Arguing for a Comprehensive Space Protection Strategy

Terry Everett

The Contributions that space brings to our daily lives extend far beyond the military. In June 2006, while serving as chairman of the House Armed Services Subcommittee on Strategic Forces, I held a hearing to bring focus to the magnitude of our military and economic dependence on space. Lt Gen C. Robert Kehler, vice-commander of US Strategic Command, provided several examples of how space capabilities are integral to the daily execution of virtually every military campaign, operation, and exercise involving US forces. In Operation Iraqi Freedom (OIF) space capabilities enabled blue-force tracking (which lowered combat losses), command and control of dispersed ground forces (which facilitated ground maneuver around enemy strong points), and the geolocation of downed aircrews. The use of global positioning system (GPS)-guided precision munitions also resulted in lower collateral damage, more efficient use of limited munitions inventory, and mission execution during adverse weather conditions.[1] On the commercial side, the executive director of the Satellite Industries Association, Mr. David Cavossa, estimated that space contributes over 90 billion dollars annually to the global economy, supporting daily activities such as truck fleet management, credit card validations, pay-at-the-pump services, ATM withdrawals, high-speed Internet, traffic and weather reports, and almost all television and radio distribution.[2] Not only has space become essential to modern warfare, it also has established itself as a permanent utility in our global commerce.

However, I believe much of Congress and the American public are largely unaware of how space capabilities contribute to our daily com-

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merce and broader economic security. Unless our nation truly understands our dependence on space, we cannot understand the risks of losing this capability. To this end, I personally included language in the 2007 National Defense Authorization Act calling on the National Space Studies Center at Maxwell Air Force Base's Air University to examine this issue "to assess the value of space contributions with emphasis on the United States' dependence on space, innovative ideas contributing to ensuring freedom of action in space, and integration of all space forces."[3]

On 30 January 2007 House Armed Services Committee ranking member Duncan Hunter of California and I signed a letter to the President calling for a change in America's defensive space strategy in the face of a singular but landmark event 19 days earlier. That letter read, in part:

> China's recent test of an anti-satellite missile, destroying a satellite in low earth orbit, marks the commencement of a new era of military competition in space. The dependency of American warfighting capability, and the economy, on space assets compels our nation to take the necessary steps to ensure our forces cannot be targeted through an adversarial space strike. Space capabilities are integral to the daily execution of virtually every military campaign, operation, and exercise involving U.S. forces today. Therefore, a review of Department of Defense programs intended to preserve American space assets is warranted. Further, new programs which provide protection, redundancy, and reconstitution of space assets should be essential.

As an advocate of a vigilant defensive space policy, the Chinese antisatellite (ASAT) test is worrisome to me and warrants a clear and considered US response. America must develop a comprehensive space protection strategy, rethink its national security space architecture, and reexamine its policies on space protection and the use of space. While some have said that we should not be overly worried about this event, I believe this is a clear wake-up call for the Administration, Congress, and the American people.

Recognizing Our Vulnerabilities

After I became chairman of the Strategic Forces Subcommittee in 2002, I warned of the potential loss of our commercial and military satellite constellations to foreign attack. The United States has more satellites in orbit than any other nation. As the most technologically advanced nation in the world, we are also the most vulnerable to disruption if our satellites are threatened.

Unfortunately, our adversaries do not need to be educated about our reliance on satellites. On 11 January 2007 the Chinese launched a medium-range ballistic missile into space. It targeted an aging Chinese weather satellite orbiting 500 miles above the planet. The kill vehicle rammed into the target satellite, sending out into orbit thousands of pieces of debris of varying sizes with speeds up to 1,400 miles per hour, according to Air Force Space Command.[4] Particles a few centimeters in length are large enough to cause major damage, which is what makes this debris so significant and why, given its potential to stay in orbit for years to come, it poses a long-term hazard to our satellites. The United States, with its space surveillance network, will bear the long-term responsibility for warning others of potential collisions, including foreign and commercial operators, and ironically, the Chinese.

