Weapons in Space: Silver Bullet or Russian Roulette?

The Policy Implications of U.S. Pursuit of Space-Based Weapons

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Introduction[1]

There is no escaping the fact that one of the most important global security policy debates of the 21st century is about to be engaged by the administration of President George W. Bush – the question of whether the United States needs to develop and deploy space-based weaponry.

For nearly 40 years, there has been an unspoken agreement among the world's space powers to refrain from putting weapons in orbit. Military use of space has been limited to surveillance and communications satellites, and scientific and commercial endeavors have largely been able to develop with minimal concerns about military interference or the possibility of becoming wartime casualties.

Even during the height of the Cold War, the two superpower rivals eschewed serious development of offensive space weapons – in fact, though they experimented with the technology, the two sides also refrained from actively deploying weapons that could shoot down satellites from ground, air or sea as well. They even signed a treaty, the 1972 Anti-Ballistic Missile (ABM) Treaty, which forbade either side to tamper with the other's "national technical means," i.e., spy satellites.

Unlike in Star Trek, the 'final frontier' has yet to become a battlefield. But if the current trends continue, that will change – not in the distance future of science fiction, but within the next several decades. Emerging Bush administration plans and policies are clearly aimed at making the United States the first nation to deploy space-based weapons. There are several drivers behind this goal, including the very real concern about the vulnerability of space assets that are increasingly important to how the U.S. military operates, and the administration's decision to pursue missile defense.

[1] The structural foundation of this paper is based on Theresa Hitchens, "Rushing to Weaponize the Final Frontier," first published in *Arms Control Today,* September 2001.

Unfortunately, the administration has done little thinking – at least publicly – about the potential for far-reaching military, political and economic ramifications of a U.S. move to break the taboo against weaponizing space. There is reason for concern that doing so could actually undermine, rather than enhance, the national security of the United States, as well as global stability. Thus it behooves the administration, as well as Congress, to undertake an in-depth and public policy review of the pros and cons of weaponizing space. Such a review would look seriously at the threat, both short-term and long-term, as well as measures to prevent, deter or counter any future threat using all the tools in the U.S. policy toolbox: diplomatic, including arms control treaties; economic; and military, including defensive measures short of offensive weapons. There is nothing to be gained, and potentially much to be lost, by rushing such a momentous change in U.S. space policy.

U.S. Policy and Military Planning: Going to Orbit?

"I believe that weapons will go into space. It's a question of time. And we need to be at the forefront of that," Pete Teets, undersecretary of the Air Force and director of the National Reconnaissance Office, told a March 6 conference in Washington.[2]

While Teets, who is now the Pentagon's lead official for procurement of space programs, was careful to say that no policy decision to put weapons in space has yet been made, his views reflect a consensus among top Air Force leaders – and indeed, among military officials across the board. The prevailing wisdom in all branches of the services is that "conflict in space is inevitable."[3]

This conclusion that warfare is going into orbit has not come out of nowhere. While there has been little public or policy-level discussion, the Air Force in particular has been seriously wrestling with the question for at least a decade (and even longer, if one counts early discussions in the post-Sputnik era). In fact, the debate continuing today had already reached national policy levels during the Clinton administration, up to and immediately after, the release of the National Space Policy in 1996. What is new is the Bush administration's seemingly wholehearted embrace of the need for space-based weapons – vice the Clinton administration's much more qualified stance – and the military's increasingly open advocacy.

The Bush administration's views were directly reflected in the 2001 Quadrennial Defense Review (QDR), released Oct. 1, 2001. "A key objective … is not only to ensure U.S. ability to exploit space for military purposes, but also as required to deny an adversary's ability to do so," states the QDR.

The QDR cites the need to improve space systems as one of six critical goals of overarching military transformation – thus placing top political priority on the issue within the Pentagon. The appointment of Teets to his two-hatted job and his subsequent stand-up of two new positions – a deputy for Military Space and a Directorate of National

[2] Sharon Weinberger, *Aerospace Daily,* March 7, 2002.
[3] Lt. Col. John E. Hyten, "A Sea of Peace or a Theater of War: Dealing with the Inevitable Conflict in Space," ACDIS Occasional Paper, April 2000.

Security Space Integration – were among the Pentagon first steps toward "national security space transformation."[4]

Even before the QDR, a report to the Office of Secretary of Defense from an independent panel called for robust efforts to assure "space dominance" as a key transformational capability. The report, called Transformation Study Report and dated April 27, 2001, states: "Space capabilities are inherently global, unaffected by territorial boundaries or jurisdictional limitations; they provide direct access to all regions and, with our advanced technologies, give us a highly asymmetrical advantage over any potential adversary."[5] The study recommended, among other things, the development of microsatellites for both offensive and defensive missions.

There also have been a number of other organizational changes at the Pentagon and across the U.S. government that reflect recommendations in the Commission to Assess the United States National Security Space Management and Organization, known generally as the Space Commission and chaired by Donald Rumsfeld until he was tapped as defense secretary by Bush.

For example, Rumsfeld on May 8, 2001, announced the creation of a Policy Coordinating Committee for Space within in the National Security Council as well as a number of other organizational shifts within the military structure for oversight of space programs. In addition, both the Air Force and the Navy have reorganized and centralized their space bureaucracies.

In fact, while now wrapped into the new flag of military "transformation," the heightened attention to the issue of space defense by the Bush administration has its real roots in the Space Commission report. The report, released in January 2001, warned that the United States could face a "Space Pearl Harbor" if myriad actions were not taken to improve the security of space assets. Noting that the United States is more dependent on the use of space than any other nation, the Space Commission report stated:

"Assuring the security of space capabilities becomes more challenging as technology proliferates and access to it by potentially hostile entities becomes easier. The loss of space systems that support military operations or collect intelligence would dramatically affect the way U.S. forces could fight, likely raising the cost in lives and property and making the outcome less secure. U.S. space systems, including the ground, communication and space segments, need to be defended in order to ensure their viability."

