SPACE AGENDA 2021

A ROADMAP FOR ASSESSING SPACE WEAPONS

Michael P. Gleason and Peter L. Hays

Given advances in the space weapon capabilities of China and Russia, and the United States Space Force's priority to project military power in, from, and to space, the United States needs a new debate on the merits of fielding U.S. space weapons. Since the last debate, the strategic context has changed dramatically, invalidating many of the previous debate's core assumptions and primary alternatives. Thinking about space weapons cannot remain frozen in Cold War or post-Cold War era analysis and debates. The roadmap offered here will help the United States fully assess the merits of deploying space weapons, the best mix of space weapons, and how their development should be prioritized. The Department of Defense (DOD) cannot do it alone. The complexities of the issue require a whole-of-government approach with contributions from academia, industry, and other partners.

Introduction

A top priority for the new U.S. Space Force (USSF) is "Projecting military power in, from, and to space in support of our Nation's interests."[1] This includes applying lethal force in, from, and to space.[2] That new organizational imperative, traditional military preferences for offensive doctrines, and advances in competitor capabilities all raise the question of whether the United States will decide to field weapons in space. U.S. decisionmakers should carefully examine this most fundamental and critical of all space security issues to assess how deployment of weapons in space by any country, including the United States, will affect U.S. strategic interests.[3] Yet the United States has not had a robust public debate about the advantages and disadvantages of weaponizing space in almost 20 years. U.S. restraint carried the day then, but the threats and the strategic environment have changed a great deal since that era, leading to the need for a fresh examination.

This chapter aims to spark a renewed public debate on any upcoming decisions to station American weapons in space. Policymakers (and taxpayers) should understand thoroughly whether the United States requires space weapons to defend U.S. space infrastructure, to provide the U.S. an advantage in conflict, or to maintain strategic stability. The United States already has a large and varied arsenal of weapons that can attack different parts of adversary ground-based and space-based networks, helping to deter aggression or win a fight in space if deterrence fails. But if the United States decides deployment of space weapons is required, policymakers will need to decide the best mix of space weapons needed and decide which types of weapons should be prioritized in development and deployment. As discussed below, options include ground-based or space-based weapons; kinetic or non-kinetic weapons; weapons with reversible or non-reversible effects, and weapons in different orbits for different purposes. Choices should be informed with deliberate thinking about the consequences of those

choices on deterrence, strategic stability, and the sustainability of the space domain. Decisions should also be consistent with U.S. treaty commitments, viewed as legitimate in international law, and ideally reinforce international norms of behavior. Today's space weapons debate should aim to identify the most effective ways to contribute to deterrence, maintain strategic stability in the absence of conflict, and achieve advantage in conflict if deterrence fails.

Space Weapons

Military satellites have been in use for decades for military communications, surveillance, navigation, and weather forecasting. While this was somewhat contentious in the initial years of the Space Age, since the 1960s the international community has generally accepted the U.S. position that these uses of military satellites are non-aggressive; i.e., peaceful uses of outer space. These military satellites are not considered weapons although they provide intelligence and enable military operations.[4] Up to the present day, spacefaring nations have refrained from employing weapons in space for hostile purposes although countries have deployed and tested weapons there.[5]

Space weapons can be divided into three main types: Earth-to-space, space-to-space, and space-to-Earth. They can be further sub-divided into kinetic and non-kinetic weapons with either temporary or permanent effects.[6]

Earth-to-space kinetic weapons include direct-ascent and briefly orbital antisatellite (ASAT) weapons with a warhead or projectile that directly strikes or detonates near the target spacecraft.[7] China, Russia, India, and the United States have tested such weapons. Kinetic weapons generally have permanent effects on a satellite and create space debris. *Earth-to-space non-kinetic weapons* include jammers, lasers, and cyber-attack methods, and their effects can be either temporary or permanent. Jamming a satellite's ability to communicate is temporary and localized, while lasers have the ability to create temporary effects, such as blinding a satellite, and permanent effects that may irreversibly damage satellite sensors. Several states have tested and deployed Earth-to-space non-kinetic weapons, including China, Russia, the United States, Iran, and North Korea. Many other countries now have residual kinetic and non-kinetic weapons-like capabilities that are inherent in the conventional technologies they have developed, such as missile defense interceptors and electronic warfare capabilities.

