Strategy Research Project

The Crumbling Sanctuary: Why America Must Restore Space Security

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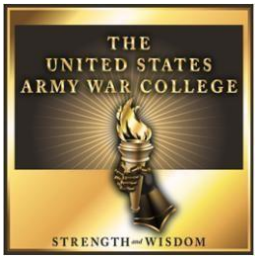

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The security of America's space assets – and the sanctuary of space – is being challenged by increasingly credible threats that come from three primary sources. One threat is the potential weaponization of space, for which some advocate despite the realities of physics and strategy. Another threat comes from the rise of adversarial counterspace programs, which can destroy, disable, or disrupt U.S. space assets. The third threat results from the international system of governance which is in decline and unable to adequately preserve peace in space. In order to defeat these threats, the United States must exhibit leadership on the international stage, forging international rules that protect its interests. It must defend its space assets through enhanced and explicit deterrence measures. Finally, it must overhaul its fractured domestic institutions that manage space policy, space strategy, and the space budget. Only by addressing these issues can America rise to meet the space security challenges of tomorrow and continue to enjoy the economic and military benefits that it derives from space.

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Abstract

The security of America's space assets – and the sanctuary of space – is being challenged by increasingly credible threats that come from three primary sources. One threat is the potential weaponization of space, for which some advocate despite the realities of physics and strategy. Another threat comes from the rise of adversarial counterspace programs, which can destroy, disable, or disrupt U.S. space assets. The third threat results from the international system of governance which is in decline and unable to adequately preserve peace in space. In order to defeat these threats, the United States must exhibit leadership on the international stage, forging international rules that protect its interests. It must defend its space assets through enhanced and explicit deterrence measures. Finally, it must overhaul its fractured domestic institutions that manage space policy, space strategy, and the space budget. Only by addressing these issues can America rise to meet the space security challenges of tomorrow and continue to enjoy the economic and military benefits that it derives from space.

The Crumbling Sanctuary:
Why America Must Restore
Space Security

Space – once referred to as a sanctuary – is facing increasingly credible threats to the stability it has enjoyed since humans first endeavored to use it. The Secretary of the U.S. Air Force referred to U.S. space assets as "a glass house built before the invention of stones."[1] This paper will help the reader to better understand those stones – or the threats to U.S. national security in space – while also describing actions that can be taken to protect America's glass house. It makes the case that current U.S. space strategy and policy allow for too much risk, leading to domestic and international systems incapable of protecting U.S. space interests. These systems have, in turn, permitted the risks to grow from stones to boulders, threatening to shatter U.S. space security. Three broad categories of threats have emerged, including the potential weaponization of space, the rise of adversarial counterspace programs, and the ineffective international system of governance. The increasingly credible danger of conflict in space threatens the American way of life, America's continued prosperity, and the ability of its military to provide for the common defense.

While we might not be able to return space to its sanctuary status, through U.S. leadership space can – and must – continue to be a safe place in which the United States and all who adhere to a rules-based international order can operate. America can take specific actions to ameliorate the situation, to include creating an international system of governance, increasing protection of current space-based assets through credible deterrence, and reforming domestic institutions to enhance space security. The United States must seek comprehensive solutions to prevent war in space, while preserving the operational integrity of its space-based assets and Earth-based

receivers. Solutions to security issues are more elusive in space than in other domains because the complexity of issues and the physics of space present unique operating circumstances that must be well understood in order to formulate a comprehensive strategy.

Threats to U.S. National Security Interests in Space

The United States faces more threats to the security of its space interests than it has at any other time in its 57-year history as a spacefaring nation. The American public is largely unaware of how reliant it has become on space for its way of life, resulting in these threats being ignored outside a relatively small group of space watchers and experts. This issue warrants greater attention because the United States relies more on space and has invested more in space than any other nation, accounting for 75% of global space expenditures.[2] America has the greatest number of operational satellites in space of any country – 803 of the world's 1738. The next two space powers, China and Russia, account for 204 and 142 operational satellites respectively.[3] While its space assets afford the United States technical, commercial, and military advantages, its reliance on space could become a comparative weakness should it lose access to its space assets during a conflict.[4]

Weaponization of Space

While space may be the literal high-ground, enabling unprecedented military capabilities, it is not the strategic high-ground from which weapons can dominate the Earth, as some strategists have suggested.[5] In fact, the weaponization of space would destroy its sanctuary status while providing systems that would be less effective and more costly than Earth-based capabilities.[6] Since there are no rules for conflict in space – or understanding of how just war standards would apply to space – there is no way of

knowing the impact space weapons would have on the system.[7] Due to the unique operational environment of space, borrowing doctrine and theories of war from other domains can lead to dangerous assumptions, resulting in counterproductive strategies that ultimately jeopardize U.S. national security interests. If space strategists better understood the true nature of conflict in space, they would understand that weapons in space are unable to achieve space control or win wars as they can in other domains.[8]

The primary threat of a conflict in space is the generation of debris, which would uncontrollably expand over millions of square miles.[9] This debris could destroy the assets of all spacefaring nations – including those of the attacker and defender – in all impacted orbits.[10] Debris from conventional conflicts at sea, in the air, or on land does not pose a lingering hazard to the future use of water, air, or territory.[11] Even if the United States spent billions developing non-debris causing weapons, it should anticipate that adversaries would develop asymmetrical responses to space-based weapons.[12] For example, an adversary could simply rig its satellites with a self-defense system that would detonate if the satellite were tampered with by a co-orbital anti-satellite (ASAT) or attacked by laser, electromagnetic pulse, or other “clean” ASAT systems. Such a self-destruction system would be a cheap and effective way of creating a debris field, that could ultimately destroy U.S. systems as well.

An assumption of some strategists is that space weapons would be able to provide for U.S. space dominance.[13] Unfortunately, space weapons are more fragile and unstable than Earth-based systems, making them unsuitable for such a task. Objects in space are constantly at risk from natural occurrences because the normal operating environment of space is inherently hostile.[14] In other domains, equipment can be

repaired, replaced, enhanced, and moved to defensive positions to counter the evolving strategy of the enemy. However, in space there is no position that would allow for such defenses and the costs of constant resupplying, repairing, reconfiguring, and maneuvering are more than would be feasible.[15] Given the vulnerabilities of space-based systems and the physics of space, asymmetric tactics present would-be adversaries with cost-effective ways to gain an advantage over the United States.[16] For example, a marble-sized piece of debris carries the force of a one-ton safe falling five stories, making it capable of causing significant damage to other objects in space.[17] Therefore, a $1 bag of marbles projected into space could destroy a $1 billion satellite.[18] If America were to deploy space-based weapons, it would spend billions of dollars on equipment that China or another country would be able to cheaply and permanently destroy.[19] If these space weapon systems are damaged – either from the harsh environment or from attack – there is no way to repair them, increasing the risk of relying on them. Until space systems can be self-sustaining, be repaired cheaply, and be refueled cost effectively, they are not able to do what Earth-based systems can do. Additionally, space-based weapon systems require proper cyber defense, protection of the electromagnetic spectrum to prevent jamming, and defense of ground sites.[20]

