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An Investment Strategy for National Security Space

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Abstract
Today's space systems fulfill five purposes: (1) environmental monitoring; (2) communications; (3) position, navigation, and timing; (4) integrated tactical warning and attack assessment; and (5) intelligence, surveillance, and reconnaissance missions. These missions are integral to a new American way of warfare. Direct and indirect challenges to American power in space are growing. Other nations are expanding their capabilities to interdict or deny U.S. access to space. Mounting fiscal pressures will likely necessitate changes in national "security space" force structures and acquisition approaches. This Special Report explores the implications of these challenges on U.S. national security space programs and policies. It sets the context for future decision making, providing insight into the myriad issues—from allied capability and intentions to extant arms control proposals—that will likely influence these decisions.

The United States is approaching a critical juncture on its investments in national security space capabilities. This juncture is imminent due to the convergence of three forces: (1) a fundamental shift in U.S. defense and diplomatic strategy from the western to the eastern Eurasian landmass—the so-called pivot toward the Asia-Pacific; (2) a large number of the national security space capabilities upon which the United States and its allies critically rely are now legacy systems in need of upgrades and replacement; and (3) severe fiscal pressures on Department of Defense and intelligence community budgets. As the strategic context shifts, the military's dependence on space systems becomes ever more acute. Since the 1990s, military use of space has grown exponentially, but new strategic demands, bolstered by the accumulating demands of technology, require development of entirely new national security space systems if the United States is to meet future national security challenges with plausible preparedness.

This *Special Report* sets out a framework that guides policymakers on how to invest in national security space capabilities over the next decade. The framework is, by necessity, holistic, as many of the individual national security space programs in question are classified. The overall purpose is not to provide hard figures for specific programs, though the study does use such data, when available, in order to support broader assertions. Rather, the framework sets the context for future decision making, states the critical questions that policymakers must ask when making budgeting decisions for national security space investments, and provides insight into the myriad issues—from allied capability and intentions to extant arms control proposals—that will likely influence these decisions. Ultimately, it is within this framework that national security space investment decisions should be made, not just by policymakers in the executive branch, but also by legislators and industry leaders. This *Special Report* is also intended to inform interested citizens about the germane issues pertaining to how their tax dollars will likely be spent on national security space capabilities in the coming decade.

The report is organized into three parts. Part One covers the current and future contexts for U.S. national security space, and includes an overview of how these capabilities are employed today and how they are likely to be employed in the coming decade. Part One concludes with a brief analysis of alternatives to national security space systems, such as unmanned aerial systems (UAS), and a comparison of their strategic utilities and limitations is provided.

Part Two identifies three broad areas that will likely impact the proposed framework of the study in adverse and unpredictable ways and which will inevitably provide challenges for policymakers, legislators, and industry executives. The three broad areas of concern are the continuing dissemination and proliferation of anti-access/area denial (A2/AD) weapons systems capable of blunting, even denying, critical U.S. capabilities, such as national security space capabilities; extant space arms control; and other diplomatic instruments that have the potential to constrain U.S. efforts to secure asymmetric advantages in national security space capabilities, and perhaps even impair the ability of the U.S. to reliably access space at all. Finally, Part Two examines the impact of domestic political imperatives, national security space organizational arrangements, and ongoing austerity measures.

Part Three analyzes the capabilities necessary to fulfill U.S. space needs. In this section, the study identifies national security space capabilities that are absolutely critical to U.S. national security, as identified by measuring them against a set of core criteria. Any capability that does not fulfill all of the criteria set out is then eligible for possible provision to the military and intelligence community by commercial or allied entities. Finally, Part Three examines allied national security space capabilities (or, at least, highly capable dual-use space capabilities) that can either supplement the U.S. core military/intelligence community or commercially provided national security space capabilities, and even provide niche capabilities that the United States is unable to provide on its own.

Part One: The Current and Future Context

Before identifying the investment needs and strategy for national security space, it is necessary to start with an understanding of the present context of U.S. national security space, and to identify the emerging trends that will reshape that context in the coming decade. The purpose of this section is to emphasize that the status quo cannot hold and that the coming decade will be one of great, and often uncomfortable, change in U.S. national security space. The investment strategy presented here seeks to provide an end state goal for policymakers and commanders, yet achieving this end state will require strategic acumen, innovative thinking, and political courage. While navigating the next ten years or so will not be easy, maintaining the status quo is simply not an option and will only compound the many challenges that lie ahead.

Current Context. To date U.S. national security space has thrived on large budgets, long and arduous (even tortuous) acquisition processes, fractious organizational oversight, and at times an antediluvian mindset in how national security space systems are managed, used, and shared. Air Force General C. Robert Kehler, then-commander of U.S. Air Force Space Command, noted at the 26th National Space Symposium in 2010 that the strategic approach to U.S. national security space today is no different from that of the Cold War era, in that a handful of large and expensive systems provide vital space services to U.S. and allied military forces and senior leaders.[1] This state of affairs has managed to continue, despite its myriad dysfunctions, thanks to a combination of relative budgetary largesse and, since the collapse of the Soviet Union, the absence of a putative adversary who might plausibly threaten a significant portion of America's military and intelligence space systems.

The statement that the U.S. national security space enterprise has for decades lived off lavish budgets might seem exaggerated to those who have toiled away in the national security space enterprise. After all, even in times of plenty, one cannot achieve everything one sets out to do, and there never seems to be enough money. In reality, however, U.S. national security space has been very well funded. This funding has provided the United States with the panoply of national security space capabilities that has made the United States the world's pre-eminent space power, not just in terms of numbers and types of satellites, but also in the unique and innovative ways it has integrated space throughout every aspect of the national security apparatus.

Over the past decade, the national security space budget has steadily decreased from approximately $15 billion in fiscal year (FY) 2000 to around $8.5 billion in FY 2010. In February 2012 the Obama Administration announced it would seek a 22 percent cut in military space spending in the FY 2013 defense budget, a precipitous reduction that will, if the request is successful, give policymakers and commanders pause in deciding how the national security space enterprise is both achieved and maintained.

The era of ever-increasing budgets and unquestioned programming decisions has long come to an end. General Kehler recognizes that the U.S. finds itself at a critical juncture, stating that "we are on the edge of some key decisions" for the future of the U.S. national security space enterprise.[2] Large budgets are no longer an option, at the same time that several states, most notably China, are developing space and counter-space capabilities that threaten not only de facto U.S. superiority in space, but also the very basis of the American way of war.[3] Business as usual is no longer a viable option.

