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AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

FINDING THE MIDDLE GROUND: THE U.S. AIR FORCE, SPACE WEAPONIZATION, AND ARMS CONTROL

by

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Abstract

This paper discusses problems associated with the current US approach to developing and deploying space weapons. Recommendations center around an alternative strategy for realizing US space control and space force application capabilities based on deployable (vice orbiting) systems. US development of an Expeditionary Space Force (ESF) would be one element of a comprehensive strategy that would include changes to US space architecture and cooperative measures with other countries.

US adherence to a space sanctuary policy dates to the earliest years of missile development and space exploration. The US determined during this time that the benefits of a secure environment within which space-based intelligence, surveillance, and reconnaissance (ISR) assets could operate outweighed those that might derive from the development and deployment of space-based weapons. Recent changes in the economic, geopolitical, and technical context have caused the US to reconsider its space weaponization policy. The debate regarding changed US policy has led to the emergence of various camps with divergent views about the best US course of action. These camps' inability to arrive at consensus continues to impede US efforts to deploy a dominant space capability. Halting US progress will encourage and allow other states to deploy their own space weapons. The commingling of US and adversary weapons in space will create conditions that encourage preemptive strategies and undermine crisis stability.

The recommendations offered within this paper are intended to prevent these conditions from emerging. They include that the US (1) adapt an expeditionary approach to space control

and space force application based on deployable systems; (2) develop a more decentralized space architecture and enhanced space situational awareness; and (3) negotiate an arms control regime that would prohibit orbiting weapons, limit testing against orbital targets, implement a robust launch notification regime, and revise the notion of space sovereignty and innocent passage.

Air Force doctrine is well suited to the sort of dynamic space campaign that would likely occur in future conflicts if the US and other states adopt the measures recommended here. Existing air power command and control arrangements are also well suited to the employment of an ESF. These arguments suggest that as the Air Force evolves toward a truly *Aerospace* Force, it should play a central role in supporting and implementing the concepts outlined in this paper.

Context

Arguments for the shifting of US policy regarding weapons in space often omit the underlying reasons for its existence. Forgotten – or conveniently ignored – is the reality that the current US space weapons policy…was, and remains, a policy entirely of our own making, with our own interests and benefits as the primary motivators.

—James E. Oberg

The United States first ventured into space weaponry in 1962. Seeking a means to negate Soviet satellites in low earth orbit (LEO), the US fashioned a primitive anti-satellite (ASAT) capability by equipping Nike Zeus missiles with nuclear warheads.[1] In the years that followed, both the US and the Soviet Union initiated additional ASAT programs, yet today – more than forty years after deployment of its first space weapon – neither the US nor any other country maintains an active or robust capability to deploy space weaponry.

How is this explained? Absent any additional information, one might reasonably conclude that the United States had reached agreement with other space faring nations to refrain from employing weapons in space. This has not been the case, however. Though the United States participated in several treaties that impose limits on its space activities – most notably the Outer Space Treaty (OST) and (until recently) the Anti-Ballistic Missile (ABM) Treaty – these agreements have not seriously curtailed its ability to deploy or employ weapons in space.[2] The OST, for instance, proscribes the deployment of weapons of mass destruction (WMD) in orbit around earth, and enjoins signatories from undertaking military activities "on celestial bodies."[3] The ABM Treaty prohibited signatories from deploying *space-based* ABM systems or ABM systems based on "other physical principals."[4] Neither treaty, however, prevented the US from deploying weapons with which it could attack its adversaries' space assets, actively defend US space assets, or launch weapons towards earth from space. As Donald Rumsfeld and the Space

Commission reported in January of 2001, "There is no blanket prohibition in international law on placing or using weapons in space, applying force from space to earth or conducting military operations in and through space."[5]

A number of factors that explain why the US historically refrained from placing weapons in space, even in the absence of treaties prohibiting such actions. Space weapons promised to be enormously costly; they faced seemingly insurmountable technical obstacles; they often appeared to provide little in the way of military utility; and arms control theorists speculated that they would create dangerous instabilities. Overshadowing these considerations, however, was a military calculation and derived space policy that originated in the Eisenhower administration. The US determined that the benefits it could derive from a threat-free environment outweighed the potential benefits of space weapons. In such a "space sanctuary," its Intelligence, Surveillance, and Reconnaissance (ISR) assets could operate freely.[6] The US felt complelled to choose between the two options – space sanctuary or space weapons – because it anticipated that adversaries would follow its lead. If the US introduced weapons into space, particularly anti-satellite weapons, a new arena for war would be created.[7] Buttressed by the considerations listed above, the US pursued a policy that encouraged space sanctuary and denigrated the role of space weapons. The Soviet Union generally followed its lead, and the inviolability of space-based ISR was ensconced in treaty as part of the 1972 SALT-1 accord, which prohibited either country from interfering with the others "national technical means of verification."[8]

In terms of historical context, it is important to note that from the 1950s through at least the end of the 1980s, the space sanctuary policy was a direct by-product of the competition between the US and the Soviet Union. Both countries valued their space-based assets because they greatly reduced the likelihood that either side could conduct a successful (surprise) first strike.

By strengthening the viability of the nuclear deterrent force, space sanctuary provided a measure of stability that was otherwise unobtainable. The US, as a relatively open society, attached great value to its space-based ISR assets. The Soviets could conduct intelligence activities within the US and from its free press, but the US required ISR overflights to glean comparable information. After Gary Powers U-2 spy plane was shot down in 1958, space-based ISR became nearly the only reliable means by which the US could monitor Soviet military developments and ensure it kept pace with Soviet strategic weapons capabilities. As Walter McDougall writes, "arguments that came to dominate American missile and space policies over the next decades had already surfaced by the end of 1959. The first was that stability...was the key to security in the missile age."[9]

If stability was the paramount concern, it is worth noting that the pursuit of stability did not completely override a US desire to preserve the latitude to deploy space weapons in the future. Senior policy makers understood that while forbearance initially served US interests, the potential for space systems was still largely unknown. A time might come when the US would want to employ the capability to attack systems in space, and it would be wise to maintain this prerogative. As Assistant Secretary of Defense Mansfield Sprague wrote, "There is a real danger that we may harm ourselves by too early commitments before the full implications of space potentials are known. Our policy and national interest should be permitted to develop first: the law and commitments should follow, and be consonant with the former."[10] The US continued to publicly espouse a "peaceful" or "non-aggressive" use of space policy, but as noted earlier, it deliberately refrained from participating in any agreements that would prevent it from revising this strategy.[11]

US policy began to change in the 1990s following the dissolution of the Soviet Union, the maturation of technology initiatives pursued as part of the Strategic Defense Initiative (SDI), and the emergence of a perceived ballistic missile threat to the US by "rogue states."[12] Primarily in response to this threat, and in particular to a 1998 report by The Commission To Assess the Ballistic Missile Threat to the United States (created by Congress and chaired by Donald Rumsfeld), President Bill Clinton accelerated the US National Missile Defense (NMD) Program.[13] Though Clinton was careful to restrict the program to testing permitted by the 1972 ABM Treaty, these actions indicated that the US was, for the first time since the 1950s, reconsidering its position on missile defense, space weapons, nuclear deterrence policy, and the means by which it sought to achieve international stability. US strategy documents reflected the changing tide. The 1997 National Military Strategy, for instance, explicitly identified "Space Control" as a "strategic enabler," and stated that US "space control capabilities will ensure freedom of action in space and, if directed, deny such freedom of action to adversaries."[14] The 1998 National Security Strategy went even further, stating that:

> Our policy is to promote development of the full range of space-based capabilities in a manner that protects our vital security interests. We will deter threats to our interests in space and, if deterrence fails, defeat hostile efforts against US access to and use of space. We will also counter space systems and services that could be used for hostile purposes against our ground, air and naval forces, our command and control system, or other capabilities critical to our national security.[15]

While these policy documents took a fairly strident tone, US implementation was decidedly less aggressive. President Clinton deferred the decision to deploy an NMD system until the technology matured and the threat became more self-evident. With respect to space control capabilities, the administration emphasized "tactical" approaches that relied on jamming, attacks on ground nodes, and other localized, non-destructive means of defeating enemy space capabilities.[16] The approach emphasized continued compliance with existing space treaties and law and downplayed the desirability of space weapons. Then Deputy Defense Secretary John Hamre made clear the administration's aversion to space weapons, stating that "our preference is that we not get into destroying satellites. We do not think that is the preferred approach for space negation."[17]

This approach did not satisfy space weaponization advocates, most notably Senator Bob Smith of New Hampshire. Smith was publicly critical of both the Clinton Administration and the Air Force for what he perceived to be their tepid support for "space warfare."[18] In 1999, Senator Smith pushed through legislation creating "The Commission to Assess United States National Security Space Management and Organization," better known as The Space Commission. In some respects, the commission's findings were curious, again reflecting the schism within US policy circles regarding the desirability of fighting wars in space. As an example, the commission's January 2001 report noted that it was in America's interest to "promote the peaceful use of space," but just two sentences later it also recommended that the US "develop and deploy the means to deter and defend against hostile acts directed at U.S. space assets and against the uses of space hostile to U.S. interests."[19] With respect to US military capabilities, the commission's report stated that the US needed, among other things, to improve in the areas of "defense in space" and "power projection in, from, and through space."[20]

The Space Commission's findings are indicative of a larger call within the US for an increased presence in space, to include the development and deployment of space weapons. This movement reflects changes in the socioeconomic, geopolitical, and technical context within which the US formulates its national security strategy and policies. The change that has received the most attention is the increased US civil and military reliance on space systems. By some accounts, US investments in space will total nearly $600 billion by 2010, on par with current US investments in Europe.[21] Military spending on space systems is projected to account for 10-15 percent of the total DoD budget, or nearly $40 billion, in the same time period.[22] By 2020, the national space industry is projected to account for 10-15 percent of the US gross domestic product.[23]

But dollar figures alone do not illustrate the extent to which space systems have come to permeate our lives. An oft-cited incident that better demonstrates US dependence is the May 1998 failure of the Galaxy IV satellite, operated by PanAmSat (a Hughes Aerospace subsidiary). When the Galaxy IV's guidance systems malfunctioned, it degraded nearly 80 percent of the US paging network, disabling 37 million pagers.[24] The failure also knocked out numerous TV news feeds, disrupted both the Reuters and United Press wire services, and made it impossible for retail stores across the country to verify credit card transactions.[25] The US military might be similarly disabled by failures in its network of space support assets. Consider, for example, that the US military services relied upon GPS guidance to direct 75 percent of the precision munitions dropped during Operation Enduring Freedom.[26] Failures in or attacks upon critical GPS nodes could render US air attack operations nearly impotent.

Space systems clearly enhance capabilities in both the civil and military sectors, but they also create potential vulnerabilities. Space now represents a potential center of gravity for the US military that adversaries are likely to target in times of conflict. Though no state or non-state actors will be able to match US space capabilities in the near future, they will likely attempt to develop asymmetric strategies to attack its space assets. Space systems are in many respects ideal targets. They are potentially quite fragile, they are largely undefended, and their remote location minimizes the risk of collateral damage and increases the prospects for plausible deniability. Military and civil capabilities have also become thoroughly intermeshed – more than

60 percent of military satellite communication now travels over commercial systems, for instance – thus rendering more difficult attempts to defend military space capabilities through passive measures.[27] The increased US reliance on space systems and its derived vulnerability in times of conflict support the argument that the US should develop means to defend these systems.

Though it has received substantially less attention, the demise of the Soviet Union and Russia's continuing economic problems may be more significant in terms of evolving US space weaponization policy than the increased US economic and military reliance on space. If US policy was initially based on the understanding that military exploitation of space would set off a costly and destabilizing arms race with the Soviet Union, calls today for a more assertive US military posture in space are based on the understanding that a meaningful response is now beyond Russia's means. If the US confronted an adversary as capable as that which it faced until very recently, it seems unlikely that it would be taking such an assertive stance with respect to space weapons.