Space-to-space kinetic weapons include debris-creating, co-orbital ASAT weapons which may directly crash into a target satellite (damaging it or pushing it out of its orbit) or even explode near the target satellite. Space-based missile defense interceptors, if deployed, could target ballistic missiles as the they transit space, but would also have inherent ASAT capabilities. *Space-to-space non-kinetic weapons* include co-orbital jammers, high-powered microwaves, and lasers with temporary or permanent effects (as noted above). Spacecraft that are used to closely track and examine target satellites, and perhaps intercept signals and communications from such a target satellite, are not considered weapons for this discussion, although the behavior of such satellites may indicate hostile intent, and could possibly be used for destructive purposes even if the satellite was not intended to be a weapon.

Space-to-Earth kinetic weapons include exotic "Rods from God"-type concepts in which some sort of weapon is de-orbited from a carrier spacecraft to attack terrestrial targets that may be airborne, on land, or at sea. Arguably, the Soviet Fractional Orbital Bombardment Systems (FOBS), fielded operationally from the late 1960s until early 1980s, would also fit in this category, though the Soviets argued that it was Outer Space Treaty-compliant (and the United States agreed) because it executed a deceleration burn and, therefore, did not complete a full orbit.[8] *Space-to-Earth non-kinetic weapons* include high-powered lasers which might attack similar target locations on land and in the sea, or in the air, although penetrating the atmosphere may make this difficult. Space-based downlink jammers are also placed in this category. Again, effects can be designed to be temporary or permanent.

The Traditional Advantages and Disadvantages of Space Weapons

As has been discussed over the last several decades, space-based weapons have some material advantages over weapons based on land, in the sea, or in the air. First, if technologically and economically viable space-based weapons can be

developed and deployed, any state that possesses them could have a significant advantage in a conflict against an adversary that relies on space capabilities. Since the last public debate about space weapons, the technical and economic feasibility of space weapons has increased. For example, space surveillance capabilities have dramatically improved and may better enable the ability to track, target and attack objects in orbit than in the past. A new class of launch vehicles is making it less difficult and less expensive to get objects to orbit. The arrival of highly capable smallsats and CubeSats and new forms of propulsion imply that space-to-space kinetic weapons are less expensive and less technologically risky than in years past. And lasers and high-powered microwave technological advances suggest the improved feasibility of space-to-space, non-kinetic space weapons. Space-to-Earth weapons remain the most speculative, but with the advent of proliferated Low Earth Orbit (LEO) constellations, even they may be more viable than in the past.

Space-based weapons, including space-based missile defenses and space-to-Earth weapons, offer enticing advantages in conflict. Space-to-Earth weapons could attack targets deep inside enemy territory without the same risk aircraft and cruise missiles have of being shot down. States possessing such capabilities would have enhanced ability to project power globally. Also, space-to-Earth and space-to-space weapons may provide a persistent (albeit less visible) presence and ability to respond to events rapidly across the globe—within minutes to hours as opposed to ships or aircraft that could take days before they are in position to attack a target.[9] Currently, intercontinental range missiles are the only weapon system with global reach and rapid response time.

Space-based weapons are potentially less vulnerable to traditional, kinetic methods of attack than terrestrial-based systems. Tracking and targeting a satellite or a weapon in orbit is a complex, high technology endeavor. While China, Russia, India, and the United States have demonstrated kinetic Earth-to-space weapons, and any nation with a sophisticated space program could develop such capabilities, space-based weapons remain relatively invulnerable to kinetic attack by less technologically sophisticated countries. In addition, space-to-space and space-to-Earth kinetic weapons would be difficult to defend against because their very high speeds and very brief flight times provide only an extremely limited window for warning and potential response options.

