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International Perspectives on Space Weapons

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CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

A Report of the
CSIS AEROSPACE SECURITY PROJECT

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Contents

EXECUTIVE SUMMARY IV

INTRODUCTION 1

DEFINING SPACE WARFARE AND SPACE WEAPONS 3

FRAMEWORK FOR EVALUATING SPACE WEAPONS 4

EXISTING INTERNATIONAL AGREEMENTS 8

PROPOSED INTERNATIONAL AGREEMENTS 10

RECENT ACTIVITIES AND STATEMENTS 15

CONCLUSIONS 19

ABOUT THE AUTHOR 21

Executive Summary

Little consensus exists in the international community on what constitutes a space weapon or the weaponization of space. This paper uses a broad framework for what may be considered a space weapon, organized by the domains in which they originate and have effects (Earth-to-space, space-to-space, and space-to-Earth) as well as the physical means by which these effects are achieved (kinetic and non-kinetic). While there are many other ways to categorize and subdivide the broad range of possible space weapons, the six resulting categories in this framework prove useful for highlighting differences in definitions, how countries view space weapons, and the current state of space weaponization. Of the six categories, three categories of space weapons have been demonstrated by nations either through testing, deployment, or operational use (Earth-to-space kinetic, Earth-to-space non-kinetic, and space-to-space kinetic). This means that by many definitions space has already been weaponized.

No international agreements exist today that completely limit space weapons within any of the six categories of the framework. However, some agreements limit certain types of space weapons that are subsets within the categories listed above. The Partial Test Ban Treaty and Outer Space Treaty are the major widely accepted international agreements that limit space weapons activity and testing. The Partial Test Ban Treaty of 1963 prohibits the testing and use of nuclear warheads on Earth-to-space and space-to-space kinetic weapons. It does not, however, affect the development, testing, deployment, or use of non-nuclear space weapons. Similarly, the Outer Space Treaty of 1967 prohibits nuclear-armed space-to-space and space-to-Earth kinetic weapons. It also prohibits all forms of space-to-space weapons from being tested and used in military maneuvers on other celestial bodies. However, the Outer Space Treaty does not prohibit conventionally armed space-to-space weapons in Earth orbit, in deep space, or in orbit around other celestial bodies nor does it prohibit conventionally armed space-to-Earth weapons. Moreover, it does not prohibit any Earth-to-space weapons.

Further insight into what other nations consider to be space weapons can be gleaned from the ongoing debate over the Russian and Chinese proposed treaty entitled "Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects," otherwise known as the PPWT. China and Russia jointly submitted their draft PPWT proposal at the United Nations in 2008. The proposed treaty defined space weapons somewhat narrowly to only apply to space-to-space and space-to-Earth weapons, both kinetic and non-kinetic. It would not prohibit Earth-to-space kinetic weapons or Earth-to-space non-kinetic forms of attack, which China and Russia both possess.

In December 2008, the Council of the European Union approved its draft Code of Conduct for outer space activities. Among its many provisions, it called for states to "refrain from intentional destruction of any on-orbit space object," which would limit Earth-to-space and space-to-space kinetic weapons. By focusing on a narrow set of potential space weapons that have the potential to produce space debris, the Code of Conduct was fairly limited in scope. In 2014, the European Union published a fifth revision of the Code of Conduct that altered the limitation on Earth-to-space and space-to-space kinetic weapons to include an exception for when the destruction of a space object may be justified. The allowable justifications are for safety (particularly if human life is involved), the prevention of new space debris, and self-defense.

Russia and China also issued an updated draft of the PPWT in 2014 that altered the defined terms in the treaty in several ways. It modified the proposed definition of a space weapon to apply to any outer space object and included additional clarification on the protection of a state's right of self-defense to include the right of collective self-defense, which hues more closely to the wording in the EU Code of Conduct.

Ultimately, both the EU Code of Conduct and the PPWT failed to gain consensus. However, in December 2015, the UN General Assembly passed a resolution that urged the commencement of negotiations on the Chinese-Russian PPWT and encouraged states to uphold a "political commitment not to be the first to place weapons in outer space." The resolution specifically cited Argentina, Armenia, Belarus, Brazil, Cuba, Indonesia, Kazakhstan, Kyrgyzstan, Russia, Sri Lanka, Tajikistan, and Venezuela as having already stated that they would not be the first to place weapons in outer space. Moreover, Russia and Venezuela issued a joint statement to the UN Conference on Disarmament saying that they "will not be the first to deploy any type of weapon in outer space and will do their utmost to prevent outer space from being turned into a theatre for military confrontation and to ensure security in outer space activities." Such statements imply that these nations believe weapons have not already been placed in space. Given the different types of space weapons that have already been tested or demonstrated, these statements may simply be duplicitous or may indicate that these nations have a narrower view of what a space weapon is.

Current activities and statements by foreign governments and non-governmental organizations also shed light on how views on space weapons are evolving. Two non-governmental groups are currently developing reports on the military uses of space and what constitutes an act of war or aggression in space. McGill University's Center for Research in Air and Space Law initiated a project to develop a Manual on International Law Applicable to Military Uses of Outer Space, known as MILAMOS, with the objective to create a manual that "clarifies the fundamental rules applicable to military uses of outer space by both States and non-State actors in times of peace and in periods of rising

tensions." Work is also underway on a similar project known as Woomera, which is a collaboration among four universities: the University of Adelaide in Australia, the University of Exeter in the United Kingdom, the University of Nebraska College of Law in the United States, and the University of New South Wales in Australia. Like MILAMOS, Woomera aims to create a manual that summarizes how existing international law applies to military uses of space.

France has become one of the most vocal nations on the need to develop better defenses in space. In 2019, it issued a new Space Defense Strategy that calls for the creation of a Space Command under its Air Force and renaming the Air Force to be the Air and Space Force. In some of the most direct and specific language by a government official from any nation on the need for active defenses in space, the French defense minister publicly stated that France intends to develop bodyguard satellites and high-powered lasers on satellites to protect French space assets from attack.

Japan has also taken a more proactive approach to space defense, largely driven by threats it perceives from China's space activities. In its 2019 defense white paper, the Japanese Ministry of Defense discusses various means of improving space control, such as bolstering its space situational awareness capabilities and passive defenses. Japan is also creating a Space Domain Mission Unit within the Air Self-Defense Force. An unnamed senior ministry of defense official was quoted in the press saying that Japan was deciding on whether or not to develop a co-orbital anti-satellite (ASAT) system using robotic arms, electronic attack, or cyberattack. According to the article, the Abe government has concluded that such a co-orbital ASAT system would be within the principals enshrined in Japan's 2008 Aerospace Basic Law.

In 2019, India became the fourth nation to demonstrate an Earth-to-space kinetic ASAT weapon. In a public address following the test, Indian prime minister Narendra Modi reiterated that India remains opposed to the weaponization of space. This statement would appear to indicate that India does not believe the capability it demonstrated—an Earth-to-space kinetic ASAT—is a space weapon or represents the weaponization of space.

The Republic of Korea (ROK) issued a new defense white paper in 2018 that, among other topics, addresses space security issues. The white paper notes that the ROK established a new space organization within the Ministry of National Defense and that it is actively working to increase its cooperation with allies in space, namely the United States. In 2015, the Korean Air Force stood up a Space Intelligence Center to develop its space control capabilities. The Korean and U.S. militaries have also conducted joint tabletop exercises that included the use of adversary jamming of satellite navigation and communications.

