Kevin McLaughlin

Would Space-Based Defenses Improve Security?

One could almost hear the gears shifting in the United States and around the world as President George W. Bush announced on December 13, 2001, that the United States would withdraw from the 1972 Anti-Ballistic Missile (ABM) Treaty on June 13, 2002. Although the formal announcement was not greatly surprising, it served notice that the United States was replacing its rhetoric regarding the deployment of missile defenses with action. The precise implications of withdrawal are still somewhat undefined, but the administration has indicated it plans to pursue an operational national missile defense system aggressively. Undoubtedly, historians will link Bush's legacy inextricably to the successes and failures in the ongoing global war on terrorism. Significant changes in the decades-long debate about national missile defense, however, will also define the first U.S. presidency of the twenty-first century. Accordingly, Bush and Secretary of Defense Donald Rumsfeld have indicated they will pursue a prominent role for space-based components in the U.S. missile defense program.

Given this near certainty, asking whether a move to use space in support of missile defenses will improve U.S. security and, if so, how is appropriate. A full understanding of the answers to these questions requires recognition of the ways space systems can contribute to the missile defense mission, as well as the strategic and operational benefits that space-based missile defense components could provide. This understanding addresses only one dimension, however, of whether such a move improves U.S. security. Determining the effects of deploying space-based missile defenses on today's geopolitical framework is also important. How will such a move affect strategic stability,

Lt. Col. Kevin McLaughlin is a National Defense Fellow at CSIS. He commanded the squadron that operates the U.S. Global Positioning System satellites and served as a staff member on the Rumsfeld Space Commission. The author's views do not necessarily represent the official position of the Department of Defense or the U.S. government.

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and how will the international community view these actions? Finally, has technology progressed to a stage that will make space-based missile defenses possible?

Ballistic Missiles Explained

The ballistic missile defense (BMD) mission is highly complex and requires the integrated use of air-, land-, sea-, and space-based systems. From the advent of the German V-2 ballistic missile in World War II to the latest intercontinental ballistic missiles (ICBMs), planners have tried to determine how they might defend their nations against the ballistic missile threat. When the October 4, 1957, launch of Sputnik I brought the world into the space age, analysts began to examine the possibilities of using space to support BMD requirements. During the past four decades, military officials have explored many space-based missile defense concepts but have deployed very few.

Although ICBMs are highly complex weapons, their basic operational philosophy is simple. A powerful, multistage rocket boosts a nuclear payload into a ballistic trajectory calculated to deliver the payload to a specific target location. All ICBMs have three well-defined phases of their mission—the boost phase, the midcourse phase, and the terminal phase.

- *Boost Phase.* The missile's rocket engines accelerate the payload to speeds of more than 15,000 miles per hour in this portion of the ICBM's mission. On a typical ICBM, the boost phase consists of the sequential firing of several separate stages that lasts for four to five minutes. The ICBM must attain extremely high speeds to allow the payload to reach targets on the other side of the world—targets that can be more than 6,000 miles from the launch site. The payload of the ICBM consists of three primary elements—nuclear warheads, decoys, and a postboost vehicle. The postboost vehicle is a small satellite that automatically functions like a high-tech taxicab for its deadly cargo of warheads and decoys, maneuvering to different points in space and dropping off each warhead and decoy at the exact speed and location required for the warhead to fall along the necessary trajectory to hit its target. Some modern ICBMs can carry as many as 10 independently targetable warheads. The boost phase is completed when the last booster stage stops firing and the booster separates from the payload.
- *Midcourse Phase*. Once the boost phase is completed, the warheads, decoys, and postboost vehicle begin the longest portion of the so-called midcourse mission, which can last up to 20 minutes. During this phase,

the postboost vehicle pirouettes through the darkness of space at speeds of more than four miles per second, dropping each warhead and decoy at their preplanned time, location, and velocity. If the postboost vehicle performs properly, the decoys will confuse BMD systems into believing that they are warheads while the real warheads will hit their intended targets.

- *Terminal Phase*. Finally, the terminal phase of the mission begins, during which the warheads reenter the earth's atmosphere and detonate in the vicinity of their target. The earth's atmosphere slows each warhead a great deal during the 30-second terminal phase; despite slowing, however, the warheads are still traveling at speeds in excess of one-half mile per second.