Recent technical achievements make it likely that the US will soon possess a capability to actively defend its space assets or to deny adversaries the ability use space to the US' detriment. The most dramatic advances have taken place in ballistic missile defense technology, much of which translates well to ASAT capabilities. Since 1999, the US has conducted five successful exoatmospheric missile intercepts as part of the NMD program. Directed energy or laser devices have not yet reached comparable levels of effectiveness, but a substantial US investment has yielded significant progress in these areas as well. For instance, the Space-Based Laser (SBL) program was on track to demonstrate a space-based prototype by 2012 until its funding was recently cut.[28] And in 1997 the Army successfully tracked and targeted an active US reconnaissance satellite with its most powerful ground-based laser, demonstrating the potential for ground-based directed energy weapons to attack space systems.[29]

The aerospace industry and its associated lobby also influence US policy towards space weaponization. It views space operations at least partially in terms of revenue and growth potential, and this perspective certainly bolsters enthusiasm for a more aggressive US posture in space. Though US defense budget increased from $274 billion to $345 billion (in constant fiscal year 2002 dollars) between 1997 and 2002, the US still spends substantially less on defense, measured in either absolute terms or as a percentage of gross domestic product, than it did at the height of the Cold War.[30] This situation could change quickly if the US were to move aggressively into space though. As an indication of how the development of space weapons might affect defense spending, consider current spending levels for the Ground-Based Mid-Course Defense Segment (GMD), a developmental missile defense system designed to intercept Intercontinental Ballistic Missiles (ICBMs) threatening the US as they transit the space environment. The FY 2002 acquisition budget for the GMD system and its associated space sensors totaled more than $4.2 billion.[31] This figure dwarfed each of the services largest acquisition programs – the Air Force F-22 ($3.9 billion), the Navy AEGIS destroyer ($3.4 billion), and the Army Longbow Apache ($951 million) – though the program is still only in its research, development, test, and engineering (RDT&E) phase.[32] Estimates suggest that spending on certain space-based weapon systems would greatly exceed GMD spending.[33] These prospects encourage industry support for an aggressive US approach to space weaponry.[34]

Notes

[1] LtCol Bruce M. DeBlois, "Space Sancuary: A Viable National Strategy," *Airpower Journal* 12, no. 4 (Winter 1998), 45.

Notes

[2] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, available at www.state.gov/www/global/arms/treaties/space1.html. *Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missiles*, signed May 26 1972, House of Representatives Document 92-3111, 13 June 1972.

[3] Outer Space Treaty, Article IV.

[4] ABM Treaty, Article V.

[5] *Report of the Commission to Assess United States National Security Space Management and Organization*, Executive Summary, (Washington, D.C.: 2001), 17.

[6] DeBlois, p. 44.

[7] Walter A. McDougal, *The Heavens and the Earth* (Baltimore, MD: Johns Hopkins University Press, 1985), 335.

[8] Ibid, 431.

[9] Ibid, 193.

[10] Ibid, 179.

[11] Ibid, 335.

[12] James C. Moltz, "Breaking the Deadlock on Space Arms Control." *Arms Control Today* 32, no. 3 (April 2002), 5.

[13] Michael Krepon, "Lost in Space," *Foreign Affairs* 80, no. 3 (May/June 2001), 2. Mike Moore, "Non-aggressive Weapons?" *Bulletin of the Atomic Scientists* 57, no. 2 (March/April 2001), 19. Walter Pincus, "From Missile Defense to a Space Arms Race?" *Washington Post*, December 30 2000, 2.

[14] *National Military Strategy of the United States of America* (Washington DC: Joint Chiefs of Staff, 1997), 29.

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[16] William B. Scott, "U.S. Adopts 'Tactical' Space Control Policy," *Aviation Week & Space Technology* 150, no. 13 (March 29 1999), 35.

[17] Scott, 35.

[18] Moore, 18.

[19] *Report of the Commission to Assess United States National Security Space Management and Organization*, 15.

[20] Ibid, 16.

[21] James E. Oberg, *Space Power Theory* (Washington, D.C.: Government Printing Office, 1999), 16.

[22] Ibid, 17.

[23] Ibid, 16.

[24] Krepon, 7.

[25] "Wayward Satellite Wreaks Havoc." Reuters News Service as reported in *Wired News*, May 20, 1998, n.p., on-line, Internet, available from http:// www.wired.com/ news/ technology/ 0,1282,12414,00.html.

[26] James G. Roche, "Transforming the Air Force," *Joint Forces Quarterly* no. 29 (Autumn/Winter 2001-2002), 12.

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[27] William B. Scott, "Space Chief Warns of Threats to U.S. Commercial Satellites," *Aviation Week and Space Technology* 150, no. 15 (April 12 1999), 51.

[28] "Space-based Laser Put on Hold," *Arms Control Today* 32, no. 10 (December 2002), 26.

[29] Todd Lowery, "Call It A MIRACL," *Bulletin of the Atomic Scientists* 54, no. 1 (Jan/Feb 98), 5.

[30] *The Long-Term Implications of Current Defense Plans* (Washington, D.C.: Congressional Budget Office, 2003), xiii.

[31] This figure includes funding for the Missile Defense Agency's GMD system ($3.762 billion) and the Air Force SBIRS-High program ($438.7 million). FY 2003 Department of Defense Budget Materials, Program Acquisition Costs by Weapon System, Office of the Secretary of Defense, available from http://www.dtic.mil/comptroller/fy2003budget/fy2003weabook.pdf.

[32] Ibid.

[33] Everett C. Dolman, *Astropolitik* (London: Frank Cass Publishers, 2002), 161.

[34] Karl Grossman and Judith Long, "Waging War in Space," *The Nation* 269, no. 22 (December 27 1999), 8.

Terms of Reference

It's politically sensitive, but it's going to happen…we're going to fight in space. We're going to fight from space and we're going to fight into space…That's why the US has development programs in directed energy and hit-to-kill mechanisms.

—General Joseph Ashy
Commander, US Space Command (1996)

When we speak of space weapons, what precisely do we mean? Which weapons are important or essential, and which have useful terrestrial surrogates? What are the technologies involved and what is the state of its development? These are questions that both sides of the space weapon debate sometimes gloss over, yet these questions should factor prominently in US decisions and policy on space weapons.

General Ashy's remarks reflect the most basic notions of space warfare, the paths by which weapons are employed and the mediums through which or from which they are employed. Ashy's terms – *into* space, *in* space, and *from* space – refer to the use of earth-based systems against space-based targets, space-based systems against space-based targets, and space-based systems against earth-based targets. These are useful concepts because they describe where weapons operate and the location of their targets, but Ashy's terms of reference are of limited utility because they fail to describe the missions weapons perform within each of the paths or mediums. There is little basis for evaluating the significance of the different paths until we better understand the missions or effects they enable.

Joint Doctrine addresses this problem by discussing "space mission areas," to include space control, space force enhancement, space support, and space force application.[1] US space control and space force application capabilities are closely linked to decisions regarding space weapons.

Joint Publication (JP) 3-14 describes space control operations as those taken to "provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include the broad aspect of protection of US and US allied space systems and negation of adversary space systems."[2] JP 3-14 goes on to note that space control activities "may involve activities conducted by land, sea, air, space and/or special operations forces." That is, the space control mission need not necessarily rely solely, or even primarily, upon space. The force application mission area receives substantially less attention within JP 3-14. The entire discussion takes three sentences:

> The application of force would consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through space. The force application mission area includes ballistic missile defense and force projection. Currently, there are no force application assets operating in space.[3]

Especially when ballistic missile defense is lumped into the force application mission area, it becomes apparent that space control and force application are buckets into which current doctrine dumps a number of disparate capabilities. They are still useful terms because they describe, at the highest level, the effects warfighters will want to accomplish: the control of space and the application of force from space. Again though, for the purposes of this discussion, they are of limited utility as terms of reference because they provide little insight to the means by which these effects might be achieved.

The space control mission area includes a number of sub-missions for which space weapons are likely candidates. The first of these is satellite attack, or ASAT. Returning to Ashy's terms of reference, ASAT can be accomplished *into* space or *in* space. One way to accomplish ASAT into space is to use direct ascent systems. Boosters launched from ground sites or airborne platforms place these systems into orbits from which they can intercept their targets. In the terminal phase of the intercept, autonomous kill vehicles usually separate from the booster, guide themselves by way of radar or optical sensors, and destroy the target with either kinetic or explosive warheads. Direct ascent systems are practical primarily as a means to attack LEO assets.[4] The US has tested several direct ascent ASAT systems in the past and the Bush administration recently revitalized the Army's Kinetic Energy Kill Vehicle Program, a direct ascent ASAT that Congress defunded and the Clinton administration eventually cancelled in the mid-1990s.[5] Many other countries possess this capability as well, though few have chosen to develop weapons specifically designed to intercept or destroy space systems. Theater missiles with a range of 1000 km are capable, if fired vertically, of reaching altitudes as great as 500 km. Matched with seekers and a guidance system, which are now available for commercial applications on the open market, these boosters could threaten many satellites in LEO.[6]

ASAT into space can also be accomplished using directed energy devices. The most prominent example of this technology is the Army's Mid-Infrared Advanced Chemical Laser (MIRACL), a megawatt-class deuterium-fluoride laser based at the White Sands Missile Range.[7] The Army used MIRACL to target an ageing, Air Force reconnaissance satellite in a 1997 test intended to demonstrate the vulnerability of US satellites to laser attack. While the results of the test were ambiguous due to a malfunction in the target satellite, most observers agreed that it demonstrated the potential for ground based, directed energy ASAT systems.[8]

An ASAT capability in space would likely entail one of three methods: co-orbital ASATs, space-mines, or directed-energy weapons.[9] Co-orbital systems and space mines differ primarily in their means of employment. Space-mines would be put into place well in advance of attack, and for all practical purposes would remain inert. They would be activated and maneuvered to intercept targets as programmed. Co-orbital systems, on the other hand, would generally be put in orbit to pursue and destroy specific targets just prior to or during ongoing military operations.

The different means of employment have implications for the weapons' thrust, maneuver, and stealth characteristics. Directed energy weapons would target adversaries as they came into range and line of sight. They would likely employ either laser or radio frequency (RF) disabling mechanisms. Direct ascent systems are generally impractical for attacks on satellites in orbits other than LEO, so these three space-space capabilities represent the most viable means to attack satellites in higher orbits.[10]

As with control of the air, control of space also entails defensive capabilities, or counter-ASAT. In the event that adversaries possess any of the capabilities described above, the US may wish to pursue means to defend space assets from attack in space. One way to do so would be to deploy satellite bodyguards. Like their human counterparts, satellite bodyguards put themselves between the object they are protecting and the threat to that object, be it a direct ascent ASAT, a co-orbital ASAT, a space mine, or a directed energy weapon.

A more effective, though more controversial, method for defending space assets from attack is to deny adversaries the means to place weapons in orbit or to launch direct ascent weapons. This capability is termed launch suppression.[11] Launch suppression from space has much to recommend itself, as hot boosters are in many respects easier to track and intercept than their cold space payloads. Space-based launch suppression also gets around problems inherent to boost phase intercepts from earth, and, in the case of hit to kill weapons, takes advantage of the energy derived from launching from the high ground.[12] Space-based alternatives for launch suppression include kinetic kill and directed energy weapons. Strictly in terms of doctrine, describing a space-based launch suppression capability in the context of the space control mission area is problematic because boost phase intercept of launch vehicles and ballistic missiles entails almost identical technical capabilities. JP 3-14 includes ballistic missile defense in the space force application mission area.[13] This discussion highlights the problems with terminology or policies that distinguish between missile defense and space control or ASAT capabilities. As a 1987 Aspen Strategy Group that included William Perry and Brent Scowcroft noted, "all space-based and many ground-based BMD weapons would make excellent ASATs, even if they were poor strategic defenses."[14]

Within the current doctrinal construct, space force application includes attacks against terrestrial-based targets and ballistic missile defense. Space-based weapons for terrestrial attack include orbital bombardment devices, directed energy weapons, and common aero vehicles (CAVs). Orbital bombardment weapons take advantage of the velocity and derived kinetic energy generated by objects launched from orbital altitudes. One concept calls for long, thin rods of dense metal (such as tungsten) launched from orbit and impacting the earth at speeds ranging from 5 to 10 kilometers per second.[15] Under these conditions, rods one to two meters long could penetrate hardened structures to a depth several times the length of the rod, with destructive effects similar to a shaped explosive warhead of equal weight.[16] Alternatively, bundles of smaller rods could be used with great effect for softer, area targets such as airfields.[17] A drawback associated with orbital bombardment devices is that their high descent velocities preclude the receipt of navigation (GPS) signals and severely restrict their precision capability.[18] Thus, orbital bombardment systems are of little use for small or moving targets. Directed energy weapons have been considered for use against airborne or surface targets, but a number of factors undermine their effectiveness against these targets, including fuel and power constraints and aiming limitations against maneuvering objects.[19] Because of these limitations, most authors discount their utility against surface or airborne targets.[20]