The likely result is that the space shuttle, the International Space Station, and many satellites in low Earth orbit will need to expend precious fuel to maneuver around debris. At some point, our satellite operators will determine the loss of "mission life" due to this extra maneuvering. This could be a sizeable impact when we are talking about multibillion-dollar satellites designed for lifetimes of five to 10 years. In recent testimony before the Strategic Forces Subcommittee, Gen James Cartwright, commander, US Strategic Command, commented that "we are going to have to make significant adjustments as collision, or, as we call it, conjunction opportunities occur over the next 20-plus years. . . . That is going to have an effect on business, on commerce. And it is going to have an effect on our national assets that are in low Earth orbit."[5]

Simply stated, the Chinese ASAT event was a significant and irresponsible act. In a recent trip to China, the Chairman of the Joint Chiefs of Staff, Gen Peter Pace, commented that China's senior military leaders still refuse to disclose any details about their recent test.[6] Though the Chinese have firmly denied any malicious intent, I remain highly skeptical based on other activities. Apparently, this single test is part of a broader effort to mature their direct-ascent ASAT capability and to develop a spectrum of counterspace capabilities. This is consistent with their larger military modernization and advanced technology efforts, evidenced by the roughly 18 percent increase in military spending this year alone. A similar observation was made in a recent report by the bipartisan US-China Economic and Security Review Commission.

China has been a student of US space operations dating back to Operation Desert Storm. It knows all too well the advantage space offers the United States, as well as our vulnerabilities. China's military planners have advocated the use of technology that would deny us access to our space assets. This tactic is consistent with what many consider China's unofficial doctrine of asymmetric warfare.

The world has not seen an ASAT test like the Chinese conducted in over 20 years; the United States last tested an ASAT system in 1985. It was believed that the Soviets had also developed and tested different ASAT variants, including co-orbital and direct-ascent ASAT systems. However, at the height of the Cold War, a delicate strategic balance was upheld. Both countries understood that a strike against a space asset would be destabilizing, leaving either side vulnerable to a debilitating first strike that could escalate to nuclear war. During this time the use of space was predominantly for strategic purposes, providing global missile warning, intelligence, and secure communications for the command and control of nuclear forces. This was before we had an operational GPS constellation, widespread satellite communications, extensive civil and commercial use, and near-real-time battlefield intelligence supporting tactical and theater-level military operations.

Today, the repercussions of an attack that existed in the Cold War seem to have diminished. In fact, ASAT incidents and tests are occurring, and we have seen few consequences for the culprits. In the past few years, we have seen a handful of GPS and increasing numbers of satellite communications (SATCOM) jamming incidents. In the early stages of OIF, US forces encountered a GPS jamming situation. In this case, precision munitions were used to hit these jamming sources, which allowed our forces to quickly resume operations.[7] We have seen several SATCOM jamming incidents, including Iranian jamming of a US satellite from Cuba in July 2003; ongoing jamming by Iran against Panamsat, AsiaSat, ArabSat, and EutelSat from June 1997 to July 2005; and Libyan jamming of two international SATCOM systems in December 2005.[8] Last fall it was reported that a Chinese ground-based laser illuminated a National Reconnaissance Office intelligence-gathering satellite.[9] What is most troubling is that these attacks are coming during a period of widespread use of GPS, satellite communications, and space-based imagery.

The Strategic Forces Subcommittee has received a number of briefings on the threats to US space systems over the past few years. As I mentioned

above, there is a spectrum of potential threat capabilities looming on the horizon to include electronic jamming, low-power laser blinding, high-energy lasers, microsatellites, direct-ascent ASATs, cyber attacks, physical attacks to ground stations, and possibly even a nuclear explosion. These threats can target satellites in orbit; their communications links to and from the ground; or their ground-based command, control, and receive stations. Our satellites are also vulnerable to other threats including space debris, close approaches, solar flares, and severe weather damaging ground stations. All produce the same general result—they render our space capabilities temporarily or permanently useless. Many of these antisatellite technologies exist today, and many are dual-use in nature, including a microsatellite that could be used as an experimental spacecraft or, with a simple command, could shadow or collide with another satellite.

