* at 311-12.

[35] *Id.*

[36] International Law Association, *Report of the Fifty-Third Conference Held at Buenos Aires – August 25th to August 31st, 1968*, 53 INT'L L. ASS'N REP. CONF. xxii (1969).

[37] International Law Association, *Report of the Fifty-Eighth Conference Held at Manila – August 27th, 1978 to September 2, 1978*, 58 INT'L L. ASS'N REP. CONF. 2 (1980).

Through the years a demarcation has been tacitly acknowledged and variously based on the lowest altitude at which Earth orbit can be maintained by a satellite, a somewhat randomly selected altitude of 100 kilometers, or an *a priori* notion regarding how little air might exist before a sector is deemed "outer space" and not "airspace."[38] Many States which were formerly proponents of the functionalist approach gradually shifted their beliefs over the years. One such shift occurred within the Soviet Union, a former functionalist State, when they published a working paper in 1979 proposing an "Approach to the Solution of the Problems of the Delimitation of Airspace and Outer Space."[39] This tripartite proposal stated that the region above 100 (110) kilometers altitude above sea level is outer space, that this boundary between airspace and outer space should be established by treaty, and that States' space objects shall retain the right of overflight at altitudes lower than 100 (110) kilometers for the purpose of reaching orbit or returning to the launching State.[40]

The U.S.S.R. reiterated this approach in a 1983 working paper as well. Once again they recommended that "outer space" should be established at an altitude not exceeding 100 kilometers and confirmed by an international agreement.[41] The right of innocent (peaceful) passage over other State territories at altitudes below 110 kilometers would also be recognized in this proposed instrument.[42]

But in the twenty years that followed these proposals, little progress was made in resolving the boundary problem. In 2003, the Report of the Legal Sub-Committee of COPUOS revealed that this Committee continues to struggle with the same defini-

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[38] *See* Martine Rothblatt, *Legal Aspects of Geostationary Platforms in the Stratosphere*, *in* AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS 1 (1999).

[39] *See* Bin Cheng, *The Legal Regime of Airspace and Outer Space: The Boundary Problem Functionalism Versus Spatialism: the Major Premises, in* STUDIES IN INTERNATIONAL SPACE LAW 425, at 427 (Bin Cheng ed., 1997).

[40] *Id.*

[41] Union of Soviet Socialist Republics: Working Paper, U.N. Doc. A/AC.105/C.2/L.139 (April 4, 1983) [hereinafter U.S.S.R. Working Paper].

[42] *Id.*

tional problems presented decades earlier.[43] Despite the reestablishment of a Working Group to address "Matters Relating to the Definition and Delimitation of Outer Space," little headway has been made to find an approach suitable to all delegates.[44] While some delegations expressed the view that a "functional approach should be taken in relation to the exploration and use of outer space," others believed that such an approach would have a negative impact on State sovereignty over national airspace.[45] Other delegates also expressed support for the delimitation of outer space at an altitude of 100-110 kilometers and the right of innocent passage during space launches and returns to Earth[46] – the same proposal championed by the former Soviet Union many years before. Given the lack of agreement on such issues, delegations continued to express concern that the "lack of a definition and delimitation of outer space would bring about legal uncertainty with regard to space law, which provided that outer space was free for exploration and use by all States, and air law, which provided for sovereignty over national airspace."[47]

Australia has fully embraced the spatial approach as one of the first countries to use domestic legislation to set a particular altitude as the official boundary between airspace and outer space.[48] As part of its official legislative definitions, "launch," "launch vehicle," "return," and "space object" each incorporate specific references to objects and/or payloads which exceed a distance "of 100 km above mean sea level."[49] These specific references setting 100 km as the official boundary were added to the original 1998 Act through the Space Activities Amendment Act 2002,[50] due in part because the former "lack of a precise

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[43] *See* U.N. Comm. on Peaceful Uses of Outer Space [COPUOS], Legal Subcomm., *Report of the Legal Subcommittee on the Work of Its Forty-Second Session, Held in Vienna from 24 March to 4 April 2003*, ¶¶ 77-82, U.N. Doc. A/AC.105/805 (Apr. 10, 2003).

[44] *Id.* ¶ 8(b).

[45] *Id.* at Annex II, ¶ 5-6.

[46] *Id.* at Annex II, ¶ 7.

[47] *Id.* ¶ 77.

[48] Space Activities Act 1998, Austl. Acts No. 123 (1998), *available at* http://www.unoosa.org/oosa/en/SpaceLaw/national/australia/space_activities_act_1998E.html [hereinafter 1998 Act].

[49] *Id.* § 8.

[50] Space Activities Amendment Act 2002, Austl. Acts No. 100, §§ 2-5 (2002), *available at* http://www.austlii.edu.au/au/legis/cth/num_act/saaa2002247/.

definition of the term 'outer space' had led to uncertainties with respect to what launch activities were covered by the Australian *Space Activities Act* of 1998."[51]

South Africa has also taken a similar approach in its division of air from space through official domestic legislation.[52] But rather than setting a particular altitude as the breakpoint between one region and another, the South African law instead simply defines outer space as "the space above the surface of the Earth from a height at which it is in practice possible to operate an object in an orbit around the Earth."[53] Ironically this boundary effectively sets outer space at the point of lowest perigee of a satellite, which in some instances could be at altitudes of as low as 80 km for highly-elliptical orbits – a location much lower than that (100 km mark) traditionally favored by the spatial approach.[54] It is also worth noting that the South African definition for *suborbital* flight includes "the trajectory of any object which leaves the surface of the earth due to a launch, but returns to the surface of the earth without completing an orbit around the earth."[55] The South African approach might represent an initial fledgling solution to functional-spatial differences, as the orbital components of these definitions are one precursor for solving the problems of an air-space boundary, and in fact comport precisely with the notions of Orbit Law proposed and explained later in this article.

The European Union (EU) also appears to be favoring the spatialist approach in recent legislation. In a recent EU Council Regulation referencing "space qualified" materials, items which are launched to heights of 100 km or more qualify for this special status.[56] "'Space Qualified' refers to products designed, manufactured and tested to meet the special electrical, me-

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[51] Peter van Fenema, *Suborbital Flights and ICAO*, 30 AIR & SP. L. 396, 398 (2005).

[52] *See* Space Affairs Act, JSRSA No. 84 of 1993 (1993) (S. Afr.), *available at* http://www.space.gov.za/docs/Space_Affairs_Act_84_of_1993.pdf.

[53] *Id.* § 1.

[54] Peter van Fenema, Lecture at the Faculty of Law, McGill University: Law of Space Applications (Mar. 19, 2007) (on file with author).

[55] Space Affairs Act, *supra* note 52, § 1.

[56] Council Regulation 1334/2000, Setting Up a Community Regime for the Control of Exports of Dual-Use Items and Technology, 2000 O.J. (L 159), Annex I, 25.

chanical or environmental requirements for use in the launch and deployment of satellites or high altitude flight systems operating at altitudes of 100 km or higher."[57] Although there are currently no other known domestic instances of official spatial demarcation by European States, this action by the EU Community represents a significant, and perhaps premature, step towards "uniformity" which might bind and limit its members in future air/space activities. For each of those States which side with the spatial approach, all activity falling below that ultimate boundary between air and space is no longer protected by the "freedoms" of space.[58]

C. Examination of the Functional Approach

The second approach which emerged to offer guidance across the expanse between airspace and outer space saw no need for boundaries, because all activities should instead be regulated according to their nature and purpose rather than a location of occurrence – a "functional" determination of applicable law.[59] These proponents found nothing "magic" about an altitude of 100 kilometers or fractions of difference in air pressure, and instead believed that law should be based on function and desired result, not happenstance coordinates.[60] For example, if an object were able to function like a satellite as a result of helium pressure instead of orbital mechanics, it should be treated like a satellite.[61] Functionalists saw no need to establish a fixed boundary, as airspace and outer space existed as a continuum in which the *activity* should dictate the law governing it – aeronautical activities governed by aeronautical law, and space activities by space law.[62] Some early authors predicted that adherence to "fixed lines or putative horizontal sheets" cre-

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[57] *Id.*
[58] *See* Outer Space Treaty, *supra* note 9, arts. I, II.
[59] *1967 Outer Space Treaty*, *supra* note 26, at 443.
[60] Rothblatt, *supra* note 38, at 4.
[61] *Id.*
[62] *Geostationary Orbit, supra* note 22, at 337-38.

ated legal difficulties, and that this problem would eventually "transform itself from one of boundaries to one of activities. . ."[63]

While this functionalist prediction had the initial support of a number of States, including both major space powers, its emergence as a unifying policy never came to pass.[64] But a number of States including the United States, United Kingdom, and Federal Republic of Germany continued to argue against the imposition of a fixed boundary between airspace and outer space.[65] The inability of most countries to monitor such a boundary; inadequate examination of relevant scientific, legal, technical, and political factors; and potential inhibiting effect that a fixed boundary might impose on future space use and exploration negated any boundary-based justifications.[66]

During the evolution of space flight, no State ever objected to the overflight of artificial Earth satellites above their territories, during which time some craft ascended and descended through the territorial air spaces of different States.[67] Therefore, some scholars proposed that such passage coupled with the cardinal freedom of exploration and use of outer space appeared to have created a limited international custom.[68] Analysis of this implied freedom to go into outer space and return to Earth while traversing foreign airspace led those authors to support the functionalist cause.[69] If an aerospace object was used for the primary purpose as a device operating in outer space, space law should apply to it.[70] Stephen Gorove summarized it thusly:

> Once the primary purpose of the object is determined, the corresponding legal regime applicable to it should continue to be applied for the duration of the object's flight, whether in the airspace or outer space, at a particular time. Attempting to

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[63] Cheng, *supra* note 39, at 425-26 (citing Leon S. Lipson & Myres S. McDougal, *Perspectives for a Law of Outer Space in* STUDIES IN WORLD PUBLIC ORDER 937 (Myres S. McDougal, ed., 1987)).

[64] *See id.* at 426-28.

[65] *Id.* at 428.

[66] *Id.*

[67] *See* Stephen Gorove, *Aerospace Object – Legal and Policy Issues for Air and Space Law*, 25(2) J. SPACE L. 101, at 109 (1997).

[68] *Id.* at 110.

[69] *See id.* at 110.

[70] *Id.*

> proceed otherwise would lead to conflicting interpretations with respect to the applicable law and would greatly confuse the problem.
>
> If the primary function of the aerospace object was to operate as a spacecraft, then air law would not be applicable to it except in situations in which the craft returns in a non-accidental situation to a non-launching state. Aerospace objects launched into outer space are subject to the rules governing the registration of objects so long as the primary purpose of the object has been to operate as a spacecraft. Such an object should be governed by the national laws of the launching state, or if it was launched from a platform in outer space, it should be governed by outer space rules. As long as the object's primary function was to operate as a spacecraft – its safe passage to and from outer space has now attained the status of international customary law.[71]

Although the functionalist approach appears to bestow more potential freedoms on those activities destined for space, it still fails to successfully address dual-use (airspace-outer space) craft mentioned elsewhere in this article, and leaves other questions such as the extent of State-sovereign airspace unanswered.

D. Common Issues to Both the Functionalist and Spatialist Approach – State Sovereignty

Despite the apparent contradictory methods of division between airspace and outer space, it should be noted that the notion of a physical boundary examines physical *conditions*, while the functional boundary approach analyzes physical *applications*.[72] Both methods of analysis are therefore "physical" and represent no real difference between the two – there is merely a change in vantage point and perspective.[73] The attempt to impose a boundary is therefore an arbitrary and artificially-conceived decision with no physical foundation behind it, but

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[71] *Id.*
[72] Mishra & Pavlasek, *supra* note 19.
[73] *Id.*

has nonetheless emerged as a result of social, cultural, economic, historical, and political forces influencing the perception that a definition or differentiation between airspace and outer space is needed.[74]

The aforementioned issue of State sovereignty has been one of the primary reasons for the perceived need for a boundary. At one end of the spectrum are scholars such as Cheng, Dembling, and Terekhov, who do not believe customary international law allows free passage of aerospace objects through sovereign airspace – State sovereignty reigns supreme.[75] Other scholars have taken a middle-ground approach recognizing limited incursions by space objects into State airspace, while Finch and Christol have asserted the outright existence of such a right of passage.[76]

It should not be surprising that the International Civil Aviation Organization (ICAO) was brought into the debate in recent years as well. In 1986, a Draft Brief for the ICAO Observer to the Legal Sub-Committee of the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS) was prepared and of particular interest to ICAO.[77] As the Legal Sub-Committee continued to examine the definition and delimitation of outer space and the character and utilization of the Geostationary Orbit, a study of the Chicago Convention and other international air law instruments was recommended.[78] Because ICAO's input was confined to factual information on the Chicago Convention with respect to the concept of airspace, it did not formulate any specific policies to be presented to COPUOS. ICAO did bring to the attention of the Legal Sub-Committee that ICAO was "responsible for developing the position of international civil aviation in all matters related to the study of questions involving the use of space technology for air navigation purposes" and "for stating the position of international civil aviation on all

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[74] *See id.* at 412-13.

[75] Gorove, *supra* note 67, at 109.

[76] *Id.*

[77] Draft Brief for the ICAO Observer to the Legal Sub-Committee of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), C-WP/8158 15/1/86 (Jan. 15, 1986) [hereinafter Draft Brief for the ICAO Observer].

[78] *Id.*

related outer space matters."[79] As such, ICAO came to a highly noteworthy finding in its interpretation of the Chicago Convention and international air law to be presented to the Legal Sub-Committee of UNCOPUOS: "The right of innocent passage of spacecraft through the sovereign airspace is a proposal *de lege ferenda* (i.e. a legislative proposal not reflecting the existing law); such right *does not exist* under the present international law of the air; an unconditional right of passage through the sovereign airspace does not exist even with respect to civil aircraft and is specifically subject to special authorization with respect to State aircraft and pilotless aircraft."[80]

UNCOPUOS also submitted a number of questionnaires to various States in an effort to refine the legal status of aerospace objects.[81] The insights and recommendations offered by this diverse group of States yielded significant legal observations. State sovereignty versus freedom of space remained at the forefront of these studies, while several States' analysis appeared to support a functionalist position. For example, the Czech Republic observed that there has not yet been sufficient support for the right of innocent passage of ascending or descending space objects to recognize it as a customary rule of international law.[82] However, they did highlight that no protests against such passage have occurred, and that an explicit admission and eventual regulation of truly innocent passage should be considered.[83] Accordingly, the norms of national and international air law would only be applicable to aerospace objects whose purpose was aeronautics, not aerospace vehicles which would be considered space objects.[84] The Czech Republic also concisely summarized liability issues for both regimes – aircraft liability being governed by international treaties and some national law, and attributable to private persons; whereas space object liability is governed by

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[79] *Id.*

[80] *Id.* (emphasis added).

[81] *See* U.N. GA Questionnaire on Possible Legal Issues with Regard to Aerospace Objects: Replies from Member States, U.N. Doc. A/AC.105/635 (1996) [hereinafter U.N. GA Questionnaire].

[82] *Id.* at 10.

[83] *Id.*

[84] *Id.*

international law and attributable to international persons.[85] Unfortunately, due to problems with the extent and bases of liability, jurisdictional concerns, and myriad other differences between aircraft and spacecraft flights and registration, the Czech Republic believed the likelihood of establishing a legal regime to govern such air and space activities was remote.[86]

Despite Russia's former transition from a functionalist approach to an apparent belief in the spatialist system,[87] many of its questionnaire answers seemed to revert back to functionalist frames of reference. They, too, believed that the issue of paramount importance was whether or not procedures should be brought into effect for regulating and notifying States of the passage of aerospace objects through the airspace of its territory.[88] However, the legal regime applicable to such flights must differ according to its purpose; for aerospace objects undertaking an Earth-to-Earth mission without entering outer space, international air law would apply.[89] Objects undertaking an Earth-orbit mission would fall within the jurisdiction of international space law.[90] As discussed later in this article, these recommendations are quite similar to the proposals for an orbital law system. But the Russians distinguished their recommendations for aerospace objects based on the object's designation, i.e. whether the object was a transportation system intended for carrying payload from one Earth-point to another, or whether it was designated to be launched into outer space.[91] While the object's intent or designation will play a role in the new Orbit Law proposals, other factors will also influence the application of appropriate legal standards.

Germany remained true to its functionalist roots in their answers to the questionnaire. Preferring the term "space transportation system" to the ambiguous and yet-defined term "aerospace object," Germany's delegates believed that space transpor-

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[85] *Id.* at 6-7.
[86] *Id.*
[87] *See* Cheng, *supra* note 39, at 427; *See also* U.S.S.R. Working Paper, *supra* note 41.
[88] U.N. GA Questionnaire, *supra* note 81, add. 1, at 4.
[89] *Id.*
[90] *Id.*
[91] *Id.*

tation systems were space objects and subject to international space law throughout its flight through airspace and outer space.[92] They also concluded that elaboration of a common legal solution for space objects re-entering the airspace of foreign States is appropriate, as sovereignty remained a particular concern of many other legal regimes.[93] An interesting portion of the German analysis included references to the flight of the U.S.S.R. spacecraft *Buran* in 1988. Because the craft's trajectory and re-entrance into Baikonur apparently took it through the airspace of Turkey, this flight provided some precedence for overflight of a space object with no known (Turkish or other) State objection to such territorial infringement.[94] Although the delegation was quick to point out that no customary international law exists since the one and only known precedent of the *Buran* overflight did not constitute international *practice*,[95] this event remains an important factor in the evolution of air and space law and highly relevant to proposals for an Orbit Law system.

Russia referenced a very similar instance of international overflight by a space object in their delegation's response to this questionnaire. Regarding precedents for the passage of aerospace objects re-entering Earth's atmosphere, Russia referred to the flight of the U.S. *Space Shuttle Atlantis* in March 1990.[96] A few hours before the *Shuttle*'s trajectory would bring it over certain eastern regions of the U.S.S.R., the United States furnished data about its planned flight to the Soviet Union as a matter of courtesy and on the basis of goodwill.[97] However, Russia indicated that the fact that such information was furnished should not be deemed to set a precedent.[98]

The absence of other State responses to this questionnaire due to the limited number of relevant and noted flights does not support a right of passage for ascending or descending space

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[92] U.N. GA Questionnaire, *supra* note 81, at 3.
[93] *Id* at *5*.
[94] *Id* at 7, 11.
[95] *Id* at 11.
[96] U.N. GA Questionnaire, *supra* note 81, at 6-7.
[97] *Id.*
[98] *Id.* at 7.

objects as a customary rule of international law.[99] But as previously mentioned, several States including Germany and Russia explicitly stated that a right of *innocent* passage which was not prejudicial to the peace, good order, or security of subjacent States *should* be considered as a way to legalize the actual practice, while support for customary international law enabling passage of aerospace objects after re-entry into Earth's atmosphere was evolving.[100] It is also momentous that these two episodes referenced in the questionnaires represent uncontested overflights into State airspace by space objects (i.e. *Space Shuttles*) designed for the transport of astronauts, and not simply satellite overflights. Although the *Buran* flight was unmanned,[101] its ability to carry passengers marries well to the Russian emphasis of examining the space object's designation as a sub-orbital or space-bound transportation system for cargo and/or passengers.[102]

There also appear to be additional instances of overflight, but few details on the particulars of those launches, from the Russian cosmodrome of Baikonur. The cosmodrome, which is 125 kilometers (75 miles) long and 85 kilometers wide, borders the Syr Daria river in southwestern Kazakhstan and is wholly administered by Russia,[103] but is described as not allowing due-east launches (the most efficient) due to lower stages impacting China.[104] Although no details could be found describing former eastern launches which may have crossed Chinese airspace, or lower stages of launch vehicles landing in China, these descriptions and the current prohibition against such launch trajectories tends to support their occurrence at some point in previous launches. Of equal significance is the fact that no record of

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[99] Gorove, *supra* note 67, at 108.

[100] *Id* (citing U.N. GA Questionnaire, *supra* note 81, at 4-5).

[101] Felicity Barringer, *Soviet Space Shuttle Orbits and Returns in Unmanned Debut*, N.Y. TIMES, Nov. 16, 1988, at A1.

[102] U.N. GA Questionnaire, *supra* note 81, at 4.

[103] *Russia, Kazakhstan extend Baikonur cosmodrome lease to 2050*, SPACEDAILY.COM (Sept. 12, 2004), http://www.spacedaily.com/2004/040109151358.forhgci8.html.

[104] Rocket & Space Technology, *World Space Centers*, http://www.braeunig.us/space/center.htm (last visited Apr. 26, 2010).

Chinese protests over such launches or impacts could be found either.

In the Republic of Korea's U.N. General Assembly questionnaire responses regarding aerospace objects, they also acknowledged the special problems that "sovereignty over airspace, aerial safety and so on" posed during the flight of an aerospace craft, and recommended that the "spatial approach has more merit than the functional approach under the present international legal system because the former can more easily decide the law to be applied."[105] Their observations also included a considerably different approach to objects passing through other State airspace when entering or leaving orbit, recommending that international air law or the relevant State's domestic law be applied to the space object to address any problems of sovereignty or security.[106] The Korean delegation also believed that simply because countries did not raise any objection to the passage of space objects over their airspace did not signify approval of such passage as international practice or precedence; rather, they speculated that those States simply did not have information about the passage and there was no perceptible disadvantage with such passage at that time.[107]

In a more recent related case of overflight concerns, the U.S. and Canada engaged in diplomatic negotiations regarding the planned launch of a rocket scheduled to fly over the area of Newfoundland.[108] Canadian officials expressed concern over the planned 2005 launch of a *Titan IV* missile by the U.S. Air Force from Cape Canaveral, Florida after learning that its flight path would take the missile over the Grand Banks off Newfoundland.[109] Fearing that debris from the launch would endanger Canadian oil platforms in this area, officials from Ottawa contacted the United States government and obtained an "indefinite

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[105] U.N. GA Questionnaire, *supra* note 81, at 5.

[106] *Id.*

[107] *Id* at 6.

[108] *Missile Test Delayed After Sparking Scare at Oil Platforms*, CBC NEWS CANADA, Apr. 8, 2005, http://www.cbc.ca/canada/story/2005/04/07/nfld-oil-050407.html [hereinafter *Missile Test*].

[109] *Id.*

delay" for such testing.[110] However, it is important to note that the basis for the Canadian objection stemmed from concerns over the potential hazard posed by falling debris from the launch to the Hibernia and Terra Nova oil platforms – debris which included a 10-ton solid rocket booster which was estimated to fall in an area within 27 kilometers of the Hibernia oil rig.[111]

As negotiations continued between the two governments, Canada ultimately capitulated and withdrew their objections to the launch after receiving "written assurances that any risk to offshore activity has been mitigated."[112] After receiving "precise assurance[s] . . . that the US Air Force would be able and prepared to destroy the rocket in the unlikely event that unforeseen circumstances arise that could result in the rocket booster falling outside of the identified safety zone," Deputy Prime Minister and Minister of Public Safety and Emergency Preparedness Canada Anne McLellan provided officials in Newfoundland written declarations that all safety mechanisms were in place to protect all offshore operations.[113] The launch ultimately occurred on April 30, 2005 without incident.[114]

There was no objection noted by Canadian officials that such a launch would be in violation of Canadian airspace, but simply concerns by Newfoundland and Labrador premier Danny Williams that the rocket could cause damage to the oil platforms if it dropped any debris.[115] Given the distance between Cape Canaveral and Newfoundland for this projected polar launch, it is highly unlikely that the rocket's trajectory and altitude obtained by the time it overflew the Grand Banks would still be in an area possibly considered to be Canadian airspace (less than 100 km). Therefore, this episode of diplomatic

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[110] *Id.*

[111] *Id.*

[112] Press Release, Government of Newfoundland and Labrador- Canada, Premier Williams Pleased to Receive Requested Assurances from Federal Government on Safety of Offshore Vessels During Launch of Titan IV Rocket (Apr. 14, 2005), http://www.releases.gov.nl.ca/releases/2005/exec/0414n02.htm.

[113] *Id.*

[114] *Controversial U.S. Rocket Launches as Planned,* CTV NEWS, Apr. 30, 2005, http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/1114869332393_5/?hub=TopStories.

[115] *Id.*

negotiations for space object overflight can be distinguished by concerns over safety rather than sovereignty. Although State interests in safety are also often linked with matters of sovereignty, in this instance corporate concerns raised to the Canadian government prompted the Canadian-U.S. intervention.[116]

E. Common Issues to Both the Functionalist and Spatialist Approach – Liability

Although later sections of this article will more closely examine the bases and solutions for *liability* in air and space flights, it is useful to first examine the topic from the shared perspective of a functional-spatial interest. By looking at the risks of error and concerns over accountability shared by all flight participants regardless of location or function, one might gain valuable insight into possible solutions to this financial burden and danger shared by all who fly in air or space.

Various commercial industries have increased their involvement in space activities which were formerly under State control, such as space transportation, satellite communications, remote sensing, and even commercial launch ventures.[117] However, such developments create unanswered questions about the accession of international organizations to the existing body of space law, and issues of responsibility and liability for private operators.[118] Unfortunately, the development of space law in this area remains sluggish, with little to no enthusiasm to rewrite or codify international principles and rules to address these new developments.[119] Not only have "major [State] players in space politics" been reluctant to create too stringent a body of space law, but new commercial players have also resisted the introduction of a legal framework they consider to be an artificial barrier to their activities.[120] It therefore remains debatable

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[116] *See Missile Test*, *supra* note 108.

[117] Peter Jankowitsch, *The Role of the United Nations in Outer Space Law Development: Past Achievements and New Challenges*, 26(2) J. SPACE L. 101, at 108 (1998).

[118] *Id.*

[119] *Id.*

[120] *Id.* at 109.

to what extent economic globalization can safely and successfully continue without some degree of regulation.[121]

This stagnation of *corpus juris spatialis internationalis* represents the single most important gap opening up in international space law proper: the absence of regulation of economic and commercial aspects of space activities.[122] Because the fundamental freedom to undertake space activities applies to private space activities also, the related obligations of Article VI of the Outer Space Treaty of authorization and continuing supervision should be a principle concern for States.[123] However, these obligations and their connection to liability in Article VII (as well as indirectly in Article VI) and the Liability Convention constitute only a minor part of the body of space law.[124] Despite the devotion of these treaty areas to this subject, this category has received very little elaboration through the years, while State implementation at the national level has taken rather different directions.[125]

The exclusive character of State liability and responsibility would seem to necessitate careful regulatory measures at the national level.[126] National legislation is indispensable in implementing international space law; indeed a number of rules on the public international level call for national implementation by individual States vis-à-vis the non-governmental entities under their jurisdiction.[127] And the twin concepts of responsibility and liability should prompt States to take domestic action to monitor and control those activities for which they could be held accountable at the national level.[128] Frans von der Dunk emphasized the importance of such State action when he stated:

> Only once such States have taken up the baton and indeed have started to exercise some substantial measure of authorization and supervision – in other words: jurisdiction – the

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[121] *Id.*
[122] *See* VON DER DUNK, *supra* note 12, at 24.
[123] *See generally id.* at 25.
[124] *Id.*
[125] *Id.* at 24.
[126] *Id.*
[127] *Id.*
[128] *Id.* at 25.