At a more strategic level, the USSF argues that space is the new high ground in modern warfare, providing a significant advantage in conflict.[10] Non-kinetic and kinetic Earth-to-space weapons provide the user an advantage by enabling targeting of adversary space support capabilities (and space-based weapons), imposing costs on the adversary to defend them and perhaps making the difference in who wins the war. The argument for space-to-space weapons—defensive and offensive—to control the high ground of space follows as well.[11] Others speculate that space weapons will be needed to protect commercial satellites and the flow of potential future wealth from mining the moon, asteroids, or other celestial bodies.[12]

Basing weapons in space, however, also has disadvantages in conflict. Even if a space weapon has self-defense capabilities, its defenses could be saturated by an adversary that can take multiple or sustained shots at it. Space-based weapons are also vulnerable to non-kinetic attacks, such as jamming or laser attacks. In addition, spacecraft follow highly predictable orbits, diminishing their ability to surprise an adversary and making them vulnerable to countermeasures. Maneuvering the space weapon reduces this weakness but might simultaneously reduce the weapon's ability to fulfill its primary mission as its fuel is used up, shortening its mission life. Making the weapons less visible through techniques to reduce their visibility, making them appear as benign satellites to obscure that they are weapons, or distracting the adversary's attention with decoys are a few of the ways to mitigate this disadvantage but also drive up the cost of the weapon. Even though the technical and economic feasibility of space weapons has improved over the last couple of decades, for the foreseeable future overall development, deployment, sustainment, and reconstitution of space-based weapons likely will be expensive compared to terrestrial-based weapon systems.

In addition, some argue that space weapons present broader geopolitical risks due to their potential effects on deterrence and strategic stability. Space capabilities have a close relationship to nuclear stability and the potential for escalation

between great powers. Space weapons could therefore alter how decisionmakers calculate nuclear deterrence. Many of the visions of space-to-Earth weapons imagine them having incredible speed and accuracy tied to the ability to target any point on Earth with minimal or even no warning. At enough scale and with sufficient destructive effects, such attributes would threaten a first-strike capability; i.e., the ability to wipe out a target country's nuclear deterrent before it has a chance to launch a retaliatory strike. If so, nuclear deterrence may fail, a consideration that may outweigh all others. Similarly, some have comparable concerns about space-based ballistic missile defenses nullifying a country's nuclear deterrent and providing a nuclear first-strike incentive for the country that possesses such capability.

Earth-to-space weapons create concerns because targeting early warning satellites, strategic surveillance satellites, and nuclear command and control communication satellites could also be perceived as the immediate prelude to a nuclear first strike by an adversary, triggering a response on the nuclear escalation ladder. Even if space weapons do not fatally undermine nuclear deterrence, they still offer another path to rapid nuclear escalation.

Space weapons might upset strategic stability in other ways as well. Space is considered an offensive dominant arena, meaning it is materially easier and less costly to attack a satellite—including space-based weapons—than to defend a satellite. Earth-to-space and space-to-space weapons provide an offensive capability for attacking targets in space. Political scientists contend that war is more likely when the offensive is dominant—especially if it is difficult to distinguish between offensive and defensive weapons—and argue that there are strong incentives for striking first should a conflict appear inevitable.[13] Surprise attack is perceived as leading to large rewards. Space weapons provide a first-mover advantage for striking in space, but their speed could create crisis instability since decisionmakers—on all sides—will have very little time (perhaps only a handful of minutes) to decide what to do in the face of a sudden attack in space, creating a high risk of rapid escalation due to misunderstanding, miscommunication, and miscalculation.

Finally, the use of destructive, non-reversible kinetic Earth-to-space or space-to-space weapons would likely leave a persistent cloud of debris and pose a long-term (potentially decades or much longer) hazard to all satellites, including commercial and scientific satellites as well as satellites from non-adversary nations. Using weapons with non-kinetic, non-permanent affects would mitigate this risk.

The Previous Debate: Changes in Context, Assumptions, and Alternatives

A vigorous public discussion covering many of the factors discussed above flared during the last period in which the U.S. seriously considered the merits of space-based weapons, peaking around 2002 and waning a few years later.[14] But a lot has changed since then.

The earlier debate centered around two key alternatives: the first was whether the United States should deploy space-based weapons first—well before China or Russia would be capable of doing so effectively—in order to take a significant strategic leap ahead or, second, whether the United States should practice restraint in order to preserve strategic stability and not provoke China or Russia to react in kind. Those core alternatives are no longer operative. Since that era, China has deployed operational ground-based, direct-ascent, kinetic-kill ASATs and demonstrated co-orbital ASAT capabilities.[15] Russia has also tested ground-based, direct-ascent kinetic ASATs and appears to have tested in-orbit anti-satellite weaponry as well. The United States no longer gets to choose whether to leap ahead or to seek to inspire restraint among U.S. competitors. Indeed, today both China and Russia have the capability to station weapons in space and the June 2020 Defense Space Strategy states bluntly that China and Russia have already weaponized space.[16] While a future administration could revise U.S. strategy in space or attempt to secure new international agreements restricting space weapons, the U.S. has rung a bell that cannot be unrung by declaring space as a warfighting domain and by revealing some of what is known about potential adversaries' activities there. There will be implications on behavior by allies, adversaries, and third parties, as well as within the U.S. government.

