CENTER for ETHICS and the RULE of LAW
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Why Outer Space Matters for National and International Security

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January 2020

I. Introduction

On December 20, 2019, President Trump signed a defense spending bill that established the U.S. Space Force as the sixth branch of the U.S. military. This caps his June 18 announcement of the creation of a dedicated space force by 2020,[1] a suggestion that led to confusion, mockery,[2] objections among commentators, and speculation that this meant the United States was preparing to bring armed conflict into space.[3] The timing is poignant. Exactly 50 years ago, Neil Armstrong and Buzz Aldrin first landed on the moon. The media devoted much attention to celebrating this anniversary as well as asking what we have achieved in outer space since and where humanity might be going next. Seeming to capitalize on this renewed attention to outer space, Vice President Mike Pence announced earlier this year that the United States would put astronauts on the moon again by 2024[4].

[1] Benjamin Hart, "Trump Announces 'Space Force' He Wants to be Sixth Branch of Military", *New York Magazine,* 18 June 2018, http://nymag.com/intelligencer/2018/06/trump-announces-space-force.html

[2] Austin Goslin, "Steve Carell's new show Space Force could be Netflix's replacement for The Office", 16 January 2019, https://www.polygon.com/2019/1/16/18185709/steve-carell-space-force-the-office

[3] See for example, Christina Wilkie, "Trump floats idea of creating a 'Space Force' to fight wars in space', *CNBC,* 13 March 2018; Jacqueline Feldscher, "Are the U.S. and China on a war footing in space?", *Politico,* 16 June 2019; Robert Walker, "Space Force is a necessity – we are at war every day in space", *The Hill,* 8 May 2019, https://thehill.com/opinion/national-security/442725-space-force-is-a-necessity-we-are-at-war-every-day-in-space

[4] Mike Wall, "U.S. to return Astronauts to the Moon by 2024, VP Pence Says", 26 March 2019 https://www.space.com/us-astronauts-moon-return-by-2024.html

Today's context is vastly different from what it was in 1969 at the time of the first moon landing. Today's space "race" is no longer a competition between two superpowers. Today there are 1 spacefaring nations with independent launch capacity, and nearly every country is dependent in some way on space-enabled capabilities, many of which are supplied not by States but by commercial entities. Moreover, recent events have rekindled public attention regarding the question of militarization and weaponization of outer space. In March 2019, India launched "Mission Shakti," a successful anti-satellite (ASAT) weapon test, destroying one of its own satellites in low earth orbit (LEO) with a direct ascent missile and publicly declaring that it had thereby joined the "elite club" of space superpowers that have demonstrated this capability in the past, namely China, Russia, and the United States.[5] In July 2019, President Emmanuel Macron announced that France will create a Space Force Command within its Air Force to "reinforce our knowledge of the situation in space, [and] better protect our satellites, including in an active manner."[6] Japan has also joined the ranks of those nations pouring more of their defense budget and resources into space.[7] What do these developments mean? Why is space suddenly at the forefront of national and international security discussions, and should we be concerned?

To understand the renewed focus on outer space, it is important to understand the ways in which space-based technologies matter. While we may not be aware of it on a day-to-day basis, our 21st century interactions and movements are highly dependent upon outer space. Satellite technologies are an inherent part of our use of Internet and e-mail; telecommunications; weather forecasting; disaster management; GPS for navigation, traffic regulation, and civil aviation; precision timing for financial transactions, and satellite remote sensing for geographical or topographical mapping. The invisibility of the space technology required for these activities means that most of us are disconnected from the importance of space in today's commercial, military, and political arenas. Our high dependency on space, however, means that there is also a growing

[5] Surendra Singh, "India joins super space club with launch of anti-satellite missile", *The Times of India,* 27 March 2019, https://timesofindia.indiatimes.com/india/india-joins-super-space-club-with-launch-of-anti-satellite-missile/articleshow/68600840.cms

[6] "Macron Announces Creation of French Space Force", *France24,* 13 July 2019, https://www.france24.com/en/20190713-macron-france-space-force

[7] Japan eyes new defense unit to monitor space in fiscal 2020, JAPAN TODAY, https://japantoday.com/category/national/japan-eyes-new-defense-unit-to-monitor-space-in-fiscal-2020 (last visited Aug 29, 2019).

vulnerability, particularly when it comes to military activities.

Despite the fact that outer space may only be used for peaceful purposes under the 1965 Outer Space Treaty, most technologically advanced States today have a high military dependence on space. In other words, space is "militarized," but not yet "weaponized." Space plays a role in States' intelligence; surveillance and reconnaissance; disaster response; troop movement tracking on land, at sea, and in the air; classified and unclassified telecommunications; refugee movement tracking; identification of evidence of war crimes, genocide, or other mass human rights violations; drone operations; GPS-guided weapons; and, of course, the recent phenomenon of cyber-warfare, which is inherently caught up in satellite technologies.[8] The first Gulf war in the 1990s is often referred to as the first "space war" because it was the first time that there was significant reliance on satellite imaging and telecommunications as an integral part of "Operation Desert Storm."[9] Since then, naval, air, and army units have relied heavily on multiple forms of space technology. Space is, therefore, already permeating armed conflict on Earth. If one wants to cripple an adversary State's ability to observe, communicate, navigate, and utilize various weapon systems, it makes sense to target the space-based systems that are integral to these capabilities.

It is important to understand that space has been militarized since humans first accessed outer space and that military activities on Earth will continue to be dependent on space-based technologies. Space-based intelligence gathering was what drove technological innovation from the beginning of the space age with early satellites providing "national technical means" of verifying compliance with the Limited Test Ban Treaty.[10] The ability of the former Soviet Union and the United States to monitor each other's activities from space during the Cold War meant that there could be a reduction in the risk posed to the lives of pilots who had previously been flying through sovereign airspace to gather intelligence. Since the 1960s, from when satellites took

[8] Dale Stephens & Cassandra Steer, *Conflicts in Space: International Humanitarian Law and its Application to Space Warfare*, XXXX ANNALS OF AIR AND SPACE LAW, 2 (2015); Cassandra Steer, *Global Commons, Cosmic Commons: Implications of Military and Security Uses of Outer Space*, 18 GEORGETOWN JOURNAL OF INTERNATIONAL AFFAIRS 9–16, 9 (2017).
[9] Sharon Watkins Lang, *SMDC History: 25 years since first "Space War"*, WWW.ARMY.MIL (2016), https://www.army.mil/article/161173/smdc_history_25_years_since_first_space_war (last visited Mar 24, 2018).
[10] Laura Grego, *A History of Anti-Satellite Programs* 16, 3.

photographs and the film had to be released back to Earth,[11] to the vast array of sophisticated remote sensing technology today, space technology has had a military focus. Thus, while there is indeed some cause for concern, we should harbor that concern less for militarization of space than for the weaponization of space.

Historically, strategic restraint was the dominant approach among spacefaring nations, all of which understood that continued access to and use of space required holding back on threats or activities that might jeopardize the status quo of peace in space. Recently, however, there has been a discernible shift in international rhetoric towards a more offensive approach to defense in space. The events described at the beginning of this introduction, combined with a lack of transparency about actual capabilities and intentions on the part of all major players in space, creates a cyclical escalation that has led some commentators to describe this as a return to a Cold War-type arms race[12] and to the foreseeability of a space-based conflict.[13]

This raises a concern that puts the United States at a possible disadvantage. In the traditional domains of land, sea, and air, having technological supremacy means having the ability to dominate militarily. When it comes to space-based technologies, those States with a high dependency are in fact the most vulnerable, and this is exactly the predicament in which the United States finds itself. It is in this context that the notion of a Space Force has gained traction but responding to threats in space requires different solutions than responding to threats in other domains. For reasons that will be explained below, the space environment is unique in many ways,

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[11] Melissa de Zwart, "Outer Space", in: WILLIAM H. BOOTHBY, NEW TECHNOLOGIES AND THE LAW IN WAR AND PEACE 341 (2018).

[12] THERESA HITCHENS ET AL., TOWARD A NEW NATIONAL SECURITY SPACE STRATEGY: TIME FOR A STRATEGIC REBALANCING (2016), http://www.atlanticcouncil.org/images/publications/AC_StrategyPapers_No5_Space_WEB1.pdf (last visited Jul 17, 2019).

[13] Jackson Maogoto and Steven Freeland, *The Final Frontier: The Laws of Armed Conflict and Space Warfare*, 23:1 Connecticut Journal of International Law 165: 169; Robert Ramey, *Armed Conflict on the Final Frontier: the Law of War in Space*, 48 AFL Rev 1 (2000); US-China Economic and Security Review Commission, *China Dream, Space Dream: China's Progress in Space Technologies and Implications for the United States,* www.uscc.gov/Research/china-dream-space-dream-chinas-progress-space-technologies-and-implications-united-states p 107; "Why Space Warfare is Inevitable", *International Policy Digest,* 1 July 2018, https://intpolicydigest.org/2018/07/01/why-space-warfare-is-inevitable/; "Is the World Ready for War in Space?", *The Guardian,* 15 Apr 2018, https://www.theguardian.com/science/2018/apr/15/its-going-to-happen-is-world-ready-for-war-in-space

and a move towards weaponization of space or even towards trying to dominate space is likely to prove not only escalatory but potentially catastrophic for all players, including the United States and its allies, neutral States, commercial actors, and international civil society.