Future Context. In the coming decade, U.S. military reliance on its space systems will increase significantly; greater efficiencies will be sought through more innovative uses of satellites in order to compensate for the looming cuts in defense manpower and capability. For the military at large, doing more with less—always a challenge—will only be slightly ameliorated by the aid of various space systems. For those charged with acquiring, operating, and maintaining the nation's national security space systems, the imperative of doing more with less is especially challenging as budgets are slashed even further while demands on existing and new systems rapidly increase.[4] All of this will happen within the context of a strategic shift of focus to the Asia-Pacific region, where U.S. and allied space systems face greater potential threats as shifting geopolitical dynamics are creating rising uncertainty and tensions.[5]

This challenge is composed of a number of trends discernible today that are pertinent to the future of U.S. national security space, which are as follows:

- **Technology.** A large measure of U.S. space superiority rests on the superiority of the technological foundations that have built U.S. national security space capabilities over the past 50 years. This technological superiority is possible thanks to the unique environment for innovation that only the United States currently possesses, through a mixture of academic, government-sponsored, and industry-funded research and development.[6] As space systems disseminate and other space powers make technological strides, it should not be unremarkable that some may be closing the technological gap with the United States in certain niche areas. This trend is likely to continue, and now is the time to redouble efforts in research and development. The Obama Administration's attempts to reduce funding of the Naval Research Laboratory, and close altogether the Air Force laboratories and the Operationally Responsive Space (ORS) office[7] have received close scrutiny. That is not to say that consolidation or reorganization of federally supported research institutions should not be pursued. Many of the structures and organizations that matured during the Cold War and evolved to meet the demands of the 1990s and 2000s may not be the appropriate ones to meet the demands of the U.S. in space moving forward.[8] Indeed, there may be significant efficiencies gained from reorganization, but those are generally seen in the long run. The Obama Administration is encouraged to undertake a comprehensive assessment of the research enterprise supporting national security space missions, covering government, universities, and corporate organizations. Such an assessment is necessary to ensure that critical capabilities are not lost and to identify core competencies of those institutions that remain.

- **Scientific and engineering skills.** The Obama Administration should continue efforts to encourage young Americans to take up science, technology, engineering, and mathematical (STEM) subjects in high school and college.[9] STEM education is vital to ensuring the long-term viability and well-being of American technological and scientific superiority, as well as for providing a new generation of well-qualified engineers and scientists who can improve upon the achievements of the current generation of space engineers and scientists.[10] The Obama Administration should continue to make STEM education a priority in its education policies and should encourage industry to continue its support of young Americans who choose to pursue a STEM education. The current focus on STEM lacks attentiveness to a key variable—demand. Moves to expand the supply of well-qualified scientists and engineers must be matched with action by industry, academia, and government to ensure that demand for these workers is sufficiently strong to ensure gainful and stimulating employment.

- **Growing commercialization.** The Obama Administration must manage the growing commercialization of space. The emergence of new companies in the U.S. and abroad offers opportunities to reshape the competitive environment for providing space needs, but also creates challenges. Many believe that the new entrants can decrease the cost of government programs through increased competition. In pursuing that opportunity, the U.S. should be active in establishing a legislative, policy, and regulatory environment that provides a measure of predictability and confidence for investors in commercial space endeavors, but also sets rigorous standards for any commercial provider of space services or satellite systems to the U.S. government to fulfill mission assurance.[11]

- **Technological diffusion.** For the past 20 years, space systems have disseminated throughout the world at a rapid pace, from a handful of national space programs in the early 1990s to nearly 60 space programs globally in 2012.[12] A combination of reduced costs, through the miniaturization of satellite technologies and more competitive launch markets,[13] and a growing recognition among many countries that space power offers economic and strategic benefits beyond mere prestige means that the trend of dissemination will continue. The Obama Administration should continue with efforts already underway to reform satellite export control laws to enable U.S. industry to compete in this expanding market while crafting controls that check the release of critical capabilities not found elsewhere.[14] Such an effort necessitates a flexible regime that is responsive to changing commercial conditions and national security demands. Similarly, the Obama Administration should assiduously monitor the dissemination of space technologies and emerging space powers to identify and help build capacity of potential strategic partners, as well as thwart any potential adversary in space.

- **Myriad threats.** Along with the dissemination of space technologies comes the dissemination of defensive and offensive counter-space technologies that might potentially harm U.S. national security space capabilities. From space situational awareness (SSA) capabilities to direct-ascent anti-satellite (ASAT) weapons and malicious software capable of disrupting satellite tracking and control, U.S. national security space assets and related systems face myriad threats to their functioning and even survival.[15] The Obama

Administration should revitalize efforts to investigate technologies, tactics, and other means of providing passive and active protection to critical U.S. national security space systems to ensure they can provide the warfighter with essential space support even in degraded circumstances.

The Uses of National Security Space. That the U.S. military, as well as the militaries of its allies, is critically dependent on space systems is beyond argument. How this dependence began and grew is traceable to the ad hoc use of meteorological, reconnaissance, and communications satellites by the United States during the Vietnam War.[16] In 1977, Congress instituted the creation of Tactical Exploitation of National Capabilities programs (TENCAP) in all services, based on the experience of the U.S. Army's pilot program and, spurred by congressional dissatisfaction with the fact that space capabilities designed and built for niche intelligence purposes and nuclear command and control at great taxpayer expense were not providing adequate value for money.[17] TENCAP set out to explore ways in which these space capabilities might be tactically exploited by conventional military components through experimentation and innovation. As this tactical exploitation grew, the need for an organizational entity to develop, train, and equip the military with space capabilities and expertise became apparent. So, in 1982 U.S. Air Force Space Command (AFSPC) was created, followed by U.S. Space Command (USSPACECOM) in 1985, under which AFSPC became a component command.[18] AFSPC, and subsequently, USSPACECOM, promulgated the first space doctrine for the military that went through several iterations informed by combat operations in Grenada, Libya, and Panama.[19] Between TENCAP and the work of AFSPC and the since disbanded USSPACECOM, an almost osmotic cooption of space capabilities in conventional military operations took place, barely perceptible to many both in and out of the military.

It was only in the first Gulf War in 1991 that the rise of national security space and its growing role in conventional military operations emerged on the public stage. Such was the perceived influence of national security space in the first Gulf War that many national security commentators declared that a Revolution in Military Affairs (RMA) was well underway that would transform the nature of war.[20] It is highly debatable whether the use of space systems in military operations constitutes an RMA; more plausibly, the widespread adoption of information technologies throughout the military, of which satellites might be included, will probably be viewed as the RMA that has taken place these past several decades. Certainly the excessive rhetoric heralding a change in the nature of war did much to bankrupt such claims.[21] Still, throughout the 1990s and the first decade of the 21st century, the dependence on space systems by the U.S. military, and increasingly among its closest allies, grew and deepened exponentially. With each passing conflict—Bosnia, Kosovo, Afghanistan, and Iraq—the military use of space systems evolved from that of enabling function to the indispensable real-time, operational/tactical contribution that exists today.

This critical dependence pervades the entire U.S. national security establishment, from the disproportionate dependence on space-based intelligence (especially imagery and signals intelligence—IMINT and SIGINT) in the decade since 9/11, to the dominance of the positioning, navigation, and timing capabilities of the Global Positioning System (GPS) navigation satellites in the delivery of precision-guidance munitions. This is not to mention the utter reliance on communications satellites, commercial as well as military, for the global command and control of deployed military forces; the extensive use of high-resolution imaging satellites, again, commercial and government-owned, for intelligence preparation, mapping, battlespace surveillance, and battle-damage assessment; and the critical role of meteorological and other environmental remote sensing systems in the planning for, and deployment of, military forces in widely varying locations. This deep use of space is found in every military function from logistics to combat medicine.

National Security Space in the Future. Changes in defense budgets, U.S. strategic orientation, and force restructuring are likely to make U.S. and allied national security even more dependent on national security space capabilities.