> question becomes acute for private enterprise, whether this freedom has also been translated on the national and private level.[129]

The Convention on the International Liability for Damage Caused by Space Objects (Liability Convention)[130] and the Outer Space Treaty[131] set no limits on the amount of potential compensation for damages caused by space activities. The liability system therefore provides relevant States the choice either to transfer this unlimited liability to the private entities to be licensed (and thereby making it largely impossible for private enterprise to take insurance), or to establish a limit of reimbursement nationally (acting as a re-insurer for damage claimed internationally above the national limit).[132] While some States have maintained jurisdiction over private entities through the establishment of a national licensing system for space activities,[133] a number of States have not yet taken any legislative activities to regulate those private activities for which they might be held responsible and/or liable at the international level.[134] Accordingly, accountability at the international level suffers from considerable uncertainties and inconsistencies.[135]

Von der Dunk argues that States are obviously the best controllers of private enterprise, possessing the legislative machinery to monitor and enforce compliance with established norms.[136] However, he believes that international legislation is necessary to define the parameters and scope within which such control of private space activities should take place.[137] In other words, international action is needed to determine substantive guidance (including uniformity of regulation), and structural

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[129] *Id.*

[130] Convention on the International Liability for Damage Caused by Space Objects, arts. I, II, III, *opened for signature* Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

[131] *See* Outer Space Treaty, *supra* note 9, at arts. VI, VII.

[132] VON DER DUNK, *supra* note 12, at 17.

[133] *Id.* at 25.

[134] *Id.* at 26.

[135] *Id.* at 25.

[136] *Id.* at 26.

[137] *Id.*

guidance (minimizing State discretion to decide which categories of private activities they are answerable for at the international level).[138]

Orbit Law will hopefully provide the necessary framework and guidance sought by von der Dunk and needed by the space industry to chart its course and determine liability risks with some stability and predictability. Later portions of this article will explain Orbit Law's ability to mesh State action, private action, liability, and responsibility into one comprehensive system of apportionment. The solutions begin with both functional and spatial notions that have come full-circle and are now considered "customary space law."[139] First, that no nation objected to satellites flying over its territory, leading to the conclusion that a right developed for such flights.[140] Second, there is no legal distinction between airspace and outer space, but such activities have thus far been conducted on the basis that airspace extends to the height where planes can fly, while outer space begins where objects can remain in orbit.[141]

States are currently charged with responsibility for authorizing and continually supervising national governmental and nongovernmental entities,[142] thereby ensuring *State* involvement in all issues of satellite overflight and the air/space distinction. Said another way, States are so intricately tied to the issues of sovereignty and liability that Orbit Law will use this "common ground" as the building blocks for its initial structure. Both national and international legislation begin with State involvement, interaction, and cooperation. Orbit Law will initially maintain this *status quo* of State predominance over all issues of flight. However, *orbital status* will also be a factor in determining which principles of tort law are applicable to each particular flight situation. Ceilings of liability may also play a role in Orbit Law to alleviate the heavy financial burden that both States and private parties share when trying to insure space

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[138] *Id.*
[139] Galloway, *supra* note 14, at 188.
[140] *Id.*
[141] *Id.*
[142] Outer Space Treaty, *supra* note 9, art. VI.

operations. As Orbit Law matures, notions of sole-State responsibility may be phased out over time in favor of more progressive apportionment of liability, updated principles of tort law, and equitable division of risk and insurance costs between actors.

III. CHAPTER II: THE NEW ORBIT LAW REGIME

Although international air and space law has historically been one of the few legal arenas where its drafting and development usually preceded its need for application,[143] it is apparent that advances in technology and the increased prevalence of hybrid flight participants may now be outpacing (and thereby creating) the need for new legal principles. Flight capabilities now exceed the traditional boundaries of both location and function (i.e. spatialist and functionalist approaches to air-space demarcation). Yet there remains a common factor which restricts a legal determination of the boundaries of flight under both the functional and spatial approach. That restrictive factor is encompassed in the attempt to determine either a certain functional event or break point at which a craft "breaks free" from the airspace realm and enters into outer space, rather than recognizing the ability to traverse both domains and embracing the capacity to function within both spheres of flight. New legal determinations of flight status based on a craft's orbital operation bridge the gap between airspace and outer space, location versus function, and application of the appropriate legal regime.

A. Explanations of Orbital Law and the "Blended Approach"

Although technology has merged air flight with space flight, current laws do not comport with such dual ambit capabilities, thus requiring a new approach to overcome the limitations of the air law and space law "either-or" determination based *solely* on flight status or location. The common flaw that both regimes

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[143] "The Outer Space Treaty was prospective in nature, establishing laws for future actions. Most international law and treaties are reactive in nature, responding to the practice of nations." Ram S. Jakhu, Lecture at the Faculty of Law, McGill University: Space Law: General Principles (Oct. 10, 2006).

share includes trying to make a mission-based (functional) or linear (spatial) determination of that boundary, both of which seem tied to *atmospheric*[144] restraints. While spatialists are looking for a dividing-line within the atmosphere, functionalists limit flight activities as either purely aeronautical or space-based, without being able to categorize these new craft which cross and function within both spheres of operation.

The more logical approach to distinguish between different types of flight would focus on time and gravitational (i.e. orbital) boundaries. This new approach would determine whether and for how long the craft were able to remain *in orbit* above Earth's gravitational force, instead of simply "aloft" in or above any certain point in its atmosphere, or simply performing a particular air or space flight duty. Identifying a craft's orbit under Orbit Law will actually reflect a blending of both the functional approach (by examining whether or not the craft is *engaged* in or *intended* for an orbital rendezvous with Earth or some other celestial body) and the spatial approach (by examining the craft's *location* and *distance* covered to determine whether it meets orbital requirements). This new method of examining a craft's orbital status (which includes an analysis of the aspects of time, space, and function) might finally overcome the arbitrary and limiting factors of examining *only* location *or* function to determine its legal status.

For example, the spatial measurement of altitude *alone* would not be a factor in determining whether a craft was in an orbital status or not. If advances in technology enabled a craft to maintain an altitude of approximately 30 miles (well below the spatialists' traditional line of demarcation between airspace and outer space), yet complete one orbit around Earth, it should

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[144] The term "atmosphere" is used in the broadest sense here. Although "space" is not typically thought of as having any atmosphere, Earth's atmosphere does extend far enough above the planet into regions that are generally agreed to constitute outer space. While the troposphere extends from Earth's surface up to a height varying from 8-14.5 km, the stratosphere begins at the top of the troposphere and extends upwards to approximately 50 km. Above that region lies the mesosphere up to approximately 85 km, after which extends the thermosphere to approximately 600 km. The outer most region of Earth's atmosphere includes the exosphere, which extends to an altitude of approximately 10,000 km. *See generally* NASA, *Earth's Atmosphere*, http://www.nasa.gov/audience/forstudents/9-12/features/912_liftoff_atm.html (last visited Apr. 26, 2010).

qualify for orbital status. But if this same craft touched down at some point before completion of one revolution around Earth, it would remain in a suborbital status.

A "time aloft" standard would also dictate whether a craft were in orbital or suborbital status. A craft which was able to remain above Earth for a certain period of time might qualify for orbital status. The ability of a craft to "hover" above Earth and qualify as an orbital flight would be logically based on comparison to satellites which appear to "hover" in the Geostationary Orbit.

By re-categorizing flights and determining a craft's legal status based on their orbital standing, rather than solely as an "aircraft" or "spacecraft," a new legal regime can be established that blends the best aspects of both air law and space law. The current trans-atmospheric capabilities of "space planes" and similar hybrid craft, and the benefit of replacing the "airspace versus outer space" dichotomy with an orbital regime, is advantageous for confronting the complex legal scenarios that modern technologies have created, and as increased actors continue to evolve.

i. The Science of Orbit and the Art of Orbit Law

In order to fully explore the prospects of Orbit Law, a brief explanation of the science of orbital motion is appropriate. In order for an object to achieve orbit with Earth, it must have sufficient boost to escape the initial pull of gravity and accelerate to the point that once it begins to fall back towards the surface, it essentially falls completely around the planet.[145] The minimum necessary speed to escape Earth's gravitational field and reach orbit is 7.9 km/sec, which is also known as First Cosmic Speed.[146] If the craft does not have enough thrust and/or speed (also approximately calculated at 30,000 km/hr) to attain suffi-

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[145] *See generally* Jet Propulsion Laboratory, California Institute of Technology, *Basics of Space Flight*, http://www2.jpl.nasa.gov/basics/index.php (last visited Apr. 26, 2010) [hereinafter *Basics of Space Flight*].

[146] *See* Thomas Beer, *The Specific Risks Associated with Collisions in Outer Space and the Return to Earth of Space Objects – the Legal Perspective*, 25 AIR & SPACE L. 42, at 44 (2000).

cient altitude and overcome gravity, the effects of gravity and atmospheric drag will cause the object to follow its ballistic arc and return to Earth.[147] For purposes of the new Orbit Law regime, such flights are considered *suborbital flights*.

But for those objects obtaining the necessary orbital launch propulsion, that object can remain in orbit for months, years, or even longer (depending on its altitude) before its orbital status begins to degrade.[148] Altitude also affects the time it takes the object to complete its orbit, which is known as the orbit period.[149] Because of the marked reduction in gravitational effects with distance, an object in low Earth orbit needs significantly more speed to maintain its orbit than an object in higher orbit.[150] These principles of physics apply not only to satellites, but to any craft engaged in *orbital flight* with Earth. For example, while the *International Space Station* located nearly 250 miles above Earth's surface makes one complete Earth orbit approximately every 90 minutes, a satellite positioned above Earth's equator in what is known as the Geostationary Orbit will take one day to complete a single circuit.[151] Each of these satellite's voyages would be considered an *orbital flight* under the Orbit Law system.

As previously mentioned, Orbit Law would include a "time aloft" standard to also qualify for orbital flight based on the comparison with satellites which appear to hang motionless above a particular point on Earth. Craft positioned at an altitude of 22,300 miles (approximately 36,000 km) will take precisely one day to complete a single circuit above Earth in what is known as the geosynchronous orbit (GEO).[152] GEO is a prograde, circular orbit having a period of 23 hours, 56 minutes, 4 seconds.[153] If the craft is placed in this orbit directly above

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[147] *Basics of Space Flight*, *supra* note 145.

[148] *Id.*

[149] *Id.*

[150] *See* Lawrence D. Roberts, *A Lost Connection: Geostationary Satellite Networks and the International Telecommunication Union*. 15 BERKELEY TECH. L.J. 1095, at 1099 (2000).

[151] *Id.*

[152] *Id.*

[153] *Basics of Space Flight*, *supra* note 145.

Earth's equator with an inclination of zero degrees, its flight will not only be synchronized with Earth's rotation, but also appear from the surface to be stationary and is commonly known as the Geostationary Orbit (GSO).[154] Based on this orbital epoch taking 23 hours, 56 minutes, 4 seconds to qualify as one geosynchronous or geostationary orbit, the new Orbit Law standard will also include the same measurement of time as one qualifier for a craft to be considered in Earth orbit.

However, as inter-planetary (or even inter-stellar) travel becomes feasible, one must also consider the potential application of Orbit Law beyond Earth's orbit. Therefore, another orbital consideration includes the launch of an object from one (planetary) orbit to another. This process is currently accomplished using Hohmann Transfer Orbits, while the portion of that orbit which takes the object to its next location is known as its trajectory.[155] Such orbital transfers would qualify as an *inter-orbital* flight in the new Orbit Law scheme. For example, if a craft were to travel from Earth to Mars, where it then remained in orbital status above that planet, the craft would be considered to accomplish *inter-orbital flight* during its transit between Earth and Mars, and then enter into *orbital flight* once it took its orbital position around the Red Planet. Although these Orbit Law proposals will apply the same legal standards to orbital and inter-orbital flights, it is nonetheless important to distinguish between these two cosmic realms.

As each planet's rotational period varies, the "time aloft" standard to qualify for orbital status will vary from planet to planet. Mars' rotation period takes 1.027 Earth days to complete one rotation, while Mercury takes 175.942 Earth days to complete its rotation; Venus' retrograde rotation results in a -116.75 Earth days comparison for its completion of one rotational cycle.[156] Jovian planets typically have much faster rotation periods; Jupiter takes only 9.9 hours to complete one rotation, Saturn requires 10.7 hours, Uranus takes 17.2 hours, and

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[154] *See* Roberts, *supra* note 150.
[155] *Basics of Space Flight*, *supra* note 145.
[156] *Id.*

Neptune needs 16.1 hours for its revolution.[157] Therefore, in order for a craft to be considered "in orbit" based on a synchronous "time aloft" above that planet, the standard will vary from planet to planet.

ii. The Need for a "Blended Approach"

Many authors have foreseen the problems posed by craft that are able to function in both air and space environments. Dr. Eilene Galloway provided an excellent overview of the problem in 1998 when she observed:

> Defining the difference between sovereign airspace and nonsovereign outer space has been a continuing concern for lawyers seeking a definite basis for legal situations involving airplanes and satellites. COPUOS sought, but found it impossible to obtain, a scientific basis for demarcation. Meanwhile, space activities flourished on the basis that airspace extends to the height that planes can fly while outer space begins where satellites can go into orbit. Proposals for an artificial line have not found acceptance, probably because there have been no problems since the space age began that required for their solution a line between airspace and outer space. . . . The probability of spaceplanes that can fly in both airspace and outer space will add a new dimension to this problem, and it will be necessary to find out what functions such an object performs and how it is to be regulated. . . . We shall need a new definition of the entire problem: the relation of this new technology to sovereignty; the effects on the International Civil Aviation Organization, and how spaceplanes fit into regulation for international security.[158]

G. P. Zhoukov's observations also provided support to the notion of a blended approach for objects based on their orbital status. Zhoukov noted that functionalists categorize space objects by referring to its propulsion systems, as opposed to aircraft which

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[157] *Id.*

[158] Eilene M. Galloway, *Guidelines for the Review and Formulation of Outer Space Treaties, in* 41ST COLLOQ. L. OUTER SPACE 245, 251-52 (1998).

rely on the properties of air for their flight.[159] However, such a functionalist approach did "not sufficiently take into consideration the potential developments of space travel – particularly the advent of reusable space ships fitted with air reactors that use the aerodynamic properties of air for their return to Earth."[160] Spatialists preferred the location in which the object was to operate, and suggested that a space object's defining characteristic be the fact that it was intended for flight operation in outer space.[161] But this approach did not account for "space objects" not yet launched into space, and would therefore not appear to meet the definition of a space object despite its locational qualifier.[162] Although space objects are technical devices, they do not qualify for treatment under international space law unless the object has been launched into or constructed in space – when the object enters artificial Earth satellite orbit or travels farther away, or is constructed in space or on some other celestial body, the international legal provisions of space law remain applicable until its landing or destruction upon re-entry into the atmosphere.[163]

Under either the functional or spatial approach, there comes a time during any craft's flight that it will likely transit national, and perhaps international, airspace. One country's methodology for combined use of airspace by aircraft and spacecraft compared the need for new regulations against the possibility that existing legal guidelines were sufficient for such transit.[164] In this study, it was discussed how Germany has structured its airspace under the supervision of the DFS (Deutsche Flugsicherungs GmbH), and that the operator of a *spacecraft* who wished to use national airspace would have to

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[159] G. P. Zhukhov, *Definition and Classification of the Space Object: An Important Issue in International Space Law, in* LIBER AMICORUM HONOURING NICHOLAS MATEESCO MATTE: BEYOND BOUNDARIES 361 (Guido Rinaldi Baccelli ed., 1989).

[160] *Id.*

[161] *Id.*

[162] *See id.* at 362.

[163] *Id.*

[164] Marina Köster, *Legal Problems Related to a Combined Use of Airspace by Air and Spacecraft*, *in* PROJECT 2001 WORKSHOP ON COMMERCIAL LAUNCH SERVICES 137 (Bremen, Germany, Jan. 19, 2000).

accept air traffic management instructions just like an airline.[165] The United States Federal Aviation Administration (FAA) also planned for a combined use of airspace by aircraft and spacecraft using the "Space and Air Traffic Management System (SATMS Project)."[166] But while these States appeared to be getting a grasp on a functional combined management system, the more difficult challenge posed by these flights focused on management of *international airspace* being used by *spacecraft*.

The main international legal instrument for all civil aviation is the Chicago Convention; given the fact that 185 States have ratified this treaty, it can be regarded not only as multilateral but as universal.[167] However, its application to spacecraft and the corresponding traffic is still subject to question. Because the Convention and it Annexes have all been released without any inclusion or reference to spacecraft, Köster believed that application of this treaty by analogy would be against the declared text and intention of this legal work.[168] As such, the Convention should not be considered applicable to spacecraft, and transit of a spacecraft through international airspace, as well as launches and re-entries from international territory, is free.[169] Köster stated that because civil aviation and spaceflight are two equal users of international airspace, and with the increasing number of space-related launches and re-entries, consideration should be given to a new international agreement to manage such traffic and ensure its safety.[170]

Stephen Gorove also predicted the potential need for new pioneering legislation:

> [I]f future technological developments were to create a hybrid vehicle capable of moving freely in the air like an aircraft and also moving at will in outer space, a consideration of new laws, both domestic and international, may become necessary in or-

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[165] *Id.* at 140.
[166] *Id.* at 141.
[167] *Id.*
[168] *Id.* at 142.
[169] *Id.*
[170] *Id.*

> der to adjust legal regulations to the latest scientific and technological innovations.[171]

Suffice it to say, each of these author's predictions have come to pass with the numerous advents in technology, thereby spurring the need for new legal considerations for blended air and space flights.

B. Examination of Sub-Orbital Flights & Progression of Orbit Law

As referenced in the introduction, the first fundamental premise of the new Orbit Law legal system includes the *application of all current public and private international Air Law tenants* to *all suborbital flights*. It should be noted that Stephen Gorove's article on *Aerospace Objects*[172] provided much of the impetus behind an orbital-based legal framework. However, one major difference between Gorove's analysis and these new proposals is that Gorove seemed to focus on the aerospace *object*, as opposed to the orbital flight emphasis of this new regime. Gorove differentiates simple "aerospace objects" from "space transportation systems," the latter having broader meaning and including space-shuttle-type transportation systems as well as typical rocket carriers.[173] "Aerospace objects" would therefore not be an appropriate term for hybrid systems that might be used for both air flights and outer space missions.[174]

Gorove also examined the Russian proposal for "aerospace objects" and its two distinct purposes as outlined in their response to the UNCOPUOS Legal Sub-Committee Questionnaire of 1996.[175] The Russian answer identified one possible aerospace object's purpose as flight from one point on Earth to another (a part of which might occur in space, but not attaining cosmic speed), while the other purpose included delivering crew and/or payload into outer space and later returning back to Earth (as

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[171] Gorove, *supra* note 67, at 112.
[172] *See generally id.* at 101-112.
[173] *Id.* at 103.
[174] *Id.*
[175] U.N. GA Questionnaire, *supra* note 81, at Add.1, 4-5.

well as being able to remain in airspace for a certain period of time).[176] Gorove stated that an appropriate legal regime for these two distinctly different aerospace objects needed to be identified, and he based his analysis of the aerospace objects on a comparison of their status as an *aerospace plane* versus a space-shuttle-type vehicle, i.e. a "*space object*."[177]

Gorove foresaw early versions of the aerospace plane as designed for terrestrial transportation purposes – taking off from a point on Earth, and flying in airspace and traversing the fringes of outer space without completing an orbit, all for the sole purpose of reaching another point on Earth.[178] He also identified the main problems with such a versatile vehicle – delimitation and definition of airspace and outer space; the status of astronauts; and issues of liability, registration, and jurisdiction.[179] While some new international agreement or other accommodation might be necessary to resolve disputes between traditional (national) airspace and outer space, Gorove suggested that if the aerospace plane only operates as an Earth-bound transportation system and incidentally reaches the fringes of outer space, then air law should be applicable to it.[180]

This proposal mirrors that of the Orbit Law regime for a craft meeting the criteria of "suborbital" status, yet with different qualifiers. While Gorove focused on the aerospace *object* itself and *functional* qualifiers, Orbit Law instead looks at the orbital status achieved, coupled with the intent of the mission. As explained in the section on Orbital Qualifiers in paragraph C below, a craft *intended* for orbital flight would maintain that status for the duration of its mission (whether or not it actually achieved orbit). But a suborbital craft which accomplishes one orbit based on the qualifiers explained in this article would <u>also</u> qualify for orbital status. In other words, suborbital flights might also qualify for orbital status, but the reverse scenario of orbital flights reverting back to suborbital status would not be

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[176] *Id.*; Gorove, *supra* note 67, at 104.
[177] *See id*. at 105-111.
[178] *Id.* at 105.
[179] *Id.*
[180] *Id.* at 106.

true under the current Orbit Law proposals. Although such a status was not discussed as an option by Gorove, justification for this one-sided consistency will follow in forthcoming sections.

Gorove also proposed that aerospace planes (i.e. suborbital craft under Orbit Law) might be expected to comply with space debris mitigation, rules of the road, and other requirements while operating on the fringes of space.[181] He also questioned whether space law would govern an object orbiting Earth at a height of 30 km if new technology enabled it to maintain that orbital height, but speculated that new technology would not likely lead to an acceptance of lowering the height of outer space to 30 km.[182] As explained in the section detailing orbital flight status, Orbit Law would not lower outer space to a different altitude, it would simply apply existing space law (and eventually new Orbit Law concepts) to all orbital flights, with air law being applicable to suborbital trips.

Therefore, the remainder of this section will analyze the importance of liability and insurance considerations for suborbital flights. Status of the craft itself and State versus private responsibility for flights will be the focus of Section C on orbital flights. But for suborbital considerations, these hybrid vehicles will essentially be treated as space-capable objects subject to air law. The considerations of public international air law and corresponding issues of State sovereignty for suborbital flights will be reserved for discussion in Section E of this chapter under the Open Skies proposal.

C. Liability & Insurance Considerations

The obligation of States to otherwise prevent harm, and provide restitution in the event of its actual occurrence, is firmly rooted in international law. *Corfu Channel* held that:

> [F]ormerly, the misuse of a right had no place in law. Anyone could exercise his rights to their fullest extent, even if the effect was prejudicial to others; in such cases there was no duty

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[181] *Id.*
[182] *Id.*

> to make reparation. That is no longer the case . . . . [T]here are two questions to be determined: (a) when is there a misuse of a right; and (b) what should be the penalty? In regard to the former point, the facts must be evaluated in any given case; and in regard to the penalty, this may consist, according to circumstances, of an apology, a rebuke or even compensation for the injury caused.[183]

These requirements and methods for reimbursement of wrongs were embraced by the Montreal Convention of 1999.[184] With the initial application of private international air law to suborbital flights during the early years of an Orbit Law administration, the suborbital system should develop a stable regime of liability similar to that of air law.

Unlike space law's system of automatic application of absolute liability as contained in Article II of the Liability Convention, a number of scholars have observed that the Warsaw-Montreal systems are a fault-based regime akin to *res ipsa loquitur*.[185] *Res ipsa loquitur* requires that (1) the accident is of a kind that does not ordinarily occur in the absence of someone's negligence; (2) it was caused by an agency or instrumentality within the exclusive control of the defendant; and (3) it must not have been due to any voluntary action or contribution on the part of the plaintiff.[186] Although the Montreal Convention creates a rebuttable presumption of carrier liability, ultimate liability is still dependent upon proof of fault.[187] The plaintiff does not have to prove negligence or misfeasance on the part of the carrier, but does carry the burden of proving that an accident has occurred.[188]

Under an Orbit Law system, suborbital flights might also be able apportion damages similar to the Montreal Convention's Article 21, and its assignment of liability under Article 17 acci-

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[183] Corfu Channel Case, (Alb. v. U.K.) 1949 I.C.J. 4, at 47-48 (1949).

[184] *See* Montreal Convention, *supra* note 2.

[185] PAUL S. DEMPSEY & MICHAEL MILDE. INTERNATIONAL AIR CARRIER LIABILITY: THE MONTREAL CONVENTION OF 1999, 137 (Montreal: McGill University Centre for Research in Air & Space Law, 2005).

[186] *Id.*

[187] *Id.*

[188] *Id.* at 141.

dents.[189] Given the likely similarities, and low survivability, of accidents or crashes involving aircraft or suborbital craft, the victim-oriented compensation scheme of the Montreal Convention should provide levels of stability and known insurable amounts to successfully finance suborbital development without overburdening insurable risks. For comparison, one insurance expert recently observed that it was not the compensation methods of the Montreal Convention which increased insurance costs for aviation, because similar recovery schemes were already known and in place before the 1999 Convention was eventually ratified.[190] Rather, it was the unknown and unforeseeable risks of the terrorist hijackings of 9/11 which drove up insurance costs.[191] Another danger to the aviation insurance industry includes the risks of litigation in U.S. courts, which typically award greater damages than courts in other countries.[192] However, the reverse of this tenant is often true as well – other countries regularly place a much lower value on losses, including loss of life.[193] Standardization of compensation for suborbital flight accidents like the Montreal Convention's Article 21 reflects a more equitable reimbursement plan; insurance actuaries should accordingly be able to predict appropriate insurance rates.[194] A clause for periodic reviews of limits of liability like that imposed by Article 24 of the Montreal Convention[195] would also be included under Orbit Law.

Certain space law principles such as State responsibility[196] are at loggerheads with the existing air law structure of private party liability. This dichotomy will be dissected in Section C on Orbital Principles. But in the initial analysis of suborbital flights (and eventually including orbital flights), Orbit Law holds the *carrier* liable for any negative outcome, subject to a

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[189] Montreal Convention, *supra* note 2, arts. 17, 21.

[190] Ulla Norrhäll, Lecture at the Faculty of Law, McGill University: Private International Air Law (Oct. 26, 2006) (on file with author).

[191] *Id.*

[192] *Id.*

[193] *Id.*

[194] *See generally* DEMPSEY & MILDE, *supra* note 185, at 183.

[195] Montreal Convention, *supra* note 2, art. 24.

[196] *See* Outer Space Treaty, *supra* note 9, art. VI.

rebuttable presumption of fault. Section C will elaborate the extent of responsibility based on the corporate structure of each carrier (along with any/all subsidiaries) and their involvement in the suborbital or orbital endeavor, but a preliminary explanation of this proposal will help prepare the playing field.

For example, sole-State airlines (e.g. Aeroflot) would bear primary responsibility for its flights, just as private carriers (e.g. United Airlines, U.S. Airways, etc.) would bear any burden of liability for its flights. Orbit Law proposes to establish an international structure for recovery regardless of national laws, sovereign status, or location of incorporation – each carrier would be ultimately responsible for any damages it causes from suborbital (or orbital) accidents. For those carriers with multiple "personalities" (e.g. sole State carriers, multi-national entities, inter-governmental enterprises, private corporations, etc.), the extent of each party's supervision and exercise of control over operations should likewise dictate responsibility over all legal matters, fiscal accountability, and corporate "ownership" of all suborbital events.[197] In other words, Orbit Law recovery for suborbital wrongs will initially mirror that system in place for private air law. Allocation of damages among the various entities[198] within a multi-partner corporate structure can be negotiated during the evolution of Orbit Law, but should be based on general principles of tort law apportioning blame based on the extent of involvement. Those carriers (public or private) which refuse to honor payment of damages which have been formally adjudicated may be subject to I.C.J. action, ICAO sanctions, and

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[197] *See generally* Bin Cheng, *Article VI of the Space Treaty Revisited: "International Responsibility," "National Activities," and "The Appropriate State,"* 26(1) J. SPACE L. 7, 20-29 (1998) [hereinafter *Article VI*] ("[W]hile the function of control may be delegated to another State, the State's responsibility and liability under Articles VI and VII of the Space Treaty or the 1972 Liability Convention cannot. Consequently, even where a State has absolute confidence in the State designated to discharge this task, and however watertight the hold-harmless clauses in the agreement may appear to be, in practice, it may not be entirely wise for it no longer to concern itself with the matter. . . . All in all 'the appropriate State' appears thus to be a rather elusive notion. In practice there may well be more than one 'appropriate State,' *de facto* or even *de jure*.").