Satellites are not able to attack points on the Earth as efficiently or as cost-effectively as land-based systems. For example, a constellation of 50 satellites would be required in order to attack any point on Earth within 45 minutes, which can be achieved by a single ballistic missile.[21] Assuming a country had a fleet of expensive co-orbital repair satellites, space-based systems could still only receive minimal repairs and maintenance after launch. Similarly, it would be cost prohibitive to have enough

satellites in order to deny an adversary access to space or to create space-based systems capable of intercepting Earth-launched ASATs.[22] It would be more cost effective to develop redundant systems than to deploy space-based weapons.[23] The United States must be careful not to engage in a strategy that provides it with a perceived short-term military gain, but ultimately sacrifices its long-term national security interests.[24] As the famous strategist B.H. Liddell Hart wrote, “a State which expends its strength to the point of exhaustion bankrupts its own policy, and future.”[25]

Another assumption, which has been accepted by an increasing number of U.S. strategists, is that the weaponization of space is inevitable. [26] This assumption, based on comparisons to other domains which have all been weaponized, is unfounded and dangerous. Following the logic of this misguided supposition, game theory postulates there is a lasting military advantage to being the first to deploy space-based weapons.[27] If America were first to weaponize space, any advantage would be fleeting. China and Russia already have the technology available to rapidly follow U.S. weaponization of space, and it would be in their interest to do so in order to ensure their continued access and to check possible U.S. space dominance.[28] Furthermore, the weaponization of space is not inevitable.[29] Weaponizing space is not in U.S. interests because it would destabilize the tenuous balance between militarization and peaceful use of space. Weaponization would also gravely reduce U.S. soft-power by harming relations with international partners and hindering America’s ability to lead in space. It would ultimately reduce space security while draining the treasury, since these weapons might never be able to deliver on their theoretical capabilities.[30] Another assumption is that technology will one day make space-based weapons viable, rendering practical their

theoretical capability to gain control over the Earth.[31] However, technology cannot overcome the physical and financial realities of space, including the harsh operating environment, limited defense options, the number of space weapons required to achieve existing terrestrial capabilities, and the exorbitant costs of maintenance and resupply systems.

Rise of Adversarial Counterspace Programs

Counterspace programs include the development of ground, air, sea, and space-based weapons that seek to temporarily or permanently disable an adversary's use of space-based assets. China is the primary counterspace threat to the security of the United States because of its space war strategy and the active development of "multidimensional counterspace capabilities."[32] According to the most recent "Worldwide Threat Assessment" published by the U.S. Director of National Intelligence, China plans "to have nondestructive and destructive counterspace weapons available for use during a potential conflict."[33] India, Russia, and rogue-regimes fall into the category of secondary counterspace threats, due to their more limited capabilities and intentions.

Space has become a critical center-of-gravity for U.S. military operations.[34] As a result, the Chinese People's Liberation Army (PLA) has adjusted its strategy to develop counterspace capabilities to maintain space control and to deny the use of space to the United States in a future war.[35] The PLA assessed that even limited space control would be required to counter U.S. space superiority.[36] Other Chinese national security documents reiterated this assessment and also noted that space superiority will be critical to future space operations.[37] China's official 2015 Defense White Paper referred to space as the "new commanding height in strategic competition."[38] The late 2015 creation of the PLA's Strategic Support Force centralized space command into one

organization, and infused the PLA's space doctrine with the requirement to deny the use of space to adversaries.[39] More than just broad statements of intent, China has pledged to fund its counterspace activities to ensure it can actually neutralize U.S. space assets during a possible military confrontation.[40]

China's counterspace strategy is largely focused on deterrence, which it assesses is strengthened by demonstrating that it has counterspace capabilities and that it is able and willing to use them.[41] These systems are designed to attack U.S. satellites in every orbit using both kinetic and non-kinetic means.[42] For example, the Chinese have explored jamming technology, collision between objects in space, kinetic energy weapons, space-based ground attack systems, lasers, high-power microwave weapons, particle beams, and electromagnetic pulse weapons.[43] China also possesses co-orbital satellite technology and offensive cyber operation capabilities that can be used for counterspace purposes.[44] While China has not acknowledged these counterspace advances, PLA writing specifically noted the need to destroy, damage, and interfere "with the enemy's reconnaissance … and communications satellites" as well as navigation and early warning satellites to "blind and deafen the enemy."[45]

The Chinese view their counterspace program as part of their strategy for anti-access area-denial operations against the United States during a possible regional conflict over Taiwan or in the South China Sea.[46] The Chinese counterspace program is not geared toward winning a potential U.S.-Chinese ASAT battle or inducing an arms race in space.[47] Instead, the Chinese assess that attacking U.S. space-based facilities would reduce the U.S. military's ability to conduct a war against China by depriving it of its reconnaissance, surveillance, communication, command, control, and other satellite-

based capabilities.[48] However, Chinese analysts do not seem to have considered the second order implications of attacking U.S. space assets, which could worsen the crisis by provoking the United States to attack the facility inside China which conducted the counterspace operation.[49]

The Chinese have avoided military to military engagement on space issues, which could help to diffuse some of the worst-case assumptions U.S. analysts make about China's intentions. As with the Soviet Union during the Cold War, China may purposely keep its space and counterspace programs shrouded in secrecy out of a sense of inferiority.[50] Increasing cooperation with China on space issues would yield insight into their intentions, the strengths and limitations of their program, and how they operate. This information would benefit U.S. understanding and analysis of China's capabilities.[51] However, such collaboration with China has been expressly forbidden by the U.S. Congress, which has long held deep suspicion of the Chinese space program.[52] Instead of preventing the Chinese from advancing its space and counterspace programs, Congress's position made China more determined to advance their space program independent of the United States.[53] While China may not intend to be a U.S. space competitor, it could become one if forced into such a position by Washington.[54] While China's counterspace program certainly poses a threat to U.S. national security, it would be unlikely to strike the United States in space during a low-intensity or Grey Zone conflict. Realistically, it would only attack U.S. space-based equipment if it was engaged in – or as preemption to – a major terrestrial war with the United States. Even then, if China attacked U.S. space assets it would immediately become an international pariah.[55]

While China has advanced its own counterspace capabilities, at the same time it has ironically criticized other countries' counterspace programs.[56] Despite these clear military developments, the ultimate goal of the overall Chinese space program is not well understood.[57] Various experts have asserted that the Chinese program is intended to build prestige and others have said that it is aimed at international cooperation and commercial development.[58] Given how much overlap there is in technology needed for peaceful space programs and for counterspace programs, misinterpretation of China's intentions could lead U.S. security experts to wrongly conclude that China is more focused on ASAT development than it actually is. The Chinese hold complex and, at times, conflicting views of space as being a place for collaboration and competition, and simultaneously having security, reputational, and commercial value.[59]

India's embryonic counterspace program poses a secondary threat to U.S. space security. ASAT programs create a classic security dilemma, where each adversary takes a series of actions intended to counter the other.[60] Such a dilemma could lead to an arms race in space between India and China. While India's counterspace program is not directly targeted against America, a conflict in space between Asian countries could create massive debris clouds which could, in turn, threaten U.S. space assets.[61] India began expressing interest in developing its own ASAT capabilities after China's 2007 ASAT test.[62] India assessed that it needed an ASAT because the Chinese possession of such a weapon put India's satellites at risk, leaving it vulnerable and with few other possibilities for deterrence against a Chinese attack.[63] In 2010, India's Defence Research and Development Organization (DRDO) announced the adaptation of a

ballistic missile defense system using a laser sensor and an exo-atmospheric kill vehicle into a hit-to-kill ASAT system.[64]