Functions of Space-Based Systems

Current U.S. BMD strategies aim to engage ballistic missiles in all phases described above. Developing a range of capabilities to intercept a missile in the boost phase, the midcourse phase, and the terminal phase of flight increases the chances that the BMD system will destroy the missile and its payload. Layering the defense throughout each phase will require sophisticated technology, however, much of which might be based in space.

Missile Warning. Space already plays a key role in fulfilling the missile-warning mission, which focuses on detecting and reporting an ICBM launch. Its primary purpose is providing the earliest possible warning and characterization of a nuclear attack on the United States, allowing the president and senior military commanders sufficient time to make appropriate decisions about the response. The United States requires this mission even without an operational missile defense system. Leaders can use the same warning needed to launch a nuclear counterstrike, however, to cue a missile defense system. Defense Support Program (DSP) satellites have performed the missile-warning mission for more than three decades. DSP satellites, orbiting 22,500 miles above the earth, use infrared detectors to see the hot missile plumes from the ICBM's booster motors and can quickly determine the location of the launch, the type of missile, and the direction in which it is headed. Unfortunately, the aging DSP satellites can detect and characterize the missiles only during the four-to-five-minute boost phase.

During the next decade, a much more sophisticated satellite system called the Space-Based Infrared System (SBIRS) will replace the aging DSP satellites. This system will have two responsibilities critical to the BMD mission: assuming responsibility over the missile-warning mission and tracking objects during the midcourse phase, which is a brand new mission focused solely on BMD.

Midcourse Tracking. SBIRS will be able to track objects during the midcourse phase, thereby eliminating a potential blind spot for any U.S. BMD systems. In this role, SBIRS will be able to observe, track, characterize, and report on postboost vehicle maneuvers, nuclear warhead deployments, and the use of various types of decoys from launches to anywhere in the world. This last capability is vital because SBIRS's sophisticated sensors will be able to discriminate rapidly between real warheads and decoys as well as provide targeting data to interceptors based on the earth, in the air, or in space. The operational advantages of such a capability are obvious. Any midcourse or terminal-phase interceptor system must receive the necessary targeting information quickly to maximize opportunities to intercept the numerous warheads associated with the launch of even a few ICBMs. Ideally, SBIRS will ensure that intercept opportunities are not wasted on any decoys flying alongside the actual warheads. Without this capability, BMD interceptors will not react quickly or accurately enough to destroy incoming warheads effectively.

No space-based boost-phase intercept system has been operationally tested or deployed.

Communications. Any modern BMD system will have a very sophisticated battle management/command, control, and communications capability. For the United States, this activity will ensure that all elements of the system are properly integrated and interoperable with external systems, including those of U.S. allies. The backbone of this capability will be the system-wide communication links that allow all components to exchange data and enable transmission of command and control orders to weapons and sensors. Operating as part of a larger communications architecture, the critical connectivity required for this mission will necessitate communications satellites and dedicated communication channels.

Boost-Phase Intercept. The ability to destroy ICBMs during their boost phase is the most difficult and controversial of all BMD missions envisioned for space systems. Boost-Phase Intercept (BPI) has tremendous operational advantages over midcourse or terminal interceptors, perhaps the most significant advantage being the ability to destroy the ICBM at its most vulnerable point and before it has deployed its deadly mix of warheads and decoys. In addition, destruction of the ICBM over the launching state's territory confines any associated hazardous debris within a relatively small area.

Many space-based BPI concepts exist on paper, but no system has ever been operationally tested or deployed. Officials have explored various technologies during the years, include particle beams, lasers, and kinetic-energy

weapons. The Bush administration's Missile Defense BPI program for fiscal year 2003 will focus on research and development for two space concepts—a chemically fueled space laser and a space-based kinetic-energy interceptor. An effective space-laser BPI system would destroy ICBM boosters with a laser beam, traveling at a velocity of 186,000 miles per second. This feature is attractive when the target is accelerating to speeds of four miles per second, because the system has more time to respond. Space-based kinetic-energy interceptors accomplish their mission by physically colliding with the warhead, which many have described as "hitting a bullet with a bullet." This system type must detect and confirm the threat missile within a few seconds of launch or the interceptor will not catch a fast-moving ICBM that has a head start.