[198] *See generally* Dimitri Maniatis, *The Law Governing Liability for Damage Caused by Space Objects: From State Responsibility to Private Liability,* 22(1) ANN. AIR & SP. L. 369, 387-88 (1997).

possibly unilateral action by States forbidding suborbital spaceplanes from entering their airspace.[199]

As Section E in this chapter on Sunset Clauses will eventually discuss, it is also proposed that a more streamlined system of liability and recovery will eventually emerge, and suborbital flights' reliance on the current private international air law system will eventually melt away. Although the Montreal Convention serves as an excellent starting point for suborbital liability determinations, it is not a perfect product. Precise definitions of "accident," the possibility (or impossibility) of punitive damages for deliberate misfeasance, and potential recovery for mental or other injuries are some of the many issues debated by air law which must be addressed and revisited during Orbit Law's growth and development. As part of this streamlining process, the next section discussing Orbital Flight Liability considerations will also propose a morphing of suborbital liability components into orbital flights as well. The two separate systems of liability for air law and space law, or suborbital/orbital law, will eventually meld into one overarching method of accountability.

D. Examination of Orbital Flights & Progression of Orbit Law

The next fundamental premise of Orbit Law includes the *application of current space law principles and treaties* to *all orbital flights*. Gorove's *Aerospace Objects* article again provided inspiration for the idea of legal determinations for flight based on orbital status, yet Gorove remained focused more on the (space) object and its functional intent rather than orbital qualifiers. He proposed defining a space object as:

> an object launched or attempted to be launched in orbit around the earth or beyond. Such object (or a part of it) is a space object (or a part of it) from the time of its launch or attempted launch, through its ascent from earth to outer space or while

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[199] PAUL S. DEMPSEY, PUBLIC INTERNATIONAL AIR LAW 373 *et seq.* (Montreal: McGill University Centre for Research in Air & Space Law, 2008).

> in outer space, as well as during its orbit, deorbit, reentry and landing on Earth."[200]

Under the current space law regime, such objects represent national assets over which the *State* wields jurisdiction and control.[201] Because spacecraft may be a more valuable bases of power than aircraft or ships, States might be unwilling to yield their jurisdiction over such craft, and will likely maintain a substantial proprietary interest in protecting its assets.[202] Contrast this sovereign stance of States and the sole-State responsibility of the Outer Space Treaty[203] (and other space instruments) against the increased role of private party action in space, and the stage is set for potential conflict between public and private international law. Although the existing space treaties attempt to resolve this problem by simply imposing State responsibility and liability for all space actions,[204] they are insufficient to adequately address today's technological and corporate spikes in space activity. Orbit Law will hopefully quell the "danger of chipping away at the 1967 Outer Space Treaty by protocols instead of adding more agreements"[205] by imposing new legal guidelines across orbital and suborbital flight.

> However, Judge Manfred Lachs also cautioned that:
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> > [T]he interdependence of the traffic in the air and outer space should not subject the activities of States to unnecessary limitations. To survive in the world today States need to open the frontiers of the air to other States unless they prefer to live in complete isolation, where very few, if any, could survive and develop.[206]

With this frame of reference, this section will explore the strictures to qualify for orbital status, and ponder whether the exist-

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[200] Gorove, *supra* note 67, at 107.
[201] *See* Outer Space Treaty, *supra* note 9, art. VIII.
[202] *See* MCDOUGAL, ET AL., *supra* note 11, at 523-24.
[203] *See* Outer Space Treaty, *supra* note 9, art. VI.
[204] *See id.* at arts. VI, VII. *See also* Liability Convention, *supra* note 130.
[205] *See* Galloway, *supra* note 14, at 190-91.
[206] Manfred Lachs, *Freedom of Air – the Way to Outer Space, in* AIR AND SPACE LAW: *DE LEGE FERENDA* 244 (T. L. Masson-Zwann and P.M.J. Mendes de Leon, eds., 1992).

ing parameters of liability for space law are appropriate for application to Orbit Law. An analysis of whether the notion of State sovereignty over airspace is an outdated principle will be reserved for Section E under the Open Skies proposal.

i. Orbital Functions & Qualifiers

The 1975 Convention on Registration of Objects Launched into Outer Space (Registration Convention) calls for the registration of space objects only upon their placement in *orbit* around Earth or farther away.[207] However, a question of great significance is whether objects *designed and destined* for orbital flight, but return to Earth before one complete revolution (i.e. a fractional orbital flight), should be considered as a space object.[208] Under the Orbit Law guidelines, an object *intended for or accomplishing orbital status* would qualify as an orbital flight.

Some jurists maintain that the international space agreements would only apply to devices which complete one revolution around the Earth, whereas fractional orbital flights such as those used in intercontinental ballistic missiles (ICBM's) would not qualify.[209] However, ICBM's are distinguished from traditional orbital objects based on their design and flight; whereas ICBM's follow a ballistic trajectory, space objects reach sufficient fractional speed to enter Earth's orbit.[210] Space objects which leave orbit to return to Earth use braking devices, and by virtue of their design and operation fall within the scope of the Registration Convention and other space treaties.[211] Such comparisons between (suborbital) fractional orbit devices and "true" (orbital) space objects fit nicely within the Orbit Law gambit.

For example, a suborbital craft which remained aloft for sufficient time to qualify for orbital status, or completed one revolution around Earth, would qualify for orbital treatment.

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[207] Convention on Registration of Objects Launched into Outer Space, art. II, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695,1023 U.N.T.S. 15 (emphasis added) [hereinafter Registration Convention].

[208] Zhukhov, *supra* note 159, at 364.

[209] *Id.*

[210] *Id.* at 365.

[211] *Id.*

But the reverse would not be true. If an orbital craft intended for orbital flight returned to Earth before meeting orbital time requirements, or before completing one revolution around the Earth, it would nonetheless still be considered an orbital flight. This one-sided approach is proposed to attain and ensure some consistency for orbital flights, especially considering the issues of liability, State responsibility and sovereignty discussed elsewhere in this article. Because the application of current space law principles to orbital flights under this newly-proposed program will initially subject States to greater potential risk through the "absolute liability" of the Liability Convention,[212] but eventually provide greater legal protections during the evolution of Orbit Law, applying orbital status to all orbital flights (intended and accomplished, as well as all flights *servicing* orbital objects) should ensure stability to adequately insure, support and promote this burgeoning industry.

Although qualifying for orbital flight under Orbit Law is based on the blended approach of location *and* function, this functional emphasis has precedence in former discussions about reusable space ships. Although some States have proposed that such space ships be considered aircraft when re-entering the lower layers of the atmosphere, prevailing opinions (including the U.S. and former U.S.S.R.) refer to such craft as space objects during *all* phases of their flight.[213]

Support for the "time aloft" standard as a second qualifier for orbital status can be referenced back to the discussion on Geostationary Orbit objects, in addition to comparing its applicability to HAPS and geostationary stratospheric platforms. Martine Rothblatt's article on such platforms speculated that a literal interpretation of current space law treaties would likely exclude such stratospheric objects as space objects, but that certain space law treaties should be amended and would be better served by defining geostationary stratospheric platforms as objects in outer space.[214] It makes no sense that one satellite located at 40,000 km is deemed a space object, when another one

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[212] *See* Liability Convention, *supra* note 130, at art. II.
[213] Zhukhov, *supra* note 159, at 365 (emphasis added).
[214] Rothblatt, *supra* note 38, at 1.

serving with identical functions at 20 km would be considered an "aircraft" subject to air law.[215] For a legal regime to apply space law for communication platforms from 40,000 km to 100 km, but then instantly "transmogrify into a regime of air law once the communication platform is located in the 20-30 km range," is illogical given their identical use and purposes.[216] In fact, Rothblatt notes that application of the principles of space law to these low Earth orbit objects, such as demilitarization, liability, and the rescue and return of stratospheric platforms, are in the interests of all countries.[217] "Based on the advent of stratospheric platforms, it is now time to extend the range of space law down to the 20 km regime above controlled airspace where the satellites of tomorrow will reside."[218]

Even at these lower altitudes where suborbital (and orbital) craft may soon transit and share airspace with HAPS, the author acknowledges that air law *currently* subjects aircraft to two different legal applications – international air law over the high seas and domestic law over the territory of sovereign States. The same tenets of international law and adherence to notions of State sovereignty hold true for ships on the high seas, versus those in a State's territorial waters. By applying Orbit Law principles based on *orbital* status (regardless of *altitude or location* over State territory, and irrespective of *transit* or *maintenance of orbital position*), this common qualifier may unite the differing and inconsistent standards that plague successful unification of an air law system across national and international borders. Open Skies enabling such trans-boundary flights will be discussed later in this chapter. Perhaps the acceptance of universal safety Standards and Recommended Practices (SARPs) much like those based on the ICAO model might serve as a unifying starting point to promote one overarching code of flight – Orbit Law. As Jasentuliyana proposed:

> A solution would be for COPUOS, like ICAO, to separate the political and technical aspects of space technology and formu-

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[215] *Id.* at 2.
[216] *Id.* at 3.
[217] *Id.* at 4.
[218] *Id.*

> late international standards and recommended practices for the regulation of space activities. The time has come to consider this option, and to lay out a basic institutional framework so that the future use of space science and technology is not hindered by protracted political discussions.[219]

For stratospheric platforms or any other craft intended to or achieving continuous and/or geostationary flight for a period of 23 hours, 56 minutes, 4 seconds (the minimum time qualifier for one geosynchronous orbit), application of orbital status and the principles of space law would prevail under the Orbit Law regime. One interesting logical extension of this orbital qualifier would create "orbital status" for many flights that are currently deemed subject to air law. Examples include aircraft missions which refuel and continuously fly beyond the approximately 24-hour requirement. Balloons which remain aloft beyond that time would also enter into orbital status. However, given the circumstance that both types of flights remain for an extended period of time above Earth's surface, albeit at lower altitudes than one might ordinarily be considered to be "in orbit," under Orbit Law it is a fact that these air refueling missions or balloon flights are maintaining an aerial presence that meet or exceed the time required for one geosynchronous orbit above the planet. It therefore does not seem too great a stretch of logic to apply orbital status, and thereby the principles of space law, under the new Orbit Law proposal. Whether exceptions or "opt out provisions" should be made for traditional yet extended air flights such as these is beyond the scope of this article's analysis.

ii. Liability & Insurance Considerations

Freedom of space and an obligation of space actors not to adversely interfere in the enjoyment of these rights[220] is founded in a "universe of law postulated that the freedom of each of its

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[219] Nandasiri Jasentuliyana, *Celebrating Fifty Years of the Chicago Convention Twenty-Five Years After the Moon Landing: Lessons for Space Law*, 19(2) ANN. AIR & SP. L. 429, 445 (1994).

[220] *See* Jakhu, *Satellite Imagery, supra* note 7, at 75.

subjects should be bounded by equal respect for the freedoms of other subjects; that States engaging in an activity which might cause injurious consequences internationally should take reasonable account of the interests and wishes of other States likely to be affected."[221] As previously mentioned, the initial application of space law principles to orbital flight will provide the starting point for Orbit Law. Application of absolute liability during the launch phase, and fault-based liability during the orbital phase of space flight,[222] should initially provide new orbital flights with the historical foundation and existing structure to support Orbit Law's embryonic development.

The U.S. Commercial Space Launch Act of 1984 and 1988 not only established a safety regimen for commercial space activities, but also addressed issues of liability emerging from this increased private industry activity.[223] In order to cover all situations of potential liability by the U.S., these Acts established licensing requirements, which included insurance coverage to address instances of third party liability.[224] These provisions required the licensee to obtain sufficient coverage to indemnify the government in case there was an accident where the U.S. was held liable to third States for damage caused by the space activities of U.S. licensees.[225] Coverage amounts at that time were capped at $500,000,000, with any successful claims above that amount to be paid by the U.S. up to a ceiling of $1.5 billion per launch.[226] Any claims above that sum would presumably revert back to the licensee.[227] These statutory guidelines, as well as other risk-sharing efforts such as cross-waivers of liability, evolved out of the necessity of the participants in outer space activities to share some of the risks involved.[228] These de-

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[221] Preliminary Report on International Liability for Injurious Consequences Arising out of Acts not Prohibited by International Law, U.N. Doc. A/CN.4/334/Add.2, paras. 52, 56, 60 (1980).

[222] *See* Liability Convention, *supra* note 130, at arts. II, III.

[223] Maniatis, *supra* note 198, at 390.

[224] *Id.* at 390-92.

[225] *Id.* at 391.

[226] *Id.*

[227] *Id.* at 392.

[228] Paul B. Larson, *Cross-Waivers of Liability*, *in* 35TH COLLOQ. L. OUTER SPACE 91, 95 (1992).

velopments in space law establish "a known regime of liability limitation to encourage space exploration and investment by reducing insurance costs and the potential for litigation."[229]

Continued progress modeled on this approach requiring national licensing and insurance coverage for private space entities looks to be a step in the right direction for Orbit Law – requiring each space actor to assume responsibility commensurate with their level of involvement in the space activities. Progression from this starting point is also in line with the current space law regime ultimately holding the State participant(s) responsible for these activities.

However, as more non-governmental entities commercially participate in and benefit from space activities, Orbit Law agrees with the position that it is mandatory for these enterprises to eventually accept and respond to their own international liability and relieve the "launching State" from the onus of this entire burden.[230] "How to split such responsibility and which aspects should remain with the relevant State in terms of supervision may be debatable, but at least the economic responsibility and potential liability for damages to third parties resulting from private launch activities should be imposed on the private entity."[231] This suggestion should come as no surprise, as the liability of entities providing capital in normal corporate structures is usually limited to the extent of their capital contribution,[232] while the Liability Convention also calls for the apportionment of damages between liable States.[233] It therefore stands to reason that in the eventual progression of Orbit Law, States would remain responsible for State action in outer space, while industry would be responsible for its own private actions. Where there is a consortium of State(s) and/or private parties sharing roles in the dispatch of space objects, even the existing

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[229] *Id.* (citing 56 Fed. Reg. 48429, 48430 (Sept. 25, 1991) (codified at 14 C.F.R. pt. 1266).

[230] Rochus Moenter, *The International Space Station: Legal Framework and Current Status*, 64 J. AIR L & COM. 1033, 1051-52 (1999).

[231] *Id.* at 1052.

[232] Francis Lyall, *Privatization, Jurisprudence and Space, in* 42ND COLLOQ. L. OUTER SPACE 149, 150 (1999).

[233] Liability Convention, *supra* note 130, art. IV, para. 2.

Liability Convention could be used as a point-of-reference to apportion liability among *all* interested actors (eventually including State and non-State).[234] These notions pose a groundbreaking departure from the imposition of (only) State responsibility and liability in the Outer Space Treaty and Liability Convention, but are now called for given the fundamentally different landscape between the time of these treaties' inception and today's space activities.

When examining these proposals, one might question the necessity for reducing or removing sole-State responsibility from its present prominence within space law. As provided in the Outer Space Treaty and seen in the U.S. Commercial Space Launch Acts, the current method of holding the "launching State(s)" responsible for all space activities, and thus placing the burden on those States to ensure the accountability of its corporations, does not appear to be overly taxing on States and actually seems to support private space activities. However, as more and more private parties undertake flights into space, the ability of States to monitor all suborbital and orbital flights, and the effectiveness of State supervision over such multinational ventures, will be diminished. Some corporations might even resort to incorporating or launching only from certain States with lax supervisory standards or ambiguous domestic laws in an effort to avoid any blame for suborbital or orbital flight accidents (much like the comparable maritime problem of "flags of convenience"). Furthermore, many developing countries might not have a mature domestic space law program requiring private insurance or other reimbursement schemes for ill-fated corporate space activities, imposition of appropriate safety standards, or careful supervision of commercial launch activities. Yet under the current method of space law "justice," only that State (and possibly any joint launching State(s)) would be responsible for compensation if an orbital (and eventually suborbital) flight accident had launched from that State. The current method of holding State(s) absolutely liable under the Liability Convention for damage on Earth, or even fault-based liability

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[234] *See id.* at arts. IV, V.

for space damage, does not properly apportion blame among *all* potentially responsible parties, and is not an equitable method for assigning fault and restitution.

One proposal for Orbit Law is a cohesive safety administration that will provide an excellent cornerstone to build a unified suborbital and orbital legal structure. Another method to address these concerns with State and private accountability would be to update the definition of "launching State" under the Outer Space Treaty and Liability Convention so as to hold private entities answerable for their space activities, and thereby require those States of incorporation to update their national laws to ensure shared responsibility. While modification of the term "launching State" might indeed be desirable, the preferred method for ensuring accountability would be through the establishment of a new international regime binding the liability of each space participant to their involvement in the space endeavor. Orbit Law should be the mechanism for such answers and clarifications.

Many of the concerns with the current space law regime and its methods of addressing liability also stem from the "victim orientation" of the existing space treaties.[235] This disposition is especially prevalent in the Liability Convention, where the effort to ensure compensation to victim States prevails, rather than emphasizing a certain, predictable, and equitable framework in which space business activity can be undertaken.[236] Dimitri Maniatis proposed one method of risk which is similar to that of Orbit Law:

> This fundamental flaw can be resolved in a manner that responds to the trends mentioned above: by abolishing the current system of State responsibility for private activities and, at the same time, unifying the private laws of States that apply to the situation of damage caused by space objects. . . . [By] harmonizing the applicable national laws, the redundancy and uncertainty of the current system would be avoided. . . . After all, this approach is not novel. It has been applied successfully to the neighboring field of air law where, both with respect to

[235] Maniatis, *supra* note 198, at 379.
[236] *Id.*

> liability for damage to persons and goods on aircraft or on the ground, private carriers are held directly liable according to a harmonized web of national laws.[237]

A similar assessment by Frans von der Dunk came to the same conclusions:

> When liability as a mechanism is transferred to the international inter-state level, it can take two fundamentally distinct forms. The first is a simple elevation of civil or private liability to the international level, or more exactly, adding transboundary aspects to the liability of (private) legal persons. The entity actually causing the damage is still held liable in those cases of transboundary damage. . . . These treaties essentially are treaties of private international law, obliging the state parties, where necessary, to harmonize their national legislation with respect to cases involving liability respectively to establish such legislation in line with the requirements provided for by the treaties. . . . Under international space law on the contrary international liability took on the second form: an elevation of the system of liability as a whole to the international level, with the subjects of international law – the States – themselves as the liable entities.[238]

Von der Dunk later proposed two potential options to solve these uncertainties and link international liability and national liability:

> Firstly, a generally accepted and very broad definition of liable state would be accepted. It should include in the term "state" those private entities with the nationality of that state, for purposes of launching, procuring launches and lending facilities for launches. Secondly, an amendment creating direct private liability under international space law would prevent national authorities from applying, consciously or unconsciously, their own, far from harmonized interpretations by means of national law. Solving this problem should be given high priority, before more and more states will find themselves confronted with the potential consequences of the ongoing privati-

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[237] *Id.* at 399-400.

[238] Frans G. von der Dunk, *Commercial Space Activities: An Inventory of Liability – An Inventory of Problems*, 37TH COLLOQ. L. OUTER SPACE 161, 163-64 (1994).

> zation of space. They will then perceive a need to issue national regulation vis-à-vis private enterprise without any authoritative international guidance as to its scope and contents. The result may be not just gaps and overlaps, but "flags of convenience," "license shopping" and a growing disinterest in taking care of liability issues altogether.[239]

Although linking the nationality of private entities to that of the State for liability purposes is one solution proposed above, the question of liking nationality to spacecraft remains unresolved.

For whatever reasons, States have so far refrained from conferring nationality to spacecraft.[240] This article will not enter the debate over whether assignment of nationality to space objects (suborbital or orbital) would be another useful method for vetting liability. Rather, a summary of Orbit Law's position is simply that liability be apportioned between all parties (State and/or private) who maintain some interest in the space object in question. The current space law regime of sole State responsibility and liability does not seem equitable; unless the State is truly the sole actor in its space missions, inconsistent and uncertain methods of assigning private party accountability hamper both the private party's involvement and their cooperation with the parent State and other States.

But States need not be removed entirely from the Orbit Law equation. If the State does maintain a role in supervising private industry, such as safety oversight, manufacturing standards, personnel qualifications, licensing, etc., and some amount of State fault contributed to an accident, then the State might be enjoined with any involved private entities for international liability and responsibility. State jurisdiction over private entities, and State imposition of national laws to ensure private party responsibility, might also be a necessary hold-over from existing air law and space law methods of accountability for wrongs and accidents. For example, contemporary space law often results in the "launching State(s)" requiring its private

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[239] Frans G. von der Dunk, *The 1972 Liability Convention – Enhancing Adherence and Effective Application*, 41ST COLLOQ. L. OUTER SPACE 366, 372 (1998).

[240] Bin Cheng, *Nationality for Spacecraft?*, *in* STUDIES IN INTERNATIONAL SPACE LAW 475, 482 (Bin Cheng, ed., 1997) [hereinafter *Nationality for Spacecraft?*].

companies to reimburse third parties for any damage resulting from its space activities; there exists no international body with jurisdiction over private space activities. Perhaps a more effective approach would be to expand Orbit Law's scope of coverage to include jurisdiction over all suborbital and orbital flights, be they *public or private*.

As discussed in the previous Section B, some aspects of the application of air law to suborbital flights, and its eventual transition to Orbit Law, might also be considered for orbital flights. One aspect of this notion that could prove especially effective includes the Montreal Convention's establishment of a set amount of first-tier liability (e.g. 100,000 Special Drawing Rights (SDRs)),[241] and a first-tier determination of fault closely akin to a blending of the notions of strict liability and *res ipsa loquitur*. Furthermore, any imposition of damages in Orbit Law *above* the first tier would require substantiation just like the current air law regime.[242]

Although suborbital and orbital flight would both likely qualify as inherently dangerous activities and thereby a subcomponent of inherently dangerous space activities,[243] the Liability Convention's imposition of "absolute liability"[244] needs curtailment if Orbit Law is expected to flourish. Absolute liability is a term of art found in the Liability Convention, and while similar to strict liability, has fewer exceptions and stricter application than true strict liability.[245] Instead, some combination of strict liability and *res ipsa loquitur* for all suborbital and orbital flight liability determinations would likely meet the dual interests of victim protection and industry/insurance stability. Although the historical imposition of strict liability for inherently dangerous activities might be well-founded, one other pro-

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[241] Special Drawing Rights are calculated by the International Monetary Fund based on the fluctuating value of the Euro, British Pound Sterling, Japanese Yen, and U.S. Dollar. *See* DEMPSEY & MILDE, *supra* note 185, at 2.

[242] *Id.* at 183.

[243] *See* CARL Q. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 59 (New York : Pergamon Press, 1982).

[244] Liability Convention, *supra* note 130, at art. II.

[245] Ram S. Jakhu, Lecture at the Faculty of Law, McGill University: Space Law: General Principles (Nov. 13, 2006) (on file with author).

posal that Orbit Law might consider over time would be to eventually apply *fault*-based liability for *all* suborbital and orbital flights. This suggestion would closely resemble the second tier liability scheme of the Montreal Convention (albeit the Montreal Convention does have a basis of presumed negligence with a reversed burden of proof),[246] and already comport with the existing rule for all space-based accidents under Article III of the Liability Convention.[247] Determination of whether a true fault-based system (i.e. Liability Convention) or a presumptive negligence system (i.e. Montreal Convention) is more effective may be tested over time as Orbit Law transitions from air law for suborbital flights, and space law for orbital flights, to the ultimate Orbit Law gambit of liability.

Analysis of whether punitive damages for deliberate malfeasance should be authorized is another area for consideration as Orbit Law matures. Although insurance premiums would likely escalate if this proposal were approved, one must weigh whether such penalties would have the desired deterrent effect on those who might consider neglecting suborbital or orbital flight safety. And as previously mentioned, a closer examination of what additional damages might be included in this new compensation design (e.g. mental injuries, financial losses, pain and suffering, etc.) must also be performed. Again, a risk-benefit analysis by those eventually drafting an Orbit Law treaty must determine whether restitution for all possible losses outweighs the need for stable and affordable insurance and liability planning.

In summary, existing air law and space law seems to display a trend of greater protection for more terrestrial or near-space damages; air accidents are provided recovery under the Montreal Convention, while space objects causing damage on Earth or to aircraft in flight are provided recovery under the Liability Convention. Both systems appear to be designed as a method for victim-oriented restitution. But if air law currently follows a pattern of *res ipsa loquitur* and presumptive fault for its liability determinations, yet space launches impose a stricter

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[246] DEMPSEY & MILDE, *supra* note 185, at 182.
[247] Liability Convention, *supra* note 130, at art. III.

standard of "absolute liability" under the Liability Convention, one must ask why there is such a difference, especially in light of the merging air and space capabilities of hybrid craft? Of greater concern is yet another standard for liability determinations when an object finally reaches space – Article III of the Liability Convention allows recovery under a fault/negligence-based system. Rather than having three separate designs for recovery (airspace under the Montreal Convention, near space under Article II of the Liability Convention, and outer space under Article III of the Liability Convention), why not apply some combination of strict liability and *res ipsa loquitur* for all suborbital and orbital flights? Or as another alternative, why not consider simple fault-based/negligence-based liability for all flights? Tiers of recovery might also be contemplated and modeled after the Montreal Convention, and perhaps even ceilings of liability as discussed in the U.S. Commercial Space Launch Act. Whether liability above certain set amounts would revert back to the State or remain with the private entity will likely be the subject of much deliberation and analysis.

Any of these considerations will require new legislation to be drafted as part of Orbit Law's eventual departure from pure air law and space law, but ineffective proposals could also be scheduled for eventual expiration as discussed in the Sunset Clause of Section E. Hopefully these thoughts will generate discussion and debate on the best methods of liability determination, which may eventually be applied to both suborbital and orbital flights. A discussion of Orbit Law's reflections on State sovereignty and overflight rights will be reserved for Section E as well.

E. Inter-Orbital Flights

Because there is not yet any data on legal issues facing interplanetary or interstellar missions, not too much can be said about the application of Orbit Law to inter-orbital flights. Nonetheless, the proposals (and flexibility) of Orbit Law should be relevant to these flights as well. The same legal provisions relevant to orbital flights (i.e. application of space law, and its eventual transition to Orbit Law) should be considered germane

to inter-orbital flights. This identical treatment represents a logical extension of existing space law to inter-orbital flight; as such travel becomes more technologically feasible, Orbit Law's growth can envelop any new nuances of inter-orbital flight into its corpus of suborbital, orbital, and inter-orbital laws.

F. Additional Provisions

i. The Solution to Sovereignty – The Open Skies Proposal

Given the numerous and liberal exceptions to the rule of State airspace exclusivity or ownership over its skies that have evolved over the years, the notion of State airspace sovereignty looks to be an outdated concept. It certainly appears to have outlived its usefulness and applicability in international law, with Orbit Law potentially offering the system to usher in a new era of Open Skies.

The extent of exclusive State sovereignty and any corresponding State action is still limited to that which is permitted under international law.[248] As one example of such limitations on State action, authorization for emergency landing by craft in distress represents a longstanding right in international law.[249] In the *Aerial Incident of 1955*, this case dictated that although aircraft are not specifically permitted a right of entry for distress under the Paris Convention, Article 22 did provide that "[a]ircraft of the contracting States shall be entitled to the same measures of assistance for landing, particularly in case of distress, as national aircraft. . .," while Article 25 of the Chicago Convention requires that "[E]ach contracting State undertakes to provide such measures of assistance to aircraft in distress in its territory. . . ."[250] Such a "right of entry" therefore means that States must not forcibly prevent a vessel in distress from land-

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[248] *See* Palmas Island Case, 2 RIAA 821 (1928); *See also* Case of SS Lotus, (France vs. Turkey), PCIJ Ser., A. No. 10 (1927).

[249] Memorial of U.K. (Israel v. Bulgaria; U.S. v. Bulgaria; U.K. v. Bulgaria), 1959 I.C.J. pleadings (Aerial Incident of 27 Jul. 1955) 331, 358-9 (Memorial dated 28 Aug. 1958).

[250] *Id.*

ing.[251] Although these caveats do not rise to the level of aircraft having an unfettered "right" to enter a State's airspace, States do have an obligation to allow craft in distress to enter.