Space is no longer a sanctuary. Those who wish to challenge America's role in the world increasingly recognize the strategic importance of space and are more willing to deny us freedom of action in space by employing a wide range of methods. The Pentagon's annual report to Congress on China's military power finds that "the direct ascent ASAT system is one component of a multi-dimensional program to generate the capability to deny others access to outer space."[10] I do not believe the threat we face is merely a question of technology; the question to ask is one of motive and intent. In the case of the Chinese, what motivated their ASAT test and why are we seeing them develop a comprehensive suite of counterspace capabilities?

To understand this we need to extend our understanding of threat capabilities and our vulnerabilities, as well as foreign actors' policies, doctrine, motives, and concepts of operations for use. Our nation must posture itself to defend its space capabilities, retain its leadership and technical advantage in space, and adapt our systems to meet and overcome the threat. These threat assessments influence our space architecture planning, acquisition programs, and operations concepts. If we presume it takes roughly 10 years to acquire a new satellite system and that satellite will be on-orbit for seven to 10 years, we place an onus on our intelligence community to predict the threat 10 to 20 years from today and our acquisition community to design satellites to perform in this threat environment 20 years from now.

Regrettably, much of our space intelligence analytical and collection capabilities have withered since the end of Cold War. As a member of the House Intelligence Committee, I see a resurgence in space intelligence, including the accession of talented young analysts. However, rebuilding

our nation's space intelligence capabilities takes time, resources, and commitment from leaders within the defense and intelligence communities. New analysts must be trained, decades of knowledge transferred from senior analysts, and new collection capabilities developed so that the nation is postured to understand, deter, mitigate, and respond to current and future threats to space.

Developing a Space Protection Strategy

As a national security space community, and as a nation, we have a vested stake in protecting our interests in space and developing a comprehensive space protection strategy. This includes both the need to protect our space systems and the need to preserve our assured use of space. The Chinese ASAT is but one striking example of why I believe this issue requires urgent attention.

Our satellite programs are often faced with size, weight, or power constraints, forcing designers and engineers to make trades, usually between performance and protection. For satellites with these constraints, adding a transponder or perhaps a secondary payload has been preferred to adding radiation hardening, fuel for maneuvering, or some other form of protection. However, as we see threats to the space domain come to fruition, we can no longer afford to ignore protection capabilities. This is not unprecedented. As antiaircraft capabilities and air defense systems matured, so too did our nation's aircraft survivability capabilities. These capabilities have matured over time, beginning with advanced research and development, modeling and simulation, and red teams, growing eventually into robust technical and operational capabilities and countermeasures. Today, these are all considered integral components of all aircraft development programs.

Based on my observations and discussions with senior military leaders, our nation currently lacks a comprehensive protection and survivability strategy for space—one that spans the defense and intelligence communities and addresses policy and strategy, architecture planning, system acquisition and requirements definition, science and technology development, and training and operations. Working with the new chairman of the Strategic Forces Subcommittee, Rep. Ellen Tauscher (D-CA), the House of Representatives has included a provision in the Fiscal Year 2008 National Defense Authorization Act which accords a priority to space protection and space situational awareness (SSA) capabilities: "It is the policy of the United States that the Secretary of Defense accord, after the date of enact-

ment of this Act, a greater priority within the Nation's space programs to the protection of national security space systems."[11] This provision further directs the Secretary of Defense to develop a comprehensive space protection strategy to include

- identification of threats and vulnerabilities to US space systems;
- description of protection capabilities contained in the program of record, including material and nonmaterial, and needed capabilities;
- assessment of gaps and shortfalls, investment plans, and how protection requirements are defined and incorporated into acquisition processes;
- description of how the Department of Defense (DoD) programs and budgets for protection capabilities; and
- description of how the DoD is organized and managed to address policy, planning, acquisition, and operations of protection-related systems and capabilities.[12]

The manner in which we protect and increase the survivability of our space capabilities spans a diverse spectrum of options. These include rapid replenishment, hardening, redundancy, distributed architectures, alternatives such as unmanned aerial vehicles, active prevention and denial, passive measures, reversible and nonreversible means, and nonmaterial solutions. Each of these solutions has its advantages and disadvantages, employment scenarios, and associated costs. In developing the protection strategy, it is my hope that the DoD will consider these factors.