While stopping short of recommending the development of space-based weapons, the report made it fairly clear between the lines that pursuit of such weapons would be desirable. "The Commissioners believe the U.S. government should vigorously pursue the capabilities called for in the National Space Policy to ensure that the president will

[4] USECAF/DNRO Announces Space Transformation, U.S. Air Force News Release, Feb. 7, 2002.
[5] Gen. Jim McCarthy, U.S.A.F. (ret.), chairman, Transformation Study Group, "Transformation Study Report Executive Summary: Transforming Military Operational Capabilities," April 27, 2001.

have the option to deploy weapons in space to deter threats to, and if necessary, defend against attacks on U.S. interests," the report stated.

The reference to the National Space Policy, however, could be seen as slightly disingenuous. The 1996 policy promulgated by the Clinton White House and still in effect, does allow – or maybe even encourage – the military to explore technologies and capabilities for space weapons as both a deterrent and a hedge against potential developments by hostile countries. At the same time, the policy continues the restraints on actually deployment of weapons in orbit. This is consistent with U.S. policy ever since the original space race with the Soviet Union of the 1950s and 60s.

The sea change in thinking about space-based weapons signaled by the Space Commission report is a direct result of the long-running internal military debate. It follows from a path of strategic thinking emanating most prominently from the Air Force. For example, the U.S. Air Force's Vision 2020 document and U.S. Space Command's long-range plan for implementing that strategic vision, both released in 1998, are clear about the need to provide planning for the development of space weaponry. More recently, Air Force Space Command's capstone planning document, "Strategic Master Plan for FY '02 and Beyond," published in February 2000, carries the logic forward by calling for "full spectrum dominance" in space and "formidable and flexible options for prompt, global conventional strike" from space by 2045.[6]

And while there has been no formal change in national policy, current military thinking and strategy already has gone a long way beyond the past emphasis on use of space assets for force enhancement (i.e., surveillance, intelligence, communications, navigation and targeting) to incorporate mission concepts for space-based weapons. Some examples of space-based weapons programs will be outlined below, however, former Pentagon officials say most of the development work is in the 'black' budget (highly classified) and thus difficult, if not impossible, to either qualify or quantify.

At the same time, there is a wealth of discussion of the potential *roles* for space weaponry. Those most often cited by the military are: 'space control,' missile defense and 'force application from space.'

Space Control

Space control, defined as the ability to "assure freedom of action in space and deny same" to the enemy, is now a key military mission, and at the center of U.S. Space Command's role.[7] The key, but not only, goal of space control is to defend U.S. space assets, from space. Space control as explained by the military has four key aspects:

Surveillance, including the ability to detect and track space objects;

Protection, concentrating on passive measures to enhance survivability of U.S. space assets, such as electronic hardening;

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[6] "Air Force Space Command, "Strategic Master Plan for FY02 and Beyond," Feb. 9, 2000, online at: http://www.spacecom.af.mil/hqafspc/library/AFSPCPAOffice/2000smp.html

[7] Air Force Col. Robert Haeckel, J-5 vice director of plans for U.S. Space Command, briefing to reporters July 15, 2001, at Army Space and Missile Defense Command, Huntsville, Ala.

Prevention, prohibiting enemies from "exploiting U.S. or allied space services" through measures such as encryption or shutter control (shutting down access to imagery satellites); and,

Negation, preventing enemies from using their own space forces, including through offensive means.[8]

Thus, space control by definition includes potential offensive operations – i.e., possible use of space-based anti-satellite weapons (ASATs). There are a number of concepts for such weapons discussed in military and independent literature, including 'bodyguard satellites' that would shadow U.S. satellites and defend them if necessary; kinetic energy ASATs that could be launched in wartime; and so-called 'space mines,' stealthy ASATs that would linger in space near enemy satellites for later activation in the event of hostilities.[9]

While U.S. Space Command is overtly charged with the mission, space control has particular resonance for the U.S. Army. Army leaders are keenly worried about the possibility that allowing hostile forces free access to space-based assets could erase the edge U.S. forces now enjoy through exploiting satellite imagery, communications and precision targeting. Army officials repeatedly claim that the famous 'left hook' maneuver of Operation Desert Storm could not have succeeded if Iraqi leader Saddam Hussein had possessed the imagery available today on the commercial market.

"The idea of being able to control what people are seeing is going to be an issue for the Army," Lt. Gen. Joseph M. Cosumano Jr., commander of the Army Space and Missile Defense Command, told reporters July 15, 2001, at a conference sponsored by the U.S. Army Space and Missile Defense Command, Huntsville, Ala.[10]

Indeed, in an unprecedented move, the Pentagon late last year entered an exclusive contract with U.S. firm Space Imaging, to buy up all the imagery of Afghanistan taken by the firm's Ikonos satellite to prevent global media firms from obtaining pictures of U.S. bombing during Operation Enduring Freedom.[11]

The Army is also the only service with an overt ASAT development program, the Kinetic Energy Anti-Satellite program. This effort was launched in 1990, and would use a ground-launched kinetic kill vehicle to hit an enemy satellite and destroy it. Currently, the program is capped at the development of three flight-tested ASATs that are to be shelved for possible future use. Some proponents of that program, notably Sen. Robert Smith, R-N.H., have been touting the expansion and continuation of the program. However, there are concerns within the military (including the Army) about the collateral damage to U.S. or other friendly satellites that might be caused by debris left after a kinetic kill of an enemy satellite.

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[8] Ibid.
[9] Air Force Maj. William L. Spacy II, "Does the United States Need Space-Based Weapons?," CADRE Paper, Air University Press, Maxwell Air Force Base, Ala., September 1999.
[10] Author's own notes.
[11] Duncan Campbell, "US buys up all satellite war images," *The Guardian*, Oct. 17, 2001.