Further examples of diminished State sovereignty include limited incursions allowed under the Law of the Sea, where both State and merchant ships enjoy a right of innocent passage through a State's territorial seas.[252] The Law of the Sea also authorizes aircraft to navigate through international straights and archipelagic sea lanes within State territory.[253] Open skies are currently a *de facto* transit right throughout most of the world under the Chicago Convention and bilateral agreements, with most restrictions on airspace overflight focused on commercial activity. And although the breadth of State sovereignty is currently expansive, it is not exclusive – international law and the relevant space treaties make it clear that national sovereignty does *not* extend to outer space.[254]

International law has also not found violations of sovereignty to be a compensable event. Respect for territorial jurisdiction has never been an *erga omnes* obligation; States are only liable for violations of international obligations which injure another State.[255]

Space law emphasizes international cooperation rather than compensation for alleged territorial violations. For example, under the Liability Convention's Article I(a) use of the phrase "damage means" rather than "damage includes" indicates a complete definition rather than a partial sampling of compensation options. This definition of "damage" does not imply any cause of action for trespass *per se*[256] and was the result of contentious negotiations which declined broader theories of recovery or more expansive definitions of "damage."[257] The legis-

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[251] *See* Bryan Schwartz & Mark L. Berlin, *After the Fall: An Analysis of Canadian Legal Claims for Damage Caused by Cosmos 954*, 27 MCGILL L.J. 676, 702 (1982).

[252] Convention on the Law of the Sea, art. 17, Dec. 10, 1982, 1833 U.N.T.S. 3.

[253] *See* Bin Cheng, *The Commercial Development of Space: the Need for New Treaties, in* STUDIES IN INTERNATIONAL SPACE LAW 648-49 (Bin Cheng, ed., 1997).

[254] *See* Bin Cheng, *From Air Law to Space Law, in* STUDIES IN INTERNATIONAL SPACE LAW 33 (Bin Cheng, ed., 1997).

[255] *See* East Timor (Australia v. Portugal), 1995 I.C.J. 90, 214 (Jun. 30).

[256] Schwartz & Berlin, *supra* note 251, at 707, 713.

[257] *Id.* at 720.

lative history of the Liability Convention reveals an intent to compensate victims of damage from space objects, not to save plaintiff States from intrusions into their territory.[258] On a similar vein, the Rescue and Return Agreement, and the Outer Space Treaty, emphasize tolerance and international cooperation to resolve instances of unintentional intrusions by space objects, rather than condemning them as violations of State sovereignty.[259] And the Liability Convention focuses on restoration of the victim to their previous status through compensation for physical, material injury; purely symbolic damage is nowhere contemplated as a theory of recovery.[260]

So what is the remedy for unauthorized overflight? Based on the existing air law and space law treaties and historical precedence, there does not appear to be any formal solution other than diplomatic rhetoric between the offending and offended States. Although ICAO has specifically stated that there is no right of innocent passage for spacecraft above State territory, there is no proposed outcome if such a flight occurs anyway.[261] Taking this outcome one step further, if one were to "lower the ceiling" of the longstanding principle that satellite orbits do not violate State-sovereign airspace, Orbit Law's Open Skies will facilitate greater freedom of air-space movement. For comparison, the United Nations Principles of Remote Sensing already reflects an Open Skies policy. Although the document is non-binding, its inception signals an imminent redefinition of traditional sovereign rights.[262]

Under current international law, in cases of unauthorized entry into the territory of another State (primarily through aircraft incursions), that aircraft-intruder's State of nationality may exercise protective competence through diplomatic intervention.[263] That State can also demand fair treatment of passengers and property, along with their safe return, and (when

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[258] *Id.* at 713.

[259] *Id.*

[260] *See* Liability Convention, *supra* note 130, at arts. VIII, XII.

[261] Draft Brief for the ICAO Observer, *supra* note 77.

[262] *See* Susan M. Jackson, *Cultural Lag and the International Law of Remote Sensing*, 23 BROOKLYN J. INT'L L. 853,(1998).

[263] MCDOUGAL, ET AL., *supra* note 11, at 522.

warranted) compensation from abuse of authority.[264] More importantly, Article 3 *bis* of the Convention on International Civil Aviation (Chicago Convention) clearly prohibits use of force against civil aircraft for violations of airspace.[265] In fact, international law requires any military response (against aircraft, space assets, or any other potential target) to take into consideration the principles of the Law of Armed Conflict, which include the determination of military necessity, distinction of targeting, proportionality in response, and humanity to reduce and alleviate unnecessary suffering.[266] Although States might certainly share security concerns over unidentified assets entering their airspace, technically Article 51 of the U.N. Charter on its face does not appear to authorize "anticipatory self defense."[267] The plain reading of the text[268] requires that an armed attack first occur before defensive actions are authorized.[269] This requirement is clearly in conflict with many State's defensive policies, but rather than taking an aggressive posture against unauthorized incursions, Open Skies under Orbit Law might reduce these security concerns and enable a more reasonable response to unexpected or unidentified overflights.

Successful methods for identification of aircraft, through registration, nationality marks, route planning, and radio correspondence, have been in place for years:[270]

> For obvious reasons, techniques for the prompt and precise identification of spacecraft are of more urgent importance for both minimum and optimum order than was the case previously with respect to ships and aircraft. It is probable that states will make reciprocal demands for comprehensive and economic systems of identification of space vehicles by means of, for example, assignment of distinct radio signals to each

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[264] *Id.*

[265] Convention on International Civil Aviation, art. 3 *bis*, Dec. 7, 1944, 61 Stat. 1180. [hereinafter Chicago Convention].

[266] *See* Michel Bourbonnière, *Law of Armed Conflict (LOAC) and the Neutralisation of Satellites or Ius In Bello Satellitis*, 9 J. CONFL. & SEC. L. 43 (2004).

[267] *See* U.N. Charter art. 51.

[268] *See* Vienna Convention on the Law of Treaties, art. 31(1), May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention].

[269] U.N. Charter, *supra* note 267.

[270] MCDOUGAL, ET AL., *supra* note 11, at 523.

> spacecraft, disclosure of orbital and transit characteristics, display of external marks, and other appropriate methods that modern technology and human ingenuity may make available.[271]

In order to reduce State concerns over national security that Open Skies might bring, Orbit Law would propose utilization of technology to identify all suborbital and orbital vehicles during flight. Identification of all air and space vehicles would hopefully alleviate State security concerns and thereby authorize access to all States' airspace by such vehicles. Although suborbital craft will initially be governed by air law, they should enjoy Open Skies which mirrors that of space law and the current proposals for orbital flights; these freedoms could eventually be applied to aircraft as well.

Whether or not prior agreements or bilateral instruments would be required is an item for those drafters of the Orbit Law treaty to examine and negotiate, but true Open Skies should not include prior "permission" for overflight that today's bilateral negotiations require. In instances where a suborbital or orbital flight raises some State concern and the craft is not able to be identified or contacted, Orbit Law might authorize the State overflown to intercept, but certainly not engage the craft unless some hostile act was performed by the "intruder." Given today's technical advancements, any obstacle to this program's success is therefore not technological, but rather diplomatic – the difficulty in motivating States to embrace these new proposals.

Are Open Skies really such a controversial proposal for suborbital and orbital flights? The history of prior space object overflights highlighted in Chapter I suggests that it is already an accepted State practice. If these multiple instances of prior State overflights by objects going into orbit constitute the emergence of customary international law, "[T]he passage of only a short period of time is not necessarily, or of itself, a bar to the formation of a new rule of customary international law . . ."[272]

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[271] *Id.* at 524.

[272] North Sea Continental Shelf (F.R.G. v. Den./F.R.G. v. Neth.), 1969 I.C.J. 3, 43, para. 74 (Feb. 20).

And as referenced in Chapter I, Open Skies comports with the *jus cogens* of freedom of exploration and use of outer space;[273] Orbit Law simply extends its scope of coverage slightly closer to Earth.

Stephen Gorove's article on *Aerospace Objects* provides an apt conclusion and a preliminary glimpse at the promise offered by the Open Skies proposal:

> Could a State lawfully deny another State's spacecraft the right of innocent passage at a height of 40-90 km in the space above its territory? Would this violate the fundamental freedom of exploration and use of outer space? Should the answer be influenced by an analogy to the law of the sea where, in the absence of mutual agreement or international convention, a land-locked State has no independent right for access to the sea and claim innocent passage through the territory of a coastal State notwithstanding the principle of the freedom of the seas? Should this be our policy choice for interpreting the freedom of exploration and use of outer space enshrined as a fundamental principle in the 1967 Outer Space Treaty? A courageous negative answer to this will be a challenge for air and space lawyers in the 21st century.[274]

Unlike landlocked States under the Law of the Sea, though, every State borders airspace, and thereby outer space. It is therefore in the interest of all States to embrace the notion of Open Skies in a unified effort to "slip the surly bonds of Earth" if we ever hope to "touch the face of God."[275]

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[273] *See* Outer Space Treaty, *supra* note 9, at art. I.

[274] *See* Gorove, *supra* note 67, at 111-12.

[275] John Gillespie Magee, Jr., *High Flight*, *in* FAVORITE POEMS 203 (Helen Ferris Tibbets ed., 1957)

> Oh! I have slipped the surly bonds of Earth
> And danced the skies on laughter-silvered wings;
> Sunward I've climbed, and joined the tumbling mirth
> of sun-split clouds,—and done a hundred things
> You have not dreamed of—wheeled and soared and swung
> High in the sunlit silence. Hov'ring there,
> I've chased the shouting wind along, and flung
> My eager craft through footless halls of air….
>
> Up, up the long, delirious, burning blue
> I've topped the wind-swept heights with easy grace

ii. Sunset Clause Proposal

It seems fitting that an analysis of a new air and space regime includes a section on sunset clauses. However, contrary to this section's title, there is really nothing heliocentric to this proposal. Black's Law Dictionary defines a sunset clause as "[a] statute under which a governmental agency or program automatically terminates at the end of a fixed period unless it is formally renewed."[276] Because this article has repeatedly referenced the eventual transition from air law and space law principles to new Orbit Law principles, the drafters of such a convention might contemplate setting a date certain to retire those old standards. If suborbital flights will eventually merge with orbital flights under one cannon of Orbit Law, a timetable for such transition is advisable. Setting such deadlines will prompt those legislators of Orbit Law to continually review and revise this regime to preserve its best aspects, test those theories requiring further analysis, and jettison any tenants which are not conducive to the success of the program.

IV. CONCLUSION[277]

Has the time finally come to reevaluate the legal dicta of international air law and space law, or are these current systems and the rhetoric that has evolved little over the past five decades sufficient to cabotage the weighty cargo of the existing air and space treaties on their journey into the twenty-first century? Continued technological advancements and extended capabilities of hybrid flight vehicles lend support to the notion of change, rather than maintaining the *status quo*. In the early days of space flight, the functional—spatial demarcation of airspace and outer space was a logical bifurcation of solutions. But the blending of airspace and outer space through the advent of

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> Where never lark nor ever eagle flew—
> And, while with silent lifting mind I've trod
> The high untrespassed sanctity of space,
> Put out my hand, and touched the face of God. *Id.*

[276] BLACK'S LAW DICTIONARY 1478 (8th ed. 1999).

[277] *Hybrid Hops*, *supra* note 1, at 806.

hybrid flight vehicles, and a recommendation to envelop *all* flights into one overarching legal system based on *orbital* status, seems to be the next logical step in the evolution of flight.

Orbit Law would initially apply existing principles of international air law to all suborbital flights, while governing all orbital and inter-orbital flights under current space law principles. Careful examination of liability systems which promote the growth and development of suborbital and orbital flights should be applied, along with the encouragement of Open Skies and eventual dissolution of sovereign boundaries for *all* such flights. Some blending of strict liability and *res ipsa loquitur* represents the most equitable method to hold public and private actors liable and responsible according to their degree of involvement in any flight accident. The separate legal structures applicable to suborbital and orbital/inter-orbital flights must be tested to determine the most successful and useful configurations, and should ultimately be united into a fine-tuned international treaty. By apportioning responsibility under one unified liability regime, and advancing Open Skies by utilizing technology to quickly identify all suborbital and orbital craft, the evolution of Orbit Law will advance State and corporate participation across all frontiers of flight.

Should States eventually embrace these suggestions, they will be able to select which solutions work best for suborbital, orbital, and inter-orbital flights. Inclusion of a Sunset Clause in Orbit Law will also give them the hindsight to retain, modify, or jettison any principles depending on their degree of success in the early years of application.

Quod Erat Demonstrandum

LEGALITY OF THE DEPLOYMENT OF ANTI-SATELLITE WEAPONS IN EARTH ORBIT: PRESENT AND FUTURE

Shang Kuan[*]

I. INTRODUCTION

We are now living in a vacuum of binding international law on the development and deployment of anti-satellite weapons. As the weaponization of outer space and proliferation of anti-satellite weapons intensifies, more and more scholars are beginning to question the legality of the development and deployment of anti-satellite weapons under the current framework of international law and are suggesting the possibility of outlawing such weapons in a future international treaty.

This paper, structured in three parts, is consequently written in response to these questions. The first part of this paper will briefly introduce the current framework of international laws regulating the development and deployment of anti-satellite weapons. As represented by Article 2(4) of the United Nations Charter,[1] Article 1(1)(a) of the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water,[2] and the Preamble and Article I, II and IV of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and

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[1] U.N. Charter art. 2, para 4.

[2] See Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water, art. 1(1), *opened for signature* Aug. 9, 1963, 14 U.S.T. 1313, 480 U.N.T.S. 43, [hereinafter Limited-Test-Ban Treaty].

Other Celestial Bodies,[3] international law has failed to respond to the legality of the development and deployment of anti-satellite weapons.

The second part of this paper is written to provide a detailed argument that the development and deployment of anti-satellite weapons do not contravene international law. The paper submits that they do not contravene the Outer Space Treaty *per se*, since the Treaty has only banned nuclear weapons and weapons of mass destruction to be placed in orbit; the "peaceful use" expression in the preamble of the Treaty is not legally binding,[4] and non-aggressive anti-satellite weapons are needed to be deployed in executing the right of self-defence. Furthermore, the development and deployment of anti-satellite weapons also do not contravene international customary law, since no State practice or *opinio juris* exists in forming an international customary law to ban the development and deployment of such weapons.

Consequently, the third part of this paper analyses the possibility of drafting a new treaty explicitly banning or restricting the usage of anti-satellite weapons. Although many nations[5] and scholars[6] suggest that a new treaty banning all

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[3] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, pmbl., arts. I, II, IV, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610, U.N.T.S. 205 [hereinafter Outer Space Treaty].

[4] *See* Major Douglas S. Anderson, *A Military Look into Space: the Ultimate High Ground*, 1995 ARMY LAW. 19, 24 (1995); Marko G. Markoff, *Disarmament and "Peaceful Purposes" Provisions in the 1967 Outer Space Treaty*, 4 J. SPACE L. 3, 11 (1976); *see also* Nina Tannenwald, *Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space*, 29 YALE J. INT'L L. 363, 404 (2004).

[5] These nations include China, Russia, France and Canada. *See* Lori Scheetz, *Infusing Environmental Ethics into the Space Weapons Dialogue*, 19 GEOIELR 57, 65-66 (2006) (stating that "China and Russia have presented proposals [at the the U.N. Conference on Disarmament] to ban weapons based in space and the use of force directed at objects in space . . . . France and Canada support the notion that the space environment should be free from weapons."). *See also* Sean R. Mikula, *Blue Helmets in the Next Frontier: the Future is Now*, 29 GA. J. INT'L & COMP. L. 531, 549-50 (2001) (the Chinese Ambassador to the United Nations on Disarmament voiced his country's view that "[t]he prevention of an arms race and the prohibition of weapon systems in outer space will ... exempt outer space from wars ... [and will] be crucial for maintaining peace, security, and stability on the Earth." Russian President Vladimir Putin […] holds to the same position […].).

militarization of outer space should be signed, preferably based on the Antarctic Treaty model, there is still a long way to go in achieving such a treaty. With the major powers of the world reluctant to sign, the possibility of ratifying such a treaty is scarce.

As a final note, this paper concludes that the current vacuum of binding international law on the development and deployment of anti-satellite weapons will possibly continue to exist for a rather long time, and international criticism will serve as the most powerful controller to slow down the process of the proliferation of anti-satellite weapons. As technology develops and the proliferation of anti-satellite weapons accelerates, the international community might finally conclude a total ban treaty in the distant future.

II. THE CURRENT FRAMEWORK OF INTERNATIONAL LAW REGULATING THE DEVELOPMENT AND DEPLOYMENT OF ANTI-SATELLITE WEAPONS

A. Article 2(4) of the United Nations Charter

Article 2(4) of the U.N. Charter[7] provides a general rule governing the use of force among States, which reads, "[a]ll Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations."

Here, the application of Article 2(4), of the U.N. Charter, in outer space makes it unlawful for any State to interfere in a hostile manner with the space assets of another State.[8]

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[6] *See generally* Frank M. Walsh, *Forging A Diplomatic Shield for American Satellites: the Case for Reevaluating the 2006 National Space Policy in Light of A Chinese Anti-Satellite System*, 72 J. AIR L. & COM. 759 (2007); Scheetz, *supra* note 5.

[7] U.N. Charter, art. 2 (4).

[8] *See* Christopher M. Petras, *The Use of Force in Response to Cyber-Attack on Commercial Space Systems -- Reexamining "Self-Defense" in Outer Space in Light of the Convergence of U.S. Military and Commercial Space Activities*, 67 J. AIR L. & COM. 1213, 1258 (2002); *see also* Ivan A. Vlasic, *Space Law and the Military Applications of Space Technology*, *in* PERSPECTIVES ON INTERNATIONAL LAW 385, 394 (Nandasiri Jasentuliyana ed., 1995).

B. Article 1(1)(a) of the Limited-Test-Ban Treaty

The Limited-Test-Ban Treaty[9] is usually considered the first legally binding document renouncing the military use of outer space,[10] as well as the first step towards the "denuclearization of outer space."[11] Article 1(1) of this Treaty reads:

> Each of the Parties to this Treaty undertakes to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control:
> (a) in the atmosphere; beyond its limits, including outer space; or under water, including territorial waters or high seas […]

Nevertheless, as the International Court of Justice's decision in the Nuclear Test Case[12] suggests, the treaty's prohibitions cannot "be regarded as declaratory of general international law."[13]

C. The Preamble and Article I, II and IV of the Outer Space Treaty

Signed in 1967, the Outer Space Treaty[14] is considered the first international agreement that deals exclusively with outer space. The Treaty has been described as the Magna Carta of international agreements pertaining to outer space.[15] Signed

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[9] Limited-Test-Ban Treaty, *supra* note 2.

[10] See Glenn Harlan Reynolds, *The Moon Treaty: Prospects for the Future*, 52 SPACE POLICY 115 (1995); *see also* Petras, *supra* note 8.

[11] G.S. Raju, *Military Use of Outer Space: Towards Better Legal Controls*, *in* MAINTAINING OUTER SPACE FOR PEACEFUL PURPOSES 90, 92 (Nandasiri Jasentuliyana ed., 1984). *See also* Petras, *supra* note 8.

[12] Nuclear Test Case (Austl. v. Fr.), 1974 I.C.J. 253 (Dec. 20).

[13] *See* Bin Cheng, Lectures at the Institute of Public International Law and International Relations, University of Thessaloniki: Outer Space: The International Legal Framework--the International Legal Status of Outer Space, Space Objects, and Spacemen (Sept. 1979), *in* 10 THESAURUS ACROASIUM 41 (1981), *reprinted in* BIN CHENG, STUDIES IN INTERNATIONAL SPACE LAW 383, 408-09 (Clarendon Press 1997). *See also* Christopher M. Petras, *"Space Force Alpha" Military Use of the International Space Station and The Concept of "Peaceful Purposes"*, 53 A.F. L. REV. 135, 149, (2002).

[14] Outer Space Treaty, *supra* note 3.

[15] Ambassador Peter Jankowitsch of Austria, Chairman of the United Nations Committee on the Peaceful Uses of Outer Space (UN-COPUS), Opening remarks to the

and/or ratified by over one hundred nations,[16] the treaty "placed restrictions on military activities in space," and also "provided the principles on which subsequent outer space treaties were drafted."[17]

Within the preamble of the Outer Space Treaty are several phrases that indicate a desire that space activities be carried out peacefully.[18] For instance, it recognizes the "common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes," and that the use of outer space should be carried out "for the benefit of all peoples."[19]

In addition, the Outer Space Treaty states that the "exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."[20] Moreover, outer space "is not subject to national appropriation"[21] and "shall be used . . . for peaceful purposes."[22] Note that the Treaty is framed mainly in terms of exploration and use, not preservation of the space environment.[23]

The extent to which military use of outer space is restricted by the Outer Space Treaty, has been greatly debated. The main focus of this dispute, however, rests on the interpretation of the term "peaceful purposes," as provided in Article IV of the Outer Space Treaty. Some nations argue that the term should be

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Committee on its Twenty-Fifth Anniversary, U.N. Coc. A/AC. 105/PV, 230, at 7, 8 (1982); *reprinted in* 10 J. SPACE L. 41, 41. *See also* Richard A. Morgan, *Military Use of Commercial Communication Satellites: A New Look at the Outer Space Treaty and "Peaceful Purposes"*, 60 J. AIR L. & COM. 237, 296 (1994).

[16] *See* Major John E. Parkerson, Jr., *International Legal Implications of the Strategic Defense Initiative*, 116 MIL. L. REV. 67 (1987). *See also* Anderson, *supra* note 4, at 24.

[17] *See* Anderson, *supra* note 4, at 24.

[18] *Id.* at 25.

[19] Outer Space Treaty, *supra* note 3, at preamble.

[20] Outer Space Treaty, *supra* note 3, at art. I.

[21] *Id.* at art. II.

[22] *Id.* at art. IV.

[23] See David Tan, *Towards a New Regime for the Protection of Outer Space as the "Province of All Mankind"*, 25 YALE J. INT'L L. 145, 165-66 (2000). *See also* Scheetz, *supra* note 5, at 59.

understood to mean "non-military," while others argue that it should mean "non-aggressive."[24]

III. STATUS QUO: THE DEVELOPMENT AND DEPLOYMENT OF ANTI-SATELLITE WEAPONS DO NOT CONTRAVENE INTERNATIONAL LAW

A. The Development and deployment of anti-satellite weapons do not contravene international treaties

i. The Outer Space Treaty and other international treaties have not explicitly banned the development and deployment of anti-satellite weapons

As discussed in the previous part of this paper, Article IV, of the Outer Space Treaty, does not represent a complete restriction on the placement of weapons in outer space.[25] Article IV prohibits only the placement of nuclear weapons and other weapons of mass destruction in outer space *sensu stricto* and is silent on the subject of conventional weapons.[26] Also, the development and deployment of anti-satellite weapons do not contravene other relevant international treaties. In other words, the current international law regime for outer space has failed to prohibit weaponization of space by failing to address conventional space weaponry.[27]

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[24] Michael N. Schmitt, *Bellum Americanum: The U.S. View of Twenty-First Century War and Its Possible Implications for the Law of Armed Conflict*, 19 MICH. J. INT'L L. 1051, 1087 (1998). *See also* Petras, *supra* note 8, at 139.

[25] *See, e.g.,* Gyula Gal, *"Threat or Use of Force" -- Observations to Article 2 of the U.N. Charter and Article III of the Outer Space Treaty*, 17 J. SPACE L. 54, 55-57 (1989). *See also* Jackson Maogoto & Steven Freeland, *the Final Frontier: the Laws of armed Conflict and Space Warfare*, 23 CONN. J. INT'L L. 165, 180 (2000).

[26] Michel Bourbonnière, *Legality of the Deployment of Conventional Weapons in Earth Orbit: Balancing Space Law and the Law of Armed Conflict*, 18 EUR. J. INT'L L. 873, 888 (2007).

[27] *See* Scheetz, *supra* note 5, at 63.

ii. Developing and deploying anti-satellite weapons do not contravene the Outer Space Treaty as long as they are used non-aggressively

Currently, there are two competing interpretations of the "peaceful purpose" provision,[28] of the Outer Space Treaty, submitted by space law scholars: "non-military" and "non-aggressive."[29] However, although it may seem to still be a disputable issue within the international community, since some space law commentators and developing countries argue in favour of the "non-military" interpretation, the reality has, unfortunately, been different.[30] In fact, a consensus has already been established among spacefaring nations that the term "peaceful" should be interpreted as "non-aggressive,"[31] while no State has ever formally protested against this interpretation.[32]

Specifically, the United States has, from the very beginning of the space age up to the present day, maintained the official position that "peaceful" means "non-aggressive" and not "non-military,"[33] and has therefore determined that pursuing space weapons is not only permitted by the Outer Space Treaty, but is also consistent with the aims of the Treaty.[34] A position also

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[28] Outer Space Treaty, *supra* note 3, at preamble.

[29] *See, e.g.*, Richard A. Morgan, *supra* note 15, at 240-241 and 304; BRUCE A. HURWITZ, THE LEGALITY OF SPACE MILITARIZATION 58, n.20 (1986); Eilene Galloway, *International Institutions to Ensure Peaceful Uses of Outer Space*, IX ANNALS AIR & SPACE L. 310 (1984).

[30] *See* Bin Cheng, *The 1967 Outer Space Treaty: Thirtieth Anniversary*, XXIII AIR & SPACE L. 156, 159 (1998). *See also* Maogoto & Freeland, *supra* note 25, at 179.

[31] *See* Morgan, *supra* note 15, at 303.

[32] *See* CHENG, STUDIES IN INTERNATIONAL SPACE LAW, *supra* note 13, 522(1997).

[33] *See* US Congress, Treaty on Outer Space: Hearings before the Senate Committee on Foreign Relations, 90th Cong. (1967), at 22, 59 (statement of Arthur J. Goldberg, US Ambassador to the UN); Bin Cheng, *Definitional Issues in Space Law: the "Peaceful Use" of Outer Space, including the Moon and other Celestial Bodies*, *reprinted in* Cheng, STUDIES IN INTERNATIONAL SPACE LAW, *supra* note 13, at, 513, 515; *See also* S.H. LAY AND H.J. TAUBENFELD, THE LAW RELATING TO THE ACTIVITIES OF MAN IN SPACE 97 (1970); and C.Q. CHRISTOL, THE MODERN INTERNATIONAL LAW OF OUTER SPACE 29-30 (1982). Petras, *supra* note 8, at 1254; Morgan, *supra* note 15, at 303-304, n.353-55.

[34] *See* White House Fact Sheet, National Space Policy (Sept. 1, 1996), *available at* http://www.fas.org/spp/military/docops/national/nstc-8.htm; Commission to Assess U.S. National Security Space Mgmt. and Org., Report of the Commission to Assess United States National Security Space Management and Organization (2001), 13-27, 27-36 *available at* http://www.fas.org/spp/military/commission/chapter2.pdf, http://www.fas.org/spp/military/commission/chapter3.pdf.

accepted by the Soviet Union.[35] This argument is reinforced by the actual state practices of the two superpowers, which quickly established that "peaceful" included passive military means.[36] In contrast, although much of the developing world objects to this interpretation,[37] and prefers to read "peaceful" as meaning "non-military,"[38] no State has ever formally protested the passive military use interpretation, as would be required to prevent a rule of customary international law from being established.[39]

In a nutshell, a consensus can be considered to be concluded in favour of the "non-aggressive" interpretation,[40] leading to the understanding that all military activities in outer space are permissible, unless specifically prohibited by treaty or customary international law.[41] Adopting this view, any non-aggressive device would therefore comply with the "peaceful purposes" provision of the Outer Space Treaty, even if the device is military in nature.[42]

iii. Anti-satellite weapons may need to be deployed in exercising the right of self-defence

The U.N. Charter has supremacy over all international treaties,[43] a concept also recognized in the Outer Space Treaty.[44] Article 51 of the Charter, recognizes that states have the right

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[35] *See* Tannenwald, *supra* note 4, at 373.