In answer to this concern, CERL hosted a public keynote in April 2018 where Lieutenant General David Thompson, newly sworn-in as Vice Commander of Air Force Space Command, spoke alongside Dr. Laura Grego from the Union of Concerned Scientists and former astronaut Steven Oswald. The topic of the discussion was "Warfighting and Law in Outer Space," chaired by this author.[14] The keynote was followed by a two-day expert roundtable to discuss "The Weaponization of Outer Space."[15] Attendees included approximately 40 experts from Canada, the Czech Republic, South Korea, and the United States from academia (including law, psychology, ethics, and philosophy), defense policy, the armed forces, the commercial space industry, legal practice, international diplomacy, and national security. This background paper provides an overview of the key issues discussed at the roundtable and describes the points of tension we face in space security to inform further debate and research. Many of the issues highlighted here have been dealt with more extensively in papers written by some of the experts who attended the roundtable event, which will appear in a volume published by Oxford University Press under the title "War and Peace in Outer Space: Ethical and Legal Boundaries."[16]

Section II of this paper will describe the unique characteristics of the space environment, including the ways in which space has become an environment contested by States and commercial entities as they attempt to monetize and control the domain. Artificial threats such as space debris and covert weaponization add to the complexity of the environment already complicated by increased commercial and international competition in space. The multiple, intertwined dependencies on space mean that all nations have a stake in the ways we respond to these threats. Section III outlines the legal framework applicable to military activities and space security. This review of applicable law includes not only the five core space treaties but many branches of public

[14] A full recording of this event is available: PENN LAW, *Warfighting and Law in Outer Space - CERL Conference* (2018), https://www.youtube.com/watch?v=Gh_EgJ7YSRE&feature=youtu.be (last visited Aug 29, 2019).
[15] https://www.law.upenn.edu/institutes/cerl/conferences/ethicalgovernancespacesecurity/
[16] Cassandra Steer and Matthew Hersch, *War and Peace in Outer Space: Ethical and Legal Boundaries,* OUP (Forthcoming, 2020).

international law, including the law of armed conflict and the law on the use of force. Given this, it is of consequence that the U.S. Department of Defense (DoD) has designated space as a "warfighting domain."[17] Many argue this is merely descriptive due to the ways in which space has become critical to all military activities; however, it sends a provocative signal to the international community. Section IV will discuss the consequences of the designation and the tensions among partners, allies, and adversaries in response to it. Section V will close with the optimistic conclusion that there is still much that can be achieved in terms of tempering these tensions through international collaboration, transparency, and clarity of behavioral norms.

II. The Space Environment

Our military and civilian dependency on space-based technologies requires policymakers, legislators, and other stakeholders to have a greater degree of awareness of what makes space unique compared to other physical domains. Unfortunately, "space literacy" is severely lacking among decision makers. It behooves all those with an interest in national and international security to become more familiar with our uses of space and the space environment's unique characteristics and challenges. Space is often described as increasingly "congested, contested and competitive,"[18] and it is important to understand why.

a) Space is *congested*

More and more States are becoming "spacefaring nations," that is, developing a capability to launch satellites from their own territory, and more and more satellites are launched each year. Currently, there are approximately 2,000 operational satellites in orbit belonging to States as well as commercial entities.[19] Space traffic management is a challenge because although space is big,

[17] This has been stated publicly by various representatives of the U.S. government, including Vice President Mike Pence, see Hanneke Weitering, "New US Space Command will launch next week, VP Pence says,", *Space.com,* 20 Aug 2019, https://www.space.com/space-command-launches-august-2019.html (last visited Nov 13, 2019); and Gen. John W. Raymond, commander of Air Force Space Command, see Steve Hirsch, "There is no 'war in space'. There is just war", *Air Force Magazine,* July 2018, http://www.airforcemag.com/MagazineArchive/Pages/2018/July%202018/There-is-no-War-in-Space.aspx (last visited Nov 13, 2019).

[18] Outer Space Increasingly 'Congested, Contested and Competitive', First Committee Told, as Speakers Urge Legally Binding Document to Prevent Its Militarization | Meetings Coverage and Press Releases , http://www.un.org/press/en/2013/gadis3487.doc.htm (last visited Mar 24, 2018).

[19] https://www.geospatialworld.net/blogs/do-you-know-how-many-satellites-earth/ (last visited July 14, 2019)

our near-Earth environment where satellites operate in useful orbital paths is limited. Every space object that is launched must be registered in a national registry and with the UN Office of Outer Space Affairs, according to the 1974 Registration Convention.[20] Furthermore, the International Telecommunications Union (ITU) determines and allots the orbital slots and frequency bands upon which satellites can send their signals back to Earth, depending on their purpose. [21] With that slot and frequency comes a right to non-interference with both, but the right only exists if satellite operators are registered. For the most part, States adhere to these obligations and require non-State entities to also adhere because it is in every space actor's interest to have as much information registered as possible and to ensure the right to non-interference.[22]

What makes management of this space traffic particularly difficult is that there are no internationally accepted "rules of the road" and no method to counteract the physical forces dictating the motion of the inanimate objects in space. There is an insufficiently accurate understanding of objects moving in the environment as well as a limited ability to avoid them, with no guidelines for what avoidance even means in the context of Earth orbit.

Moreover, those 2,000 operational satellites make up only part of the challenges to space traffic management. There are also another 3,000 or so satellites that have outlived their life and are still in orbit, creating a problem of space debris. Added to this is the enormous amount of orbital space debris from the after-effects of routine space activity conducted by State and non-State actors since the beginning of the Space Age—more than 750,000 pieces of orbital space debris currently orbits the Earth.[23] But we can only track objects larger than a softball, of which there are now approximately 23,000 traversing the orbits.[24] The U.S. Air Force has been testing a new radar detection technology called Space Fence, developed by Lockheed Martin, which is expected to increase our ability to track space debris down to the size of a ping pong ball, or about tenfold our current capability.[25] On the one hand, the ability to more easily identify potential

[20] 1974 Convention on the Registration of Objects Launched into Outer Space
[21] Article 45, Constitution of the International Telecommunications Union
[22] See e.g. Yoon Lee, *Registration of space objects: ESA member states' practice*, 22 SPACE POLICY 42–51 (2006).
[23] See: Union of Concerned Scientists Satellite Database, available online at http://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database
[24] Id.
[25] https://www.lockheedmartin.com/en-us/products/space-fence.html

collisions in space will assist with space traffic management. On the other hand, an increased awareness of all the smaller bit of debris will make traffic management much more complex, especially given that this new technology could predict hundreds of thousands of potential collisions each month.[26]

Space debris is a concern because objects in space are travelling at the extremely high velocity of approximately five miles a second, and something as small as a paint fleck can cause damage to a satellite sufficient to impact its ability to function[27] or, as has happened more than once to the International Space Station, damage infrastructure that may put human life at risk.[28]

The international community is attempting to reduce the impact that debris from routine space activities has on the space environment by developing guidelines like the Guidelines for the Long Term Sustainability of Outer Space Activities adopted in June 2019 by the UN Committee on Peaceful Uses of Outer Space (COPUOS),[29] and the Space Debris Mitigation Guidelines[30] developed by the Inter-Agency Debris Committee. Although these guidelines are not binding, some States have implemented the latter ones into national requirements, mandating that any entity seeking a license to develop or launch a satellite must integrate into the design of that satellite a mitigation plan for its end of life.[31] This could include ensuring reserve fuel is kept for de-orbiting the satellite or identifying ways to extend its life. Many research institutions that develop, build, and test satellites have also integrated these guidelines into their work.

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[26] Id.
[27] Akshat Rathi, *Photos: This is the damage that tiny space debris traveling at incredible speeds can do*, QUARTZ, https://qz.com/773511/photos-this-is-the-damage-that-tiny-space-debris-traveling-at-incredible-speeds-can-do/ (last visited Jul 14, 2019).
[28] Jeff Foust, *ISS leak highlights concerns about orbital debris and station operations*, SPACENEWS.COM (2018), https://spacenews.com/iss-leak-highlights-concerns-about-orbital-debris-and-station-operations/ (last visited Jul 14, 2019).
[29] Guidelines for Long Term Sustainability of Outer Space Activities, A/AC.105/L.318/Add.4. 19 June 2019. See also Peter Martinez, *Development of an international compendium of guidelines for the long-term sustainability of outer space activities*, 43 SPACE POLICY 13–17 (2018).
[30] Official Records of the General Assembly, Sixty-second Session, Supplement No. 20 (A/62/20), paras. 117 and 118 and annex
[31] See for example the U.S. Government Orbital Debris Mitigation Standard Practices, https://www.orbitaldebris.jsc.nasa.gov/library/usg_od_standard_practices.pdf; NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments, NPR 8715.6B, https://orbitaldebris.jsc.nasa.gov/library/NPR_8715_006B_.pdf

The second main source of orbital space debris is created from the testing or use of kinetic anti-satellite (ASAT) weapons that physically collide with satellites at high speed. As military satellites play a more active role in force enhancement missions during wartime, the use of ASAT weapons has become a greater concern. Both the United States and the former Soviet Union developed and tested ASAT weapons during the 1970s and 1980s.[32] In 2007, a direct-ascent ASAT interception test initiated by China against one of its own aging weather satellites caused an unprecedented amount of space debris,[33] which could be considered a moment of disruption in the otherwise placid assumption that space would remain a stable environment.

