> The Secretary of Defense is charged with developing capabilities, plans, and options to ensure freedom of action in space, and if directed, to deny such freedom of action to adversaries.[59]

General Armor's statement demonstrates that the United States is sensitive to the vulnerability of its space assets. Furthermore, the General clearly states that the United States is prepared to prevent other parties from enjoying space capabilities that the United States perceives as "hostile."[60]

Significantly, though General Armor's statement concerns American space capabilities, and America's preparations to deny its enemies access to space, General Armor makes no attempt to define "space." He simply explains that the United States "rejects claims of sovereignty by any nation over outer space" but does not define "outer space."[61] This highlights Major Reinhart's concerns that the lack of a definition of outer space creates the potential for conflict.[62] A nation defining the limits of its sovereignty while attempting to avoid conflict with the United States is left simply to guess what the United States (or other nations) consider to constitute outer space. In order to avoid the potential for conflict, the international community must reach a concrete consensus on the meaning of outer space.[63]

## IV. DESIRABILITY OF ESTABLISHING A DEMARCATION BETWEEN EARTH AND SPACE

Before setting out to establish a line defining the upper limits of Earth and of a State's control over its territory, policymakers must first determine whether establishing such a designation is advantageous or desirable. In the early days of spacefaring, even before humans had first ventured into space, governments showed reluctance – or even hostility – toward the idea of establishing a line between Earth and space. American officials

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[59] Armor Testimony, *supra* note 54, at 33.
[60] *Id*. at 38.
[61] *Id.* at 33.
[62] Reinhardt, *supra* note 7, at 4.
[63] *Id*.

were particularly opposed to establishing such a limit. Policymakers did not want to fix an altitude above which a nation had no right to control objects "over" that nation's territory.[64]

United States Air Force officials voiced several justifications for their reluctance to allow such a limit to be established. The first such reason was that space technology was simply too young to be constrained by such agreements. In a 1958 Memorandum, Assistant Secretary of Defense for Internal Security Affairs, Mansfield D. Sprague, articulated the concern that America did not have enough information about the applicability of space technology to place restraints on it: "there is a real danger that we may harm ourselves by too early commitments, before the full implications of space potentials are known. Our policy and national interest should be permitted to develop first: the law, and commitments should follow, and be consonant with the former."[65] For Secretary Sprague, the United States should not close the door to space technologies before the door was even discovered.

The Department of Defense also discouraged the Department of State from adopting or agreeing to a "rigid definition of outer space" before the performance of a "detailed evaluation by *all* agencies concerned of possible consequences of such a definition to the US and its allies."[66] Highlighting the implications that such a definition may have on the development of unforeseen technologies, the statement concluded: "The proposed definition would establish a space floor which might at some future date be lower than the capabilities of very high flying aircraft."[67] The Department of Defense feared that establishing a boundary

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[64] TERRILL, *supra* note 38, at 37-39, 54-59.

[65] *Id*. at 37 (*quoting* Outline, *Some Elements Requiring Consideration in Formulating a National Policy on Outer Space*, at 6, *attachment to* Mansfield D. Sprague, assistant secretary of defense, to assistant secretary of the Air Force et al., memorandum, subject: Proposal for a National Policy on Outer Space Feb. 25, 1958).

[66] *Id.* at 56 (*quoting* DOD Planning Luncheon, paper, United States Initiative at the 16th General Assembly, at 3 (Sept. 12 1961)) (emphasis added).

[67] *Id.* at 56 (*quoting* DOD Planning Luncheon, paper, United States Initiative at the 16th General Assembly, at 3 (Sept. 12, 1961)).

could have unforeseen consequences that would be revealed only with the advent of future technologies.[68]

In a 1962 memorandum to the Secretary of Defense, the Joint Chiefs of Staff opposed the establishment of a definition of outer space because they felt such a definition would be "premature" and would place unnecessary restraints on military uses of outer space.[69] Such concerns were not without historical foundation. American policymakers had likely learned from the mistakes of the Soviets who had to reverse their policies concerning sovereignty in outer space after the launch of *Sputnik*.[70]

