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Weaponization of the Final Frontier:

Security Challenges and Prospects of Regulations

Weaponization of the Final Frontier: Security Challenges and Prospects of Regulations

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While space weapons are not a new phenomenon, recent technological developments have significantly increased the destructive potential of space warfare. Space has been militarized for a while but has yet to be weaponized. The United States is poised to weaponize outer space and has created a Space Force – a move that threatens other countries such as China and Russia and is likely to trigger an arms race in outer space. Countries like India are also joining the race, posing a direct threat to Pakistan. This escalation will jeopardize global security and risk the weaponization of space, a global common. Existing space regulations need to be revised to address the new weapons being developed by major powers. Therefore, there is an urgent need to negotiate comprehensive international laws and treaties to prevent an arms race in outer space. The paper aims to assess these developments and the threat posed by space weapons and explore possible solutions through international law to mitigate this threat.

Keywords: Space Weapons, Hypersonic Missiles, Missile

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Introduction

The peaceful use of outer space has yielded enormous benefits to humanity over the past half-century. However, its increasing use for military purposes starkly contrasts its initial promise. While the militarization of space is not new, recent technological advancements have significantly enhanced the destructive potential of space warfare. States such as Russia and China have expressed growing concern over certain US weapons systems, which they perceive as threats to their space assets. These systems include the US Prompt Global Strike program (PGS), hypersonic missiles, and components of ballistic missile defense systems.

In 2016, Russian Deputy Foreign Minister Sergey Ryabkov voiced Moscow's apprehensions regarding the potential deployment of weapons in outer space. For nearly four decades, Russia and China have proposed negotiations on a treaty to prohibit all types of weapons in orbit or on celestial bodies and the use of force against space assets. However, the US has consistently declined to participate in such talks and has been proposing responsible use of outer space that implies not abiding by new international law instruments. In April 2020, Mr Ryabkov reiterated Russia's commitment to not being the first to place weapons in space, underscoring the persistent refusal of the US to engage in arms control negotiations for outer space. A joint statement was signed in 2019 pledging no first placement of weapons in outer space.[2]

The American reluctance to negotiate a treaty banning space weapons has raised an atmosphere of mistrust, prompting countries like China and Russia to assume the worst and develop their own defensive and offensive space systems. However, the

2 . "Pakistan and Russia sign Joint Statement on No First Placement of Weapons in Outer Space." Ministry of Foreign Affairs of Pakistan, May 22, 2019. Pakistan and Russia sign Joint Statement on No First Placement of Weapons in Outer Space (mofa.gov.pk).

US cites Russia and China's advancements to justify its offensive space developments, thereby initiating a renewed arms race in outer space, which is now considered the fourth domain of warfare. Even smaller states, such as India, are joining this race for status instead of security reasons, as evidenced by its Anti-Satellite Weapons (ASAT) test in March 2019.

These alarming developments have remained relatively peaceful over the decades. Examining the offensive and defensive space systems being developed by major powers, the current state of space regulation, and potential measures to regulate these systems is crucial. As a global common, maintaining the peaceful status of outer space is vital for peace, security, and sustainable development. This paper assesses the threat posed by space weapons and explores possible solutions through international law to mitigate this threat. The theoretical framework is the security dilemma theory, developed by John Herz. This theory posits that in a realist, self-help world, an increase in one country's power decreases the security of others, leading to a vicious cycle of power accumulation and heightened security concerns.[3]

In such scenarios, security becomes a zero-sum game that often results in arms races. The environment is particularly challenging in space, where satellites are inherently fragile and vulnerable. This vulnerability makes it easier to attack space assets than to protect them. States base their threat assessments on the adversaries' capabilities rather than their intentions. Consequently, the development of offensive technology in space is driven by the need to stay ahead of adversaries. Characterized by action-reaction dynamics, this situation epitomizes a classic security dilemma.

3 . Herz, John. "Idealist Internationalism and the Security Dilemma." World Politics, vol. 2, 1950; Buzan, Barry. Herring, Eric. "The Arms Dynamics in World Politics." (London: Lynne Rienner Publishers, 1998); Evera, Stephen Van "Offense, Defense, and the Causes of War." *International Security*, Vol. 22, No. 4, 5–43, Jervis, Robert. "Cooperation under the Security Dilemma." *World Politics*, Vol. 30, No. 2, 1978, 167–214.

Space Weapons

The concept of space weapons lacks a universally agreed-upon definition due to the dual-use nature of most space technology. Such technologies can have civilian applications as well as adaptations for military use. Systems may have offensive purposes or defensive capabilities, further complicating the definition of space weapons. A wide range of systems can fall under this definition, making the matter of defining space weapons more complex. For instance, military space satellites can be used for navigation, intelligence, surveillance, reconnaissance (ISR), and guided weapons systems. Some systems can be deployed in space to target objects both in space and on Earth.