A foundational component of space protection is space situational awareness. The DoD defines SSA as "the requisite current and predictive knowledge of the space environment and the operational environment upon which space operations depend—including physical, virtual, and human domains—as well as all factors, activities, and events of friendly and adversary space forces across the spectrum of conflict."[13] As we learned on 9/11, seemingly benign systems can have latent or concealed offensive capabilities. An object that appears to be orbital debris or a research satellite may, in fact, be an ASAT targeted at US or friendly assets. Likewise, noise in a data link may be accidental interference or intentional jamming. Unless we can detect and distinguish a hostile event from a malfunction or other benign effect and then attribute that hostile event to the right actor, we will be limited in our ability to mitigate and respond to attacks against our assets.

I do not believe we have invested sufficient resources in SSA to address the growing threat to space, and the defense bill attempts to address this by authorizing additional resources for SSA and protection efforts. The Air Force is starting to place greater emphasis on SSA, and the commander of Air Force Space Command has made it a top priority.

The House continues its support of ground-based radars and optical telescopes, which enable frequent detection and tracking of all objects in orbit. The House version of the defense bill includes additional resources for the development of the Space Fence—an upgraded ground-based radar "fence" that will enable us to detect and track very small objects, including space debris such as that ejected from the Chinese ASAT test. We also continue to support system development efforts such as the Rapid Attack Identification and Detection Reporting System to detect electronic jamming of communications and GPS satellites and the Space-Based Surveillance System—the low Earth orbiting system intended to detect small objects out to geosynchronous orbit. A relatively straightforward means of increasing SSA is to make each satellite its own sensor, able to monitor its own health and status and detect any anominal activity. I am pleased we were able to add resources for an Air Force unfunded priority in this area and some classified programs.

As I look forward, I also see a greater opportunity for sensors from other mission areas to contribute to the SSA mission. Missile defense assets, such as the ground- and sea-based tracking radars and the soon-to-launch Space Tracking and Surveillance System, when not on missile warning/missile defense alert, could be configured to support SSA missions. Furthermore, there is potential to leverage capabilities from our allies/friends as well as civil and commercial entities that could be brought to bear on the SSA mission.

SSA and all options for protecting our space interests must be examined and weighed as part of a comprehensive space protection strategy. This strategy should encompass the desired mix of active, passive, material, and nonmaterial capabilities; how these capabilities fit together; as well as our priorities for protection. I recognize we will not be able to protect, nor can we afford to protect, all systems to the same level. Therefore, risk management, informed by our knowledge of threats and vulnerabilities, should be our guide.

While the emphasis in the Strategic Forces Subcommittee has been on space protection efforts within the DoD, the intelligence community must also emphasize protection and analysis of its foreign counterspace capabilities or risk losing its vital space-based intelligence-collection systems. To be

successful in protecting our space assets and use of space, we need the defense and intelligence communities tightly coupled. The success of the DoD in executing its space defense mission is dependent on an accurate intelligence assessment and timely reporting of the threat. In addition, the protective measures used for a low Earth orbit intelligence-gathering satellite may be the same as those used to protect a weather or communications satellite. There is too much work, too few resources, and too much riding on these communities not to fully integrate efforts and minimize duplication.

Reexamining Our National Security Space Architecture

I believe the Chinese ASAT can also serve as a catalyst for reexamining our national security space architecture and planning our future capabilities in space beyond protection and SSA. We have an opportunity to take a hard look at what implications this incident might have on our nation's future space architecture, specifically the desired attributes of the architecture, composition of needed capabilities, and investment strategy.

One of the most common themes emerging from ongoing discussions on space threats is the desire to create a more distributed and robust space architecture with greater numbers of satellites, more frequent launches, and shorter development timelines. Others have discussed placing satellites in higher orbits, making them more difficult for antisatellite systems to reach. I encourage the exploration of concepts to fly intelligence and other traditionally lower-altitude satellites in higher orbits. There is great performance value, given sufficient science and technology development and systems engineering. These concepts may also buy time against some threats such as direct-ascent ASATs—at least until countries develop space launch systems that can reach higher orbits, which the Chinese already possess—and mitigate the effects of others like laser blinders, which would have insufficient energy to damage systems in higher orbits. Some key benefits of this thinking include a quicker ability to adapt to threats, greater ability to prove out and stay ahead in technology, and strengthening of the industrial base.