This analysis finds that the way other nations view space weapons hinges on several key distinctions. The first distinction is between nuclear and conventional space weapons. An international taboo against the placement

and use of nuclear weapons in space endures through treaties that have garnered widespread support, but no such consensus exists for conventionally armed space weapons. A second distinction is whether the weapon is stationed on Earth or in space. The Chinese and Russian PPWT proposal would only prohibit weapons that are stationed in space, while the European Union's proposed Code of Conduct would limit weapons stationed on Earth and in space. A third distinction is whether the weapon produces orbital debris. Much of the focus of the Code of Conduct and the stated motivation of many non-aligned states is on the prevention of orbital debris and the preservation of the space environment for peaceful uses. A final, and more recent, distinction in how nations view space weapons is whether the weapons are used for self-defense rather than for offensive purposes. The latest version of both the PPWT and Code of Conduct include exceptions for self-defense, and the Code of Conduct is more specific in delineating when the use of space weapons in self-defense is legitimate.

Competing definitions for key terms have proven to be a particularly difficult issue to overcome. Nations use phrases such as space weapons, the militarization of space, and the weaponization of space to mean different things at different times, often to suit their own geopolitical agendas. A common framework for discussing space weapons could be useful to establish and clarify thresholds among likeminded nations for what constitutes conflict and escalation in space.

Efforts to place limits on the development of space weapons, create a code of conduct, or even establish norms of behavior in space have so far failed to gain consensus among the key nations needed for such an agreement to be effective, namely the United States, Russia, China, India, and the European Union. While discussions continue at the United Nations about preventing an arms race in space, the actions of some nations—namely Russia and China—are leading others to prepare for conflict.

Introduction

The past three decades have given rise to gradual but sweeping changes in the way the space domain is viewed and used by militaries around the world. From the launch of Sputnik in 1957 through the 1980s, the United States and Soviet Union primarily used military space systems to support strategic missions, such as missile warning, strategic intelligence, and nuclear command and control. The use of space systems to support conventional military operations was less of a priority by comparison. Beginning in the 1990s, however, the First Gulf War and the conflicts in Bosnia and Kosovo revealed the many ways space systems can serve as an enabler and force multiplier for conventional military operations. By the late-1990s, space systems had quickly become a critical enabler for military forces across the full spectrum of conflict. A 1997 United States Space Command publication stated that, "so important are space systems to military operations that it is unrealistic to imagine that they will never become targets. Just as land dominance, sea control, and air superiority have become critical elements of current military strategy, space superiority is emerging as an essential element of battlefield success and future warfare."[1]

Other nations took note of how important space had become to the U.S. military for conventional operations. They began to build similar capabilities for their own forces and to develop counterspace weapons to negate the U.S. advantage in space. In 2004, the Air Force produced its first doctrine publication on counterspace operations to provide "operational guidance in the use of air and space power to ensure space superiority."[2] Importantly, this document defined space superiority as the ability to ensure "the freedom to operate in the space medium while denying the same to an adversary."[3] In the years since the publication of this doctrine, senior military and civilian leaders in the United States have become more comfortable publicly referring to space as a "warfighting domain" and often cite the need for "American dominance in space."[4]

This shift—particularly in the way the nations talks about the space domain—has led some to become concerned that space will become weaponized or that

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1 United States Space Command, *Vision for 2020* (Peterson AFB, CO: February 1997), 6, https://thecommunity.com/vision-for-2020/.

2 John P. Jumper's foreword in Office of the Secretary of the Air Force, *Counterspace Operations* (Washington, DC: August 2, 2004), https://fas.org/irp/doddir/usaf/afdd2_2-1.pdf.

3 Ibid.

4 "Remarks by President Trump at a Meeting with the National Space Council and Signing of Space Policy Directive-3," Executive Office of the President, June 18, 2018, https://www.whitehouse.gov/briefings-statements/remarks-president-trump-meeting-national-space-council-signing-space-policy-directive-3/.

an arms race will begin in space. While debates over whether space will or should be weaponized continue to simmer, much of the language underlying this debate remains murky. What is a space weapon, and what does it mean to weaponize space? The answers depend in no small part on one's perspective, and the rhetoric used by different nations on this subject indicates they have significantly different understandings of what constitutes a space weapon and the types of systems and activities they believe are legitimate uses of space.

This paper explores the views of other nations in this debate and how they define space weapons and the weaponization of space. It also reviews major international efforts to prevent the weaponization of space and how these efforts have implicitly and explicitly defined space weapons. The United States, China, and Russia are among the main space powers involved in this debate, and much about their views is well known. This analysis therefore focuses relatively more on the views of other nations and their reactions to the rhetoric, policies, and actions of the United States, China, and Russia.

Defining Space Warfare and Space Weapons

If weapons are instruments of war, then defining what constitutes war in space can help elucidate what is or is not a space weapon. Clausewitz defined war as an "act of violence intended to compel our opponent to fulfill our will." He went on to further refine his definition of war, writing that "violence, that is to say, physical force . . . is therefore the *means*; the compulsory submission of the enemy to our will is the ultimate *object*. In order to obtain this object fully, the enemy must be disarmed, and disarmament becomes therefore the immediate object of hostilities in theory."[5] Thus, the act of making war includes actions intended to disarm one's opponent and to limit its ability to fight. While Clausewitz did not contemplate war extending into outer space, there is little reason to believe that the object of a war that begins or extends into space would be fundamentally different than terrestrial warfare.

Space has been used to support military planning and operations on Earth since the beginning of the space age, even before human spaceflight. Early military space missions used space systems for intelligence, surveillance, and reconnaissance (ISR); communications; position, navigation, and timing (PNT); and other functions to allow terrestrial forces to operate more effectively. These passive uses of space to support military forces are often referred to as the militarization of space, and there is little disagreement that space systems have and will continue to be used for military purposes.[6]

There is little reason to believe that the object of a war that begins or extends into space would be fundamentally different than terrestrial warfare.

The weaponization of space, however, is generally viewed as going beyond mere passive support to military forces on Earth. As Joan Johnson-Freese defines it in her book, *Space as a Strategic Asset*, "force application is the overt weaponization of space, as compared with the de facto weaponization that has occurred under the guise of space control."[7] Air Force doctrine previously defined space force application as "those forces that deliver kinetic effects to, from, or through space."[8] However, the most recent update to joint space operations doctrine in 2018 does not use this terminology and explicitly calls for

5 Carl Von Clausewitz, *On War*, 3rd ed., vol. 1 (New York: Dutton and Co., 1918), 2, http://oll-resources.s3.amazonaws.com/titles/2050/Clausewitz_1380.01_Bk.pdf.

6 United Nations Institute for Disarmament Research (UNIDR), *Prevention of an Arms Race in Outer Space: Guide to the Discussions in the Conference on Disarmament* (Geneva: United Nations, 1991), 14, https://www.unidir.org/files/publications/pdfs/prevention-of-an-arms-race-in-outer-space-a-guide-to-the-discussions-in-the-cd-en-451.pdf.

7 Joan Johnson-Freese, *Space as a Strategic Asset* (New York: Columbia University Press, 2007), 106.

8 Office of the Secretary of the Air Force, *Counterspace Operations*, 32.

its "removal from the DoD dictionary."[9] The 2018 joint doctrine defines space control as both offensive and defensive operations "to ensure freedom of action in space for the US and its allies and, when directed, to deny an adversary freedom of action in space."[10]

A 1991 United Nations report on space security adroitly noted that, "the adoption of common definitions must take account of complex technical, legal, and doctrinal meanings of words, phrases, terms, and weapon systems, as well as military and military-related space activities."[11] The UN report notes that "the term weaponization of outer space has been used to include space-based weapons consisting of space/Earth-strike devices. For some delegations, however, weaponization of outer space also covers ground-based weapons consisting of space-strike devices."[12]

A wide variety of nations have attempted to define what a space weapon is and is not. For example, in 1982 the Italian delegation to the United Nations Conference on Disarmament raised a number of key questions for defining anti-satellite (ASAT) weapons, such as whether non-kinetic means of interfering with a satellite (such as radio frequency jamming or lasing) should be considered ASAT activities. The Conference on Disarmament established an ad hoc committee to explore these issues in 1985. The following year the Venezuelan delegation proposed a definition for "space strike weapons" that included both offensive and defensive systems launched from the ground, air, sea, or space. However, it limited its initial definition to only include weapons that targeted an object in space. In 1988, Venezuela tabled a more comprehensive proposal that defined space weapons to also include systems capable of attacking targets on the land, air, and sea from space. It specifically included all types of weapons "whatever the scientific principle on which its functioning is based," which includes both kinetic and non-kinetic forms of attack. Germany weighed into the definition debate in 1989, but the German proposal focused on kinetic forms of ASAT weapons from Earth and space-based platforms.[13]

9 Joint Chiefs of Staff, *Joint Publication: Space Operations* (Washington, DC: April 2018), https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_14.pdf.