Launcher Attack Operations. Officials could conduct another potential missile defense mission—launcher attack operations—from space, even though the Department of Defense does not technically define this mission as a missile defense program. Launcher attack operations would preemptively attack launch silos or mobile ICBM transporter erector launchers (TELs) before ICBM launch. This mission, especially when employed against mobile missiles, might require the combined efforts of two space capabilities. The first would be a global space-based radar system that could detect and track mobile missiles as they departed their home bases for their operational deployment areas. This system would close a gap in current U.S. capability: the inability to track mobile missiles continuously. The second space capability needed to support this concept would be a space-to-earth weapon capable of destroying an ICBM silo or a TEL.

New Geopolitical Constructs for Space Contributions

In discussions of how space is or could be used to meet BMD requirements, one must also examine the effect of such moves on strategic stability and the international community. To understand if using space in support of missile defenses can enhance or weaken U.S. national security, one must consider the environment that has shaped the debate on this important but poorly understood topic. Since the dawn of the missile age, analysts dealing with international and security policies have argued about the proper role space should play in programs designed to defend the United States from ballistic missile attack.

From these concepts flowed a calculus that produced a family of interlocking ideas such as nuclear deterrence, mutual assured destruction, and mutual vulnerability that guided the United States through the Cold War. During this era, the ABM Treaty and U.S. policy constrained any serious at-

tempts to utilize space in ways deemed destabilizing. In particular, both the treaty and U.S. policy prohibited using space-based weapons for any purpose—missile defense or otherwise. Other space capabilities that could be directly tied into BMD architectures also caused concern. For example, strategic analysts viewed a missile-warning satellite as a stabilizing factor if it provided enough warning for U.S. decisionmakers to launch retaliatory nuclear strikes and preserved the concept of mutual assured destruction. The missile-warning satellite might also enhance the effectiveness of missile defenses, however, and some analysts viewed that possibility as a destabilizing influence because it would reduce U.S. vulnerability. Within this framework, the national security community carved out mature policy positions on how space and missile defense affected nuclear stability, arms control, force structure, and other important aspects of defense policy.

Actions should be taken only after consultation and negotiation with friends and allies.

The dawn of the twenty-first century has turned this issue on its head. Revolutionary advances in the use of space to support nonstrategic and nonmissile defense missions have led to calls for the normalization of space in support of U.S. objectives. Recent high-level studies, such as the one authored by the Commission to Assess U.S. National Security Space Management and Organization, chaired by Rumsfeld, have described space as a vital national interest that the United States must protect and use to support U.S. national interests. International perceptions and reactions are evolving in ways that the United States may not fully recognize or acknowledge, particularly as European and Asian nations move to deploy satellites that will support their security needs. The European Galileo navigation satellite is a key example of a satellite system that will likely revolutionize the manner in which European nations use space to meet national security requirements. The French Ministry of Defense is also interested in developing a space-based system to provide early warning of ballistic missile attacks. These facts suggest that strategic analysts and policymakers should strive to understand these new dynamics fully and resist efforts to use old and outdated methods to solve new problems. Unfortunately, entire bureaucracies and constituencies have evolved on all sides of the debate, and adjusting to the realities of how the world has changed around them is often difficult.

The nation's best thinkers, strategists, and planners must intellectually engage these changes to allow a full and proper debate on the issue. In other words, the time has come for the Cold Warriors and arms controllers to surrender their old guards. Without this transition in the intellectual and aca-

demic approach to the problem, characterizing the new environment accurately or developing a new calculus for analyzing current strategic issues, including those associated with integrating space capabilities into U.S. ballistic missile defenses, will not be possible.

Effects of U.S. Dominance

No examination of this topic is adequate without a short discussion of how new geopolitical realities mandate a new approach. First, the United States occupies a predominant position in the new millennium—economically, technologically, and militarily—relative to all other countries. The U.S. dollar is the benchmark currency in a world that increasingly uses English as the global language. To define this new reality, French foreign minister Hubert Védrine has labeled the United States a "hyperpower."[1] Although his use of the term is not complimentary, the term does reflect the perception and, in many ways, the reality of the current global dominance of the United States.

