

Enabling Leaders to Dominate the Space Domain

Capt. Nicholas Deschenes, U.S. Army

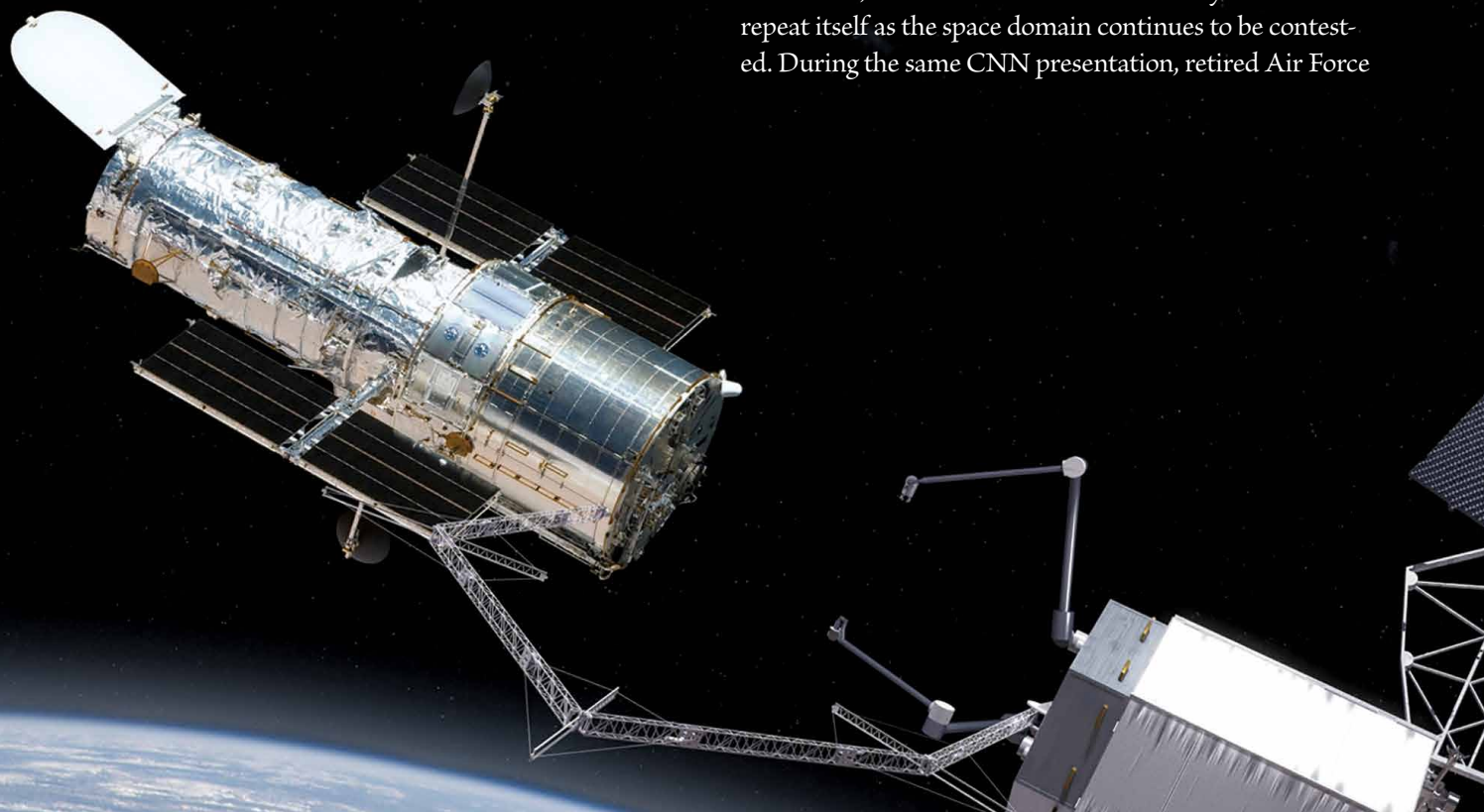
The skillful leader subdues the enemy's troops without any fighting; he captures their cities without laying siege to them; he overthrows their kingdom without lengthy operations in the field.