Broadly, space weapons are defined as those placed in space or on Earth, capable of striking targets in space, and systems that traverse outer space. This includes satellites capable of firing lasers or launching rockets from Earth into Low Earth Orbit (LEO). Several countries possess these capabilities, including the US, France, Russia, China, India, Ukraine, and Japan. More than fifty countries, including Pakistan, have some space satellites in orbit. Many countries possess space reconnaissance satellites or satellites used for military purposes, including the US, Russia, China, France, Germany, India, Italy, Japan, and Israel.

Space weapons can be categorized into three broad types:

Space Strike Weapons (SSW)*:* These include Directed Energy Weapons (DEW) like lasers and kinetic energy weapons, designed to destroy targets in space, on land, in the air, and at sea.

ASAT*:* These can damage or destroy satellites and can be based on land, in the air, at sea, or in space. Several countries, including the US, China, Russia, Japan, India, and Israel, have developed hit-to-kill systems intended for ASAT missions or missile defense, and these systems are categorically considered space weapons.

Ballistic Missile Defense (BMD) Systems and Hypersonic Missiles: The US BMD initiative includes space-based components that utilize destruction methods such as lasers, kinetic kill vehicles, or interceptors. Although designed to neutralize incoming missiles, these systems can also target objects in space, air, or ground, thus falling under the space weapons category. Likewise, Russia, Israel, France, China, India, and some other states are working on BMDs.

Space Weapons Competition

Over the years, states have increasingly competed for dominance in outer space. The US is developing offensive systems in space, while Russia and China are developing offensive and counter-offensive capabilities. India has demonstrated ASAT capabilities and is increasingly developing military space capabilities. This may tempt other states to develop similar strike capabilities, exacerbating a security dilemma among major powers and leading to an arms race in outer space.

US Space Ambitions

The US has actively worked on offensive space systems and ASAT weapons for decades. Various US policy iterations have asserted that, given the multitude of satellites and other assets in space, the US needs to dominate and control the space domain to safeguard its assets. These iterations span several decades and are championed by leaders like Secretary of Defense Donald Rumsfeld, who asserted that the weaponization of space is inevitable and the US must not wait to suffer a "Space Pearl Harbor."[4]

The US is concerned about the vulnerability of its space assets vis-à-vis Russia and China's rising power, believing that space dominance is crucial for space security. Concepts such as space deterrence are infiltrating its space doctrine.[5] The

4. Krepon, Michael. 'Weapons in the Heavens: A Radical and Reckless Option.' Arms Control Today 34, no. 9 (2004): 11-18.

5. MacDonald, Bruce W. 'China, Space Weapons, and U.S. Security.' Council Special Report No. 38, September 2008, p.19. https://cdn.cfr.org/sites/default/files/pdf/2008/07/China_Space_CSR38.pdf.

doctrinal emphasis on dominating the space arena and the programs pursued by the US to support these goals are causing concern worldwide, especially among US competitors like Russia and China.

The US is actively working on several offensive space systems. DEWs, which utilize lasers or high-powered microwaves to damage or destroy adversaries' satellites or other space-based assets, are a significant focus area. The US Air Force has been experimenting with DEW technologies for potential anti-satellite capabilities.

Another initiative is the Magneto Hydrodynamic Explosive Munition (MAHEM), which uses electromagnets to propel molten metal and is designed to be mounted atop a missile. Additional laser weapons include those that can be attached to aircraft, such as the Active Denial Technology, which uses electromagnetic waves, and the Tactical High Energy Laser (THEL), designed to detonate targets with directed energy.[6] These laser weapons are cost-effective, precise, and useful against smaller threats.

The US also maintained an ASAT program called Kinetic-Energy ASAT under the Army in 1989.[7] This program envisions ground-based interceptors that could be launched through Intercontinental Ballistic Missiles (ICBMs) to attack satellites. It is working on kinetic energy weapons, also known as "rods from god," involving dropping large projectiles from space onto targets on Earth's surface. These weapons use the energy of their high-speed impact to cause destruction.

Additionally, the US has invested in microsatellites, which can function as ASATs. Weighing less than 100 kilograms, these satellites include the Experimental Satellite Series (XSS), with

6. Al-Rodhan, Nayef. "Weaponization and Outer Space Security." Global Policy Journal, March 2018. https://www.globalpolicyjournal.com/blog/12/03/2018/weaponization-and-outer-space-security.
7. "Ground-Based Weapons: Kinetic Antisatellite Weapons – Space Security Index." April 23, 2020.https://spacesecurityindex.org/2020/04/ground-based-weapons-kinetic-antisatellite-weapons/.

XSS-10 launched in January 2003[8] and XSS-11 designed to conduct proximity operations with multiple space objects. Although these dual-use satellites have the primary function of inspecting and servicing satellites, they could also serve as effective space weapons.

The US Missile Defence Agency (MDA) is developing space-based elements of missile defense that essentially function as space weapons. Two such systems are the space-based laser and kinetic energy-based hit-to-kill systems. The US is also pursuing BMD systems with interceptors capable of destroying targets in space, air, or on the ground. It has been actively pursuing the deployment of missile defense interceptors in space to enhance the ability to defend against long-range missile threats. However, this initiative has faced opposition from nations like Russia and China, who fear it could neutralize their nuclear deterrent capabilities.