[36] *See* STUDIES IN INTERNATIONAL SPACE LAW, *supra* note 13, at 515-16, 528-29; Ivan A. Vlasic, *The Legal Aspects of Peaceful and Non-Peaceful Uses of Outer Space*, *in* PEACEFUL AND NON-PEACEFUL USES OF OUTER SPACE 37, 44-45 (1991) [hereinafter PEACEFUL AND NON-PEACEFUL USES OF OUTER SPACE].

[37] *See* Tannenwald, *supra* note 4, at 373, n. 25.

[38] *See* Morgan, *supra* note 15, at 296.

[39] Tannenwald, *supra* note 4, at 373.

[40] *See* Morgan, *supra* note 15, at 303.

[41] PEACEFUL AND NON-PEACEFUL USES OF OUTER SPACE, *supra* note 36, at 37, 38, & 45.

[42] Cynthia B. Zhang, *Do as I Say, not as I Do -- is Star Wars Inevitable? Exploring the future of International Space Regime in the Context of the 2006 U.S. National Space Policy*, 34 RUTGERS COMPUTER & TECH. L.J. 422, 449 (2008).

[43] Article 103 of The U.N. Charter states: "In the event of a conflict between the obligations of the Members of the United Nations under the present Charter and their obligations under any other international agreement, their obligations under the present Charter shall prevail." U.N. Charter art. 64. *See also* Zhang, *supra* note 42, at 436.

[44] *See* Zhang, *supra* note 42, at 436.

of self-defence when facing "an armed attack,"[45] which is also applicable to the regulation of outer space.[46]

Article IV of the Outer Space Treaty prohibits States from stationing weapons of mass destruction or nuclear weapons in outer space; it does not, in any way, invalidate the inherent right of national self-defence pursuant to customary law and Article 51 of the U.N. Charter.[47] In other words, the "non-aggressive" device has left room to permit armed assets that are capable of self-defence. [48]

Since a State's inherent right to self-defence encompasses military support and application missions, whether terrestrial or space-based,[49] deploying non-aggressive anti-satellite weapons in outer space would therefore not violate the Outer Space Treaty.

iv. The Preamble of the Outer Space Treaty is not legally binding

Apart from the previous arguments listed above, it is also worthy to note that even if the "non-military" interpretation of the "peaceful use" expression in the preamble of the Outer Space Treaty is adopted, the development and deployment of anti-satellite weapons do not contravene international law, since a preamble of a treaty is not legally binding.[50] Therefore, the phrase of "peaceful use" can only be used as persuasive evidence of the drafters' intent.[51]

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[45] U.N. Charter art. 51.

[46] *See* Tannenwald, *supra* note 4, at 397.

[47] *See* CHRISTOL, supra note 33, at 37.

[48] *See* Zhang, *supra* note 42, at 449.

[49] *Id*. at 449.

[50] *See* Anderson, *supra* note 4, at 24; Markoff, *supra* note 4, at 11; Tannenwald, *supra* note 4, at 404.

[51] See Markoff, *supra* note 4, at 11.

v. The Outer Space Treaty, outdated as it may be, does not need an interpretation "in the light of its object and purpose"

Some scholars acknowledge[52] the fact that conventional space weapons are not explicitly banned by the text of the Outer Space treaty, yet they argue[53] that the text of the treaty has became vague[54] as technology advances; thus, the treaty needs to be interpreted "in the light of its object and purpose,"[55] as stipulated under the Vienna Convention of Law of Treaties.[56] Nevertheless, this argument cannot stand since the interpretation of a treaty should always be initially centred on the actual text of the agreement, with an emphasis on the analysis of the words used,[57] closely followed with the subsequent "object and purpose" approach in the interpretation process.[58] A typical argument of these scholars[59] might look like the following:[60]

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[52] *See, e.g.,* Bourbonnière, *supra* note 26, at 881; Kimberly M. Schlie, *Developing and Deploying Laser Weaponery in Space: Is it Legal?*, 4 DEPAUL INT'L L.J. 17, 157 (2000); Alex B. Englehart, *Common Ground in the Sky: Extending the 1967 Outer Space Treaty to Reconcile U.S. and Chinese Security Interests*, 17 PAC. RIM L. & POL'Y J. 133, 142 (2008).

[53] Adam G. Quinn, *The New Age of Space Law: the Outer Space Treaty and the Weaponization of Space*, 17 MINN. J. INT'L L. 475, 487, 491 ("[t]he Outer Space Treaty is inadequate to govern space [… and] is irrelevant to modern space policies.").

[54] *Id*. at 496 (arguing that without proper interpretation, "the [Outer Space] Treaty itself may actually be invalid under the Vienna Convention on the Law of Treaties. . . [due to a] fundamental change in circumstances.").

[55] Article 31.1 of The Vienna Convention on the Law of Treaties states: "A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose." Vienna Convention on the Law of Treaties, art. 31.1, May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention].

[56] Vienna Convention, *supra* note 55, at art. 31.

[57] Gerald Fitzmaurice, *The Law and Procedure of the International Court of Justice 1951-54: General Principles and Sources of International Law*, XXXV B.Y.I.L. 204-07 (1959).

[58] ULF LINDERFALK, ON THE INTERPRETATION OF TREATIES: THE MODERN INTERNATIONAL LAW AS EXPRESSED IN THE 1969 VIENNA CONVENTION ON THE LAW OF TREATIES, 202-3 (Springer, 2007).

[59] *See, e.g*., Quinn, *supra* note 53, 496; Bourbonnière, *supra* note 26, at 888-9; Lieutenant Colonel John C. Kunich, USAF, *Planetary Defense: the Legality of Global Survival*, 41 A.F. L. REV. 119, 134-135 (1997); Morgan, *supra* note 15, at 311-312.

[60] *See generally* Quinn, *supra* note 53; Bourbonnière, *supra* note 26; Kunich, *supra* note 59; Morgan, *supra* note 15; Englehart, *supra* note 52.

a. The Vienna Convention provides that a treaty shall be interpreted in the light of its object and purpose

The Scholars who advocate[61] that the Outer Space Treaty should be interpreted first point to Article 31.1 of the Vienna Convention, which provides that "[a] treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose."[62] Pursuant to this provision, these scholars argue[63] that the "object and purpose" of a treaty is the most important background against which the meaning of any particular treaty provision should be measured.[64] Thus, where a treaty's text is vague and ambiguous, it needs to be interpreted so as to safeguard its object and purpose.

b. The Outer Space Treaty is outdated, and the text of the Treaty becomes vague as technology advances

These scholars[65] would then point to the preamble of the Outer Space Treaty, where the drafters' purpose is indicated: "[The State Parties of this treaty] [r]ecognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes…"[66]

They argue that the goals set forth in the preamble to the treaty remain equally valid today.[67] Nonetheless, technology has changed to such an extent that the text of the treaty is no longer capable of fulfilling those goals,[68] as demonstrated by a broad consensus throughout the international community, there are "some deficiencies in the existing outer space architecture which

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[61] *Id.*

[62] Vienna Convention, *supra* note 55, at art. 31.

[63] *See* Kunich, *supra* note 59, at 134-138.

[64] *See* MALCOLM NATHAN SHAW, INTERNATIONAL LAW, 839 (2006).

[65] *See generally* Quinn, *supra* note 53; Englehart, *supra* note 52.

[66] Outer Space Treaty, *supra* note 3, preamble.

[67] *See* Englehart, *supra* note 52, at 143. *See also* Press Release, The White House, President Bush Announces New Vision for Space Exploration Program (Jan. 14, 2004) http://georgewbush-whitehouse.archives.gov/news/releases/2004/01/20040114-3.htm.

[68] Englehart, *supra* note 52, at 142.

could be strengthened through . . . improving or enhancing the implementation and universalisation of existing agreements."[69]

Furthermore, these scholars argue that the actual meaning of the text of the Outer Space Treaty has increasingly become vague as technology advances.[70] They argue that in 1967, when the Outer Space Treaty was signed, the contracting States had sufficient reason to believe that by banning nuclear weapons and WMDs they were actually banning all space weapons from being placed in outer space.[71] Back in 1967, the stationing of nuclear weapons in orbit was the only significant military threat that most contracting States could envision in space.[72] There was real fear and concern that nuclear weapons would soon be stationed in space,[73] and thus a ban would be best for both superpowers, at that time, and for humanity at large.[74] Moreover, the idea of conventional weaponry in orbit was science fiction at the time, and thus did not merit serious attention in the treaty.[75] Nevertheless, these weapons are being actively pursued currently,[76] and have posed threats which are at least as serious today as the stationing of nuclear weapons in space was in 1967.

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[69] *See* Letter Dated 14 August 2008 from the President of the Conference on disarmament on behalf of the 2008 presidents addressed to the secretary-General of the Conference Transmitting the reports of the seven coordinators submitted to the president of the conferences on the work done during the 2998 session on agency items 1 to 7, U.N. Doc. CD/1846, 15 Aug. 2008.

[70] *See, e.g.*, Englehart, *supra* note 52, at 145; Quinn, *supra* note 53, at 477-478.

[71] *See* Englehart, *supra* note 52, at 145; Quinn, *supra* note 53, at 496.

[72] Englehart, *supra* note 52, at 144.

[73] The U.S. Department of State, Narrative of Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, http://www.state.gov/t/isn/5181.htm#narrative (last visited Jan. 16, 2010).

[74] *Id.*

[75] Englehart, *supra* note 52, at 144.

[76] *See* Andrew T. Park, *Incremental Steps for Achieving Space Security: The Need for a New Way of Thinking to Enhance the Legal Regime for Space*, 28 HOUS. J. INT'L L. 871, 881 (2006); Englehart, *supra* note 52.

c. Interpreting the Outer Space Treaty is therefore needed to safeguard its object and purpose correctly understood by the international community

Finally, scholars advocating for an interpretation of the Outer Space Treaty have reached the conclusion that interpreting the treaty according to its object and purpose[77] is the only way to fulfil the spirit of the treaty in the 21st century. Additionally, they point out that the International Court of Justice pays attention to the advancement of technology when interpreting a treaty, by taking the state of present-day scientific knowledge into account. For instance, the International Court of Justice stated in the *Case concerning Kasikili/Sedudu Island*[78] that: "[i]n order to illuminate the meaning of words agreed upon in 1890, there is nothing that prevents the Court from taking into account the present-day state of scientific knowledge."[79] Consequently, the international community also needs to consider and balance the present-day state of scientific knowledge with that existing in 1967.

Pursuant to the arguments above, these scholars conclude[80] that the Outer Space Treaty should be interpreted in accordance with its object and purpose, with all anti-satellite weapons banned from being deployed in outer space.

Nevertheless, this author submits that the "object and purpose" interpretation should not be employed until textual interpretation fails. When an advocate uses the object and purpose of a treaty in accordance with the provisions of the Vienna Convention, Article 31, the object and purpose is not considered independently of other means of interpretation.[81] The object and purpose is always used in relation to conventional language ("the ordinary meaning"); it is always a second step in the interpretation process.[82]

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[77] *See* Englehart, *supra* note 52, at 143.

[78] Case concerning Kasikili / Sedudu Island (Botswana v. Namibia), 1999 I.C.J. 19, at para. 20 (December 13) (Judgment).

[79] SHAW, *supra* note 64, at 40.

[80] *See, e.g.*, Englehart, *supra* note 52, Quinn, *supra* note 53.

[81] *See* LINDERFALK, supra note 58.

[82] *Id.*

vi. The "non-military v. non-aggressive" debate and the making of future customary law

Detached and apathetic to the "non-military v. non-aggressive debate," many scholars tend to adopt a pragmatic view of the current situation,[83] as they argue that the debate is a "redundant argument"[84] and rather meaningless. They submit that since outer space has been, and continues to be, used for an expanding array of military activities,[85] it is likely that space will increasingly be utilized to further the military and strategic aims of specific countries, particularly as military and space technology continues to evolve and develop.[86] Consequently, a fully developed rule in customary international law may emerge that legalizes the development and deployment of anti-satellite weapons, superseding all "non-military" arguments, unless concrete steps are taken to stop this trend.

B. The development and deployment of anti-satellite weapons do not contravene international customary law

Under the current international framework, the development and deployment of anti-satellite weapons contravene not only the international treaties, but also customary international law. Custom comprises two elements: the usage or practice of customary international law (State practice), and *opinio juris sive necessitatis*, the belief that the usage is a legal right (*opinio juris*).[87] In this case, however, no State practice or *opinio juris* exists in forming an international customary law banning the development and deployment of anti-satellite weapons.

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[83] *See* Maogoto & Freeland, *supra* note 25, at 181.
[84] *Id*.
[85] *See* Cheng, *supra* note 30, at 159.
[86] Maogoto & Freeland, *supra* note 25.
[87] Continental Shelf (Libya v. Malta), 1985 I.C.J. 13, 20 (June 3).

i. No State practice exists to form an international customary law banning anti-satellite weapons

a. Space-faring nations have not stopped developing anti-satellite weapons

Although the space-faring nations stopped testing anti-satellite weapons in 1985,[88] they never stopped developing these weapons.[89] In fact, the development of anti-satellite weapons is actively pursued by these nations. For instance, the U.S. government has declared: "[p]urposeful interference with U.S. space systems will be viewed as an infringement on our sovereign rights. The U.S. may take all appropriate self-defence measures, including, . . . the use of force, to respond to such an infringement on U.S. rights."[90] Several U.S. government publications have similarly called space a "vital national interest," a traditional governmental term of art for objectives of such importance that armed force would be used to protect them.[91] "Space was also of growing importance to the U.S. military, as evidenced by the 1982 creation of a separate Space Command within the U.S. Air Force."[92] Moreover, in 2006 the

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[88] *See, e.g.,* Walsh, *supra* note 6, at 760, n.3; Lori Damrosch, *The Future of International Law*, 101 AM. SOC'Y INT'L L. PROC. 233, 235 (2007) (stating that "the Soviet Union ended its [anti-satellite weapon] testing in 1982, and the last U.S. test was in 1985."); Michael W. Taylor, *Trashing the Solar System One Planet at a Time: Earth's Orbital Debris Problem*, 20 GEO. INT'L ENVTL. L. REV. 1, 11. (2007).

[89] *See* Englehart, *supra* note 52, at 133.

[90] U.S. Dep't of Defense, *"U.S. Department of Defense, Dir. 3100.10" Space Policy*, *in* DEPARTMENT OF DEFENSE DICTIONARY OF MILITARY AND ASSOCIATED TERMS 253 (1999).

[91] John M. Logsdon, George Washington University's Space Policy Institute, Reflections On Space As A Vital National Interest, 2 (2003) (citing The White House, A National Security Strategy for a New Century (1999) and U.S. DOD, Quadrennial Defense Review Report (2001)) 45, *available at* http://www.gwu.edu/%7Espi/assets/docs/space_as_a_national_interest.pdf.

[92] Major Elizabeth Seebode Waldrop, *Integration of Military and Civilian Space Assets: Legal and National Security Implications*, 55 A.F. L. REV. 157, 160 (2004). A unified Command, the United States Space Command (USSPACECOM), was created in 1985, including three service component commands-the Air Force Space Command (created in 1982), the Naval Space Command (created in 1983), and the Army Space Command (created in 1988). *See* COLIN S. GRAY, AMERICAN MILITARY SPACE POLICY: INFORMATION SYSTEMS, WEAPON SYSTEMS & ARMS CONTROL 115 (1982); Anderson, *supra* note 4, at 20; Burrus M. Carnahan, *The Legality of A High-Technology Missile Defense System: The ABM and Outer Space Treaties*, 78 AM. J. INT'L L. 418, 422, n 43; Lieutenant General Thomas S. Moorman, Jr., United States Air Force, *Space, a New*

U.S. government announced a new National Space Policy (2006 Space Policy).[93] It is estimated that the United States also invested approximately $1 billion in developing anti-satellite weapons, in that year.[94] In addition, Russia sees "space warfare as a distinct possibility in the future."[95]

Similarly, China has also expressed its determination in developing military satellites. In 2003, a Chinese military official commented on China's army already integrating the concept of space force strength,[96] indicating that Chinese space programs are significantly driven by military and security considerations,[97] and "the Chinese space program has always been under the command of senior officers of the People's Liberation Army."[98] China's Central Committee has given "its highest priority to the development" of anti-satellite weapons since 1998;[99] this nation has invested between $1.4 and $2.2 billion on its space program over the past decade.[100]

Strategic Frontier, AIRPOWER J., 14, 18 (Spring 1992); Mikula, *supra* note 5, at 554 (noting that "the Army, Navy, and Air Force. . . . fall[s] under the overall control of the United States Space Command.").

[93] U.S. Office of Science & Technology Council, United States National Space Policy 1 (2006), www.fas.org/irp/offdocs/nspd/space.pdf [hereinafter "2006 Space Policy"].

[94] *See* David A. Koplow, *ASAT-Isfaction: Customary International Law and the Regulation of Anti-Satellite Weapons*, 30 Mich. J Int'l L 1187, 1194 (2009); *see also* National Public Radio (NPR), *Does China Test Signal Weapons Race?*, *Talk of the Nation: Science*, Jan. 26, 2007, http://www.npr.org/templates/transcript/transcript.php?storyId=7039546 (noting that Ms. Victoria Samson, a research analyst at the Center for Defense Information, stated that "[w]e looked at the budget request from last year, and there could be $1 billion for programs that could have that kind of [anti-satellite] space weapons capability.").

[95] *See* Maogoto & Freeland, *supra* note 25, at 169; *see also* Michael R. Gordon & David S. Cloud, *U.S. Knew of China's Missile Test, but Kept Silent*, N.Y. TIMES, Apr. 23, 2007, at A1; Peter Spiegel, *U.S. Gauges the Threat to Satellites*, L.A. TIMES, Apr. 22, 2007, at A1.

[96] Leonard David, Pentagon Report: China's Space Warfare Tactics Aimed at U.S. Supremacy, Space (2003) http://www.space.com/news/china_dod_030801.html.

[97] *See* James Perry, *Operation Allied Force: The View from Beijing*, 14(2) AEROSPACE POWER J. 79, 81-82 (Summer 2000); *see also* Maogoto & Freeland, *supra* note 25, at 169.

[98] Maogoto & Freeland, *supra* note 25, at 186; *See* China in Space, China's Spacecraft, SPACE TODAY, http:// www.spacetoday.org/China/ChinaSatellites.html (last visited Jan. 16, 2010); *See* Gabriele Garibaldi, The Chinese Threat to American Leadership, http://www.asianresearch.org/articles/2435.html (last visited June 14, 2010).

[99] Walsh, *supra* note 6, at 767; *See* Paul Beaver, *China Develops Anti-satellite Laser System*, JANE'S DEF. WKLY., Dec. 2, 1998, at 18; Paul Richter, *China May Seek Satellite*

b. Space-faring nations have recently carried out new tests of anti-satellite weapons in outer space

In recent years, space-faring nations have restarted testing anti-satellite weapons, after such tests ceased in 1985. On January 11, 2007, China shot down one of its satellites using a ground-based ballistic missile known as an anti-satellite weapon.[101] On February 20, 2008, America destroyed a defunct spy satellite using a warship-based missile.[102]

ii. No opinio juris exists in forming an international customary law banning anti-satellite weapons

a. Space superpowers have stopped testing anti-satellite weapons for various reasons other than fearing a contravention of international law

The space powers have stopped testing anti-satellite weapons since 1985 for several decades.[103] Also, during the late 1980s, the United States and the former Soviet Union negotiated to end the space arms race by freezing tests of anti-satellite weapons.[104]

Laser, Pentagon Warns, L.A. TIMES, Nov. 28, 1998 http://articles.latimes.com/1998/nov/28/news/mn-48519.

[100] *See* Marcia S. Smith, Cong. Research Serv., Doc. No. RS21641, China's Space Program: An Overview 4 (2005); Walsh, *supra* note 6, at 768.

[101] Tim Reid, *"Star Wars" Missile Test Heralds New Arms Race in Space*, LONDON TIMES, Jan. 19, 2007, *available at* http://www.timesonline.co.uk/tol/news/world/asia/article1294519.ece; Zhang, *supra* note 42, at 427.

[102] *See* Koplow, *supra* note 94, at 1210; Catherine Elsworth & Richard Spencer, *Protests after US shoots down rogue spy satellite*, THE DAILY TELEGRAPH, Feb. 21, 2008, http://www.telegraph.co.uk/news/worldnews/1579552/Protests-as-US-shoot-down-rogue-spy-satellite.html; Ewen MacAskill, *US plans missile launch to destroy rogue spy satellite*, THE GUARDIAN, Feb. 15, 2008, http://www.guardian.co.uk/world/2008/feb/15/usa1.

[103] *See, e.g.*, Walsh, *supra* note 6, at 760, n.3; Damrosch, *supra* note 88, at 235; Taylor, *supra* note 88, at 11 unrelared. *See also* Mark Kaufman & Dafna Linzer, *China Criticized for Anti-Satellite Missile Test*, WASH. POST, Jan.19, 2007, at A1, *available at* http://www.washingtonpost.com/wpdyn/content/article/2007/01/18/AR2007011801029.html.

[104] *See* Koplow, *supra* note 94, at 1219. *See also* Harold Jackson, *Reagan now ready to end space arms race: US set to offer a freeze on tests of anti-satellite weapons*, THE GUARDIAN, Sep. 22, 1984.

Scholars[105] advocating that the development or deployment of anti-satellite weapons contravenes international law, argue that the arms race ended, and negotiations[106] began, in the 1980s. At such time, the space powers began to realize that such tests were in contravention of international law, and that anti-satellite weapons tests could produce thousands of pieces of space debris, making it much riskier to put either commercial or military satellites into low-Earth orbits.[107] For example, the Soviet representative to the United Nations Committee on the Peaceful Uses of Outer Space, unofficially acknowledged that the space debris problem affecting the "space environment must be dealt with immediately, rather than leaving it until late in the day as had happened with the Earth's environment."[108] Similarly, former U.S. Vice President Al Gore indicated that the problems of orbital debris and radioactive pollution from space-based nuclear reactors merit international concern.[109]

However, the previous argument can hardly stand, since environmental concerns have never been a major reason for the space powers to stop the arms race. In fact, the negotiations were started for "practical purposes" rather than fearing a contravention of international law as a result of environmental problems. The United States, for instance, stopped testing anti-satellite weapons in the 1980s when it experienced "technical problems" which "forced a delay in the testing of its anti-satellite weapons."[110] Moreover, it is also significant to note that while the space superpowers stopped testing anti-satellite weapons from 1985 to 2007, at the same time they were investing heavily in developing these weapons, as discussed above.

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[105] *See, e.g*. Koplow, *supra* note 94.

[106] *See* Englehart, *supra* note 52, at 141.

[107] *See* David Tan, *supra* note 23, at 165; Scheetz, *supra* note 5, at 59.

[108] Press Release, U.N., Outer Space Committee Considers Agenda of Legal Sub-Committee (1986) OS/1259 3; H.A. Baker, *Liability for Damage Caused in Outer Space by Space Refuse*, 12 ANNALS cited in David Tan, *Towards a New Regime for the Protection of the Outer Space as "Province of All Mankind"*, 25 YALE J. INT'L L. 145, 153 (2000); AIR & SPACE L. 183 (l988).

[109] *See* Albert Gore, Jr., *Outer Space, the Global Environment, and International Law: Into the Next Century*, 57 TENN. L. REV. 329, 334 (1990).

[110] *Id.*

b. No State has expressed the view that developing and deploying anti-satellite weapons would contravene international law

As anti-satellite weapons remain one of the main aspirations that the space powers pursue in their space policies, no State has ever expressed the view that developing and deploying anti-satellite weapons would contravene international law.

Some scholars[111] point to China's 2007 anti-satellite weapon test,[112] and argue that since the international community responded negatively against the test, it could be considered that such weapons would contravene international law. Specifically, they argue that shortly after the test, China was criticized by the United States[113] and Japan.[114] The U.S. expressed its belief that China's development and testing of such weapons is inconsistent with the spirit of cooperation,[115] and labeled the event "regrettable," "very troubling,"[116] "destabilizing,"[117] as well as complained that it was "inconsistent with the spirit of cooperation that both countries aspire to in the civil space area."[118] Japan cast doubt over China by stating: "if

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[111] *See, e.g.,* Koplow, *supra* note 94, at 1215-1264.

[112] On January 11, 2007, China shot down one of its satellites using a ground-based ballistic missile known as an anti-satellite weapon. *See* Tim Reid, *supra* note 101.

[113] *See, e.g.*, *U.S. Criticizes Chinese Anti-Satellite Weapons Test*, THE ASSOC. PRESS (2007).

[114] *See Chinese Foreign Ministry spokesman denies knowledge of anti-satellite weapons test*, THE ASSOC. PRESS, Jan. 20, 2007.

[115] Richard Spencer, *Chinese Missile Destroys Satellite in Space*, THE TELEGRAPH, Jan. 19, 2007, *available at* http://www.telegraph.co.uk/news/worldnews/1539948/Chinese-missile-destroys-satellite-in-space.html.

[116] Christina Rocca, Ambassador, U.S. Permanent Representative to the United Nations, Prevention of an Arms Race in Outer Space, Statement to the Conference on Disarmament (Feb. 13, 2007), http:// www.usmission.ch/Press2007/0213PAROS.html (last visited June 30, 2009) (expressing the U.S. government's view that China's 2007 ASAT test was "regrettable"); *see also* Marc Kaufman & Dafna Linzer, China Criticized for Anti-Satellite Missile Test, Wash. Post, Jan. 19, 2007, at A1 (quoting U.S. administration official saying: "It's unfortunate that China is going down this path .... This sort of thing is such a throwback to the Cold War.").Theresa Hitchens, *U.S.-Sino Relations in Space: From "War of Words" to Cold War in Space?* 5 CHINA SECURITY 12, 25 (Winter 2007). *See also* Koplow, *supra* note 94, at 1237.

[117] Wade Boese, *Chinese Satellite Destruction Stirs Debate*, ARMS CONTROL TODAY, Mar. 2007, at 27, 28. *See also* Koplow, *supra* note 94, at 1238.

[118] Space Security 2008, *supra* note 2, at 55 (quoting a U.S. official calling the Chinese test "inconsistent with the spirit of cooperation that both countries aspire to in the

we could call this a peaceful use" on the legitimacy of the test.[119] The European Union, United Kingdom, Australia, Canada, India, South Korea, and Taiwan also joined in protesting over the test.[120] Even China itself promised after the test that it will conduct no more anti-satellite tests,[121] and reiterated that it was against the militarization of space.[122]

The flaw of the above argument, again, is that these criticisms, harsh they might be, were made mainly out of political concerns rather than based on international legal beliefs. Above all, among these criticisms, no State has ever expressed the position that developing and deploying anti-satellite weapons contravene international law.[123] In contrast, several nations, Britain for instance, expressly declared that they do not believe China's test has contravened international law.[124] The U.S. reacted strongly against the Chinese test, but it did not label the test "illegal" or "inconsistent with" any particular legal obligations.[125] In fact, the U.S. position is contradictory. As delivered in the 2006 Space Policy,[126] the U.S. states that it "will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space."[127]

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civil space area"); *see also* Richard Weitz, *U.S. Allies Criticize China's Anti-Satellite Weapon Test; Media Notes Concerns About U.S. Space Policies*, 13 WMD INSIGHTS 2, 3 (2007) (quoting NASA spokesperson Jason Sharp as saying: "We believe China's development and testing of such weapons is inconsistent with the constructive relationship that our presidents have outlined, including on civil space cooperation").

[119] Chisaki Watanabe, *Allies protest China's Anti-Satellite Test as Militarization of Space*, THE ASSOCIATED PRESS, Jan. 19, 2007 (quoting Japanese Foreign Minister Taro Aso).