The growing reliance on U.S. national security space systems has evolved under relatively benign conditions. Over the past decade, national security space budgets grew and then peaked before showing a relative decline in the past few years. These budgetary allocations existed within the largest defense and intelligence budgets since the height of the Cold War. However, the current anemic economy, fears over levels of government spending, and the staged withdrawals from both Iraq and Afghanistan signal an end to the era of large budgets when the majority of Department of Defense requests were fulfilled without question. Indeed, this trend is already evidenced in the current discussions of the FY 2013 budget. The Space

Foundation's comparison of congressional action on the various defense spending bills noted that "a number of the space program budget requests were lowered to 'support higher Department of Defense priorities.'"[22]

For the foreseeable future, declining budgets for national security will likely reduce requirements and spending, and perhaps create an environment where national security leadership provides greater focus to defense planners. National security space will not be exempt. U.S. national security space policymakers have done themselves no favors in trying to achieve political immunity from the discipline of tight budgets. Acquisition failures and disasters abound in U.S. national security space, ranging from the outrageously expensive failure of the National Reconnaissance Office's (NRO) Future Imagery Architecture program[23] to the acquisition debacles of the Space-Based Infrared System (SBIRS) ballistic missile early warning satellite program intended to replace the rapidly aging Defense Support Program.[24] Add to these examples other tales of acquisition woes that include expensive yet abandoned programs such as Space-Based Radar and the Transformational Satellite communications programs,[25] and ongoing acquisitions, such as the Advanced Extreme High-Frequency (AEHF) communications satellite program and the Evolved Expendable Launch Vehicle program (EELV), which have not lived up to the initial promises of cost savings.[26]

While acquisition reforms are underway, as evidenced by the U.S. Air Force's Evolutionary Acquisition for Space Efficiency, where satellites are acquired through block buys at fixed prices,[27] the flaws in the defense acquisition system are broader than the space segment and will demand concerted effort by policymakers, industry, and the Defense Department to correct.

Nevertheless, the military's demand for the services provided by space systems continues to grow. This growth in demand and axiomatically increased dependence of the country on space-based systems will intensify as defense budget cuts compel forces stripped of manpower and capabilities to leverage space systems as an ever greater force multiplier. Even if defense budget cuts do not occur, or are not as severe as anticipated, demand for services provided by space systems will nevertheless increase, as the strategic focus of the United States shifts to the Asia-Pacific region. This shift also signals an imminent doctrinal shift from irregular warfare in Iraq, Afghanistan, and elsewhere to a re-emphasis on conventional capabilities and concepts in order to project forces across the Pacific, reassure allies, and hedge against the rise of a hostile China. While U.S. and allied national security space systems have played a critical role in the counter-insurgencies in Afghanistan and Iraq, the Asia-Pacific environment will demand more from space systems, and is certainly a more threatening context for these systems.[28]

The combination of fiscal stringency and the strategic shift to the Asia-Pacific will result in changes to U.S. force structures reflected in the growing utility and role of space systems. These changes in force structure will leave U.S. forces deployed across the Pacific and Asia exposed, should force-multiplying space systems be significantly disrupted or denied. While U.S. forces regularly train to operate in a space-degraded environment, smaller force structures optimized for space support over extended lines of communications are less than robust and especially vulnerable in such circumstances. Indeed, for some national security space systems, even temporary disruption might have negative implications for deployed forces. One example of temporary disruption having a disproportionate negative strategic effect would be the intermittent, intentional interference with GPS signals, leading to failures of critical timing of operations, critical navigational errors, and the inability to use long-range precision strike weapons that depend on the GPS signal.[29]

Allies had initially been slow to follow the United States' exploitation of space for operational and tactical use. Many reasons explain this slow up-take of space dependencies: The long-term provision of space services by the U.S. that allows its allies to use U.S. resources without assuming the risks and cost of these systems; the high cost of building and operating indigenous space systems in the past; and doctrinal and political obstacles to the pervasive integration of space systems in national security establishments and to the lowest military echelons. Today, however, many circumstances are combining to push allies closer to U.S. national security space practices. These combined circumstances include continuing expeditionary operations, and a desire to be as interoperable as possible with the space-dependent U.S. military.[30] Add to these changes in technology that enable smaller and cheaper space systems to be built, and there is a discernible and growing trend underway among U.S. allies of increased space dependence, doctrinal adaptation, and substantive integration. But direct challenges to allied security have offered ample incentives for the expansion of their space capabilities.

Over the past two decades, several watershed events have convinced U.S. allies that they, too, must make their own investments in national security space systems. The first event was the collapse of the Soviet Union and the subsequent end of the Cold War that resulted in the significant drawdown of U.S. forces in Western Europe, and with that, the inevitable diminishment, though not abandonment, of U.S. strategic commitment to European security. While extraordinarily close ties were maintained with some European countries, such as the United Kingdom, other European countries perceived that they would have to make provisions for their own national security space needs, especially in military satellite communications and high-resolution satellite imagery. Thus, in the 1990s, a nascent European effort in national security space spearheaded by France quickly established a relatively ambitious military space program.[31]

The second watershed event was the launch of North Korea's Taepo-Dong 2 ballistic missile over the Yellow Sea in August of 1998. This event crystallized Japanese security fears and exposed a perceived dissatisfaction with U.S. intelligence support to Tokyo. As a result, the Japanese government began work on its Information-Gathering System comprising high-resolution electro-optical (EO) and synthetic aperture radar (SAR) satellites, supplemented by intelligence products provided by the U.S. and by commercial systems.[32]

The third watershed event was the 1999 conflict between U.S.-led North Atlantic Treaty Organization (NATO) forces and Yugoslavian forces in Kosovo. The aftermath of that conflict made clear a serious capability gap among European NATO partners, which demonstrated that Europe was ill equipped to prosecute modern warfare autonomously from the United States.[33] The Kosovo watershed event spurred further development of European space capabilities to include high-resolution EO and SAR imaging satellites and military satellite communications by France, Germany, Italy, and Spain, among others, and also instigated the development of an autonomous satellite navigation system called Galileo.[34]

The fourth watershed event is the rise of Chinese space power, both in civil and national security realms, that has instigated a regional space competition mirroring existing geopolitical dynamics in the Asia-Pacific region. Hence, numerous countries in the region—India, Japan, South Korea, Vietnam, Malaysia, and Indonesia—have developed, or are developing, significant space capabilities with credible national security applications.[35]

While allied national security space capabilities and the extent of their military integration lag behind the United States, allies of the U.S. are mimicking the U.S. approach to national security space and are also becoming increasingly reliant on their systems for military effectiveness. Both the United States, and increasingly its key European and Asian allies, have grown more dependent on space systems for national security purposes—a trend that shows no sign of abating.

Alternatives to National Security Space Capabilities. Critical dependencies on national security space systems create critical vulnerabilities that can be costly and difficult to fix. In essence, as long as the United States derives real military, diplomatic, and economic power from its space systems, any competent adversary will attempt to deny the United States access to the source of that advantage. It is therefore understandable that defense planners seek alternatives to, and even replacements for, national security space systems in order to eliminate these vulnerabilities, or at the very least to create redundancies by building additional or supplemental communications and intelligence, surveillance, and reconnaissance (ISR) systems. Among the more common alternatives to space systems are unmanned aerial systems (UAS), manned and unmanned aerostats, fiber-optic cabling, and terrestrial radio and microwave communication devices.