Russia maintains a counterspace capability, as witnessed by the November 2015 Nudol ASAT missile test.[65] In 2014, Russia also conducted a launch of three separate objects, one of which was able to make maneuvers and even “bump” into another satellite.[66] While these maneuvers could be designed to allow Russia to test new space-based repair vehicles, this same technology could be used to create sophisticated ASATs that could be used to disable or otherwise interfere with U.S. satellites. Despite these capabilities, Russian budgetary constraints – as well as a consistent policy of no first deployment of space weapons – make it a secondary threat to U.S. space security.[67] However, if there were a space arms race, Russia would likely put more money and research into the issue and it could become a very serious adversary in short order.[68]

Finally, given the fact that space presents an asymmetric advantage to any type of debris-causing explosion in space, any rogue state that has ballistic missile capabilities or access to other rudimentary ASAT technology could pose a threat to U.S. space security. Cuba, Iran, and North Korea have all exhibited the ability to interfere with satellite operations.[69] Furthermore, North Korean and Iranian ballistic missile technology – especially if these missiles could be paired with a nuclear warhead – could be used to inflict catastrophic damage to U.S. space systems.[70] Troublingly, during a conflict a country like North Korea might have little to lose by attacking U.S. space assets, while gaining significant tactical and strategic advantages.[71] Without a legally

binding international agreement, development of counterspace systems and ASAT testing will continue unconstrained.[72]

Degradation of International Governance

The general security and stability that have been hallmarks of the space domain are eroding.[73] The United States has not seriously focused on international governance issues of space, because it was able to rely on high barriers to entry and the enormous distances of space for protection. This provided an illusion of security, which was shattered by the May 2013 Chinese launch of a ballistic rocket into near geosynchronous orbit.[74] Despite that this test of a possible new ASAT weapon proved U.S.-satellites were vulnerable in every orbit, there are no rules that allow the United States to restrain or retaliate against perceived bad actors. The United States can ill-afford to ignore the lack of governance in space, especially as it becomes increasingly congested, contested, and competitive.[75]

While the United Nations (UN) was involved in ensuring space was open for peaceful use by all countries at the beginning of the space race, its five foundational space governance documents suffer from a lack of enforcement, low participation, and are increasingly irrelevant in the post-Cold War era.[76] The 1967 Outer Space Treaty has been signed by 129 countries, including all space faring nations, and remains the primary governing treaty of space.[77] However, it focuses on the use of space and does not govern space itself.[78] Additionally, it provides no mechanism to regulate private sector use or disputes of space.[79] Even basic principles such as satellite non-interference have not been extended beyond the U.S.-Russia relationship, injecting instability and risk into the system as more space actors emerge.[80] The UN has had no recent successes in advancing space governance through new space-related treaties.[81]

This has left space without a universally accepted set of rules for governance.[82] Instead, the governance of space has been relegated to a mixture of informal industry standards, unofficial UN guidelines, and bilateral agreements to prevent or mitigate potential satellite collisions and interference from space debris.[83] As stated in the Joint Publication on Space Operations, “there are relatively few legal restrictions on the use of space for military purposes.”[84]

The lack of U.S. international leadership to control space weapons hinders the creation of norms to govern space, causes other countries to question U.S. intentions, and makes China assume the worst of U.S. objectives.[85] Furthermore, the lack of U.S. leadership may actually be spurring further disorder in space by encouraging others to act in their own interests, accelerating their counterspace programs, and purposely thwarting the international system as a venue for space governance. Even allied nations may grow weary of continued U.S. obstructionism to creating an international system of governance.[86] In time, they may turn to other international players such as Russia or China to create an international order in space, making it even more difficult for U.S. initiatives to gain traction.[87]

The Prevention of the Placement of Weapons in Space Treaty (PPWT) provides an example of how China and Russia have tried to advance their own interests through existing international institutions. This China-Russia co-sponsored treated initially gained some international support, but ultimately failed when it was rejected by the United States in 2014. The PPWT lacked a credible verification mechanism, failed to prohibit Earth-based ASATs, and did nothing to prevent the stockpiling of counterspace weapons, allowing a country to abrogate the treaty then rapidly deploy offensive

weapons.[88] Essentially, the PPWT would allow the Chinese to appear to lead the fight against weaponization of space, while continuing to pursue and test their own ground-based ASAT technologies, even if testing resulted in debris that endured for centuries.[89] At the same time, the PPWT would limit the U.S. ability to develop systems to defend against Chinese or Russian advances in ASAT technology.[90] In keeping with China's "talk and take" strategy in the South China Sea,[91] China used the PPWT as a means to buy time while it advanced its own counterspace programs.[92]

Restoring Space Security

Despite these destabilizing trends, the United States can take steps to ensure the continued peaceful development of space and universal access to its benefits. As stated by Deputy Assistant Secretary of Defense for Space, "a more cooperative, predictable environment enhances our national security and discourages destabilizing behavior."[93] The national security requirements in space are complex, requiring their own unique solutions and requiring a strong leader – preferably the United States – to shepherd the international community toward a lasting system of governance. This international system of governance will allow the United States to identify and pursue nations who cause damage to the global common of space. At the same time, the United States must improve its deterrence, harden its space assets, and advance its space situational awareness capabilities. Finally, it must reorganize its bureaucracy so that it can be more dynamic, efficient, and responsive to the rapidly evolving domain of space. Should Washington continue to ignore these options to improve space security, then it must accept the risk inherent in that choice.

Renovating International Space Governance

Throughout history, the commons – those domains and resources which are unowned and to which all have access – have required a strong leader to enforce governing rules.[94] Of the current space powers, only the United States can fulfill this role for the common of space, but it seems unable or unwilling to do so. Even if America were interested in assuming the leadership role in space, there are currently few international rules and accepted norms which the United States could use to punish or compel states it judges are not behaving in an acceptable manner.[95] The inability of the United States to criticize China – or any other country – for pursuing dangerous and destabilizing counterspace programs is caused by the lack of a binding rules-based system founded on relevant, contemporary treaties or customary international law.[96]

Customary international law is a powerful tool, which carries the weight of treaties. When looking at how to shape the governance of space, the United States can leverage the strength of customary international law to its advantage. Unlike treaties, customary international law does not require unanimous consent of other countries and is binding on all nations, even those that did not contribute to the pattern of behavior which ultimately creates the rules.[97] This would allow the United States to exert pressure on China, for example, to stop violating accepted norms, even if China did not formally help to establish them.[98] However, the more countries that participate in the pattern of behavior that leads to the creation of the customary international law, the stronger rules will be. Furthermore, additional weight is given to the behavior of those countries that have more of an interest in what the emerging customary international law protects.[99] For space, this would mean that spacefaring nations' behavior would help to establish

the customary international law, with U.S. behavior counting the most since it is undisputedly the largest space actor.[100]

One way for the United States to shape customary international law would be through the use of executive agreements on space issues. Executive agreements would allow the United States increased flexibility when compared with treaties because they could be negotiated by the executive branch in a timely manner without the need for ratification by the Senate, though they are usually made with Congressional consent.[101] Executive agreements can be bilateral or multilateral depending on the ultimate goal and could be expanded or adjusted as needed to meet the rapidly changing challenges of space and space technology. They would give the United States total control over the process, timing, and scope of new rules, allowing it to focus on issues of the highest importance to its space security. Executive agreements would help the United States identify nefarious actors and use the full range of national power to punish them, while bolstering the taboo on space warfare.[102] The United States has already unilaterally implemented some transparency and confidence building measures (TCBMs) such as notifications, coordination, and exchanges to mitigate risk of mishaps and miscommunication.[103] Use of executive agreements would help to codify these TCBMs, ensure Washington receives reciprocal information from other space powers, and create international norms where such behavior is expected of all spacefaring nations.