—Sun Tzu

Sun Tzu's 2,500-year-old quote remains timeless as adversaries exploit the United States by taking advantage of its overwhelming dependence on the capabilities provided from space.¹ Inevitably, the conflict occurring in the contested space domain will

descend to Earth, and the United States can only hope its adversaries show restraint.² As tactics like rendezvous and proximity operations evolve, and with the ambiguity of current international laws, the gray line of decision-making is blurring to indecisiveness in the minds of U.S. leadership.³ However, codifying international norms and behaviors regarding the space domain will establish a position of strength for national leaders to operate from, permit delegation of authorities over space assets down to tactical-level subordinates, and allow them to dominate space by executing effective tactics in defense of U.S. space-based assets.

During a CNN Special Report in 2016, Air Force Gen. John E. Hyten, commander of U.S. Forces Strategic Command, reminded the world that history is set to repeat itself as the space domain continues to be contested. During the same CNN presentation, retired Air Force



Gen. William Shelton, Hyten's predecessor at the Air Force Space Command, stated that in the event of such a war, the United States would be unable to defend itself from the technologies being developed by its adversaries.⁴ Almost two decades ago, Donald Rumsfeld, leading a space commission, disclosed that the United States is vulnerable to attack via space and is susceptible to a "space Pearl Harbor."⁵ It is important to understand the significance of these statements and how incredibly dependent the United States is on space-based assets. An attack on strategic or commercial space assets could cripple the United States' military prowess and its economy, and degrade the global economy along with it.⁶ In the chaos of a broken economy and with space assets unable to support military operations, the U.S. becomes vulnerable.⁷

Inadequacy of Current International Law

The most widely adhered-to international agreements associated with space are those within the Outer Space Treaty of 1967.⁸ The basic precepts of the treaty are

- all nations are free to scientifically investigate space,
- celestial bodies are only to be used for peaceful purposes,
- weapons of mass destruction are prohibited in space,
- compensation is required for damage to another country's spacecraft, and
- contamination of space is to be avoided.⁹

Since this treaty was established when only a few nations could achieve orbit, this fifty-one-year-old document is most notably scrutinized for its irrelevancy and ambiguity regarding modern practices in the space domain.¹⁰

The Chinese antisatellite missile demonstration in 2007 provides the best illustration of the inadequacies of the 1967 space treaty. China destroyed one of its aging weather satellites traveling 800 kilometers above the earth with a ground-based kinetic strike missile.¹¹

Previous page: A U.S. satellite uses a robotic arm to capture the Hubble Telescope satellite 2 July 2014 for in-space repair. A commercial satellite tracking agency has monitored a Chinese SHIYAN satellite with a similar robotic arm practicing maneuvers to capture and release other satellites. China could potentially use this capability for military applications against U.S. and other friendly satellites in the event of the outbreak of hostilities. (Photo courtesy of NASA)

It is estimated that the collision formed a debris cloud consisting of an estimated 300,000 fragments at altitudes ranging between 200 and 3,800 kilometers.¹²

The European Space Agency reports that identifying objects less than five centimeters in diameter in low Earth orbit is not feasible at this time.¹³ Notwithstanding, simulations of the collision indicate that the majority of the generated debris was below this threshold, thus rendering the particles as "invisible" to ground or spacecraft detectors.¹⁴ For perspective, collisions in low Earth orbit between particles four inches across and spacecraft are equivalent to a semitruck hitting a barrier at seventy miles per hour. Should one of these particles strike another satellite, it would spark a dangerous orbital chain reaction of satellite collisions that could render space useless for everyone.¹⁵ Worsening the situation, the lack of atmospheric drag above an altitude of seven hundred kilometers allows this debris to orbit the earth for thirty years or more.¹⁶

China's use of a conventional kinetic weapon in space is legal under current international law.¹⁷ A nation victimized by China's irresponsible proliferation of debris must rely on today's space treaties to seek compensation because the laws of armed conflict are irrelevant since China targeted their own satellite.¹⁸ However, should a nation demand compensation for the damage caused by the resulting debris, it must prove, beyond a reasonable doubt, that China's demonstration caused the damage. China's legal representation will likely counter that "contamination" is debatable because it is undefined within current treaties. If the affected nation can correlate damage with Chinese actions, it must demand payment through the bureaucracy of the United Nations and hope China honors their obligation, as a forcing function does not exist. Lawmakers and politicians alike recognize these inadequacies and simply cannot agree on a resolution.