The Assistant Judge Advocate General of the Air Force, Major General Moody R. Tidwell also believed that "it was unwise to attempt to define a line of demarcation where a nation's sovereignty ended."[71] General Tidwell believed that a discussion centered around the altitude of an object or activity was misplaced. For General Tidwell, the concern should be the *activities* carried out over a subjacent state, not the altitude at which the activities are executed.[72] General Tidwell wisely stated that the "agreement to any fixed distance" is meaningless "as long as an equal danger may exist from above such point."[73]

General Tidwell's focus on the function of the spacecraft rather than the craft's location begs the question whether a "vertical limit" of sovereignty is even necessary.[74] However, given the secretive nature of many satellites and other space objects, it seems unlikely that satellite-operating nations would

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[68] *Id.* at 56 (*quoting* DOD Planning Luncheon, paper, United States Initiative at the 16th General Assembly, at 3 (Sept. 12, 1961)).

[69] *Id.* at 57 (*citing* Will H. Carroll, The Role of the Air Force JAG in the Early Development of the Law of Outer Space, at 7 (unpublished, n.d.)).

[70] *See* Reinhardt, *supra* note 7, at 19 (*citing* MYRES S. MCDOUGAL ET AL., LAW AND PUBLIC ORDER IN SPACE 235 (1963)) Ironically, many believe that the fact that the U.S.S.R. launched a satellite into outer space before the United States actually aided the American Space program in that it "establish[ed] the concept of freedom of international airspace." Goodpaster, *supra* note 33, at 193-95.

[71] TERRILL, *supra* note 38, at 54.

[72] *Id*.

[73] *Id*. at 54 (*quoting* Major General Moody R. Tidwell).

[74] *See also* Rosenfield, *supra* note 11, at 148 ("[a] definition of the geographic point where sovereign air space ends and free outer space begins may never need to developed").

be willing to disclose information about satellites and other space objects.

Even if States were willing to share information concerning the nature and missions of their spacecraft, verification of that information by other nations would be extremely difficult. Therefore, it is unlikely that a workable agreement based on the mission and function of the concerned spacecraft could ever be reached. In his history, Colonel Delbert R. Terrill notes that a 1967 letter between U.S. Military officials "concluded that making a distinction between civil and military satellite observations opened a Pandora's box."[75] Given that the United States has wisely declined to disclose significant information about its satellites, the United States cannot expect other nations to disclose such information. Therefore, it seems unlikely that a standard of State sovereignty based on the activities conducted over a State will be achieved.

Dr. Seddon suggested that there has been an intentional decision not to define "outer space."[76] The astronaut stated that the United States has "not been pushing for anyone to define [space] so there must be some reason; it either has no applicability or people do not want it defined for some reason."[77] Colonel Terrill's history provides evidence that the latter of Dr. Seddon's options is the answer.[78] It seems that, at least historically, U.S. Military officials have feared that defining "space" too early or too concretely could limit American options in this new frontier.[79]

The United States is not the only nation to express reservations about establishing a space boundary. In 1959, The Outer Space Committee of the British House of Lords discussed "what view they [should] take as to the jurisdiction of sovereign powers over outer space and whether this matter has been the sub-

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[75] TERRILL, *supra* note 38, at 58.
[76] Seddon Interview, *supra* note 8.
[77] *Id*.
[78] *Id.* at 35-39, 54-59.
[79] *Id*.

ject of international discussion."[80] The Lord President of the Council (Lord Hailsham) explained that while there is most definitely a point at which British sovereignty terminates, not enough was known about space to establish that limit:

> My Lords, Her Majesty's Government consider that sovereignty over space above national territory cannot extend indefinitely upwards. . . however . . . International Law has [not] yet determined the exact limit to be placed on the extension of sovereignty upwards or what legal régime should apply in realms of outer space to which sovereignty does not extend. There are still too many unsolved problems in this field to justify the adoption at present of any sweeping legal propositions, in whatever direction they tend.[81]

England, as well as the United States, maintained that nations should not establish the "vertical limit of state sovereignty"[82] while space exploration was still in its infancy. Lord Hailsham's statement "there are still too many unsolved problems" to establish such a limit[83] suggests that Britain, like the United States, feared that to establish such a limit so early in the history of space exploration risked foreclosing opportunities before those opportunities were recognized.