While creating redundant communications and ISR networks should be a prerequisite to sound operational practice, the notion that space systems can be entirely replaced with terrestrial technologies is a dangerous one. Such a notion masks the realities about the role that space systems play even in the functioning of so-called alternatives, and ignores both the strategic attributes of space power and the limitations of these alternatives to satellites.

First, it is imperative to acknowledge that the majority of UAS capabilities for ISR purposes use space-based position, navigation, and timing (PNT) and satellite communications links to operate. The efficient uses of scarce UAS ISR capabilities often depend on high-resolution imagery satellites for their cueing and tasking.[36] While a number of small-unit UAS capabilities are not necessarily space-dependent, the larger and more capable UAS systems certainly are and will remain so for the foreseeable future.

Second, the notion that satellites can be replaced *in all circumstances* with their aerial and terrestrial alternatives shows an ignorance of the strategic attributes of space power in peace and war. On October 4, 1957, the Soviet satellite *Sputnik* became the first artificial satellite to orbit the Earth and thereby set an important legal precedent, establishing the principle of freedom of space which recognizes that satellites in orbit can pass overhead sovereign territory, waters, and airspace with the reasonable expectation on non-interference by the sovereign state over which they pass.[37] UAS capabilities and aerostats do not enjoy the same legal privileges and so can only be used in foreign airspace with the permission of the sovereign state, as is the case today in Pakistan, or operate in that airspace after a hostile or resistant state has been neutralized by the force of arms. Use of UAS capabilities and aerostats in foreign airspace without permission risks provoking the sovereign state to force such assets from its airspace, or, at the very least, creating diplomatic and political challenges to the use of such capabilities. Therefore, space systems play a strategic role that alternatives are unable to do legally.

Space systems also provide a strategic perspective and presence that aerial systems are only able to do in limited ways. These attributes are only possible because satellites occupy the high ground of space that, in turn, enables strategic presence and access globally, to include otherwise denied territories. This presence and access can provide strategic early warning of events that aerial and terrestrial alternatives cannot.[38]

For communications, alternative means pose more of a challenge to the primacy of satellites. Fiber-optic cabling now provides speed-of-light communication links to most major population centers around the world, providing communications that are cheaper, quicker, and more efficient than satellite communications.[39] Similarly, older means of communications, such as radio, cellular, and microwave communications, often suffice for most needs under normal circumstances. For national security purposes, however, circumstances are often anything but normal. While militaries use fiber-optic cables and legacy communications capabilities where available, they often operate in remote and insecure parts of the world where other means of communications are unavailable or unreliable. Communications satellites provide the main source of strategic and tactical communications. For navies, the utility of satellite communications is obvious for both strategic and tactical communications at sea. Similarly, modern air power relies on satellite communications for real-time data exchange while platforms are airborne. Therefore, while there are possible communications alternatives available to the military under certain circumstances, only satellite communications offer the flexibility and connectivity that modern militaries require.

Finally, concern has been expressed about the ability of U.S. national security space systems to survive a concerted effort to render them inoperable by various means during open conflict.[40] Certainly space systems are vulnerable to a number of methods of attack due to their predictable orbits and physical fragility. The United States should certainly expect to lose satellites in a future peer, or even near-peer, military conflict. Expectations, however, that an enemy would have a continuous clear shot at U.S. space assets without inviting some kind of response from the United States, or that clearing the Earth orbits of all U.S. assets in a short period of time is feasible, are completely misplaced. Certainly, under current circumstances where the immense strategic value of U.S. national security space systems is not deemed to be worth the expense of protecting it, the prospects that U.S. space capabilities would be able to withstand a concerted attack without serious consequences to U.S. forces on the ground are indeed unsettling. Yet, by undertaking a number of programmatic initiatives (space protection measures), research, development, and eventually, acquisition (responsive launch capability to replenish constellations), as well as commercial and allied arrangements, U.S. national security space systems can be made more resilient to attack, and at the very least, degrade gracefully over a longer period of time.

Thus, alternative capabilities and technologies offer complementarity and redundancy for space systems, rather than outright replacement. Space systems are not just networks of sensors and conduits for information flows, which are interchangeable with other capabilities. They offer unique strategic attributes that terrestrial capabilities are simply unable to provide.

Part Two: Challenges to National Security Space Investments

U.S. national security space investments, as outlined and proposed in Part Two, must contend with a number of challenges abroad and at home. If the investments outlined in this study are to be effective and provide U.S. warfighters the capabilities they need, the challenges outlined below must be confronted. Some of these challenges will require further investments not yet identified, while others will require significant legislative, policy, organizational, and cultural changes in order to make the U.S. national security space establishment the world's leading provider of national security space effects.

A2/AD Capabilities and U.S. National Security Space Requirements. U.S. national security space systems underpin the American way of warfare that is the sine qua non of enduring U.S. tactical and operational success over the past few decades.[41] Success, however, can sow the seeds for future failure, and adversaries of the United States—actual and potential—have assiduously looked for vulnerabilities that might be successfully exploited, should conflict with the U.S. arise.[42]

These adversaries, real and potential, have identified the critical role that space systems play in the American way of warfare and are developing capabilities designed to degrade, deny, and destroy U.S. satellites. These counter-space systems are part of a broad range of anti-access (A2) and area denial (AD) capabilities that seek to thwart U.S. air, sea, and space superiority by denying U.S. forces the strategic advantages they have enjoyed in these domains for many decades.[43] In this regard, A2/AD counter-space capabilities include direct-ascent anti-satellite (ASAT) weapons; directed-energy weapons designed to dazzle the sensors on imaging satellites; jamming capabilities that disrupt the data-links between satellites and their terrestrial users; electromagnetic pulse (EMP) weapons that disable electronics within their blast radius; and the capabilities to ensure that these counter-space weapons can be used for effect, such as space situational awareness capabilities.[44] Among the more prominent countries developing these counter-space A2/AD capabilities are the People's Republic of China and Iran, though others are also thought to be developing similar capabilities.[45]

Since national security space systems are critically vital to the effective use of air, sea, and land forces, overcoming the A2/AD threat is among the biggest challenges and priorities facing the U.S today. In order to do so the United States needs to focus on the following areas:

- **Space protection.** Greater effort and funding must be devoted to space protection efforts that can prevent U.S. satellites from being dazzled and jammed by nonlethal A2/AD capabilities. This can be achieved through hardening against jamming attempts, and shutters and filters to protect imaging sensors. Space protection also involves defensive counter-space capabilities such as missile defense to counter direct-ascent ASAT weapons, offensive airpower against well-defended A2/AD targets, and special operations against critical A2/AD targets.[46] Further research is also required for space propulsion technologies that can help critical space systems maneuver away from certain A2/AD counter-space threats, or at least complicate adversary attempts to track and target space assets. In order to ensure that commercially provided national security space capabilities can overcome the A2/AD threat, legislation and policy regulating commercial provision of these capabilities should stipulate that they feature the latest protective measures deemed necessary by the client (e.g., the U.S. Air Force).[47] Similarly, the U.S. should carve out a leadership role in space protection technologies and methods, setting the standard for space protection among friends and allies. Indeed, among the criteria for deep collaboration among friends and allies in national security space should be minimum standards of space protection in foreign space systems before the U.S. engages.