To little avail, numerous revisions to treaties, proposals of transparency, and additional conventions have been attempted to fix the inadequacies of space law.¹⁹ The committee with the most participants, the United Nations' Peaceful Uses of Outer Space Committee, was established in 1959, but military and security operations are not applicable to this organization as its purpose is to promote international cooperation for the research of space.

Additionally, the nonproliferation of weapons in space and the security of space are supposed to be discussed



during Geneva's Conference on Disarmament, but attendees cannot agree on their own agenda, let alone make substantial progress in determining international law. Furthermore, the Committee on the Prevention of an Arms Race in Outer Space at the United Nations has not had a substantial agreement in almost forty years.²⁰

Contrary to the popular belief of many U.S. citizens, the Russians and Chinese have submitted the most documentation to the United Nations for solidifying space regulations.²¹ In 2008, they codrafted the "Treaty on the Prevention of the Placement of Weapons in Outer Space" and introduced it to the Conference of Disarmament.²² In 2014, their revised draft was voted on by the General Assembly of the United Nations, yielding a vote of 126 in favor, forty-six abstentions, and four against.²³ The United States was the primary party against the resolution because the treaty did not discuss any process to verify compliance with the treaty's stipulations. In late 2015, the United Nations General Assembly adopted Russia's "No first placement of weapons in outer space" resolution with similar ballot results. The United States, again the primary voice against the resolution, stated that "weapons" in space remains undefined.²⁴

U.S. Secretary of State Dean Rusk signs the Treaty of Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (known as the Outer Space Treaty) 27 January 1967 at a White House ceremony. At the table are (right to left) President Lyndon B. Johnson; Ambassador Arthur J. Goldberg, permanent representative of the United States to the United Nations; Sir Patrick Dean, minister of state for foreign affairs and permanent representative of the United Kingdom to the United Nations; and USSR Ambassador to the United States Anatoly F. Dobrynin. Dramatic advances in technology have rendered the treaty obsolete and largely irrelevant. (Photo courtesy of the United Nations)

At face value, the United States' noncommittal stance may be misconstrued as an unwillingness to enhance prosperity for all in space. In this regard, China and Russia appear politically just in their resolve to foster peace. However, it is important to understand the United States' justification of not committing to formal agreements without a forcing function to ensure all parties are adhering to a clearly defined policy.²⁵ With the fall of the Soviet Union, space became a relatively benign environment where the United States reigned supreme. However, during this time of complacency, U.S.

adversaries made significant progress in their efforts to control the space domain and exploit the United States' reliance of it. Tactics like rendezvous and proximity operations, utilized by Russia and China near sensitive military satellites, reinforced the United States' political position to "trust but verify" when establishing international space policy.²⁶ Thus, while China and Russia are proposing supposedly peaceful legislature, their actions speak louder than their words. The United States remains vigilant to politically negate any actions that may threaten its security, but this does not excuse its lack of proposals to solve identified issues and foster sovereignty in a more peaceful manner than building military power.

Inadequate Solution to Evolving Threats

China and Russia are adapting rendezvous and proximity operations currently utilized by spacecraft docking at the International Space Station and turning them into potential offensive capabilities.

A commercial satellite tracking agency, known as Analytic Graphics Incorporated, observed LUCH, a Russian satellite, approach a European communication satellite and at least three sensitive U.S. military communication satellites using these tactics. They have also observed SHIYAN, a Chinese satellite possessing a robotic arm capable of capturing and releasing other satellites, practicing these maneuvers.²⁷

Each country states that the purpose of their respective satellite is to exercise servicing operations, but their proximity to sensitive targets alludes to more sinister intentions.²⁸ SHIYAN could use its robotic arm to maneuver a satellite out of position; rendering it unable to complete its mission. Both SHIYAN and LUCH can



A Chinese rocket launches CHUANGXIN-3, SHIYAN-7, and SHIJIAN-15 satellites into space 20 July 2013 from the Taiyuan Satellite Launch Center in North China's Shanxi Province. The trio of satellites reportedly were to engage in scientific experiments associated with space maintenance technologies. However, observers noted that the SHIYAN-7, a type of satellite equipped with a robotic arm for capturing and releasing other satellites, subsequently demonstrated extraordinary maneuverability, positioning and repositioning itself at different altitudes and appearing to converge to the near proximity of other Chinese satellites, prompting concern that the Chinese were actually testing antisatellite technology. (Photo by Xinhua/Yan Yan)

closely approach satellites by conducting rendezvous and proximity operations, then accelerate into or unleash hidden weapons at their targets before decision-makers are able to react.²⁹ While the United States has previously refrained from any commitment to China and Russia's proposed legislature, perhaps U.S. leaders can regain a moral high ground on the world stage by generating political solutions to these lingering issues.