Executive agreements concerning space activities made by the United States should aim to achieve the following six goals:[104] (1) Eliminate or severely restrict debris causing activities in space; establish penalties for any violations. The most problematic ASATs would be eliminated through this rule. Verification rules and agreements to

eliminate kinetic-kill weapons could be created and legally enforced. (2) Create self-defense zones around spacecraft, allowing satellites to protect themselves against would-be intruders. Any aggressive actions taken by another nation within this zone would be assumed to indicate intent to harm the space asset. (3) Establish clear rules to avoid interference with other space objects, including jamming activities and use of lasers on satellites.[105] (4) Improve space situational awareness. The United States has already carved out a leadership position in this area, by providing space situational awareness information to other countries and companies.[106] (5) Improve communication between spacefaring entities, possibly through a new international organization as described below. (6) Improve traffic management and administration activities of space. All six goals would increase the level of governance in space, while reducing the potential for conflict.

Executive agreements aimed at creating satellite self-defense zones can anchor themselves in established treaties. The Outer Space Treaty stated that space activities must following international law and the UN Charter.[107] Article 51 of the UN Charter permits countries to take actions for their self-defense, a principle that could also be applied to space.[108] Defensive measures, which would be further clarified in the agreements, would be permitted and could include maneuvering the threatened satellite out of the way, or even disabling or knocking the intruding satellite out of orbit.[109] The Convention on International Liability for Damage Caused by Space exempted signatories from liability to damage of other object in cases of “gross negligence from an act or omission done with intent to cause damage.”[110] Thus, the owner of a satellite

under threat could legally destroy the aggressor's satellite, though how to do so responsibly without creating debris would be crucial to figure out.

An international organization focused on space governance should be created. This organization could help write the definitions and enforcement criteria required to ensure the success of new international agreements and could also serve as a clearing house for space situational awareness information, traffic management, registration of space assets, and other administrative issues. The organization could formalize U.S. agreements made with over 60 other countries, commercial partners, and multilateral organizations to share space situational awareness information.[111] The organization may need to be created outside of the UN to increase its chances of success and to ensure that it would effectively advocate for U.S. interests. The organization could be similar to the one proposed in the European Union's International Code of Conduct (ICoC) on Space, which was supported by most U.S. allies and therefore may help Washington to garner initial support.[112] The organization could make member states responsible for contributing to space situational awareness by tracking and self-reporting the location of satellites registered by each state. States that did not accurately report information leading to satellite damage or debris could be held accountable.[113]

The organization could also provide a forum for participants to give notice of planned actions requiring exceptions to the emerging space norms. Such actions might include removing a satellite from space for safety or security reasons using a ground-based missile or having a co-orbital repair satellite traverse the self-defense zone of another country's satellite.[114] This entity could also be used to share and coordinate

information between member states about planned maneuvers, use of lasers for approved reasons, or other actions that could interfere with another satellite.[115] While notification would not necessarily authorize members' actions, it could help reduce misunderstandings and lower tensions, decreasing the chances of conflict.

Since Beijing's counterspace program presents the most serious threat to U.S. space interests, Washington could initially focus on creating executive agreements with China. At the beginning of the process, these negotiations could concentrate on issues where common agreement would be easiest to find, such as non-interference with early warning systems, reconnaissance satellites, and other sensitive spacecraft.[116] After initial successes, Washington could expand the scope of what it included in executive agreements, according to what was in its best interests. The United States could even seek other security concessions through the process of negotiating these executive agreements.[117] For example, there are indications that the Chinese would be willing to consider a Fissile Material Cut-Off Treaty – a top priority of several past U.S. administrations – in exchange for U.S. guarantees not to place weapons in space.[118]

Executive agreements may be met by some resistance from the international community, with some countries preferring to continue to work through established UN mechanisms. Since executive agreements are negotiated by the executive branch, they do not represent permanent agreements with the United States itself, as do treaties. Therefore, some countries' leaders may be hesitant to use their political capital to sign-up to executive agreements that are domestically controversial, since there would be no automatic guarantee that successive U.S. administrations would abide by the agreement.

Dual-use technology has been a stumbling block to the progress of previous international space arms-control agreements. America should not let problems associated with dual-use technology prohibit it from establishing space norms.[119] Instead, it could start the process by seeking a limited ban against the placement of technology in space that can clearly only be used as a weapon, such as kinetic-energy, proximity explosion, and other debris causing devices.[120] Dual use technology normally intended for peaceful and productive uses – such as co-orbital repair vehicles – should not be outlawed, only the misappropriation of these technologies as weapons.[121] In other words, the international norms should be directed at regulating the behavior of space actors to ensure that there are clear punishments for the nefarious use of space-based platforms. These norms can be adjusted to reflect future consensus, updated science, or new developments in technology. Similarly, a verification mechanism could be created after the establishment of norms. The complexity of creating such a verification mechanism should not continue to prevent the United States from establishing basic governing rules.[122] The scientific community and commercial sector should be consulted to help draft and advance new space verification and inspection regimes.[123] The United States must act as soon as possible in order to formulate responses to these complicated issues and hold accountable those who may attempt to engage in hostile actions in space.[124]

Another issue that makes space security initiatives so difficult for the United States is the fact that space has become intertwined with ballistic missiles and ballistic missile defense.[125] One way for the United States to handle this issue would be to make a clear distinction between ASAT weapons in space – those that are intended for use

against other satellites – and space-based anti-ballistic missile (ABM) capabilities, since these would be targeted at Earth. Such a distinction might allow the prohibition of those weapons for which broad international consensus can be established, while leaving the more sensitive ABM debate for a future date.[126]

Improving Space Deterrence

The United States does not have to make a false choice between no defense in space or deploying space weapons.[127] Enhancing deterrence is a powerful way to improve the security of space without weaponizing it. As stated by General Hyten, Commander of U.S. Strategic Command, "We have to deter bad behavior on space. We have to deter war in space. It's bad for everybody. We could trash that forever."[128] Washington should have an explicit policy that the use of force in space will not be tolerated and that it reserves the right to respond as it sees fit.[129] Such a message would be intended to reassure the domestic space industry and foreign partners of the U.S. commitment to protecting space, while also serving as a warning to potential enemies. Space assets should be explicitly protected by the national security structure though a formal policy declaration asserting that an attack on U.S. space assets will be responded to in the same manner as an attack on the U.S. homeland.[130] The United States should consider attacks on terrestrial facilities supporting space assets as valid targets in response to – or in preemption of – attacks on U.S. space infrastructure, while avoiding the need to place offensive weapons in space itself.[131] This would include research and development or other facilities that support an enemy's ability to conduct war in space.[132] The threat of retaliatory action against a would-be aggressor increases the cost calculation, which should help to deter it from considering an attack in space.[133]

Current U.S. ballistic missile technology gives America all of the ASAT capability that it would need to hold other nation's space capabilities at risk.[134] While China and Russia would also be able to adapt their ballistic missiles to serve as ground to space weapons, the United States is in the best position to rapidly adapt its missiles to an ASAT mission.[135] Therefore, ballistic missiles provide an existing credible ASAT capability and deterrence against other countries' counterspace programs.[136] This further reduces the need to spend billions of dollars in research and development for new anti-satellite weapons – even if a space war were inevitable – since the United States has the weapons it would need to fight such a war.