10 Ibid., 1-3.

11 UNIDR, *Prevention of an Arms Race in Outer Space*, 9.

12 Ibid., 14.

13 Ibid., 15-19.

Framework for Evaluating Space Weapons

While there is no universally agreed upon definition for what constitutes a space weapon, it is useful to begin by establishing a broad framework (with some boundaries) for what could potentially be considered a space weapon and then evaluating how different definitions fit into this framework. Using a broad view of space weapons, something could be considered a space weapon if it either originates in space or has effects in space. Weapons that originate on Earth and have effects on Earth are generally not considered space weapons even if they transit through space, such as intercontinental ballistic missiles.[14] Space systems that are merely used for passive support to other forces, such as communications, PNT, or intelligence collection, are also generally not considered to be space weapons. A space weapon is used to apply force directly against an adversary (force application) or to directly interfere with an adversary's ability to conduct military operations in, through, or enabled by space (space control).[15]

The proposed framework, shown in Table 1, categorizes potential space weapons by the domains in which they originate and have effects (Earth-to-space, space-to-space, and space-to-Earth) as well as the physical means by which these effects are achieved (kinetic and non-kinetic).[16] Of the six categories, three categories of space weapons have been demonstrated by nations either through testing, deployment, or operational use (Earth-to-space kinetic, Earth-to-space non-kinetic, and space-to-space kinetic).

While there are many other ways to categorize and subdivide the broad range of possible space weapons, the six resulting categories in this framework prove useful for highlighting differences in definitions, how countries view space weapons, and the current state of space weaponization. For example, within each category, the effects created can be permanent or temporary, depending on the means of attack. Another important subcategorization within kinetic attacks is between conventional and nuclear. This framework illustrates that unless one takes a rather narrow definition of space weapons that excludes space-to-space kinetic forms of attack, space has already been weaponized.

Earth-to-space weapons include direct-ascent ASAT missiles (kinetic), uplink satellite jamming (non-kinetic), directed energy ASAT weapons (non-kinetic), and cyberattacks against satellites (non-kinetic). The United States, China, Russia, and India have all demonstrated direct-ascent ASAT

14 Ibid., 14.

15 While it is true that any satellite could theoretically be used as a crude weapon to collide with another satellite, it is also true that any hard object could be used as a weapon to strike another person. This line of logic leads to the trivial conclusion that everything is a weapon regardless of intent or use. This analysis looks instead at how objects are used or are intended to be used.

16 For the purposes of this analysis, Earth is defined as anything below 100 km altitude and space is anything 100 km and above, including the moon and other celestial bodies.

Table 1: Framework for Types of Space Weapons

	Kinetic	Non-Kinetic
Earth-to-Space	**Example** Direct-ascent ASAT **How do they work?** A missile fires a warhead or projectile into space to directly strike or detonate near a target satellite. The warhead can be conventional or nuclear. **What are the effects?** A kinetic Earth-to-space weapon produces space debris that can affect the safe operation of other satellites in affected orbits. Nuclear detonations in space increase the radiation exposure of other satellites and can significantly shorten their lifespan. **Have they been demonstrated?** Earth-to-space kinetic weapons have been tested by the United States, Russia, China, and India. The United States and Soviet Union tested nuclear weapons in space in the 1960s.	**Examples** Uplink Jammer, Laser Dazzler/Blinder, Cyberattack **How do they work?** Non-kinetic counterspace weapons can be stationed on ground, maritime, or airborne platforms and used to affect the operation of satellites or the sensors they carry, without making physical contact. **What are the effects?** Non-kinetic weapons disrupt or degrade the ability of satellites to function properly. They can have temporary or permanent effects, but they do not generally produce orbital debris or other collateral damage. **Have they been demonstrated?** Multiple nations have demonstrated these capabilities, including Russia, China, Iran, and others.
Space-to-Space	**Examples** Co-orbital ASAT, Space-based Missile Defense Interceptors **How do they work?** A satellite is placed into orbit and maneuvers to intercept its target by striking it directly or detonating a conventional or nuclear warhead in its vicinity. **What are their effects?** A kinetic space-to-space weapon would produce space debris that can affect the safe operation of other satellites in similar orbits. A nuclear detonation in space would increase the radiation exposure of other satellites and significantly shorten their lifespan. **Have they been demonstrated?** The Soviet Union tested co-orbital kinetic ASAT weapons repeatedly during the Cold War.	**Examples** Co-orbital Crosslink Jammer, Co-orbital High-powered Microwave **How do they work?** A satellite is placed into orbit and uses non-kinetic means (such as a high-powered microwave or jammer) to disrupt the operation of another satellite. **What are their effects?** They can degrade, disrupt, or destroy a target satellite without making physical contact, producing orbital debris or otherwise affecting other satellites. The effects can be temporary or permanent depending on the form of attack used and the protections on the target satellite. **Have they been demonstrated?** No open-source examples could be found of such a system being demonstrated, although such tests could look like remote proximity operations to outside observers.
Space-to-Earth	**Examples** Space-based Global Strike (e.g., "Rods from God") **How do they work?** Weapons are placed in orbit and, when commanded, deorbit and reenter the atmosphere to strike a target on the Earth. Damage can be inflicted using the kinetic energy of the weapon itself, or a warhead can be deployed from the reentry vehicle (either conventional or nuclear). **What are their effects?** The effects depend greatly on the type of warhead used (conventional or nuclear) but would be like terrestrial-based ballistic missiles in terms of their ability to hit targets anywhere on Earth with little warning. **Have they been demonstrated?** While the idea of using space-based weapons for prompt global strike has been contemplated by the U.S. military, there are no open-source examples of such a system being tested.	**Examples** Space-based Downlink Jammer, Space-based High-powered Laser **How do they work?** A satellite equipped with a non-kinetic weapon could target forces on Earth, such as a laser used to intercept missiles or aircraft in-flight or a jammer used to interfere with radars or satellite ground stations. **What are their effects?** When used, the effects would be localized to the target area, but such a system could theoretically strike anywhere without warning. **Have they been demonstrated?** While the U.S. military has contemplated space-based lasers for boost-phase missile defense, there are no open-source examples of such a system being tested.

capabilities.[17] Missile defense systems can also double as direct-ascent ASAT weapons against satellites in low Earth orbit (LEO), as the United States demonstrated in 2008 with its use of an SM-3 missile interceptor to strike its own malfunctioning satellite.[18] Uplink jamming of satellite communications signals, which interferes with the signal received on the satellite, is a more commonly available means of attacking space systems. Iran, Libya, and Egypt, for example, have each been accused of using uplink jammers to interfere with satellites.[19] Directed energy weapons, such as lasers designed to dazzle or blind the sensors on satellites, can also be used to attack satellites in space from Earth. China has demonstrated the ability to dazzle a satellite with a laser from Earth, and Russia is reportedly developing new land and airborne lasing systems to replace its older *Sokol Eshelon* airborne lasing aircraft.[20]

Unless one takes a rather narrow definition of space weapons that excludes space-to-space kinetic forms of attack, space has already been weaponized.