On 18 June 2018, the president of the United States announced his intent to secure and dominate the space domain.³⁰ But the trivial disagreements associated with international space law cause leadership to refrain from delegating authorities over space-based assets because they remain responsible for the consequences. As concisely stated by Michael Hyatt, "Military leaders can delegate authority, but always maintain responsibility for the outcome."³¹ There are few willing to risk their careers or civil freedoms because laws cannot be adequately explained or relied on. However, if conflict in space does occur, the actor willing to accept these risks is favored to win, especially if the adversary leader's first thought is to consult a lawyer, which is a fight already lost unless decisions are already made and legally vetted.³²

Logically, Hyatt believes the solution to dominating space is for the United States to treat the global commons of space just as it treats the air and sea.³³ For example, to preserve its perceived right of global commerce, the United States built the strongest navy in the world and only when dominance of the seas was established did the U.S. work with international partners to establish the laws of the sea. The U.S. Air Force was created in much the same way—once the Air Force negated hostilities from the air, regulations and civil aviation laws emerged globally.³⁴ Simply put, peace grows from strength and dominance. This remains the stance of the United States as it formulates the establishment of a sixth military branch—the "Space Force."³⁵ However, in both previous cases, a centralized international entity was not solidified to maintain global stabilization. Also, today, the transparency inherent in global cooperation gives governments and the United Nations awareness of activities such as rocket launches even before such events occur.

Todd Harrison's Center for Strategic and International Studies report argues that a military space force within the Department of Defense (DOD) is not an adequate solution. Referencing a 2016 Government Accountability Office study, he elaborates that with over

sixty agencies between the DOD and intelligence community responsible for the acquisition of space technology, a space force within the military will not consolidate authorities and streamline the acquisitions process as intended. Rather, he suggests establishing a Department of Space with a secretary of space focally responsible for all space-related activities. He argues that a secretary of space would consolidate authorities and potentially expedite acquisition of space capabilities (thus spanning the entire federal government and addressing the aforementioned issues).³⁶ However, a space force will not deter the rate that our adversaries increase their space capabilities. History tends to repeat itself, and this Cold War mindset of promoting peace by building military power greater than an equivalent adversary's will most likely increase rates of production instead of curbing them. Hopefully, restraint will prevail now as it did during the Cold War when global leaders were considering the mutual destruction of each other.

The Cold War mentality is a reactive approach that keeps the United States grounded in a defensive posture. Rather, the U.S. needs an offensive mindset focused on dominating space. A space force will not solve a leader's reluctance to delegate authorities because vague international law constricts their understanding when determining proportionality of action. It is difficult for leaders to trust a subordinate's decision when they do not understand the framing of the problem set themselves, let alone determine a solution to navigate the national and strategic consequences. In turn, the concise decision cycle required to effectively defend the nation's space capabilities is elongated by briefings, disagreements, approval boards, and legality debates through bureaucratic chains of command. With over sixty nations already utilizing satellite payloads, adversaries demonstrating

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advanced tactics to control space, and entrepreneurs commercializing the newest global commons, the increasing congestion demands the United States expand its internal policies to proactively establish international regulations.³⁷

Dominating Space by Delegating Authorities

The United States' 2018 *National Defense Strategy* defines the purpose of the DOD as allowing civilian leaders to operate from a position of strength. Several specified tasks to accomplish the former Secretary of Defense James Mattis's intent directly apply to space, the priority of which is to defend the United States from attack. Other applicable tasks include deterring adversary aggression, maintaining regional power across the world, ensuring the five physical domains remain free to use, and changing the speed that capabilities are produced. To accomplish these tasks, the outlined strategy suggested offering U.S. adversaries "an outstretched hand" and to remain "open to opportunities for cooperation but from a position of strength based off our national interests." Mattis then discussed the need to modernize the space domain by prioritizing the assurance of the United States' space capabilities. In conclusion, he stated, "We must use creative approaches ... to field a Joint Force fit for our

time, one that can compete, deter, and win in this increasingly complex security environment."³⁸