India's ASAT test earlier this year created more debris. At the time, they incorrectly asserted that the altitude at which the targeted satellite was impacted was sufficiently low that all debris would de-orbit and burn up on re-entry into Earth's atmosphere within weeks.[34] The problem is that even during a few weeks, an increase in small, untrackable pieces of debris increases the risk of collision and raises tensions of all parties operating critical services in LEO. Moreover, because of the unique physics of space, it is impossible to control where debris is sent after an impact. Since the March test, it has been verified that some pieces have been sent into higher trajectories, meaning they will remain in orbit for longer, as an immediate test of Space Fence indicated.[35] A smaller amount of debris is also known to have entered into higher trajectories when the United States undertook a similar test in 2008, ostensibly to prevent the re-entry of a defunct satellite that contained toxic gases. Many believed the United States took this action to prove that it had the same capability that China revealed in its 2007 test.

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[32] Grego, *supra* note 8.
[33] https://celestrak.com/events/asat.php (last visited Jul 14, 2019). See also *Id.* at 13.
[34] The Indian Ministry of External Affairs published a series of statements online immediately following the test, but subsequently removed those statements. They are, however, repeated in news articles to sound like objective reporting. See All you need to know about Mission Shakti, @BUSINESSLINE, https://www.thehindubusinessline.com/news/all-you-need-to-know-about-mission-shakti/article26652887.ece (last visited Jul 14, 2019).
[35] Oscar Gonzalez, *Air Force Space Fence passes debris test*, CNET, https://www.cnet.com/news/air-forces-space-fence-passes-debris-test/ (last visited Jul 14, 2019); Caleb Henry, *India ASAT debris spotted above 2,200 kilometers, will remain a year or more in orbit*, SPACENEWS.COM (2019), https://spacenews.com/india-asat-debris-spotted-above-2200-kilometers-will-last-a-year-or-more/ (last visited Jul 14, 2019).

The overall danger of space debris is spelled out in the "Kessler Syndrome,"[36] which states that once there is a critical mass of debris in a particular orbit, collisional cascading begins even if no more objects are launched into that orbit. The existing space traffic is already dense enough to set up the conditions for this, meaning we may be on the precipice of entering the Kessler scenario. For instance, in 2009 a defunct Russian satellite collided with and disabled a functioning U.S. commercial satellite, creating more than 2,000 pieces of trackable debris, the potential cascade effects of which are impossible to predict.[37] Once the cascading starts, even small spacecraft may suffer damage or fatal collisions within just a few years of being in orbit.[38] If the amount of space debris in orbit continues to increase, then traditional lines of transit to and from the space environment will become impassable.

b) Space is c*ontested*

Negotiated during the Cold War between the two competing superpowers, the 1967 Outer Space Treaty (OST)[39] is the framework treaty for all space activities. Space had become the newest domain in which U.S. and Soviet competition for technological and political dominance played out. Both States tested nuclear and electro-magnetic pulses in space in the early years.[40] Very quickly, both realized that the effects of the tests were impossible to contain or control in space due to the unique physical environment, and that they were bringing under threat their own satellites. Despite their competitive relationship, the two States were willing to negotiate an important series of general principles in what amounts to a constitutional document for space activities.

[36] The Kessler Syndrome Explained, SPACE SAFETY MAGAZINE , http://www.spacesafetymagazine.com/space-debris/kessler-syndrome/ (last visited Feb 11, 2019).
[37] Mark Garcia, *Space Debris and Human Spacecraft*, NASA (2015), http://www.nasa.gov/mission_pages/station/news/orbital_debris.html (last visited Jul 14, 2019).
[38] Donald J. Kessler et al., *The Kessler Syndrome: Implications to Future Space operations*, 137 ADVANCES IN THE ASTRONAUTICAL SCIENCES (2010), https://www.researchgate.net/publication/265991606_The_Kessler_Syndrome_Implications_to_Future_Space_operations (last visited Feb 12, 2019).
[39] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (OST)
[40] Grego, *supra* note 8.

The importance of the OST can be seen in its first two articles. Article I guarantees freedom of access to and use of space for all. Article II establishes the non-appropriation principle: "Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." But as recent events indicate, although the OST remains important and relevant in terms of providing restraints and limits on State behavior in space, it cannot prevent States from contesting each other's capabilities in the space environment. This is especially true given the degree to which modern militaries are dependent on space systems for their daily operations during both peacetime and conflict. Space has become a truly contested environment.

According to Article IV of the OST, "the Moon and other celestial bodies shall be used…exclusively for peaceful purposes"; the placement of nuclear weapons or other weapons of mass destruction in orbit around the Earth is prohibited; and the establishment of military bases on the Moon or any other "celestial body," meaning any natural body in space, is prohibited. With the approval of a budget for the new U.S. Space Command, it appears that military contest in space is on the rise, which may bring under threat the "peaceful purposes" principle of the OST. While Article IV may appear to be far-reaching, it should be noted that it does not reserve the use of *space* itself for exclusively peaceful purposes, which may be an important but disconcerting loophole in years to come. The preamble of the OST does mention that "space" shall be used for "peaceful purposes" but does not reiterate the all-important adjective "exclusively." It must be remembered, too, that preambles of treaties are not in themselves binding. They do, however, provide context for interpreting the clauses of a treaty.[41] Moreover, the general understanding of the meaning of "peaceful purposes" is that it only prohibits aggressive purposes and does not prohibit other military purposes such as intelligence or even defense against an act of aggression.[42]

In an age of cross-domain warfare, the ability to target or compromise an adversary's systems and the fear that adversaries may wish to reciprocate have raised tensions. They have also led to changes in domestic space policies and strategies by all key States and to an escalatory cycle

[41] Art 31, Vienna Convention on the Law of Treaties (1969)
[42] Stephan Hobbe and Niklas Hedman, "Preamble" I STEPHAN HOBE ET AL., COLOGNE COMMENTARY ON SPACE LAW: OUTER SPACE TREATY 22 (2009).

of developing counterspace technologies, or a range of ways in which to target or interfere with each other's space-based assets. In 2018, Secure World Foundation released a report that details the counterspace capabilities of several countries. The report highlights the growing concern for weaponization against space systems as well as the weaponization of space itself.[43]

Another way in which space may become more contested in the near future is with respect to commercial rights. The non-appropriation principle mentioned above has come under threat recently, as some see a $5 trillion potential in the space resources mining industry.[44] This industry seeks to extract heavy metals for use in computers and smartphones and, more importantly, to mine the base ingredients that will provide energy and water for future human inhabitants of space stations. These companies have lobbied for national legislation because they saw legal uncertainty surrounding their investments due to the OST prohibitions. In 2015, Congress adopted the Commercial Space Launch Competitiveness Act, which in the eyes of many international lawyers breached the OST.[45] The act states that any U.S. citizen, which includes U.S. registered companies, shall be entitled to "possess, own, transport, use, and sell (any) asteroid resource or space resource obtained in accordance with applicable law,"[46] and also promises to protect the landing rights of any U.S. citizen who first lands on an asteroid. Both promises go against the non-appropriation principle and the freedom of use principle. Luxembourg followed suit in 2017 with the Space Resources Act but went a step further, offering similar legal protection to any corporation with a registered office in Luxembourg,[47] thus encouraging a kind of "forum shopping." There is no doubt that in the near future a legal regime will be needed to support this new industry. However, the steps taken by the United States and Luxembourg have only served to create an even more contested legal environment.

The race to access precious resources in space is not only commercially driven; it also is competitive between nation States. In January 2019, China was the first country to successfully

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[43] Brian Weedon and Victoria Samson (ed.s), GLOBAL COUNTERSPACE CAPABILITIES: AN OPEN SOURCE ASSESSMENT, Secure World Foundation (2019), https://swfound.org/counterspace/
[44] Cassandra Steer, *The commercial space race*, THE OTTAWA CITIZEN, November 27, 2015, https://ottawacitizen.com/news/world/the-commercial-space-race (last visited Aug 6, 2019).
[45] *Id.*; Justin Rostoff, *Asteroids for Sale: Private Property Rights in Outer Space, and the SPACE Act of 2015*, 51 NEW ENG. L. REV. 373 (2016).
[46] 51 US Code Section 51303
[47] LUXEMBOURG, *Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace.* (2017), http://data.legilux.public.lu/file/eli-etat-leg-loi-2017-07-20-a674-jo-fr-pdf.pdf.

land a rover on the dark side of the moon.[48] The Japanese space agency JAXA successfully landed a probe on an asteroid twice in 2019 to collect and analyze subsurface materials.[49] And recently, a spacecraft built by Israeli company SpaceIL crashed upon reaching the moon, which may have been a disappointment to the company and to the nation of Israel. Reaching the moon was an achievement, however. The Israeli Space Agency was providing technical support and is already making plans with SpaceIL for the next attempt.[50] While these activities are ostensibly benign and done in the name of scientific exploration, there is historically a high risk of conflict whenever this kind of competition for resources and technological advancement exists. As human activity extends into space, we must recognize this risk and seek ways to regulate our own behavior.

c) Space is *competitive*

Space mining is still a technology that is a few decades from being realized. But there are some companies specializing in all things space that have become household names such as SpaceX, Blue Origin, and OneWeb. Although Elon Musk's company may be most famous for claiming to take us to Mars in the next decades, SpaceX has already pushed many former technological limits in important ways. In 2018, SpaceX successfully launched the Falcon Heavy rocket,[51] the largest operational rocket today. This rocket will be able to carry many more satellites in a single launch mission than any competing rocket system, and SpaceX already has a contract to shuttle cargo and soon people to and from the International Space Station (ISS).[52] This is important because commercial entities have a much higher risk profile than governments and are able to push the boundaries of technology much faster. Until recently, the United States was paying Russia millions of dollars per launch to shuttle its astronauts and supplies to and from the ISS. Now, a commercial company registered in the United States may soon be doing that.