Space-to-space methods of attack include a broad range of kinetic and non-kinetic co-orbital ASAT weapons and space-based missile defense systems. A kinetic co-orbital ASAT can be used to crash into another satellite or to detonate a conventional or nuclear explosive near another satellite. During the Cold War, Russia conducted some 20 tests of its *Istrebitel Sputnikov* co-orbital ASAT system, and since then it has continued to develop and test kinetic co-orbital ASAT weapons.[21] A non-kinetic co-orbital ASAT weapon could use jamming to interfere with satellite-to-satellite communications links or a high-power microwave weapon to damage electrical components on other satellites. Non-kinetic space-to-space weapons could be difficult to detect because their use may not be readily observable from Earth, and on-orbit tests against one's own satellites could look like remote proximity operations to outside observers. Space-based missile defense systems, while not intended to target other satellites, would also have an inherent space-to-space capability. For decades the United States has studied and debated developing a constellation of space-based kinetic interceptors and space-based high-powered lasers capable of intercepting missiles in flight, although nothing has been deployed or demonstrated to date.[22]

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17 Todd Harrison, Kaitlyn Johnson, and Thomas Roberts, *Space Threat Assessment 2019* (Washington, DC: CSIS, April 2019), 3, 11-12, 19-20, https://www.csis.org/analysis/space-threat-assessment-2019.

18 Staff Reporters, "Navy Hits Satellite with Heat-Seeking Missile," Space.com, February 21, 2008, https://www.space.com/5006-navy-hits-satellite-heat-seeking-missile.html.

19 Harrison, Johnson, and Roberts, *Space Threat Assessment 2019*, 28-29, 35, 39.

20 Andrea Shalal-Esa, "China Jamming Test Sparks U.S. Satellite Concerns," Reuters, October 5, 2006, as quoted in Yousaf Butt, "Effects of Chinese Laser Ranging on Imaging Satellites," *Science & Global Security* 17, no. 1 (2009): 20-35; Pavel Podvig, "Russia Has Been Testing Laser ASAT," Russian Strategic Nuclear Forces, October 8, 2011, http://russianforces.org/blog/2011/10/russia_has_been_testing_laser.shtml.

21 Asif A. Siddiqi, "The Soviet Co-Orbital Anti-Satellite System: A Synopsis," *Journal of the British Interplanetary Society* 50, no. 6 (1997): 225–40, http://faculty.fordham.edu/siddiqi/writings/p7_siddiqi_jbis_is_history_1997.pdf.

22 See: Bob Preston et al., *Space Weapons Earth Wars* (Santa Monica, CA: RAND, 2002), https://www.rand.org/pubs/monograph_reports/MR1209.html.

Space-to-Earth weapons can be used to hold targets at risk across broad areas of the Earth. Kinetic space-to-Earth weapons can be armed with conventional or nuclear warheads, or they can use sheer kinetic energy to destroy targets. For example, the so-called "Rods from God" concept called for a constellation of satellites armed with tungsten rods that would deorbit and strike targets on Earth with explosive force, although no such system was ever developed or tested.[23] Non-kinetic space-to-Earth weapons include space-based jammers that could disrupt the downlink signals from satellites over large regions and space-based high-powered lasers that could target objects in the air or on the surface, although the technology required for this remains challenging.

Four of the six categories listed above involve weapons designed to attack satellites—commonly referred to as counterspace weapons. Not all counterspace weapons, however, are included in this framework. Weapons that are based on Earth and have effects on Earth are not considered space weapons under this framework, even if they may affect the ability to use space systems. An example of this would be a cruise missile or cyberattack against a satellite ground station. The attack originates on Earth and has effects on Earth, which means it would not be considered a space weapon under this framework, even though it would be a counterspace weapon.

Existing International Agreements

Existing international agreements that limit different types of space activities provide insight into other nations' perspectives on space weapons and which activities and capabilities they want to restrict. No agreements exist today that completely limit space weapons within any of the six categories of the framework. However, some agreements limit certain types of space weapons that are subsets within the categories listed above.

One of the first international agreements to limit activities in space was the Partial Test Ban Treaty of 1963. The treaty came about in part because both the United States and Soviet Union were testing nuclear weapons in space and, in the process, discovering the grave effects these weapons had on the overall space environment. In 1961 and 1962, the Soviet Union conducted a series of high-altitude nuclear tests with relatively low-yield warheads (1.2 to 40 kilotons), which prompted the United States to begin a high-altitude test program of its own. On July 9, 1962, the United States detonated a massive 1,400-kiloton warhead at an altitude of 400 km over the Pacific in a test known as Starfish Prime.[24] The Soviets followed suit by detonating a 300-kiloton warhead at an altitude of 290 km over Kazakhstan on October 22, 1962, followed days later by two similar tests at lower altitudes.[25] Notably, the Soviet tests occurred during the Cuban Missile Crisis, a period of particularly heightened tensions between the Soviet Union and the United States. Since the Partial Test Ban Treaty was signed in August 1963, however, no nuclear tests have been conducted in space by any nation.

Using the above framework, the Partial Test Ban Treaty prohibits the testing and use of nuclear warheads on Earth-to-space and space-to-space kinetic weapons. Specifically, the treaty says that the parties to it agree "to prohibit, to prevent, and not to carry out any nuclear weapon test explosion, or any other nuclear explosion, at any place under its jurisdiction or control: (a) in the atmosphere; beyond its limits, including outer space . . . ."[26] It does not, however, affect the development, testing, deployment, or use of non-nuclear space weapons. This treaty is widely accepted, with 104 signatory nations. Notably, France, China, and North Korea are among the few remaining countries that have not signed the treaty and are not bound by its limitations.[27]

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24 Phil Plait, "The 50th anniversary of Starfish Prime: the nuke that shook the world," Discover, July 9, 2012, https://www.discovermagazine.com/the-sciences/the-50th-anniversary-of-starfish-prime-the-nuke-that-shook-the-world.

25 Jerry Emanuelson, "The Soviet Nuclear EMP Tests over Kazakhstan," Futurescience, July 7, 2019, http://www.futurescience.com/emp/test184.html.

26 *Treaty Banning Nuclear Weapon tests in the Atmosphere, in Outer Space and Under Water*, Moscow, August 5, 1963, UNTS, no. 6964, https://treaties.un.org/doc/Publication/UNTS/Volume%20480/volume-480-I-6964-English.pdf.

27 Ibid. See: Status of the Treaty, http://disarmament.un.org/treaties/t/test_ban.

No agreements exist today that completely limit space weapons within any of the six categories of the framework.

The Outer Space Treaty of 1967 is arguably the most important international agreement for space. A total of 89 nations are signatories, and 109 nations are party to the treaty.[28] While it includes a number of critical provisions for how space and the activities within it are governed, it does little to prohibit the development, testing, deployment, and use of space weapons. Article III of the treaty says that nations should carry out activities in space "in accordance with international law, including the Charter of the United Nations." Article IV of the treaty prohibits nuclear weapons from being placed into orbit. Article IV also prohibits the testing of any type of weapon (nuclear or conventional) on the moon and other celestial bodies. Specifically, it says that parties to the treaty agree "not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner." It further states that "the establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden."[29]

Thus, the Outer Space Treaty effectively prohibits nuclear-armed space-to-space and space-to-Earth kinetic weapons. It also prohibits all forms of space-to-space weapons from being tested and used in military maneuvers on other celestial bodies. What is most notable about the treaty, however, is what it does not restrict. It does not prohibit conventionally armed space-to-space weapons in Earth orbit, in deep space, or in orbit around other celestial bodies nor does it prohibit conventionally armed space-to-Earth weapons. Moreover, it does not prohibit any Earth-to-space weapons, although the Partial Test Ban Treaty separately restricts nuclear-armed Earth-to-space kinetic weapons and was already in effect by the time the Outer Space Treaty was negotiated.