As noted earlier, the new space weapons debate should inform decisionmakers on which space weapons, if any, contribute the most to deterrence and strategic stability, in the absence of conflict, while providing an effective means to achieve and maintain advantage in conflict. In addition to the factors outlined above, that debate requires due consideration of major changes in the strategic environment over the last 20 years.

The Strategic Space Environment in 2021

The strategic challenges in space presented by China and Russia, taken alone, may provide compelling reasons for the United States to deploy space weapons of its own. However, rather than basing a U.S. decision primarily as a reaction to China's and Russia's provocations, the United States should carefully consider the viability and effectiveness of space weapons for itself, bearing in mind the advantages and disadvantages outlined above and in light of the changes in the strategic environment identified below. Only then should the United States consider the best strategy and best mix of capabilities needed to respond to China's and Russia's space weapons. U.S. decisionmakers must weigh the considerations offered below when making decisions regarding space weapons.

China and Russia are great power competitors and space powers. The United States was far ahead of China 20 years ago in economic and military power, and in space capabilities. Today, China is a near-peer competitor with much more military power across the board than two decades ago and possesses significant space capabilities, including a variety of space launch vehicles, a wide array of modern satellites, and ASATs. China is asserting itself in its immediate region, the South China Sea, Taiwan, and Hong Kong as well as globally. Space systems are an integral part of China's ability to achieve its goals.

China has an extensive arsenal of Earth-to-space weapons, including operational communication, radar, and GPS jammers as well as Earth-to-space direct-ascent, kinetic-kill ASAT missiles to target satellites in LEO. In addition, in 2019, the Defense Intelligence Agency (DIA) said China was likely to deploy a ground-based laser weapon in 2020 to target the optical sensors of satellites in LEO, and have a more powerful laser by the mid-2020s that can damage the structural components of LEO satellites.[17]

Because of these extensive Chinese capabilities, from the moment they are placed in orbit, future U.S. space-to-space and space-to-Earth weapons in LEO will face potential attacks from these kinetic and non-kinetic capabilities. China is also likely developing kinetic ASATs capable of destroying satellites in geosynchronous orbit (GEO), so these vulnerabilities are not unique to LEO.[18] The potential benefit of U.S. deployment of space-based weapons and whether their fielding will contribute substantially to achieving and maintaining advantage against China will have to be carefully weighed in this light.

Like the United States, China has also tested satellites with technologies which could be used as space-to-space weapons. Technologies for on-orbit servicing, and rendezvous and proximity operations could serve dual-purpose roles as benign on-orbit servicing and inspection satellites or as space weapons.[19] U.S. defenses against these space-to-space capabilities might be placed on the ground, as noted above, or placed in space. The merits of placing U.S. ASAT weapons on the ground or in space, and the merits of relying on kinetic or non-kinetic options to defend against adversary space-to-space weapons should differ significantly between satellites in LEO, GEO, and other orbits and should therefore be debated separately.

The United States also should consider the possibility of China placing space-to-Earth weapons in orbit and debate the most effective means to counter them. At present, this threat remains highly speculative and no open-source examples of space-to-Earth weapons tests—kinetic or non-kinetic—exist. But the threat of space-to-Earth weapons to the United States from China should not be entirely dismissed.[20] The People's Liberation Army's (PLA's) 2013 *Science of Military Strategy*, (SMS) published by the PLA's top think tank and considered an authoritative, credible open source of PLA doctrine on military space, indicates the PLA has done the intellectual groundwork for fielding space-to-Earth weapons.[21] SMS

identifies space-based attack operations against ground, sea surface, and targets in the air as a military space mission.[22] SMS also stresses development of new technologies to offset U.S. military advantages, including space weapons, that will leapfrog the United States in next generation defense technologies and give China asymmetric advantages.[23] Culturally, the Chinese put military strategists on a pedestal,[24] and as an authoritarian political system, military requirements and capability development more closely align with pronounced, authoritative strategy than is sometimes the case in the United States. The United States should consider the possibility of China developing space-to-Earth weapons and debate the best mix of capabilities to counter them should they appear.