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[48] Matt Rivers, Helen Regan & Steven Jiang, *China moon mission: Chang'e-4 probe touches down on far side, state media announce - CNN* (2019), https://www.cnn.com/2019/01/02/health/china-lunar-rover-far-moon-landing-intl/index.html (last visited Jul 17, 2019).
[49] http://www.hayabusa2.jaxa.jp/en/
[50] Mike Wall, *Israel's Beresheet Spacecraft Crashes Into Moon During Landing Attempt*, SPACE.COM (2019), https://www.space.com/israeli-beresheet-moon-landing-attempt-fails.html (last visited Jul 17, 2019).
[51] Falcon Heavy, world's most powerful rocket, launches – as it happened | Science | The Guardian, https://www.theguardian.com/science/live/2018/feb/06/spacex-falcon-heavy-launch-elon-musk-live-updates (last visited Jul 17, 2019).
[52] Malik Tarik, *SpaceX Dragon Delivers NASA Cargo to Space Station*, SPACE.COM, May 6, 2019, https://www.space.com/spacex-dragon-space-station-arrival-nasa-crs17.html (last visited Aug 6, 2019).

The competition created by these advances in technology has a positive upward spiral in terms of what is becoming possible in space travel. Both SpaceX and Blue Origin, SpaceX's main competitor, have been successful at testing launch vehicles that can launch then re-enter Earth's atmosphere, land at a designated point, and be used again for multiple space flights.[53] Falcon 9 will purportedly be able to launch 10 times without any refurbishment.[54] This is an incredible feat, and one that redefines what is possible for rocket and spacecraft design. Currently we discard every single rocket and spacecraft that is suitable for human spaceflight after a single flight—the equivalent of discarding every airplane after a single use, except that the costs are much higher. If commercial entities can use a single rocket for multiple flights and to push technological limits in satellite systems, satellite tracking, and human spaceflight, governments may be more inclined to outsource both their civil (NASA) and military space programs to these entities. This makes space a highly competitive sector and brings with it a range of complex issues when it comes to national security and international law, as discussed below in Section III.

Beyond these major players, there is an increasing number of commercial entities entering the space market today with offers of services to governments and individuals that are used every day, adding to the competition in space. TV broadcasting, telecommunications, and Internet remain traditional competitive commercial sectors that are dependent on space-based technologies. The most commercially valuable orbits for these services are geostationary, meaning that a satellite orbits the Earth at 36,000km altitude, at the same rate as the spin of the Earth, so that it appears to be stationary above one point on the ground. But the number of orbital slots is limited. Remember that objects are moving at a very high speed in orbit, so this is not about how much "space" there is in space to fill with satellites but rather about how many slots can be assigned within an orbital trajectory to ensure that space traffic management is possible and that the signals being sent from each satellite do not interfere with each other. This is the work of ITU, described above. However, ITU's task will become even more complicated in the near future, as commercial players such as

[53] Mike Wall January 23 & 2019 Spaceflight, *Blue Origin's New Shepard Launches NASA Experiments, Aces Rocket Landing*, SPACE.COM , https://www.space.com/43088-blue-origin-new-shepard-ns10-launch-success.html (last visited Jul 17, 2019); Amy Thompson, *SpaceX Falcon Heavy Sticks Triple Rocket Landing with 1st Commercial Launch | Space*, SPACE.COM (2019), https://www.space.com/spacex-falcon-heavy-triple-rocket-landing-success.html (last visited Jul 17, 2019).
[54] Thompson, *supra* note 36.

OneWeb,[55] Starlink,[56] and others prepare to launch constellations of hundreds or even thousands of satellites in LEO to provide a similar kind of continual Internet or television coverage as those larger satellites in GEO. Lower costs of required technology and the need to launch into GEO result in new competitors to the traditional players that have dominated GEO and new challenges for ITU as well as for space traffic management in general.

Beyond these traditional services, more complex services have become critical to our 21st century existence. This includes monitoring climate change, including weather forecasting, multi-spectral imaging of crops, disaster relief, and ocean temperatures and currents, as well as monitoring the rate of polar ice cap melts. More complex space-enabled defense technologies have also become integral to defense operations, such as missile detection, hypersonics, Radio Frequency interference, protected communications, GPS-guided weapons, and many other precision timing activities. With this increase in space-based services, access to and use of the most valuable orbital slots have become more competitive.

Because not all countries have the wherewithal to develop space programs, not all countries have equal access to these commercially valuable orbits and to the technologies offered from space. This may well be in contravention of Article I of the OST, which declares that "outer space…shall be free for exploration and use by all States without discrimination of any kind." Moreover:

> "The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."

It is unclear what the legal effect is of the phrase "province of all mankind." It is an emotive turn of phrase, and it suggests that space is intended to be a global commons. However, it is not a legal

[55] OneWeb plans to launch between 650 and 900 satellites, https://onewebsatellites.com/
[56] Starlink intends to launch 12,000 satellites by the mid 2020s, with a projection of to 42,000 satellites in the future. Mike Wall, "SpaceX's Starlink Constellation Could Swell by 30,000", *Space.com,* 16 October 2019, https://www.space.com/spacex-30000-more-starlink-satellites.html (last visited 13 Nov 2019).

term of art.[57] There is, therefore, not much enforceability in this article, which has left some developing countries feeling that they are once again cut out of international competition where the rules are set (and often broken) by the biggest players. For this reason, in 1997 the UN General Assembly adopted the "Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries" (otherwise known as the "Space Benefits" Declaration).[58] While General Assembly resolutions are not binding, this declaration represents an important political signal that developing countries are fully cognizant of the competitive nature of space operations, both commercially and militarily, and of the impact upon their economies and their security if they are excluded from these activities.

This congestion, contestation, and competition in space explain the recent upsurge of attention towards issues of national and international security in the space domain. Understanding the rising tensions requires consideration of the international legal framework that applies to outer space, as discussed in the next section.

III. The Legal Framework Applicable to Military Uses of Outer Space

National and international security activities are bound by domestic and international laws, and activities in outer space are no different. There are five core space treaties, all of which were drafted and negotiated within a short period of time, between 1965 and 1979, under the auspices of the UN Committee on the Peaceful Uses of Outer Space (COPUOS): the OST, the Astronaut Agreement (sometimes known as the "Return and Rescue" Agreement),[59] the Liability Convention,[60] the Registration Convention,[61] and the Moon Agreement.[62] The geopolitical

[57] Cassandra Steer, *Global Commons, Cosmic Commons: Implications of Military and Security Uses of Outer Space*, 18 GEORGETOWN JOURNAL OF INTERNATIONAL AFFAIRS 9–16 (2017).
[58] UN General Assembly A/RES/51/122, 4 February 1997
[59] AGREEMENT ON THE RESCUE OF ASTRONAUTS, THE RETURN OF ASTRONAUTS, AND RETURN OF OBJECTS LAUNCHED INTO OUTER SPACE, UNITED NATIONS TREATY SERIES VOL. 672, NO. 9574 (1968).
[60] CONVENTION ON THE INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS, UNITED NATIONS TREATY SERIES VOL. 961, NO. 13810 (1972).
[61] CONVENTION ON REGISTRATION OF OBJECTS LAUNCHED INTO OUTER SPACE, UNITED NATIONS TREATY SERIES VOL. 1023, NO. 15020 (1976).
[62] AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES, UNITED NATIONS TREATY SERIES VOL. 1363, NO. 23002 (1979).

conditions of the Cold War are what informed these negotiations as much as the technological advances of the space race, a historical and political factor that needs to be kept in mind. But many other branches of international law apply to activities in outer space and are relevant for space security, as discussed below.

A. The Five Core Space Treaties and Public International Law

As already mentioned, the OST is a framework treaty provides key general principles and outer limits to behavior in space. The key ones have been discussed above such as non-appropriation principle, the peaceful purposes principle, the freedom of access to and use of space, and the prohibition on the placement of nuclear weapons or military bases in orbit around the Earth or on the Moon. However, it is important to note that Article III of the OST states that activities in outer space "shall be in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security." Thus the entire body of public international law, including the law of treaties, State responsibility, international environmental law, the law of armed conflict, human rights law, and any other branch of international that may have relevance in space, is applicable.[63] As a result, there are clear legal restraints on military activities in outer space based on the legal restraints applicable in any other domain.