America has already achieved strategic stability in space, which makes offensive movements imprudent.[137] Placing weapons in space could be viewed as an offensive action by adversaries, or at least as an action that upsets the current strategic balance. Space-based weapons would make attractive targets for an adversary's offensive action since it would be in its interest to attack these weapons. This, in turn, makes space less stable and means such weapons are not in the U.S. strategic interest. Unlike other domains, military power in space does not ensure space control. Therefore, deterrence ultimately would be a better option for the protection of U.S. space assets than placing weapons in space.[138] The strategy for space must be about achieving the best possible policy that will continue to ensure space is a free and open common, while dissuading any other nation from aggression by imposing costs and denying benefits derived from an attack in space.[139]

Gaps in space situational awareness can be exploited by malicious actors to conduct space attacks, while making it difficult for the international community to

attribute their actions.[140] Additionally, increasingly small satellites could put a strain on the ability of the United States to track those objects with current technology.[141] The United States must enhance its existing capabilities to monitor activities in space and to develop increasingly accurate sensors, in order to be able to identify nefarious actors and provide attribution for any violations of norms, laws, or agreements.[142] Such a system would enhance deterrence, since aggressors would be less likely to act if their actions could be attributed. Beyond space situational awareness, America must have the proper intelligence about the plans and intentions of space adversaries and competitors in order to properly defend itself, thwart new anti-satellite technology, and preemptively attack ground-based installations if needed.[143] To that end, Washington must expand its space surveillance network, to better understand adversaries' locations, capabilities, and movements in space.[144]

A key component of any space strategy should be for the United States to invest in technology and programs that will help to harden and protect its space-based assets. Equipping U.S. military and civilian satellites with countermeasures can be an effective, albeit a costly, means of protecting them from attacks. Typical countermeasures from attacks include hardening satellites, providing them with maneuver capabilities, having redundant systems, being able to quickly repair or replace damaged or destroyed equipment, dispersion of satellites into wide areas of space, and denial and deception about a satellite's capabilities.[145] Certain countermeasures can be used to protect satellites from specific types of attacks. For example, equipping satellites with shuttering equipment can provide effective countermeasure against laser attacks.[146] Countermeasures can deter a country from attacking a satellite, because they increase

the chances of that attack failing, while giving the United States justification for conducting a counterattack.

The United States must balance the cost of these countermeasures against the threat and the intended benefit the countermeasures provide. In space, attacking is almost always cheaper than defending, especially when the cost of shielding spacecraft can be approximately $10,000 per pound.[147] Moreover, space assets are not designed to stay in space indefinitely, and the cost of fully hardening them could be more than the cost to replace them. The U.S. priority should be to ensure that its space assets are more resilient and able to withstand or avoid an attack.[148] Increased situational awareness, redundancy, and cost-effective hardening of satellites and their ground-based links should be a key goal of a space strategy.[149]

The United States must develop the capabilities to ensure that it would be able to continue to fight in all other domains, even without access to its space assets.[150] This can be achieved through redundant systems, the ability to quickly launch replacement systems, or the ability to use other platforms to replace capabilities provided by space.[151] Drones and new, compact satellites could also provide limited reconstitution and resilience capabilities, should large U.S. platforms be attacked. Jamming U.S. space equipment is a concern that could play a large role in a future conflict for control or denial of space.[152] Jamming systems against land-based receiving stations are easy to deploy and can be difficult to identify during a crisis.[153] Space-based jamming systems are best suited for blocking uplink communications, but may not be easy to employ during an actual conflict since they would have to maneuver into place in order to be effective and military satellites may be able to maneuver to avoid them.[154]

Demonstrating the capability to continue to use its advanced military systems even if its space assets were jammed or incapacitated could also serve as a deterrent against an attack in space, since the consequence of an adversary breaking the taboo on space war would not be worth the military objective.

The United States should establish formalized agreements with partner countries allowing U.S. use of partner satellites during a conflict.[155] This would provide the U.S. with additional capacity when needed, while increasing the number of satellites an adversary would have to target to deny U.S. use of space-based technology. Similarly, America could have agreements to discreetly mount redundant systems on the payloads of partner countries to provide additional capabilities in the event of an attack.[156] Another deterrent measure would be the creation of a space alliance. The alliance would act as a collective deterrent against an attack in space and provide legitimacy for member states to respond to such an attack.[157] Members of the alliance could agree to equip appropriate satellites with situational awareness instruments, to create a system from which all member states would benefit.[158] Measures taken to defend U.S. space technology should be done in conjunction with other multilateral efforts rather than in a vacuum. In conjunction with partners, the United States will be better suited to protect its space equipment and reduce conflict, while making space safer for American-owned platforms, its commercially owned assets, and the peaceful use of space for all mankind.[159]

Overhauling Domestic Space Institutions

The United States should transform its domestic space institutions with the goal of increasing the unity of effort between civilian and military space programs, enabling them to create comprehensive policies and strategies while reducing redundancies.

U.S. policies should consider space issues in the broad spectrum of other national security issues, increasing the visibly and importance of space in the national dialogue. A national Department of Space would be the best solution to provide the level of coordination and gain increased efficiency from current resources.[160] Space is not an issue which is suited for a decentralized policy formulation mechanism, so common in the U.S. Federal system.[161] Currently, U.S. space infrastructure is spread across the Department of Defense (DOD), multiple civilian agencies, and the private sector.[162] In addition to hindering the effective management of its own space policy, this system restricts the United States from playing an active role in leading the international effort to govern space.[163]

A Space Department would pull all space-based national security assets into one department. The department would have cabinet-level coordination of the U.S. space effort, allowing it to formulate the best possible strategy while also maximizing budgetary efficiency. As the number stakeholders has grown, so too has the complexity of space issues. U.S. space policy formulation should reflect this complexity, making it too large for either the National Aeronautics and Space Administration or the DOD to handle, as each is ill-suited for the task.[164] The Space Department would be able to have a fully fleshed out space policy, taking into consideration theory, doctrine, military needs, national security requirements, the needs of the scientific community, technological requirements, the industrial base, political issues, and public opinion.[165] The Secretary of the Space Department would be a full member of the National Security Council, allowing him or her to develop, coordinate, and implement a strategy that would have a greater chance of success than one coming from a parallel structure

outside of the National Security Council. In the words of Dr. Everett Dolman, the problem with “current U.S. space strategy is that it most certainly is not decisive, guiding, or illuminating. In a word, it is not *strategic.*”[166]

The Secretary would be given control over the space budget. This would be crucial to allow him or her to direct and execute a coherent strategy. With budgetary control, the Space Secretary would also be able to leverage investments in the commercial, civilian, defense, and intelligence sectors. This power would allow him or her to advance U.S. capabilities in each sector, advance initiatives that enhance U.S. access to space, and reduce existing impediments to the use of space for national security purposes.[167] The current ad hoc coordination of space activities and lack of integration and interoperability of space systems between military services and civilian agencies has increased costs and reduced the productivity that should be expected from space dollars. Critics of the current DOD system worry that the lack of efficiency has already denigrated U.S. space capabilities.[168] A Space Department would not be constrained by the slow procurement systems that plague the DOD and would create new systems designed to move at the speed of technology today.

In the void of any other more powerful or influential bureaucracies involved in space, the DOD has taken on a large role in coordinating space policy. Such an arrangement may not be in the best interest of U.S. national security. The DOD is by far the best U.S. government department at developing long-term plans and strategies, which influence policy makers. However, the plans and strategies that it creates are made through its military lens, focusing on military issues and perceived military threats. Therefore, for better or worse, U.S. space policy tends to have a distinct military tone to

it. Space, however, as outlined above, is a unique domain which requires its own unique solutions. Without a higher authority actively providing oversight and coordinating U.S. space programs across agencies and departments, the DOD will continue to be the de facto go-to strategist. If, as a result of this DOD dominated space policy, the United States were to develop a fully functional space weapons program, it would be difficult to justify scrapping it in favor of an agreement that pursued banning counterspace programs and peace in space.[169] As a result, Washington would be unlikely to lead the international effort to limit the weaponization of space, even though this may be in the best interests of the country, its space assets, the space industry, and the economy writ large. Currently, the DOD receives the largest percentage of the overall space budget, and therefore has a greater ability to advocate for its programs, perpetuating the military focus of U.S. space policy.[170] What the United States needs in space is a strategy that drives resources, instead of resources driving the strategy.