The level of U.S. dominance gives rise to some predictable and some unanticipated results. Europe, driven primarily by French and German concerns, will strive mightily to forge a common European identity that might be capable of keeping U.S. power in check and will work to maintain a strong role for Europe in global affairs. Russia and China will continue to use their limited resources in broad efforts to reduce the relative imbalance between their national power and that of the United States. Other countries and regions may also act in ways designed to counteract U.S. strength. These possibilities are not new ideas; commentators have extensively written about them. No one has given much thought, however, to how this new reality shapes the potential effect that more extensive use of space may have on strategic stability.

The current geopolitical landscape is a multilateral maze of unequal partners, increasingly proliferated technology (including the technology needed to develop and deliver weapons of mass destruction [WMD]), and a suddenly unsatisfying U.S. stance on deterrence and vulnerability.[2] U.S. and Russian nuclear stockpiles are moving toward their lowest levels in decades, and the risk of a massive Russian nuclear strike on the United States is no longer a primary concern. In this new environment, the nation's deterrent forces do not counter the threats that give rise to its greatest concerns. The strategic vulnerability that perversely formed the basis of U.S. security during the Cold War has become a glaring weakness and perhaps an invitation to those who might harm the United States. In this context, developing and fielding capabilities that reduce U.S. vulnerability and deter the most dangerous threats apparently best enhance U.S. security and strategic stability.

Missile defenses are one of the areas that could potentially reduce U.S. vulnerability, and officials should carefully examine the use of space to its fullest extent.

Observers have not yet fully understood or analyzed another possible reality. The current striking disparity between the United States and all other countries in economic, technological, and military endeavors places extreme limits on most countries' abilities to respond meaningfully. Old concerns that U.S. advances in missile defense or space would spawn undesirable arms races may no longer be valid.[3] For example, the United States is the only nation capable of implementing and sustaining decisive military force on a global basis. The war in Afghanistan provided a snapshot of this ability. The nation's development and use of many capabilities—modern airpower; long-range precision weapons; command, control, and communications and intelligence; and highly skilled soldiers, sailors, marines, and airmen—have drastically outpaced all other countries. No other country could carry out the mission that the United States is executing in Afghanistan. Any other country or alliance, such as the proposed 60,000-person European Rapid Reaction Force, performing a similar mission in the near term or in the midterm is equally doubtful. Even more significantly, in the current global war on terrorism, the United States is working to increase the scope of its capabilities to operate simultaneously in several spots around the world.

The U.S. should place missile defense cooperation high on the political agenda with Russia.

Primarily, U.S. wealth, global responsibilities, and national security needs drive this reality. The administration's FY 2003 defense budget request of $379 billion is more than six times larger than that of Russia, the second-largest spender, and more than the combined spending of the next 25 nations.[4] This disparity creates its own dynamic with unique qualities, one of which may be the elimination of the incentive for many nations even to try to compete, decreasing the likelihood that U.S. developments will face traditional countermeasures. For example, the B-2 stealth bomber provides the United States with an unchallenged military capability that other nations would have viewed as destabilizing only a few years ago. The airplane can fly anywhere in the world undetected and can attack targets through defenses that officials previously thought were impenetrable. Yet, this revolutionary capability has not given rise to a race to build stealth bombers, nor has it resulted in a huge defensive investment by the Chinese, the Russians, or the Europeans to develop technology to counter it. Other nations have not cried out in indignation—an indication that the

United States can use such overwhelming capabilities without threatening the world's strategic stability.

Other than the B-2, any number of U.S. technological advances, such as unmanned combat air vehicles (UCAVs), information dominance capabilities, and the previously mentioned SBIRS system, serve as examples of advanced U.S. warfighting capabilities revolutionizing the nation's military capabilities and further increasing the disparity between the United States and the rest of the world, but that have not seemed to produce arms races or other traditional responses. For these reasons, U.S. development of space-based missile defenses will arguably contribute to U.S. security and possibly in a way neither destabilizing nor likely to spawn an arms race in space.