Manfred Lachs, a former International Court of Justice judge and a pioneer in international space law, wrote in 1972 that space has always been subject to international law, it had just never been put to the test before.[64] It is noteworthy, then, that the drafters found it necessary to underscore the fact that the UN Charter itself applies, since this forms a part of international law. The *traveaux preparatoires* suggest that the reason has to do in particular with the prohibition on the use of force codified in Article 2(4) of the Charter and the corresponding right of self-defense in Article 51.[65] There can be no doubt that the law on the use of force is also applicable in outer

[63] Cassandra Steer, *Sources and Law-Making Processes Relating to Space Activities*, *in* ROUTLEDGE HANDBOOK OF SPACE LAW , 12 (Ram Jakhu & Paul Stephen Dempsey eds., 2016).
[64] MANFRED LACHS, THE LAW OF OUTER SPACE: AN EXPERIENCE IN CONTEMPORARY LAW-MAKING 125 (Re-Issued ed. 1972).
[65] I HOBE ET AL., *supra* note 36

space and was at the forefront of the minds of the OST drafters. These drafters were attempting to place mutual restraints on the activities of the vying superpowers in this new domain of technological and military competition. Moreover, the clause that states activities shall be carried out "in the interests of international peace and security" draws directly from the language of the UN Charter that establishes the responsibility of the Security Council, negotiated only 20 years earlier. Thus, amid the tensions of the Cold War, the OST was intended to limit military activities in outer space and reduce the threat of conflict entering this new domain.

The Liability Convention was drafted to further define the very general determinations in Article VI of the OST that States "shall bear international responsibility for national activities in outer space…whether such activities are carried on by governmental or non-governmental authorities."[66] The Liability Convention also further clarifies Article VII of the OST, which determines that the launching State shall bear liability for damage to another State party or its natural or juridical persons. These two articles create far-reaching consequences for States for all activities under their jurisdiction, even if they are carried out by commercial entities, though the extent of those consequences is not clear. The Liability Convention, therefore, provides definitions to further clarify the applicable foundations and requirements. For example, the definition of a "launching State" includes the State that launches or procures a launch or a State from whose territory or facility a space object is launched.[67] Thus more than one State may be liable for damage in a given situation, and they may be held jointly or severally liable.[68] Furthermore, absolute liability applies for damage caused by a State's space object on the surface of the Earth or to an aircraft in flight,[69] whereas fault liability applies for damage caused by a space object anywhere else.[70] This treaty has never been tested in a domestic or international court, though it was triggered once when radioactive debris from a Soviet satellite landed on Canadian territory, and Canada referred to this obligation in a diplomatic exchange. Ultimately, the two States reached a settlement rather than bringing a case before the world court.[71]

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[66] Article IV OST, *supra* note 39.
[67] Article 1(c) CONVENTION ON THE INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS, *supra* note 52.
[68] Articles IV and V *Id.*
[69] Article II *Id.*
[70] Article III *Id.*
[71] The diplomatic letter making the claim can be found in Cosmos 954 Claim (Canada v USSR) [1979] 18 ILM 899. I HOBE ET AL., *supra* note 36 at 143; Steer, *supra* note 55.

The Registration Convention is essentially a peacetime agreement to aid in space traffic management, requiring the registration of all launches in both a national and a UN registry as outlined in Section II above. The Astronaut Agreement is also a peacetime agreement, although it has a role to play in reducing tensions between States regarding space activities. Not only does it oblige all States to rescue and repatriate astronauts in distress who land in their territory or on the high seas[72] regardless of the political relations between the State of nationality and the territorial State, it also requires States to return any part of a space object that lands on its territory to the launching State.[73] This was intended to protect the technologies and capabilities developed by each nation from becoming known to their adversaries.

The Moon Agreement is the least impactful of the five core space treaties, as it has only 18 signatories. None of those are traditional leading players in space security, and only a few of them are spacefaring nations.[74] It was drawn up towards the end of the Cold War on the initiative of States that foresaw future national and commercial activities on the Moon could lead to tensions or conflicts if not properly regulated. It provides that the Moon shall be used for *exclusively* peaceful purposes; [75]prohibits claiming ownership of any part of the Moon, including its subsurface or resources found there;[76] and provides for the establishment of a legal regime to govern the exploitation of natural resources of the Moon.[77] Given the race for resources and control of the orbits surrounding the Moon and cislunar orbits (those between the Earth and the Moon), it is unfortunate that this agreement has not received wider support. It may be that more nations decide to become signatories, but it is unlikely the major players like China, Israel, or the United States will join. This leaves the international community in a precarious position as new sectors of commercial and international competition in space emerge.

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[72] Articles 3 and 4, AGREEMENT ON THE RESCUE OF ASTRONAUTS, THE RETURN OF ASTRONAUTS, AND RETURN OF OBJECTS LAUNCHED INTO OUTER SPACE, *supra* note 51.
[73] Article 5 *Id.*
[74] See summary table "Status of international agreements relating to outer space (as at 1 January 2019), pp 5-10, http://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2019_CRP03E.pdf (last visited 29 Aug 2019).
[75] Article 3 AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES, *supra* note 62.
[76] Article 11(2) *Id.*
[77] Article 11(5) *Id.*

B. Developing International Space Law for 21st Century Security Issues

One of the greatest challenges to modernizing the legal frameworks that govern conduct in space is the lack of political will surrounding the negotiation of new treaties or other binding norms since the end of the Cold War. Since then, COPUOS has been ineffective in advancing international space law, partly because it is bound by consensus decision-making and States can block any advances for any number of political reasons. Its ineffectiveness can also be attributed to the fact that geopolitical conditions have shifted in favor of a single nation, the United States, since the end of the Cold War. This means that even if there is an international desire to move towards more treaties or firmer rules on behavior in outer space, they are unlikely to take place unless the United States wishes to see such developments. Because all nations are so dependent on space and because military tensions in space are on the rise, there is pressure on the United States to determine the kind of leadership it wishes to demonstrate. The leadership could be either nationalistic or internationalist and for the benefit of all.

International efforts to create a clear legal regime with respect to responsible behavior in outer space have been stymied over recent years. Despite the nearly annual reiteration of the resolution on the Prevention of an Arms Race in Outer Space (PAROS) by the UN General Assembly,[78] and despite the call by the UN Group of Government Experts to develop Transparency and Confidence Building Measures (TCBMs),[79] there has been little success. The proposal for a Treaty on the Prevention of the Placement of Weapons in Outer Space by Russia and China has been before the Conference for Disarmament in various iterations over the years.[80] Because of the requirement of consensus voting and resistance by the United States and some of its allies, the proposal has not succeeded.

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[78] CD Documents related to Prevention of an Arms Race in Outer Space, , UNITED NATIONS OFFICE AT GENEVA , https://www.unog.ch/80256EE600585943/(httpPages)/D4C4FE00A7302FB2C12575E4002DED85?OpenDocument (last visited Aug 29, 2019).

[79] *Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities,* U.N. GAOR, 68th Sess. U.N. Doc A/68/189* (July 29, 2013), http://www.un.org/ga/search/view_doc.asp?symbol=A/68/189 (last visited Aug 29, 2019).

[80] The most recent draft is from 2014, see PEOPLE'S REPUBLIC OF CHINA MINISTRY OF FOREIGN AFFAIRS, *Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects(Draft)* (2014), https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/jks_665232/kjfywj_665252/t1165762.shtml (last visited Aug 29, 2019).

The arguments against the passage of this treaty are that it is impossible to define what constitutes a "weapon" in space and that it is nearly impossible to verify whether a particular technology is for benign or threatening purposes. Thanks to commercial services tracking the movement of space objects we can gain a fair amount of situational awareness of objects moving through space. However, experts are often left guessing as to the exact purpose of some of those objects. Even with a high level of international compliance with the Registration Convention, it is still nearly impossible to verify that what is being launched aligns with what is being registered. For example, when North Korea began successfully launching objects into orbit in 2015, it duly registered those launches with the UN Office of Outer Space Affairs (UNOOSA). At the time, South Korea objected because it was highly likely that North Korea was developing missile technology in breach of the moratoriums against it (missile technology and rocket launch technology are the same). UNOOSA's stance was that it had no way of verifying and no powers to intervene, and indeed, it quickly became apparent that North Korea had been developing a conventional weapons capability under the guise of a peaceful space program.[81]

While verification may be a problem, the United States has not counter-proposed an alternative treaty or mechanism for arms control in space. It appears that the United States simply does not want to be bound by any treaty that might limit its own technological advances and behavior in space.[82] In July 2019, the UN hosted a meeting for the Group of Government Experts on further effective measures for the prevention of an arms race in outer space.[83] No publication has been released to date on the results of this meeting. It appears, however, that U.S. representatives pushed back against the development of an arms control treaty for space. Representatives of the U.S. Department of State stated openly at a recent international conference

[81] Choe Sang-Hun, *North Korea Tests Five Missiles*, THE NEW YORK TIMES, February 8, 2015, https://www.nytimes.com/2015/02/09/world/asia/north-korea-launches-5-short-range-missiles.html (last visited Aug 30, 2019); Melissa Hanham & Seiyeon Ji, *Advances in North Korea's Missile Program and What Comes Next*, ARMS CONTROL ASSOCIATION (2017), https://www.armscontrol.org/act/2017-08/features/advances-north-korea-missile-program-what-comes-next (last visited Aug 30, 2019).

[82] Jeff Foust, *U.S. Dismisses Space Weapons Treaty Proposal As "Fundamentally Flawed,"* SPACE NEWS, September 11, 2014, http://spacenews.com/41842us-dismisses-space-weapons-treaty-proposal-as-fundamentally-flawed/ (last visited Aug 29, 2019).