Getting the right balance between military and civilian interests in the U.S. space program is critical. Too little focus on defense issues could lead to critical vulnerabilities to U.S. space security going unnoticed and unfunded. Vulnerabilities in space could result in vulnerabilities to U.S. security on Earth.[171] Too little attention to civilian programs could restrict potential economic and scientific benefits they provide, giving the impression that the United States would rather arm itself in space than continue to explore it and peacefully exploit it commercially.[172]

In the absence of a strong, empowered cabinet-level coordinating agency for space policy and strategy formulation, the White House must play an active role. The civilian political leadership has, for too long, abdicated its role in creating strong policies

and strategies that allow the United States to lead in space. Space is, after all, a subset of broader political activity.[173] A specific, detailed space strategy implemented at the level of the President is currently the only way to coordinate all of the pieces of the bureaucracy that deal with space, while also leveraging international partners and the international system.[174] Any national strategy for space must come from the center of government and must be specific enough that all of the collaborating agencies know what the end objectives are and know what their specific roles are.[175] The resurrection of the National Space Council[176] – if intended as a way to create a strategy using all elements of national power – is a step in the right direction, though its effectiveness remains to be seen.[177]

In conclusion, while the United States has built a glass house, it is able to protect that house from the stones that threaten it with the right policies and strategy. America needs to focus on space security, while accounting for the unique risks found in space. It must accurately assess the capabilities and intentions of potential adversaries' counterspace programs, while leading the effort to improve international governance. Washington needs to improve the defense and deterrence of its space assets and reform domestic space institutions, in order to secure the peaceful use of space for generations. After ensuring space security for the orbits around the Earth, America will once again find itself as the vanguard of space as it continues to explore ever distance reaches of the solar system.

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[76] The five foundational agreements are: the Outer Space Treaty (1967) http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html, the Space Rescue Agreement (1968) http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/rescueagreement.html, the Space Liability Convention (1972) http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html, the Registration Convention (1975) http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/registration-convention.html, and the Moon Agreement (1979) http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/moon-agreement.html. The moon treaty was not signed by any major spacefaring nations and marked the end of the UN's ability to advance space governance issues.

[77] Roger D. Launius, "National Security, Space, and the Course of Recent U.S. History," in *Harnessing the Heavens: National Defense through Space,* ed. Paul G. Gillespie and Grant T. Weller (Chicago, IL: Imprint Publications, 2008), 11.

[78] Henry R. Hertzfeld, Brian Weeden, and Christopher D. Johnson, "Outer Space: Ungoverned or lacking Effective Governance? New Approaches to Managing Human Activities

in Space," *SAIS Review of International Affairs* 36, no. 2 (Summer-Fall 2016): 16, https://search.proquest.com/docview/1856846740?accountid=4444 (accessed January 20, 2018).

[79] Peter L. Hays, "Space Law and the Advancement of Space Power," in in *Toward a Theory of Spacepower,* eds. Charles D. Lutes and Peter L. Hays (Washington, DC: National Defense University Press, 2011), 309-312.

[80] Moltz, *Crowded Orbits,* 144. Satellite non-interference was part of the U.S.-Soviet space consensus, which was transferred to the U.S-Russian relationship. However, this concept of non-interference has not been extended to other space powers such as China. Separately, as an example of how more space actors have emerged one can look at the number of countries with satellites in orbit and the number of countries capable of launching satellites into orbit from 1966 to 2017. In 1966, three countries (the United States, the USSR, and France) could launch satellites, and six had satellites in space. Today, over 62 countries have sole control over at least one satellite, with many additional countries participating in multinational satellite ventures, and at least 25 have space launch capabilities. Union of Concerned Scientists, "UCS Satellite Database."

[81] Frank G. Klotz, *Space, Commerce, and National Security* (New York: Council on Foreign Relations, 1999), 23, https://www.cfr.org/report/space-commerce-and-national-security (accessed November 20, 2017).

[82] Hertzfeld, Weeden, and Johnson, "Outer Space: Ungoverned or lacking Effective Governance," 16.

[83] Zenko, *A Code of Conduct for Outer Space*, 2-3.

[84] U.S. Joint Chiefs of Staff, *Space Operations,* Joint Publication 3-14 (Washington, DC: U.S. Joint Chiefs of Staff, May 29, 2013), V-8, http://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_14.pdf (accessed December 13, 2017).

[85] Blazejewski, "Space Weaponization and US-China Relations," 43-44.

[86] Johnson-Freese, *Space Warfare in the 21st Century,* 156-158.

[87] For example, in 2013, the European Space Agency announced that it was going to seek a closer alliance with China. Kevin Holden Platt, "Europe Eyes China in Space Race," *Der Spiegel,* February 8, 2013, http://www.spiegel.de/international/europe/esa-mulls-new-alliance-as-china-becomes-space-leader-a-882212.html (accessed February 21, 2018). As recently as 2017, Chinese and ESA astronauts had engaged in joint training. European Space Agency, "ESA and Chinese Astronauts Train Together," August 24, 2017, http://m.esa.int/Our_Activities/Human_Spaceflight/Astronauts/ESA_and_Chinese_astronauts_train_together (accessed February 21, 2018).

[88] Conference on Disarmament, *Note Verbale Dated 2 September 2014 from the Delegation of the United States of America to the Conference on Disarmament addressed to the Acting Secretary-General of the Conference transmitting the United States of America analysis of the 2014 Russian-Chinese draft treaty on the prevention of the placement of weapons in outer space, the threat or use of force against outer space objects,* September 3, 2014,

CD/1998, https://documents-dds-ny.un.org/doc/UNDOC/GEN/G15/007/57/PDF/G1500757.pdf?OpenElement (accessed November 22, 2017).

[89] U.S.-China Economic and Security Review Commission, *China's Position on a Code of Conduct in Space*, 3.

[90] Paul Meyer, "Dark forces awaken: the prospects for cooperative space security," *The Nonproliferation Review* 23, nos. 3-4 (2016): 497, https://doi.org/10.1080/10736700.2016.1268750 (accessed January 20, 2018).

[91] U.S.-China Economic and Security Review Commission, *China's Position on a Code of Conduct in Space*, 4.

[92] Blazejewski, "Space Weaponization and US-China Relations," 39-40.

[93] Schulte, "China and the New National Security Space Strategy."

[94] Hertzfeld, Weeden, and Johnson, "Outer Space: Ungoverned or lacking Effective Governance," 20.

[95] Michael Krepon, "Promoting US National and Economic Security Interests in Space," *House Armed Services Committee, Subcommittee on Strategic Forces* (January 28, 2014) http://docs.house.gov/meetings/AS/AS29/20140128/101680/HHRG-113-AS29-Wstate-KreponM-20140128.pdf (accessed January 31, 2018).