Growing Use of Space in Pursuit of U.S. National Objectives

Space capabilities, beyond those contributing to missile defenses, are becoming central to the pursuit of broader U.S. national objectives. In early January 2001, the Rumsfeld Space Commission provided the clearest statements to date of this new reality. The bipartisan commission "unanimously concluded that the security and well-being of the United States, its allies, and friends depend on the nation's ability to operate in space" and that the U.S. national interest lies in taking the following steps:

- promoting the peaceful use of space;
- using the nation's potential achievements in space to support its domestic, economic, diplomatic, and national security objectives; and
- developing and deploying the means to deter and defend against hostile acts directed at U.S. space assets and against uses of space that are hostile to U.S. interests.[5]

The Space Commission recognized space as simply a place where nations conduct business, no different than air, land, or sea. Following this logic, space possesses no qualities that imply special moral or ethical connotations but is simply a physical domain with its own physical properties. Those who operate in space must act in an ethical, moral, and legal manner—no different than the requirement nations have for operating in other domains. Accordingly, the United States should use space to underpin a broader strategy aimed at exercising U.S. economic, military, and technological leadership.

This concept is most evident regarding the use of space to support air, land, and sea operations conducted in the course of traditional military contingencies. Since the Persian Gulf War in 1991, military planners have revolutionized the use of space to support conventional military operations. Recent conflicts in Bosnia, Kosovo, and Afghanistan have matured U.S.

concepts to the point where space systems are now woven into the fabric of modern U.S. military operations. The Space Commission summarized:

> Today, information gathered from and transmitted through space is an integral component of American military strategy and operations. Space-based capabilities enable military forces to be warned of missile attacks; to communicate instantaneously; to obtain near real-time information that can be transmitted rapidly from satellite to attack platform; to navigate to a conflict area while avoiding hostile defenses along the way; and to identify and strike targets from air, land, or sea with precise and devastating effect. This permits U.S. leaders to manage even distant crises with fewer forces because those forces can respond quickly and operate effectively over longer ranges. Because of space capabilities, the [United States] is better able to sustain and extend deterrence to its allies and friends in our highly complex international environment. Space is not simply a place from which information is acquired and transmitted or through which objects pass. It is a medium much the same as air, land, or sea. In the coming period, the [United States] will conduct operations to, from, in, and through space in support of its national interests both on earth and in space. As with national capabilities in the air, on land, and at sea, the [United States] must have the capabilities to defend its space assets against hostile acts and to negate the hostile use of space against U.S. interests.[6]

How does this thinking affect the possible use of space to support U.S. missile defense activities? One barrier to using space to support missile defenses has been the belief that the United States should not use space to provide overwhelming U.S. advantage or in any way contribute to a strategic imbalance between the United States and other great powers. Nonetheless, the above paragraphs indicate that the United States quietly crossed this space threshold at the end of the last century in ways that did not pertain to missile defense. The United States now leverages satellites to fight battles in ways that overwhelm adversaries. Our satellites allow field commanders to see the entire battlefield, communicate globally and instantaneously, attack targets precisely, avoid threats, and warn of aggression in ways that no other nation in the world can match. Arguing that space already affords the United States an overwhelming military advantage is no overstatement.

Defense requirements that do not involve missiles may drive the development of the first weapons to operate from space. U.S. military planners have increasingly stressed requirements for engaging global targets with conventional weapons within a few minutes or a few hours of target identification. This requirement may drive the necessity for power projection through and from space, which U.S. forces could accomplish with almost no delay. Such a capability would arguably provide the United States with a much stronger deterrent and, in a conflict, an extraordinary military advantage. Effective nonnuclear deterrent concepts could also create a safer and more stable

strategic environment by potentially reducing reliance on nuclear weapons. Finally, if the United States fields these capabilities in support of nonmissile defense requirements, the absence of a precedent in developing defenses that operate in, from, or through space will no longer constrain missile defense planners and policymakers.