While Russian resources are modest compared to China, the nation continues to develop high technology weapons systems under Vladimir Putin's authoritarian leadership. Since the last serious debate in the United States on deploying weapons in space, Russia has invested in and tested counterspace weapons, including worrisome systems it never developed even in the depths of the Cold War.

Russia has fielded Earth-to-space weapons (such as communication, radar, and GPS jammers) and in April 2020, Russia tested a direct ascent ASAT. In addition, in 2018, Russia began fielding a mobile ground-based laser weapon that the Russia Defense Ministry said could be used against satellites and is developing an airborne laser weapon system to use against space-based missile defense sensors.[25] As with the PLA ground-based ASATs, U.S. decisionmakers will need to take into account U.S. space-based weapons' potential vulnerability to these Russian capabilities and prudently evaluate their ability to provide substantial benefit, compared to terrestrial-based alternatives, against Russia.

Russia has also tested space-to-space kinetic weapons. In late 2017, a Russian satellite demonstrated the ability to get close to another satellite and fire a projectile at a very high velocity. In late 2019, a similar Russian satellite maneuvered provocatively close to a U.S. government satellite in LEO, and in July 2020 the same satellite that approached the U.S. LEO asset was observed firing a projectile.[26] U.S. options for achieving and maintaining space superiority in this scenario may include Earth-to-space, or space-to-space weapons with kinetic or non-kinetic effects. The merits and risks of each of these options should be debated and assessed thoroughly.

While the Soviets decommissioned their FOBS system after negotiating them away as part of the second Strategic Arms Limitation Treaty (notwithstanding the U.S. Senate's failure to ratify the treaty), at least the concept is back in the news. In March 2018, Russian President Vladimir Putin showed a graphic of the RS-28 Sarmat heavy ICBM placing a nuclear warhead on an orbital trajectory and descending on Florida. And although FOBS was a ground-based nuclear weapon system, it demonstrates Russia has long had the technological capability to successfully reenter targeted warheads from orbit.[27] In considering options for space-to-Earth weapons, the United States will want to evaluate whether it would be more or less secure on balance if they were widely fielded.

Based on the discussion above, the new debate should carefully weigh how U.S. space weapons would fare in a conflict with China or Russia in the face of the Chinese and Russian capabilities. It is reasonable to argue that U.S. space-to-space and space-to-Earth weapons would be exposed, at some level, to already existing Chinese and Russian Earth-to-space capabilities and nascent space-to-space capabilities. The United States will need to make significant investments to protect and defend U.S. space-based weapons. In comparison, U.S. Earth-to-space weapons would not be directly threatened by these Chinese or Russian capabilities but, instead, would be able to threaten Chinese and Russian space-based weapons and other space-based capabilities. With U.S. territory spanning almost 60 percent of the globe East to West (Maine to Guam), with territories from near the Equator to the Arctic Circle, and with bases around the world, U.S. Earth-to-space weapons should be able to rapidly reach LEO to defend U.S. satellites or threaten adversary satellites there. However, U.S. Earth-to-space weapons might not be so effective in scenarios at GEO and other orbits. In light of these considerations the new space weapons debate should consider the best strategy and best mix of U.S. space-based weapons and terrestrial-based weapons that gain the United States the most advantage and impose the most costs on Russia and China.

The new strategic environment presents additional complexities, however. As noted above, the space weapons debate has always included discussion of the affects space weapons could have on deterrence, and strategic stability. Those traditional concerns still exist and should be debated anew. However, the changes to the strategic context outlined next need to be added to the debate in order to more holistically inform decisionmakers of new potential strategic problems and dilemmas that deployment of space weapons could create.