As previously mentioned, the United States was historically the primary critic to the new and updated space regulations proposed to the United Nations. However, under new direction from the president's cabinet, now is the time for the United States to act by offering solutions to the issues identified in Russia's "No First Place of Weapons in Space" resolution and the joint Chinese and Russian codrafted Prevention of Weapons in Outer Space treaty. Taking the political offensive by proactively proposing solutions to the issues identified will ensure the United States negotiates from a position of strength. Without updated international space laws, authorities will remain held at the highest military echelons. Without delegated authorities, there cannot be rules of engagement. The space domain is the only physical domain without standardized rules of engagement, which is important in differentiating defensive tactics from acts of war.³⁹

Consider traffic-control-point procedures utilized to safely admit personnel into a military installation or forward operating base. Obstacles are in place to manipulate traffic, identities are scanned prior to admitting entrance, measures are in place to ensure proportionality of action should an incident occur, the guards are trained and armed in case of an emergency, and in extreme circumstances, quick reaction forces are on standby to assist. More importantly, the service members understand how to react to



likely scenarios. They have exercised every situation to muscle memory, as a team. Without civil laws dictating the consequences of their actions, or how personnel will react to threats, the rules of engagement would be impossible to maintain because every situation would require leadership's analysis and approval. The effective teamwork that defends key infrastructure would cease to exist.

The absence of law at traffic control points is analogous to current operations in space. While there is a "status quo" of how to act in space, decisions become complicated as norms are stressed. The United States' inaction to solve the problems it identifies in space legislature is the same issue that makes strategic leaders hesitate and consult guidance before making critical decisions should a war erupt in space. Simultaneously, rejecting semilogical treaty proposals without offering solutions, establishing a sixth military service to control the domain, and acting without gaining global consensus promotes an arms race in space. Thus, the United States will only be able to dominate space if international law is defined and authorities are delegated to the appropriate levels of leadership from a centralized authority.

Recommendations for Establishing Modern International Space Policy

The first step required to generate international law will be establishing a consensus on the vocabulary defined

in the policies.⁴⁰ Remarkably, there is no internationally defined altitude separating the air and space domain. This is an issue because the cornerstone of all international space politics is founded on individually perceived concepts of where space begins. Some define the beginning of space as where Earth's atmosphere is no longer traceable—roughly six hundred miles in altitude (almost three times greater than the orbit of the international space station). The U.S. military and NASA award the title of astronaut to all who travel above eighty kilometers in altitude. However, the widely accepted baseline for where space begins is known as the Kármán Line, which is one hundred kilometers above sea level. At this altitude, the atmosphere is too thin to support lift in traditional aeronautics and thus represents reasonable separation of the domains.⁴¹ Defining the separation of the space domain from the air domain begins to address the limitations associated with the rules of engagement for strategic leaders of the United States government.

The thin line of Earth's atmosphere and the blackness of space are featured in this image photographed 8 June 2014 by an Expedition 40 crew member on the International Space Station. The Kármán Line, an imaginary boundary roughly one hundred kilometers above sea level, is widely (but not universally) accepted as the edge of space—an important distinction as different laws govern the domains of air and space. (Photo courtesy of NASA)



Decisions cannot be proposed, vetted, and negotiated in a short amount of time, which is why it is important to address limitations of rules of engagements. Take, for example, the fact that a three hundred kilometer range Scud missile developed by the Soviet Union in the 1960s is capable of intercepting the International Space Station in less than ten minutes, despite it being relatively simple to produce and not a very powerful rocket.⁴² In a tactical situation, with bullets, explosions, and chaos on the battlefield, ten minutes is an eternity. However, in a strategic environment, where echelons of bureaucracy need to be navigated, ten minutes is not enough time for effective decision-making.

Therefore, decisions must already be made, understood down to the operator level, and the operators must be certified in the actions required for success. Understanding where space begins identifies which leaders are responsible for solving the problem, which means risk can be mitigated effectively and authorizations can then be delegated to execute specified tasks down to the tactical level. Leaders at this level can then start to develop standard operating procedures aligned with these specified tasks and defend U.S. space assets, beginning the process required to dominate the space domain.