CAVs may represent a more effective and practical approach to the space force application mission than orbiting, space-based platforms. One Air Force proposal called for a first stage, sub-orbital Reusable Launch Vehicle (RLV) capable of launching multiple CAVs.[21] While the first stage vehicle would stay within US airspace, the CAVs could deliver precision munitions anywhere in the world within an hour of launch. According to the proposal, launches could be accomplished within six hours of notification, the sub-orbital vehicle could be ready for a subsequent sortie within eight hours of launch, and each vehicle could launch two to three CAVs. CAVs could also be deployed via expendable rockets or upon orbital, reusable Space Maneuver Vehicles (SMVs).[22] In either case, a prominent advantage of the CAV concept is that they do not involve placing weapons in permanent, fixed orbits.[23] Besides keeping the weapons beyond the reach of potential countermeasures, CAVs allow the National Command Authority (NCA) or Joint Force Commander (JFC) to visibly escalate the US response in times of crisis and to stand-down the force once tensions have eased.[24]

The prior discussion of launch suppression briefly covered space-based missile defense capabilities. Brilliant Pebbles, a system that emerged from the Strategic Defense Initiative (SDI) as perhaps the most viable candidate for space-based missile defense, exemplifies the basic concept of missile defense from space. Deployed as a constellation of 700-1000 individual kinetic kill interceptors in more than 20 individual low earth orbits, the system was designed to simultaneously engage several hundred individual missiles during their boost phase ascent.[25] Although it was defunded by Congress in 2002 and eventually relegated to a technology development effort by the Missile Defense Agency (MDA), the Space-Based Laser (SBL) was another system designed primarily for missile defense. That program at one time called for a constellation of more than 20 satellites circling the globe, providing worldwide missile defense coverage from an orbit near 1200 km.[26]

Table one summarizes the space control and space force projection mission areas broken down according to paths, sub-missions, and specific space weapons. It also includes information regarding the status of existing capabilities and lists terrestrial alternatives (including earth-space alternatives for space-based weapons). Alternatives that the chart highlights are those capable of executing the same specific capability – the attack or defense of satellites, the destruction of a booster or missile during launch, the interception of a missile, or the delivery of munitions against targets on earth – under worst case conditions (no strategic or tactical warning). This leaves out functional equivalents such as jamming communications links, destruction of command and control nodes, or disabling launch facilities.

Table 1: Space Mission Areas, Weapons, and Status

Mission Area	Path	Sub-mission	Weapon	Status	Alternatives
Space Control	Earth to space	ASAT	Direct assent kill vehicle (LEO)	KE ASAT, residual capabilities	None
			Directed energy	MIRACL	None
	Space to space	ASAT	Co-orbital	1980s Soviet systems (LEO), concept	Earth-space systems, none otherwise
			Space mine	Concept	Earth-space systems, none otherwise
			Directed energy	SBL	Earth-space systems, none otherwise
		Counter-ASAT	Bodyguard satellites	Concept	None
			Directed energy	SBL	Possibly earth-based directed energy
	Space to earth	Launch suppression	Kinetic kill interceptors	Brilliant Pebbles	None
			Directed energy	SBL	None

Force Projection	Earth to space	Missile Defense	Exoatmospheric kill vehicle	Under development for national missile defense system, 2005 IOC	Sea/ground-based boost phase intercept in certain areas
			Directed energy	Concept	None
	Space to earth	Terrestrial targets	Orbital bombardment	Concept	Strategic systems
			Common aero vehicle	Concept under exploration by Air Force and NASA	Strategic systems
		Boost phase missile defense	Kinetic kill	Brilliant Pebbles	None
			Directed energy	Space-Based Laser	None

This table highlights several important points. First, if the US is unable to disable adversary space launch or control infrastructure and adversaries are able to place their own weapon systems in space (either space control or force projection), there are few alternatives to space-based weapons that satisfy its space-control requirements. Direct ascent or earth-based directed energy weapons provide limited capabilities against LEO assets, but in the face of a robust enemy capability, some space-based systems will be required to defend US systems or territory from attack, and to hold adversary systems at risk. A second point the table makes apparent is that space basing provides a unique capability for launch suppression and boost-phase missile defense. Ground, sea, or air-based systems (such as the Air Force's Airborne Laser) will provide some boost-phase intercept capability, but these systems will have limited value against surprise missile attacks or against launches from geographically sheltered locations (i.e. those emerging from within a large, isolated land mass). To the extent that this is true, US satellites, especially those in LEO, will be susceptible to attack by adversaries' direct ascent systems in the absence of space-based defenses.

The table suggests that existing strategic systems represent viable alternatives to some space force projection capabilities. This is not necessarily the end of the story with respect to evaluating the utility of space force projection systems, however. CAVs in particular bring some unique capabilities, namely the ability to rapidly strike strategic targets with precision capability over global ranges without having to first negotiate overflight rights or disable adversary integrated air defense systems (IADS). A subsequent chapter will highlight other qualities of the CAV and important capabilities they might provide to the National Command Authority or Joint Force Commander.

Clearly, space weapons or space-based weapons are not a panacea. Development and deployment costs would be extraordinary and would compete with funding for proven, terrestrial systems.[27] With the exception of ground based kinetic energy systems for missile defense or LEO ASAT, most of the capabilities depicted above require quantum leaps in technology before they become operationally viable. Even if the requisite technologies were available now, there are solid reasons to question the military utility of some of these systems. Space-based directed energy weapons, for instance, would be limited by fuel consumption rates, and would thus be susceptible to adversary strategies aimed at overwhelming their defensive capability. Because of the periodic nature of orbiting systems, gaps inevitably occur in weapon system coverage that detract from system effectiveness.[28] For example, based on a constellation with five times as many satellites as planned and allowing for capabilities well beyond current technology, Barry Watt concludes that an SBL-like system would destroy fewer than 20 ICBMs salvoed against the US from Korea.[29] Watt allows that these numbers fluctuate according to specific assumptions, but the larger point he emphasizes is that "opportunities for the attacker to maximize the chances of overwhelming SBL defenses are frequent and, because the SBL satellites move in accordance with orbital mechanics, predictable. Like any static defense, an SBL constellation can be saturated in space and time, and a determined opponent can be expected to evolve the weapons and tactics to do so."[30]

Notes

[1] Joint Publication 3-14, *Joint Doctrine for Space Operations*, 9 August 2002, IV-5 – IV-10.

[2] JP 3-14, IV-5.

[3] JP 3-14, IV-10. This is a definitional issue. Though JP 3-14 states that "no force application assets operation in space," some would assert that ICBMS, which transit the medium, constitute space force application systems.

[4] William L. Spacy II, *Does the United States Need Space-Based Weapons?* (Maxwell AFB, AL: Air University Press, 1999), 36.

[5] "Something to Watch Over You." *The Economist* 360, no. 8232 (Jul 28, 2001), 71. "Army Kinetic Energy Kill Vehicle." National Security Space Architect web page, on-line. Available from www.fas.org/spp/military/program/nssrm/initiatives/kkill.htm.

[6] US Air Force Scientific Advisory Board, *New World Vistas: Air and Space Power for the 21st Century*, Space Applications Volume, 141.

[7] "Something to Watch Over You," 71.

[8] Todd Lowery, "Call It a MIRACL." *Bulletin of the Atomic Scientists* 54, no. 1 (Jan/Feb 98), 6.

[9] For an extended discussion of each of these types of systems, their capabilities, and limitations, see Spacy, 10-26.

[10] Strictly speaking, attacking satellites in higher orbits would require a variation in the co-orbital system, one in which the ASAT device was first placed in LEO and then intersected the target's orbit via a transfer orbit.

[11] Spacy, 10.

[12] Bob Preston, *Space Weapons: Earth Wars* (Santa Monica, CA: Rand Corporation, 2002), 38.

[13] JP 3-14, IV-10.

[14] Joseph S. Nye and James A. Schear, editors, *Seeking Stability in Space: Anti-Satellite Weapons and the Evolving Space Regime* (Lanham, MD: University Press of America, 1987), 91.

[15] Spacy, 26.

[16] Ibid, 27.

[17] Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment* (Washington, D.C: Center for Strategic and Budgetary Assessments, 2001), 87.

[18] Spacy, 29.

[19] Ibid, 18. Preston, 25.

[20] Barry R. Schneider, "Space-Based Lasers and the Evolution of Strategic Thought," in *Laser Weapons in Space: Policy and Doctrine*, ed Kieth B. Payne (Boulder, Colorado: Westview Press, 1983), 174.

[21] Watts, 63.

Notes

[22] Simon P. Worden and Martin E.B. France, "Towards an Evolving Deterrence Strategy: Space and Information Dominance," *Comparative Strategy* 20, no. 5 (December 2001), 462.
[23] Worden and France, 461.
[24] Ibid, 461.
[25] Spacy, 30.
[26] Watts, 90, Ibid 16.
[27] David W. Ziegler, "Safe Heavens: Military Strategy and Space Sanctuary Thought" (thesis, School of Advanced Airpower Studies, 1997), 59.
[28] Preston, 35.
[29] Watts, 91.
[30] Ibid, 92.

"And In This Corner…"

> *To best prepare for the future, we have to energize our thinking…We need the national debate on the existing policies and open questions affecting military capabilities and possibilities in space. And we need resolution of that debate sooner rather than later."*
>
> —General Richard B. Myers, Chairman Joint Chiefs of Staff

Opinion on the wisdom of the US introducing weapons into space is still very divided. In his most recent work on the subject, Lieutenant Colonel Peter Hays describes "four entrenched camps within the United States" each with divergent views regarding the utility of space weapons, the merits of negotiated agreements to regulate these weapons, and the course that the US should take with respect to weapons in space and associated arms control treaties.[1] Though Hays describes four camps – "space hawks," "inevitable weaponizers," "militarization realists," and "space doves" – these can readily be divided into two groups on either side of the space weapons debate.[2] Space hawks and inevitable weaponizers support the development of space weapons and hold a dim view toward arms control measures that would limit or regulate these weapons. Militarization realists and space doves view weapons in space as a dangerous prospect and call for negotiated measures to limit their development and deployment. James Moltz echoes Hays' theme of entrenched and divided camps. He writes in *Arms Control Today* that:

> The Bush administration's consideration of space weapons for both missile defense and anti-satellite (ASAT) purposes has reopened a domestic and international debate…regarding military uses of space…Today, the arms control community and advocates of missile defense are renewing this debate in the face of emerging challenges, and the gap between their two positions seems insurmountable…Although the positions of some individuals are more nuanced, it is fair to say that, in general, the two sides in the U.S. debate are not speaking to one another.[3]

Hays writes that the existence of these entrenched camps makes the likelihood of progress towards meaningful arms control unlikely.[4] The corollary to this statement is that the existence of these camps, and their inability to find common ground, also hinders the development of cogent US policy or doctrine to justify these weapons. This is because, though the current administration is on record as favoring a more aggressive stance with respect to US development and deployment of space weapons, many very powerful opponents stand in their way.