To capitalize on this thinking, we must first fix the problems plaguing our space acquisition programs leading to cost overruns, schedule delays, and technical challenges. Delays in critical space programs can have ripple effects on multiple other defensewide systems, such as the Future Combat

System, unmanned aerial vehicles, and missile defense, all of which depend on space. The importance of space requires that we be successful in our acquisitions and deliver on what is promised.

I am concerned that the current acquisition path we are on is unsustainable. Nearly all of our satellite programs are being recapitalized and modernized, placing great strain on the acquisition community and the space budget. We are seeing the symptoms of this strain in Nunn-McCurdy program acquisition breaches (e.g., the Space-Based Infrared System [SBIRS]-High and National Polar-orbiting Operational Environmental Satellite System), schedule delays to the GPS IIF and Advanced Extremely High Frequency (AEHF) satellite programs, and the program restructuring of the Transformational Communications Satellite System (TSAT) and Space Radar programs.

We in Congress recognize that we have tough defense budget choices ahead of us given costs associated with ongoing operations in Iraq, the global war on terrorism, and force reset and modernization. The President wants to eliminate the federal deficit in the next five years and impose greater spending discipline. The Air Force, the predominant provider of military space capabilities, spends roughly 11 percent of its budget on space even though space is one-third of its core missions—the other two being air and cyberspace. Without a significant increase to the space budget top line or realignment of recapitalization and modernization programs, the space portfolio will become unaffordable and unexecutable.

We must strike a balance between continuing with legacy systems and moving ahead with modernized systems. I support a measured approach that overlaps new acquisition programs with continuing legacy programs and one that avoids any drastic changes that could severely impact the delivery of war-fighter capability or affect the stability of the industrial base. This thinking is reflected in the House-passed defense bill, which curtails some new-start acquisition programs such as the Alternative Infrared Satellite System and the High Integrity GPS concept. We provide resources for an additional legacy AEHF satellite to mitigate any risk of a gap to our protected strategic communications and fully fund continuing technology and system development of TSAT. We are responsive to the war fighter's demand for orders of magnitude increases in communications and Internet-like connectivity across platforms and users.

I am particularly pleased we maintained funding for the Space Radar program. Space Radar, with its sophisticated synthetic aperture radar and moving target indicator sensors, will provide all-weather, day-night, 24-7

coverage of static and moving targets, greatly enhancing our intelligence, surveillance, and reconnaissance capabilities and protection of our armed forces. As William B. Scott and Linda H. Strine point out in a recent *Aviation Week and Space Technology* article, "Visionaries believe Space Radar will not only revolutionize the way military forces locate, track and target an enemy, but have as profound an impact on commerce and citizens' daily lives as GPS does" if applications such as ship tracking for business and homeland security and all-weather, around-the-clock imaging for marketing are realized.[14]

In case it is not yet obvious, I believe we need to quickly improve space acquisition. To do this, government and industry must increase confidence in cost estimating, mitigating risk, and quality control and improve systems engineering. Congress must do better to provide constant and reliable funding for these programs. The DoD must follow through on existing acquisition programs such as the SBIRS, Wideband Global SATCOM System, and GPS IIF to show us these can work. In short, we have all been part of the problem, and we all need to work together on the solution; for even the best war-fighter capability must be affordable and executable. The development and operations of national security space systems are too complex and costly for any one organization to go it alone; jointness and integration are critical. We must be mindful that there is one set of national needs.

I have hope for one solution in particular which, over multiple years, has the potential to revolutionize our nation's space architecture. Last year's defense bill established an Operationally Responsive Space (ORS) program office. ORS offers promise not only as a way to supplement a battlefield commander's capabilities, but also to quickly replace damaged or destroyed satellites to meet the immediate needs of the war fighter. This office brings together science and technology, acquisition, operations, and combatant-command support elements. With this effort, I see a stronger national security space portfolio in which ORS systems complement, not replace, large, traditional space programs.