While there has been a traditional reluctance to define space, the time has come to resolve this ambiguity. As Major Reinhardt notes, failing to define such a boundary creates the potential for conflict.[84] With an ever-increasing number of States – and now even some private actors[85] – joining the space community, the potential for conflict will only increase.[86] While we should certainly allow for flexibility so that the rules can

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[80] OUTER SPACE COMMITTEE OF THE BRITISH HOUSE OF LORDS, 216 PARL. DEB., H.L. (June 11, 1959) § 975-7, at 53 *available at* http://hansard.millbanksystems.com/lords/1959/jun/11/outer-space [hereinafter OUTER SPACE COMMITTEE].

[81] *Id*.

[82] *See* Reinhardt, *supra* note 7.

[83] OUTER SPACE COMMITTEE, *supra* note 80.

[84] Reinhardt, *supra* note 7, at 4, 14, 76.

[85] *See generally* MICHAEL BELFIORE. ROCKETEERS: HOW A VISIONARY BAND OF BUSINESS LEADERS, ENGINEERS AND PILOTS IS BOLDLY PRIVATIZING SPACE (Harper Collins 2007); Reinhardt, *supra* note 7, at 25.

[86] *See* Reinhardt, *supra* note 7, at 4, 14, 76.

adapt with evolving technology, we now have enough information, and know enough about space capabilities and potential, that such an agreement is no longer "premature." [87] The international community must reach a consensus as to the maximum extent of a State's control over its airspace.

## V. IMPLICATIONS OF THE CHINESE ANTI-SATELLITE TEST

The Chinese ASAT test of 11 January 2007 shed new light on the old problem of the lack of rules for space. With China on the cusp of superpower status, "the test appears to mark a new sphere of technical and military competition."[88] The test (that was almost certainly intended as a warning to the United States[89]) is particularly concerning because the weather satellite hit by the weapon orbited further from Earth than American spy satellites do.[90] China has long openly expressed an interest in the ability to attack American space capabilities; as early as 2000, *Chinese State News* reported that the Chinese military was creating new methods to counter American space assets.[91] With its ASAT test, China has presumably demonstrated the capability to destroy American spy satellites.[92] Because some Chinese assert that their country's sovereignty extends into outer space, this capability is particularly concerning.[93]

Commenting on China's claim of sovereignty over space, Air Force General Ted Kresge maintained that Chinese claims of sovereignty were "illegitimate" because of international trea-

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[87] TERRILL, *supra* note 38, at 56.

[88] Broad and Sanger, *supra* note 5.

[89] *See* Zissis, *supra* note 3, at 1-2.

[90] Broad and Sanger, *supra* note 5.

[91] REPORT OF THE COMMISSION TO ASSESS UNITED STATES NATIONAL SECURITY SPACE MANAGEMENT AND ORGANIZATION 22-23 (Jan. 11, 2001), *available at* http://www.fas.org/spp/military/commission/report.htm [hereinafter REPORT OF THE COMMISSION].

[92] Broad and Sanger, *supra* note 5.

[93] Bill Gertz, *U.S. Satellites dodge Chinese missile debris*, THE WASHINGTON TIMES, Jan. 11, 2008, *available at* http://www.washingtontimes.com/news/2008/jan/11/us-satellites-dodge-chinese-missile-debris/; *Disharmony in the Spheres – The Militarization of Space, The Vulnerability of Military Satellites,* THE ECONOMIST, Jan 19, 2008, *available at* http://www.economist.com/displaystory.cfm?story_id=10533205 [hereinafter *Disharmony in the Spheres*].

ties.[94] General Kresge continued that if China intends to "enforce" those claims "we run into a space protection problem, and that is why we are so aggressively working the issue."[95] The Chinese ASAT test makes America's "aggressive" work on this issue all the more urgent.

The urgency of the Chinese ASAT test issue is due largely to the fact that space-based technology is a critical component of American military and economic supremacy.[96] While these capabilities allow the United States to achieve its unprecedented power, America's extensive reliance on space-based technology creates an "Achilles heel," which is vulnerable to any party able to launch an object into space.[97] General Armor warned that, "space is a critical enabler for U.S. forces . . ., and potential adversaries *have and will* continue to seek capabilities to counter this advantage."[98]

Particularly concerning to United States military officials is that they do not know how to interpret the Chinese ASAT Test. The Chairman of the Joint Chiefs of Staff, Marine General Peter Pace explained that the ASAT test concerned "the international community" primarily because, "it was [not] clear what their intent was . . . when things are not clear, and there are surprises, then it tends to confuse people and raise suspicions."[99] General Pace continued that while it is not necessary for nations to "agree or disagree with any particular country's objective . . . it [is] very helpful to understand what those objectives are and why they [are] going in that direction."[100] General Pace suggested the establishment of "officer exchanges" between the two nations.[101] Highlighting the necessity for open communication and understanding between the two powers, General Pace

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[94] Gertz, *supra* note 93.