Within the US Senate, for instance, Tom Daschle, Joseph Biden, and Carl Levin have all expressed deep reservations about space weapons, while republican icon Richard Lugar has questioned the need for a multilayered national missile defense system and has argued for the cancellation of associated space-based weapons components.[5] Even Brent Scowcroft, National Security Adviser to President George H. Bush, took part in a 1987 study that argued for “negotiated measures” in order to “avoid a major commitment of resources to the advanced satellite attack mission that would drive up the costs of satellite protection dramatically in the long run.”[6] Opponents of a large-scale US commitment to deploying weapons in space may well represent the majority view in the current Congress.[7]

Considerable opposition to US plans exists within the international arena as well, and foreign states have the means to exert substantial influence over US policy. As Clinton administration deputy secretary of defense John Hamre noted in 1999, a decision by the US introduce weapons into space over the protests of our allies “is going to be highly confrontational to the international community… it will make it much, much harder for us to get international cooperation” on issues such as frequency and orbital slot allocations.[8] In testimony before the Senate Strategic Forces subcommittee, Hamre reiterated this theme, stating that such initiatives would “undercut US commercial interests that depend on global cooperation.”[9]

These deep divisions have produced a stalemate regarding US funding for space weapons and associated capabilities. While Congress increased funding for missile defenses by $8.3

billion in 2001, it also gutted funding for several important space-based components.[10] The Space-Based Laser (SBL) lost $120 million of its planned $170 budget fiscal year budget, for example. Even more dramatically, the Space Based Infra Red System (SBIRS), a space-based sensor network that would dramatically enhance US capabilities to detect and track targets in space, was defunded entirely.[11] Other developments are also worth noting. Senator Smith, by far the most vocal supporter of space weaponization, was defeated in his 2002 reelection bid. US Space Command – originally established in 1983 to serve as the warfighting command for space – was recently subsumed by Strategic Command. That Space Command's new headquarters building at Peterson AFB is now to be occupied by the newly established Northern Command is also significant. As the *Wall Street Journal* noted, the nation's focus on more immediate threats, such as domestic terrorism, has undermined support for "expensive research on exotic space-based lasers and particle-beam weapons to intercept Soviet missiles."[12]

Such two-steps-forward-one-step-back policy debates are not unusual in this country. Graham Allison describes the process by which such policy deliberations take place as the "Governmental (or bureaucratic) politics model," and he suggests the model is particularly relevant to foreign or military policy decisions.

> The nature of foreign policy problems permits fundamental disagreement among reasonable men about how to solve them. Analyses yield conflicting recommendations. Separate responsibilities laid on the shoulders of distinct individuals encourages differences in what each sees and judges to be important… This milieu necessitates that government decisions and actions result from a political process. In this process, sometimes one group committed to a course of action triumphs over other groups fighting for other alternatives. Equally often, however, different groups pulling in different directions produce a result, or better a resultant – a mixture of conflicting preferences and unequal power of various individuals - distinct from what any person or group intended.[13]

In this instance in particular, the process by which the US formulates space weaponization policy may be especially dangerous and counterproductive. As it makes halting progress toward employing space weapons and developing space control or space force application capabilities, US behavior signals to potential adversaries its intent to abandon the space sanctuary policy. The lack of consensus regarding US space policy means that even if US capabilities are developed, they will be deployed piecemeal over an extended timeline. This will provide potential adversaries with a window of opportunity to surreptitiously deploy their own space weapons before the US has the means to detect or prevent it. Even if adversaries are unable to match US technology or funding, they will likely attempt to develop strategies and countermeasures to defeat US capabilities in this area.[14] As the Soviet Union demonstrated with Sputnik in 1958, authoritarian regimes in particular might make up in single minded focus what they lack in technological prowess.[15] US actions could in this way produce the worst possible outcome: an incomplete and indecisive military capability, a targeted and robust response by US adversaries, and less stable and less secure space and international environments. The point this discussion highlights is that it is critical for the US to resolve its internal disagreements and arrive at some sort of consensus on space weapons and US space policy *before* it proceeds further down the path of space weaponization. Of course if this were an easy task it would already have been accomplished. Both sides of the debate need to acknowledge several propositions and use these as the basis for negotiations towards a compromise solution.

The first proposition is that the current situation is counterproductive to US interests. As discussed above, the US has effectively abandoned the sanctuary policy, but has not established any level of consensus on a policy supporting space weaponization. Thus, the US proceeds under self-imposed limitations, while potential adversaries – spurred by US developments and rhetoric – proceed unconstrained by the same level of internal disagreement.[16] The US needs to develop a policy that either allows it to effectively defend itself from attack in or from space <u>or</u>

one that dissuades other countries from developing the capability to use space as a medium for attack against US interests. The current US approach accomplishes neither or these things.

The second proposition that both sides of the debate need to acknowledge is that space weapons and international regimes to regulate these weapons need not be mutually exclusive concepts. The US-Soviet experience with strategic arms control agreements in particular (notably SALT and START) demonstrates that states can posses specified weapon systems even while they implement regimes to regulate the level and method of weapon system employment. While arms control agreements sometimes seek to ban or eliminate whole classes of weapons (as with the Chemical Weapons Convention), more often they seek to influence methods of employment or to limit specific technologies (such as Multiple Independently Retargetable Reentry Vehicles – MIRVs) so as to reduce the likelihood of war, the damage that would result if war did occur, or the cost of preparing for war.[17]

Finally, it is important that both sides start treating the space medium more like the air medium, both in terms of the strategies employed and the international rights acknowledged. It is unrealistic to think that space itself will continue to confer a significant defense against attack in the near future. Having said this, it would be unwise to anticipate that other states will stand idly by and while the US deploys weapons in space. Friends and foes alike will be no more tolerant of weapons in space that threaten vital national interests than they would of terrestrial systems posing a similar threats, regardless of US assurances about the weapons' defensive or non-aggressive purposes.[18] The US needs to develop a policy with respect to space weapons that accounts for the vulnerability of its space assets, but also acknowledges the concerns of other countries, the notion of reciprocity, and the idea of a security dilemma in space.

Notes

[1] Peter L. Hays, *United States Military Space: Into the Twenty-First Century* (Maxwell AFB, AL: Air University Press, 2002), 117.

[2] Hays, 117.

[3] James C. Moltz, “Breaking the Deadlock on Space Arms Control.” *Arms Control Today* 32, no 3 (April 2002), 3.

[4] Hays, 136.

[5] Moltz, 6.

[6] Joseph S. Nye and James A. Schear, editors, *Seeking Stability in Space: Anti-Satellite Weapons and the Evolving Space Regime* (Lanham, MD: University Press of America, 1987), 15.

[7] Moltz, 7.

[8] William B. Scott, “U.S. Adopts ‘Tactical’ Space Control Policy,” *Aviation Week & Space Technology* 150, no. 13 (March 29 1999), 35.

[9] Steven Lambakis, “Space and Security: A US Policy Quandary,” *Space Policy* 16, no. 1 (February 1 2000), 15.

[10] Moltz, 6.

[11] Ibid, 6.

[12] “Massive Federal R&D Initiative to Fight Terror Is Under Way,” *Wall Street Journal*, November 25 2002, A4.

[13] Graham T. Allison, *Essence of Decision* (Boston, MA: Little, Brown, and Company, 1971), 145.

[14] Bill Gertz, “Space Seen as Battlefield of the Future,” *Washington Times*, February 8 2001, 1. Michael Krepon, “Lost in Space, The Misguided Drive Toward Antisatellite Weapons,” *Foreign Affairs*, Volume 80 No. 3 (May/June 2001), 6.

[15] Walter A. McDougal, *The Heavens and the Earth* (Baltimore, MD: Johns Hopkins University Books, 1985), 132.

[16] For an excellent summary of Chinese counterspace strategy and modernization efforts, for instance, see Mark A. Stokes report *China’s Strategic Modernization: Implications for the United States* (Carlysle, PA: Strategic Studies Institute, 1999), 117-123.

[17] Thomas C. Schelling and Morton H. Halperin, *Strategy and Arms Control* (McLean, VA: Pergamon-Brassey International Defense Publishers, 1975), 3.

[18] Mike Moore, “Non-Aggressive Weapons?” *Bulletin of the Atomic Scientists* 57, no. 2 (March/April 2001), 19.

The Problem of Stability

Those who oppose the introduction of weapons into space typically cite several factors: the substantial technological hurdles still to be overcome; the cost of space weapons systems and the adverse affect that this cost would have on other defense and non-defense related programs; that many of the missions for which space weapons would be employed can be executed using terrestrial or non-destructive means; and that space weapons, particularly ASAT and force projection systems, would introduce dangerous instabilities into crisis situations.[1]

Technology and cost concerns are entirely reasonable and should factor prominently into any US decision on how to proceed with our space program. Having said that, the arguments space weapons opponents make regarding technology and costs bear a strong resemblance to those that were made in opposition to the early space and missile programs. In his Pulitzer Prize winning history of the space age, Walter McDougal writes that

> The decision to shelve the ICBM reflected at least four mentalities current at the time: the need for rigorous economy, which dictated that scarce funds be put into bigger bombers and eventually jet aircraft; the assumption of American superiority in aviation; the preference of 'blue sky' air officers for manned bombers; and scientific pessimism about the technical problems. Vannevar Bush reflected the last trait in December 1945: "I say technically I don't think anybody in the would know how to do such a thing [build an accurate ICBM] and I feel confident it will not be done for a long period of time to come."[2]

Vannevar Bush's prediction proved inaccurate. The development of the thermonuclear warhead increased the ICBM's lethality, decreased the accuracy requirements, and compelled the Air Force in 1951 to give highest priority to a program that had been effectively abandoned just four years earlier.[3] It is not hard to imagine changes in either the technical or political landscape that could create similar shifts in the US commitment to space weapons.

Additional considerations also suggest that concerns regarding the *net* cost of space weapons could be overstated. Space weapons such as CAVs or orbital bombardment systems employing precision conventional or kinetic strike weapons might render unnecessary whole classes of strategic nuclear systems.[4] Replacing US strategic nuclear forces with conventional space surrogates would have two beneficial effects in terms of costs. First, it would help to dissuade other countries from pursing a nuclear capability and thus reduce the weapons of mass destruction (WMD) threat against which the US needs to defend.[5] Second, the promise of conventional space weapons as a more effective and useful deterrent force may substantially reduce the likelihood of even smaller, regional wars. As General Simon Worden writes:

> Nuclear weapons…are certainly not the tools upon which future deterrence strategy aimed at addressing a broader range of contingencies than large-scale nuclear attack by a peer competitor should be based…Future deterrence strategy should be based on the most effective, usable military weapons available…Space and cyberspace strike, as the basis for a 21st Century deterrence strategy, offer the combination of utility, lethality, and flexibility most useful to a National Command Authority facing a much broader spectrum of threats than during the Cold War.[6]

Finally, considered as a percentage of revenue derived from a *secure* space environment, space weapons might prove be a cost-effective alternative to other prospects.

As described earlier, the US strategy for space control over the past decade has relied largely on non-destructive measures and the capability for terrestrial systems to disable ground based command and control stations or launch facilities. These measures have sufficed until now because of the relatively primitive state of potential US adversaries' systems and the paucity of their command and control links. In the near future, however, robust communications links and mobile ground stations will frustrate US efforts to defeat adversaries space capabilities through tactical measures.[7] Geographically isolated, mobile, or hardened launch systems will offset efforts to disable launch capabilities. Perhaps more importantly, an approach that emphasize attacks on adversaries ground nodes overlooks the role that space weapons may play in defending the US from ballistic missile attack or defending US space-based assets from attack by space-based or direct-ascent ASAT weapons.[8]

The argument that opponents make regarding the potentially destabilizing effects of space weapons is more sophisticated, however, and has been evident since the beginning of the space age. There are several interrelated factors relating to weapons (in general) and the operational environments within which they operate that influence strategic stability. The first of these factors is a weapon's vulnerability to attack. Simply put, if a weapon is vulnerable, there is an incentive for the country that possesses that weapon to employ it early on in a conflict.[9] The second factor is potency, or the threat that a weapon poses to a potential adversary. If a weapon is vulnerable, yet capable of dramatically affecting the outcome of a conflict, the state that possesses it has an even more powerful incentive to employ the weapon early on in a conflict. Accordingly, that state's adversary has a compelling incentive to attack the weapon before it can be put to use. The third factor to consider is proximity. If a weapon is near potential targets, either spatially or temporarily, and provides an adversary little time to react or defend itself, that adversary will again be inclined to eliminate the threat before the overt hostilities break out.