For this office to be successful it must retain a strong, joint core, bringing together leaders and participants from across the military services, agencies, research labs, and industry. It must also create an environment that expects and rewards innovation. The strain of rising costs will continue to put pressure on our space and defense programs. At the same time, technologies are evolving at much higher rates than our current 10-year or longer acquisition timelines. ORS must first get simple, low-cost solutions

rapidly on orbit to meet the dynamic needs of our combatant commanders; and second, ORS must provide more frequent opportunities to prove out innovative concepts and technologies at a lower cost. This must be done while strengthening our industrial base and technical workforce.

In addition, ORS might also serve as a deterrent to nations pursuing programs to threaten our satellites. If we have numerous ORS systems in space along with more traditional military and intelligence satellites, then we can rapidly reconstitute our space assets. This makes it a lot harder for an adversary to effectively deny us freedom of action in space.

While ORS has much promise in getting us to a more numerous, distributed architecture in space, it is still a very nascent capability. We must give it time to mature; after all, we only have one ORS launch under our belts—TacSat 2. It will take time, investment in technology and system development, new thinking on employment and operating concepts, and the adaptation of government and industry to this new paradigm to make ORS successful and transition these successes to the rest of our space architecture.

The nucleus of our space acquisition efforts—our nation's space cadre—has weakened over time. We have seen a reduction in the number of trained, experienced government space acquisition, science and engineering, and program management professionals. Those remaining have become increasingly reliant on industry without having the wherewithal to provide experienced leadership or question technical findings. We need to break this pattern and foster a space cadre of smarter, more empowered professionals who know the technical, operational, and programmatic aspects of their acquisition programs.

I introduced an amendment that was accepted in this year's defense bill requiring the Secretary of Defense to submit a report to Congress on the management of the space cadre within the DoD. I commend efforts by the military departments to expand their space professional development activities, to include increased education and training opportunities, establishment of space-related specialty codes, and development of personnel databases. However, as noted in a September 2006 Government Accountability Office report, management actions are needed to better identify, track, and train Air Force space personnel. This is an issue broader than the Air Force. Without an assessment of space cadre requirements and the development and use of metrics, I believe it will be difficult to track progress in ensuring the DoD has sufficient numbers of personnel

with the expertise, training, experience, and leadership to meet current and future national security space needs.

Framing the Policy Debate

The Chinese ASAT test also rekindles the larger policy discussion of how we use space and how we best protect our interests in space, including our pursuit of potential defensive and offensive capabilities. This spectrum ranges from international organizational regimes, such as arms-control regimes that seek to prohibit or limit myriad systems that could threaten space assets, to "space weapons" such as space-based interceptors or orbiting weapons that reenter the atmosphere to strike land-based targets.

The recently released national space policy acknowledges the importance of space to our economy and national security and elevates space as a vital national interest. It further states that the United States will "take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests."[15] The policy does not indicate a preference for how space capabilities should be protected nor, contrary to some interpretations, does it indicate support for space weapons. It does provide for space to be used as a medium for multilayered and integrated missile defense capabilities.

The policy debate centers primarily on how we use space and whether it should be a matter of US policy to develop and deploy "weapons in space" as a means of protection. The difficulty with this proposition starts with our understanding of space weapons. A definition is elusive. If a space weapon is any weapons system capable of rendering a satellite temporarily or permanently useless, then it could target the satellite in orbit, its data link to the ground, or its ground-control station. Moreover, a space weapon could be land-, sea-, air-, or space-based and use kinetic energy (e.g., direct-ascent missile), directed energy (e.g., laser), other electromagnetic energy (e.g., jammer), or even nuclear energy to disable a satellite. If one believes this definition, then space is already "weaponized." The Cold War–era Soviet co-orbital ASAT and US F-15-launched ASAT would qualify, as would present-day GPS and SATCOM jamming and, surely, the Chinese ASAT test.