Another major international space agreement that helps define, but not limit, actions in space is the Liability Convention of 1972. Article I of the treaty defines several terms that are important for understanding space weapons and the weaponization of space. Specifically, it defines damage in a way that is not specifically limited to kinetic effects, and it defines the launching state broadly as both the state that launches or procures a launch and the state from whose territory or facility the launch is conducted. Importantly, the treaty distinguishes different types of liability for space-to-Earth and space-to-space damage. Article II makes the launching state absolutely liable for space-to-Earth damage, regardless of fault. Article III makes the launching state liable for space-to-space damage "if the damage is due to its fault or the fault of persons for whom it

28 "Status of International Agreements relating to activities in outer space as at 1 January 2019," Committee on the Peaceful Uses of Outer Space, April 1-12, 2019, https://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2019_CRP03E.pdf.

29 "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967)," United Nations Office of Outer Space Affairs, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

is responsible."[30] The Liability Convention has been ratified, signed, or otherwise accepted by 96 nations and international organizations.[31]

The Moon Agreement of 1979 reaffirmed the prohibitions on weapons and military activities on the moon as stated in the Outer Space Treaty. However, it was only ratified by 18 nations, including Australia, Belgium, France, India, the Netherlands, Pakistan, Saudi Arabia, and Turkey. Notably, it was not signed by the United States, Russia, China, the United Kingdom, Germany, and most other nations, and thus it remains limited in its relevance.

The Partial Test Ban Treaty and Outer Space Treaty are the major widely accepted international agreements that limit space weapons activity and testing today. Although the treaties do not specifically define space weapons or the weaponization of space, the prohibitions on nuclear weapons being used in space and the stationing of nuclear weapons in orbit are clear indications that these activities are widely considered space weapons. These agreements do not, however, provide a comprehensive view of whether other capabilities and activities not covered by the treaties are considered space weapons and weaponization, leaving much room for differences in interpretations and definitions.

30 "Convention on International Liability for Damage Caused by Space Objects (1972)," United Nations Office of Outer Space Affairs, https://www.unoosa.org/pdf/gares/ARES_26_2777E.pdf.

31 "Status of International Agreements relating to activities in outer space as at 1 January 2019," Committee on the Peaceful Use of Outer Space.

Proposed International Agreements

Further insight into what other nations consider to be space weapons can be gleaned from the ongoing debate over the Russian and Chinese proposed treaty entitled "Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects," otherwise known as PPWT. Of particular interest is the way other nations have responded to the PPWT proposal and the alternative proposals that have been offered.

After the United Nations Conference on Disarmament's initial efforts in the 1980s, progress in creating an agreement or framework to prevent an arms race in space stalled for many years. In the early-2000s, China and Russia began working closely together to push the issue to the forefront of the conference's agenda again. In 2005, the two nations hosted an open meeting on the issue, and later that year the UN General Assembly approved two non-binding documents on the Prevention of an Arms Race in Outer Space (PAROS) and the need for Transparency and Confidence-Building Measures in space (TCBM).[32] While this was not the first time the United Nations had passed similar provisions, it marked the beginning of a more concerted effort on the part of Russia and China to build international support for restrictions on space weaponization activities. The PAROS document was co-sponsored by 36 nations, including Russia, China, India, Indonesia, Iran, Pakistan, and Saudi Arabia.[33]

In parallel, China was working to develop and test a direct-ascent ASAT weapon capable of destroying satellites in LEO. On January 11, 2007, after several failed attempts, China conducted its first successful ASAT test. It destroyed one of its own satellites and generated thousands of pieces of space debris in the process. The test was widely condemned by other nations, including the United States, Russia, Japan, India, and many European nations.[34] In June of that year, the UN Committee on the Peaceful Uses of Outer Space (COPUOUS) adopted a set of voluntary space debris mitigation guidelines (which had been in development for several years), and in December the guidelines were endorsed by the General Assembly. Among other things, these guidelines state that "the intentional destruction of any on-orbit spacecraft and launch vehicle orbital stages or other harmful activities that generate long-lived debris should be avoided. When intentional break-ups are necessary, they should be conducted at sufficiently low altitudes to limit the orbital lifetime of resulting fragments."[35] Notably, these guidelines stand in stark contrast to the Chinese ASAT test

32 Center for Nonproliferation Studies, *Proposed Prevention of an Arms Race in Outer Space (PAROS) Treaty* (Washington, DC: Nuclear Threat Initiative, 2019), 10.

33 UNIDR, *Prevention of an Arms Race in Outer Space*.

34 Carin Zissis, "China's Anti-Satellite Test," Council on Foreign Relations, February 22, 2007, https://www.cfr.org/backgrounder/chinas-anti-satellite-test.

35 United Nations Office of Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful uses of Outer Space* (Vienna: 2010), 3, https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

that was conducted, which occurred at a relatively high altitude and resulted in many pieces of long-lived debris.

Also in 2007, the European Union introduced a draft Code of Conduct for space at the United Nations with one of the main principles of the code being "to prevent space from becoming an area of conflict" while also recognizing that space systems are "essential to the safeguarding of national security and strategic stability."[36] The proposed scope of the code mainly focused on the prevention of collisions and debris, which would mainly affect kinetic types of space weapons.

In February 2008, two important events occurred. First, China and Russia formally submitted their draft PPWT proposal at the United Nations. The following week, the United States shot down one of its own satellites using a Standard Missile-3 (SM-3) missile defense interceptor from a U.S. Navy ship in the Pacific. Unlike the Chinese test a year prior, this intercept took place at a relatively low altitude, and much of the debris burned up in the atmosphere within a few days.[37]

One of the stated goals of China and Russia in the PPWT treaty was "to keep outer space as a sphere where no weapon of any kind is placed." But it defined space weapons somewhat narrowly to mean "any device placed in outer space, based on any physical principle, specially produced or converted to eliminate, damage or disrupt normal function of objects in outer space, on the Earth or in its air." It further specified that placing a weapon in space means putting the object into an orbital trajectory or stationing it permanently somewhere else in space, such as the moon.[38] Therefore, the PPWT proposal only applies to space-to-space and space-to-Earth weapons, both kinetic and non-kinetic. It would not prohibit Earth-to-space kinetic weapons, such as the Chinese ASAT missile tested the year prior. The U.S. SM-3 missile used as an ASAT system in 2008 would also not be prohibited nor would any Earth-to-space non-kinetic forms of attack, which China and Russia both possess.[39]

In July 2008, the European Parliament passed a resolution on space security that said, "under no circumstances should European space policy contribute to the overall militarisation and weaponisation of space." While it did not define the terms militarization and weaponization, the resolution stated that it "deplored" the lack of an independent European ballistic missile warning capability and called for the development of "satellite-based early warning against ballistic missile launches." Given the resolution's call for additional space systems to support military missions, its use of the term militarization of space would not appear to mean the use of space systems to support military operations. The resolution also noted the need for more defenses for European satellites, to include "anti-jamming, shielding, on-orbit servicing, high-orbit and multi-orbital constellation architectures," which again would not appear to be included under its definition of

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36 "Transparency and Confidence-building measures in outer space activities," United Nations, September 17, 2007, 7, http://www.reachingcriticalwill.org/images/documents/Resources/Factsheets/paros/A-62-114-Add1.pdf.

37 Jim Wolf, "U.S. satellite shootdown debris said gone from space," Reuters, February 27, 2009, https://www.reuters.com/article/us-space-usa-china/u-s-satellite-shootdown-debris-said-gone-from-space-idUSTRE51Q2Q220090227.

38 "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects" (draft), 1-2, http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/cd/2008/documents/Draft%20PPWT.pdf.

39 Harrison, Johnson, and Roberts, *Space Threat Assessment 2019*, 11-12, 19-20.

militarization or weaponization. The resolution recommended a legally binding ban on "the use of weapons against space assets and the stationing of weapons in space," which could be interpreted to include all six categories of space weapons in the proposed framework in Table 1.[40]

The PPWT proposal only applies to space-to-space and space-to-Earth weapons, both kinetic and non-kinetic.

In December 2008, the Council of the European Union approved the draft Code of Conduct for outer space activities. The code was intended to be voluntary and open for all nations to adopt beyond just EU states. Among its many provisions, it called for states to "refrain from intentional destruction of any on-orbit space object," which would limit Earth-to-space and space-to-space kinetic weapons.[41] By focusing on a narrow set of potential space weapons that have the potential to produce space debris, the Code of Conduct was fairly limited in scope.