The Army is by no means the only service worried about space control. The Navy and Air Force are concerned that allowing enemies to use space freely could diminish not only ground and sea operations, but also the edge U.S. forces have in command, control and communications, and precision targeting. Some experts have specifically identified the threat to U.S. military and commercial freedom of the seas as a critical issue if other countries are allowed to develop space-based weapons.

The Air Force alone is investing $185 million in fiscal year 2003 in space control, according to Lt. Col. John Hyten, chief of the space control division in the air and space operations staff and himself a proponent of weaponizing space. In speaking to a Feb. 27 conference sponsored by the Defense Industrial Association, Hyten said Air Force Space Command is developing a concept of operations for space control and, in addition, has launched a 'red force' – the 527th Space Aggressor Squadron – to pinpoint vulnerabilities in U.S. systems.[12]

Missile Defense

The second factor driving U.S. political-military thinking about weaponizing space is the push, now being rapidly accelerated by the Bush administration, to develop missile defenses. The administration already has announced its intent to withdraw, on June 13, 2002, from the ABM treaty, not only opening the path for development of missile interceptors but also clearing the way for the United States to develop anti-satellite weapons targeted against potentially hostile spy satellites.

The Pentagon's just-revised missile defense plans include a much greater emphasis on the potential for space-based systems, in particular for shooting down enemy missiles in their boost phase as they begin to ascend through the atmosphere. Although it is unclear if these plans are a deliberate foot in the door to the weaponization of space, their implementation would have that effect. A decision to move forward with space-based missile defense systems would end today's policy of restraint – with or without an overt move to rewrite the National Space Policy.

The newly named Missile Defense Agency (formerly the Ballistic Missile Defense Agency) has proposed spending $1.33 billion from 2003 to 2007 on developing "Space-Based Boost" – in essence reviving the Reagan-era concept of Brilliant Pebbles, a constellation of orbiting, kinetic kill vehicles designed to knock out enemy ICBMs in their boost phase. "Concept assessment" is due to be completed in early 2003, according to Pentagon fiscal year (FY) 2003 budget documents, with an aim to "support a product line decision not earlier than FY 2006."[13] The development program is being designed to include at least limited experiments in space.

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[12] Kerry Gildea, "Air Force Space Officials Believe U.S. Use of Weapons in Space is Inevitable," *Defense Daily,* Feb. 28, 2002.

[13] Missile Defense Agency RDT&E Budget Item Justification (R-2A Exhibit), P.E. No. 0603883C Boost Defense Segment, Project 4040, February 2002.

Research on the Space Based Laser has been ongoing for some time, and laser technology has slowly progressed. The program has experienced developmental trouble, however, and Congress cut FY 2002 funding, bringing to a halt the program's planned Integrated Flight Experiment of an early prototype. The Missile Defense Agency is now reevaluating the program, but intends to continue exploring technologies through 2007 – proposing $284.8 million in spending from FY 2003-2007.[14] Deputy Defense Secretary Paul Wolfowitz recently testified to Congress that the Pentagon budget for FY 2003 includes about $103 million for directed energy technology (including Space-Based Laser).[15]

The Air Force also has begun openly discussing other potential missions for the Space-Based Laser beyond missile defense. According to a July 18, 2001, briefing at the Huntsville conference by Air Force Col. William N. McCasland, then system program director for the Space-Based Laser, such missions could include:

- "defense/offensive counter space operations" (i.e., anti-satellite missions);
- "deny access to space" (for example, knocking out enemy launchers as they blast off);
- "deny flow of information to/from satellite" (perhaps using low-power beams to disrupt rather than destroy a satellite);
- "defense/offensive counter-air operations"; and
- knocking out high-altitude aircraft, cruise missiles, or unmanned aerial vehicles.[16]

Force Application

The latter mission mentioned for Space-Based Laser falls directly into the category of missions dubbed 'force application' from space, i.e. attacking airborne and terrestrial targets (some officials and experts also lump missile defense into the force application category).

At the conference in Huntsville, Air Force Col. Ronald Haeckel, J-5 vice director of plans for U.S. Space Command, told reporters that the command is directly tasked to plan for "force application from space" – a mission he characterized as a hedge against potential future need. Weapon concepts include not only lasers, but also kinetic energy weapons and more conventional explosive warhead type weapons.[17]

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[14] Missile Defense Agency RDT&E Budget Item Justification (R-2A Exhibit), P.E. No. 0603883C Boost Defense Segment, Project 4043, February 2002.

[15] *Defense Daily*, March 4, 2002.

[16] Col. William N. McCasland, System Program Director, Space-Based Laser, Ballistic Missile Defense Organization, briefing charts on "Space Based Laser (SBL) Integrated Flight Experiment (IFX)," July 18, 2001.

[17] For a comprehensive look at potential space-based weapons against terrestrial targets, see Bob Preston, Dana J. Johnson, Sea J.A. Edwards, Michael Miller, Calvin Shipbaugh, "Space Weapons/Earth Wars," Project Air Force, RAND, Santa Monica, Calif., 2002. The study was sponsored by the U.S. Air Force Office of the Deputy Chief of Staff, Plans and Programs.