[96] Cornell Law School provides the following definition of customary international law: "Customary international law refers to international obligations arising from established state practice, as opposed to obligations arising from formal written international treaties. According to Article 38(1)(b) of the International Court of Justice Statute, customary international law is one of the sources of international law. Customary international law can be established by showing (1) state practice and (2) opinio juris. Put another way, 'customary international law' results from a general and consistent practice of states that they follow from a sense of legal obligation." See "Customary International Law," *Legal Information Institute,* https://www.law.cornell.edu/wex/customary_international_law (accessed February 10, 2018).

[97] Koplow, "ASAT-isfaction," 1222-1229.

[98] The exception to the universal binding nature of a piece of customary international law would be the "persistent objector" state, which consistently and publically rejects the norm as it is emerging. Michael John Garcia, *International Law and Agreements: Their Effect upon U.S. Law*, (Washington, DC: U.S. Library of Congress, Congressional Research Service, February 18, 2015) 16-17, https://fas.org/sgp/crs/misc/RL32528.pdf (accessed February 11, 2018).

[99] Koplow, "ASAT-isfaction," 1224.

[100] For a perspective on how customary international law would not be sufficient to achieve a full ban on ASATs, see Ibid.,1241. This shortcoming of customary international law may be overcome through the executive agreements which could cover specific technologies and even behaviors. While nothing would be as comprehensive as a full treaty, each of these measures

would help to increase the governance of space, which is the ultimate objective to protect U.S. space assets.

[101] For additional background on Executive Agreements, including their use and status in U.S. law, how they are commonly used, and a comparison of Executive Agreements and Treaties, see Garcia, *International Law and Agreements,* 2-21.

[102] Johnson-Freese, *Space as a Strategic Asset*, 246.

[103] Robert A. Wood, "Remarks at the 70th UN General Assembly First Committee Thematic Discussion on Outer Space, Disarmament Aspects," *United Nations,* (October 23, 2015), https://2009-2017-usun.state.gov/remarks/6920 (accessed February 10, 2018).

[104] The six goals listed in this section were adapted from similar suggestions in Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 130-134 and Joan Johnson-Freese, *Space as a Strategic Asset* (New York: Columbia University Press, 2007), 247.

[105] Restrictions on the use of lasers to damage, dazzle, or blind satellites could be based on other international treaties that restrict usage of lasers during peacetime, such as the Prevention of Dangerous Military Activities Agreement and the Incidents at Sea agreement. Using lasers to dazzle, blind, or damage satellites could be deemed acts of war, while using lasers for range finding, communication, and information gathering in space would be permitted. Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 132-134.

[106] Zenko, *A Code of Conduct for Outer Space*, 2.

[107] U.S. Joint Chiefs of Staff, *Space Operations,* V-8 - V-9.

[108] Johannes Wolff, "'Peaceful Uses' of Outer Space Has Permitted Its Militarization – Does It Also Mean Its Weaponization?," *Disarmament Forum* 1, no. 1 (2003): 8, http://www.unidir.org/files/publications/pdfs/making-space-for-security-en-346.pdf (accessed February 21, 2018).

[109] Chow, "Stalkers in Space: Defeating the Threat," 95.

[110] David C. DeFrieze, "Defining and Regulating the Weaponization of Space," *Joint Forces Quarterly* 74, no. 3 (2014): 112, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-74/jfq-74_110-115_DeFrieze.pdf (accessed November 22, 2017).

[111] Douglas Loverro, "Fiscal Year 2017 National Defense Authorization Budget Request for National Security Space Activities," *House Armed Services Committee, Subcommittee on Strategic Forces,* 114th Cong., 2nd sess., March 15, 2016, 9-11, http://docs.house.gov/meetings/AS/AS29/20160315/104620/HHRG-114-AS29-Wstate-LoverroD-20160315.pdf (accessed February 10, 2018).

[112] Meyer, "Dark Forces Awaken," 499-501.

[113] Moltz, *Asia's Space Race*, 216.

[114] For example, in 2008 the United States modified the Aegis Ballistic Missile Defense system to destroy a National Reconnaissance Office satellite that threatened to deorbit and release poisonous hydrazine gas into the atmosphere. Clearly, there must be a mechanism to permit the destruction of such a satellite before it posed a danger to life on Earth. Therefore, the United States could have given notice to such an organization of its intention to destroy the satellite without being in violation of its obligations under the proposed agreements. Brian D. Green, "Space Situational Awareness Data Sharing: Safety Tool or Security Threat?," *The Air Force Law Review* 75 (2016): 74-76, https://search-proquest-com.usawc.idm.oclc.org/docview/1906107483?accountid=4444 (accessed January 13, 2018).

[115] While international space agreements may require satellite owners be notified about some provocative activities, the level of detail of information required would have to be worked out in the agreements. Some countries may wish to withhold full details for national security reasons. In general, the sharing of space situational awareness information could follow the current "tiered" sharing system used by the United States. Theresa Hitchens and Joan Johnson-Freese, *Toward a New National Security Strategy: Time for a Strategic Rebalancing* (Washington, DC: Atlantic Council, 2016), 33-37, http://www.atlanticcouncil.org/images/publications/AC_StrategyPapers_No5_Space_WEB1.pdf (accessed November 22, 2017).

[116] Moltz, *Asia's Space Race*, 214.

[117] Blazejewski, "Space Weaponization and US-China Relations," 45-46.

[118] Loring Wirbel and Dave Webb, "Toward a Common Space Policy in a Multilateral World," *Peace Review: A Journal of Social Justice* 22, no. 1 (February 2010): 43, https://doi.org/10.1080/10402650903539919 (accessed February 14, 2018).

[119] Wolff, "'Peaceful Uses' of Outer Space Has Permitted Its Militarization, 6.

[120] Ross Liemer and Christopher F. Chyba, "A Verifiable Limited Test Ban for Anti-satellite Weapons," *Washington Quarterly* (July 2010): 154, https://www.princeton.edu/sgs/publications/LiemerChyba_Verifiable-Limited-Test-Ban.pdf (accessed January 5, 2018).

[121] DeFrieze, "Defining and Regulating the Weaponization of Space," 111-113.

[122] Steer, "Global Commons, Cosmic Commons," 14.

[123] Meyer, "Dark Forces Awaken," 500.

[124] Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 123.

[125] Shen, "A Collaborative China-US Approach to Space Security," 522-523.

[126] Another school of thought on how to set aside the ABM issue would be to permit ASAT weapons in low Earth orbit (LEO) while prohibiting them at higher orbits, thus both ASATs and ABMs could be deployed to LEO. In addition to not having to restrict ABM development, the logic here is that objects attacked by ASATs in LEO would deorbit faster than other orbits, limiting how long the debris from the conflict would last. However, such an exception – if not properly scoped and framed – could have the unintended consequence of allowing ASAT

programs to continue unabated. Furthermore, any weapon designed for LEO could be easily adapted for more distant orbits. Shen, "A Collaborative China-US Approach to Space Security," 532-533. Another glaring problem with this approach is that the 2007 Chinese ASAT test was in LEO and its debris did not deorbit. In fact, 97% of that debris is still in orbit, with 79% expected to remain in orbit after a century. Brian Weeden, *2007 Chinese Anti-Satellite Fact Sheet* (Washington, DC: Secure World Foundation, November 2010), https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf (accessed February 14, 2018).

[127] Michael E. O'Hanlon, "Balancing U.S. Security Interests in Space," in *Toward a Theory of Spacepower,* eds. Charles D. Lutes and Peter L. Hays (Washington, DC: National Defense University Press, 2011), 137.

[128] Clifton B. Parker, "Deterrence in space key to U.S. security," *Center for International Security and Cooperation,* January 24, 2017, http://www.stratcom.mil/Media/News/News-Article-View/Article/1059106/deterrence-in-space-key-to-us-security/ (accessed January 5, 2018).