Opponents of space weapons argue that these systems demonstrate each of these characteristics: they are vulnerable to attack, they pose a significant threat to adversaries, and (temporally if not spatially) they operate in close proximity to one another or to potential targets.[10] Some space weapon advocates argue that US weapons would not be vulnerable because the US could quickly establish the same level of space dominance as it has for air and sea dominance, but this misses the point.[11] The US may be sufficiently confident in its ability to defend its own space assets – and in particular its own space weapons – that it can escape the "use it or lose it" dilemma, but this is only half of the equation. If adversaries possess space weapons they believe would be capable of striking a decisive blow against US space capabilities (say, for instance, by disabling half of the GPS constellation), but they realize their weapons would be targeted early in any conflict with the US, they would face an almost overwhelming temptation to strike preemptively. Thomas Schelling describes the situation well: "The danger does not depend on the belief that by striking quickly one may come off with a clean win. The comparison is not between initiating war and no war at all, but between initiating war and waiting for the other to initiate it. It may not be optimism that provides the dangerous incentive, but pessimism about the loss from failing to act in time."[12] This is a powerful argument because it suggests that even if the US is able to deploy a dominant space force, it may be in its best interest to refrain from doing so. This is because the result would be a less stable strategic environment and the possibility of conflict that might otherwise have been avoided.[13]

Other characteristics of the space environment reinforce space weapon's destabilizing tendencies. The first is anonymity. Especially with respect to ASAT weapons, space may provide a degree of plausible deniability that would encourage attacks on space assets. The vastness of space and its isolation from population centers may also contribute to a perceived lack of collateral damage. An adversary could launch an attack on space assets with little or no risk of directly harming any human population. A related consideration for the US is that it may be hard pressed to justify responding to such a non-lethal attack, in terms of human lives, even if it vaporized billions of dollars in assets and undermined valuable earth services. These considerations could all reinforce an adversary's inclination to preemptively attack in space.[14] Short of achieving absolute space supremacy, there is little that the US could do to avert this situation. James Oberg comes to a similar conclusion near the end of his book *Space Power*

Theory, which was commissioned by then Commander in Chief of US Space Command General Howell M. Estes III. Oberg writes that "the possibility of a preemptive strike in space will become all too likely. The strategic military gain, system vulnerability, and detachment from an earthbound public's concerns will combine to render space a target much too tempting to pass over."[15]

There is a tendency to dismiss concerns regarding strategic stability as intellectual exercises that have little relevance to the real world concerns of national security. Steven Lambakis, for instance, writes:

> The quest for strategic stability and the compelling desire to maintain a composed environment for international diplomacy, while important in the overarching national security picture, must not take precedence over measures to guard the country against old and new menaces…Would the introduction of weapons into the space environment be as bad as modern-day Cassandras portray?…My own sense is that, contrary to what balance of power theory may tell us, instability resulting from the actions of a particular state and its activities is more a function of the nature of that state and its activities, and not simply that state's accumulation of instruments of power.[16]

Title X wargames conducted by the US Army and the Air Force's Space Warfare Center suggest that concerns over space weapon's effects on strategic stability may be well founded. The results of these games confirm that the proliferation of space weaponry creates dangerous incentives to pre-empt and that states are likely to act on this temptation.[17] Ominously, the results of these games also indicate that the US may come out on the losing end of pre-emptive gambits. Writing in the *Army Times* about the results of the Army's 1998 Winter Wargame, Dr. Jonathan Lockwood observed that "an enterprising opponent, even if technologically inferior, still can achieve pre-emptive strikes against our most obvious center of gravity, our space systems. The Red team's successful pre-emptive strike in space in the Winter Wargame poses a critical problem for future U.S. warfighting doctrine …Regardless of how much we might wish otherwise, the inescapable strategic reality for at least the early 21st century is that a space denial strategy, given both current and projected technology, will be cheaper and easier for our prospective adversaries to execute than our strategy of space control."[18]

Notes

[1] Bruce M. DeBlois touches on each of these themes in "Space Sanctuary: A Viable National Strategy," *Airpower Journal* 12, no. 4 (Winter 1998), 45.

[2] Walter A. McDougal, *The Heavens and the Earth* (Baltimore, MD: Johns Hopkins University Books, 1985), 98.

[3] McDougal, 106

[4] Simon P. Worden and Martin E.B. France, "Towards and Evolving Deterrence Strategy: Space and Information Dominance," *Comparative Strategy* 20, no. 5 (December 2001), 455.

[5] George Perkovich, "Bush's Nuclear Revolution," *Foreign Affairs* 82, no. 2 (March/April 2003), 3.

[6] Ibid, 458-459.

[7] Simon P. Worden and John E. Shaw, *Whither Space Power? Forging a Strategy for the New Century* (Maxwell AFB, AL: Air University Press, 2002), 101.

[8] James C. Moltz, "Breaking the Deadlock on Space Arms Control." *Arms Control Today* 32, no 3 (April 2002), 5.

[9] Thomas C. Schelling and Morton H. Halperin, *Strategy and Arms Control* (McLean, VA: Pergamon-Brassey International Defense Publishers, 1975), 10.

[10] Senator Tom Harkin, "Star Wars: A Trojan Horse For ASAT Weapons," *Arms Control Today* 19, no. 2 (March 1989), 4.

[11] Everett C. Dolman, *Astropolitik* (London: Frank Cass Publishers, 2002), 156-159.

[12] Schelling and Halperin, 9.

[13] It is worth noting that stability also ranks high on the list of priorities for many space weapon advocates, but they aim for stability by establishing a dominant space regime. Everett Dolman, for example, advocates that the US "seize control of outer space and become the shepherd (or perhaps watchdog) for all who would venture there... The ability to shoot down from space any attempt by another nation to place military assets in space, or to readily engage and destroy terrestrial ASAT capacity, makes the possibility of large-scale space war and or military space races less likely, not more." Dolman, 156-159. See also Steven Lambakis, "Space and Security: A US Policy Quandary?" *Space Policy* 16, no. 1 (February 2000), 18.

[14] Oberg, 152.

[15] Oberg, 155.

[16] Lambakis, 18.

[17] Mr. Mike Terry, US Air Force Space Warfare Center, interviewed 27 Mar 2003.

[18] Jonathan S. Lockwood, "Growing Vulnerability in Space." *Army Times* 58, no. 38 (April 20 1998), 54.

The Expeditionary Space Force

Where does this leave us? The arguments presented thus far seem to suggest that unless the US is able utterly deny space to the weapons of potential adversaries or render those weapons strategically insignificant, it faces a hopeless situation. The key to escaping this conundrum is to recognize that space weapons *per se* are not destabilizing. It the vulnerability of either side's weapons to attack that undermines stability. Even if the US establishes a survivable space weapon infrastructure, the vulnerability of its adversaries' weapons creates instability, especially in times of crisis. Strangely, this suggests that the US has a vested interest in ensuring a degree of security for its adversaries' space weapons as well as its own.[1] Short of a technology revolution, however, it is unlikely that space-based systems will ever become substantially less vulnerable to destruction from the multiplicity of kinetic and directed energy weapons that technology will soon make available. Given this situation, how does the US retain the ability to defend its own space assets, deny space to its adversaries, or use space as medium for strategic attack without creating a destabilizing operational environment?

The first step is to work toward an Expeditionary Space Force (ESF) capability. The ESF would consist of various systems that could be deployed *from earth* on short notice to provide specific space control or force application capabilities to the Joint Forces Commander (JFC). The obvious difference between the ESF concept and prevailing notions of space weapons employment is that ESF capabilities would only be deployed to space as threats warranting the employment of space weapons emerged. ESF would emphasize robust launch-on-demand capabilities, rapidly deployable assets, and maneuverable manned and unmanned vehicles.

Unilateral, US implementation of an expeditionary approach to space weapons would only have the effect of ceding the high ground of space to its adversaries, and that is *not* what this paper proposes. Rather, the US should adopt an ESF approach as one part of a coordinated and comprehensive strategy that would also entail changes to its larger space architecture, cooperative measures with other states, and revisions to the legal rights and obligations associated with space passage. Taken as a whole, this approach would reinforce international stability even as it provided the US with a robust means to defend itself from attack in or from space.

The motives behind the ESF in many respects mirror those that led to the Air Expeditionary Force (AEF) concept. As the US reduced the number of overseas bases and forward operating locations through the 1990s, AEF was a way to reduce its operational footprint without jeopardizing air power effectiveness.[2] Similarly, the ESF is a way of reducing the US military footprint in space while retaining a potent operational capability. AEF responded to the dynamic and unpredictable threat environment that emerged in the wake of the Cold War. As described by *The USAF Transformation Flight* Plan: "The AEF CONOPS provides JFCs with fully capable, rapidly deployable air and space packages that can be tailored to meet the spectrum of contingencies. It will contain the full range of sustainable air and space power and ensure a seamless transition from garrison to expeditionary operations."[3] Similarly, the ESF will provide a rapidly deployable space control or space force application capabilities that can be tailored to the threat and to specific mission requirements.

General Simon Worden suggests a similar approach in an article he published nearly two years ago in the *Aerospace Power Journal*. Within that article, Worden writes: "The new systems most consistent with our current doctrine and approach are those capable of doing "sorties" into and from space, vice those that are permanent 'utilities' on orbit. If the Air Force is to bear any criticism of its approach to space, it would be due to its slowness to demonstrate and test sortie-type systems for space access and space control."[4] General Worden highlights many of the technologies necessary to execute a "sortie-type" capability, first among these being a launch-on-demand spaceplane along the lines of the NASA X-33 or X-37.[5] These systems would enable the rapid deployment of satellites into orbit; recovery of satellites; survey, assessment and possible disabling or capture of adversary systems; and the delivery of conventional weapons over intercontinental ranges via the CAV weapons delivery platform. Microsatellites constitute another important technology. Reduced size and weight is the most salient characteristic of the microsatellite, enabling them to deploy in either greater quantities using existing boost systems, or at a reduced cost using smaller and more easily assembled launch systems. Launched en masse, constellations of microsatellites could quickly establish a robust offensive or defensive counterspace presence. Deployed individually or in small numbers on short notice via low cost boosters, so-called microsats could interrogate or disable adversary capabilities or service friendly systems. Microsat-based bodyguards could be designed to orbit in close proximity to high value assets and to interdict attacks by space-based or direct ascent ASATS.[6] To validate the microsat concept, the Air Force and Boeing recently tested a prototype system that demonstrated many of the requisite capabilities to perform these missions. The XSS-10, launched as one of two payloads from a Delta II booster, weighed in at 68 kilograms, included on-board processors, avionics, propulsion systems, and high-resolution cameras.[7] These subsystems allowed the XSS-10 to track and image the Delta booster's second stage from as close as 100 meters distance and send that imagery back to ground stations from a 800 kilometer orbit.[8]

More flexible and less provocative US capabilities constitute only the first part of a four part strategy. The second element addresses US vulnerabilities and its adversaries' incentives for attack. Numerous authors have written about the need for the US to move to a more decentralized space architecture.[9] Though a decentralized architecture would bring a number of benefits, the most important consideration for the purposes of this discussion is the effect it would have on an adversary's incentive to attack preemptively. Earlier it was noted that one way to counter the temptation to preempt was to render an adversary's weapons strategically insignificant. Transitioning to a more decentralized space architecture, with constellations comprised of dozens or even hundreds of low-cost satellites, would have this effect, as it would greatly reduce the strategic benefits derived from attacking any particular space target. Smaller satellites would also facilitate a move to simpler and less costly launch systems, thus enhancing the ability to rapidly reconstitute space systems. Undersecretary of the Air Force Peter Teets emphasized this capability in a recent address to Air University students.[10] Whereas even the most modern US expendable launch systems take on the order of weeks or months to assemble, test, and launch, Teets spoke of developing a capability to place small payloads in space on timelines measured in days or even hours. A rapid reconstitution capability would further undermine the incentive for adversaries to attack US space systems by providing the US with the ability to replenish these systems on short notice.

Notions of satellite constellations comprised of hundreds of satellites and supported by a rapid reconstitution fleet imply that the US will also need to expand and improve its launch and space support infrastructure. Anyone who has visited the Air Force's primary launch locations at Vandenberg and Patrick Air Force Bases appreciates that these facilities, at least in their current condition, are inadequate for the purposes of supporting the ESF concept. Similar limitations apply to the small number of Air Force Space Operations Squadrons (SOPS). Much as the AEF has mandated dramatic changes in the way the US Air Force organizes and operates, the ESF would necessitate a new way of deploying and employing space assets, with a robust infrastructure to support those new capabilities.

Notes

[1] It was this realization that led the US and the USSR to include prohibitions on vulnerable, soft site (above-ground) ICBM launchers in the START I agreement. See START Treaty, Article V, paragraph 9. Available from http:// www.state.gov/ www/ global/ arms/ starthtm/ start/start1.html.