- **Responsive launch capability.** Overcoming A2/AD threats also involves being able to expand space capability in a timely manner (meaning days, if not hours) in order to bolster capability already in orbit or to replace capability already lost. The U.S. has already demonstrated that the mass manufacturing of small yet capable satellites in a short period of time is possible through the Operationally Responsive Space (ORS) program or similar undertaking (see "Off-the-shelf satellites" below). What has not advanced is the ability to rapidly and responsively launch such capability on demand, and this is the second priority for investment in overcoming the counter-space A2/AD challenge. The United States must reinvigorate exploration of all possible methods for rapid and responsive launch, preferably developing a mix of capabilities between traditional launch vehicles launched from fixed sites, launch vehicles launched from mobile platforms, and air and sea launch.[48]

- **Off-the-shelf satellites.** As already mentioned, the United States has demonstrated its ability to mass manufacture small but capable satellites in a short period of time. Yet the White House, in its FY 2013 budget request for national security space, proposed to shut the ORS program down. Parts of Congress have acted to save the program, while others have endorsed the President's decision. In the face of the A2/AD threat, shutting down the ORS program appears a retrograde step. Further gains in research and technology development, as well as enabling the entrenchment of the skill sets required for the development, acquisition, manufacturing, operation, and maintenance of small, mass-produced satellites, are a clear security priority. Whether through restoration of ORS or establishing the requirement in other programs, improving the speed to orbit is a recommended priority for national security space.[49] To be clear, it is not argued here that all national security space functions can or should be carried out by small, mass-produced satellites. However, in overcoming the A2/AD threat, large numbers of small satellites (imaging and communications) launched rapidly can provide redundancy for U.S. space forces, and thwart adversary efforts to deny U.S. forces their space advantage.

- **Commercial and allied space systems.** Overcoming the A2/AD counter-space threat can also be achieved by employing commercial and allied space systems as appropriate. Commercial systems, especially foreign systems, and allied space systems can provide increased capacity as part of a surge in space capability, and as a measure of redundancy. The importance of engaging friends and allies in national security space will be discussed further, though it should be stated here that engagement and collaboration with allies must be based on strict criteria and guided by concise strategic necessity.

- **Terrestrial redundancy.** Also critical to overcoming the counter-space A2/AD threat is the development and sustainment of robust terrestrial communications and ISR networks that can decouple from the space-based component to provide a measure of continuity for U.S. forces, even though a diminishment of capability would inevitably result.

- **Mission assurance.** Finally, overcoming the counter-space A2/AD threat requires that all U.S. forces—land, sea, air, space, and cyberspace—be able to achieve mission objectives in the face of degraded capabilities and compromised domain superiority. While every effort is required to ensure that U.S. forces receive critical space support through every phase of combat and post-combat operations, there is always the possibility that the adversary might succeed in its attempt to deny the U.S. its space superiority. In that case, all U.S. forces must be trained and equipped to achieve mission objectives in a severely degraded space environment. This training is already underway and should be further encouraged.

Confronting the counter-space A2/AD threat requires long-term preparation and development of technologies that will not appear and mature overnight. Long-term, sustained investments in the areas identified above are prerequisites to assuring U.S. superiority in every domain when confronted by any adversary.

Arms Control, Codes of Conduct, and U.S. National Security Space. Investments made by the Obama Administration in space protection and counter-space capabilities will most certainly run afoul of Chinese and Russian advocates of the proposed Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT),[50] and supporters of the International Code of Conduct (ICoC) for Outer Space Activities, formerly known as the European Union Code of Conduct (CoC) for Outer Space Activities.[51]

The PPWT was first proposed by China and the Russian Federation in early 2008. It has been rejected outright by the Bush and Obama Administrations and will most certainly be rejected by a new Administration. On this topic, U.S. policy is abundantly and unambiguously clear since the draft treaty proposal was made by China and the Russian Federation.[52] Given the outright rejection of the PPWT, as well as disquiet about its proposed provisions by other countries, the European Union proposed its voluntary and non-binding CoC late in 2008 as a compromise agreement. The Obama Administration has expressed its support for a revised and rebranded CoC (now called the ICoC) and is encouraging international discussion of its proposed provisions.[53] While there is no prospect of any Administration agreeing to the proposed provisions of the PPWT, there is growing support in some circles in the United States for the ICoC.[54] Such support fails to consider matters in which a CoC is not in the interests of the United States and can leave U.S. national security space capabilities needlessly vulnerable. Should the United States sign up to a renegotiated ICoC, it would doubtlessly take its obligations seriously, while other signatories would circumvent its provisions in order to gain a strategic advantage of the U.S. Should conflict occur between the U.S. and a country that has not lived up to the spirit and letter of the CoC, then U.S. space systems will be rendered needlessly vulnerable. Similarly, it is unclear how compatible the proposed provisions of the CoC are with the right of countries to act in self-defense of core interests if attacked. Many of the investments in programs associated with space protection and counter-space are likely to be at variance with the proposed provisions of the CoC.[55]

Finally, while building a set of enduring norms of behavior in space operations is very much in the interests of the U.S. and other space-faring nations, it is far from clear how any CoC is better at establishing and instilling such norms than the widespread adoption of the norms already practiced by commercial satellite operators—norms established by experts (rather than diplomats) based on pragmatic need, enabling satellite operators to compete in the marketplace while at the same time engaging in mutual cooperation to avoid collisions, spectrum interference, and other mishaps.

Rejection of the PPWT is thoroughly justified and this sentiment should be reiterated to China and the Russian Federation. Similarly, the U.S. should eschew the draft CoC, given that it undermines U.S. interests and does not constrain countries of concern. Instead, the United States should complement the rejection of formal and semi-formal space arms control with a serious and concerted effort to bilaterally engage in space confidence-building measures with key space-faring nations, and support and encourage the establishment of meaningful norms of behavior in space operations as practiced by space operators every day.

Domestic Challenges and U.S. National Security Space. While the actions of adversaries and potential adversaries are almost impossible to control, and diplomatic initiatives by others can only be influenced, action—or lack of action—on the domestic front is very much within our control. An Administration looking to invest and revitalize U.S. national security space capabilities may not be able to directly control the actions of adversaries and international diplomats, but it can have a direct effect on domestic issues that can impede and undermine the overall effectiveness and readiness of U.S. national security space.

Continued support for export control reform already underway is warranted, especially reform of the International Trafficking in Arms Regulations (ITAR). Bipartisan support for ITAR reform appears to be strengthening even though the required legislation has yet to pass through the House and the Senate.[56] To be clear, the problem is not the intent of ITAR, which is to prevent the unauthorized export of sensitive technologies that could undermine the U.S. advantage in key areas. The problem, rather, has been its implementation and the vast number of technologies that are subject to its strictures.[57] It is now recognized that ITAR implementation stymies competitiveness and that many of the technologies subject to ITAR restrictions are in fact innocuous and freely and widely available on the open market abroad. ITAR reform is needed in order to help the U.S. space industry—especially second-tier and third-tier industry—compete in an increasingly competitive international market.[58]

Reform of ITAR not only allows American space companies to better compete in the international satellite market, it will also have the long-term effect of solidifying the overall technological superiority of the United States. As currently implemented and interpreted, ITAR in fact impedes U.S. competitiveness and as a result acts as a disincentive to innovation over the long term. This is not to say that the technological "crown jewels" of the United States should be allowed to be sold to the highest bidder. There are technologies that offer the United States real advantages over the capabilities of other nations and these technologies should be protected with no expense spared. However, it is reasonable to speculate that the numbers of technologies that provide this kind of critical advantage are fewer than the total of the list, meaning that a preponderance of U.S.-developed satellite technology is safe enough to sell on the international market and that the list should evolve as technologies become diffused. Innovation is sustained through intense competition as well as through adequate research and development funding. Intense market competition without adequate research and development funding can result in missed opportunities; adequate research and development funding absent intense market competition results in fewer, if any, technological breakthroughs that might contribute to American technological superiority.