[120] *See* Koplow, *supra* note 94, at 1239.

[121] *See China has no plans for more anti-satellite test, Japan's former defense chief says*, THE ASSOCIATED PRESS, Feb. 12, 2007.

[122] Chisaki, *supra* note 119.

[123] *See* Koplow, *supra* note 94, at 1237 (stating that the international community "criticize each other's ASAT experiments [... as] unwise, unwelcome, adverse for international peace and security -- but not illegal.").

[124] *Id.* at 1240 (noting that "Tom Kelly, the spokesperson for Britain's Prime Minister Tony Blair, stated that: 'We are concerned about the impact of debris in space and we expressed that concern. We don't believe that this does contravene international law.'"); *See also* Chisaki, *supra* note 119.

[125] *See* Koplow, *supra* note 94, at 1238.

[126] See 2006 Space Policy, *supra* note 93.

[127] *Id.*

IV. A LONG WAY TO GO FOR THE FUTURE TOTAL-BAN TREATY

A. Some nations and scholars suggest that a new treaty governing the use of outer space should be signed based on the Antarctic Treaty model

As discussed above, military and civilian uses of outer space have overlapped from the outset, blurring the line between fortress and sanctuary.[128] Consequently, space has, arguably, already been militarized.[129] As the militarization of space intensifies, scholars and government officials have begun to evaluate the possibility of having the space powers sit down and negotiate a stricter treaty, banning the development and deployment of all anti-satellite weapons.[130] Specifically, Russia and China have pressed the international community for such a treaty,[131] and China's recent weapon test has been interpreted as an attempt to redefine the "rules of the game" to bring the United States to the negotiating table.[132]

The ideal model for the new treaty, favored by most nations[133] and scholars,[134] is the Antarctic Treaty. Taking the Ant-

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[128] DETLEV WOLTER, COMMON SECURITY IN OUTER SPACE AND INTERNATIONAL LAW 31 (2006).

[129] *See* MICHAEL E. O'HANLON, NEITHER STAR WARS NOR SANCTUARY: CONSTRAINING THE MILITARY USES OF SPACE 8 (2004).

[130] *See* Gordon, *supra* note 95; Joseph Kahn, *China confirms anti-satellite test*, NEW YORK TIMES, Jan. 23, 2007, *available at* http://www.nytimes.com/2007/01/23/world/asia/23cnd-china.html (noting that "China's intentions in conducting this test may have been more diplomatic in nature, designed to pressure the United States to negotiate a treaty to ban weapons in space," and "Russia and China have pressed for the international treaty that would limit the use of space for military purposes.").

[131] Jacob M. Harper, *Technology, Politics, and the New Space Race: the Legality and Desirability of Bush's National Space Policy Under the Public and Customary International Laws of Space*, 8 CHI. J. INT'L L. 681, 682 (2008). *See* Scheetz, *supra* note 5, at 66; Tannenwald, *supra* note 4, at 377; Englehart, *supra* note 52, at 133.

[132] *See, e.g.,* Kahn, *supra* note 130 (reporting that "Xu Guangyu, a former Chinese army officer and an official at the government-run China Arms Control and Disarmament Association, said the anti-satellite test amounted to an attempt to redefine the 'rules of the game' and bring the United States to the negotiating table."); Harper, *supra* note 131, at 682.

[133] *See* Mikula, *supra* note 5 (noting that "Russia and China […] claim to desire complete demilitarization."); Zhang, *supra* note 42, at 435 (noting that "Eisenhower advocated that the basic tenants of the Antarctic Treaty should also apply to outer space."); Tannenwald, *supra* note 4, at 413.

arctic analogy[135] for outer space, supporters of this notion suggest that the new treaty should be made parallel to the Antarctic Treaty,[136] which has prevented the militarization of Antarctica by banning all military activities there,[137] as provided by Article I of the Antarctic Treaty:[138]

> Antarctica shall be used for peaceful purposes only. There shall be prohibited, inter alia, any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military maneuvers, as well as the testing of any type of weapons.

Similar considerations suggest that outer space should be demilitarized like the Moon and other celestial bodies,[139] as provided by Article 3 of the Agreement on the Activities of States on the Moon and Other Celestial Bodies,[140] and that "peaceful purposes" mean no militarization of any sort:

> 1. The moon shall be used by all States Parties exclusively for peaceful purposes.
>
> 2. Any threat or use of force or any other hostile act or threat of hostile act on the moon is prohibited. . . .
>
> 3. States Parties shall not place in orbit around or other trajectory to or around the moon objects carrying nuclear weapons or any other kinds of weapons of mass destruction or place or use such weapons on or in the moon.

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[134] *See generally* Zhang, *supra* note 42; Tan, *supra* note 23; Major Robert A. Ramey, *Armed Conflict on The Final Frontier: The Law of War in Space*, 48 A.F. L. REV. 1 (2000).

[135] *See* Tannenwald, *supra* note 4, at 373 (arguing that outer space, like Antarctica, is among the last unclaimed territories).

[136] *See* Quinn, *supra* note 53, at 483.

[137] See Tannenwald, *supra* note 4, at 374.

[138] Antarctic Treaty, Dec. 1, 1959, 12 U.S.T. 794, 402 U.N.T.S. 71; *see also* Tannenwald, *supra* note 4, at 413.

[139] *See* M.J. Peterson, *The Use of Analogies in Developing Outer Space Law*, 51 INT'L ORG. 245, 257-60 (1997).

[140] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, *opened for signature* Dec. 18, 1979, 1363 U.N.T.S. 21 at arts. 3.1-3.3 [hereinafter Moon Treaty].

> 4. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on the moon shall be forbidden. . . .

B. With the major powers of the world reluctant to sign, the possibility of the signature of a Total-ban Treaty is scarce

Amid suggestions for the adoption of a stricter treaty, this author is of the view that the possibility for a accepting a hardline treaty banning all anti-satellite weapons in the near future is scarce. The main obstacle, as many scholars[141] have pointed out, is the United States' uncompromising position[142] in which it refuses to talk, and instead seeks to preserve "freedom of action" in space.[143]

Another obstacle, albeit one less obvious, is that China and Russia are also reluctant to completely ban space weapons. This sentiment is reflected in the treaty proposal titled, "Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects," submitted by the two nations to the Conference on Disarmament on 2008.[144] As pointed out by the United States, the draft has not banned the research, development, production or storage of anti-satellite weapons, nor has it banned the test

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[141] *See* Zhang, *supra* note 42, at 428; Walsh, *supra* note 6, at 795; Park, *supra* note 76, at 899.

[142] *See* Scheetz, *supra* note 5, at 66 (noting that "the United States has […] a general unwillingness to agree to a weapons-free space environment."). *See generally* Englehart, *supra* note 52.

[143] *See* Kahn, *supra* note 130 (reporting that "President Bush authorized a new space policy that seeks to preserve 'freedom of action' in space, and he said that the United States reserves the right to use force against countries that seek to disrupt American satellites.").

[144] *See* Letter from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament (Feb. 12, 2008), Addressed to the Secretary-General of the Conference Transmitting the Russian and Chinese Texts of the Draft "Treaty on Prevention of the Placement of Weapons In Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT)" Introduced By the Russian Federation and China, Conference on Disarmament, CD/1839 (2008); Letter from the Permanent Representative of China to the Conference on Disarmament (Feb. 12 2008), Addressed to the Secretary-General of the Conference Transmitting A Message from the Minister For Foreign Affairs of China to the Conference on Disarmament, Conference on Disarmament, CD/1836 (2008).

or development of ground-based anti-satellite weapons.[145] Therefore, "[s]ince the draft Treaty only bans the placement of weapons in space . . . a Party could build a breakout capability [of anti-satellite weapons]."[146]

The United States, while finding the Chinese-Russian submission "even more unacceptable" than their previous positions,[147] restated the view that it has consistently stated for nearly three decades: it is not possible to develop an effectively verifiable agreement for the banning of either space-based weapons or terrestrial-based anti-satellite systems.[148]

Therefore, with the major powers of the world all reluctant to fully ban the use of anti-satellite weapons, the probability of obtaining full international acceptance of a future total-ban treaty is slight.

V. CONCLUSION: IS THE PROLIFERATION OF SPACE WEAPONS INEVITABLE?

The current vacuum of binding international law on the development and deployment of anti-satellite weapons will likely continue to exist for a long time. International criticism, political as it may be, will serve as the most powerful force to keep the space powers restrained in their ambitions to develop such weapons, and in turn, slow down the process of anti-satellite weapons, just as the international community accomplished in 2007. Nevertheless, as technology develops, fears will arise that world peace will be greatly threatened if the "States of concern" acquire anti-satellite weapons in the future. If so, then perhaps the international community will finally call again for acquiescence to a total-ban treaty.

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[145] *See* Letter from the Permanent Representative of the United States of America Addressed to the Secretary-General of the Conference (Aug. 19, 2008) Transmitting Comments on the Draft Treaty on Prevention of the Placement of Weapons In Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT) As Contained In Document CD/1839 of 29 February 2008, Conference on Disarmament, CD/1847 (2008).

[146] *Id.* at para. 25.

[147] *Id.* at para. 23.

[148] *Id.* at para. 24.

INSURING HUMAN SPACE FLIGHT: AN UNDERWRITER'S DILEMMA

Paul Ordyna[*]

I. INTRODUCTION

In this last decade, a number of events have significantly altered the way the world perceives risk. Acts of terrorism, natural disasters, and economic turmoil have fundamentally altered public awareness of the inherent risks that permeate human activity. Nowhere has this awareness had such an impact as it has had in the insurance industry. Many of the greatest losses the industry has ever experienced have occurred in the past ten years, including the catastrophic losses sustained in the United States from the September 11, 2001, terrorist attacks. Losses sustained by insurers from these attacks alone amounted to more than one and a half times the next largest catastrophic loss in insurance history.[1] As a result, insurers and underwriters have become extremely sensitive to assessing risk and pricing insurance to adequately cover these risks.

Despite the heightened level of sensitivity among insurance underwriters, many industries still rely on insurance to manage risk, thus affording opportunity for growth.[2] Insurance acts as a risk-shifting device.[3] Essentially, risk is passed from a risk adverse party to a risk-neutral party for a fee.[4] The difficulty lies in fully understanding and assessing the risk. Although both parties present information concerning the risk, a level of un-

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[1] R. Glenn Hubbard et al., *The Economic Effects of Federal Participation in Terrorism Risk,* 8(2) RISK MGMT. & INS. REV. 177 (2005).

[2] Damian Ward & Ralf Zurbruegg, *Does Insurance Promote Economic Growth? Evidence from OECD Countries,* 67(4) J. RISK & INS. 489 (2000).

[3] KENNETH S. ABRAHAM, INSURANCE LAW AND REGULATION 3 (4th ed. 2005).

[4] *Id.*

certainty remains in every insurance contract.[5] Surprisingly, one would think that a phrase like "Anything is possible," should scare insurers, but in actuality, a limited amount of uncertainty provides an opportunity to increase profits. These limits derive from the fact that insurance companies are not risk-neutral.[6] Like most businesses, insurers act in an environment full of risks, where cost and information constraints limit the amount of exposure an insurer can take. These constraints influence insurers in situations where imperfect or no information exists, or where it costs too much to ascertain and manage the risk.[7] Logically, insurers will not insure a risk of loss that may be immeasurable. Put more simply, insurers will not insure a risk of loss that does not result in a profit. Importantly, commercial human space flight is one industry that must rely on insurance to grow. However, cost and informational constraints inhibit the industry from taking full advantage of insurance benefits.[8] This paper will address insurability issues with respect to commercial human space flight, and provide recommendations to improve the likelihood of insurability from an underwriter's point of view.

II. THE PROSPECTS OF MORAL HAZARD, ADVERSE SELECTION, AND THE CATASTROPHIC LOSS

The principle question that an underwriter wishes to answer with respect to commercial human space flight is, whether flights can be insurable where the insurer can still create a profit? Generally, insurers will try to avoid three adverse prospects when insuring commercial human space flight in order to create a profit. They are moral hazard, adverse selection, and catastrophic loss. First, insurers wish to avoid moral hazard. Moral hazard refers to an insured party's propensity to act with

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[5] *Id*. at 6.
[6] *Id*. at 3.
[7] *Id*. at 4.
[8] *See generally* John R. Olds et al., *Space Tourism: Making it Work for Fun and Profit*, *in* 51ST INTERNATIONAL ASTRONAUTICAL CONGRESS (Rio de Janeiro, Brazil, Oct. 2-6, 2000), http://smartech.gatech.edu/dspace/bitstream/1853/8405/1/IAA-00-IAA.1.3.05.pdf.

less care to avoid an insured loss than would be exercised if the loss were not insured.[9] Moral hazard also includes taking additional risks after acquiring insurance with the underlying belief that the insurance will cover the loss.[10] Moral hazard could be a significant issue in the commercial human space flight industry because of misinformation. As operators apply for insurance, insurance underwriters will require the operator to disclose information that materially influences the risk of loss. Often developing industries, like commercial human space flight, may not fully understand the factors that materially influence the risk of loss because those factors may be unknown or unclear. Operators may provide their "best guesses" or partial explanations to an underwriter, but ultimately the underwriter is still misinformed. After the operator acquires insurance, the operator may learn through experience that the information previously conveyed to the underwriter understates the risk. If the operator continues to offer space flights without notifying the underwriter about this new information, then moral hazard has occurred. Meaning, the operator may act with less care knowing that the insurer will still cover a loss if it should occur. This propensity may be particularly strong in the commercial human space flight industry because insurance is a significant cost in conducting the activity.[11] Moreover, an operator may believe that an admission of any adverse information could tip the scale to a higher premium, or worse, uninsurability.

Underwriters may combat moral hazard in a number of ways. Typically, with an unfamiliar industry, such as commercial human space flight, underwriters may look to an operator's propensity and approach towards risk-taking in other activities.[12] If an underwriter determines that an operator has had a

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[9] ABRAHAM, *supra* note 3, at 7.

[10] Sumon C. Mazumdar, *Regulatory Monitoring, Closure Costs and Bank Moral Hazard Behavior*, 12 J. REG. ECON. 267, 270 (1997).

[11] Pierre Miquet, *Private Manned Access to Space: Space Insurance Questions, but also a Broader View on Insurance Matters,* in PROCEEDINGS OF THE IAA 1ST SYMPOSIUM ON PRIVATE HUMAN ACCESS TO SPACE CD-ROM (May 30, 2008) (on file with author). Insurance cost for space projects amount to 10-15% of the whole project.

[12] Jaap H. Abbring et al., *Moral Hazard and Dynamic Insurance Data*, 1(4) J. EUR. ECON. ASS'N. 767, 770 (2003).

previous problem with moral hazard that may indicate a similar incident in the future. Arguably, some people see human space flight as a tourist activity reserved for risk-taking adventurers.[13] While this may raise a red flag to an underwriter, stereotypes have little influence if the operator has avoided moral hazard and managed risk well in the past.

Second, insurers try to limit adverse selection as a part of underwriting. Naturally, a party having a higher risk of loss is more likely to obtain insurance coverage than a party with a lower risk of loss. The party with the higher risk may have a greater incentive to misinform an insurer to obtain insurance, thus resulting in adverse selection.[14] In commercial human space flight, adverse selection could occur when an operator either knows or suspects information that will influence an underwriter's risk assessment of the operator's activity. The operator could subsequently withhold, underestimate, or even lie about that information, to either obtain insurance, or to obtain insurance at a lower cost. Moreover, operators still have many questions that remain unanswered with regard to the operational risk involved in commercial human space flight. Operators hold a unique position as the principle provider of risk information for commercial human space flight. Even though information provided by a single source raises questions of quality and may be difficult to verify, underwriters receive the best available information to assess risk from operators. More importantly, operators are willing to work with insurers by taking steps to become more informed and to minimize risks.[15]

However, underwriters must reasonably address adverse selection to make an accurate risk assessment. Invariably, the answers to the questions surrounding risk change with each

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[13] Dominic DePasqulae, et al., *The Emerging Orbital Space Tourism Industry: New Insight into Demand an Prospects for Success*, American Institute of Aeronautics and Astronautics (Sept. 2006), *available at* http://www.sei.aero/eng/papers/uploads/archive/AIAA-2006-7478.pdf (last visited Feb. 11th, 2009).

[14] ABRAHAM, *supra* note 3, at 6.

[15] Denis Bensoussan - Hiscox, *Space Tourism Risks: An Insurance Perspective* (paper presented at the IAA 1st Symposium on Private Human Access to Space, Arcachon, France, May 30, 2008) (highlighting a risk management strategy that operators will have to explain to the underwriter what they are doing to justify their technical choices) (on file with author).

new development and test flight. Operators can help underwriters prevent adverse selection by sharing information on the associated risks and developing methods to address these risks.[16] For example, the National Aeronautics and Space Administration (NASA), along with the Commercial Spaceflight Federation and the Universities Space Research Association have created the Commercial Suborbital Research Program.[17] This program was designed to provide valuable research on ways to reduce risk in commercial human spaceflight.[18] Thus, a concerted effort to understand information concerning safety, regulation, informed consent, vehicle design and delivery, consumer demand, as well as other factors, will help operators and underwriters address adverse selection appropriately.

Finally, the insurer will try to avoid a catastrophic loss. A catastrophic loss has the potential to force the insurer into a situation where the insurer is unable to pay all claims levied against it, thus forcing the insurer out of business.[19] Scenarios that could make an insurer insolvent include, substantial loss of life and limb, extensive property damage, immeasurable third-party liability, and other domestic and international tort liability. Significantly, the risk for catastrophic loss is pervasive throughout commercial human space flight activities. For example, one could conceive a collision of a space flight with an orbiting space hotel, or a launch explosion taking the lives of the crew, space flight participants, and innocent third parties, as catastrophic events.[20] Conceivably, insurers could lose billions

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[16] Press Release, X Prize, Space Entrepreneurs Resolve to Create Industry Group to Promote Safety Standards and growth of the Personal Spaceflight Industry (Feb. 8, 2005) http://www.xprize.org/foundation/press-release/space-entrepreneurs-resolve-to-create-industry-group-to-promote-safety-stan (cited as an example of commercial human space flight operators working together to develop safety systems).

[17] Commercial Suborbital Research Program, *Commercial Suborbital Research Program: Overview*, http://sites.google.com/site/commercialsuborbitalflight (last visited Jan. 16, 2010).

[18] *Id.*

[19] Dwight M. Jaffee & Thomas Russell, *Catastrophe Insurance, Capital Markets, and Uninsurable Risks*, 64(2) J. RISK & INS. 205, 208 (1997).

[20] Micheal C. Mineiro, *Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Space Flight Vehicle Accident*, 74 J. AIR L. & COM 371, 391 (2009) (citing the destruction of a space hotel as a potential catastrophic loss).

of dollars as the result of a single incident, especially where many lives are lost and property damage is extensive.[21]

Traditionally, underwriters have dealt with moral hazard, adverse selection, and catastrophic losses by 'risk-pooling' and relying on the law of numbers.[22] 'Risk pooling' involves combing individuals with similar characteristics into a single pool, whose individual insurance costs are combined and then divided to calculate premiums.[23] Essentially, pooling risks together allows the costs of risky to be subsidized by the less risky.[24] Even though the individuals in a pool seem to carry the same risk because of supposedly similar characteristics, actual conduct reveals that some individuals may be more risky, or less risky, than others in the pool. Where risks are uncorrelated and independent insurers can pool and allocate these risks, thus making the sum of the individual risks less risky as a whole.[25] Consider car insurance, some car operators provide perfect and truthful information to their insurers, others do not. The underwriter evaluates this information then organizes each insurance contract into pools by various degrees of risk. Although some contracts in a pool may not belong to that pool because they are actually more or less risky, the other contracts balance out the difference. Thus, the insurer has a greater ability to cover losses from the riskiest car operators and a greater ability to predict losses in larger pools. Unlike automobiles, only a handful of commercial human space flight vehicles and operators exist. Apart from the handful of operators scattered around the world, only 20 commercial space launch licenses are currently active and issued by the U.S. Office of Space Transportation (FAA/AST).[26] Additionally, each commercial human space flight

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[21] *Id.*

[22] ABRAHAM, *supra* note 3, at 3.

[23] Cori Uccello & David Shea Jr., *Wading Through Risk Pools: Practical implications for Health Insurance* (Captiol Hill briefing, Washington D.C., United States of America, May 20, 2008) *available at* http://www.actuary.org/briefings/pool08.asp (last visited Mar. 9, 2009).

[24] *Id.* at 2.

[25] ABRAHAM, *supra* note 3, at 4.

[26] Federal Aviation Administration, Commercial Space Data - Active Licenses, http://www.faa.gov/about/office_org/headquarters_offices/ast/launch_data/current_licenses/ (last visited Jan. 16, 2010).

vehicle possesses unique characteristics that make analogous comparison impossible, and pooling and the use of the law of numbers ineffective.

Consequently, insurers have used other techniques to mitigate the effects of moral hazard and adverse selection. For instance, limiting warranties and voiding policies due to misrepresentations are used as defenses in both property and life insurance claims.[27] Typically, their effectiveness comes to light in insurance litigation.[28] While, their effectiveness with respect to insuring commercial human space flight is yet unknown, at this point, only one fatal accident has occurred in the commercial human space flight industry with the potential to merit litigation. In 2007, three Scaled Composites employees were killed while testing a rocket engine.[29] According to the FAA, this accident was not a launch related accident, but an industrial accident.[30] As such, no issue with respect to insuring the space flight was raised. Only when space flight insurability becomes an issue in litigation will warranty and misrepresentation defenses enlighten underwriters as to their effectiveness in mitigating risks that involve imperfect information.

III. GOVERNMENTAL EFFORTS

Despite the difficulties of dealing with uncertainty and misinformation in the commercial human space flight industry, many governments have taken steps to improve the likeliness of obtaining lower cost insurance. The most notable being the principles established in the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (Outer Space Treaty). Now ratified by 98 countries, and signed by 27 others, the Outer Space Treaty outlines the responsibilities of State

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[27] ABRAHAM, *supra* note 3, at 7.

[28] *Id*.

[29] Leonard David, *Explosion Kills Three at Mojave Air and Space Port*, SPACE NEWS, Aug. 9, 2007, http://www.space.com/news/070727_scaled_explosion_update.html.

[30] Brian Berger, *FAA Defers to State Authority in Mojave Mishap Inquiry*, SPACE NEWS, Aug. 14, 2007, http://www.spacenews.com/archive/archive07/scaledfolo_0806.html.

Parties for their outer space activities.[31] While the Outer Space Treaty does not directly address insurance issues, the treaty does establish a liability regime for governmental and non-governmental parties associated with a particular State. As such, the Outer Space Treaty requires that States regularly regulate and monitor all space activities under their jurisdiction to avoid international liability.

Thus, the Outer Space Treaty is the foundation for existing national laws that address the licensure and safety of commercial human space flight. For example, in the United Kingdom, the 1986 Outer Space Act establishes standards for licensing and safety.[32] Sweden, Norway, and Belgium also have laws that govern certain space activities.[33] In 2004, the United States enacted the Commercial Space Launch Amendments Act (hereinafter 2004 Launch Act).[34] Unlike the space laws in other countries, the U.S. legislation provides operators the most advantageous environment to foster commercial human space flight. In general, the 2004 Launch Act aims to protect the commercial human space flight operator as well as the public.[35] It grants authority to the Federal Aviation Administration (FAA) to issue licenses and experimental permits to commercial human space flight operators.[36] Through its Office of Commercial Space Transportation (AST), the FAA fosters progress in commercial human space flight by facilitating the expansion of space trans-

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[31] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[32] Axelle Cartier & Christopher Stott, *The UK Outer Space Act (1986) and its Application to the Potential Licensing of Commercial Manned Spaceflight,* (paper presented at 1st IAA Symposium on Private Human Access to Space, Archachon, France, May 30, 2008) (on file with author).

[33] Julie Abou Yehia & Kai-Uwe Schrogl, *European Regulation for Private Human Spaceflight in the Context of Space Traffic Management,* European Space Policy Institute, (paper presented at 1st IAA Symposium on Private Human Access to Space, Arcachon, France, May 30, 2008) (on file with author).

[34] Commercial Space Launch Amendments Act, H.R. 5382, Pub. L. No. 108-489, 108th Cong. (2d Sess. 2004) (hereinafter 2004 Space Act).

[35] Timothy R. Hughes & Esta Rosenberg, *Space Travel Law (and Politics): The evolution of the Commercial Space Launch Amendments Act of 2004*, 31 J. SPACE L. 1, 35 (2005).

[36] *Id*. at 43.

portation infrastructure.[37] The AST issues FAA licenses, tracks space launch data, and works with industry to develop safety programs.

Aside from the regulatory benefits provided by the FAA, the 2004 Space Act also contains a unique indemnification provision that substantially influences insurance underwriting.[38] According to the legislation, operators that obtain a license and operate in the United States must demonstrate financial responsibility by obtaining a specified amount of liability insurance.[39] Analogous to underwriting, the FAA performs a maximum probable loss (MPL) risk analysis.[40] Based on that risk analysis, the operator must obtain insurance for the lower of the computed MPL or $500 million.[41] The United States government will then indemnify the operator for liability losses in excess of the required amount up to $2 billion.[42] Liability in excess of $2 billion must be borne by the operator.[43] Unfortunately, this indemnification regime only applies to operator loss and third party claims, not to space flight participants.[44] By participating in commercial human space flight, space flight participants will be assuming their own risk and will have to sign personal liability waivers after receiving written disclosure and giving informed consent.[45] Essentially, space flight participants will have to obtain individual insurance if they wish to insure their flight. Unfortunately, individual insurance may be difficult to obtain and may be very expensive for the space flight participant. Considering that only a few hundred people have flown to space, eight-

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[37] Federal Aviation Administration, About the Office, http://www.faa.gov/about/office_org/headquarters_offices/ast/about/ (last visited Jan. 16, 2010).

[38] Hughes & Rosenberg, *supra* note 35, at 56.

[39] *Id.*

[40] The MPL Calculation varies by launch vehicle type authorized to a launch site under FAA license at the FAA/AST. Federal Aviation Administration, Office of Commercial Space Transportation, http://www.faa.gov/about/office_org/headquarters_offices/ast/ (last visited Jan. 16, 2010).

[41] Hughes & Rosenberg, *supra* note 35, at 57.

[42] *Id*.

[43] *Id.*

[44] *Id*.

[45] Tracy Knutson, *What is "Informed Consent" for Space-Flight Participants in the Soon-to-launch Space Tourism Industry?*, 33 J. SPACE L. 105, 106 (2007).

een of which have lost their lives, the data and mortality rates do not support the insurability of space flight participants.[46]

Aside from the benefits of the indemnification regime, the MPL risk analysis could provide valuable information to an underwriter. Although an underwriter's methodology may vary greatly from that of the MPL analysis, the MPL analysis should give an underwriter a basic understanding of the risks involved in commercial human space flight. Also, since the FAA requires coverage for the lesser of the MPL analysis amount or $500 million, the MPL analysis could serve as a risk comparability tool among operators in the industry. More importantly, the MPL analysis highlights the FAA's focus on public safety by requiring riskier operators to obtain additional insurance coverage.[47] Some operators, however, have questioned the FAA's current safety focus claiming that the risk analysis focuses too much on the safety of the public versus the safety of the space flight participants.[48] Understandably, the FAA's focus on the safety of the public must support the current indemnification regime in the 2004 Launch Act. In contrast, other industry experts argue that the safety of space flight participants will influence the safety of the third party public.[49] The likelihood of an accident involving the death of a space flight participant directly effects damage to third parties due to the likelihood of collateral damage.[50] Unintentionally, operators may forget that the overall purpose of a government is to protect and promote the public health and safety of its citizens. The protection of a few at expense of the majority conflicts with this purpose.