Canada also weighed into the debate in 2009 in a working paper delivered to the UN Conference on Disarmament. The Canadian paper made the point that both the EU Code of Conduct and the Chinese-Russian PPWT allow for a potential proliferation path for ASAT weapons. It argued that a ban on the testing and use of weapons against a satellite should also be done in parallel with a ban on the placement of weapons in space, "lest we inadvertently provide a sanctuary for space-based weapons."[42] It further noted that the risks of settling for a weakened or ill-defined proposal are that it could implicitly endorse the proliferation of some types of ASAT weapons or inadvertently limit self-defense measures against space-based weapons.[43]

Deliberations in the UN Conference on Disarmament picked up in 2010, with several delegations making statements in support of the PPWT treaty. Specifically, Australia, Belarus, and Kazakhstan each came out in support of the draft PPWT submitted by China and Russia in 2008, and the delegations from Bangladesh, the European Union, Ireland, Libya, South Korea, Romania, and Switzerland made positive references to the treaty.[44] Brazil voiced support for the draft PPWT as a starting point for negotiations and expressed concern about the EU Code of Conduct, noting that "the reference to self-defense could be interpreted in a way that justifies the use of force in outer space. That is a scenario we cannot afford to contemplate, not even in theory."[45]

The First Committee of the UN General Assembly passed a resolution in 2010 creating a Group of Governmental Experts to explore the development of transparency and confidence building

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40 "European Parliament Resolution on 10 July 2008 on Space and Security," European Union, July 10, 2008, https://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT%2BTA%2BP6-TA-2008-0365%2B0%2BDOC%2BXML%2BV0//EN&language=EN.

41 "Draft Code of Conduct for Outer Space Activities," Council of the European Union, December 17, 2008, 9, https://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2017175%202008%20INIT.

42 "On the Merits of Certain Draft Transparency and Confidence-Building Measures and Treaty Proposals for Space Security," Government of Canada, working paper, June 5, 2009, 3, http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/cd/2009/documents/CD1865.pdf.

43 Ibid., 4.

44 Center for Nonproliferation Studies, *Proposed Prevention of an Arms Race in Outer Space (PAROS) Treaty*, 8.

45 Statement by Brazil to the United Nations Conference on Disarmament, October 23, 2012, 3, https://unoda-web.s3-accelerate.amazonaws.com/wp-content/uploads/assets/special/meetings/firstcommittee/67/pdfs/Thematic/23%20Oct%20TD%20Clust%203%20Brazil.pdf.

measures for outer space. It involved representatives from 15 nations, including the United States, Russia, China, France, Brazil, and the United Kingdom. The group reported back to the General Assembly in July 2013 with a set of recommended voluntary measures that included the exchange of information on national space policy and military space spending, notifications of outer space activities, and visits to launch sites.[46] While the General Assembly encouraged states to adopt the proposed measures on a voluntary basis, little progress was made on building a broader consensus.

Discussions on the EU Code of Conduct continued, with meetings held to solicit input from experts through 2014. The European Union published a fifth revision of the code in March 2014 that incorporated some of the views and feedback from its consultations with other nations. The revised code altered the limitation on Earth-to-space and space-to-space kinetic weapons to say that subscribing states will "refrain from any action which brings about, directly or indirectly, damage, or destruction of space objects unless such action is justified." The allowable justifications are for safety (particularly if human life is involved), the prevention of new space debris, and self-defense.[47] An earlier version of the code only made passing reference to the right of individual or collective self-defense, as already allowed under the UN Charter, and did not specify that self-defense could be a justifiable reason for destroying a space object.

In June 2014, Russia and China issued an updated draft of the PPWT. The revised version altered the defined terms in the treaty in several ways. It no longer attempted to define outer space as above 100 km altitude and instead broadened the definition of an outer space object to be "any device placed in outer space and designed for operating therein." It also modified the proposed definition of a space weapon to apply to any outer space object (as newly defined) while retaining the key phrase "to eliminate, damage or disrupt normal functioning of objects in outer space, on the Earth's surface or in the air." The revised version also included additional clarification on the protection of a state's right of self-defense to include the right of collective self-defense, which was not explicitly stated in the original version and hues more closely to the wording in the EU Code of Conduct.[48] Importantly, the revised PPWT continued to be limited to space-to-space and space-to-Earth forms of kinetic and non-kinetic weapons and would not limit Earth-to-space weapons.

In 2015, the European Union brought the revised Code of Conduct to the United Nations for multilateral negotiations. Russia, China, Brazil, India, and South Africa were among the most vocal opponents of the EU proposal. They argued, among other things, that the European Union's drafting process was not inclusive enough, despite years of open meetings and subsequent revisions to the proposal. Ultimately, the Code of Conduct failed to gain consensus and stalled at the United Nations.

A non-governmental organization, the Women's International League for Peace and Freedom, weighed into the debate in 2015 with a letter to the UN Conference on Disarmament. The group voiced support for efforts to prevent the weaponization of outer space and lamented that little progress had been made. As examples, it cited that "some countries continue to research, design, test, and deploy 'missile defense' systems and antisatellite technologies," implicitly defining space

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46 United Nations, *Report of the Ground of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities* (New York: July 13, 2013), 6, https://undocs.org/A/68/189.

47 "Draft International Code of Conduct for Outer Space Activities," Council of the European Union.

48 "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects" (draft).

weapons to include these systems. The letter also pointed to the tensions that exist between states that have robust space capabilities and those that do not in negotiating international agreements such as the EU Code of Conduct.[49]

In December 2015, the UN General Assembly passed resolution 70/27 on weapons in outer space. The resolution "urged" the commencement of negotiations on the Chinese-Russian PPWT and encouraged states to uphold a "political commitment not to be the first to place weapons in outer space." The resolution specifically cited Argentina, Armenia, Belarus, Brazil, Cuba, Indonesia, Kazakhstan, Kyrgyzstan, Russia, Sri Lanka, Tajikistan, and Venezuela as having already stated that they would not be the first to place weapons in outer space.[50] Moreover, Russia and Venezuela issued a joint statement to the UN Conference on Disarmament saying that they "will not be the first to deploy any type of weapon in outer space and will do their utmost to prevent outer space from being turned into a theatre for military confrontation and to ensure security in outer space activities."[51] Such statements imply that these nations believe weapons have not already been placed in space. Given the description in Table 1 of different types of space weapons and those that have already been tested or demonstrated, these statements may simply be duplicitous or may indicate that these nations have a narrower view of what a space weapon is.

49 "Statement to the Informal CD Civil Society Forum on Outer Space," Women's International League for Peace and Freedom, March 19, 2015, 1, http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/cd/2015/statements/part1/19March_WILPF-OuterSpace.pdf.

50 "No first placement of weapons in outer space," United Nations Resolution 70/27, December 7, 2015, https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/409/53/pdf/N1540953.pdf?OpenElement.

51 "Letter from the Permanent Representatives of the Bolivarian Republic of Venezuela and the Russian Federation to the Secretary-General of the Conference on Disarmament," United Nations, April 4, 2016, https://undocs.org/pdf?symbol=en/CD/2060.

Recent Activities and Statements

NON-GOVERNMENTAL ORGANIZATIONS

Given the increased economic and military dependence on space and the increased development and proliferation of counterspace weapons, several non-governmental organizations have begun working to define and potentially limit the use of space weapons. Two of these efforts are of interest because they focus specifically on the military uses of space and what constitutes an act of war or aggression in space. In May 2016, McGill University's Center for Research in Air and Space Law initiated a project to develop a Manual on International Law Applicable to Military Uses of Outer Space, known as MILAMOS. The objective of MILAMOS is to create a manual that "clarifies the fundamental rules applicable to military uses of outer space by both States and non-State actors in times of peace and in periods of rising tensions." Funding for the project comes primarily from McGill University and the Canadian government, and the project includes partnering institutions from other countries, such as the Beijing Institute of Technology in China, the Saint Petersburg State University in Russia, and the Institute for Defense Studies and Analysis in India.[52] Although its initial deadline was 2019, work on the manual is still in progress.