[95] *Id.* and accompanying text (*quoting* General Ted Kresge).

[96] Armor Testimony, *supra* note 54, at 32-33; *See generally*, *Disharmony in the Spheres*, *supra* note 93

[97] *Disharmony in the Spheres*, *supra* note 93.

[98] Armor Prepared Statement, *supra* note 54, at 39.

[99] Ben Blanchard, *U.S. general says China missile test "Confusing"*, REUTERS, Mar. 23, 2007, *available at* http://www.reuters.com/article/idUSPEK17108920070323 (*quoting* General Peter Pace).

[100] *Id*.

[101] *Id.*

stated, "[t]he biggest fear I have of the future is miscalculation, misunderstanding based on misinformation."[102] While the capability demonstrated by the ASAT test is sobering, the ambiguous motivation for the test is terrifying.

General Pace is not the only American official concerned about "miscalculation." General Armor explained that China is building a variety of anti-space capabilities. The General continued that, "[t]he lack of transparency into China's . . . overall intentions is most troubling as it could lead to miscalculation of intent and crisis instability."[103] General Armor's statement shows the need for a determination of space. Because China has a demonstrated ability to control outer space, the United States must reach an agreement as to how much of outer space China intends to control – or will be permitted to control – under established principles of international law so that the United States can conduct our space activities accordingly. If China and the United States are not clear as to each other's sovereign claims, this could lead to "miscalculation" and conflict.[104]

One particularly concerning aspect of Chinese space policy is that China does not appear to have a unified space policy. While the Chinese government claims that its sovereignty extends to *all* space above Chinese territory[105] a white paper issued by the China National Space Administration in 2006 insists that "China is unflinching in taking the road of peaceful development, and always maintains that outer space is the common wealth of mankind."[106] The same white paper states that "[a]dhering to the policy of opening up to the outside world, and actively engaging in international space exchanges and cooperation. [sic] China supports all activities that utilize outer space for peaceful purposes."[107] While this statement suggests

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[102] *Id.* (*quoting* General Peter Pace).

[103] Armor Testimony, *supra* note 54, at 41.

[104] *See id.*; Reinhardt, *supra* note 7, at 4, 14, 76.

[105] Gertz, *supra* note 93 (emphasis added).

[106] Information Office of the State Council of the People's Republic of China, China National Space Administration, *China's Space Activities in 2006*, 1, *available at* http://www.fas.org/spp/guide/china/wp2006.pdf.

[107] *Id.* at 3.

that China supports an "freedom of access" policy, it conflicts with China's stated claims of infinite "vertical sovereignty."[108]

In addition to the contradictions between China's statements and actions, there is concern that the various branches of the Chinese government may not be communicating adequately. The delay between China's ASAT test and the government's confirmation of that test caused some to theorize that China's civilian government and military leaders had not been in adequate communication with each other.[109] Such fears, if true, are particularly alarming. If transparency of action is important between powers, it is essential within a power. [110]

As General Pace's statements suggest, the United States believes that transparency is vital, particularly in the realm of space. In a media roundtable discussion, Secretary of Defense Robert Gates explained that the United States ASAT test was a "very different activit[y]" from the Chinese ASAT test.[111] Secretary Gates explained that the primary differences were that the United States was "open and transparent" about its test, conducted its test at a lower orbit so as to mitigate the creation of debris, and that the United States conducted the test in order to protect human beings from harm by the malfunctioning satellite:

> First of all, we were very open and transparent from the very beginning about the problem that we saw and that we were going to try and modify the software in some of our missile defense capability in order to be able to deal with this threat. Our view was however remote the possibility that this hydrazine tank[112] might harm people here on Earth that the only responsible thing was to try and deal with the problem. We were very open about it. We hit this dead satellite in a very low orbit so that the debris was very limited and would decay and burn up in the atmosphere within a matter of hours to days or weeks.

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[108] *See* Gertz, *supra* note 93.

[109] Zissis, *supra* note 3, at 1.