The Outer Space Treaty, Arms Control Treaties, and Overflight. Fresh thinking is needed regarding the right of overflight as it pertains to space-based weapons. The 1967 Outer Space Treaty (OST)[28] and U.S.-Russia arms control treaties since the 1970s established the legitimacy of satellite overflight, but neither instrument provides unambiguous protection for space-based weapons in international law. The OST established the legitimacy of overflight when done for peaceful purposes. Even after the OST went into effect the Soviets argued that accepting "nonaggressive" military overflight as "peaceful" overflight did not mean they acknowledged the legitimacy of overflight that endangers their security.[29] With that in mind, it is difficult to argue convincingly that space-based weapons would be considered legitimate, peaceful, or nonaggressive uses of space. The OST does not ban conventional weapons from being placed in orbit, but neither does it provide any treaty protections.

Beginning with the 1972 Anti-Ballistic Missile (ABM) Treaty provision for noninterference with National Technical Means (NTM) and language repeated in several subsequent agreements, arms control treaties legitimized overflight of photo reconnaissance satellites and other types of satellites used to verify treaty compliance. The last of these arms control treaties, the 2010 New Strategic Arms Reduction Treaty (New START) currently in force between the United States and Russia is set to expire on February 5, 2021.[30] If that happens, formal prohibitions on interference with NTM also expire. U.S. decisionmakers should not reflexively assume the OST or U.S.-Russia arms control treaties would protect the legitimacy of overflight of space weapons, even in peacetime.

These two treaty-based protections for overflight helped establish a norm of unrestricted overflight that is broader than the treaties grant. In fact, the norm of unrestricted overflight has become so taken-for-granted that the presence of the norm is not even noticed. However, norms can shift suddenly, especially in response to a triggering event.[31] The new debate should evaluate if deploying space-to-space or space-to-Earth weapons might be a strong enough catalyst for nations to recalculate the norm's value given their national security interests.

For example, if an adversary put a space-to-Earth weapon that presented a grave threat to U.S. national security into an orbit that passed over U.S. territory tomorrow, adhering to the norm of unrestricted overflight means the United States would accept the situation, not protest, and only retaliate if the adversary took some sort of destructive action. But some political and military leaders—and opinion leaders—might reject acquiescing to such a grave new threat. The United States and the other countries overflown may have the right to challenge such a space-to-Earth weapon based on the UN Charter right to self-defense and the Law of Armed Conflict with its provisions on self-defense and anticipatory self-defense. On the other hand, in the analogous nautical sense, in some cases another country's warship may have a right to freedom of passage within a state's territorial waters. U.S. decisionmakers should work out what the U.S. strategy would be if China or Russia deployed space-to-Earth weapons first.

Space-to-space weapons produce similar concerns although the risk to the overflight norm is less straightforward since space-to-space weapons would not directly target a country's sovereign territory—but only its assets in orbit (although those, too, might be considered sovereign). In addition, the new debate should consider whether deploying any type of space-based weapon could weaken the right of overflight for other military satellites. Just deploying space-based weapons may mark all military satellites as targets, even in peacetime, since there is no guarantee that space-based weapons could be confidently distinguished from other military satellites. Today's debate should examine the indirect risks the deployment of space-based weapons might create for military and intelligence community intelligence, surveillance, and reconnaissance (ISR), communication, and other satellites.

Earth-to-space weapons would not raise questions about the overflight norm, but they do allow the countries that possess them to hold space-based weapons at risk even if a conflict has not started. When debating space-based weapons—along with the merits of each weapon type—the United States should evaluate how such systems—whether China's, Russia's or America's—might not be protected by the assumed right of unrestricted overflight. Without a full assessment, major decisions may be based on faulty assumptions and not result in the expected advantages for the United States.

The Expanding Gray Zone. U.S. policymakers and decisionmakers will also need to understand what effect deploying space weapons would have on gray zone activities. Gray zone tactics are the use of force or other means to achieve objectives while staying below the threshold of a conventional war.[32] Satellites have long been an integral part of gray zone activities. Fielding space-based weapons would add another dimension of ambiguity to such activities that the United States should consider when making space weapon deployment decisions.

As space becomes more congested with more countries and commercial entities in orbit and dual-use capabilities proliferate, threats increase and space becomes more contested with an expanded gray zone. Space is not immune from China's growing emphasis on its military-civil fusion (MCF) strategy in which China seeks to integrate military and civilian resources more effectively for military purposes. The employment of MCF in China's space activities focuses on using dual-use space capabilities militarily and portends China's use of gray, proxy forces in space, much as China's maritime militia of armed fishing vessels plays an influential role in asserting China's claims in the South China Sea.[33] Gray, proxy space forces could potentially challenge U.S. space-to-space and space-to-Earth weapons (as well as non-weapon space capabilities) without crossing the threshold that triggers a military response. Such a scenario would create difficult dilemmas for decisionmakers and disturb strategic stability.