Pentagon exploration of space-based weapons also has received a recent boost from congressional interest in development of new types of earth-penetrating weapons for destroying hardened and deeply buried targets, particularly underground chemical and biological weapons facilities. The Defense Threat Reduction Agency has launched an Advanced Concept Technology Demonstration program on a ballistic missile-delivered penetrator weapon, called the Tactical Missile System – Penetrator ACTD.[18] (The idea, however, is not new: as long ago as the early 1990s, the Air Force was studying conventional ICBMs using tungsten and/or steel rods for taking out hard and deeply buried targets.) Some military experts also have touted the concept of dropping earth penetrating kinetic energy weapons from orbit, since such rod-like reentry vehicles could attain high speeds and thus deep vertical penetration.[19]

For example, the Air Force Research Laboratory has begun a study on a new earth penetrator that might be eventually fitted onto the Air Force's proposed Common Aerospace Vehicle (CAV).[20] The CAV would be a maneuverable reentry vehicle deployed from an orbiting satellite in low-earth orbit (there are also concepts for delivering the CAV from ICBMs or other missiles), and carry different types of submunitions possibly including a penetrator. Then Air Force Chief of Staff Gen. Michael E. Ryan, himself a strong proponent of weaponizing space, told *Air Force Magazine* in September 2001 that the reentry vehicles could be carried into space by either a rocket or a reusable launch vehicle.[21]

In addition, in the wake of the Sept. 11 terrorist attacks on the United States, space weapons proponents have been more vocal about concepts for using space weapons to attack a wide range of terrestrial targets anywhere on the globe. For example, Sen. Mac Thornberry, R-Texas, in March called on the Pentagon to begin studying possible delivery of precision-guided weapons from space in the wake of the Sept. 11 terrorist attacks on the United States. "We ought not to be afraid to think about studying those things right now," Thornberry said in a March 12, 2002, speech to the Center for Strategic and International Studies.[22]

In sum, while a direct statement by the Bush administration of a new policy has so far been absent, the direction of U.S. policy and military planning is clear. Indeed, Haeckel told the Huntsville conference last summer that the military is expecting "new guidance for space" from the Bush administration relatively shortly.

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[18] Report to Congress on the Defeat of Hard and Deeply Buried Targets, Submitted by the Secretary of Defense In Conjunction with the Secretary of Energy, In Response to Section 1044 of the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001, PL 106-398, July 2001.
[19] Preston et al, "Space Weapons/Earth Wars."
[20] Frank Wolfe, "Air Force Research Lab Undertaking High Speed Penetrator Effort," *Defense Daily*, March 29, 2002.
[21] John A. Tirpak, "Bomber Questions," *Air Force Magazine*, September 2001.
[22] Kerry Gildea, "Thornberry Advocates Early Study of Space-Based PGM Options," *Defense Daily*, March 13, 2002.

The Threat: Vulnerabilities vs. Capabilities and Intent

Current Pentagon planning is driven by the perception of an urgent, emerging threat to U.S. space assets. The Space Commission report is seminal here, in the same way that the 1998 report of the Commission to Assess the Ballistic Missile Threat to the United States, known as the Rumsfeld Commission, propelled the threat of ballistic missile attack to the forefront of U.S. national security policy. While the immediate impact of the Space Commission's report was not as direct as that of its predecessor, the document has had a pervasive influence on administration officials, the military and Congress.

In a March 19 hearing of the Senate Armed Services Committee, U.S. intelligence officials said the threat to U.S. dominance in space is growing. Navy Vice Adm. Thomas Wilson, director of the Defense Intelligence Agency, testified that potential adversaries would have significant means to disrupt U.S. space systems by 2010 – citing efforts abroad to explore directed energy weapons (lasers), methods of attacking satellite ground stations, jamming and computer attacks.[23]

During the same hearing, CIA Director George Tenet said the development of increasingly sophisticated reconnaissance satellites by countries such as China and India – as well as the growing commercial market in communications, navigation and imagery – is eroding the U.S. edge.[24]

While it is true that other countries are pursuing both space assets and counter-space options, there is some reason to question whether the current threat assessment is justified. Leaving aside the question of the ballistic missile threat, it is unclear what real threats to U.S. space assets exist today or will exist in the near and medium term.

Proponents of weaponizing space usually cite the emergence of an acute threat in the 2020 time frame or beyond; the Space Commission report puts the possible development of hostile anti-satellite systems at decades away.

They cite as an indicator of the threat trend the fact that there are more and more countries, now 50-plus, with space capabilities. Available technologies, from imaging to telecommunications to tracking and signals intelligence, are progressing rapidly; and many are available on the commercial marketplace.

The Space Commission report also includes extensive analysis of the possible vulnerabilities of U.S. space assets, especially commercial satellites and communications grids: "The reality is that there are many extant capabilities to deny, disrupt or physically destroy space systems and the ground facilities that use and control them."

For example, a September 2001 report by the U.S. Department of Transportation, "Vulnerability Assessment of the Transportation Infrastructure Relying on the Global Positioning System," highlights the fact that the GPS network is easily disrupted in part

[23] Marc Selinger, "U.S. space dominance faces growing threat, officials say," *Aerospace Daily,* March 20, 2002.
[24] Ibid.

due to its low power signals and because its characteristics are well known due to its civil uses.[25] The Space Commission noted that there already are available Russian-made, handheld jamming devices that can block GPS receivers for up to 120 miles. In addition, like other satellite networks, the 24 GPS satellites have stable and predictable orbits.

However, vulnerabilities do not necessarily result in threats. In order to threaten U.S. space assets, military or commercial, a potential adversary must have both technological capabilities and intent to use them in a hostile manner. There is little hard evidence that any other country or hostile non-state actor possesses either the technology or the intention to seriously threaten U.S. military or commercial operations in space – nor is there much evidence of serious pursuit of space-based weapons by potentially hostile actors.

Currently, the simplest ways to attack satellites and satellite-based systems involve ground-based operations against ground facilities, and disruption of computerized downlinks. Hacking and jamming also are the least expensive options for anyone interested in disrupting space-based networks, because they do not require putting anything into orbit. The high cost of space launch (ranging between $5,000 and $10,000 per pound) is not a trivial matter, even for space-faring nations such as Russia and China, much less for 'rogue' states such as North Korea or non-state actors.

Indeed, the Space Commission report acknowledges that: "Attacking or sabotaging the supporting ground facilities has long been considered one of the easiest methods for a U.S. adversary to conduct offensive counter-space operations. Most of these facilities are relatively easy to get in close physical proximity to or access by way of a computer network, making them a prime target."

It is true that the incidences of computer hacking against U.S. military, financial and industrial networks continues to rise and that several countries including China are known to be exploring information warfare capabilities. Many countries already have developed military electronic jamming systems, and that technology is becoming widely available even on the commercial market.