[2] "The USAF Transformation Flight Plan FY03-07," HQ USAF/XPXT, Transformation Division, as reprinted in the Air Command and Staff College *Joint Force Employment* readings book, 55.

[3] Ibid, 55,

[4] Simon P. Worden, "The Air Force and Future Space Directions: Are We Good Stewards," *Aerospace Power Journal*, Spring 2001, 54.

[5] Worden, 54. For more information on Reusable Launch Vehicles, see Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment* (Washington, D.C: Center for Strategic and Budgetary Assessments, 2001), 124.

[6] William L. Spacy II, *Does the United States Need Space-Based Weapons?* (Maxwell Air Force Base, Alabama: Air University Press, 1999), 33.

[7] "Boeing Demonstrates Capabilities of Micro-satellites," *Satellite Today* 2, no. 18. (February 5, 2003), n.p.

[8] Ibid.

[9] David W. Ziegler, "Safe Heavens: Military Strategy and Space Sanctuary Thought" (thesis, School of Advanced Airpower Studies, 1997), 38. Thomas Karas, *The New High Ground* (New York: Simon and Shuster, 1983), 167.

[10] Address to Air University, February 4, 2003.

Securing the High Ground Through Arms Control

> *Unfortunately, too often in verification debates the irreducible margin of uncertainty becomes more important than the overall level of confidence, obscuring the central issue of whether the activities that could be verified should be constrained.*
>
> Paul Stares[1]

> *U.S. activity in space, both governmental and commercial, is governed by treaties and by international and domestic law and regulations, which have contributed to the orderly use of space by all nations. As interest in and use of space increases, both within the United States and around the world, the U.S. must participate actively in shaping the space legal and regulatory environment.*
>
> Commission to Assess United States National Security
> Space Management and Organization

It may seem that there is little difference between orbiting space-based weapons and an expeditionary or sortie-based alternative. This overlooks two important distinguishing factors. The first is that an expeditionary approach, when implemented as part of a larger regime to regulate space weapons, counteracts the vulnerability and proximity issues that undermine stability. Expeditionary forces would reduce the fear of a surprise attack and diminish the likelihood of a preemptive attack in space. But what cost would the US be willing to pay for stability? Clearly it would be unwise to cede the initiative in space by withdrawing forces while allowing adversaries' weapons to remain there, especially given the US military's increasing dependence on space support systems. This is where the second important difference between ESF and orbiting weapons comes into play. An expeditionary capability, deployed only in times of war or imminent conflict and otherwise withheld from space, provides a clear and verifiable demarcation point for international agreements that would prevent states from placing weapons in space in times of peace.

Critics of arms control schemes designed to limit space-based weapons often charge that proposals for space-based arms control are inherently unverifiable.[2] They insist that any state determined to circumvent controls on space weapons will find ways to do so. They point to the significant strategic advantage that would accrue to a state that covertly employed even a small number of space weapons to buttress their argument. They also point to the complications and definitional problems associated with latent, ASAT capabilities and dual-use missile defense systems. Colin Gray, for example, writes that "an ASAT control treaty would be reliably verifiable only in the trivial sense that known ASAT-dedicated deployed hardware could be monitored…There is no way that anything even approaching the full range of ASAT capability, realistically broadly understood (to include electronic warfare), could be verified."[3]

Gray's critique is accurate insofar as agreements that focus on limiting systems and hardware and their associated *capabilities*. Focusing on prohibited *activities* and *behavior* – most notably the actual deployment of space weapons into orbit – rather than on prohibited systems allows signatories to largely get around this problem. Agreements that prohibit the placement of weapons in space and limit the testing of these systems against space-based targets could be readily verified, especially if they also created a robust and mandatory launch notification regime, and if the signatories to this agreements develop better systems for tracking and characterizing space born objects.

The central component of such an agreement would be the prohibition on the placement of weapons in orbit. Signatories would need to arrive at a common definition for the term "weapon in space," but it would include any orbiting system capable of attacking or disabling other space-based systems, or any orbiting system capable of launching or releasing weapons towards earth. With respect to laser or directed energy devices that might provide legitimate communications or information services, the agreement would need to account for permissible power or wavelength thresholds.

A number of mechanisms would reinforce the prohibition on orbiting space weapons. The first would be a "rules of the road" agreement.[4] Such an agreement would establish minimum separation distances between satellites, prohibit simulated satellite attacks, establish limits on "fly-by" speeds, and establish a system to deconflict the ascent of high-altitude systems through intermediate orbits.[5] Enforcement and tracking could be enhanced by requiring satellites to carry signal beacons and by providing for specific punitive measures, including inspection, disablement, or destruction.

The second reinforcing mechanism would be a ban on testing weapons, either earth-based or space-based, against *orbiting* targets. The selection of terminology is very important here, for two reasons. Testing that supports ballistic missile defense capabilities against *ballistic missile* targets would be permitted, at least for the purposes of evaluating ground-based missile defense systems and, on a limited basis, for evaluating elements of the ESF. This would allow states to develop legitimate missile-defense capabilities, but would constrain their ability to develop robust direct-ascent capabilities, especially against satellites in orbits other than LEO. Blocking testing against targets in orbit would also address the scientific community's concern regarding the accumulation of debris in LEO that would result from weapon tests in orbit. An average sized satellite operating in an 800-kilometer orbit already faces a one in 100 chance of being struck by a BB-sized piece of debris.[6] The risks that larger satellites such as the International Space Station face are even greater. Scientists fear that weapons testing in orbit will lead to a "chain reaction of debris" as orbiting fragments collide with other orbiting fragments, eventually creating a "lethal halo around the Earth" that renders useless and make impassible whole orbital regions.[7]

The third mechanism reinforcing a prohibition on orbiting weapons would be a comprehensive launch notification regime. Participating states would be required to declare in advance (with allowances made for necessary launch schedule flexibility) launch date and location, payloads, payload mission, and all satellite orbital parameters. The regime might also require states or corporate entities to provide information that would enable other states to confirm that an asset in space was performing its intended mission. The launch notification regime might also provide for challenge inspections, similar to those authorized by the Chemical Weapons Convention (CWC).[8] Within the CWC framework, states that are parties to the convention submit their basis for suspicion to an international governing body that rules on the veracity of the charges. If the governing body determines that the charges are credible, the treaty authorizes the body to assemble an inspection team that proceeds to the suspect-state to collect evidence that either supports or refutes the charges. In the case of a challenge inspection of a suspect satellite prior to launch, physical inspection and confirmation of the devices size, weight, protective measures, means of maneuver, and external sensors and transmitters would enable inspectors to establish whether the device served a legitimate purpose or was designed for other purposes.

An improved space characterization capability constitutes the final reinforcing mechanism behind the orbiting weapon ban. This capability would consist of a networked system of ground and space-based sensors capable of detecting, tracking, and characterizing space-based objects about the earth. As described above, maneuverable satellites capable of approaching, imaging, and electronically interrogating unidentified space assets would complement the network of earth-based and orbiting space-based sensors. If this were a multilateral effort, such a network would bolster enforcement of the orbiting weapons prohibition and provide a basis for consensus on violations and punitive measures. But even in the absence of multilateral participation, the US has a powerful incentive to develop more robust space situational awareness. Again borrowing from the ideas of General Worden, this capability will be a key enabling mechanism for the ESF. Worden writes "if we are to control space effectively, we must recognize that continuous real-time surveillance and tracking of all targets is essential. Superior situational awareness, the basis of America's overwhelming air and sea superiority today, will be necessary if we are to achieve space dominance tomorrow."[9]

Notes

[1] Paul Stares, *Space and National Security* (Washington, D.C.: The Brookings Institution, 1987), 87.

[2] Peter L. Hays, *United States Military Space: Into the Twenty-First Century* (Maxwell AFB, AL: Air University Press, 2002), 120.

[3] Colin S. Gray, "Space Arms Control: A Skeptical View," *Air University Review*, no. 37. (Nov/Dec 85), 81.

[4] Joseph S. Nye and James A. Schear, editors, *Seeking Stability in Space: Anti-Satellite Weapons and the Evolving Space Regime* (Lanham, MD: University Press of America, 1987), 15.

[5] Ibid, 15.

[6] Joel Primack, "Pelted by Paint, Downed by Debris," *Bulletin of the Atomic Scientists* 58, no. 5 (September/October 2002), 25.

[7] Primack, 24.

[8] *Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and Their Destruction* (Washington, D.C.: United States Arms Control and Disarmament Agency, October 1993), 31.

[9] Simon P. Worden and John E. Shaw, *Whither Space Power?* (Maxwell AFB, AL: Air University Press, 2002), 109.

Space Sovereignty

Technology dominates the US Space Command *Long Range Plan*. Within each of the space control objective areas – assured access, surveillance of space, protection, prevention, and negation – the plan identifies "key capabilities," "candidate systems," and "candidate technologies."[1] Near the end of the chapter describing space control capabilities, however, a recommendation appears having little to do with technology or topics otherwise addressed by the plan to that point: "Advocate national policy and legislation to support Negation."[2] Later in the plan, under a paragraph entitled "shaping the environment," this theme reemerges: "Development of enforcement policies and means is also presumed, since without the former, the latter may be unattainable…Increasing competition for influence in space will lead to a code of acceptable behavior for its common use. This logic flows naturally toward enforcement against the state to interfere or disrupt this balance in space or elsewhere."[3] And in a chapter entitled "Out of Our Lane (Policies, Treaties, and Agreements," the plan notes that "policies, treaties, and agreements needing to be addressed" include "policy on 'sovereignty of space systems' and international law for protection of National space assets."[4]

These selections emphasize that decisive capabilities and potent space weapons will be largely ineffective if they are employed in a political or legal context that is ambiguous or unresolved. In many respects, however, this is the situation in which the US finds itself today. This undesirable condition follows from the related but as yet unresolved concepts of space sovereignty and innocent passage in space.

Innocent passage describes the notion that states are limited in their right to prohibit or restrict transit through mediums adjacent to their own sovereign territory. That is, passage deemed not "prejudicial to the peace, good order, or security" of a state is deemed innocent, and states exercise only limited ability to restrict this passage.[5] International law treats the air, sea, and space mediums differently in terms of innocent passage. Innocent passage for the air regime is the most restrictive. States must give explicit permission for scheduled international air service, they may establish prohibited or no-fly zones, and they "may prohibit or regulate the use of photographic apparatus in aircraft above its territory."[6] Innocent passage for the sea regime is much more permissive. Passage is generally regarded as innocent unless a vessel undertakes specific, threatening actions, such as the "threat or use of force against the…coastal state," "exercise or practice with weapons," or similar measures.[7] Proposals as benign as requiring previous notification for innocent passage of warships have been considered and rejected.[8]

The US realized as early as 1946 that its interests would be best served if space followed the sea precedent for innocent passage.[9] Only this regime would legally allow for unrestricted overflight by ISR satellites, a capability that the US anticipated well in advance of actually achieving it.[10] Walter McDougall suggests that the US considered this issue as more important than the propaganda benefits derived from being the first in space, so much so and that it influenced the US not to make a concerted effort to place a satellite in orbit before Sputnik.[11] Once the Soviets placed Sputnik in earth orbit, they had little basis for contesting US efforts to establish a permissive definition of innocent passage in space or for protesting overflights by US satellites.

Must it be the case that space follows either the sea or air precedent exclusively? Space, it seems, shares qualities of both. Like the sea, it is a domain that does not lend itself readily to sovereign or territorial claims. As technology progresses, however, it is more like the air in that unregulated access, especially as exercised by space weaponry, could subject states to the possibility of devastating surprise attack. Though the space medium constrains a state's ability to scramble forces analogous to fighter escorts or naval destroyers to confront an impending threat, it is no longer a medium within which states are entirely bereft of the means to defend themselves.

A revised notion of space sovereignty and innocent passage should acknowledge these realities. Innocent passage for truly non-threatening systems should continue to be protected, and at least in times of peace, allowances for peaceful overflight by commercial and civil space systems, as well as military imagery, weather, communications, and navigation/timing systems, should remain in place. At the same time, and consistent with a prohibition on orbiting space weapons in times of peace, the international community should explicitly acknowledge a state's right to attack or disable systems that pose imminent threat to a state's sovereign territory or people. It is not unreasonable that this right be extended to allow states to defend against threats to vital, space-based interests or assets.