Some believe a space weapon is purely a weapons system based in space that collides with another space object or intercepts a missile traveling through

space. However, I would argue, the damage caused by a ground-based high-energy laser is just as severe for a target satellite as the damage caused by a physical on-orbit collision. The key difference is the latter may create an unacceptable debris field, posing further risks to other orbiting satellites.

It is the ambiguity in definition that makes arms-control measures which ban space weapons difficult to implement and nearly impossible to enforce. This is compounded by the fact that satellites have tremendous dual-use value, making it very difficult to distinguish a nonweapon space system from a weapon space system. Any satellite could be maneuvered in such a way as to collide with a target satellite. Any ballistic missile, with sufficient orbital ephemeris data and software changes, could be used to target a satellite.

Would a space weapon used purely for defensive purposes be acceptable? Assuming space-based interceptors were technically and fiscally feasible, would we hesitate deploying and using them to intercept an incoming ballistic missile armed with a nuclear payload? Though the US ballistic missile defense system has several land-, sea-, and air-based efforts under way to intercept incoming missiles, space provides unparalleled global coverage and access. What about the deployment of space-based interceptors to absorb or counter a potential ASAT strike against our multibillion-dollar intelligence or missile warning satellites? Though I acknowledge the complete undesirability of debris resulting from any kinetic collision, is the cost worth the benefit to all the users and missions reliant on the preservation of that space capability? Are there technologies or methods that could mitigate the creation of debris worth exploring?

It is my position to strongly support reversible means, such that any of our protection or denial capabilities do not cause permanent damage or create widespread orbital debris. However, I do believe it is our responsibility to provide for the strongest defense possible, including the defense of our space assets and the use of space to strengthen our national security. It is for this reason I see value in exploring space-based defensive concepts, including space-based interceptors, to inform the policy debate with sound technical and cost data, ample thought given to operating concepts, and thorough analyses of the policy and international ramifications.

Summary

In this article, I have described several elements of a comprehensive solution to one of our nation's most urgent security threats. Given our reliance upon

space assets and the nature of the growing threat against them, it is imperative that our nation develop a strategy to detect, deter, and respond to any space-threat contingency. This strategy must include careful consideration of methods and technologies to improve space survivability, new concepts of operation, improvements to space acquisition, and an investment in the people necessary to make this new strategy effective. Let me be clear, however: it is essential that we begin taking necessary steps now to reduce our strategic vulnerability and that we bring the full power of innovative thinking to bear on this problem.

Our economic and military prowess in, and reliance on, space is not so unique. To borrow two well-known examples, the ancient Romans with their extensive road infrastructure and the nineteenth century British with their command of the high seas both mastered a domain critical to commerce and military power and, as a result, held great sway in their world. However, the Romans proved vulnerable to dedicated competitors who took advantage of their roads to ease invasion, while the British saw their preeminence challenged by nations able to find and exploit vulnerabilities of the Royal Navy. Our nation finds itself in a similar position today with regards to space. We are the unquestioned global leaders in use of and access to space. The question is whether we will be able to adapt to new and emerging challenges and, in so doing, stay ahead of our competitors and overcome our vulnerabilities. SSQ

Notes

1. *Statement by Lieutenant General C. Robert Kehler, Deputy Commander, United States Strategic Command, before the Strategic Forces Subcommittee, House Armed Services Committee on Space and National Power*, 109th Cong., 2nd sess., 21 June 2006.

2. *Written Statement of David Cavossa, Executive Director, Satellite Industry Association (SIA), Hearing on "Space and US National Power" before the Committee on Armed Services Subcommittee on Strategic Forces, United States House of Representatives,* 109th Cong., 2nd sess., 21 June 2006.

3. House Committee on Armed Services, *National Defense Authorization Act for Fiscal Year 2007*, 109th Cong., 2nd sess., H. R. 109-452.

4. Craig Covault, "Space Control," *Aviation Week and Space Technology* 166, no. 4 (22 January 2007): 24–25.

5. *Statement of General James E. Cartwright, Commander, United States Strategic Command, before the Strategic Forces Subcommittee, House Armed Services Committee on United States Strategic Command*, 110th Cong., 1st sess., 8 March 2007.

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