It is obvious that the United States must ensure the integrity of its increasingly important space networks, and find ways to defense against threats to space assets. Still, there is little reason to believe that it is necessary for the U.S. to put weapons in space to do so. Space warfare proponents are making a suspect leap in logic in arguing that space-based weapons are, or will soon be, required to protect the ability of the United States to operate freely in space. One could argue much more rationally that what is needed most urgently is to find ways to prevent computer network intrusion; to ensure redundant capabilities both at the system and subsystem level, including the ability to rapidly replace satellites on orbit; to improve security of ground facilities (perhaps moving to underground facilities); and to harden electronic components on particularly important satellites.

[25] Jason Bates, "Attacks Increase Scrutiny of GPS Vulnerability Study," *Space News*, Oct. 15, 2001.

Furthermore, the evidence of actual space weapons programs by potential adversaries is thin. There have been Chinese press reports about China's military researching microsatellites (weighing less than 100 kilograms) or nanosatellites (weighing less than 10 kilograms) to attack U.S. satellites in space in a future war, but evidence of actual progress is scant. Russia also has long explored anti-satellite technology, but there is little reason to believe that Moscow has changed its policy against deploying such weapons (Russia has had a unilateral ban on ASAT testing for some time), especially given the current cash-starved state of the Russian space program. No other countries have shown visible signs of interest (although obviously any space-faring nation, such as India or Pakistan, have latent capability).

Indeed, the technical barriers to development and deployment of space-based weapons cannot be overestimated, even for the U.S. military. There are serious, fundamental obstacles to the development of both kinetic kill weapons and lasers both for use against targets in space and terrestrial targets – not to mention the question of the staggering costs associated with launch and maintaining systems on orbit. Problems with lasers include power generation requirements adding to size, the need for large quantities of chemical fuel and refueling requirements, and the physics of propagating and stabilizing beams across long distances or through the atmosphere. Space-based kinetic energy weapons have their own issues, including achieving proper orbital trajectories and velocities, the need to carry massive amounts of propellant, and concern about damage to own-forces from debris resulting from killing an enemy satellite. Space-based weapons also have the problem of vulnerability, for example, predictable orbits and the difficulty of regeneration.

A detailed discussion of technology challenges is beyond the scope of this paper, but a comprehensive primer on the myriad problems with developing space-based weapons is a September 1999 paper by Maj. William L. Spacy II, "Does the United States Need Space-Based Weapons?" written for the College of Aerospace Doctrine, Research and Education at Air University, Maxwell Air Force Base, Ala.

As noted, there is also the question of intent. It is not obvious that any nation has any intention, or even incentive, to launch a war in space. Instead, most countries, including China and Russia, have been urging a global ban on weapons in space. Many experts, including a number of Air Force strategists, persuasively argue a U.S. move to put offensive weapons in space could have the perverse effect of creating a new threat because other countries would feel compelled to follow suit.[26]

Nonetheless, it is impossible to completely assess any threat to U.S. national security without the benefit of classified information. That said, it also must be recognized that threat assessment is not the only necessary input to the creation of national security policy. Even assuming an urgent threat to U.S. space operations, an assessment of how

[26] Lt. Col. Bruce M. DeBlois, "Space Sanctuary: A Viable National Strategy," Airpower Journal, Winter 1998. See also Karl Mueller, "Space Weapons and U.S. Security: The Dangers of Fortifying the High Frontier," prepared for the 1998 Annual Meeting of the American Political Science Association, Boston, Mass.

best to counter those threats – including the pros and cons of the United States responding by becoming the first country to put weapons in space – would still be necessary.

In particular, it is imperative to look at risks emanating from such a decision. These include: the potential for starting an arms race in space that does both military and political damage to the United States; and the possibility that the advent of space warfare might negatively impact the U.S. commercial space and telecommunications industry, which now dominates the world marketplace.

Could a Space Race Undercut U.S. Military Dominance?

The United States already enjoys an overwhelming advantage in military use of space; space assets such as the Global Positioning System satellite network have proven invaluable in improving precision-targeting giving the U.S. military a decisive battlefield edge. There would be even a more formidable military advantage to possession of weapons in space – global power projection and the enormous difficulty in defending against space weapons aimed at terrestrial targets. "It is…possible to project power through and from space in response to events anywhere in the world. Having this capability would give the United States a much stronger deterrent and, in a conflict, an extraordinary military advantage," notes the Space Commission report.

Space weapons – even those primarily designed for defense of U.S. satellites – would have inherent offensive and first-strike capabilities, however, (whether aimed at space-based or earth-based targets) and would demand a military and political response from U.S. competitors.

"To be sure, not deploying weapons in space is no guarantee that potentially hostile nations (such as China) will not develop and deploy ASATs. However, it is virtually certain that deploying U.S. weapons in space will lead to the development and deployment of ASATs to counter such weapons," notes a new policy brief by the Cato Institute.[27]

China and Russia long have been worried about possible U.S. breakout on space-based weaponry. Officials from both countries have expressed concern that the U.S. missile defense program is aimed not at what Moscow and Beijing see as a non-credible threat from rogue-nation ballistic missiles, but rather at launching a long-term U.S. effort to dominate space.

Both Russia and China also are key proponents of negotiations at the UN Conference on Disarmament to expand the 1967 Outer Space Treaty to ban all types of weapons. The effort to start talks known as PAROS, for "prevention of an arms race in outer space," has been stalled due in large part to the objection of the United States. For example, in November 2000, the United States was one of three countries (the others were Israel and

[27] Charles V. Pena and Edward L. Hudgins, "Should the United States 'Weaponize' Space? Military and Commercial Implications," March 18, 2002.