Rules of the road agreements are a partial solution to the problem posed by innocent passage in that they establish specific rules and conditions which, if violated, would provide states with the right to attack or disable another state's assets in space. A prohibition on orbiting space weapons also creates a demarcation between behavior and systems deemed acceptable and unacceptable. Beyond these arrangements, however, it is appropriate that the international community revise its notion of space sovereignty and innocent passage. If it is established that states are not permitted to orbit weapons in space, it must also be acknowledged that states have the right to respond when other states violate these norms.

Notes

[1] United States Space Command, *Long Range Plan*, March 1998, 26.
[2] *Long Range Plan*, 47.
[3] Ibid, 105.
[4] Ibid, 139.

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[5] Louis B. Sohn and Kristen Gustafson, *The Law of the Sea* (St. Paul, Minnesota: West Publishing Company, 1984), 97.

[6] Irvin L. White, *Decision-Making for Space: Law and Politics in Air, Sea, and Outer Space* (West Lafeyette, IN: Purdue University Press, 1971), 107.

[7] Ibid, 103

[8] Ibid, 103.

[9] Ibid, 109.

[10] Ibid, 110.

[11] Walter A. McDougal, *The Heavens and the Earth* (Baltimore, MD: Johns Hopkins University Books, 1985), 124.

An Imperfect Solution

A number of arguments based on theoretical, technical, and political/organizational issues can be made against the approach outlined in this paper. Two points merit emphasis, however. First, the strategy this paper recommends was fashioned in part as a means of resolving the debate between Hays' entrenched camps over space weaponry.[1] It provides a solution to which all sides of the debate might agree and around which the US might formulate cogent policy toward space control and space force application capabilities. Alternative proposals – some of which will be discussed in the following section – deal more effectively with the competing issues of security and stability, but they are unlikely to attract the sort of consensus that would allow the US to move forward in a decisive manner.

Second, the approach this paper advocates is low risk. It recommends that the US agree to prohibitions on orbiting weapons, but it encourages the development of technology that the US could apply to orbiting space weapons if it determines that an expeditionary capability no longer serves US interests. In fact, these technology initiatives may find greater support than is currently the case if opponents of space weaponry perceive that the technology underlies a less provocative US space strategy.

In light of this second point, it is conceded that the strategy recommended in this paper is only a partial remedy to the problem of stability discussed earlier. This strategy addresses the issues of vulnerability and proximity with respect to orbiting, space-based weapons, but it seems that the likely effect will be to simply redirect competition between potential adversaries in the direction of expeditionary capabilities. Some will argue that this will result in a less stable situation because in the absence of robust capabilities by all sides in space, an overwhelming advantage will now be conferred upon the state that is able to deploy even a small space force first.[2] Thus, the argument goes, even minor crises would provoke adversaries to race into space, exacerbating a crisis situation.

While this is a legitimate concern, it overlooks the significance of overt versus covert actions. It also downplays the effects that test limitations would have on the confidence with which aggressors could mount a preemptive attack. The stability concern that the strategy outlined here was primarily designed to address was the temptation to preempt. Orbiting space control or space force application weapons lend themselves to covert, preemptive attacks because of their temporal proximity to the targets they are attacking. They generally require little in the way of direction or maneuver in order to unleash their effects on space or ground targets.[3] Thus, a state that is armed with orbiting space weapons could attack preemptively without signaling its intent in advance or expending significant resources.

The situation would be much different if states were to agree to a prohibition on orbiting weapons. States would be required to take overt actions simply to deploy their space forces to a position from which they could attack. In so far as these actions violated international agreements, they would provide a basis for international condemnation and would likely subject an aggressor's own space assets to attack. A state's decision to deploy weapons would invite serious repercussions and would, in most instances, dissuade them from deploying space forces in times of crisis.

Prohibitions on orbiting weapons and test limitations would also limit an aggressor's offensive options and would substantially reduce the certainty that a surprise attack would yield victory or decisive advantage. These measures would make certain types of weapons – those requiring massive boosters, an extensive constellation of satellites, or access to higher orbits, for instance – infeasible within the context of a rapidly deployable force or surprise attack. An aggressor's order of battle and offensive options would thus be severely limited. At the same time, the proposed test limitations and prohibitions would undermine an aggressor state's confidence that permitted weapons could be employed effectively against targets in space or on earth. This highlights an important point. The measures proposed here will not prevent a determined state from developing a limited, quick strike capability, but this is an unreasonable and unnecessary objective. A more realistic and attainable objective is to create a readily verifiable regime that denies states robust, tested, and reliable space weapons with which they can mount quick strike attacks.[4]

This logic raises another potential concern though: if constraints would limit the capabilities of aggressor states and undermine the confidence with which they might undertake preemptive attacks, would they not also undermine the effectiveness of the US ESF? The answer, of course, is yes. In net terms, however, the US military advantage over potential adversaries may increase due to a decisive US advantage in certain technology areas. For example, the US enjoys a substantial lead over the rest of the world in advanced computing and modeling and simulation based testing.[5] The nuclear stockpile stewardship program and the Advanced Strategic Computing Initiative (ASCI) illustrate US capabilities to apply these resources to develop and maintain complex weapon systems within regimes that prohibit realistic testing. The ASCI came about as a result of the Clinton administration's 1992 decision to sign the Comprehensive Nuclear Test Ban Treaty (CNTBT).[6] The CNTBT prevents signatories from testing nuclear weapons of any size in any medium. The US Department of Energy (DOE) initiated the ASCI to develop advanced computing resources and simulation technologies capable of modeling nuclear detonations.[7] With an initial investment of more than $500 million dollars in 1999, the DOE set out to develop computers capable of more than 200 trillion floating-point operations per second

(TFLOPS) by 2004.[8] The program will eventually enable computers to replicate activities that occur inside a detonating nuclear weapon, and DOE hopes that computer based simulation will supplant underground testing as a means of ensuring the safety and reliability of the nuclear stockpile.[9] No other country on earth can match this capability, and it is already being leveraged to support US commercial and industrial testing programs.[10] Similar capabilities could enable the US to develop and test its deployable space force even while complying with the constraints and prohibitions outlined in this paper.

The US also has a wealth of experience more directly related to expeditionary space forces to fall back upon. The US ballistic missile defense programs rely extensively on modeling and simulation to evaluate system performance and assist with system design.[11] NASA, the commercial aerospace industry, and the Defense Department laboratories have also developed a network of facilities to evaluate component and system level performance under conditions that replicate the stress of launch, maneuver, and the space environment.[12] This test infrastructure has enabled the US to launch numerous interplanetary vehicles and deep space probes. Many of these systems are completely unique and execute complex maneuvers which can never be full replicated or tested under realistic conditions prior to launch. Proficiency in space system modeling and simulation, experience developing and deploying interplanetary vehicles, and an extensive space test and development infrastructure confer a significant advantage on the US in terms of its ability to develop deployable space forces while abiding by the constraints recommended in this paper.

Notes

[1] Peter L. Hays, *United States Military Space: Into the Twenty-First Century* (Maxwell AFB, Ala: Air University Press, 2002), 136.

[2] Colin S. Gray, "Space Arms Control, A Skeptical View," *Air University Review, 81.*

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[3] Bob Preston, *Space Weapons: Earth Wars* (Santa Monica, CA: Rand Corporation, 2002) 102. The exception to this rule would be co-orbital ASATs or space mines, which would need to maneuver proximate to their targets. If the maneuvers were begun well in advance or if the ASATs or space-mines included stealth characteristics, however, they would also be able to achieve surprise within the scope of a well planned and coordinated attack. Orbiting directed energy weapons would require little in the way of advanced maneuver.

[4] Joseph S. Nye and James A. Schear, editors, *Seeking Stability in Space: Anti-Satellite Weapons and the Evolving Space Regime* (Lanham, MD: University Press of America, 1987), 20.

[5] Judi Hasson, "Compaq to Deliver Explosive Power," *Federal Computer Week*, Auguest 28 2000, n.p., on-line, Internet, available from http://www.fcw.com/fcw/articles/2000/0821/web-energy-08-23-00.asp

[6] The US still abides by the treaty, though it was never brought up for Senate ratification.

[7] Gary H. Anthes, "Nuclear Aging." *Computerworld* 32, no. 12 (March 23, 1998), 83.

[8] Robert K. Ackerman, "Nuclear Warhead Designers Aim and Computing Advances." *Signal* 52, no. 2 (October 1997), 50.

[9] Anthes, 83. Judi Hasson and Margret Johnston, "Supercomputer Souped Up," *Federal Computer Week*, July 03 2000, n.p., on-line, Internet, available from http://www.fcw.com/fcw/articles/2000/0703/news-super-07-03-00.asp.

[10] Anthes, 83.

[11] "Don't Scrimp on Testing for Missile Defense," *Aviation Week and Space Technology* 146, no. 9 (March 3 1997), 74.

[12] Barry Rosenberg, "Modeling and Simulation Win NASA's Software of the Year", *Aviation Week and Space Technology* 158, no. 2 (Jan 13 2003), 42. Edward H. Phillips, "Test Chamber Upgraded," *Aviation Week and Space Technology* 152, no. 9 (February 28 2000), 55. Joseph C. Anselmo, "Satellite Builders Tap NASA Facility," *Aviation Week and Space Technology* 146, no. 3 (Jan 20 1997), 62.

Consider the Alternatives

In evaluating the utility and feasibility of the proposal put forward in this paper, it is worthwhile to consider the merits and drawbacks of alternative solutions to determine which approach offers the US the best chance of improving its national security outlook. The most prominent alternatives include the status quo, space sanctuary, and *Astropolitik.*

The status quo has already been discussed at length. It is characterized as much by its base of support, or lack thereof, as by any specific policy or aims. The most notable feature of the status quo is the divided nature of its constituency. The current administration supports a more aggressive move toward space control and space force application capabilities (including missile defense), but their efforts towards accomplishing these objectives are impeded by powerful opponents in and out of Government.[1] This would be immaterial to the merits of the policy were it not that, after having signaled its intent to abandon the sanctuary policy, the US has produced little progress towards more effective capabilities because of the internal divide.[2] As a result, while the US deploys incomplete capabilities in a piecemeal fashion, potential adversaries proceed unconstrained.[3] This is not to suggest that US adversaries are likely to develop superior space control or space force application capabilities, only that they may achieve sufficient capability to threaten or hold hostage vital US assets.[4] The direct threat to US interests is less important than the implications for strategic stability. Status quo US policy prevents the US from establishing a dominant posture in space, but it does little to retard adversary programs. This will result in the commingling of potent and yet vulnerable systems in space, which creates powerful incentives for preemption in times of crisis. If the US continues along this path, it may well bear out the results of a number of forward looking wargames that have shown the next great war beginning in space.[5]

The most appealing alternative to the status quo is a return to the space sanctuary policy. Space sanctuary has much to recommend itself. It would enable commercial and military space support applications to operate in a threat free environment, preserve the US military superiority based on existing terrestrial capabilities, and ensure the continued viability of the US nuclear deterrent force and the associated stabilizing regime.[6] The problem with the space sanctuary policy is that it places a great deal of faith in the willingness of potential US adversaries to comply or in the ability of verification measures to ensure their compliance. The most thoughtful representatives of this view emphasize many of the same measures with respect to decentralizing the US space architecture and improving space surveillance capabilities that this paper puts forward.[7] In a sense, though, these proposals only confirm suspicions regarding adversary states incentives and willingness to comply. And in the event of non-compliance, the space sanctuary policy provides little in the way of US or international enforcement mechanisms. This also calls into question the stabilizing effects of a sanctuary policy. US willingness to completely forego space weapons would create a situation where non-compliance on the part of US adversaries would yield tremendous military advantage.[8] In sum, the sanctuary policy does not acknowledge the very serious responsibilities of the US security establishment to consider and prepare for all plausible risk scenarios when planning for the defense of vital US interests.