IV. SAFETY REMAINS THE FOCUS

Notwithstanding these arguments, a focus on safety is paramount to an underwriter. An underwriter's focus on safety

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[46] *Id.* at 115 (*citing* Jeffery F. Bell, *Rocket Plane Roulette,* SPACE DAILY, Mar. 7, 2007, http://www.spacedaily.com/reports/Rocket_Plane_Roulette_999.html (discussing the flight history of experimental rocket plans)).

[47] Hughes & Rosenberg, *supra* note 35, at 57.

[48] Melanie Walker, *Suborbital Tourism Flights: An Overview of Some Regulatory Issues at the Interface of Air and Space Law*, 33 J. SPACE L. 375, 379 (2007).

[49] *Id.*

[50] *Id.*

does not emphasize to whom the benefit will be given, but to what extent does the emphasis on safety cover the risk of loss. Even though the MPL analysis does address certain safety issues, it is unlikely that the analysis provides enough safety information for an underwriter to adequately ascertain the risk of loss. Logically, spacecraft operators will have to close the information gap. The challenge facing the industry concerns setting standards that each operator can achieve, but also satisfy an underwriter's need for adequate information. For instance, Scaled Composites LLC founder, Burt Rutan, suggested an alternative solution to this challenge that would create a hybrid arrangement between the commercial human space flight industry and the FAA.[51] Collectively, the commercial human space flight industry and the FAA could define and implement safety standards through self-governing policy and FAA regulation.

Currently, the commercial human space flight industry has established the Commercial Spaceflight Federation (CSF) to promote and pursue higher standards of safety within the industry.[52] However, previous self-policing industry standards have achieved mixed results. For example, the ISO 9000 management standards created by the International Organization for Standardization to address enhanced quality management.[53] Presently, the aerospace industry successfully uses AS9100 standards, a supplement to ISO 9000, to enhance quality in aerospace design and manufacturing.[54] Conversely, the American accounting profession has had difficulty maintaining independence standards between auditors and their clients. In 2001, the Enron scandal exposed the failings of the American Insti-

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[51] Reason Foundation, Annual Privatization Report 2005 - Space Travel, http://reason.org/news/show/126612.html (last visited Jan. 16, 2010) (interview by Ted Balaker with Burt Rutan, Space Entrepreneuer, Scaled Composites).

[52] Press Release, Commercial Spaceflight Federation, Newly Renamed Commercial Spaceflight Federation Launches New Website (June 15, 2009), http://www. commercialspaceflight.org/pressreleases/CSF%20Press%20Release%2020New%20Name%20and%20Website%20-%20Jun%202009.pdf (prior to May 2009, the Commercial Spaceflight Federation was known as the Personal Spaceflight Federation).

[53] International Organization for Standardization, ISO 9000 and ISO 14000, http://www.iso.org/iso/iso_catalogue/management_standards/iso_9000_iso_14000.htm (last visited Jan. 16, 2010).

[54] Katrina C. Arabe, *Aerospace Industry Readies for the AS9100*, THOMASNET NEWS, Oct. 5, 2001, http://news.thomasnet.com/IMT/archives/2001/10/aerospace_indus.html.

tute of Certified Public Accountants (AICPA) as a regulating industry authority.[55] As a result of the AICPA's inadequate efforts to address client-auditor relations, the Securities and Exchange Commission (SEC) stripped the AICPA of its self-standardized policing and auditing power.[56] Despite the mixed successes, the commercial human space flight industry can use the CSF to either police safety standards that exceed the FAA mandated level, or better yet, work with the FAA to improve safety standards. [57]

Moreover, the continued development of safety standards between governments and operators sends a positive signal to underwriters that operators are combating moral hazard. Because of the developing character of the industry, operators realize that safety functions as a vital part of each space flight. Accidents would be destructive to the industry by reducing consumer confidence and opening the door to potential liability.[58] Unfortunately, an over emphasis on safety may also be cost-prohibitive to many operators.[59] Like all businesses starting out, a time arrives when an operator needs to generate profits. However, the emphasis on the bottom line may give rise to actions that push safety aside, increasing the likelihood of moral hazard for the insurer. Notwithstanding, opportunities exist where operators can more effectively utilize working capital without sacrificing safety.

Principally, operators can focus on safety development in areas of high risk through the use of simple control procedures. Operators that focus on immediate considerations such as reliability of reusable launch vehicles, the training and skill of flight and ground crews, and the adequacy of launch and landing sites, should address the majority of risk in the space flight activity.[60]

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[55] Sue Ravenscroft & Paul F. Williams, *Rules, Rogues and Risk Assessors: Academic Responses to Enron and Other Accounting Scandals,* 14-2 EUR. ACCT. REV. 363, 364 (2005).

[56] *Id.* at 369.

[57] Walker, *supra* note 48, at 401.

[58] *Id.*

[59] *Id*. at 402.

[60] Richard W. Scott, *Policy/Legal Framework for Space Tourism Regulation*, 28(1) J. SPACE L. 1, 7 (2000).

An example of a cost effective approach using simple control procedures in particular areas is financial auditing. Part of an auditor's responsibilities include understanding and providing an opinion on the risk of material misstatement in a company's internal control.[61] According to the Public Company Accounting Oversight Board (PCAOB), internal controls "must be in place to see that records accurately and fairly reflect transactions" of the company.[62] When a weakness in internal control exists the risk for material misstatement increases.[63] However, material misstatement can be hidden in one the of millions of transactions a company processes each year. Consequently, in order to manage auditing costs, the PCAOB recommends that auditors focus risk assessment on internal controls that have the greatest impact on material misstatement, as well as accounts where material misstatements are more likely to occur.[64] Using a risk based approach, an auditor can address the majority of risk by testing only a few areas of internal control.

Applying this example to commercial human space flight, an area of very high risk is likely the launch and landing of the vehicle. Here, the commercial human space flight industry can take a lesson from the airline industry. For instance, after the 9/11 attacks, underwriters became more aware of the risks in aviation.[65] As premiums increased, the airline industry appreciated the importance of identifying and remedying risky areas to control aviation insurance costs.[66] Furthermore, empirical evidence shows that of the total number of commercial jet accidents, 57% occurred during take-off and landing. Specifically,

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[61] PCAOB *Briefing Paper*, *Board Considers Adopting Standard for Audits of Internal Control Over Financial Reporting* (Mar. 9, 2004) http://www.pcaobus.org/rules/docket_008/2004-03-09_briefing_paper.pdf.

[62] *Id.* at 2.

[63] Public Company Accounting Oversight Board, Auditing Standard No. 5, 401 ¶ 11, *available at* http://www.pcaobus.org/Rules/Rules_of_the_Board/Auditing_Standard_5.pdf (last visited Jan. 16, 2010).

[64] *Id.*

[65] Yi-Hsin Lin et al., *Determinants of Aviation Insurance and Risk Management Strategy*, *in* PROCEEDINGS OF THE 13TH ASIA PACIFIC MANAGEMENT CONFERENCE 1289 (Melbourne, Australia, 2007) (citing a 2003 Boeing study of commercial jet aircraft accidents) *available at* http://www.infotech.monash.edu.au/research/centres/cdsesr/apmc/papers-pdf/t127.pdf .

[66] *Id.*

12% of commercial accidents occurred at takeoff, and 45% occurred at landing.[67] As a result, the trend has shifted in assessing aviation insurance from the total volume of passenger miles flown as an insurance basis, to the number of passengers flown and the number of departures.[68] Thus, recent developments in aviation insurance have encouraged airlines to address the majority of risk by focusing on take-offs and landings in an effort to improve safety. Appropriately, in 2008 the airline industry had one of the safest years on record.[69]

Likewise, the commercial human space flight industry may also reduce risk of loss by focusing on the launch and the landing of the space vehicle. Not only do the launch and landing present a significant risk to the public, but also could present substantial stress to the vehicle itself.[70] This is such a significant concern that the FAA issued a guide to operators that focuses on the reliability of reusable launch and reentry vehicles.[71] In addition, the FAA report to the U.S. Congress on the analysis of human space flight safety, suggests that lessons can be learned from the *Challenge*r launch and *Columbia* reentry to avoid future public safety hazards in commercial human space flight.[72]

V. REDUCING THE COST OF INSURANCE: AN OPERATOR'S EFFORT

As part of focusing on areas of risk, operators should realize that an underwriter's assessment of risk would likely involve an expected value analysis to compute a premium. Generally, an

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[67] *Id.* at 1292.

[68] *Id.*

[69] Press Release, ASCEND, Passenger safer in the skies as airline fatalities drop 25 per cent in 2008 (Jan. 7, 2009) http://www.ascendworldwide.com/story.aspx?story=299.

[70] Tommaso Sgobba, *An International Civil Aviation Organization for Outer Space, in* SECURITY IN SPACE: THE NEXT GENERATION-CONFERENCE REPORT 110 (United Nations Institute for Disarmament Research (UNIDIR), Mar. 31 - Apr.1, 2008) *available at* http://www.unidir.org/pdf/articles/pdf-art2819.pdf.

[71] Federal Aviation Administration, *Guide to Reusable Launch and Reentry Vehicle Reliability Analysis* (April 2005), *available at* http://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/FAA_AST_Guide_to_Reliability_Analysis_v1.pdf.

[72] The Aerospace Corporation, *Analysis of Human Space Flight Safety – Report to Congress* (Nov. 11, 2008), *available at* http://www.faa.gov/about/office_org/headquarters_offices/ast/media/Human%20Spaceflight%20Safety%20Report_11Nov08.pdf.

underwriter will convert the likelihood of an accident occurring, at some point in the space flight, into a percentage. The underwriter will also assess the amount of property damage from that event. The likelihood that something may occur, and the amount of loss, are computed to arrive at an expected value.[73] For example, let's assume that an underwriter assesses that there is a 10% likelihood that a $100,000 loss could happen at a particular point in the space flight. Also, assume that at another point in the space flight a 1% chance of a $1,000,000 loss could occur. An operator may think to focus safety procedures on the greater loss, but to an underwriter the expected value (.01 X $1,000,000 = $10,000 = .1 X $100,000) of each event is the same. Therefore, an insurer would likely assess a similar premium for both events. Thus, a simple expected value analysis of different phases of the launch can help operators understand where to focus their safety efforts. As operators address risks at areas of higher expected value, costs of insurance will decrease.

An operator may also strategically locate a spaceport to reduce insurance costs. For example, while constructing a spaceport closer to sea level may provide access to a greater number of people, a spaceport located at higher altitude may be less risky and save on fuel costs to enter and return from a suborbital trajectory.[74] On the other hand, a launch from high altitude may be riskier because of cooler temperatures and the presence of other physical elements, such as snow or ice. Another influential factor for underwriters would be a decision to locate a spaceport near a highly populated area versus a more rural location.[75] Logically, the risk of loss to third parties should be less in a rural setting compared to that of an urban setting.

In addition, another important consideration relating to third party loss would be the use of a range safety officer in commercial human space flight. Traditionally, range safety procedures concentrate on protecting the public throughout the

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[73] ABRAHAM, *supra* note 3, at 3.
[74] Scott, *supra* note 60, at 8.
[75] *Id.*

launch and flight.[76] Part of these procedures involves the range safety officer's ability to terminate a vehicle during launch or flight if it poses a serious risk to the public.[77] Currently, range safety procedures do not differentiate between manned and unmanned flights.[78] For example, a range safety officer monitors each flight of NASA's *Space Shuttles*.[79] In fact, after the explosion of *Challenger* in 1986, a range safety officer detonated the solid rocket motors as they veered towards land.[80] The officer determined that the motors posed a serious threat to the general public.[81] Obviously, underwriters will pay close attention to an operator's emphasis on range safety. The part a range safety officer plays in the overall range safety strategy remains to be seen. The ability to detonate the insured's property adds a new dimension to underwriting commercial human space flight.

Furthermore, the design of the space vehicle, and method of delivery, are also significant factors in risk analysis for insurability.[82] Typically, rockets contain explosive propellants that can cause extensive and deadly damage. Alternatively, some vehicles are launched from airplanes as opposed to being launched from the ground.[83] Notably, the risk of loss varies with an air launch versus a ground launch. Although making comparisons among vehicle design, vehicle delivery, and range safety can be difficult, an expected value analysis can translate risks into comparable monetary amounts. This tool allows the operator to weigh the benefits and detriments of a particular

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[76] National Aeronautics and Space Administration, NASA Range Safety Program - Overview, *available at* http://kscsma.ksc.nasa.gov/Range_Safety/Overview.htm (last visited October 19, 2009).

[77] National Aeronautics and Space Administration, NASA Range Safety Glossary of Terms, Range Safety Officer (RSO), http://kscsma.ksc.nasa.gov/Range_Safety/Definitions_6.htm (last visited Jan. 16, 2010).

[78] *Analysis of Human Space Flight Safety – Report to Congress*, *supra* note 72, at 19.

[79] National Aeronautics and Space Administration, Report of the Presidential Commission on the Space Shuttle Challenger Accident, 184 (commonly called the Rogers Commission Report) June 1986 and Implementations of Recommendations, June 1987, *available at* http://history.nasa.gov/rogersrep/v1ch9.htm (last visited Oct. 21, 2009).

[80] *Id.* at 185.

[81] *Id.*

[82] Lloyd's, *Lloyd's insurers look to the challenge of aviation's final frontier*, LLOYD'S, Dec. 27, 2007, http://www.lloyds.com/News_Centre/Features_from_Lloyds/Lloyds_insurers_look_to_the_challenge_of_aviations_final_frontier_27122007.htm.

[83] *Id.*

operational strategy and make changes where necessary to improve safety and perhaps profitability.

VI. UNDERWRITER CONCERNS

Despite the many methods an operator can apply to improve the insurability of space flight, there is an overriding concern that troubles the underwriter: imperfect information continues to inhibit the industry from literally getting off the ground. Consider the question of whether consumer demand will be sufficiently consistent to support commercial human space flight? Business risk and going concern questions still plague the commercial human space flight industry.[84] These questions relate to operators actively engaging in business with the expectation of indefinite continuance.[85] Operators, however, maintain that consumer demand will be strong enough to support the continued activity of commercial human space flight.[86] Others have offered evidence to the contrary. One study, conducted by the Futron Corporation, targeted 450 households with a net worth of $1 million or a household income of $250,000.[87] The Futron Study considered these respondents to be the potential customers of the commercial human space flight industry. The respondents were informed of the benefits and detriments of human space flight, and then were questioned regarding their level of interest in the activity.[88] Only 20% of the respondents showed interest in commercial human space flight after being informed about the dangers, and only 16% indicated they would be willing to pay $250,000 for a space flight.[89] This information not only suggests that income and informed consent may be barriers for some consumers, but it may also suggest a weakness in demand.

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[84] Roger D. Launius & Dennis R. Jenkins, *Is it Finally Time For Space Tourism?*, 4 ASTROPOLITICS 253, 254 (2006).

[85] BLACK'S LAW DICTIONARY (8th ed. 2004).

[86] DePasqulae et al., *supra* note 13, at 3.

[87] Futron, *Space Tourism Market Study* (Oct. 2002), *available at* http://www.futron.com/pdf/resource_center/white_papers/SpaceTourismMarketStudy.pdf.

[88] *Id.* at 48.

[89] *Id.*

Aside from consumer demand, the absence of historical and comparable information remains a weighty concern for underwriters. In an attempt to improve the quantity and quality of information, industry leaders have promised to work to inform insurers.[90] This could include relaying information obtained from trials and testing. However, the inability to ascertain every loss scenario in the real world through testing makes trial data preliminary at best. Only through actual operating experience will the underwriter become informed enough to make an accurate assessment.

A more recent concern for both the underwriter and the insurer has developed in the past year. Accessibility to capital financing has influenced the risk portfolios of insurers, banks, and businesses. Exacerbated by the worthlessness of mortgage-backed securities, the world capital markets are functioning in extreme volatility and uncertainty.[91] As a result, banks and insurers continue to tighten cash flow until a solution is presented that removes these abnormally risky securities, or until the markets stabilize.[92] Essentially, banks and insurers feel that extending or insuring credit is currently too risky. This severely affects the commercial human space flight industry, because commercial human space flight is inherently risky. Additionally, insurers have shown a disinterest in adding risk to their risk laden portfolios. Therefore, operators will either have to pay more for insurance or be uninsurable.

Notwithstanding the current world economic environment, the commercial space flight industry has received help to weather this tough financial environment. Recently, NASA announced plans to invest $50 million in orbital commercial hu-

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[90] Press Release, Commercial Spaceflight Federation Press Release, *Personal Spaceflight Federation Announces* Future Plans (August 26, 2006) *available at* http://www.commercialspaceflight.org/press_releases.shtml (last visited Oct. 21, 2009).

[91] Serena Ng & Liam Pleven, *An AIG Unit's Quest to Juice Profit – Securities – Lending Business Made Risky Bets; They Backfired on Insurer*, WALL ST. J., Feb. 5, 2009, at C1.

[92] Peter Porrino & Robert Stein, *Ernst & Young on Reflections on Current Market Conditions for the Insurance Industry*, 2008 EMERGING ISSUES 3108 (Dec. 2, 2008).

man space flight.[93] NASA believes that investing in commercial human space flight will "foster entrepreneurial activity leading to job growth" and "reduce the gap in U.S. human space flight capability."[94] This investment not only shows NASA support for commercial human space flight, but the possibility that the commercial human space flight industry will provide cargo and crew for the international space station.[95] Additionally, SpaceX recently acquired a maximum investment of $60 million from Draper Fisher Jovelson Venture Capitalists.[96] Such investments demonstrate that the industry may be financially less risky than the current economic environment indicates. In the meantime, operators should continue to conduct test flights and develop safety procedures to reduce the risk of an accident.

Information obtained from these developments help underwriters to classify the type of insurance that is appropriate for the operator. The arguments vary among underwriters as to the type of insurance best suited for commercial human space flight. Some insurers refer to the structure of the space vehicle and argue that aviation insurers should insure the industry, while others argue that space insurers are better suited to insure the activity.[97] However, simply deciding whether the vehicle is like an airplane, or more like a rocket, does not automatically categorize which insurers should insure the activity. Methods of delivery, the payload, and other technical criteria will determine who will insure the commercial human space flight. Undoubtedly, both aviation and space insurers will demand a focus on safety to deter liability.[98] The underwriter will likely look to an operator's process management to see how the operator has built safety and emergency contingencies into the system. In

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[93] John Gedmark, *NASA Announces Plan to invest in Commercial Crew Concepts*, COMMERCIAL SPACEFLIGHT FEDERATION NEWS (Aug. 4, 2009), http://www.commercialspaceflight.org/?p=458.

[94] *Id.*

[95] John Gedmark, *Growing Investment Moves Industry Forward, Enables New Scientific Capabilities*, COMMERCIAL SPACEFLIGHT FEDERATION NEWS (Aug. 7, 2009) *available at* http://www.commercialspaceflight.org/?p=468.

[96] *Id.*

[97] Bensoussan – Hiscox, *supra* note 15, at 4.

[98] Lloyd's, *supra* note 82 (highlighting that principle concern for underwriters will likely be avoidance of personal accident liability as an example).

addition, underwriters look to the experience and training of ground and flight personnel, including the operator's plan for continued training.[99]

Moreover, an emphasis on redundancy and backup systems in high-risk areas is very important. The operator's plans for the aging and frequency of use of the spacecraft will factor into the risk assessment.[100] Flight environmental control procedures, including the role of the space flight participant, inform the underwriter what will happen during flight. Emergency systems explain the capability of the operator to handle potential accidents that could occur during flight. These emergency systems could be as basic as handing out parachutes, or as complex as utilizing an ejection capsule.[101]

In addition, sound process management decreases the likelihood of an accident and potential liability. Although process management helps an underwriter gain an understanding of certain risks, other risks are still unknown. For example, what happens if an accident occurs resulting in a space flight participant fatality? Will the waiver of liability based on the law of informed consent be an adequate defense?[102] Successful informed consent defenses rely on a standard of care that includes a premise that the individual is adequately informed of the material risks.[103] Insurers and operators can only hope that they have informed the space flight participants adequately to allow them to understand the inherent risks and make a reasonable prudent decision.[104] Even though some inherent risks may be unknown, or difficult to define, the standard of care depends on whether the space flight participant can make an informed decision from the information provided.[105] The strength of informed consent policies and disclosures is an important consideration in any risk assessment. Process management and informed consent are only a couple of the risks that the underwriter will con-

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[99] *Analysis of Human Space Flight Safety – Report to Congress*, *supra* note 72, at 5.
[100] *Id.* at 62.
[101] Bensoussan – Hiscox, *supra* note 15, at 7.
[102] Knutson, *supra* note 45, at 106.
[103] *Id.* at 111.
[104] *Id.* at 118.
[105] *Id.* at 119.

sider. Other material risks worth consideration include risks of terrorism; business and market stability; and the soundness of political climates. Carefully identifying and addressing many of these risks allows the underwriter to form a better risk assessment of commercial human space flight.

VII. CONCLUSION

In conclusion, the dilemma an underwriter faces with respect to insuring commercial human space flight lies in the quantity of imperfect information and uncertainty. The industry is so new that insurers and underwriters know little about the potential risks and liabilities associated with the activity. Underwriters can rely on experience and make comparisons to other industries, but ultimately they have to rely on information provided by the operator. A one-sided source of information places the insurer at an extreme disadvantage when contracting for coverage. As such, the prospects for moral hazard and adverse selection abound in insuring the commercial human space flight industry. Due to the overwhelming informational constraints, the current state of the financial industry and inherent riskiness of space travel, the initial commercial human space flights will likely carry high insurance costs until insurers can obtain sufficient information to accurately assess an acceptable risk. In the meantime, operators, governments, and insurers should continue to develop safety standards, processes, and relationships to assure the success of the industry.

USE OF OUTER SPACE FOR PEACEFUL PURPOSES: NON-MILITARIZATION, NON-AGGRESSION AND PREVENTION OF WEAPONIZATION

Jinyuan Su[*]

I. INTRODUCTION

The "use [of outer space] for peaceful purposes" is one of the guiding principles for the global commons, which includes Antarctica, outer space, and the high seas. However, this principle is currently being challenged or even derogated in one way or another. This is particularly true in the context of outer space, which since the inception of human exploration has been one of the major issues for political contention. States, while agreeing to use outer space for peaceful purposes in principle, interpret its use in divergent manners, particularly with regard to non-militarization and non-aggression. As the "militarization-aggression" debate continues fruitlessly, the issue of space weaponization has become one of the top agendas in various international fora.

The use of outer space for peaceful purposes is governed by a body of U.N.-based multilateral treaties and bilateral treaties between the two adversaries of the Cold War—the former Soviet Union and United States.[1] Apart from the outer space treaty system, there are arms control and disarmament agreements relating to outer space. Among these agreements, for the purpose of preserving the peaceful use of outer space, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celes-

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[1] After the dissolution of USSR, Russia succeeded to its membership in international organizations, including a permanent membership in the Security Council, and rights and obligations under the international treaties in which USSR was a party.

tial Bodies (Outer Space Treaty) remains the cornerstone treaty. Article IV of the Outer Space Treaty is the central provision in this connection, stating:

> States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or 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 the 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.[2]

State governments and scholars have construed from this article, and sometimes in conjunction with other articles, two interpretations of the peaceful principle, namely non-militarization *vis-à-vis* non-aggression, which are different but not antonymous terms.

Before commencing with the peaceful principle it would be helpful to make some preliminary terminological clarifications, between outer space, outer void space, and celestial bodies. In the United Nations, prior to 1963, outer space had always been referred to as separate from celestial bodies, meaning solely the void space between celestial bodies. No wonder the term "outer space and celestial bodies" appeared in the document texts on several occasions.[3] Then as the discussions proceeded, the ter-

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[2] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, art. IV, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

[3] Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962 (XVIII), U.N. GAOR, 18th Sess., 1280th plen. mtg., U.N. Doc. A/RES/1962(XVIII) (Dec. 13, 1963); International Co-operation in the Peaceful Uses of Outer Space, G.A. Res. 1721 (XVI), U.N. GAOR, 1085th plen. Mtg., U.N. Doc. A/RES/1961(XVI) (Dec. 20, 1961).

minology "outer space" underwent semantic change, embracing both the innumerable celestial bodies and the immense void space in between. They are defined by Professor Bin Cheng as "celestial bodies" and "outer void space" respectively.[4] While, the international treaties do not adopt those definitions, they are very helpful to the present analysis.

II. NON-MILITARIZATION

The militarization of outer space is defined as "the use of assets based in space to enhance the military effectiveness of conventional forces or the use of space assets for military purposes."[5] It is inferred that non-militarization would mean the prohibition of using space-based facilities for any military purpose. This prohibition does not include development and testing not conducted in outer space. In fact, this strict interpretation of the peaceful principle is commonly agreed upon in some other international treaties, such as the treaties on Spitzbergen of 9 February 1920, and on the Aland Islands of 20 October 1921, the Statute of IAEA, and the Antarctic Treaty of 1959.

Here our task is to see whether this strict interpretation should be applied to the use of outer space for peaceful purposes. In this connection, Article IV, paragraph 2 of Outer Space Treaty, reserves celestial bodies "exclusively for peaceful purposes" by explicitly prohibiting "the establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres" but not "the use of military personnel for scientific research or for any other peaceful purposes" or "the use of any equipment or facility necessary for peaceful exploration." A comparison could be made between this provision and Article I of the Antarctic Treaty, which is prevalently regarded as an example of non-

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[4] "Properly speaking, only celestial bodies have been reserved for use exclusively for peaceful (non-military) purposes, but not outer void space", Bin Cheng, *International Law Across the Spectrum of Conflict: Essays in Honour of Professor L.C. Green on the Occasion of his Eightieth Birthday*, *in* INTERNATIONAL WAR STUDIES 83-84 (Michael N. Schmitt ed., Naval War College 2000) [hereinafter *International Law Across the Spectrum of Conflict*].

[5] MATTHEW MOWTHORPE, THE MILITARIZATION AND WEAPONIZATION OF SPACE 3 (Lexington Books 2004).

militarization in the strictest sense. While the military related uses explicitly not prohibited by the two provisions are basically the same, the explicitly prohibited military activities by the Antarctic Treaty could be broader than those by the Outer Space Treaty. The Antarctic Treaty seems to indicate that the above enunciated prohibitions are not exhaustive of all military uses. Article I, paragraph 1 of the Antarctic Treaty interprets them as part of a "measure of a military nature" because of the use of "such as"; and this is in turn understood as part of the prohibition because of the term "*inter alia.*" Therefore, even for celestial bodies, non-militarization in the strictest sense is not fully proscribed. As to outer void space, it is more apparent that military activities are not prohibited as Article IV paragraph 2, only applies to celestial bodies, and paragraph 1 only bans weapons of mass destruction. Therefore, in conclusion, the non-militarization interpretation could only be applicable to celestial bodies at best, but not to outer void space. This interpretation is faithful to the text, but its correctness needs to be proved in relation to the context, State practice, the preparatory work and circumstance of the conclusion.

According to the 1969 Vienna Convention on the Law of Treaties, "[a] treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose."[6] The context includes, *inter alia*, the text, preamble and annexes.[7] The agreement's object and purpose are usually stated in the Preamble.

First, whether military activities in outer space are consistent with the spirit of the Preamble, such as "the benefit of all peoples," "international cooperation," and "friendly relations," to a large extent depends on what kind of military activities is under discussion. Since we are rebutting the non-militarization interpretation, the question we should ask is whether all military activities in outer space go against the spirit of the treaty. The reality is that during the past few decades, military satel-

[6] Vienna Convention on the Law of Treaties, art. 31(1), May 23, 1969, 1155 U.N.T.S. 331.

[7] *Id.* at art. 31(2).

lites have reduced the risk of conflict by promoting transparency, verifying arms control compliance, and avoiding surprise attacks. Obviously, it could also be argued that military enhancement has been one of the prime motives for States to reach out into space, which in turn promotes civilian technological development.