International Perceptions and Reactions

In today's globalized society, the United States must balance its security needs with the implications of U.S. actions on the international community. Despite the changing geopolitical environment, the United States should act only after careful consultation and negotiation with its friends and allies. Earnest consultations do not guarantee agreement, however, and the United States may have to act unilaterally to protect its interests. Such actions may animate other nations to conclude that the United States is too powerful and must be opposed at every level to reduce the level of U.S. dominance in a particular domain. In particular, the idea of using space in support of U.S. missile defense capabilities will quite likely meet with skepticism and disagreement abroad. How can the United States, then, pursue its own interests in a manner that might engender support or at least bring about neutral reactions on the part of others?

> Space possesses no qualities that imply special moral or ethical connotations.

First, the United States must try to understand the motivations of those who would be and are concerned about U.S. activities in this area. This exercise is important if U.S. planners and policymakers want to minimize any adverse effects of U.S. pursuits on the international community, including the following actors:

- *Europe.* Characterizing the European position on this issue is difficult because the views differ from country to country. Some European nations fundamentally and philosophically oppose missile defenses and any efforts to militarize the realm of space further. Others fully embrace the concept of leveraging space capabilities in support of national security needs, including those associated with missile defense. Despite these differences, making some general observations about the core group of European countries that typically cooperate on European defense and space policy—France, Germany, Italy, and Great Britain—is possible. Concerns about economic, industrial, and technological competition seem to dominate these nations' views of U.S. military space programs. Current dis-

parities between U.S. and European investment in defense and space capabilities drive a perception, which the French articulate most often, that these disparities are a threat to Europe. Europe will likely resist any effort to field missile defense capabilities in a manner that does not include a strong role for itself and the likelihood of sharing technology with the United States.

- *Russia.* The Russians have a long-standing and mature understanding regarding the use of space in support of their national interests, including military and missile defense missions. Like the United States, the Soviet Union of the Cold War viewed a broad-based space program as a political statement of the superiority of Soviet technical know-how and capability. Their national effort included an advanced military space program with interests in space weapons, antisatellite systems, and missile defense. Since the collapse of the Soviet Union, the Russian economy has forced the Russian government to reduce the scope of many of its activities, including its national space program, drastically. This cutback has pressured the Russian government to consolidate its space efforts around its most important core capabilities while striving to preserve the perception within the international community that it remains a preeminent space power. Russia resists U.S. plans to deploy a layered missile defense, especially one that heavily leverages space capabilities, because they would highlight glaring weaknesses in the Russian ability to fund and deploy equivalent systems. In addition, such steps would provide ammunition to Russian conservatives who would try and cast U.S. missile defense plans as threats to the effectiveness of the Russian nuclear deterrent force. If successful, such arguments could cause Russia to pursue nuclear modernization programs aggressively and to reject U.S. calls for further cuts in strategic nuclear warheads.

> The U.S. quietly crossed the space threshold at the end of the last century.

- *China.* China also has deep misgivings about U.S. missile defense plans, but its concerns are different from Europe's and Russia's problems. No country has ever perceived China as a premier economic, military, or technological power. Its limited nuclear deterrent capability is one of its most valued military capabilities, however, especially as a balance to U.S. capabilities and interests in East Asia. China's national potential and ambitions all point toward a desire to challenge the United States as a strategic power in the first half of the twenty-first century. Increases in China's strategic, conventional, and space military investments, as well as

a determined effort to enlarge its economy, are evidence of these ambitions. China also recognizes the current U.S. advantages made possible by the integration of space throughout the U.S. economy and national security sector. The Chinese have openly discussed the need in any war with the United States to attack U.S. space capabilities using asymmetric methods, including antisatellite weapons. Within this environment, China objects to U.S. missile defense plans and the use of space to support those plans. Such U.S. efforts throw the viability of the Chinese nuclear force into question and create political pressures for the Chinese to respond in a manner that appears to counterbalance new U.S. capabilities and in ways that other nations might find destabilizing.

U.S. International Strategy

As the United States refines its missile defense plans, it must work equally hard to craft an effective international strategy that accounts for the international perceptions and concerns discussed above. This strategy, tailored for each nation or region, will establish the best possible conditions for friends and allies to support U.S. actions in this area.