In collaboration with the US Space Development Agency (SDA), the MDA is developing a hypersonic missile defense system to counter emerging threats like hypersonic missiles. This system includes the Proliferated Warfighter Space Architecture (PWSA) tracking and transport layers, which encompasses several interceptor programs. The transport layer is envisaged as a constellation of approximately 300-500 satellites, with a requested budget of USD 1.8 billion in fiscal year (FY) 2024.[9]

Hypersonic missiles are a new class of weapons capable of traveling at least Mach 5 and can avoid detection and interception by missile defense systems. These missiles are considered systems that can be used against space assets. The US, Russia, China, and India are developing these missiles, with Russia, the US, and China already having deployed them.[10]

8. "XSS-10 Micro Satellite - Aerospace Technology." January 30, 2024. https://www.aerospace-technology.com/projects/xss-10microsatellite/.
9. Sayler, Kelley M. "Hypersonic Missile Defense: Issues for Congress." *Congressional Research Service*, August 21, 2023. https://sgp.fas.org/crs/weapons/IF11623.pdf.
10. Jalil, Ghazala Yasmin. "Hypersonic Missile Race: Implications for Regional and Global Security." *Issue Brief*, October 2, 2020. https://issi.org.pk/issue-brief-on-hypersonic-missile-race-implications-for-regional-and-global-secu-

Thus, the race for hypersonic and counter-hypersonic missiles is underway.

With a requested budget of USD 30 billion for the Space Force in FY 2024[11] and a space economy worth USD 211.6 billion in 2021, the US has made significant investments in space.[12] Of an estimated 6,718 active satellites orbiting the Earth by December 2022, the US owns 4,529, or roughly 67 percent. Among these, 247 are military satellites,[13] making the country the most vulnerable to space weapons. Therefore, states with the most space assets also have the highest interest in securing outer space. The real question is why, then, do states like the US choose to develop more space weapons instead of pursuing arms control?

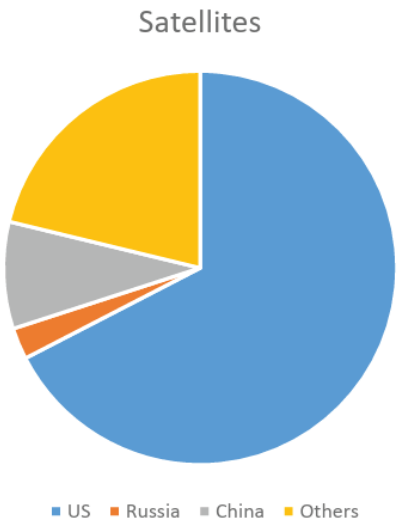

Figure 1: Satellites Owned by States[14]

rity/.
11. Erwin, Sandra. "U.S. Space Force budget hits $30 billion in 2024 proposal." *Space News*, March 13, 2023. https://spacenews.com/u-s-space-force-budget-hits-30-billion-in-2024-funding-proposal/.
12. Highfill, Tina and Chris Surfield. "New and Revised Statistics for the U.S. Space Economy 2012–2021." Survey of Current Business. June 27, 2023.
13. "Satellite Database." Union of Concerned Scientists, Dec 31, 2022. https://www.ucsusa.org/resources/satellite-database.
14. "Satellite Database | Union of Concerned Scientists." January 30, 2024. https://www.ucsusa.org/resources/satellite-database.

Space Capabilities of Russia and China

The US pursuit of space weapons has increased the security dilemma for its major adversaries, China, and Russia. They are actively developing offensive and defensive technologies to protect their space assets and to hold the adversary's systems at risk. Taking hypersonic missiles as an example, which heavily rely on satellites for their flight and targeting, China and Russia are developing technologies to manage the development of US satellites. This includes strategies to blind military command and disrupt the targeting and guidance capabilities of hypersonic missiles.

Russia, threatened by the US space weapons development trajectory, created the Aerospace Defence Forces in 2015. Among several tasks, this organization is responsible for space facilities, observing and detecting threats against Russia from space and in space, and countering such threats. It is also responsible for spacecraft launch and control of military and dual-purpose satellite systems.[15]

Russia has been developing and fielding its space-based weaponry and ASATs, which include satellites capable of firing projectiles at other satellites and space assets. Russia has worked on ASAT systems and conducted ten tests of ground-launched anti-satellite systems. The US protested the latest test in November 2021, stating that it threatened space assets and created space debris that could harm satellites and space stations. Russia possesses DEW, including terrestrial-based lasers capable of blinding or destroying satellites, space-based microwave weapons, and electronic warfare nuclear-powered satellites. The US and China also possess these weapons. Russia reportedly has "nesting doll" or "Matryoshka" killer satellites. It launched the satellite KOSMOS-2542 in November 2019, which later released a sub-satellite that carried out a series of maneuvers close to a US spy satellite.[16]

15. "Missions: Ministry of Defence of the Russian Federation." January 30, 2024. https://eng.mil.ru/en/structure/forces/aerospace/mission.htm.
16. Jalil, Ghazala Yasmin. "Russian ASAT Test Heralds Hastening Arms Race in Outer Space." *Issue Brief*, January 7, 2022. https://issi.org.pk/wp-content/up-

Russia launched Kosmos-2535 and Kosmos-2536 satellites in July 2019, suspected of operating beyond their official mission, and conducted proximity activity around their satellites.[17] While Russia officially denied any offensive activity surrounding these satellites operations, it may be developing satellites capable of close-proximity maneuvers.