Work is also underway on a similar project known as Woomera, named for the Woomera Test Range in South Australia. Like MILAMOS, Woomera aims to create a manual that summarizes how existing international law applies to military uses of space. Woomera is a collaboration among four universities: the University of Adelaide in Australia, the University of Exeter in the United Kingdom, the University of Nebraska College of Law in the United States, and the University of New South Wales in Australia.[53] The project is funded principally by the four universities involved, and it plans to produce a manual by 2021.

FRANCE

In September 2018, France publicly charged Russia with interfering with the operation of one of its satellites. The *Athena-Fidus* satellite is a jointly operated French-Italian military satellite that provides broadband military communications. France alleged that the Russian satellite, known as *Luch* or *Olymp-K*, maneuvered close enough to *Athena-Fidus* in 2017 to intercept military communications. The same Russian satellite was earlier accused of conducting similar close proximity operations with three different Intelsat commercial communications satellites.[54] The

52 McGill University, *Manual on International Law Applicable to Military Uses of Outer Space: Rules for Peacetime* (Montreal: December 2018), https://mcgill.ca/milamos/files/milamos/milamos-description_and_structure_dec2018.pdf.

53 University of Adelaide, *The Woomera Manual on the International Law of Military Space Operations* (Adelaide: October 2018), https://law.adelaide.edu.au/woomera/system/files/docs/Woomera%20Manual.pdf.

54 Kyle Mizokami, "France Accuses Russia of Space Satellite Espionage," *Popular Mechanics,* September 10,

alleged actions of the Russian *Luch* satellite could fall under the category of space-to-space non-kinetic weapons, depending on whether one considers intercepting communications to be a way of interfering with military operations. Maneuvering the satellite into close proximity with another satellite without prior coordination could also be interpreted as a threatening action, which would violate the Chinese-Russian PPWT prohibition on threats against outer space objects.

Following this public denunciation of Russian space activities, France issued a new Space Defense Strategy in 2019. Among other things, the French strategy calls for the creation of a Space Command under the Air Force and renaming the Air Force to be the Air and Space Force. The strategy notes that "renewed analysis of the space environment and its threats, risks and opportunities, as well as the recognition of the strategic nature of the space assets for France force our country to revisit its model in order to remain a leading space power." The strategy notes the need to develop a "space defense capacity" that will "enable the armed forces to impose a peaceful use of space, deter unfriendly or hostile acts against our space assets, and be able, as the case may be, to defend our space-based interests."[55]

France alleged that the Russian satellite, known as Luch or Olymp-K, maneuvered close enough to Athena-Fidus in 2017 to intercept military communications

French minister of defense Florence Parly spoke at some length about the change in space posture being implemented under the new strategy in a July 2019 speech. In some of the most direct and specific language by a government official from any nation on space defense, the defense minister said, "I want to be precise: active defence is not an offensive strategy, what it is about is self-defence." She went on to add that, "If our satellites are threatened, we will consider dazzling those of our opponents. We reserve the time and means of the response: this may involve the use of high-power lasers deployed from our satellites or from our patrol nano-satellites."[56]

JAPAN

Japan has also taken a more proactive approach to space defense, largely driven by threats it perceives from China's space activities. In its 2019 defense white paper, the Japanese Ministry of Defense notes that China is bolstering its ability to "restrict enemies' use of space" as part of its overall anti-access/area denial capabilities.[57] The document goes on to discuss the various counterspace activities and capabilities of other countries, including direct-ascent ASAT missiles, co-orbital "killer satellites," jammers, and laser ASAT weapons. It calls these developments a "risk to

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2018, https://www.popularmechanics.com/military/a23067892/france-charges-russia-with-space-satellite-espionage/.

55 French Ministry of Defense, *Defense Space Strategy Summary* (Paris: DICoD Publishing Office, July 2019), https://www.defense.gouv.fr/content/download/574375/9839912/Space%20Defence%20Strategy%202019_France.pdf.

56 Florence Parly, "Presentation of the Defense Space Strategy," July 25, 2019, English translation from gosnold, "France's new space defense strategy," SatelliteObservation.net, July 27, 2019, https://satelliteobservation.net/2019/07/27/frances-new-space-defense-strategy/.

57 Japanese Ministry of Defense, *Defense of Japan* (Tokyo: 2019), 58, https://www.mod.go.jp/e/publ/w_paper/2019.html.

the stable use of outer space" and "one of the critical security challenges for countries." Moreover, it notes that existing treaties and international agreements, such as the Outer Space Treaty, do not directly prohibit the destruction of space objects and the creation of space debris.[58] Although the white paper does not attempt to define space weapons, its discussion of space threats includes kinetic and non-kinetic Earth-to-space and space-to-space capabilities as part of what Japan considers to be a threat to peace and stability in space.

To protect its space systems, the white paper discusses various means of improving space control, such as bolstering its space situational awareness capabilities, passive defenses, and other measures to disrupt an adversary's command and control capabilities on the ground. It calls on the Japanese Self-Defense Forces to enhance cooperation with the United States and other countries in space and to set up a new organization, known as the Space Domain Mission Unit, within the Air Self-Defense Force that specializes in space defense.[59] More recently, Japanese prime minister Shinzo Abe announced that this new organization would be operational by April 2020. Citing Japan's need to bolster its defenses from adversary missiles and electromagnetic interference, Prime Minister Abe said this new organization will work closely with its American counterparts, the U.S. Space Force and U.S. Space Command. With a small core established in 2020, the Space Domain Mission Unit plans to be fully operational by 2022 and will be responsible for operating the ground stations necessary to conduct space defense operations.[60]

Japan is reportedly deciding whether or not to develop a co-orbital ASAT system that can "disable the operations of other countries' military satellites," using robotic arms, electronic attack, or cyberattack.

A senior ministry of defense official was also quoted in the press on the need for Japan to develop active defenses in space. The unnamed official was quoted as saying that the Self-Defense Forces "don't have any defense capability for the satellites." Japan is reportedly deciding whether or not to develop a co-orbital ASAT system that can "disable the operations of other countries' military satellites," using robotic arms, electronic attack, or cyberattack. It expects to make a decision on whether to begin such a program by the end of fiscal year 2020, with initial deployment of the system in the mid-2020s. According to the article, the Abe government has concluded that the type of defensive co-orbital ASAT system it is considering would be within the principals enshrined in the 2008 Aerospace Basic Law.[61] Article 14 of the Aerospace Basic Law states, "The State shall take necessary measures to promote Space Development and Use to ensure international peace and security as well as to contribute to the national security of Japan."[62]

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58 Ibid., 162.

59 Ibid., 219.

60 Mari Yamaguchi, "Japan reveals plan for space defense unit," *Defense News*, January 21, 2020, https://www.defensenews.com/space/2020/01/21/japan-reveals-plan-for-space-defense-unit/.

61 Yomiuri Shimbum, "Satellite interceptor sought by mid-2020s," Japan News, August 19, 2019, https://the-japan-news.com/news/article/0005948349.

62 Government of Japan, Basic Space Law (Law No. 43 of 2008), enacted May 21, 2008, http://stage.tksc.jaxa.jp/spacelaw/country/japan/27A-1.E.pdf.