Micronesia) to refuse to vote for a UN resolution citing the need for steps to prevent the arming of space.[28]

It is inconceivable that either Russia or China would allow the United States to become the sole nation with space-based weapons. "Once a nation embarks down the road to gain a huge asymmetric advantage, the natural tendency of others is to close that gap. An arms race tends to develop an inertia of its own," writes Air Force Lt. Col. Bruce M. DeBlois, in a 1998 article in Airpower Journal.[29]

Chinese moves to put weapons in space would trigger regional rival India to consider the same, in turn, spurring Pakistan to strive for parity with India. Even U.S. allies in Europe might feel pressure to "keep up with the Joneses." It is quite easy to imagine the course of a new arms race in space that would be nearly as destabilizing as the atomic weapons race proved to be.

Such a strategic-level space race could have negative consequences for U.S. security in the long run that would outweigh the obvious (and tremendous) short-term advantage of being the first with space-based weapons. There would be direct economic costs to sustaining orbital weapon systems and keeping ahead of opponents intent on matching U.S. space-weapon capabilities – raising the proverbial question of whether we would be starting a game we might not be able to win. (It should be remembered that the attacker will always have an advantage in space warfare, in that space assets are inherently static, moving in predictable orbits. Space weapons, just like satellites, have inherent vulnerabilities.) Again, the price tag of space weapons systems would not be trivial – with maintenance costs a key issue. For example, it now costs commercial firms between $300 million and $350 million to replace a single satellite that has a lifespan of about 15 years, according to Ed Cornet, vice president of Booz Allen and Hamilton consulting firm.[30]

Many experts also argue there would be costs, both economic and strategic, stemming from the need to counter other asymmetric challenges from those who could not afford to be participants in the race itself. Threatened nations or non-state actors might well look to terrorism using chemical or biological agents as one alternative.

Karl Mueller, now at RAND, in an analysis for the School of Advanced Airpower Studies at Maxwell Air Force Base, wrote, "The United States would not be able to maintain unchallenged hegemony in the weaponization of space, and while a space-weapons race would threaten international stability, it would be even more dangerous to U.S. security and relative power projection capability, due to other states' significant ability and

[28] Theresa Hitchens, "Rushing to Weaponize the Final Frontier," *Arms Control Today*, September 2001.
[29] DeBlois, "Space Sanctuary."
[30] Nick Johnson, "Analyst: Smaller satellite companies likely to consolidate over 10 years," *Aerospace Daily,* March 6, 2002.

probably inclination to balance symmetrically and asymmetrically against ascendant U.S. power."[31]

Spurring other nations to acquire space-based weapons of their own, especially weapons aimed at terrestrial targets, would certainly undercut the ability of U.S. forces to operate freely on the ground on a worldwide basis – negating what today is a unique advantage of being a military superpower.[32] U.S. commercial satellites would also become targets, as well as military assets (especially considering the fact that the U.S. military is heavily reliant on commercial providers, particularly in communications). Depending on how widespread such weapons became, it also could even put U.S. cities at a greater risk than they face today from ballistic missiles.

The potential for strategic consequences of a space race has led many experts, including within the military, to tout a space arms control regime as an alternative. A ban on space weapons and ASATs could help preserve – at least for some time – the status quo of U.S. advantage (especially if coupled with U.S. moves to shore up passive satellite defenses). In a recent article in Georgetown Journal of International Affairs, Jeffrey Lewis, a graduate research fellow at the Center for International Security Studies at the University of Maryland, makes a good case for an arms control approach, arguing: "If defensive deployments in space cannot keep pace with offensive developments on the ground, then some measure of restraining offensive capabilities needs to be found to even the playing field."[33]

In any event, it is clear that U.S. policy-makers must look at the potential strategic and direct military risks, and the costs, of weaponizing space.

Economic Risks in a Globalized Market

Besides the potential for undercutting, rather than strengthening, the U.S. military edge, there also is reason to be concerned about the possibility that moves toward weaponizing space could damage the competitiveness of the U.S. space industry, which currently dominates the international marketplace and therefore bolsters U.S. economic and military power.

The commercial space and telecommunications sector is also arguably the most globalized of today's economic sectors. The customer base is international; the industry itself is largely comprised of multinational alliances among companies and consortia, as well as joint government programs.

Whereas space used to be available only to the most developed nations, there are more than 1,100 companies in 53 countries now exploiting space.[34] Space is a major

[31] Karl Mueller, "Space Weapons and U.S. Security: The Dangers of Fortifying the High Frontier," prepared for the 1998 Annual Meeting of the American Political Science Association, Boston, Mass.
[32] Spacey, "Does the United States Need Space-Based Weapons."
[33] Jeffrey Lewis, "Rumsfeld Aims for the Stars: An Arms Control Alternative to the Pentagon's Plans in Space," Georgetown Journal of International Affairs, Winger/Spring 2002.
[34] Hyten, "A Sea of Peace."

worldwide market accounting for many billions in revenue, and U.S. firms are dominant in the sector.

According to a 2000/2001 study (the 2001/2002 version should be released shortly) by the Washington-based Satellite Industry Association, worldwide revenue (including both government and commercial customers) for the satellite industry was $85.1 billion in 2000, and $97.7 billion is estimated for 2001. Over the past five years, the average annual growth has been 17 percent. The industry association was predicting year-end numbers in 2001 to show 15 percent growth. The U.S. satellite industry pulled in $8.9 billion in 2000, and $10.3 billion in 2001 in satellite manufacturing alone, out of worldwide revenue of $17.2 billion and $20.7 billion respectively. Importantly, exports account for half or more of U.S. industry revenue.[35]

A parallel study, released by the Satellite Industry Association April 5, 2001, and conducted by Henry R. Hertzfeld, senior research scientist at the George Washington University Space Policy Institute, showed worldwide spending on "civilian space programs totaled $20.8 billion in 2000 excluding spending by Russian, Ukrainian and Chinese governments. Government spending on space reached $35.8 billion when adding in military space budgets. The United States accounted for more than three-fourths of all spending on civil space (78 percent), while combined spending by European countries and all other governments (Japan, China, Brazil and others) accounted for the remaining spending."[36]

While commercial space was a booming market during most of 1990s, the market for low-earth orbit satellites has collapsed over the past two years. Launch providers are predicting a flat marketplace for a number of years.[37] In addition, the market for large geosynchronous orbit satellites for communications also is at near rock bottom and is expected to remain flat through 2011, according to a recent report by Forecast International/DMS Inc.[38]

The growth in the market is now being driven by satellite services, such as direct downlinks for Internet (with high hopes pinned on the development of broadband Internet services) or TV.