In addition, if a U.S. space-based weapon is attacked in peacetime, either by gray or conventional forces, public attribution of the attack could be problematic. While U.S. military capabilities to attribute bad behavior in space have improved over the last 20 years, unless the attack is easily observable to many independent observers, public attribution may require release of sensitive information about U.S. satellites and the sources and methods used to attribute the attack. Commercial or partner unclassified space surveillance information about an attack might be shared with the public, but an adversary could potentially obscure the information and create doubt about its validity. In that way, since conflict escalation might need broad support by American politicians (and therefore the public), as well as allies and partners, the adversary may avoid significant retaliation in such a case. Furthermore, tempting adversaries to use gray zone tactics to challenge space-based weapons, without facing clear consequences, could weaken deterrence and disrupt strategic stability.

In total, this argues that all scenarios would have to be explored if a decision is made to field a classified space weapon. An analogy could be made to the risk associated with an alternative history in which the U.S. fielded submarine-launched nuclear missiles while attempting to hide the very existence of those submarines; if an adversary became aware of the threat and the submarines were fielded anyway, adversaries could have incentives to destroy the submarines on the presumption that the U.S. would not acknowledge the destruction.

For these reasons, the new debate on space weapons must evaluate the challenges gray zone activities (the new normal today) create for the viability and effectiveness of space weapons, and the risks gray zone activities produce for deterrence and strategic stability. Decisionmakers will need to decide the best mix of space weapons and decide which types of weapons should be prioritized in development and deployment while keeping the gray zone firmly in mind.

Way Ahead

The strategic environment has changed since we last had a national debate about deploying weapons in space. The United States should revisit the debate in the new era of great power competition and in light of the creation of U.S. Space

Command and the U.S. Space Force. This paper provides a roadmap for the new debate but does not fully assess all the factors introduced here and reaches no fully fleshed out conclusions. That is for the community to do now.

Today's debate should be informed by the debates of the past, but must be updated and based on a fresh analysis, new core assumptions, and an appreciation for new conditions. To avoid Russia and China imposing unnecessary costs on the United States, U.S. decisions on space weapons should not be made simply in reaction to China and Russia's space weaponization. U.S. decisions on space weapons require an exhaustive comparative analysis of the value to U.S. national security to develop, build, and deploy any type of space weapon and the downsides to such a decision. Is the United States better off with or without space weapons of any type? Indeed, the answer may not be binary. The analysis might lead to a conclusion that certain types of weapons or certain functions of such weapons are advantageous while others are not.

The United States should consider how deployment of space-based weapons might drive changes internationally in the interpretation of the OST right to peaceful uses of outer space and the norm of unhindered overflight. The status of U.S.-Russia arms control agreements and likely demise of treaty provisions for noninterference with overflight should also weigh on decisionmakers' minds. The United States should recognize space lends itself to gray zone approaches and consider how gray zone attacks against space weapons would be deterred. As well, we must bring back to mind the old concerns about the effect of space weapons on strategic stability. China and Russia face most of the same concerns discussed above. The question is, can the United States use such concerns and technologies to its advantage?

The increasingly congested space domain with ever more debris, more spacecraft, and more stakeholders may create additional dilemmas and trades for decisionmakers to balance. For example, how does a decisionmaker balance an increased risk of casualties (by not denying an adversary use of its space capabilities) with the risk that use of a debris-creating weapon in space may later cause the unintended destruction of friendly or third-party satellites, significantly increase the risk of operating in that orbit and surrounding regions of space for generations, or cause unknowable, harmful, tertiary effects? While current political tensions may make it unlikely in the near term, it is possible the United States, China, Russia, and other countries could find it in their mutual interest to agree to formally proscribe weapons that create space debris. The Geneva Conventions and their Additional Protocols regulate armed conflict and seek to limit its effects, providing an example of a framework for limiting conflict that extends into space. Mutual restraint in deployment and/or employment of debris-creating space weapons would reduce the indirect risk of indiscriminate, disproportionate harm to civilians or non-combatants, help preserve the sustainability of space environment, and temper decisionmakers' dilemmas. The community should continue to investigate ways to develop diplomatic instruments that would reduce the indiscriminate risks of debris-producing space weapons.