[110] *See* Blanchard, *supra* note 99.

[111] Defense Link News Transcript, Media Roundtable with Sec'y of Def. (Feb. 27, 2008), *available at* http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=4161 (quoting Sec'y of Def. Robert Gates) .

[112] A toxic fuel used to power the satellite.

> The Chinese anti-satellite test was conducted in secret, never explained to anyone, was carried out at an altitude several hundred miles higher than ours and led to a significant debris field that will be in orbit for decades. So I think that there is a significant difference between what we did and the way we approached it and the Chinese anti-satellite test last year.[113]

For Secretary Gates, the American and Chinese ASAT tests are completely different due to the manner in, and the circumstances under, which they were carried out.[114] Like General Pace, Secretary Gates stressed the openness with which the United States conducted its test as the key difference between the American and Chinese ASAT tests.[115] Furthermore, the high altitude of the Chinese test creates a long-lasting debris field: an act not consistent with responsible space citizenship.[116]

As Secretary Gates' statement implies, an ASAT test does not have to directly target or strike an American satellite to effect American space-based interests.[117] The Chinese ASAT tests created a "debris field" in the orbit of some 800 satellites (between 300 and 400 of which are American) satellites.[118] The American satellites alone are valued at approximately $100 billion.[119] The debris is no passing threat; the single Chinese ASAT test added twenty percent more space debris which will remain in orbit for as much as 100 years.[120]

The debris problem demonstrates than an ASAT test does not have to directly impact a nation's satellite to have an impact on the nation. As of 11 January 2008, two U.S. satellites had to alter their orbits to prevent becoming cosmic "road kill."[121]

The debris created by the Chinese ASAT test, and the impact it is having on other nations' space activities demonstrate the need for a clear consensus of sovereignty in space. If China,

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[113] Defense Link News Transcript, *supra* note 111.
[114] *Id*.
[115] *Id*.
[116] *Id*.
[117] *Id*.
[118] Zissis, *supra* note 3, at 3; Gertz, *supra* note 93.
[119] Zissis, *supra* note 3, at 3.
[120] Gertz, *supra* note 93.
[121] Zissis, *supra* note 3, at 3 (*quoting* Michael Krepon and Michael Katz-Hyman of the Henry L. Stimson Center). Gertz, *supra* note 93.

or other nations, continue to operate in space with such reckless disregard for the welfare of other States – aided no doubt by the Chinese belief that they are sovereign over their territory[122] – then their actions will continue to have a negative impact on the space operations of other States. The international community must reach a clear resolution concerning sovereignty in space to prevent similar acts in the future.

## VI. SPACE TERRORISM

America's reliance on space has caused the United States to "identify space capabilities as a top national priority and vital to U.S. National interests."[123] The *Report of the Commission to Assess United States National Security Space Management and Organization* called attention to the gravity of the threat. The Report warned that the United States is "an attractive candidate for a 'Space Pearl Harbor'"[124] and could fall victim to such an attack if it fails to "take seriously the possibility of such an attack on US Space Systems."[125] As the chaos caused by the Chinese ASAT test shows, a party does not have to be able to accurately target the satellite in order to destroy it. Due the "predictable orbit" of satellites, one only has to release "a cloud of 'dumb' pellets in [a satellite's] path – using a shotgun rather than a hunter's rifle to kill the orbiting 'bird.'"[126] Therefore, while China has demonstrated its ability to destroy a particular, targeted satellite, any party with the ability to place an object into orbit poses a potential threat to satellites and therefore to the United States.

Ten nations and two commercial entities have demonstrated capabilities to place satellites into orbit.[127] It is widely known that any object in space can become a space weapon.[128] Thus, any entity – including non-State actors – which have the

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[122] *See* Gertz, *supra* note 93.
[123] Armor testimony, *supra* note 54, at 57.
[124] REPORT OF THE COMMISSION, *supra* note 91, at 22.
[125] *Id*. at viii-ix.
[126] *Disharmony in the Spheres*, *supra* note 93.
[127] *Id.*
[128] *Id.*

capability to "reach space" have the potential to challenge this key component of American military supremacy.[129]

Using history as a guide, it is clear that technology becomes rapidly cheaper and more widely available with the progression of time. With the 1957 launch of *Sputnik*, it would have been inconceivable that a non-State actor would be able to achieve orbit. Now, at least two commercial entities have demonstrated this capacity.[130] In addition, for a cost of $25 million, the privately developed and owned *SpaceShipOne* successfully put the equivalent weight of three people into suborbital "space" (for the purposes of the *X-Prize*) when it reached an altitude of 367,463 feet (69.6 miles or 112 km).[131] Space is no longer the domain of superpowers; it is not even reserved for State actors. Even private entities have joined the "elite club" of spacefarers.