The US accused Russia of conducting a non-destructive ASAT test in July 2020, using Kosmos 2543 to launch a projectile. Commander of US Space Command General John Raymond stated that it was "consistent with the Kremlin's published military doctrine to employ weapons that hold US and allied space assets at risk."[18]

In April 2020, Russia launched and tested the PL-19 Nudol direct-ascent anti-satellite (DA-ASAT) interceptor missile into low orbit. Operating in LEO, it can move between orbital paths and threaten satellites in multiple orbital paths.[19] Russia can also electronically disrupt satellite communications. Using remote-sensing capabilities, Russian satellites can potentially disrupt military and civilian satellite communications and navigation systems.

China is concerned that the US is pursuing a "Space Control" strategy. Over the years, US military planning documents have envisioned US control of space and global military superiority using weapons in or from space. Official US statements propose responding with the forceful domination of space and denying access to adversaries.

loads/2022/01/IB_Ghazala_Jan_7_2022.pdf.

17. Unal, Dr. Beyza and Mathieu Boulègue. "Russia's Behaviour Risks Weaponizing Outer Space." Chatham House, Comment, July 27, 2020. https://www.chathamhouse.org/2020/07/russias-behaviour-risks-weaponizing-outer-space.

18. O' Callaghan, Jonathan. "Russia Accused of Firing 'Anti-Satellite Weapon' From One Of Its Satellites In Space." *Forbes*, July 24, 2020. https://www.forbes.com/sites/jonathanocallaghan/2020/07/24/worrisomerussia-accused-of-firing-a-projectile-in-space-from-one-of-its-satellites/?sh=5897755665a5.

19 Blatt, Talia M. "Anti-Satellite Weapons and the Emerging Space Arms Race." Harvard International Review, May 26, 2020. https://hir.harvard.edu/anti-satellite-weapons-and-the-emerging-space-arms-race/.\\uc0\\u8221{}.

Thus, China is worried that through space weaponization, Washington seeks to render China's nuclear deterrence ineffective. This can also allow the US to intervene in Chinese affairs and coerce it, especially regarding the Taiwan issue.[20] China fears that US space weaponization plans would inevitably lead to an arms race in outer space. When threatened by US weaponization, adversaries are bound to develop offensive measures.

China tested an ASAT in 2007[21] when it launched a ballistic missile armed with a kinetic kill vehicle that destroyed a defunct weather satellite in LEO. Reportedly, in October 2021, China tested a Fractional Orbital Bombardment System (FOBS), a platform capable of placing weapons and hypersonic glide vehicles in LEO with the capability to deorbit above a target. It can also defeat early warning systems.

Also, India has reportedly tested an array of anti-satellite concepts, including spacecraft with the ability to engage other satellites and de-orbit them, land-based ASATs, DEW such as lasers,[22] and several "scavenger" satellites which use grappling arms to capture other satellites. It has also demonstrated the capability to maneuver a satellite around the geosynchronous orbit.[23]

The US has asserted China is developing co-orbital anti-satellite systems, ground-based satellite jammers, and DEW. The co-orbital satellites can be armed with explosive charges, fragmentation devices, kinetic energy weapons, lasers, radio

20. Podvig, Pavel and Hui Zhang. "Russian and Chinese Responses to U.S. Military Plans in Space." American Academy of Arts and Sciences, 2008. https://www.amacad.org/publication/russian-and-chinese-responses-us-military-plans-space.
21. "Chinese_asat_fact_sheet_updated_2012.Pdf." January 30, 2024, https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf.
22. Tingley, Brett. "The Pentagon Is Worried About Space Weapons from Russia and China. Here's Why." September 1, 2022. https://www.space.com/pentagon-worried-space.
23. Bowman, Bradley. Jared, Thompson. "Russia and China Seek to Tie America's Hands in Space." Foreign Policy, March 31, 2021. https://foreignpolicy.com/2021/03/31/russia-china-space-war-treaty-demilitarization-satellites/.

frequency weapons, jammers, or robotic arms, which can be used to disable, destroy, or interfere with enemy satellites. China's Shenzhou 7 spacecraft launched in September 2008, the SJ–12 satellite launched in June 2010, and the CX–3, SY– 7, and SJ–15 satellites launched in July 2013 reportedly all fit into the US offensive co-orbital space category.[24]

India's Space Capabilities

India possesses an advanced space program that includes dedicated military satellites, and satellites for civil- and dual-use applications. It also boasts an array of space launch vehicles used to launch these satellites. India intensified its efforts to develop military-oriented space capabilities.