The United States could take the key step of leveraging the global war on terrorism to create the political imperative for protecting itself and its allies against the threat of WMD attacks by extending missile defense concepts to the nation's friends and allies. The United States must make the offer in a manner that all nations involved view as fair and equitable. During a recent trip to Europe, I had an opportunity to speak with various European defense officials, who indicated a strong interest to join the United States on missile defense activities, including those involving space aspects of missile defense. They desire a true partnership, however, as opposed to performing as a sort of U.S. "subcontractor." This position obviously raises difficult technology transfer, industrial base, and proliferation issues, which are worth resolving in order to broaden international involvement and spread the cost burden of expensive missile defense architecture.

In addition, the United States should place cooperation with Russia on missile defense high on the political agenda. Such cooperation could take the form of exchanges of personnel and data, common architectural development, common research and development programs, or even common development programs. A primary goal of these efforts would be providing transparency in U.S. plans and deployments to reduce Russian fears and anxieties that U.S. activities threaten Russian security.

Given the state of current relations between the United States and China, envisioning any U.S. international missile defense strategy that includes a heavy dose of cooperation with China is difficult. Nevertheless, not

pursuing a dialogue with the Chinese leadership to clarify U.S. intentions and reduce China's fears that U.S. activities threaten its interests would be a mistake. In this relationship, advances in areas such as human rights discussions, the deepening of economic ties, and cultural exchanges may establish conditions for improved long-term U.S.-Sino relations. Defense cooperation, including space and missile defense, might be possible once the overall relationship matures and improves.

Technological Feasibility

No discussion of this topic is complete without addressing the technical feasibility of the various space concepts in support of missile defense. Obviously, some space systems, such as missile-warning and communications systems, are proven technologies. The SBIRS program and a space-radar system for tracking moving targets are probably within the technological grasp of the United States. Although these programs are approaching state of the art in many areas, most experts agree that their development and deployment will most likely be successful. The technical feasibility of the space laser and the space-based kinetic-energy interceptor is an open question. These spacecraft present difficult technological challenges and perhaps even more difficult problems for battle management and command, control, and communications. The Bush administration evidently recognizes the difficulty associated with space-based BPI concepts and is pursuing technical risk reduction and technology demonstrator programs for both concepts. In summary, most space-based elements for missile defense are within the country's technological grasp, but some will require a few more years of focused research and development before officials can provide any accurate assessment.

Conclusion

The world is changing at an ever-increasing rate. The global war against both terrorism and WMD, the emergence of a consolidated European political entity, instability in the Middle East and in much of the Muslim world, and an uncertain global economy are just a few of the forces transforming the geopolitical landscape. Amid this backdrop, the Bush administration is poised to pursue little by little a missile defense program that will feature a role for space-based components. Even though space systems can clearly help satisfy missile defense mission requirements, fewer people agree that such a move will improve U.S. security. Yet, the radically new geopolitical framework, new threats to U.S. security, new concepts for deterrence, and

the important role space can play in satisfying larger U.S. interests underpin my assessment that space systems used in support of the missile defense mission could improve U.S. national security. The United States must balance its security needs with the implications of its actions on the international community and should deploy missile defenses only after careful consultation and negotiation with U.S. friends and allies. Although such consultations do not guarantee agreement, they increase the likelihood that many in the international community will at least understand U.S. efforts and at best support them.

Notes

1. Hubert Védrine, *France in an Age of Globalization* (Washington, D.C.: Brookings Institution Press, 2001).
2. Therese Delpech, "Ballistic Missile Defense and Strategic Stability" (presentation at the forum on The Missile Threat and Plans for Ballistic Missiles Defense: Technology, Strategic Stability, and Impact on Global Security, Rome, Italy, January 2001), pp. 55–56.
3. See Keith B. Payne, "Action-Reaction Metaphysics and Negligence," *The Washington Quarterly* 24, no. 4 (autumn 2001): 109–121.
4. Center for Defense Information, "World Military Expenditures: The U.S. vs. the World," http://www.cdi.org/issues/wme/ (accessed April 10, 2002).
5. Executive summary to the Report of the Commission to Assess U.S. National Security Space Management and Organization, Washington D.C., January 11, 2001, p. 7.
6. Report of the Commission to Assess U.S. National Security Space Management and Organization, Washington D.C., January 11, 2001, ch. 2, p. 13.