While *SpaceShipOne* did not achieve an altitude sufficient to pose a direct threat to any orbiting satellite, the accomplishment should raise eyebrows. If a $25 million, privately-funded program, nearly five years ago, demonstrated the capability to propel the equivalent of three human beings to such a height, what capabilities might such private actors have today? Which capabilities might they achieve in the future?

As previously stated, at least two commercial entities have achieved orbit, which gives them the capability to compromise American space assets.[132] Control of these corporate entities could become a matter of national – if not *international* – security. Al-Qaeda and other terrorist organizations are devoted to destroying the United States. Through their actions, these terrorist organizations have proven that they will stop at nothing to inflict damage upon the United States. With non-State actors achieving space capabilities, the age of "space terrorism"[133] may be a future risk.

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[129] *Id.*

[130] *Id.*

[131] Reinhardt, *supra* note 7, at 25.

[132] *Disharmony in the Spheres*, *supra* note 93.

[133] Gerry Oberst, *Protecting Satellites from "Space Terrorism",* SATELLITE TODAY, Mar. 1, 2009, http://www.satellitetoday.com/via/globalreg/29927.html

The threat posed by the prospect of "space terrorism"[134] should not be overlooked. This author's research did not reveal any government sources predicting such a threat; the prospect appears to be largely ignored. Aside from a report by the European Space Policy Institute stating that the prospect is not getting enough attention, the possibility appears to be largely ignored.[135]

The effects of "space terrorism"[136] would hold the potential to be more spectacular than any act of terrorism the world has ever seen.[137] Due to modern society's heavy reliance on satellite technology, interference with satellite "constellations" could disrupt military operations (particularly those of the United States) and "essential daily functions – from financial transactions to telephone communication to power grids . . ."[138] Commenting on the Chinese ASAT test, Professor William C. Martel explained that the destruction of American satellites could cause the United States to "be propelled back into the nineteenth century."[139] Professor Martel's statement should not be dismissed as alarmist. Even a single satellite attack could have wide sweeping implications. In 1998 one American satellite malfunctioned causing many television video feeds to be lost and eighty percent of pagers in the United States to lose service.[140] Technicians took several weeks to completely restore service.[141]

With more and more States becoming increasingly reliant on space and space assets for their economic and defense operations, States will view space as essential to their national security.[142] This increasing reliance on space will create a greater incentive to protect one's own space assets. Furthermore, the

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[134] *Id*.

[135] Oberst, *supra* note 133.

[136] *Id*.

[137] *Id*.

[138] Zissis, *supra* note 3, at 2.

[139] *Id*. (*quoting* William C. Martel, "a professor of international security studies at the Fletcher School of Law and Diplomacy and a former member of the U.S. Air Force Scientific Advisory Board").

[140] REPORT OF THE COMMISSION, *supra* note 91, at 22.

[141] *Id*.

[142] SPACE SECURITY INDEX, *supra* note 44, at 63, 67, 136.

increasing importance of space assets will increase the incentive to develop the ability to neutralize the space assets of one's adversaries. In addition, those non-State actors (e.g. terrorists) will view space assets as an increasingly attractive target due to the impact such an action would have on the targeted State or States. Conflicts concerning sovereignty in space will only fuel the flames of disputes concerning the security of space assets. In order to prevent such conflicts, the global community must agree upon an elevation at which the sovereignty of nations terminates.