In 2010, India established the Integrated Space Cell (ISC), a central agency jointly operated by the Indian Space Research Organization (ISRO), the Department of Space, and the armed forces. Its primary purpose was to oversee the military use of the country's space assets and safeguard them.[25] The Indian armed forces increasingly rely on satellites for communication, missile guidance, reconnaissance, and surveillance; the ISC oversees and coordinates all these activities.

India's civilian space program has many military applications. Its space assets include the Indian Remote Sensing Satellites (IRS), constituting the world's largest constellation of remote-sensing satellites. Although made for civilian use, these dual-use satellites can also serve for military purposes. Many have a spatial resolution of less than one meter, and some are equipped with panchromatic cameras and synthetic aperture radars (SAR), providing scene-specific spot imagery for military use.

With the launch of the Cartosat and Risat series, and its naval satellites, India now possesses nearly two dozen dedicated

24. Khan, Ahmad. Eligar, Sadeh. "Introduction: Space Power and Security Trilemma in South Asia." Astropolitics, March 26, 2019. https://doi.org/10.1080/14777622.2019.1589996.

25. Chopra, Air Marshal Anil. "India's Military Space Program." South Asia Defence and Strategic Review, Vol. 11, Issue 5, December 2017. https://capsindia.org/wp-content/uploads/2022/08/Anil-Chopra.pdf.

military satellites. These satellites provide formidable reconnaissance and surveillance capabilities, particularly over neighboring countries like Pakistan. They give the Indian armed forces a significant advantage in real-time communication and surveillance, providing an edge over the adversaries in the advent of conventional or nuclear warfare. This has significant implications for Pakistan, which perceives its primary security threat from India due to the latter's constant aggression and military advancements.

India has also demonstrated offensive capabilities in space. It joined the ASAT race by conducting a test in March 2019, using a Prithvi missile to destroy one of its satellites in LEO. India claimed the test was purely for "defensive purposes," using missile defense technology.[26]

Indian Prime Minister Narendra Modi announced the test in a televised address, declaring India a space superpower. The announcement, made just two weeks ahead of the Indian elections, was primarily aimed at boosting Modi's electoral popularity.

While the US criticized China's 2007 ASAT test, the condemnation of the Indian test was muted. This was partly because India falsely claimed to create less debris and partly because the US perceived India as a strategic partner, indirectly risking encouragement for more countries to conduct ASAT tests.

In response to the Indian attempt, Pakistan's Foreign Ministry issued a statement against Indian militarization of space, asserting, "Space is the common heritage of mankind, and every nation has the responsibility to avoid actions which can lead to the militarization of this arena."[27] India's demonstrated capability to destroy other countries' satellites poses a threat to Pakistan and heightens its security dilemma vis-à-vis India.

26. Langbroek, Marco. "Why India's ASAT Test Was Reckless." The Diplomat, April 30, 2029. https://thediplomat.com/2019/05/why-indias-asat-test-was-reckless/.
27. "Pakistan urges no militarization of space after India tests anti-satellite missile." Reuters, March 27, 2019. https://www.reuters.com/article/idUSKCN1R8154/.

India's military space program has implications for Pakistan's security and the fragile strategic balance of South Asia. India's space-based reconnaissance, surveillance, navigation, and communication capabilities add a new dimension to the military equation in South Asia. India's domination of this fourth medium of warfare can potentially undermine deterrence between the two nuclear-armed adversaries, affecting outcomes in conventional wars and directly threatening Pakistan's security. For instance, India's space-based assets give its nuclear forces an edge in their deterrence equation with Pakistan as well. India's dedicated military satellites can provide around-the-clock reconnaissance capability for Pakistan's military and nuclear installations. Such targeting information would be ideal for a counterforce strike.

India's network of military and dual-use satellites gives it an edge in tracking the movements and positions of Pakistan's armed forces. This technological advantage can be used for both tactical and strategic purposes in the event of war. For instance, Indian satellites with high-resolution imagery and superior intelligence, navigation, and surveillance undermine Pakistan's defenses.[28] With the ability to monitor Pakistani forces along the borders, Pakistan loses the element of surprise in the event of a conventional strike.

India's space-based assets also enhance its conventional superiority over Pakistan. According to the Indian Land Warfare Doctrine (LWD) 2018, Indian space assets are to be utilized and enhanced to support its conventional deterrence against opponents – and India's most significant opponent is Pakistan, as reflected in its intentions, military doctrines, and actions. The document emphasizes the integration of space-based assets with ground-based weapons platforms as a priority development.

28. Mansoor, Raja. "Pakistan Is Losing the Space Race." The Diplomat, February 1, 2018. https://thediplomat.com/2018/02/pakistan-is-losing-the-space-race/.