Further research and analysis in the areas identified in Table 1 should inform a new public debate on space weapons. Doing so will contribute to strategies to advance U.S. security and promote strategic stability.

The spotlight should be placed on countering China's capabilities first, since China is developing and deploying space weapons the most aggressively. The USSF and Department of Defense (DOD) cannot do it alone, however. The issues require a whole-of-government approach with contributions from academia, industry, and other partners. While the DOD and Intelligence Community (IC) should take the lead on evaluating the advantages and disadvantages of space weapons, for example, the Department of State (DOS) should take the lead on evaluating if space-based weapons are protected by the right of unrestricted overflight and investigating diplomatic avenues to reduce the risk of debris-producing space weapons. Then the DOS, working in close coordination with the DOD, should articulate U.S. positions in the international community in order to shape international opinion favorably toward the U.S. position. Likewise, the Department of Commerce (DOC) could play an important role in narrowing the gray zone with its civil space traffic management initiatives establishing international standards, guidelines, best practices, and norms of behavior for activities in outer space. The DOC will play a key part in bolstering stability and deterrence in space by working with commercial and international partners to shine light on non-standard or nefarious gray zone activities there.

Table 1: Areas for Further Research and Strategizing
1. Consider the advantages and disadvantages of U.S. space weapons given Chinese and Russian ASAT capabilities against potential U.S. space weapons. a. Separately weigh the relative advantages and disadvantages of each space weapon type, for each type of orbit, in the overall context of U.S. security. b. Review the various technologies available, determine potential asymmetries, and assess if these asymmetries are acceptable or can be offset in some way.
2. Evaluate if space-based weapons are protected by the right of unrestricted overflight and the effect on decisions if they are not protected.
3. Explore how space-based weapons can be protected against nefarious gray zone activities or how such activities can be deterred. a. Assess if potential gray zone vulnerabilities in space could weaken deterrence and stability.
4. Examine potential U.S. courses of action should China or Russia deploy space-to-Earth weapons first.
5. Gauge the indirect risks the U.S. deployment of space-based weapons might create for U.S. military and intelligence ISR, communication, and other satellites.
6. Investigate ways to develop diplomatic instruments that would reduce the indiscriminate risks of debris-producing space weapons.
7. Develop strategies for the U.S. to turn the concerns raised here to its advantage

Only by considering all these points can the United States make fully informed decisions about the deployment of space weapons, the best mix of space weapons, and how their development and deployment should be prioritized. Hopefully, the roadmap offered here will help inform and guide those decisions. Times have changed and the new era of great power competition means core assumptions, questions, and concerns about space weapons cannot remain frozen in Cold War or post-Cold War era analysis and debates. U.S. decisionmakers should make these choices consciously having weighed each of the considerations flagged here.

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About the Authors

Dr. Michael P. Gleason is a national security senior project engineer at The Aerospace Corporation's Center for Space Policy and Strategy. Prior to joining Aerospace, he supported the Office of the Secretary of Defense Office of Net Assessment as a senior strategic space analyst. He served 29 years in the Air Force and is an accomplished national security space expert with experience in space policy, strategy, satellite operations, and international affairs. While in the Air Force, he served for five years at the Pentagon and two years at the Department of State. A graduate of the U.S. Air Force Academy, he holds a Ph.D. in international relations from George Washington University.

Peter L. Hays is a retired Air Force Lt Col who works as a defense contractor in the Pentagon supporting the assistant secretary of the Air Force for Space Acquisition and Integration. He has been directly involved in developing and implementing all major national security space policy and strategy initiatives since 2004. Professor Hays currently teaches graduate seminars on "Space and National Security" and "Science, Technology, and National Security Policy" at George Washington University, serves as the space chair at Marine Corps University (MCU), and teaches air- and spacepower seminars at the MCU School of Advanced Warfighting. He previously taught at the Air Force Academy, Air Force School of Advanced Airpower Studies, and National Defense University. Hays holds a Ph.D. from the Fletcher School and was an honor graduate of the Air Force Academy. Major publications include: *Handbook of Space Security*, *Space and Security*, and *Toward a Theory of Spacepower*.

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