[83] Group of Governmental Exerts on further effective measures for the prevention of an arms race in outer space – UNODA, UNITED NATIONS OFFICE FOR DISARMAMENT AFFAIRS (2019), https://www.un.org/disarmament/topics/outerspace/paros-gge/ (last visited Aug 29, 2019).

that they were instrumental in pushing back against talks on whether any kind of arms control treaty for space could be developed.[84]

Even the attempted negotiations for a non-binding International Code of Conduct (ICoC) reached a stalemate in 2015. The ICoC was a European initiative that was intended to be a non-binding document with clear statements of responsible behavior in space and the limits of unacceptable behavior.[85] At first, the United States and many of its key allies were in support of the ICoC; however, many developing nations were highly critical of the process, which they considered to be Western-centric, once again ignoring their interests and concerns for equity.[86] When the UN hosted a meeting in 2015 to focus on the content of the draft ICoC, the critiques were almost all procedural except for the United States' important objection that there was no clear statement about the use of force in space in the case of self-defense.[87] But the ICoC was never intended to be a document that regulated or managed questions of force or military activities in space. The vision was that it could curb irresponsible behavior concerning space debris, access to and use of space, and long-term accountability. Moreover, the right to use force in self-defense is guaranteed in Article 51 of the UN Charter so long as the customary law conditions of necessity and proportionality are fulfilled. Given that Article III of the OST reinforces the application of the UN Charter to all activities in outer space, the presence or lack of a statement regarding the use of force in a non-binding document has no impact on the legal norms that apply.

The roadblock faced by the ICoC process created a great sense of disappointment internationally and highlighted what appears to be a general international deadlock in terms of moving forward on space governance for the 21st century. At a time when concerns for the inevitability of a space-based conflict are increasing, it is important to consider whether and how the international rule of law can play a role in conflict prevention. It may be that the role of

[84] This author was present at the Fifth Space Security Conference held in Prague in June 2019 by Prague Security Studies Institute, at which the Department of State representatives made these statements.
[85] EUROPEAN UNION, *Proposal for an International Space Code of Conduct, Draft* (2014), https://eeas.europa.eu/headquarters/headquarters-homepage/14715/eu-proposal-international-space-code-conduct-draft_en (last visited Aug 29, 2019).
[86] Paul Meyer, *Star-crossed: An international code of conduct for outer space?*, OPENCANADA, 2015, https://www.opencanada.org/features/star-crossed-an-international-code-of-conduct-for-outer-space/ (last visited Aug 29, 2019).
[87] *Id.*

international non-binding norms is even more important than binding ones. Although the ICoC reached a standstill, there are other non-binding instruments that have proven to be very successful like the Debris Mitigation Guidelines mentioned above. There is also some hope with the recent adoption by consensus of the COPUOS Guidelines on the Long-Term Sustainability of Outer Space Activities. These guidelines encourage States to voluntarily adopt updated national legislation and regulations relevant to the peaceful exploration and use of space, share information about space activities to improve safety of operations, observe measures of caution, promote and facilitate international cooperation, and raise awareness of space activities, among others.[88] But there is nothing in those guidelines with respect to weaponization, and it is likely that militaries will not respond to such guidelines if they feel in any way limited in their actions.

Other independent projects may also contribute to the rule of law and help to prevent escalation to conflict in space. One project underway is the development of the Woomera Manual on the International Law Applicable to Military Space Operations.[89] It follows in the successful footsteps of other non-binding manuals developed by independent experts on the application of the law of armed conflict to new, technologically advanced forms of warfare like air and missile[90] or cyber warfare.[91] The purpose of the Woomera Manual is to provide clarity on the rules applicable to military activities in space, particularly on the use of force and the law of armed conflict; to reduce the risk of space-based conflict created by lack of transparency; and to mitigate the effects of a conflict should it take place.

The Woomera Manual purports to be a re-statement of the law, that is, it contains statements of how a rule of international law on the use of force or the law of armed conflict applies to space, which has been formulated based on consensus of the experts who contribute to the Manual. Each rule then has a commentary, similar to commentary one would find in a publication

[88] WORKING GROUP ON THE LONG-TERM SUSTAINABILITY OF OUTER SPACE ACTIVITIES, *Guidelines for the Long-term Sustainability of Outer Space Activities* (2019), https://undocs.org/A/AC.105/C.1/L.366 (last visited Aug 29, 2019).
[89] The Woomera Manual | The Woomera Manual, https://law.adelaide.edu.au/woomera/home (last visited Jul 17, 2019).
[90] CLAUDE BRUDERLEIN, HPCR MANUAL ON INTERNATIONAL LAW APPLICABLE TO AIR AND MISSILE WARFARE (2013).
[91] MICHAEL N. SCHMITT, TALLINN MANUAL ON THE INTERNATIONAL LAW APPLICABLE TO CYBER WARFARE (2013).

of the International Committee of the Red Cross (ICRC) in which the customary law in other domains is explained and experts' majority or minority opinions are reflected to reveal where there may have been a lack of clarity on some issues. It is not a binding document, however. The process of drafting the manual includes engagement with States and observation by members of the ICRC to ensure that it is representative without being hampered by the political processes of an international legal instrument. Moreover, previous manuals like the San Remo Manual on Warfare at Sea[92] have become important sources for national military manuals and for operators and commanders who must make legal assessments in new conditions. Hopefully, the Woomera Manual will provide similar clarity that is sufficiently international and independent such that if countries follow its interpretations of the law, there is a greater chance of de-escalation in situations where the "unknown" can be escalatory. The goal is for the project to be completed in 2020, and an assessment of its success can only follow in subsequent years.

C. *Jus ad bellum* and *Jus in bello* Applicable in Space

Some of the issues tackled in the Woomera Manual include the most difficult questions of *jus ad bellum,* or the law on the use of force. Most importantly, the Woomera Manual examines the legal technical assessment of what amounts to a use of force and/or an armed attack in space. This is one of the issues operators are faced with often in space operations, and there is currently no clarity at a national or international level as to how to determine this. Article 2(4) of the UN Charter prohibits the use of force unless, according to Article 51, a party has suffered an armed attack in which case this would trigger the right to use force in self-defense. And even if there is a use of force that does not amount to an armed attack, it would raise tensions and likely trigger a military response of some sort, including responses in a domain other than space.

It is critically important to clarify what amounts to "force" or an "armed attack" in space, even though the technologies and operations are so different from those we are accustomed to in the traditional domains of land, air, and sea. For instance, if a satellite executes a close proximity operation by sidling up to another satellite in its orbital trajectory, is this a threat of use of force?

[92] Louise Doswald-Beck, *The San Remo Manual on International Law Applicable to Armed Conflicts at Sea*, 89 AMERICAN JOURNAL OF INTERNATIONAL LAW 192–208 (1995).

If a cyber-attack interferes with the ability of a satellite to send its signal, impairing communications, navigation, or any number of critical services, does this amount to an armed attack? The Tallinn Manual on International Law Applicable to Cyber Warfare has answered these questions to a certain extent: a cyber-attack constitutes use of force if the "scale and effects are comparable to non-cyber operations rising to the level of a use of force";[93] cyber operation or even the threat of one can constitute an unlawful threat of use of force "when the threatened action, if carried out, would be an unlawful use of force";[94] and "whether a cyber operation constitutes an armed attack depends on its scale and effects."[95] The test of "scale and effects" is based upon the rulings of the International Court of Justice determining when a use of force or armed attack has taken place in traditional domains like the *Nicaragua* judgment[96] and the *Oil Platforms* case.[97] The Tallinn Manual points us specifically to physical effects. It is not necessary to employ a "weapon" to have an "armed" attack.[98] Because all activities in outer space must be in accordance with international law, we can likely say the same about cyber or close proximity operations in space: that when there are physical effects of a sufficient scale to be considered a use of force or an armed attack in a traditional sense or in a traditional domain, that activity would also constitute an "armed attack" in space. Of course, it will always be up to operators and commanders to determine the application of this legal test to a specific factual situation.

A key concern that the Woomera Manual will deal with regarding the use of force in space is the line between harmful but lawful interference on the one hand, for instance dazzling or jamming a satellite signal, and unlawful use of force on the other such as perhaps lasing a satellite (a technology that does not yet exist in the sense of a destructive capability but which is often discussed). The Woomera Manual will also look at whether some kinetic activities in space might be lawful or whether all such activities would amount to a use of force such as physical interference with or unwanted capture of a satellite. We will have to wait until the manual is completed to know what the consensus is among experts on these difficult questions.

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[93] Rule 11, *supra* note 82 at 45.
[94] Rule 12 *Id.* at 52.
[95] Rule 13 *Id.* at 54.
[96] Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America), [1986] ICJ Rep 14
[97] Oil Platforms (Iran v. United States of America) [1996] ICJ Rep 803
[98] Rule 41, Definition of Means and Methods SCHMITT, *supra* note 82 at 141 See also the commentary on Rule 13 , p 55.

The lack of transparency surrounding these questions in space operations leads to a lack of understanding of the intentions behind many actions. This is a key factor in the cyclical escalation currently underway, an escalation that is exacerbated by competing space policies and that feeds the potential weaponization of outer space. For example, in 2014 Russia launched a telecommunications satellite. Soon after the satellite reached its orbit, observers noticed a smaller object, assumed to be space debris from the launch, begin to make complex maneuvers, moving around in orbit to come close to other satellites.[99] It is commonly referred to as the Luch satellite.[100] It was unclear what the Luch satellite was doing, and Russia refused to clarify the technology or the intention. At the time, tensions were rising with Russia due to the annexation of Crimea, and suspicions were therefore raised even higher. The United States and others saw this as a threat precisely because it was not clear what the technology entailed and whether any interference caused by it could amount to a use of force. Coming to an agreement or at least a more explicit unilateral position on the definition of the threat and use of force in space would help to mitigate the cyclical escalation and the risk of a space-based conflict.