Additionally, the LWD highlights the surveillance of borders to provide input for planning operations. The document also advocates for the development of microsatellites for the Army on a demand basis.[29] LWD promotes the Cold Start Doctrine (CSD) style incursions or surgical strikes and seeks to maintain escalation dominance to achieve deterrence by punishment. In response, Pakistan developed Short-Range Low-Yield Weapons to counter Indian CSD, thereby "pouring hot water over Cold Start," as said by Lieutenant General Khalid Kidwai, former Director General of Pakistan's Strategic Plans Division.

An Indian analyst observes, "If New Delhi acquires dedicated military reconnaissance satellites that provide daily coverage of Pakistan's military installations, it will obtain a better counterforce capability versus Pakistan... Pakistan's nuclear arsenal is itself small and concentrated at a few locations, and India's limited capabilities are, therefore, sufficient for a first-strike mission against these few crucial targets. Ultimately, deterrence rests on perceptions and capabilities, even if it does not intend to launch a first strike. New Delhi still has the capabilities to undertake a first strike against Islamabad's nuclear assets and delivery systems."[30] Hence, India is moving towards counterforce targeting. This is also in contrast to the Indian No First Use (NFU) doctrine.

This may encourage a pre-emptive strike tendency on India's part, with the belief that it can destroy Pakistan's nuclear assets. Other analysts also believe that the war-fighting advantage provided by India's space-based capabilities "is likely to create incentives for India to attempt a decapitating first strike in case of a crisis with Pakistan."[31] It creates a use-it-or-lose-it dilemma for Pakistan, making Pakistan's nuclear arsenal and, thereby, its

29. "Indian Army Land Warfare Doctrine 2018." p. 25. http://www.ssri-j.com/MediaReport/Document/IndianArmyLandWarfareDoctrine2018.pdf.
30. Mistry, Dinshaw. "The Geo-strategic Implications of India's Space Programme." *Asian Survey* Vol. 41, no. 6 (2001), p.1039. https://www.jstor.org/stable/10.1525/as.2001.41.6.1023.
31. Khan, Sameer Ali. Irteza, Imam. "Outer Space and Strategic Stability in South Asia." *Astropolitics* 17, no. 1 (2019): 4. https://www.tandfonline.com/doi/full/10.1080/14777622.2019.1578936.

nuclear deterrence vulnerable.

Indian space capabilities affect South Asia's deterrence dynamics and strategic stability, and such technological advancements directly impact the balance of power.[32] This heightens Pakistan's threat perceptions and security dilemma, decreasing deterrence stability in South Asia and undermining strategic stability.

Implications for Security

The militarization and weaponization of outer space present several security challenges, including an arms race where great powers respond to each other's offensive capabilities by developing offensive and counter-offensive powers of their own.

The creation of space debris due to offensive activities in space threatens all space assets. Space systems may also be linked to advertent or inadvertent nuclear escalation. Developing and deploying offensive systems in outer space will likely set off an arms race. Today, economies and militaries worldwide rely on space-based assets – the US military relies heavily on them to secure qualitative superiority over adversaries. Satellites are a vital element of US ballistic missile defense, helping to detect and track enemy missiles.

Thus, the US, with the largest assets in outer space, is most vulnerable. US vulnerability and its efforts to achieve space dominance heighten threat perceptions of China and Russia, which are developing counter-space systems. This is setting off an arms race in offensive and defensive space systems.

In space, it is much easier to attack a target rather than defend one. Thus, it is easier to hold the adversary's systems at risk with ASATs or offensive systems than to defend them. Space is thus "offense-dominant." Weapons deployment in space is more effective than defensive measures like making satellites

32. Arif, Misbah. "Strategic Landscape of South Asia and Prevention of Arms Race in Outer Space." *Astropolitics* 17, no. 1 (2019): 8. https://www.tandfonline.com/doi/full/10.1080/14777622.2019.1578934.

resistant to jamming or improving GPS. States prepare against the adversary's capabilities and work with worse-case scenarios. This is also true in outer space, and constant technological developments and counter-developments by adversaries like the US, China, and Russia are classic cases of security dilemma.[33]

The increasing competition between the US and China and the resurgence of the Cold War rivalry between the US and Russia is also playing out in outer space, resulting in a hastening of arms race in this domain. Countries like India are trying to become major players in outer space by developing military assets and ASAT capabilities in space. This will likely threaten countries like Pakistan that utilize space assets for civilian purposes.

Major powers like China, Russia, and the US have integrated space systems into their nuclear deterrence architecture, such as communication, missile early warning systems, ISR, and navigation. With increasing counter-space capabilities, there is a risk that these systems can be vulnerable to attack or interference through direct-ascent and co-orbital ASAT weapons, DEW, electronic interference, and cyber operations.[34] Thus, there is a direct linkage between space systems and nuclear escalation. Additionally, the risk that major powers may be drawn into war through regional conflicts and great power competition is heightened.