Along with the main challenges to revitalizing and investing in U.S. national security space, the study now identifies the capabilities in need of sustained investments in order for U.S. space superiority to endure over the coming decades, and as a result, ensure superior U.S. military effectiveness in the face of 21st-century challenges.

Part Three: How to Invest in National Security Space

So far this study has provided context for U.S. national security space that describes its current state and discusses discernible trends for the future, and has identified the main challenges to national security space investments. The study now turns to an analysis of what investments are required over the coming decades and how these investments might be made. The contextual analysis of Part One and Part Two provides the underlying assumptions of and potential impediments to the proposed investments outlined in Part Three. These assumptions include an austere budget environment, an expectation of doing more with less, a strategic focus in which there is at least latent potential for major war between two powerful states, and a foreseeable lack of adequate technological alternatives to space systems. The impediments include adversary (and potential adversary) efforts to blunt the effectiveness of U.S. and allied military effectiveness with A2/AD capabilities, poorly conceived space arms control efforts and the domestic challenges of export control reform, and maintaining a healthy space industrial base.

The following analysis provides investment recommendations for the entire remit of current and foreseeable national security space activities. These investment recommendations are made based on the enduring assumptions of defense planning where the future is, by its very nature, uncertain and unknowable, yet preparations are bounded by political choice and finite resources. For the majority of national security space investments, only the Department of Defense and the intelligence community can assume primary roles. This analysis makes the case for serious consideration of the viability of public-private partnerships for national security space missions as a complement to government. The analysis also covers investments that leverage other government departments and agencies beyond the Defense Department and the intelligence community, and investments that can be supplemented by allied capabilities.

In "Sustaining U.S. Global Leadership: Priorities for 21st Century Defense," the Obama Administration correctly points out that "[m]odern armed forces cannot conduct high-tempo, effective operations without reliable information and communication networks and assured access to cyberspace and space."[59] With the strategic focus of the United States shifting to the Asia-Pacific and considering the vast distances between the various theaters there and in North America, it is difficult to overstate the importance of U.S. national security space systems in maintaining a significant and effective military presence in the region. Deployed U.S. air, sea, and land forces, stationed in the Asia-Pacific along extended lines of communication from the United States, will be utterly reliant on space systems for strategic early warning, survivable communications, PNT, and a significant part of their ISR needs. These space systems, in turn, will be operating in an increasingly uncertain and dangerous space environment that contains threats ranging from space debris through to counter-space capabilities fielded by certain states in the Asia-Pacific who view a U.S. presence in that region as a threat. It is imperative that national security space systems, and their protection, remain a major strategic priority. In short, and to put it bluntly, diminished, aging, and vulnerable national security space systems seriously jeopardize the ability of the United States to maintain a significant and effective military presence in the Asia-Pacific and beyond.

Critical National Security Space Capabilities. Certain national security space functions can only be provided by the federal government, through the Department of Defense and the intelligence community. These national security space systems are critical to the existential security of the United States, such that without these capabilities the United States is severely weakened and fatally vulnerable. These critical capabilities are as follows: ballistic missile early warning satellites; secure and hardened satellite communications for nuclear command and control and select high-value or emergency communications; certain extremely high-resolution EO and SAR imaging satellites operated by the NRO; SIGINT satellites; and a strategic space-launch capability.

Ballistic missile early warning satellites are fundamental to the security of the United States since they are capable of detecting the launch of ballistic missiles, possibly nuclear-armed, soon after their launch. Since nuclear weapons are the most serious threat to U.S. national security, and will remain so for long into the future, ballistic missile early warning satellites are fundamental to U.S. security, as they buy precious time for defensive and offensive responses to a possible nuclear attack.[60]

Since the early 1970s ballistic missile early warning was conducted by satellites with infrared sensors in the Defense Support Program (DSP). In the mid-1990s, the Defense Department decided that DSP should be replaced by the SBIRS, originally to be launched in the early 2000s.[61] SBIRS has been plagued with budget overruns, schedule slippage, and requirements integration.

Furthermore, the original architecture of SBIRS has changed markedly, and, to date, the entire SBIRS constellation is still not in orbit, leaving aging DSP satellites to carry out this most critical of functions.[62]

SBIRS will be due for replacement at some point in the 2030s, and it is imperative that the policy and budgetary foundations for its replacement be laid down now, with an emphasis that the lessons learned from the difficult SBIRS development and acquisition are taken on board. Ongoing debates about SBIRS reveal one challenge to space system acquisition that will affect the direction of SBIRS and other programs as well.[63] As space systems involve long lead times and generally have lengthy acquisition processes, a challenge is to balance the desire to incrementally alter the design to incorporate new technologies or respond to new requirements against the inevitable delay in schedule and cost increases that those accommodations produce. In the current case of SBIRS, the House appropriations bill warns the Defense Department not to sacrifice "components with high technology readiness levels" in favor of "immature concepts and technologies," as justification for removing $32 million from the SBIRS Space Modernization Initiative.[64]

On the other hand, the Senate Appropriations Committee endorsed the initiative arguing that "limiting investment in this area increases the risk that the government will be locked into old technologies, suppliers, and concepts."[65] The merits of SBIRS or the initiative aside, the controversy is illustrative of the broader concern that touches every major national security space program. Improving the responsiveness of the space acquisition process must remain a priority for the Defense Department, policymakers, and industry.

A second priority area is communications. The Department of Defense must also provide a constellation of highly secure and hardened communications satellites for nuclear command and control, high-value communications missions, and other national emergencies. While the majority of satellite communications needs used by the military will likely continue to travel on commercial satellites, the Defense Department must remain solely responsible for those communications satellites reserved for purely nuclear command and control purposes. Providing high-quality, high-reliability, jam-free communications for strategic and tactical missions likely will remain a shared responsibility.

The Defense Department today operates a number of satellite communications constellations, yet over 80 percent of all Defense Department satellite communications traffic today is carried by commercial satellite communications providers.[66] This commercial traffic is not entirely non-essential communications; it includes communications links for UAS operations and other essential missions.[67] The Mobile User Objective System (MUOS), Advanced Extremely High Frequency (AEHF) system, Wideband Global SATCOM (WGS), along with a variety of service-specific programs, form the basis for future communications capabilities solely provided by the Defense Department. Hosted payloads or contracted services augment the remaining demand.

The intelligence community should provide for a small number of niche intelligence satellites, focusing on extremely high-resolution imaging (EO and SAR) and SIGINT satellites devoted to serving the intelligence needs of command authorities at the highest levels.