There further is excess capacity in the commercial space market place, with five major manufacturers (three U.S., two European), according to Christopher E. Kubaski, chief

[35] Presentation by Richard DalBello, executive director of the Satellite Industry Association, "SIA/Futron Satellite Industry Indicators Survey: 2000/2001 Survey Results, April 2002, at http://www.sia.org/papers/satstats01.pdf

[36] Satellite Industry Association press release, "Satellite Industry Association Releases Global Satellite Statistics," April 5, 2001.

[37] Jefferson Morris, "Multinational launch companies strive to differentiate service in flat market," *Aerospace Daily*, Oct. 31, 2001.

[38] Nick Johnson, "SATCOM market to bottom out by mid-decade, report says," *Aerospace Daily*, March 27, 2002.

financial officer of Lockheed Martin Corp.[39] Kubaski and other U.S. industry leaders are predicting little growth in the commercial sector in the near term.

Corporate chieftains at major defense and space firms already are citing missile defense as a much more lucrative future market than commercial/civil space operations. Such a market assessment by U.S. industry is not without consequences. As one corporate strategist at a major U.S. defense/space firm explained, market assessments drive where corporate research and development dollars go.[40] Considering that it is industry, rather than DoD and NASA, that carries the bulk of R&D spending in the defense and civil space arena, there is some possibility that an emphasis on space weaponization could shift technology investment from the commercial to the defense world.

Granted, this would hold only for those firms – such as Lockheed Martin Corp., Boeing Co., Raytheon Co., and TRW – that do large percentages of government businesses, rather than for those companies more vested in the commercial end of space operations (providing telecommunications and Internet services for example.) Nonetheless, the ramifications of shifting R&D on market edge in the commercial arena deserve some consideration.

Interestingly, the U.S. industry has not done as well over the past two years as the overall marketplace. Overall, the worldwide market rebounded in 2000 with a 23 percent growth in revenue, according to the Satellite Industry Association. The association data show that while the global market for satellite manufacturing grew by 9 percent in 2000, U.S. revenue declined by 11 percent. Similarly, worldwide revenue in the satellite launch segment grew by 29 percent in 2000, whereas U.S. revenue grew only by 17 percent.[41]

(Still, U.S. manufacturers snagged more than half the satellite orders in 2001, according to data from Futron Corp., a consulting firm specializing in the space market.[42])

U.S. industry officials partially blame the government for their recent poor performance – worried about the effects of U.S. regulatory requirements and export controls on their bottom line. The global marketplace is highly competitive, and U.S. policy and regulations are a major factor in determining U.S. competitiveness.

For example, a RAND study of the remote sensing industry states: "Success for these new U.S. commercial remote sensing satellite firms heavily depends on both understanding and overcoming various risks (e.g., technical, market, policy and regulatory) that could diminish their prospects in the highly competitive global marketplace for geospatial information products and services. Within this context, U.S. government policies and regulations exert a major influence on the ability of U.S. remote

[39] Peter B. de Selding, "Boeing, Lockheed Expect Minimal Growth in Commercial Space Work," *Space News*, Dec. 3, 2001.
[40] Interview with Author, March 25, 2002.
[41] DalBello, "SIA/Futron Satellite Industry Indicators Survey."
[42] *Aerospace Daily,* "Futron: More satellite orders in 2001 went to U.S. firms," Jan. 8, 2002.

sensing satellite firms to realize their competitive potential in both the domestic and international marketplace."[43]

This is just as true for other segments of the space industry.

For example, in 1998 licensing of satellite exports was switched by Congress from the Commerce Department to the State Department and now is handled in a similar manner to weapon export controls because of national security concerns, particularly about technology leakage to China. In an open letter to Congress in June 2001 urging a reversal of the law, the Satellite Industry Association stated that the U.S. market share for geostationary communications satellites dropped from its 10-year average of about 75 percent to 45 percent during 2000, and it largely blamed the regulatory switch to State and the subsequent slowing of the export licensing process for the problem.[44]

Thus, U.S. industry officials are concerned about Pentagon plans to deny "enemies" access to space assets, including commercial imagery and other services provided by U.S. firms. In his Huntsville address, Cosumano admitted that as "some of these assets belong to U.S. companies and they don't feel too good about the idea that we might shoot them out of the sky."[45]

The U.S. Defense Department already has the legal ability to exercise so-called shutter control of U.S. civilian satellites – that is, the ability to shut down a satellite to prevent enemies from using images or data to help them defeat the U.S. military in wartime. In addition, U.S. export policy requires that any foreign government purchasing a U.S.-made imaging satellite must sign a government-to-government agreement to take into account American national security interests. While the Pentagon did not use its shutter control privilege in Afghanistan, as noted earlier, DoD did take commercial imagery off the market by buying exclusive rights to all pictures taken by Space Imaging's Ikonos satellite. This was done despite the fact that Russia's Cosmos satellite network could provide equivalent imagery.[46]

The Pentagon move immediately caused a stir overseas. Because the United Arab Emirates, a Space Imaging customer, was directly affected by the Pentagon buy, the six countries of the Gulf Cooperation Council commissioned a joint committee to consider buying their own military imaging satellite rather than rely on U.S. commercial providers.[47] Besides the United States, France, Israel and Russia are in the imagery satellite business – and obviously, U.S. industrialists cannot like the idea that defense policy or actions may be rebounding to create stronger competitors for them.