Another major threat to space assets is the increasing presence of space debris. Human activities, ASATs, and deployment of offensive systems contribute to the accumulation of debris in space. This debris travels at tremendous speeds and poses a serious risk to satellites and space stations. Estimates suggest that the near-Earth space may have about 36,500 pieces of

33. Johnson-Freese, Joan and David Burbach. "The Outer Space Treaty and the Weaponization of Space." Bulletin of the Atomic Scientists 75, no. 4 (2019): 137-141. https://www.tandfonline.com/doi/full/10.1080/00963402.2019.1628458.
34. Raju, Nivedita and Tytti Erästö. "The Role of Space Systems in Nuclear Deterrence." SIPRI Background Paper, September 2023. https://www.sipri.org/sites/default/files/2023-10/the_role_of_space_systems_in_nuclear_deterrence.pdf.

debris larger than 4 inches, 1 million pieces under 4 inches, and 130 million smaller than 0.4 inches.[35]

The US Global Space Surveillance Network (SSN) sensors regularly track over 28,160 pieces of debris. SSN tracks pieces 5-10 centimeters in LEO and 30 centimeters to 1 meter in geostationary (GEO) orbit.[36] Larger debris can be catastrophic to satellites and space stations, but smaller pieces can cause significant harm. A recent ASAT test by Russia in 2021 created some 1500 pieces of traceable debris, while the Indian test produced about 400 pieces of debris.[37] The potential space weaponization could exacerbate the space debris problem, especially with plans from the US and others to deploy a larger number of space weapons.

Some estimates suggest that in fifty years, the proliferation of debris might reach a point where launching additional satellites becomes unfeasible. Much like climate change, the issue of space debris is critical. If humanity wishes to continue benefiting from the use of outer space, addressing this growing problem is essential.

Space Regulations

A basic legal framework exists to address space-related issues. This section examines relevant international treaties and initiatives. The existing space law only bans the placement of nuclear weapons in space, leaving other types of weapons unregulated. Moreover, the existing space regulations must be updated to adequately address the challenges posed by new technologies and the deployment of offensive weapons in space.

35. Pultarova, Tereza. "How Many Satellites Can We Safely Fit in Earth Orbit?" N2YO, February 27, 2023. https://www.n2yo.com/satellite-article/How-many-satellites-can-we-safely-fit-in-Earth-orbit/86.
36. "About Space Debris," https://www.esa.int/Space_Safety/Space_Debris/About_space_debris.
37. Davenport, Kelsey. "Indian ASAT Test Raises Space Risks." *Arms Control Association*, May 2019. https://www.armscontrol.org/act/2019-05/news/indian-asat-test-raises-space-risks.

The Limited Test Ban Treaty

The Limited Test Ban Treaty (LTBT) of 1963 is one of the earliest treaties. Its Article 1 prohibits "any nuclear weapons test explosion or any other nuclear explosion from being carried out in the atmosphere or beyond its limits, including outer space."[38] The LTBT thus bans nuclear testing in outer space. This can be interpreted as having a normative connotation against placing or testing nuclear weapons in outer space. It does not cover any ASAT, lasers, or kinetic kill weapons.[39] Overall, the treaty was meant to put an end to nuclear testing in outer space but does not regulate space weapons per se. It came at a time when both the US and the former Soviet Union conducted nuclear tests in the atmosphere and space.

Outer Space Treaty

The second most crucial treaty regarding space is the Outer Space Treaty (OST) of 1967. This is the most robust and substantive international law dealing with weapons in outer space. Article IV of the treaty prohibits party states from "placing in orbit around the earth any objects carrying nuclear weapons or any other kinds of WMD, install such weapons on celestial bodies, or station such weapons in outer space in any other manner."[40] It also states that "the establishment of military bases, installations and fortifications, the testing of any type of weapons, and the conduct of military maneuvers on celestial bodies" are prohibited.[41] The OST prohibits the placement of nuclear and other weapons of mass destruction in outer space and on other celestial bodies but does not prohibit conventional weapons like laser and kinetic kill weapons or other ASATs.

The Moon Agreement

The 1979 Moon Agreement puts limits on military activities on the Moon. The agreement bans the testing and use of all

38. "Limited Test Ban Treaty." https://www.armscontrol.org/treaties/limited-test-ban-treaty.
39. "Limited Test Ban Treaty."
40. "Outer Space Treaty." https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.
41. "Outer Space Treaty."

kinds of weapons, including weapons of mass destruction on the Moon. It also bans using weapons from the Moon against the Earth and space assets. The Moon agreement is limited in scope and efficacy due to limited adherence. Only nineteen countries, including Pakistan, have ratified it, while six have signed. India has signed but not ratified.[42]

Anti-Ballistic Missile Treaty

The Anti-Ballistic Missile (ABM) Treaty concluded between the US and the former Soviet Union in 1972, restricted ground, sea, air, and space-based anti-ballistic missile systems and prohibited the placement of BMD systems in space. The US withdrew from the treaty in 2002 to develop unchecked BMD systems as well as its space-based components.[43]

Recent ASAT Testing Ban Efforts

In April 2022, the US declared a voluntary self-imposed ban on destructive kinetic-energy ASAT weapons testing. Announcing the ban, US Vice President Kamala Harris called on all nations to join. She said the US would "work with other nations to establish this as a new international norm for responsible behavior in space."[44] Seven countries formally committed to the initiative, including Canada, New Zealand, Japan, Germany, the UK, and South Korea. In contrast, France and Ireland have informally committed.