Even if the questions on *jus ad bellum* remain unresolved, as soon as a situation becomes one of armed conflict, the *jus in bello,* or the law of armed conflict (LOAC), is triggered and applies equally to all parties, regardless of who the aggressor was. The applicability of targeting rules in LOAC as well as of rules protecting the environment are key issues for many military lawyers who are already engaged in the space domain or in cross-domain assessments.

There appears to be a national and international consensus that use of kinetic weapons in space would cause catastrophic long-term effects on the accessibility to and freedom of use of space as well as on our terrestrial dependence on space-based technologies. Already in 2006, then Air Force Undersecretary for Space Programs Gary Payton stated that the United States needed an explicit policy of rejecting debris-producing weapons and that "we'd be fools to actually get into

[99] Michael Listner & Joan Johnson-Freese, "Object 2014-28E: Benign or Malignant?", *Space News* (8 December 2014), www.spacenews.com/42895object-2014-28e-benign-or-malignant/ (accessed 6 January 2017).
[100] https://www.globalsecurity.org/space/world/russia/luch.htm

the kinetic energy anti-satellite business."[101] And NASA chief Jim Bridenstine's response to India's recent ASAT test was that it is a "terrible thing" to create more space debris, even if it is assumed that it will not stay in orbit very long.[102] Indeed, it may be possible to say that kinetic destruction of a satellite is unlawful. For instance, rules protecting the natural environment during armed conflict determine that when a method of warfare will cause "widespread, long-term and severe damage" to the environment, it shall not be employed. [103] Since all activities in outer space are subject to international law, this rule of customary international law must apply to the natural environment of outer space, and activities that are known to cause space debris to such a scale as to cause "widespread, long-term and severe damage" to our near-Earth environment must be presumptively unlawful. One physicist describes space as "the most fragile environment that exists because it has the least ability to repair itself…any kind of space warfare will put all satellites at risk."[104]

On the other hand, there are no explicit norms determining that testing an ASAT is unlawful, despite the debris these tests are known to create. Since India's test this year, there has been a greater concern expressed internationally, and it may be that some minimum norms could be agreed upon, building on the Long-term Sustainability Guidelines.

Even though kinetic ASATs are the most obvious kind of weapon, they are perhaps not the greatest threat because they are not the kind of weapon most actors would prefer. This is because kinetic ASATs are easy to track, and they create debris that threatens all space systems, including an attacker's own assets. Rather, there is a concern for being able to protect satellites against more covert technologies. Close proximity and co-orbital satellites like Russia's Luch satellites described above are at the forefront of many operators' minds. And there is some fear of the potential for re-purposing even the most benevolent of space applications such as projects being developed by universities and industry to capture space debris by way of a harpoon or net or to

[101] Quoted in *Jeremy Singer*, "*USAF Interest* in *Lasers* Triggers Concerns About Anti-Satellite Weapons," *Space News*, May 1, 2006, p. A4
[102] India's Anti-Satellite Test Created Dangerous Debris, NASA Chief Says | Space, , https://www.space.com/nasa-chief-condemns-india-anti-satellite-test.html (last visited Jul 17, 2019).
[103] Articles 35(3) and 55 Additional Protocol I; See also *Id.* at 9.
[104] Joel R. Primack, *Debris and Future Space Activities*, 28 *in* UNIVERSITY OF CALIFORNIA AT SANTA CRUZ. PRESENTED AT THE CONFERENCE ON FUTURE SECURITY IN SPACE, AT NEW PLACE (SOUTHAMPTON, ENGLAND) MAY 29, 18 (2002).

reservice and repair satellites with robotics. If there is the ability to capture or mechanically alter a satellite for benign purposes, there is the potential to do so for military gain as well. But the greater threats today are in the form of non-kinetic weaponization such as temporarily blinding or dazzling a satellite's sensors, jamming a signal, or spoofing the signal (sending false signals that confuse the users dependent on that service). Many of these are ground-based technologies, not space-based, making it more likely that in the case of an attack, a response could take place across any physical domain and not necessarily in space.

These cross-domain and dual-purpose characteristics of space technologies raise one of the most difficult questions of LOAC when applied to space, namely, how to determine when an object is a lawful target or not. The central principle of LOAC is that of distinction: it is unlawful to target a civilian object such as a school or hospital, or to target a civilian.[105] Many satellites are dual-use, offering services both for civilian and military purposes such as GPS navigation, communications, weather tracking, and more.[106] It may be that a dual-use satellite is a lawful target if it is a military object, but this will not always be clear as customary law says it depends on the "nature, purpose, location and use" of the object in question.[107] Again, the physics of space and the ways in which satellites are critical for so many of our terrestrial services render these terms of art difficult to apply. Is the nature or purpose of a GPS satellite easy or even possible to determine if it is providing a service to guide military weapons at the same time as it is providing a service for civil aviation traffic management? And if a satellite moves at five miles per second, what is meant by "location"? It could refer to an orbital slot or trajectory, but even these are useful for both civilian and military purposes. And by its very identification as a dual-use satellite, it will be difficult to determine whether such a satellite can lawfully be targeted. This is an issue already familiar to operators in other physical environments. For instance, a bridge may be dual use as may a communications center. In those cases, a factual determination must be made based on an accumulation of the factors.

[105] Article 48 Additional Protocol to Geneva Conventions
[106] Joseph Pelton, *Satellite Security and Performance in an Era of Dual Use*, ONLINE JOURNAL OF SPACE COMMUNICATION (2004), http://spacejournal.ohio.edu/issue6/perspectives1.html#top (last visited Feb 17, 2015).
[107] Article 52(2) Additional Protocol

Even if a target is identified as a military objective and can thus lawfully be targeted, the principle of proportionality comes into play: that "an attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated" would be prohibited as an indiscriminate attack.[108] In space, this becomes more complicated than one might think. We often hear the catchphrase that "satellites have no mothers," meaning that if a satellite is targeted, no loss of life will take place, making an attack in space very attractive during conflict. This is an over-simplification. Given the multiple ways in which we depend critically upon satellites, it is possible that human lives may be at risk by losing GPS navigation for the thousands of passenger airplanes in flight or for large and slow ships at sea with low visibility over long distances, losing the services necessary for advanced medical technologies, or losing communications in remote areas. Moreover, as argued previously, the principle of proportionality may play out as weighing even heavier in targeting decisions in space than it does in the targeting calculus in other domains because of the knock-on or secondary effects to civilian services.[109] It could be that the collateral damage is immense and even impacts one's own civilians.

Furthermore, there may be risk to human life in space. Even though currently the number of astronauts in space at any given moment is limited, human spaceflight is going to expand exponentially in the near future, both for civilian transport and for military purposes. In just a few decades, it will become the norm for suborbital flights to carry people across the globe in mere hours. We must, therefore, consider the principle of precaution in attack. Article 57(2)(ii) of Additional Protocol I to the Geneva Conventions (and its customary international law equivalent) requires that when undertaking attacks on land, belligerents shall: "Take all feasible precautions in the choice of means and methods of attack with a view to avoiding, and in any event to minimizing, incidental loss of civilian life, injury to civilians and damage to civilian objects." [110] Any debris-creating attack in space would cause tremendous risk of incidental loss of civilian life, injury to civilians, and especially damage to civilian objects like the ISS. As more humans begin

[108] Article 51(5)(b) Additional Protocol
[109] Dale Stephens & Cassandra Steer, *Conflicts in Space: International Humanitarian Law and its Application to Space Warfare*, XXXX ANNALS OF AIR AND SPACE LAW (2015).
[110] NWP 1-14M (US Navy) THE COMMANDER'S HANDBOOK ON THE LAW OF NAVAL OPERATIONS 2007, http://www.lawofwar.org/naval_warfare_publication_N-114M.htm para 8.1.

travelling in or through space, and the nations of the world become ever more dependent upon space-based systems for flight safety, those risks will increase. The responsibility to exercise precaution before undertaking an attack will also become more burdensome.

Finally, the issue of the status of military astronauts must be resolved should their State of nationality enter a conflict. Under LOAC, these astronauts would be considered combatants, but under international space law astronauts are considered to be "envoys" of humankind, guaranteed of protection, aid, and assistance at all times.[111] It is unclear which of the two bodies of law should be considered to be *lex specialis* and therefore to prevail. There are strong arguments that LOAC should prevail because it is the body of law developed specifically for times of armed conflict. It is also compelling to say that international space law has given astronauts this special status to recognize the specialized training and high risk they undertake to further human exploration of space.[112] The question can be posed in more general terms: is there some guiding rule giving prevalence to LOAC over international space law? Most likely, it would depend on the specific case and legal question rather than on which body of law is "more" *lex specialis* than the other. Again, we will have to wait for the completion of the Woomera Manual to know what the experts have concluded, which is beyond the scope of this paper.