Addressing rendezvous and proximity operations is also important because these tactics have an expanding usefulness in servicing obsolete and aging satellites—as retorted by Russia and China.⁴³ Rather than banning equipment such as robotic arms or tactics (e.g., rendezvous and proximity operations), thresholds akin to spacecraft approaching the International Space Station and boundaries associated with communication satellites in geostationary orbit can be created.⁴⁴ These boundaries can be assigned to all satellites in every orbit. The distance can differ per satellite based on an agreed upon criteria: the national sensitivity of the satellite, the respective orbit, and the nature of the payload mission sets. Recognizing that foreign satellites may not approach within these boundaries, unless granted permission, is critical when formulating rules of engagement.⁴⁵

Spacecraft boundaries allude to a greater acceptance of defensive weapons in space. Understanding a clearly defined defensive posture and the separation between the air and space domains leads to the refinement of nuclear weapons and weapons of mass destruction in space, such as electromagnetic pulses,

due to their ability to destroy electronic equipment over vast distances.

To ensure safe conduct of space operations for all, testing of any space weapon that has the potential to propagate debris must be prohibited to limit contamination orbiting Earth. This includes weapons such as ballistic nuclear warheads, which can remain viable for homeland security if they do not contribute debris or electromagnetic pulse effects above the Kármán Line and do not orbit the earth.

Clarifying contamination in space as the intentional or accidental creation of debris generated by or from a spacecraft, no matter the amount or size, is important to securing space for all parties involved. Incidents caused by natural phenomena, such as meteor strikes, should not penalize an offending party. However, the party would be responsible for providing evidence to distinguish natural phenomena from faulty satellite equipment to not pay a penalty.

In today's international society, enforcement of space laws by only the United States can easily be interpreted as an act of war. To enforce these regulations, penalties need to be implemented proactively and globally, not reactively. Sponsoring the establishment of a United Nations' entity to analyze the scope of an incident's contamination and enforce repercussions, if necessary, positions the United States to shape modern international space policies in their image.⁴⁶

Using the debris proliferated by China's antisatellite missile demonstration in 2007 as an example, the United Nations entity will identify all satellite payloads in the affected orbital region. Furthermore, they will determine a monetary compensation the offending party is to pay affected parties. This value can be based on the cost to manufacture each payload or satellite, correlated with its respective age, and the satellite's projected lifespan. To do this, a percentage fee will be required by the United Nations to generate a conventional, nonkinetic, space system used only by the United Nations entity to decommission an offending nation's spacecraft. One percent of a nation's total value of all space assets, both operational and nonoperational (to include all sixty nations owning space assets) should provide enough compensation to fund the United Nations entity and operational asset. While this might be viewed as a drastic measure to ensure

compliance, it resolves long-standing issues of self-regulatory rules and a general lack of enforcement capability from the United Nations.⁴⁷ The teams that decommission spacecraft can additionally be used to inspect compliance of China and Russia's proposed updated space treaties prior to launch. This also enhances space situational awareness along with missile warning because unregistered launches will immediately generate the notification of all other associated parties.

Conclusion

The real story is about the destruction that didn't occur because we were so precise. The real story is about the troops on the ground that were not put in harm's way. The real story is also about the collateral damage that did not occur to civilian populations. The bottom line is our space capabilities save lives and minimize destruction.

—Gen. Lance W. Lord, U.S. Air Force, retired⁴⁸

Long before the federal government contemplated establishing a sixth military branch dedicated to space operations, retired Air Force Gen. Lance Lord eloquently addressed the importance of why the United States must operate freely in the space domain. Dominating space preserves U.S. military dominance across the globe because its space capabilities protect the world's most cherished asset: human life.

As U.S. adversaries make threatening advancements in space operations and technologies, the United States

has a unique opportunity to regain the moral high ground through offering solutions by establishing new international space policies. The United Nations entity addresses the United States' issue regarding the lack of forcing functions associated with Russia and China's proposed international space policies. The United States will be positively received on a global scale by proposing such transparency in launch payloads. By sponsoring the United Nation's entity, U.S. strategic leaders can influence the consequences for a lack of compliance to proposed space policies without being viewed as an aggressor by other world powers. This tactic will deescalate Cold War-like tensions between the United States and its adversaries while allowing U.S. strategists to preemptively formulate favorable rules of engagement.

This position of political strength and establishment of international space policy will allow U.S. strategic leaders to delegate authorities, with clear rules of engagement, to tactical leaders who will generate standard operating procedures from specified tasks and effectively dominate the battlefield when the first shots are fired in the ultimate high ground. ■

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Notes

Epigraph. Sun Tzu, *The Art of War*, trans. Lionel Giles (New York: Race Point, 2017), 112.