INDIA

Over the past two decades, India has emerged as a significant space power. The Indian Space Research Organization (ISRO) has focused on developing space capabilities to advance India's economy, including the development of a fleet of reliable, indigenously produced launch vehicles and satellites. The ISRO is now one of the six largest space agencies in the world, and it uses space-based capabilities to deliver important services to its population, ranging from telemedicine to distance education.[63]

As a rising space power, India took note of the Chinese ASAT test in 2007. As one scholar noted, "It suddenly reminded them that their diverse space assets were now at risk, hostage to the dangers emanating from their most formidable regional threat." This led India to focus more on how to protect its space capabilities from the Chinese threat. Defense planners debated the merits of conducting a similar kinetic ASAT test to signal to China and other nations that India had the ability to retaliate in kind if its space assets were attacked.[64]

India does not believe the capability it demonstrated—an Earth-to-space kinetic ASAT—is a space weapon or represents the weaponization of space.

In 2019, India became the fourth nation to demonstrate an Earth-to-space kinetic ASAT weapon. On March 27, 2019, it launched a Prithvi Delivery Vehicle Mark-II (PDV MK-II) missile defense interceptor at one of its own satellites. The target satellite, *Microsat-R*, was launched specifically for this purpose on January 24, 2019, into a sun-synchronous orbit at just 282 km altitude. The first attempt to intercept the satellite failed on February 12, leading to the successful second attempt on March 27. The Indian ASAT test did not receive the same level of international outcry as the Chinese ASAT test, in part because it produced much less orbital debris. Because the intercept took place at a relatively low altitude and while the interceptor was on a downward trajectory, it appears that the Indian government was attempting to limit the potential for long-lasting orbital debris.[65] By the end of 2019, just 18 pieces of debris large enough to track remained in orbit.[66]

In a public address following the test, Indian prime minister Narendra Modi reiterated that "India has always been opposed to the weaponization of space and an arms race in outer space, and this test does not in any way change this position."[67] This statement would appear to indicate that India does not believe the capability it demonstrated—an Earth-to-space kinetic ASAT—is a space weapon

63 Ashley J. Tellis, "India's ASAT Test: An Incomplete Success," Carnegie Endowment for International Peace, April 15, 2019, https://carnegieendowment.org/2019/04/15/india-s-asat-test-incomplete-success-pub-78884.

64 Ibid.

65 Ibid.

66 Jonathan McDowell, Twitter post, December 27, 2019, 8:54 PM, https://twitter.com/planet4589/status/1210786046943739904.

67 Daniel Oberhaus, "India's Anti-Satellite Test Wasn't Really About Satellites," *Wired*, March 27, 2019, https://www.wired.com/story/india-anti-satellite-test-space-debris/.

or represents the weaponization of space. But Modi hinted at the true intent of India's actions, saying that by conducting the test "India registered its name as a space power."[68]

SOUTH KOREA

The Republic of Korea (ROK) issued a new defense white paper in 2018 that, among other topics, addresses the issue of space security. The paper states that, "the ROK Armed Forces will also build the capabilities and systems for effective response to cyber and space threats."[69] It established a new space organization within the Ministry of National Defense and is actively working to increase its cooperation with allies in space, namely the United States. In 2014, the United States and ROK signed a memorandum of understanding on the sharing of space situational awareness data, and in 2015, the Korean Air Force stood up a Space Intelligence Center to develop the "fundamental capabilities for space control." The Korean and U.S. militaries conducted joint tabletop exercises in 2017 that included "risky space situations over the Korean Peninsula, such as the jamming of navigation and communications satellite[s]."[70] While the Korean military does not appear to be developing defensive counterspace capabilities yet, its recent actions and policy statements indicate it is concerned about developments in the space domain and the use of weapons against its space assets in a conflict.

68 David Dickinson, "What India's Anti-Satellite Test Means for Space Debris," Sky & Telescope, April 5, 2019, https://www.skyandtelescope.com/astronomy-news/what-indias-anti-satellite-test-means-for-space-debris/.

69 Republic of Korea Ministry of National Defense, *2018 Defense White Paper* (Seoul: 2018), 47, http://www.mnd.go.kr/user/mnd/upload/pblictn/PBLICTNEBOOK_201907110548253080.pdf.

70 Ibid., 74-76.

Conclusions

Since the Outer Space Treaty was signed in 1967, little progress has been made in negotiating international agreements that would limit the testing, deployment, and use of weapons in outer space. The main sticking points are a lack of consensus on what constitutes a space weapon and mechanisms for verification and enforcement of an agreement. Competing definitions for key terms have proven to be a particularly difficult issue to overcome. Nations use phrases such as space weapons, the militarization of space, and the weaponization of space to mean different things at different times, often to suit their own geopolitical agendas. A common framework for discussing space weapons could be useful to establish and clarify thresholds among like-minded nations for what constitutes conflict and escalation in space.

This analysis finds that the way other nations view space weapons hinges on several key distinctions. The first distinction is between nuclear and conventional space weapons. An international taboo against the placement and use of nuclear weapons in space emerged early in the space age and endures through treaties that have garnered widespread support. However, no such consensus has emerged on the use or placement of conventional weapons in space. A second distinction is whether the weapon is stationed on Earth or in space. The Chinese and Russian PPWT proposal would only prohibit weapons that are stationed in space, while the European Union's proposed Code of Conduct would limit weapons stationed on Earth and in space. A third distinction is whether the weapon produces orbital debris. Much of the focus of the Code of Conduct and the stated motivation of many non-aligned states is on the prevention of orbital debris and the preservation of the space environment for peaceful uses. The actions in space that provoke the loudest protests by other nations tend to be those that create large amounts of orbital debris.

A final and more recent distinction in how nations view space weapons is whether the weapons are used for self-defense rather than for offensive purposes. The latest version of both the PPWT and Code of Conduct include exceptions for self-defense, and the Code of Conduct is more specific in delineating when the use of space weapons in self-defense is legitimate. France is perhaps at the forefront of this space self-defense movement, having announced publicly that it intends to field non-kinetic space-to-space weapons to defend its satellites. Japan also notes the need for improved self-defense capabilities in space, but it has not yet publicly endorsed active defenses. With its 2019 ASAT test, India made clear that it believes kinetic Earth-to-space ASAT weapons are a legitimate means of self-defense by deterrence. Yet many other nations, particularly in Latin America, continue to oppose any weapons in space, even if they are intended solely for self-defense.

In the United Nations, much of the focus on space weapons has been in the Conference on Disarmament and its efforts to prevent an arms race in space. But concern about preventing an arms race is based largely on the assumption that weapons in space would lead to instability and ultimately conflict. However, conflict could occur in space without an arms race, and an arms race in space could potentially lead to a stable deterrence posture that prevents conflict—just as the nuclear arms race between the United States and Soviet Union ultimately helped avoid nuclear war on Earth by making the consequences of war intolerable to both sides.

Efforts to place limits on the development of space weapons, create a code of conduct, or even establish norms of behavior in space have so far failed to gain consensus among the key nations needed for such an agreement to be effective, namely the United States, Russia, China, India, and the European Union. While discussions continue at the United Nations about preventing an arms race in space, the actions of some nations—namely Russia and China—are leading others to prepare for conflict.

About the Author

Todd Harrison is the director of Defense Budget Analysis and the director of the Aerospace Security Project at CSIS. As a senior fellow in the International Security Program, he leads the center's efforts to provide in-depth, nonpartisan research and analysis of defense funding, space security, and air power issues. He has authored publications on trends in the overall defense budget, military space systems, civil space exploration, defense acquisitions, military compensation, military readiness, nuclear forces, and the cost of overseas military operations.

Mr. Harrison joined CSIS from the Center for Strategic and Budgetary Assessments, where he was a senior fellow for defense budget studies. He previously worked at Booz Allen Hamilton where he consulted for the U.S. Air Force on satellite communications systems and supported a variety of other clients evaluating the performance of acquisition programs. Prior to Booz Allen, he worked for a small startup (AeroAstro Inc.) developing advanced space technologies and as a management consultant at Diamond Cluster International. Mr. Harrison served as a captain in the U.S. Air Force Reserves. He is a graduate of the Massachusetts Institute of Technology with both a BS and an MS in aeronautics and astronautics.

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United Nations Secretary-General António Guterres addresses the Conference on Disarmament's High-Level Segment 2019.

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