Finally, the Department of Defense should provide its own space situational awareness (SSA) capabilities, defensive and offensive counter-space capabilities, and invest in the research, development, and incubation of cutting-edge space technologies through service laboratories and the Defense Advanced Research Projects Agency (DARPA). Regarding SSA, it is not suggested here that the Defense Department act as the only provider of SSA data, but that the department maintain an independent capability supplemented by other SSA capabilities. Since defensive and offensive counter-space capabilities and actions are essentially military activities, the Defense Department is obliged to take sole responsibility for the research, development, acquisition, operation, and maintenance of such capabilities. By retaining its own research and development expertise and facilities, the Defense Department and the intelligence community can focus efforts on their own specific needs and requirements for national security space by funding pure science research, incubating promising technologies that emerge from such research, and then developing them for critical functions or farming them out to the commercial sector for further development.

In addition to the urgent investments mentioned above, further investments are required in the following space functions currently undertaken by the Department of Defense and the intelligence community. In no particular order, these functions are as follows:

- **Launch services.** Continue facilitation of the expeditious rigorous certification of new launch vehicles, such as those produced by SpaceX, in order to improve competitiveness in the national security launch market.[68] If new competitors to current launch providers to national security space missions are certified, the ensuing competition should see better value for the money for Air Force Space Command, the National Reconnaissance Office, and the American taxpayer.

- **Launch ranges, telemetry, and satellite control facilities.**

- **Space Situational Awareness (SSA).** Continue expansion of coverage through strategic international partnerships; modernization of the Joint Space Operations Center (JSPOC); maintaining healthy and consistent funding for SSA sensor modernization and data processing.[69]

- **Communications.** Continue funding for completion of Worldwide Global System (WGS) and Advanced Extremely High Frequency (AEHF) satellite communications constellations;[70] revisiting laser communications technology using new block acquisition approach; maintaining healthy budget for procurement of commercial satellite communications bandwidth.

- **Position, navigation and timing (PNT).** Continue strong funding for full constellation of GPS III follow-on, as well as funding for defense and civil support infrastructures, that features enhanced protection against jamming of the GPS signal.[71]

- **High-resolution imaging (EO, SAR, and hyper-spectral).** Development of a tactical space-based reconnaissance capability to be operated by Air Force Space Command for purely military purposes. The experiment in operating classified and exquisite reconnaissance satellites for both the intelligence community and senior national leadership as well as for warfighters has produced intolerable operational, technological, and bureaucratic strains.[72] The NRO should develop and fund, with close congressional oversight, the successor to the failed Future Imagery Architecture system—the Next Generation Electro-Optical program.[73] Lastly, revisiting space-based radar concepts using the new block-build acquisition approach.

- **Wide-area remote sensing (EO, SAR, and hyper-spectral).** Conduct a broad investigation into U.S. government Earth monitoring needs for remote-sensing, geodesy, mapping, and ocean surveillance and monitoring; modernization of identified capability gaps, establishing partnerships with key allies.[74]

- **Ballistic missile early warning.** Fund and complete the SBIRS program as currently planned; begin work on follow-on to SBIRS.[75]

- **Precision Tracking Space System (PTSS).** Increase funding for PTSS in order to enable greater tracking of in-flight ballistic missiles for enhanced missile defense.[76]

- **Test and evaluation.** Maintain healthy and stable budgets.[77]

- **Space protection.** With national security space set to be an even more critical enabler of all other national security efforts and operations, it is imperative that Congress make an enduring political and budgetary commitment to developing passive and active space protection capabilities and concepts. The Defense Department and intelligence community established a Joint Space Protection Program in 2008 to provide analytical insights into vulnerabilities and dependencies across the national security enterprise.[78] Actions to complement these insights with programs and activities to protect U.S. space assets remain unclear, but are strongly encouraged.

- **Counter-space capabilities.** Use a mix of passive and active, strengthening dissuasion against attack, making a strong but accountable budgetary commitment. Counter-space funding has been reduced in the past several years, and this trend must be reversed.[79]

Commercial and Civil Capabilities in National Security Space

While the Department of Defense and the intelligence community must be solely responsible for developing, acquiring, operating, and maintaining certain national security space capabilities that are fundamental to maintaining existential U.S. national security, other national security space capabilities can be provided by the commercial sector or shared with other government departments and agencies as dual-use systems.

The commercial sector provides hundreds of millions of dollars' worth of space services to the Defense Department and intelligence community today, primarily through satellite communications, space-based imagery, geographical information systems (GIS), and other satellite services. The provision of these services has become so pervasive that in many areas the Defense Department and the intelligence community are unable to operate without commercial support. As defense and intelligence budgets shrink in the coming years and the Defense Department and intelligence community are expected to continue to provide the same level of performance, it is the commercial sector that will likely make up the shortfall. Expanded partnership between industry and government will only successfully occur once the government, and the Defense Department and intelligence community in particular, explicitly outline roles, responsibilities, and expectations. Once this delineation is made, robust policies and legislation are required in order to encourage commercial sector engagement and provide a predictable business climate that nurtures confidence that any investments made by the commercial sector will see a reasonable return.

The Defense Department and intelligence community, on the other hand, must also make their requirements and the minimum standards that the commercial sector must meet explicitly clear. In a wider sense, what is proposed here is not new. A number of Western countries, most prominently the United Kingdom, use public-private partnerships in order to provide costly yet essential national security space capabilities. The U.K.'s Skynet-5 military satellite communications constellation was developed and acquired, and is operated, by a company called Paradigm Secure Services, which operates the system on behalf of Britain's Ministry of Defense.[80] Excess capacity is sold off to NATO allies, including the United States.

Another trend is the use of dual-use satellite systems. Again, in many parts of the world this is an enduring reality, with only one or two satellite functions critical to existential national security actually run exclusively by national security establishments. Other non-critical systems are shared with other government departments and agencies in order to maximize value to the taxpayer, as well as provide better utilization of unique capabilities across a range of applications. In a number of cases, the United States is already doing this, though often by default rather than design. For example, the U.S. Air Force has, since 1973, operated the Defense Meteorological Satellite Program (DMSP), which will have to be replaced in the next few years.[81] The proposed replacement was to be the Defense Weather Satellite System (DWSS), part of the larger National Oceanic and Atmospheric Administration (NOAA) National Polar-orbiting Operational Environmental Satellite System (NPOESS).[82] In early 2010, the White House canceled NPOESS in favor of the Joint Polar Satellite System (JPSS), and in January 2012, at the behest of Congress, the U.S. Air Force cancelled the DWSS program.[83] As a result, the proposed JPSS is the only replacement system on the horizon for both NOAA and the Defense Department. This begs the question what the compelling reasons are that militate against the proposition that both NOAA and the Defense Department share JPSS.

Similarly, the GPS originated as solely a Defense Department program and until the mid-1990s the governance of the program was a purely defense matter. With the establishment of the Interagency GPS Executive Board and its successor National Space-Based PNT Executive Committee, the governance of GPS is now the responsibility of all interested federal government departments and agencies, even though the actual GPS system is acquired, operated, and maintained by the Air Force.[84] While the Defense Department is chartered by legislation to operate a space-based PNT system and ensure that it will not be subject to interference,[85] GPS has become a public good not just within the United States, but also abroad. Indeed, GPS sets the standards for performance that rival PNT systems, such as the European Galileo program, Russia's GLONASS, and China's Compass program, must meet in order to be viable.[86] GPS has become, by design or by default, a dual-use program, and with looming budget cuts it is proposed that the funding of GPS operations, as well as the costs of its follow-on block, be shared among all federal government departments and agencies which use and depend on GPS, leaving the Air Force to fund only those GPS sub-systems necessary for military operations and the overall protection of GPS in all of its segments.