1. Jim Sciutto, *War in Space: The Next Battlefield*, produced by Ken Shiffman, CNN Special Report (video), 29 November 2016, accessed 22 January 2019, <https://www.youtube.com/watch?v=j-ZBLFhblg>; Ken Mondschein, introduction to *The Art of War & Other Classics of Eastern Philosophy*, ed. Peter North (San Diego: Canterbury Classics, 2016), xx; Maj. Aaron Sprecher and Maj. Sameek Parsa, "Gateway to Multi-Domain Command and Control: The E-3A Final Lifetime Extension Program," *Journal of the Joint Air and Power Competence Center* 25 (Winter 2017/2018): 12–18, accessed 15 August 2018, <https://www.japcc.org/gateway-to-multi-domain-command-and-control/>; Brian G. Chow, "Space Arms Control: A Hybrid Approach," *Strategic Studies Quarterly* 12, no. 2 (Summer 2018): 111, accessed 15

January 2019, https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-12_Issue-2/Chow.pdf.

2. Sciutto, *War in Space*; Adam Frey, "Defense of US Space Assets: A Legal Perspective," *Air and Space Power Journal* 22, no. 4 (Winter 2008): 79; Jean-Michel Stoullig, "Rumsfeld Commission Warns against 'Space Pearl Harbor,'" *Space Daily*, 11 January 2001, accessed 15 August 2018, <http://www.spacedaily.com/news/bmndo-01b.html>.

3. Michael Nayak, "Deterring Aggressive Space Actions with Cube Satellite Proximity Operations: A New Frontier in Defensive Space Control," *Air and Space Power Journal* (Winter 2017): 92, accessed 22 January 2019, https://www.airuniversity.af.edu/Portals/10/ASPI/journals/Volume-31_Issue-4/SEW-Nayak.pdf; Chow, "Space Arms Control," 108.