[129] Morgan, *Deterrence and First-Strike Stability in Space,* xiv.

[130] Larned, Swan, and Swan, *National Security Space Strategy Considerations*, 19.

[131] Justin Anderson, Walt Conrad, and Sarah Jacobs Gamberini, "International Negotiations, Emerging Space Powers, and U.S. Efforts to Protect the Military Use of Space," *Space and Defense* 7, no 1 (Winter 2014): 23-24, https://s3.amazonaws.com/academia.edu.documents/33821657/Space__Defense_Vol_7_No_1.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1515863293&Signature=42OPfZg8raOErIpyajut5SpriO0%3D&response-content-disposition=inline%3B%20filename%3DIdentifying_America_s_Vital_Interests.pdf (accessed January 13, 2018).

[132] Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 126.

[133] Baines, "Prospects for 'Non-Offensive' Defenses in Space," 31.

[134] Laura Grego, *Public Interest Report: The Anti-Satellite Capability of the Phased Adaptive Approach Missile Defense System* (Washington, DC: Federation of American Scientists, 2011), 4, https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/2011-winter-anti-satellite.pdf (accessed February 21, 2018).

[135] Moltz, *Crowded Orbits*, 140.

[136] Grego, *A History of Anti-Satellite Programs*, 11-12.

[137] Johnson-Freese, *Space as a Strategic Asset*, 243.

[138] Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 124.

[139] James P. Finch and Shawn Steene, "Finding Space In Deterrence: Toward a General Framework for 'Space Deterrence'," *Strategic Studies Quarterly* 5, no. 4 (Winter 2011): 13-14,

http://www.airuniversity.af.mil/Portals/10/SSQ/documents/Volume-05_Issue-4/FinchSteene.pdf (accessed January 20, 2018).

[140] Green, "Space Situational Awareness Data Sharing" 78-81.

[141] Chow, "Stalkers in Space: Defeating the Threat," 97.

[142] Gene H. McCall and John H. Darrah, "Space Situational Awareness: Difficult, Expensive – and Necessary," *Air and Space Power Journal* 28, no. 6 (November-December 2014): 8-11, http://www.airpower.au.af.mil/apjinternational/apj-c/2015/2015-3/2015_3_03_mccall-E.pdf (accessed January 31, 2018); Moltz, *Crowded Orbits*, 144.

[143] Larry R. Moore, "China's Antisatellite Program: Blocking the Assassin's Mace," *Asian Perspective* 38, no. 1 (January-March 2014): 174-176, https://search-proquest-com.usawc.idm.oclc.org/docview/1501333921?pq-origsite=summon (accessed January 13, 2018).

[144] Johnson-Freese, *Space as a Strategic Asset*, 245.

[145] Baines, "Prospects for 'Non-Offensive' Defenses in Space," 40-45

[146] DeBlois et al., "Space Weapons: Crossing the U.S. Rubicon," 58-59.

[147] Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 128-129.

[148] Morgan, *Deterrence and First-Strike Stability in Space,* 44-45.

[149] Krepon, Hitchens, and Katz-Hyman, "Preserving Freedom of Action in Space," 126.

[150] B.T. Cesul, "A Global Space Control Strategy," *Air & Space Power Journal* 28, no. 6 (November-December 2014): 71-73, http://www.airuniversity.af.mil/Portals/10/ASPJ/journals/Volume-28_Issue-6/V-Cesul.pdf (accessed January 20, 2018).

[151] Michael E. O'Hanlon, *Neither Star Wars Nor Sanctuary: Constraining the Military Uses of Space* (Washington, DC: Brookings Institution Press, 2004), 128-130.

[152] Wright, Grego, and Gronlund, *The Physics of Space Security*, 118-123.

[153] Theresa Hitchens, "Monsters and Shadows: Left Unchecked, American Fears Regarding Threats to Space Assets Will Drive Weaponization," *Disarmament Forum* 1, no. 1 (2003): 20, http://www.unidir.org/files/publications/pdfs/making-space-for-security-en-346.pdf (accessed February 21, 2018).

[154] Baines, "Prospects for 'Non-Offensive' Defenses in Space," 32-33.

[155] U.S. Joint Chiefs of Staff, *Space Operations,* A-2.

[156] Morgan, *Deterrence and First-Strike Stability in Space,* 46-47.

[157] Mastalir, "The PRC Challenge to U.S. Space Assets," 79-81.

[158] Appropriate satellites would be those that member states would feel comfortable equipping with such sensors, based on national security considerations. Mastalir, "The PRC Challenge to U.S. Space Assets," 82.

[159] Blazejewski, "Space Weaponization and US-China Relations," 34.

[160] Luke R. Stover and Alan Johnson, "Space Separatism: Degree of Differentiation," *Air and Space Power Journal* 28, no. 6 (November 2014): 17-37a.

[161] Johnson-Freese, *Space as a Strategic Asset*, 234.

[162] Civilian agencies include National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, Department of Commerce, Department of Transportation, the Federal Communications Commission, the National Reconnaissance Office, and the National Security Administration. While the Air Force has primacy for DOD space programs, the Army and Navy also have space programs.

[163] Simon P. Worden, "Future Strategy and Professional Development," in *Toward a Theory of Spacepower,* eds. Charles D. Lutes and Peter L. Hays (Washington, DC: National Defense University Press, 2011), 321-326.

[164] W. Henry Lambright, "Adapting NASA for the Twenty-First Century," in *Space Policy in the 21st Century,* ed. W. Henry Lambright (Baltimore, MD: Johns Hopkins University Press, 2003), 267-269.

[165] Dolman, *Astropolitik,* 146-148.

[166] Ibid.*,* 156. Emphasis in original.

[167] John M. Logsdon, "Emerging Domestic Structures: Organizing the Presidency for Spacepower," in *Toward a Theory of Spacepower,* eds. Charles D. Lutes and Peter L. Hays (Washington, DC: National Defense University Press, 2011), 280-281.

[168] Stover and Johnson, "Space Separatism: Degree of Differentiation," 17-37a.

[169] Cesul, "A Global Space Control Strategy," 67-69.

[170] Patricia Moloney Figliola, Carl E. Behrens, and Daniel Morgan, *U.S. Space Programs: Civilian, Military, and Commercial – CRS Issue Brief for Congress* (Washington, DC: U.S. Library of Congress, Congressional Research Service, June 13, 2006), https://fas.org/sgp/crs/space/IB92011.pdf (accessed 20 February 2018).

[171] Schulte, "China and the New National Security Space Strategy."

[172] Johnson-Freese, "Ceding American Leadership in Space," 92.

[173] Moltz, *Asia's Space Race*, 192.

[174] Christopher Hemmer, American Pendulum (Ithaca, NY: Cornell University Press, 2015), 174.

[175] Logsdon, "Emerging Domestic Structures," 279.

[176] The executive order signed on 30 June 2017, designated the Vice President as the principal advisor on national space policy and strategy and created a staff headed by an executive secretary. See: Executive Order no. 13,803, *Federal Register* 82, no. 129 (June 30, 2017): 31429-31432, https://www.gpo.gov/fdsys/pkg/FR-2017-07-07/pdf/2017-14378.pdf (accessed October 25, 2017).

[177] As much as history can be a guide, however, the Space Council has not been an effective tool to coordinate the various pieces of the bureaucracy that play a role in space, including when the Vice President was the head. Logsdon, “Emerging Domestic Structures,” 291.