With the appropriate set of legislation and policies, there is no reason why such programs cannot be developed, manufactured, operated, and maintained by the commercial sector on behalf of federal government departments and agencies. These programs might include launch services, launch-range operations and maintenance, wide-area remote sensing, environmental monitoring systems, and certain types of satellite communications.

Military satellite communications that are not used for nuclear command and control, high-resolution imaging satellites (EO, SAR, and hyperspectral), space-based tracking and surveillance, complementary space situational awareness (in conjunction with Defense Department systems), and all necessary support services offer opportunities for expanded government-industry partnerships.

Expanded use must guard against posing unacceptable risks to U.S. security. These risks are identifiable on a case-by-case basis, however. Preemptively rejecting the business model is unwarranted, as is its uncritical embrace.

Provided that sound legislation and policies are in place that unambiguously delineate government and commercial roles and responsibilities, establish a climate where public-private partnerships can flourish, and create the conditions for investor confidence in allowing the commercial sector to take the lead on many of these programs, national security risks can be mitigated or avoided altogether. A more disciplined approach to establishing requirements for national security space systems, using an iterative, block-building approach that takes advantage of mature technologies while maintaining the flexibility to incorporate new and emerging technologies at a later date, can help militate against budget and schedule slippage. Indeed, it might be argued that the dysfunctional and wasteful acquisition processes that have resulted in a litany of cancelled national security space programs, or programs that are woefully over budget and years behind schedule, have exposed U.S. national security to more risks than anything proposed here. With such a framework and best practices in place, everyone can then focus on the main priority of getting much-needed capability in the hands of the warfighter on time and on budget.

Allies and National Security Space. The final part of this study's approach to investing in the future of U.S. national security space is to establish a series of bilateral, and where feasible, multilateral, relationships with close friends and allies around the world in order to complement and supplement U.S. capabilities, and in some cases to enhance these capabilities. These relationships will involve everything from capacity building, data sharing, interoperability (where feasible and cost-effective), basing rights, and permission to use U.S. national security space systems provided by the commercial sector. The nature, scope, and depth of these bilateral relationships will vary on a case-by-case basis according to strategic imperatives, risk factors, and the depth of the pre-existing relationship.

Many friends and allies are developing their own national security space systems, a number of which are dual-use, and foreign commercial entities are also in the business of not just providing satellite services, such as communications and imagery, but of developing, acquiring, operating, and maintaining national security space systems on behalf of their respective government clients. Some already possess, or are in the process of acquiring, national security space systems. France, Germany, Israel, Italy, Japan, South Korea, and the United Arab Emirates (UAE) all possess EO or SAR high-resolution imaging satellites, or are actively seeking to acquire such systems.[87] Similarly, Australia, Canada, France, Germany, Israel, Italy, South Korea, the UAE, and the United Kingdom all possess secure military communications satellites.[88] Some countries, such as France and Israel, have an impressive array of national security space capabilities, while other countries, such as Canada, Germany, Italy, Japan, South Korea, and the United Kingdom, boast impressive commercial systems with national security applications. Japan and Turkey are likely to develop national security space systems in the coming years,[89] while friends of the United States, such as India, Malaysia, and, more recently, Vietnam, also possess impressive space capabilities with national security applications.[90] For the most part, many of these systems are not as sophisticated or mature as those used by the United States, with the exception of European military satellite communications systems, but they are capable of complementing and supplementing U.S. systems. It should be noted that a number of allies are rapidly catching up with the U.S. in terms of mature and sophisticated national security space systems.

The rationale for engagement with friends and allies should be based purely on strategic need and which available capabilities meet these needs, rather than on vague rhetoric about cooperation with allies. Engagement should also be conducted from a position of strength so that U.S. sovereignty and unilateral freedom of action is assured.[91] Engagement and cooperation with friends and allies is never a substitute for, and should never compromise, mission assurance. If there is no strategic rationale for meaningful engagement on national security space issues, effort should not be wasted. Where strategic rationale does exist, such as a shared threat or issue of mutual concern and interest, the United States should use the tools at its disposal to develop that relationship. At times the situation may require the U.S. to assist a friend or ally in building up its nascent space capabilities so that regional security is bolstered and the systems can complement superior U.S. systems. On other occasions, allied systems may be good enough, and what is required is a data-sharing agreement. Some allies may possess systems of sufficient sophistication and use, so that ways are found to establish interoperability between such systems and their U.S. equivalents. Or, if for purposes of telemetry, tracking, and control (TT&C) or space situational awareness, the U.S. requires basing rights.

All of these, or a combination of them, can be used to forge close ties with friends and allies in the national security space field, and all of this can be done without giving away critical technologies or systems. However, these arrangements will require the United States to share capabilities and know-how in order to secure reciprocal cooperation from friends and allies, something with which the United States national security space community has traditionally had problems, especially with relationships beyond the "Five Eyes" (United States, United Kingdom, Australia, Canada, and New Zealand). There must be a cultural sea-change within the U.S. national security space community that eschews stovepiped approaches and does not hide behind the cloak of security classifications, in order to make meaningful collaboration with allies a reality. Cooperation and collaboration will require a comprehensive approach on the part of all U.S. national security space elements concerned, and will certainly require a degree of transparency that hitherto has not existed to facilitate allied interoperability. However, rigid discipline is required among policymakers in establishing the criteria and strategic rationale for collaboration in the first place.

Finally, national security space systems operated by the commercial sector for the Department of Defense can also be used by select allies and friends, provided they pay the commercial rate for such services. Again, access must be subject to disciplined criteria and strategic rationale, but such an approach can help bolster U.S. leadership in space, and also be a source of further legitimate revenues for the commercial entity operating the system.

Conclusions

The expense of operating in space will always create challenges for defense planners and budgeters, while offering opportunities for criticism from those who seek to cut the defense budget or who wish to change the allocation of funds within the budget. The contributions of space systems to the joint fight are significant and difficult to replace or replicate. To the extent then that the U.S. values space-based imagery, precision guidance, precise timing, real-time communications, and the host of other information provided by space systems, the investment in the maintenance of the systems and further development of those capabilities is justified. But, the sheer demand for space products and the expense of designing, developing, and reaching space requires a change in how the U.S. government plans, operates, and manages its space needs.

This *Special Report* has identified a number of steps the U.S. might take in light of the changed circumstances of austere budgets, diffuse technologies, increasingly capable partners, and diversifying threats. Before taking any action, however, the Defense Department, with congressional oversight, should conduct a comprehensive assessment of architectures, plans, and options to ensure that future programs, plans, and budgets reflect current and expected mission needs. Such an effort must centrally focus on maximizing the utility of space systems to terrestrial warfighting operations. From that orientation, decision makers can more effectively judge which activities to prioritize, where cooperation with allies is sensible, and which can be provided by others.

Endnotes

1. Author's notes of speech by General C. Robert Kehler, USAF, Commander, Air Force Space Command, to the 26th National Space Symposium, Colorado Springs, Colorado, April 13, 2010.
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4. See, for example, some of the incisive comments by Bob Butterworth in "In Space, Doing More with Less Much Scarier than Budget Cuts," *AOLDefense*, March 5, 2012, http://defense.aol.com/2012/03/05/in-space-doing-more-with-less-much-scarier-than-budget-cuts/ (accessed October 26, 2012).
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