In October 2022, the US introduced a resolution on the ASAT test ban in the UN General Assembly (UNGA), approved by 154 votes and denounced by Belarus, Bolivia, China, Cuba, Iran,

42. "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies." United Nations Office for Outer Space Affairs. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html.
43. "Anti-Ballistic Missile Treaty." Fact Sheet, Center for Arms Control and Non-Proliferation. Treatyhttps://armscontrolcenter.org/wp-content/uploads/2017/05/ABM-Treaty-Fact-Sheet.pdf.
44. Panda, Ankit. Benjamin, Silverstein. "The U.S. Moratorium on Anti-Satellite Missile Tests Is a Welcome Shift in Space Policy." Carnegie Endowment for International Peace, April 20, 2022. https://carnegieendowment.org/2022/04/20/u.s.-moratorium-on-anti-satellite-missile-tests-is-welcome-shift-in-space-policy-pub-86943.

Nicaragua, and the Russian Federation, as "insufficient."[45]

Prevention of Arms Race in Outer Space

China and Russia have been advocates of a Treaty on the Prevention of an Arms Race in Outer Space (PAROS). They submitted the first draft of the treaty to the UN Secretary General in 1981 and the Conference on Disarmament (CD) in 1983. Later, a draft treaty was presented to the CD in 2008 and 2014. However, the US-led bloc opposes the negotiation of a legally binding treaty that prohibits weapons in outer space and may put a check on its space domination ambitions.[46] Thus, negotiations have remained deadlocked for decades.

As recently as 2020, former US Assistant Secretary of State Christopher Ford, in a briefing, dismissed the proposal by China and Russia as a "terrible" idea, stating that "It would by careful design fail to address in any meaningful fashion the terrestrially-based ASAT systems… US diplomats are looking... to work constructively with their counterparts in other spacefaring nations to develop approaches to outer space norms that will help improve predictability and collective 'best practices' in the space domain."[47] The US has emphasized a norms-based approach that shuns negotiations for any binding arms control treaties in outer space.

Other efforts for space regulations include the UN Office for Outer Space Affairs (UNOOSA) – a collection of space debris mitigation standards was issued in 2014.[48] In 2011, the UN

45. "Approving 21 Drafts, First Committee Asks General Assembly to Halt Destructive Direct-Ascent Anti-Satellite Missile Tests in Outer Space." GA/DIS/3703, November 1, 2022.https://press.un.org/en/2022/gadis3703.doc.htm.
46. "The CD and PAROS A Short History." April 2011. https://unidir.org/files/publication/pdfs/the-conference-on-disarmament-and-the-prevention-of-an-arms-race-in-outer-space-370.pdf.
47. "Russian ASAT Test Sparks War of Words." May 2020, https://www.arms-control.org/taxonomy/term/178?page=5.
48. "Compendium of space debris mitigation standards adopted by States and international organizations." March 12, 2014. https://www.unoosa.org/pdf/limited/c2/AC105_C2_2014_CRP15E.pdf.

promoted transparency and confidence-building measures vis-à-vis activities in outer space. However, a significant challenge lies in the reluctance of states leading in offensive space technologies to engage in serious discussions about space arms control.

Negotiating effective arms control faces various challenges, ranging from disagreement on the definitions of space weapons to the desire of certain states to dominate space. There is also a division on the types of offensive systems that should be prohibited. The US-led group of states has prioritized the ASAT threat, while China and other like-minded countries are concerned about BMDs and their ability to preserve a nuclear deterrent. Consequently, the focus remains on eliminating weapons in outer space and space systems capable of striking targets on Earth. The US bloc advocates for voluntary, non-legally binding rules in outer space, contending that existing law is adequate to regulate outer space. In contrast, China and others have spearheaded efforts to negotiate a legally binding treaty banning space weapons. However, any meaningful discussions in preventing the weaponization of outer space have remained dead-locked for decades.

Conclusion

The way the states are interconnected today, space is much the same. Both civilian and military activities heavily rely on space assets. Although space has been militarized since the dawn of the space era, there is a growing trend toward weaponization. Deploying offensive systems in space can destabilize peace efforts, escalate security dilemmas among states, and lead to an arms race in outer space. As the US, India, and other states are rapidly moving toward the overt weaponization of space, it is imperative to halt the space weapons race because this competition is counterproductive to peace and security in outer space. It is also necessary as the states developing space weapons become the most vulnerable by their significant, targetable space assets – succumbing to the temptation of developing and using space weapons against adversaries will

only put thousands of space assets at risk. Therefore, there is a need to adopt a collective principle that space is safe for all or none and develop and negotiate a legal framework to control and regulate space weapons. In a space arms race, there can be no actual winners, and the humanity will risk losing collectively.