Second, one may question in the alternative whether military activities in outer space are contrary to other provisions of the treaty, such as "for the benefit and in the interests of all countries" in Article I(1), and "cooperation and mutual assistance" in Article IX. These written principles, although broad, entail contractual obligations with binding force on States Parties rather than merely reflecting a statement of goals and good will. Whether military activities are contrary to "the benefit and in the interests of all countries" is a question answered. As to international cooperation, although States are obliged to facilitate cooperation, how they implement cooperative measures in practice is subject to agreement. This is specifically addressed by the U.N. General Assembly declaration that "States are free to determine all aspects of their participation in international cooperation in the exploration and use of outer space on an equitable and mutually acceptable basis."[8] Therefore, whether States give up military activities to make way for international cooperation is also subject to States' discretion.

In interpreting a treaty, apart from the context, subsequent State practice in application shall also be taken into account.[9] Ultimately, non-militarization was too strict an approach for States to follow. In fact, outer space has been militarized since the earliest communication satellites were launched. Military uses of outer space have also been accelerated in terms of both participating countries and technologies used. To date, they are mainly passive uses such as reconnaissance, surveillance, early warning, communication, and global positioning, which can

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[8] Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries, G.A. Res. 51/122, U.N. GAOR, 51 plen. mtg., Sess., 83d plen. mtg., U.N. Doc. A/Res/51/122 (Dec. 13, 1996), at Annex, ¶ 2.

[9] Vienna Convention on the Law of Treaties, *supra* note 6, at art. 31(3)(b).

multiply the strength of conventional military forces. Although particular activities conducted from outer space, like espionage, are disliked by many States, they seldom result in official protests. Neither has any country accused any State(s) of violating the Outer Space Treaty by conducting passive military uses of outer space. The passive use of outer space is thereby agreed to be one of the peaceful uses protected by Outer Space Treaty. Today, military satellites are protected by multilateral treaties, such as the International Telecommunication Convention, and other bilateral treaties, for instance between Russia and the United States.

In order to confirm this interpretation, or where one thinks the foregoing interpretation leads to a manifestly absurd or unreasonable result, recourse may be had to the preparatory work of the treaty and the circumstances of its conclusion.[10] The peaceful principle for outer space was borrowed from the Antarctic Treaty, which adopts a stringent approach. It is evident that a similar approach was intended initially, with "peaceful" antonymous to "military." One can even discern the United States support from its early official documents. For instance, in a memorandum submitted on 12 January 1957, to the First Committee of the General Assembly, the U.S. proposed that "the first step toward the objective of assuring that future developments in outer space would be devoted exclusively to peaceful and scientific purposes would be to bring the testing of such objects under international inspection and participation."[11] In January 1958, President Dwight D. Eisenhower proposed to the U.S.S.R. that they should agree to use outer space "only for peaceful purposes," and not for the "testing of missiles designed for military purposes."[12] But this approach was soon discarded for the sophism of non-aggression in 1959, when the great value of reconnaissance satellites was recognized, and the U.S.S.R. took the lead in space exploration. The U.S.S.R., on the other

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[10] *Id.* at art. 32.

[11] US Senate Comm. On Aeronautical & Space Sciences, *Documents on International Aspects of the Exploration and Use of Outer Space*, 1954-1962, 88th Cong., 1st Sess., 38 (1963).

[12] *Id.* at 52.

hand, stuck to the non-militarization school of thought for a longer duration; but it was simply lip service, because its satellites had been carrying out military functions in the guise of conducting "scientific research."[13] In 1985 the Soviet Union acknowledged to the United States and public that it had military satellites in orbit.[14] In the end, the same gestures found in the Antarctic Treaty did not appear in Outer Space Treaty. Therefore, the drafters of the Outer Space Treaty did not reach the equivalent degree of consensus on preserving outer space as a military-free zone like their counterparts did with regard to Antarctica.

Thus far, I have been rebutting the non-militarization interpretation of the peaceful principle. On account of the contribution of passive military uses of outer space to international peace and security, and the interconnection between military activities in outer space and those on earth, demilitarization of outer space is unlikely. To some extent, I partially agree with the U.S. view that "[t]he question of military activities in space cannot be divorced from the question of military activities on earth" and "[t]o banish these activities in both environments we must continue our efforts for general and complete disarmament with adequate safeguards."[15] However, this by no mean reflects on my support of the lawfulness of all military activities in outer space. Military uses of outer space can be placing reconnaissance satellites into orbit, installing military space stations, conducting military exercises and maneuvers, stationing weapons, etc. Some activities are under the explicit prohibition or permission of international treaties, some are justified through State practice accompanied by State acquiescence, while others are still not governed. Their legality merits case-by-case study, rather than simply being concluded in favor of the non-militarization doctrine.

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[13] Bin Cheng, *The Commercial Development of Space: the Need for New Treaties*, 19 J. SPACE L. 17, 27 (1991).

[14] NICHOLAS L. JOHNSON, THE SOVIET YEAR IN SPACE 1990, 81 (Colorado Springs, Colo., Teledyne Brown Engineering 1991).

[15] First Committee on the United Nations, U.N. Doc. A/C.1/PV.1289, 13 (Mar. 12, 1962).

III. NON-AGGRESSION

Proponents of the non-aggression interpretation of the peaceful principle, in particular the United States, suggest that the military use of outer space, as long as it is in compliance with Article 2(4) of the U.N. Charter and other international obligations, is compatible with international law. For instance, U.S. Senator Albert Gore addressed the First Committee of the U.N. on 3 December 1962, stating:

> It is the view of the United States that outer space should be used only for peaceful—that is, non-aggressive and beneficial—purposes. The question of military activities in space cannot be divorced from the question of military activities on earth. To banish these activities in both environments we must continue our efforts for general and complete disarmament with adequate safeguards. Until this is achieved, the test of any space activities must not be whether it is military or non-military, but whether or not it is consistent with the United Nations Charter and other obligations of law.[16]

The United States has adhered to this view consistently since 1959, in the context of outer space and other arenas. For example, the U.S. delegation expressed their view at the Law of the Sea Conference, declaring that:

> The United States had consistently held that the conduct of military activities for peaceful purposes was in full accord with the Charter of the United Nations and with the principles of international law. Any specific limitation on military activities would require the negotiation of detailed arms control agreement. The Conference was not charged with such a purpose and was not prepared for such negotiation. Any attempt to turn the Conference's attention to such a complex task could quickly bring to an end current efforts to negotiate a law of the sea convention.[17]

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[16] *Id.*

[17] Third United Nations Conference on the Law of the Sea 1973-1982, 67th plen. mtg., U.N. Doc. A/CONF.62/SR.67 (Dec. 10, 1982), at ¶ 81.

The non-aggression doctrine has brought up several questions, including: (1) whether the non-aggression principle is applicable to outer space; (2) whether permissible use of force may be conducted in outer space; and (3) whether all non-aggressive uses of outer space are compatible with the peaceful principle.

As to the first question, non-aggression is one of the general principles of international law that regulates inter-State relations universally, without regard to geographical seating. International law, as Professor Lowder writes, has adhered to no intrinsic geographical limits since its creation.[18] Thus, the extension of human activities into new spatial areas may require special rules to cope with the particularities of these areas. However, this does not affect the application of fundamental inter-State norms. Outer space, despite the sparseness of human activities to date in that region, is not an area void of law. In fact, Article III of the Outer Space Treaty provides:

> States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.[19]

This provision has more of a declaratory value. The non-aggressive use of outer space places a limitation on the behavioral, rather than technological, aspect of State actions in outer space. States must not use force or threaten to use force from outer space, just as they may not do from the high seas. States' assets in outer space, as is the case in other common areas, are not subject to another's attack if used in accordance with international law.

As to the second question, there are two permissible uses of force under international law, specifically, the use of force under the authorization of the U.N. Security Council, in accordance with Article 42 of the UN Charter, and self-defense in accor-

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[18] Stacey L. Lowder, *A State's International Legal Role: From The Earth To The Moon*, 7 TULSA J. COMP. & INT'L L. 253, 256 (1999).

[19] Outer Space Treaty, *supra* note 2, at art. III.

dance with Article 51 and customary international law. The use of force under the authorization of the Security Council aims to restore international peace and security.[20] This use of force is compatible with the wording of "in the interest of maintaining international peace and security" stipulated in Article III of the Outer Space Treaty. Therefore, it is indeed compatible with the peaceful principle, although the means employed may not be peaceful. For example, this is what happened in the first Gulf War, a military conflict initiated by a coalition force from 34 nations, with U.N. authorization, and a mission to expel invading Iraqi forces from Kuwait. The coalition's reliance on space technology greatly enhanced the strength of the conventional military forces, and earned the name "the first space war." The *jus ad bellum* of the First Gulf War, and the *jus in bello* of the strategic utilization of outer space technologies are seldom questioned. The Iraq War initiated in 2003 by a multinational force led by the United States and the United Kingdom has been more heavily reliant on space assets.[21] While the legality of waging the war itself is widely disputed, there is little discussion with regard to the space reliance. The use of outer space to assist conventional wars on earth such as through intelligence, communication, and global positioning measures, has been accepted as legal. These measures have actually furthered the purpose of humanitarian law by promoting precision and reducing casualties. But it is important to note that it does not justify the war itself, and what has been accepted is limited to what has been employed so far.

As for the use of outer space for self-defense, traditional international law would give an affirmative answer, as in the case of the high seas. Moreover, States' "inherent right of individual or collective self-defence" is recognized and preserved by the UN Charter.[22] It fits well into the realm of use of outer space "in accordance with international law, including the Charter of the United Nations," as in Article III of the Outer Space Treaty. In

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[20] U.N. Charter art. 2.

[21] Everett C. Dolman, *U.S. Military Transformation and Weapons in Space* (2006) 26(1) SAIS REV. 163, 165.

[22] U.N. Charter art. 51.

fact, the Legal Sub-Committee of COPUOS has explicitly rejected the idea "that the right of self-defence [is] not applicable in regards to outer space."[23] Although international treaties may impose limitations on means available in outer space for self-defense (for instance, Article IV of the Outer Space Treaty bans the use of certain weapons), they don't restrict the right to self-defense itself. So, a question arises as to whether a State Party to the Outer Space Treaty could legally degrade the de-weaponization clauses by, for example, placing weapons of mass destruction in orbit or stationing other weapons on celestial bodies, for the purpose of self-defense. The legality of using nuclear weapons for self-defense is an unsettled question, as the ICJ said in its *Nuclear Weapons* Advisory Opinion in 1996:

> [T]he threat or use of nuclear weapons would generally be contrary to the rules of international law… and in particular the principles and rules of humanitarian law… However, in view of the current state of international law, and of the elements at its disposal, the Court cannot conclude definitively whether the threat or use of nuclear weapons would be lawful or unlawful in an extreme circumstance of self-defense, in which the very survival of a State would be at stake…[24]

Whether the Court is declaring a *non liquet* situation or proposing a necessity test is disputed. Either way, the Court does imply that in very extreme cases nuclear self-defense could be lawful. Nevertheless, use of weapons from outer space may breach a State's obligation under the treaty vis-à-vis all other States Parties. The defending State's wrongful actions and obligations, vis-à-vis the attacking State, could be precluded by Article 21 of the ILC Draft Article on State Responsibility, which provides "[t]he wrongfulness of an act of a State is precluded if the act constitutes a lawful measure of self-defence taken in

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[23] BRUCE A. HURWITZ, THE LEGALITY OF SPACE MILITARIZATION 72 (Elsevier Science Pub. Co., 1986).

[24] Legality of the Threat or Use of Nuclear Weapons (Adv. Op.), 1996 I.C.J. 226, ¶ 105 (July 8).

conformity with the Charter of the United Nations."[25] Nonetheless, the breach of a State's obligation vis-à-vis other States Parties cannot be precluded. Yet, under this circumstance, the invocation of other States Parties with regard to the wrongful act is unlikely.

Notwithstanding, that outer space shall not be used for aggression and may be used for self-defense, we now turn to the question of whether all non-aggressive uses of outer space are in conformity with the peaceful principle. Proponents make their argument based on two rationales: (1) the non-aggressive use of outer space has already been accepted by States; and (2) under international law, what is not specifically prohibited, is allowed.

The United States maintains the view that "no State has ever *formally* protested the U.S. interpretation of the phrase 'peaceful uses' in the context of outer space activities," by citing the enormous amount of military activities of both the U.S. and U.S.S.R. in outer space.[26] As to non-aggressive uses of outer space, there are certainly many. For example, launching communication satellites, deploying weapons, testing weapons, shooting down one's own satellites etc. It is true that some uses, such as operating reconnaissance satellites, have already been accepted by States and, therefore, are lawful under international law. But the mere absence of protests concerning some uses does not legitimatize others, which have yet to be conducted. Thus, the absence of formal protests against a State's space activity, before it is conducted, does not mean acquiescence of the operation either. In this connection, Professor Bin Cheng rightly opines:

> … one can definitely not speak of any subsequent practice acquiescing in the United States' interpretation of the term "peaceful" based on the absence of any protest insofar as Article IV(2) is concerned, since States are certainly not required

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[25] Draft Articles on Responsibilities of States for International Wrongful Acts 2001, art. 21, a*vailable at* http://untreaty.un.org/ilc/texts/instruments/english/commentaries/9_6_2001.pdf.

[26] Ivan Vlasic, *The Legal Aspects of Peaceful and Non-Peaceful Uses of Outer Space*, *in* BHUPENDRA JASANI (ED.), PEACEFUL AND NON-PEACEFUL USES OF SPACE 44-45 (Taylor & Francis 1991).

> to monitor and correct other States' mistakes in their understanding of the law or legal malapropisms, as long as they do not put their misinterpretation into practice.[27]

It is also noteworthy that some uses of outer space, which have been planned but not yet implemented, have already drawn protests from States. Therefore, non-aggression is a necessary, rather than sufficient, condition for the peaceful principle. Furthermore, another argument could be made as to the judgment of the Permanent Court of International Justice (PCIJ) in the *Lotus Case*: if an act is not specifically prohibited, it is permitted under international law. This is the major legal barrier to the prevention of space weaponization.

IV. PREVENTION OF WEAPONIZATION

Weaponization of outer space is defined as "weapons based in space or weapons based on the ground with their intended targets being located in space."[28] Technically, ground-based weapons targeting space objects are not placed in outer space; hence, they are not considered as part of the weaponization of outer space. Nevertheless, a discussion here is of crucial relevance in the present context.

Although weaponization of outer space hasn't happened yet, the possibilities are intense. The United States, since President Ronald Reagan's announcement of the Strategic Defense Initiative (SDI) in the early 1980s, has been the country most likely to put it into practice. Although the plan was temporarily discarded in the early 1990s, the United States Space Command Vision for 2020, published in 1997, delineated a plan for U.S. dominance of the Earth from space. Entering the 21st century, the United States was enthusiastic about establishing "space superiority" and initiated a missile defense system plan in 2001. In June 2002, the United States withdrew from the Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty), which expressly prohibits the development, testing, and de-

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[27] *International Law Across the Spectrum of Conflict*, *supra* note 4, at 98.
[28] MOWTHORPE, *supra* note 5, at 3.

ployment of sea-based, air-based, space-based, and mobile land-based ABM systems.[29] The 2006 U.S. National Space Policy adopts a hard line saying that US will, among other things, ". . . take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to US national interests."[30]

After the U.S. withdrew from the ABM Treaty, the Outer Space Treaty remains the only international convention limiting space weaponization. The Outer Space Treaty, in Article IV paragraph 1, prohibits weapons of mass destruction in outer void space as well as on celestial bodies; whereas, paragraph 2 strictly bans all types of weapons from celestial bodies. However, it is widely acknowledged that two loopholes exist in this Article: (1) conventional weapons are not banned in outer void space, including the orbit around the Earth and (2) ballistic missiles which temporarily transit through outer space are not prohibited. The first point is relevant for our purpose here. The United States maintains the view that placing weapons like kinetic-kill-vehicles and laser satellites in orbit is not contrary to Article IV. This is true, because when read "in accordance with the ordinary meaning," Article IV indeed does not contain an explicit prohibition. And this double standard applied to outer void space on the one hand and celestial bodies on the other hand could be confirmed by the preparatory work of the Treaty. In fact, during the treaty negotiations India did propose to extend the application field of "exclusively for peaceful purposes," as in paragraph 2, to all outer space areas. In 1962, the Indian delegation to the United Nations Committee on the Peaceful Use of Outer Space stated "[m]y delegation cannot contemplate any prospect other than that outer space should be a kind of warless world, where all military concepts of this earth should be totally inapplicable."[31]

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[29] Treaty on the Limitation of Anti-Ballistic Missile Systems, art. V, May 26, 1972, U.S.-U.S.S.R., 23 U.S.T. 3435, 944 U.N.T.S. 13 [hereinafter ABM Treaty].

[30] U.S. National Space Policy (Unclassified) (Aug. 31, 2006), 2, *available at* http://www.nss.org/resources/library/spacepolicy/2006NationalSpacePolicy.htm.

[31] U.N. Doc. A/AC.105/PV.3 (Mar. 20, 1962), 63.

This proposal was rejected because it denotes total demilitarization of outer space, including the prohibition of military communication satellites. This was not acceptable to either the United States or the Soviet Union. The U.S., as aforementioned, links the disarmament in outer space to that on earth. Consequently, at the beginning of negotiations the United States proposed a treaty limited to celestial bodies, and "only after the negotiations had started that it agreed to extend the scope of the Treaty to include also the outer void space.[32] However, the Legal Sub-Committee of COPUOS was never authorized to conclude any decisions pertaining to general disarmament.[33] Hence, it could only be concluded that the double standards in Article IV were deliberately adopted. For instance, the Outer Space Treaty does not prohibit conventional weapons in outer void space. However, neither can we infer from this lack of prohibition that the Treaty permits it implicitly. Because there was simply no international consensus for permission, the drafters could not have explicitly permitted it like they did concerning the use of military personnel in scientific research.[34] In fact, the Outer Space Treaty was drafted at a time when the drafters were primarily concerned with the placement of nuclear weapons in outer space. Thus, conventional weapons in outer void space were not foreseen, and therefore not prohibited.

Because space weaponization has not been implemented in practice, there is no customary international law in place to which to refer. Nonetheless, the predominant political will of the international community is much more likely to prohibit, rather than to permit, the weaponization of outer space. The issue of space weaponization is most hotly debated between three major space-faring States, namely the U.S., Russia, and China. Among them, one is keen on, but has not yet realized space weaponization. Russia and China, the two countries believed to have the capacity to weaponize outer space following the U.S., are actively advocating the preservation of a weapon-free outer space.

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[32] *International Law Across the Spectrum of Conflict*, *supra* note 4, at 95.

[33] Marko G. Markoff, *Disarmament and 'Peaceful Purposes' Provisions in the 1967 Outer Space Treaty*, 4 J. SPACE L. 3, 10 (1976).

[34] Outer Space Treaty, *supra* note 2, at art. IV, ¶ 2.

The recent efforts by Russia and China at the Conference on Disarmament on adopting a treaty on preventing space weaponization are appreciated by a larger number of States.[35] In the Legal Subcommittee of COPUOS, the delegates of a large number of nations do not favor the extension of the arms race into outer space either, leaving the U.S. to stand alone on the opposite side. For example, in 2006, the U.N. General Assembly Resolution on "Transparency and confidence-building in outer space activities" was adopted by 167 yes votes, with only the United States voting against and Israel abstaining.[36] In 2004, the PAROS resolution reserving outer space for peaceful purposes was adopted by 178 countries voting in favor, and Israel, Haiti, Palau and the U.S. abstaining.[37] Of course, the U.S., as a space superpower, well deserves the status of "specially affected" State and its acts do carry substantial weight in international law.[38]

Consequently, the above analysis could conclude that placing conventional weapons in outer void space is neither permitted nor prohibited by international law, but the prevalent international political will is on the side of prohibition. The question before us is whether this lacunae could be filled by the *Lotus Case* principle that "[r]estrictions upon the independence of States cannot . . . be presumed,"[39] which could be rephrased as, "in international law what is not specifically prohibited is permitted." Proponents of this approach make two assumptions, which must not be overlooked: (1) the completeness of international law and (2) the *Lotus* principle as the closing rule for its lacunaes.

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[35] Compilation of Comments and Suggestions to the CD Working Paper on PAROS(CD/1679), CD/1818 (on file with author).

[36] Transparency and Confidence-Building Measures in Outer Space Activities, G.A. Res. 61/75, U.N. GAOR, 61st Sess., 67th plen. mtg., U.N. Doc. A/RES/61/75 (Dec. 18, 2006); Press Release, General Assembly, General Assembly Adopts 55 Texts Recommended by First Committee on a Wide Range of Disarmament, Security Matters, U.N. Doc. GA/10310 (Mar. 12, 2004).

[37] Press Release, General Assembly, Arms Trade Treaty, 'Nuclear-Weapon-Free World', Outer Space Arms Race Among Issues, As General Assembly Adopts 54 First Committee Texts, U.N. Doc. GA/10547 (Dec. 6, 2006).

[38] North Sea Continental Shelf Cases 1969 I.C.J. Reports 3, 42, ¶ 73.

[39] Case of the S.S. "Lotus" (Fr. v. Turk., 1927 P.C.I.J. (Ser. A) No. 10, at 18.

Occurring in both municipal and international law, lacunaes develop where legal rules and principles are unclear or insufficient in relation to a concrete case, or where the law is silent on a certain matter, thus creating a material gap.[40] As Sir Hersh Lauterpacht noted,

> "in the international sphere the 'gaps' . . . are more ostensible and more frequent. . . . Even when the law is clear and generally accepted it occasionally exhibits what some consider to be lacuna . . . inasmuch as it represents a rule which . . . may be deemed to be morally questionable, or which has become politically reprehensible and obsolete on account of changed conditions, or which leaves outside its orbit a situation clearly and urgently calling for regulation."

The system of international law is an incomplete one only if the material gaps, in Judge Higgins' words, "are not remediable either by a liberal interpretation of the judicial function or by reference to Article 38(1)(c) [of the Statute of the International Court of Justice] on the 'general principles of law recognised by civilized nations'."[41] Whether international law is complete or not has been subject to longstanding debates since initiated by Lauterpacht and Stone over fifty years ago, and need not be resolved for our present purpose. Suffice it to point out that the question of completeness of international law is skipped by proponents who take the *Lotus* principle as a *panacea*.

Today, the *Lotus* principle has become so widely upheld in academic and political circles that it is regarded as a "ground rule" for the former, and a "golden rule" for the latter. In fact, the PCIJ upheld Turkey's way of thinking as a starting point, allowing Turkey's jurisdiction whenever such jurisdiction does not come into conflict with a principle of international law, but very unlikely declared as a closing principle. That the principle justifies all that is not prohibited, even those acts not governed

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[40] Sir Hersh Lauterpacht, *Some Observations on the Prohibition of 'Non Liquet' and the Completeness of the Law*, *in* Elihu Lauterpacht (ed.), International Law: Being the Collected Papers of Hersch Lauterpacht, Vol. 2, Part I, (Cambridge University Press, 1975) 213, at 220-21.

[41] R. Higgins, *Policy Considerations and the International Judicial Process* 17 INT'L & COMP. L.Q. 58, 67 (1968).

by existing norms, is an exaggeration accelerated by subsequent discussions. In the *Lotus Case* itself, at least three judges explicitly disagreed, and to different extents, with the above dictum.[42] Somewhat ironically, the Justices' disagreement played an important role in contributing to the ensuing debates, by setting the issue as an important agenda. Subsequently, the Court, unlike in the academic and political arenas, has been very cautious in referring to the *Lotus* principle by avoiding it as much as possible. For instance, in the *Arrest Warrant* case it ruled against Belgium without dealing specifically with the Belgium citation to the *Lotus Case*,[43] and in the *Nuclear Weapons* advisory opinion the Court avoided clarification by saying that it was "without particular significance for the disposition of the issues before the Court," because "the nuclear-weapon States appearing before it either accepted, or did not dispute, that their independence to act was indeed restricted by the principles and rules of international law . . ."[44] In a survey conducted on the application of the *Lotus* principle in the Court, Hugh Handeyside concludes that the Court has viewed the principle at best as inapposite, and at worst as an inaccurate statement, of the principles of international law.[45]

The *Lotus Case* was adjudicated early in 1927, since then significant changes have occurred. Significantly, it has not been this principle that has guided the development of inter-State relations; otherwise, the world we are living in today could be one where Antarctica is divided up and nuclear weapons continue to be tested in the air and the on the high seas. As Judges Higgins, Kooijmans, and Buergenthal noted in their joint separate opinion to the *Arrest Warrant Case*, "[The *Lotus* principle] represents the high water mark of laissez-faire in international

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[42] *Case of the S.S. "Lotus"*, *supra* note 39, at 34 (Loder M., dissenting), 43 (Weiss M., dissenting), & 52 (Lord Finlay, dissenting).

[43] Case Concerning the Arrest Warrant of 11 April 2000 (Congo v. Belg.), 2002 I.C.J. 1 (Feb. 14).

[44] Legality of the Threat or Use of Nuclear Weapons, 1996 I.C.J. 1, 239.

[45] Hugh Handeyside, *The Lotus Principle in ICJ Jurisprudence: Was the Ship Ever Afloat?*, 29 MICH. J. INT'L L. 71, 72-73 (2007).

relations, and an era that has been significantly overtaken by other tendencies."[46]

Today States are unprecedentedly interrelated not only in the sense that they are more inter-dependent on each other in economics or other fields, but also because the global issues challenging cooperation among States are more demanding than ever before. The weaponization of outer space reaches far beyond the business interests of a sole country. With little doubt, one State's weaponization of outer space would cause a chain reaction by inviting others to follow suit and ignite an arms race. This in turn will break the current global strategic balance and stability under the philosophy of mutually assured destruction (MAD). Meanwhile, it would encourage the increase in nuclear stockpiles and the development of anti-satellite weapons (ASATs). None of these subsequent actions, under the *Lotus* principle, are prohibited by international law. The rise of inter-State conflicts would replace issues on the international agenda concerning the common benefits of all mankind, such as climate change, poverty and disease. This scenario would be contrary to the current underlying theme of international law. The *Lotus* principle may not be completely outdated. But at least for space weaponization, it is not, and should not be, applicable.

V. CONCLUSION

In international law it frequently happens that when the use of something is not yet feasible, it is much easier to regulate it in a somewhat ideal, if not Utopian, way. But when exploitation or other uses become feasible, State interests start to penetrate and encroach upon the former ideal spirit. This is exactly what happened in the context of outer space. The non-military initiative proved too impractical to sustain. Fortunately, the space race brought the world more benefit than harm. To some extent, it fixed the troubles on earth. But beneficial outcomes are very unlikely to be with us if weapons are placed in the space.

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[46] The Arrest Warrant Case (Dem. Rep. Congo v. Belg.), 2002 I.C.J. 3, 78 (Feb. 14) (joint separate opinion of Judges Higgins, Kooijmans, and Buergenthal).

The non-militarization interpretation has become completely outdated. Consequently, efforts to prevent space weaponization by the doctrine are fruitless. On the other hand, non-aggression cannot provide justification for space weaponization either. If we simply test "peaceful" by the minimum standard of inter-State norms, for what do we need a peaceful principle? Moreover, the lack of a specific prohibition does not mean space weaponization is permitted under international law. Relying on the *Lotus* principle would undermine the international legal framework and instigate a laissez-faire attitude in the international community. In essence, all hopes for prevention of space weaponization are pinned on the space-faring States and international political will.

There are two ways to prohibit an issue that should not happen from happening: first, reach an international consensus on prohibition before it happens or, second, reach a consensus after human beings learn a serious lesson. Of course, no one would practice the second alternative with space weaponization.