The most provocative proposal for US space policy is the *Astropolitik* approach advanced by Dr. Everett Dolman of the US Air Force School of Advanced Aerospace Studies. Dolman's formulation is arguably the most efficient solution to the competing interests of security and stability discussed earlier. He recommends that that the US "declare that it is withdrawing from the current space regime and announce that it is establishing a principal of free-market sovereignty" and "endeavor at once to seize the military control of low-Earth orbit."[9]

Astropolitik is offered as an alternative to predictions that space will otherwise and inevitably devolve into another medium for warfare.[10] The *Astropolitik* approach would prevent this, as the US would act as a benign hegemon, permitting states to continue to exploit space for peaceful and productive purposes, but forcefully precluding its use for hostile purposes.[11] *Astropolitik* avoids the tradeoffs between security and stability by putting the US in a position from which it would exercise absolute control over low earth orbit. The great appeal of Dolman's approach is that it would advance not only US security interests, but those of other nations as well. *Astropolitik*, for example, would empower the US to prevent a missile exchange between India and Pakistan.[12] Dolman predicts that "in time, US control of low-earth orbit could be viewed as a global asset and a public good."[13]

The obvious arguments against the *Astropolitik* relate to political will, technical feasibility, and the likelihood that it will lead to US overreach. In terms of political will, suffice to say that if the US is unable to agree to a less ambitious program today, it is unlikely to coalesce around a substantially more provocative (and costly) one in the near future, regardless of its merits. The technical argument is also straightforward. It does not appear that the state of technology will enable the US to deploy a system to seize control of low-earth orbit anytime soon.[14] Dolman obviously offers *Astropolitik* as an objective for shaping US policy though, not a near term goal, so these are not the most critical problems. More serious is the issue of overextension. In *The Rise and Fall of the Great Powers,* Paul Kennedy observes that "the United States now runs the risk, so familiar to historians of the rise and fall of previous Great Powers, of what might roughly be called 'imperial overstretch': that is to say, decision-makers in Washington must face the awkward and enduring fact that the sum total of the United State's global interests and obligations is nowadays far larger than the country's power to defend them all simultaneously."[15]

Dolman's prescription would exacerbate this situation, as *Astropolitik* would expand US sovereignty, with its associated military and economic burden, into space. Anticipating this argument, he implies that other states, once they realized the benefits derived from the US shield, would share in the cost of maintaining it.[16] But it is difficult to imagine that other states would willingly contribute to maintaining a system that the US imposed unilaterally, especially following a US declaration of "free-market sovereignty" and the military seizure of the low earth orbit. There would also be countless additional costs and administrative burdens that would follow from the *Astropolitik* regime, even beyond the substantial cost of maintaining and operating the space shield. For example, the US would need to establish and maintain a global regime to inspect and verify that all commercial and foreign military space missions were consistent with US restrictions on space use. *Astropolitik* also begs questions regarding US policy toward a state's desire to launch systems that are militarily benign but otherwise inconsistent with US interests (such as the European Galileo project), and whether the US would abide by existing international regimes that regulate the commercial use of space.[17] These issues could generate pervasive and enduring enmity toward the US and call into question the desirability of the *Astropolitik* vision.

Notes

[1] James C. Moltz, "Breaking the Deadlock on Space Arms Control," *Arms Control Today* 32, no 3 (April 2002), 6.

[2] Ibid, 7.

[3] Bob Preston, *Space Weapons: Earth Wars* (Santa Monica, CA: Rand Corporation, 2002), 107.

[4] Michael Krepon, "Lost in Space," *Foreign Affairs* 80, no. 3 (May/June 2001), 6.

[5] Jonathan S. Lockwood, "Growing vulnerability in space." *Army Times* 58, no. 38 (April 20, 1998), 54.

[6] For an extended discussion of the merits of the space sanctuary policy, see David W. Ziegler, "Safe Heavens: Military Strategy and Space Sanctuary Thought" (thesis, School of Advanced Airpower Studies, June 1997).

[7] Ibid, 42.

Notes

[8] Colin S. Gray, "Space Arms Control: A Skeptical View," *Air University Review*, 81.

[9] Everett C. Dolman, *Astropolitik* (London: Frank Cass Publishers, 2002), 157.

[10] Ibid, 158.

[11] John J. Miller, "Our 'Next Manifest Destiny'," *National Review* 54, no. 13 (July 15 2002), 37.

[12] Ibid, 37.

[13] Dolman, 159.

[14] Preston, 25. William L. Spacy, *Does the United States Need Space-Based Weapons?"* (Maxwell AFB, Ala.: Air University Press, 1999), 21.

[15] Paul Kennedy, *The Rise and Fall of the Great Powers* (New York: Random House, 1987), 515.

[16] Dolman, 159.

[17] Peter Hays describes conflicts already arising between US military and international commercial interests in *United States Military Space: Into the Twenty-First Century* (Maxwell Air Force Base, Ala: Air University Press, 2002), 76.

Toward an Aerospace Force

> *I don't think we would be good stewards of space capabilities if we only thought about 'integration.' We also need to be spending resources and intellectual capital on space control and space superiority.*
>
> General Ralph E. Eberhart, Commander, US Space Command

Acting on the recommendations of the Space Commission, the Bush administration appointed the Department of the Air Force as Executive Agent for Space in 2001.[1] Some critics have argued that the Air Force is no better qualified than the other services to lead this endeavor, but the Expeditionary Space Force (ESF) shifts the debate strongly in favor of Air Force leadership.[2] No service is better postured to implement the expeditionary space concept, and the ESF goes a long way toward rationalizing the Air Force notion of integrated *aerospace* doctrine and capabilities.[3]

Space campaigns would in many respects resemble classic air campaigns if the US and other states implement the measures described in this paper. Adversaries would deploy and employ offensive and defensive *counterspace* assets to contest *space superiority*. Many of these assets -- launch-on-demand boosters, reusable space vehicles, and maneuvering systems – would more nearly resemble traditional air assets than they would conventional orbital systems. Once a state or coalition established space superiority, it would use the medium to execute strategic attack, ground attack, information operations, and possibly even mobility operations *through space* in support of the Joint Force Commander (JFC).

Air Force doctrine is already well suited to execute this sort of dynamic space campaign.[4] The tenets of air and space power listed in *Air Force Basic Doctrine* include "centralized control and decentralized execution," "flexibility and versatility," "concentration," "priority," and "balance."[5] These terms summon images of an unfolding, expeditionary aerospace campaign within which JFC employs space weapons, as well as other space assets, to realize specific effects at the time and place of his choosing. Existing command and control arrangements are also optimized to execute joint air and space campaigns in support of coordinated ground force actions. The Combined or Joint Air and Space Operations Center (C/JAOC), as both a command and control system and a decision making entity, is ideally suited to employ an ESF and to execute an expeditionary space campaign.[6] ESF operations fit logically into the C/JAOC's planning process and could be incorporated in the C/JAOC's daily Air Tasking Order (ATO).[7] Returning to a theme raised earlier, redirecting competition in space toward expeditionary capabilities reinforces the similarities between the air and space mediums and supports the integration of air and space operations. Seen in this light, the ESF gives new meaning and greater significance to the term *Aerospace* Force.

The Air Force cannot implement this vision on its own, however, and this is perhaps the greatest obstacle to realizing the comprehensive proposal offered here. Unilateral US implementation of an expeditionary approach in lieu of orbiting weapons would be counterproductive in the absence of the other measures outlined in this paper: decentralized architecture, enhanced space surveillance, and arms control measures that include prohibitions on orbiting weapons, test limitations, and a revised notion of space sovereignty and innocent passage. These additional measures would require nearly unprecedented coordination between the defense, diplomatic, and intelligence communities, and their activities would only be a prelude to complex international negotiations. It remains to be seen if this level of coordination is possible. This task is made all the more difficult by the fact that responsibility for US space policy is distributed throughout the US Government.

Air Force leadership in exploring and demonstrating the feasibility of the ESF concept may help overcome some of the bureaucratic resistance to the larger strategy. If the Air Force can demonstrate that an expeditionary force is advantageous from an operational and strategic perspective, it will influence the debate on other aspects of the proposal. The Space Warfare Center (SWC) has already made strides in this direction, having sponsored wargames over the past two years to assess the viability of expeditionary space assets, as well as other transformational concepts.[8] Several specific issues merit further investigation by the SWC. Most notably, how does the ESF compare to proposed orbiting systems in terms of its effect on strategic stability in times of crisis? If Title X wargames have already demonstrated that orbiting weapons generate dangerous incentives to preempt, do expeditionary forces alter these incentives or lead to enhanced crisis stability? Related to this, how does an ESF alter the ability of the National Command Authority (NCA) and the JFC to control crisis escalation? Worden postulates that deployable capabilities will allow the NCA "to either escalate the conflict or respond to reduced tension over the course of a crisis."[9] The SWC exercises are an ideal forum to test this theory. Finally, what is the outcome associated with capabilities that an expeditionary force would preclude, such as persistent space-based missile defense and launch suppression? Are these capabilities that a decentralized space architecture and ground-based missile defense (supplemented by deployable defenses) can offset, or are they indispensable to US security?

At a more concrete level, the Air Force should boost research and development initiatives that explore the technical feasibility of the expeditionary concept. While the XSS-10 experiment demonstrated basic microsatellite functionality, substantial work remains to be done to determine whether microsatellites constitute a technology upon which the US can establish a robust offensive or defensive counterspace capability.[10] Even more fundamentally, the Air Force needs to continue to explore new launch concepts and technologies. Whether the US pursues an expeditionary space capability or some other approach, the ability to regenerate space assets will likely be a key component of its future defense strategy.[11] Inexpensive, expendable boosters and reusable launch vehicles will likely both play a role in meeting this requirement. The theoretical arguments that support the Common Aero Vehicle (CAV) and the vital contribution CAV would make to US strike *and* strategic deterrent forces suggest that this is another area that merits a concerted Air Force research and development effort.

A laundry list of technology initiatives or an exclusively Air Force centric focus threatens to obscure the more important point, however: technology and the weapons it enables must derive from and support operational *strategy*. Operational strategy in turn must be based on US national security strategy and its associated objectives. As the US executive agent for space, the Air Force must engage leaders at all levels of the command structure to determine how US operational objectives in space contribute to US national security strategy, what operational strategy is most likely to attain these objectives, and what technology and capabilities support this operational strategy.

This discussion needs to consider internal political constraints and external sensitivities. Domestic opposition to efforts to establish a dominant military presence in space will likely persist. US planning efforts need to account for this internal resistance in terms of developing a *realistic* strategy that can be effectively and decisively implemented. Externally, US plans and strategies must account for efforts underway in other states to develop means to counter the dominant US space posture. Evidence suggests that potential adversaries are aggressively pursuing their own military space capabilities and narrowing the technological gap with the US.[12] As these states approach an effective counterspace capability, their willingness to participate in cooperative measures on terms favorable to the US will decline. This suggests that the US should seek to reconcile its space strategy and capabilities sooner rather than later. Once other states deploy weapons in space, it is unlikely that the US will persuade them to reverse course. It will be compelled to establish a permanent and pervasive military presence in space. The end result will be dangerous, unpredictable, and inconsistent with US national interests.

Notes

[1] John A. Tirpak, "Challenges Ahead for Military Space," *Air Force Magaine* 86, no. 1 (January 2003), n.p., on-line, Internet, available from http://www.afa.org/magazine/jan2003/0103space.html.

[2] Peter Hays and Karl Mueller, "Going Boldly – Where?" *Aerospace Power Journal Aerospace Power Journal* 15, no. 1 (Spring 2001), 36.

[3] Ibid, 35.

[4] Simon P. Worden, "The Air Force and Future Space Directions: Are We Good Stewards," *Aerospace Power Journal Aerospace Power Journal* 15, no. 1 (Spring 2001), 52

[5] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 1 September 1997, 21.

[6] Joint Pub 3-56.1, *Command and Control for Joint Air Operations*, 14 November 1994, III-1.

[7] Ibid, IV-4.

[8] Mr. Mike Terry, Space Warfare Center, interviewed 27 March 2003.

[9] Simon P. Worden and Martin E.B. France, "Towards an Evolving Deterrence Strategy: Space and Information Dominance," *Comparative Strategy* 20, no. 5 (December 2001), 461.

[10] "Boeing Demonstrates Capabilities of Micro-satellites," *Satellite Today* 2, no. 18. (February 5, 2003), n.p.

[11] Undersecretary of the Air Force Peter Teets, Address to Air University, February 4, 2003.

[12] Frank J. Gaffney, "Time for Countdown on U.S. Space Defense," *Washington Post*, 9 January 2001. Mark A. Stokes, *China's Strategic Modernization: Implications for the United States* (Carlisle, PA: Strategic Studies Institute, 1999), 120. Worden and France, 464.

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