## VII. CONCLUSION

Surprisingly, humankind has been exploring space for over half of a century without yet defining where "space" begins and where the Earth's airspace, and therefore a nation's sovereignty "ends." Even more surprising is that this lack of a definition of the extent of national sovereignty has not sparked any significant international conflict. However, this good fortune cannot reasonably be expected to continue. The world's increasing reliance on space will create a greater incentive to protect one's own space assets. In addition, the increasing importance of space assets will also create a greater incentive for nations and non-State actors to develop the potential to neutralize the space assets of other nations.[143] As the international uproar caused by the Chinese ASAT test demonstrates, the desire to protect one's own space assets while developing the ability to neutralize others' space assets creates the potential for conflict. This potential for conflict will only be exacerbated if there is not an agreement as to the "vertical extent" of the sovereignty of the subjacent nations.[144] As space assets become increasingly integrated into national economic systems and military defenses, space will become an increasingly attractive battleground.[145] The potential

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[143] *Id*.
[144] *See* Reinhardt, *supra* note 7, at 4, 14, 76.
[145] SPACE SECURITY INDEX, *supra* note 44, at 63, 67, 136.

for a conflict in space will only be increased if there is no clear definition of the extent of a State's sovereignty.[146]

While it is essential that the global community come to a consensus on the "vertical limit of State sovereignty,"[147] reaching such a consensus will be a difficult task. Because space is a continuum, there is no clear physical boundary which could be established as the end of the Earth's airspace.[148] However, as stated above, there are a number of different elevations and designations in the "continuum" of the atmosphere[149] which have been suggested as the boundary between Earth's airspace and space and therefore the upper extent of State sovereignty.

The most logical boundary to establish as the "vertical limit of State sovereignty"[150] is 400,000 feet, a number based on astronaut Rhea Seddon's proposal: the Earth Entry Interface. This limit should be defined and established as the static elevation of 400,000 feet above sea level. To define the limit simply as the Earth Entry Interface would be unwise, as a limit so defined would be open to interpretation and could change with advances in technology or changes in the climate. Basing a limit on the Earth Entry Interface is the most attractive designation to establish as the upper extent of State sovereignty. The Earth Entry Interface is tantamount to a physical boundary and is presently detectable in space.[151] Furthermore, ground-based systems can easily verify the altitude of an object to determine whether the sovereignty of a State has been violated. It has many of the characteristics of a boundary because it has a physical impact on objects that encounter it (the drag of the atmosphere and the heat produced on the space craft).[152] As the name implies, the Earth Entry Interface is a point at which it is logical to say an object has "entered" the Earth's atmosphere. As nations are considered to be Earthly entities, it is only logical that they should extend to the outer limit of the Earth's atmos-

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[146] Reinhardt, *supra* note 7, at 4, 14, 76.
[147] *See generally id*.
[148] *See* Seddon Interview, *supra* note 8.
[149] *See id*.
[150] *See* Reinhardt, *supra* note 7.
[151] *See* Seddon Interview, *supra* note 8.
[152] *Id.*; ROGERS, *supra* note 10, at 2-3.

phere. While this paper proposes establishing the altitude of 400,000 feet as the extent of State sovereignty, the fact that this altitude is based upon the Earth Entry Interface should allow the established altitude of 400,000 feet to enjoy the same benefits of logic afforded to the Earth Entry Interface.

The inherently logical nature of the Earth Entry Interface should make it more likely to be accepted by other nations. Because the Earth Entry Interface is a number based on real significance, rather than an arbitrary number selected with no independent importance, it should be easier to convince other nations to agree to it. Furthermore, it is a high enough elevation that it will not have to be adjusted to allow for underlying geographical features.[153]

In addition to being logical, the Earth Entry Interface is also practical. The fact that it is far higher than any conventional aircraft can fly[154] should help to assuage many security concerns from over flight. However, the standard would infringe minimally, if at all, on the lowest possible orbit.[155] Therefore, it is a level high enough to prevent over flight by conventional aircraft while low enough that it would not significantly interfere with space activities. The Earth Entry Interface is high enough, without being too high.

The need for a clear definition of the upper limit of State sovereignty will only become more urgent. With space assets becoming increasingly important, space is becoming an increasingly attractive battlefield.[156] This battlefield will attract not only State actors, but also terrorists.[157] Nations can be expected to execute at least those actions which they feel are necessary to protect their national interests. Each State will likely do everything in its power to prevent threats to its interests from persisting in what the State considers to be its sovereign domain. A failure to establish an international standard defining the

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[153] *See* Reinhardt, *supra* note 7, at 65.

[154] Rosenfield, *supra* note 11, at 139.

[155] Kopal, *supra* note 13, at 155 (*quoting* Cooper, *Background of International Public Air Law*. 6 YB. AIR & SPACE L. 26-27 (1965)).

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

[157] Oberst, *supra* note 133.

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.