IV. The Impact of Denoting Space as a Warfighting Domain

Many of the issues just discussed may appear highly theoretical given that to date there has been no conflict in outer space and there is a general desire in the international community to maintain this peaceful status quo. However, the general picture is also clear that the ways in which we depend on space will increase over time, and the need to protect space-based systems becomes more critical with that dependence. As mentioned above, covert weaponization may be a greater threat than kinetic shoot-to-kill ASATs. Alongside Russia raising tensions with its Luch satellite is China's demonstration of close proximity capability with a subsatellite that was "spawned" from another satellite earlier this year. The subsatellite began to rendezvous with other satellites, again without any clarity as to whether it was spying on, interfering with, or simply observing those

[111] Art. V Outer Space Treaty; GA Res 1962 (XVIII).
[112] Stephens and Steer, *supra* note 55 at 15.

satellites.[113] The United States has not demonstrated this capability, but the highly secretive X-37 spaceplane is suspected to have capabilities that could amount to covert weaponization of outer space.[114] This increased threat of weaponization from the main actors in space, together with the fact that space is inherently a part of terrestrial warfare these days, led the United States to denote space as a "warfighting domain." Though intended to be descriptive rather than normative, this terminology has put many other States on alert as they see it as a signal that the United States might be planning to escalate existing armed conflicts into space.

Until 2014, the emphasis in U.S. space strategy had been on "preventing and deterring aggression on national security space systems."[115] The space policy rhetoric changed that year, and the NDAA authorized a budget for "the development of offensive space control and active defensive strategies and capabilities."[116] It may be no accident that this was the year that Russia launched its mysterious Luch satellite and that tensions were on the rise with respect to the situation in Crimea. The 2018 National Space Strategy goes further, stating explicitly that "any harmful interference with or attack upon critical components of our space architecture … will be met with a deliberate response at a time, place, manner, and domain of our choosing" while also placing the blame on the shoulders of "[U.S.] competitors and adversaries [who] have turned space into a warfighting domain."[117]

There are some signs that the DoD seeks clarity on the legal implications of this, which is to be applauded. In 2017, the DoD undertook a Strategic Multilayer Assessment of its space security policies and strategies by engaging with independent academic, commercial, and military experts.[118] It is also involved in developing the Woomera Manual and in a parallel project to

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[113] https://space.skyrocket.de/doc_sdat/tjs-3.htm
[114] Subrata Ghoshroy, "The X-37B: Backdoor weaponization of space?" *Bulletin of the Atomic Scientists*, 71 nr 3 (2015) 19, www.thebulletin.org/2015/may/x-37b-backdoor-weaponization-space8292 (accessed 6 January 2017).
[115] U.S. *National Security Space Strategy*, January 2011, www.defense.gov/home/features/2011/0111_nsss
[116] TEXT - H.R.3979 - 113TH CONGRESS (2013-2014): CARL LEVIN AND HOWARD P. "BUCK" MCKEON NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2015, (2014), https://www.congress.gov/bill/113th-congress/house-bill/3979/text (last visited Jul 15, 2019).
[117] President Donald J. Trump is Unveiling an America First National Space Strategy, , THE WHITE HOUSE , https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unveiling-america-first-national-space-strategy/ (last visited Aug 30, 2019).
[118] The full report has not been publicly released, but was circulated among all contributing experts, and is therefore on file with this author.

develop a Manual on International Law Applicable to Military Activities in Outer Space (MILAMOS),[119] which looks at the interaction between space law and military activities in peacetime. Furthermore, the DoD explicitly stated in the 2015 Law of War Manual that international law in general, and LOAC in particular, are applicable to space warfare.[120] However, blaming others for turning space into a warfighting domain and then incorporating this language into policies like the National Space Strategy merely sends negative signals to potential and actual adversaries. Recently, NATO announced that as of November 2019 it will officially acknowledge space as a warfighting domain in its own space strategy despite that fact that the United States is the only member State of NATO that uses this nomenclature.[121]

Denoting space as a warfighting domain is not merely a descriptive tag; it has intended normative effects. It falls in line with arguments that the United States should try to exercise domain control in space. Many who work in national security may argue that domain control is the best way to ensure adversaries do not gain the upper hand.[122] However, as scientists and policymakers alike discovered in the early years of the 20th Century space race, continued access to and use of space for all purposes may require strategic restraint rather than domain control.[123] Space security experts, including Joan Johnson-Freese and Theresa Hitchens, have argued that policies and strategies asserting control in space and highlighting space as warfighting rather than war-supporting are in fact escalatory and dangerous and could be self-fulfilling in terms of bringing armed conflict into the space domain.[124]

The majority of those working in the sector seek to prevent such a conflict from taking place. The challenge is translating the importance of this position to policymakers who may not have the requisite understanding of the uniqueness of the space domain or of the true cost to the United States of the escalation of any tensions in space. Given this, it is extremely difficult for

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[119] https://www.mcgill.ca/milamos/
[120] Department of Defense Law of War Manual, 924 (2015).
[121] https://spacewatch.global/2019/06/space-wars-nato-to-acknowledge-space-as-warfighting-domain-approve-space-policy/
[122] See for example the comments by U.S. Strategic Commander General John Hyten compared with comments by Air Force Secretary Heather Wilson NATIONAL SECURITY SPACE STRATEGY, (2017), https://www.c-span.org/video/?438064-2/national-security-space-strategy (last visited Aug 30, 2019).
[123] JAMES MOLTZ, THE POLITICS OF SPACE SECURITY: STRATEGIC RESTRAINT AND THE PURSUIT OF NATIONAL INTERESTS 125 (2011).
[124] Hitchens and Freese, supra note 12.

the United States and its key allies to maintain their leadership role in space without contributing to an escalatory cycle of weaponization and policy tensions.

V. Conclusion: Harnessing International Co-operation

There is often a lack of understanding as to the intentions behind any given actor's activities in outer space, which is a key factor in the cyclical escalation currently taking place in terms of competing policies and technologies seeking to dominate space. This is a unique factor in space security when compared to other domains. There are certain common understandings about specific maritime, air, or land-based maneuvers, depending in large part upon whether there is a state of peace, tension, or armed conflict between the parties concerned. In space, the opposite is true. An activity may be read by one State as aggressive when it may in fact be intended as benign or even unintentional. The shift in relations, trust, and communication inherent in any transition from peace to hostility to armed conflict compounds this problem. If there are terrestrial-based tensions between parties, it may become even more difficult to interpret certain behaviors in outer space.

One of the dilemmas faced by leading space powers is the desire to maintain secrecy as to one's own capabilities while at the same time understanding that lack of transparency is a key factor in the escalatory cycle towards weaponization of space and potential aggressive actions. Military experts tell us that lack of transparency is one of the main causes for escalation during war games or role-play vignettes.[125] While it may appear counter-intuitive to support increased co-operation and collaboration, right now the United States and its allies may not be the lead players in the space domain, and it may be prudent to consider policies that support increased international scientific collaboration and other transparency and confidence building measures (TCBMs).

As the number of State and commercial actors in space continues to grow and the capacity of various States develops rapidly, the number of factors that must be considered when seeking to

[125] Wargames and vignettes of this nature are classified, and such statements are not made publicly. However, this author has heard similar statements repeated in general terms at academic conferences and in private conversations, by those who have taken part in the Schrieber War Games on behalf of Australia, Canada and the U.S.

protect satellites and spacecraft from adversarial interference also increases. The international urgency of this situation is highlighted by the fact that since 2015, the UN General Assembly's Fourth Committee, which has historically had "peaceful uses of outer space" as part of its portfolio, and the First Committee, which deals with Disarmament and International Security, hold annual joint meetings to discuss these issues.[126]

In answer to the increasing complexity of the political landscape in outer space (or the "political spacescape"), we must look beyond traditional alliances. For example, the Five Eyes allies already share a lot of information and intelligence. However, relations with non-Five Eyes allies such as Japan, Germany, and France are also critical in space. Furthermore, countries like India, Poland, and Spain are not part of traditional Western alliances but are becoming more important in the space sector. It behooves the more powerful nations to engage directly with India as it continues to build its space defense capabilities. Such cooperation may occur in the form of space alliances that cross over traditional geopolitical alliances. India wants to partner with both Russia and the United States and already partners with China. Increased international cooperation and transparency must be encouraged in the face of these non-traditional political and commercial partnerships.

Commercial actors have a key role in increasing cooperation and transparency because they often support multiple international clients among whom political relations may be unclear or shifting. Some commercial actors have an explicit desire to remain neutral, others have fixed alliances. All these factors may complicate the development of policies that support collaboration and TCBMs. However, it is undeniable that increased data sharing of SSA and the development of mechanisms to clarify intentions behind space-based maneuvers are essential to ensure stability in space.

There is a critical need for clear representations from States as to their position on national and international law applicable to space and well-informed policy positions on the emerging

[126] Fourth Committee Approves Two Texts Without a Vote as It Concludes General Debate on International Cooperation in Peaceful Uses of Outer Space, UNITED NATIONS MEETINGS COVERAGE AND PRESS RELEASES (2018), https://www.un.org/press/en/2018/gaspd675.doc.htm (last visited Aug 30, 2019).

weaponization of space. Due to the specificity of the space domain, specialized expertise must be provided to decision-makers, and interdisciplinary opinions must be sought from a multitude of stakeholders. Finding answers to these questions requires interdisciplinary engagement and collaboration, not only among substantive experts in different fields but also between public agencies and private commercial entities.

This is not merely aspirational. There are lessons to be learned from the Cold War era when scientists pushed for increased collaboration even during periods of high tension between the two superpowers. There is a need for exchange of information and evidence-based policy, particularly in terms of SSA, cross-domain thinking, minimization of the escalatory cycle, and appreciation of the long-term effects of any space-based conflict. The challenge will be knowing how to balance this against the need to protect one's own space assets and the need to maintain secrecy about one's own capabilities. Space is a unique domain and requires a unique way of thinking about policy and strategy.