4. Sciutto, *War in Space*.

5. Frey, "Defense of US Space," 75; Stoullig, "Rumsfeld Commission Warns against 'Space Pearl Harbor.'"

6. Sciutto, *War in Space*; Frey, "Defense of US Space," 76; Lance W. Lord, "Why America Needs Space: The Prerequisites for Success," *U.S. Air Force Space Command High Frontier: The Journal for Space & Missile Professionals* 2, no. 1 (n.d.): 2, accessed 22 January 2019, <https://www.afspc.af.mil/Portals/3/documents/HF/AFD-060524-005.pdf>.
7. Nayak, "Deterring Aggressive Space Actions," 92.
8. Frey, "Defense of US Space," 76; Rajeswari Pillai Rajagopalan, "Beyond Outer Space Treaty—Time for New Mechanisms," in *50 Years of the Outer Space Treaty: Tracing the Journey*, ed. Ajey Lele (New Delhi: Pentagon Press, 2017), 172.
9. Frey, "Defense of US Space," 76–77; Rajagopalan, "Beyond Outer Space Treaty," 173.
10. I. H. Ph. Diederiks-Verschoor and V. Kopal, *An Introduction to Space Law*, 3rd ed. (Alphen aan den Rijn, Netherlands: Kluwer Law International, 2008), 125; Rajagopalan, "Beyond Outer Space Treaty," 173; Frey, "Defense of US Space," 77.
11. Frey, "Defense of US Space," 78; Rajagopalan, "Beyond Outer Space Treaty," 174.
12. Frey, "Defense of US Space Assets," 78.
13. "CLEANSAT," Clean Space, European Space Agency, 18 August 2018, accessed 20 August 2018, http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/CleanSat.
14. Frey, "Defense of US Space Assets," 78.
15. Sciutto, *War in Space*.
16. "Aircraft and Space Vehicles" (Technical Committee 20) and "Space Systems and Operations" (Subcommittee 14), *Space Systems—Estimation of Orbit Lifetime*, 1st ed. (Geneva: International Organization for Standardization, 2011 [obsolete]), 18.
17. Rajagopalan, "Beyond Outer Space Treaty," 173; Frey, "Defense of US Space," 76–77.
18. Frey, "Defense of US Space," 78–79.
19. *Ibid.*; Chow, "Space Arms Control," 107; Rajagopalan, "Beyond Outer Space Treaty," 173.
20. Chow, "Space Arms Control," 110–14; Rajagopalan, "Beyond Outer Space Treaty," 178–80.
21. Chow, "Space Arms Control," 111; Rajagopalan, "Beyond Outer Space Treaty," 179–80.
22. "Proposed Prevention of an Arms Race in Space (PAROS) Treaty," Treaties and Regimes, Nuclear Threat Initiative, last updated 29 September 2017, accessed 16 January 2019, <https://www.nti.org/learn/treaties-and-regimes/proposed-prevention-arms-race-space-paros-treaty/>.
23. *Ibid.*
24. Chow, "Space Arms Control," 113.
25. *Ibid.*, 110–14; Rajagopalan, "Beyond Outer Space Treaty," 178–80.
26. Sciutto, *War in Space*.
27. *Ibid.*
28. *Ibid.*
29. *Ibid.*; Chow, "Space Arms Control," 108.
30. Associated Press, "We Must Have American Dominance in Space, Says Donald Trump – Video," *The Guardian* (website), video, 18 June 2018, accessed 25 August 2018, <https://www.theguardian.com/us-news/video/2018/jun/18/we-must-have-american-dominance-in-space-says-donald-trump-video>.
31. "Don't Do What Others Could Do—Lessons for Delegation and Authority," *The Military Leader* (blog), accessed 4 November 2018, <https://www.themilitaryleader.com/lessons-for-delegation-and-authority/>.
32. Thomas Pugsley, "Situation Overview of the Space Domain" (briefing, Space Operations Officer Qualification Course, Colorado Springs, CO, 13 September 2018).
33. Johnathan Joshua, "USSTRATCOM Commander Offers Perspective on Space Force & Cyber Force at Air Force Association's 2018 Air, Space, & Cyber Conference," LinkedIn, 20 September 2018, accessed 4 October 2018, <https://www.linkedin.com/pulse/usstratcom-commander-offers-perspective-space-force-cyber-joshua/>.
34. *Ibid.*
35. Marcia S. Smith, "DOD 'Moving Out' on Space Force as Space Council Approves Six Recommendations to President," SpacePolicyOnline.com, 23 October 2018, accessed 4 November 2018, <https://spacepolicyonline.com/news/DOD-moving-out-on-space-force-as-space-council-approves-six-recommendations-to-president/>.
36. Todd Harrison, "Why We Need a Space Force," Center for Strategic and International Studies, 3 October 2018, accessed 16 January 2019, <https://www.csis.org/analysis/why-we-need-space-force>.
37. Rajagopalan, "Beyond Outer Space Treaty," 176.
38. Office of the Secretary of Defense, "Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge" (Washington, DC: Department of Defense, 2018), 1–11, <https://DOD.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.
39. Sciutto, *War in Space*.
40. Frey, "Defense of US Space," 77; Chow, "Space Arms Control," 111–13.
41. Stefania Waldek, "Where Does Outer Space Start? It All Depends on Who You Ask," *Popular Science* (website), 1 June 2018, accessed 25 August 2018, <https://www.popsci.com/where-does-space-begin>; National Environmental Satellite, Data, and Information Service, "Where is Space?," National Oceanic and Atmospheric Administration, 22 February 2016, accessed 25 August 2018, <https://www.nesdis.noaa.gov/content/where-space>.
42. David Wright, Laura Grego, and Lisbeth Gronlund, *The Physics of Space Security: A Reference Manual* (Cambridge, MA: American Academy of Arts and Sciences, 2005), 90, 168, accessed 22 January 2019, <https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/physics-space-security.pdf>.
43. Chow, "Space Arms Control," 110.
44. Diederiks-Verschoor and Kopal, *An Introduction to Space Law*, 65; Cornelius J. Dennehy and J. Russell Carpenter, "A Summary of the Rendezvous, Proximity Operations, Docking, and Undocking (RPODU) Lessons Learned from the Defense Advanced Research Project Agency (DARPA) Orbital Express (OE) Demonstration System Mission," NASA Technical Memorandum 2011-217088 (Hampton, VA: NASA, Langley Research Center, April 2011), 4–33, accessed 22 January 2019, <https://www.nasa.gov/externalflash/dart/Resources/Rendezvous%20Proximity%20Operations%20Docking%20and%20Undocking%20Lessons%20Learned.pdf>.
45. Chow, "Space Arms Control," 126–28.
46. Frey, "Defense of US Space," 79.
47. *Ibid.*
48. Lord, "Why America Needs Space."