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[43] Kevin M. O'Connell, John C. Baker, Beth E. Lachman, Steven Berner, David R. Frelinger and Kim E. Gavin, "U.S. Commercial Remote Sensing Satellite Industry: An Analysis of Risks," October 2001, RAND.

[44] Satellite Industry Association Letter to Congress, "Ensure U.S. National Security and the Competitiveness of the U.S. Satellite Industry," June 4, 2001.

[45] Author's own notes.

[46] Campbell, "US buys up all satellite war images."

[47] Warren Ferster and Gopal Ratnam, "GCC Mulls Spy Satellites: Six Aligned Gulf States Seek Independent Image Source," *Defense News*, Dec. 10-16, 2001.

The 15-nation European Union already is moving forward on plans to buy a European version of the U.S. Global Positioning System navigation satellite network, called Galileo, in part due to fears that future access might be denied or downgraded by the U.S. military. "Europe cannot accept reliance on a military system which has the possibility of being cut off," Rene Oosterlinck, head of the European Space Agency's navigation department, was quoted by the *New York Times*.[48]

Some international customers also already are questioning the reliability of U.S. suppliers (and government-supplied products). After the 1998 change in export-licensing authority, German-controlled Daimler-Chrysler Aerospace announced it would no longer purchase U.S.-made satellite components.

The competitive and cost challenges the U.S. satellite industry faces could be increased if the United States moved to make space a battlefield. Up to now, the threat that commercial satellites could become direct wartime casualties has been negligible. But an aggressive U.S. pursuit of ASATs would likely encourage others to do the same, thus potentially heightening the threat to U.S. satellites. Space industry executives, whose companies often are working at the margins of profitability, are concerned about U.S. commercial satellites and their operations becoming targets, especially because current commercial satellites have little protection (electronic hardening, for example, has been considered too expensive). There would be costs to commercial providers for increasing protection, and it is highly unclear whether the U.S. government would cover all those costs.

Another area where Defense Department policy could threaten U.S. industry competitiveness is in access to the radio spectrum. DoD has been resisting calls from the telecommunications industry to free from government-only access a portion of the spectrum that companies believe is essential to providing high-speed Internet access over cellular phones. That portion of the spectrum (1755-1850 megahertz) is now denied to U.S. commercial users because it is the spectrum band of choice for military (and other government) communications, as well as precision targeting. However, that band is being used by many other firms abroad for commercial wireless communications, raising the possibility that a continued U.S. policy of denial, although perhaps making short-term military sense, will inhibit the ability of U.S. firms to compete abroad. Stephen Price, head of the Pentagon's new office for spectrum management, recently said that the greater information demands of the war on terrorism and increased homeland security efforts are making DoD even more leery of freeing the disputed spectrum bands.[49]

The health of the U.S. commercial space and telecommunications industry is critically important to the computerized, globalized U.S. economy, but also directly to the U.S. military. The Department of Defense now uses commercial satellite systems to cover

[48] Jennifer Lee, "Europe Plans to Compete With U.S. Satellite Network," *New York Times*, Nov. 26, 2001.
[49] Sharon Weinberger, "War on terrorism raises concerns over spectrum, DoD official says," *Aerospace Daily*, Feb. 5, 2002.

about 60 percent of its satellite communications needs, and that dependence is growing.[50] Military use of commercial assets is unlikely to significantly decline, in part due to the high costs of building and operating military-dedicated satellites.

Of course, it must be pointed out that some U.S. firms will no doubt benefit from any new U.S. programs to develop space-based weaponry – particularly the large defense contractors already involved in military space programs. Nonetheless, there remains reason to be concerned about the affect on other companies more involved in the commercial use of space. And since there are, and will remain, direct benefits to the military of maintaining a strong and competitive commercial space and telecommunications industry, the possibility that the deployment of weapons in space or a policy of aggressive targeting of satellites (and subsequent government regulatory restraints) may have negative industrial implications must be more fully explored.

Conclusion

As this paper has attempted to outline, there are a number of serious issues surrounding the question of whether the United States should deploy weapons in space. It is clear that there are measures that should be taken in the near- and medium-term to protect increasingly important U.S. space assets. However, what has yet to be truly analyzed is whether doing so requires space-based weapons any time in the foreseeable future.

Outside of the technical challenges and the non-trivial issue of whether the U.S. government is willing or able to take on the long-term budgetary investment required to sustain military operations in and from space, there are potential national security and economic risks involved with such a path. There is a fundamental question as to whether a U.S. policy to weaponize space would be a 'silver bullet' for future security, or a game of Russian roulette.

It is therefore crucial that before any change to today's policy of restraint takes place, the U.S. government undertake an in-depth review of the possible consequences and alternatives. The short-term military advantages to the U.S. military of being first to utilize space weapons, however dramatic, must be weighed against the long-term military, political and economic costs. The burden lies on the administration to prove that any policy change would provide a net, and sustainable, improvement is U.S. national security writ large. Such a formal policy review should be undertaken immediately, given the Bush administration's fast-forward missile defense plans. It is imperative that the missile defense program not be allowed to solely drive a decision to weaponize space, especially in absence of serious consideration of the potential strategic, military and economic consequences.

Under ideal circumstances, the National Security Council would put together an interagency group to look at options and alternatives including passive defenses for space assets and arms control solutions, and provide the opportunity for independent experts and industry to have input. Obviously, such a study could be done under the auspices of

[50] Linda L. Haller and Melvin S. Sakazaki, "Commercial Space and United States National Security," background paper prepared for the U.S. Space Commission, January 2001.

the new Space Policy Committee. Congress, too, should begin studying the issue – including holding near-term hearings to draw out the implications of a space-based element to a missile defense architecture, as well as to address the wider issue. A broad-based public debate is necessary to ensure that policy-makers fully understand the implications of breeching the 'final frontier.'