Leveraging Space to Improve Missile Defense

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President George W. Bush's National Space Policy received a flurry of attention in the trade press in October 2006, but interest waned quickly because, in the end, the new policy is a fairly inconsequential document.[1] Truth is, policies come to life through programs and budgets. Words unsupported by money or deeds are, well, just words. That said, there was goodness in the policy's publication. It reminded us of the realities and potentialities of combat on the edge of Earth. It also caused us to once again consider ways space may be used to enhance traditional military missions.

There are three combat mission areas in particular that could benefit significantly from a more thoroughgoing exploitation of space—space control, offensive strike, and missile defense. I will focus on the latter. Adding a space-based layer of hit-to-kill interceptors to enhance the performance of the newly deployed United States ballistic missile defense system could offer numerous military and diplomatic advantages. Highly effective defenses against ballistic missiles carrying nuclear or other weapons of mass destruction would offer a great pay-off over the long-term when one takes into account threat and national vulnerability to catastrophic attack.[2]

Ballistic Missile Threat

The ballistic missile threat to the US, its deployed forces, and allies and friends was defined and analyzed comprehensively in 1998 by a respected bipartisan commission.[3] The commissioners reaffirmed that foreign governments, some of whose leaders have hostile intentions toward the US and its allies, seek ballistic missiles in order to confront tactically superior US conventional military forces or build up an inventory of terror weapons.

The US has been incrementally fielding point defenses to defend populations and military assets from short- to medium-range ballistic missiles and demonstrated the progress made with this capability in Operation Iraqi Freedom, when Patriot batteries intercepted all threatening short-range ballistic missiles launched by Iraqi forces. Until fall 2004, when the US fielded limited defensive capabilities, the country was completely vulnerable to a long-range ballistic missile strike. Without such protection the citizens were exposed to sudden attacks from above and the government exposed to foreign strategies involving coercion, intimidation, and deterrence. The summer of 2006 crisis in Lebanon, when Hezbollah forces relentlessly bombarded Israel's northern territory with more than 4,000 projectiles, illustrated that states and non-state actors are willing to use missiles and rockets to produce terror and further political aims.

The adversaries of the US are looking hard at ballistic missiles because they represent a challenging threat. An intercontinental ballistic missile (ICBM) can travel at extremely high speeds—at times more than 15,000 mph. Kinetic energy interceptors collide with targets in space thousands of miles away at closing speeds that can exceed 25,000 mph. Besides hurling very small objects through air and space at very high speeds, ballistic missiles can be launched from anywhere at any time from multiple directions, to anywhere on the globe. Adding to this challenge, we can expect adversaries to employ countermeasures to foil missile defense calculations and disrupt system operations.

With intercontinental flight times measured in minutes, ballistic missiles are the surest and fastest way to destroy a distant city or military asset. They can give a state regional or even global prestige and are a potentially significant military weapon and tool of terror, especially if those missiles are married to weapons of mass destruction. Longer-range systems would give hostile rogue states a capability to vault over the oceans to strike American cities and blackmail US leaders.

In the future, we may face adversaries unknown to us today, fight in unexpected regions, or have to defend against new types of ballistic missiles and countermeasures. The significance of this uncertainty for missile defense planners is enormous. This means that we cannot be totally focused on "who" poses the threat today because the "who" can change with a political decision or by a surprise shift in capabilities from one region to another. Similarly, a focus on the "how" does not mean we can ignore today's enemies or their present-day capabilities. On the contrary, today's ballistic missile threats continue to drive our Nation's near-term missile defense fielding and long-term development efforts. Today's threats provide "ground truth," a measure of what is possible today and, therefore, a low-end representation of what we must be prepared to defeat tomorrow. The "high end" represents ballistic missile threats that today are either unrealized or unknown but yet are possible to develop.

There has been steady interest and investment of scarce resources by some 20 to 30 countries in acquiring ballistic missiles and improving payload destructive power, warhead accuracy, and delivery range. Turnkey missile systems have been transferred from one state to another and may one day be purchased by terrorists. So why must we pay attention? Because a missile strike involving nuclear, biological, or chemical weapons could wreak catastrophic damage, far surpassing the levels of destruction, economic dislocation, and terror produced by the 11 September 2001 attacks.

The international web of trading relationships in ballistic missiles and related technologies is extensive. Short-range ballistic missile systems are plentiful and available for sale on the international black market. Equally worrisome is the heightened interest in longer-range systems. For example, North Korea is developing an improved performance intermediate-range ballistic missile that can travel about 3,200 km. North Korea also has an intense development program to produce an ICBM. The

Taepo Dong-2 ICBM may have a two-stage variant (and travel around 10,000 km) and a three-stage variant (15,000 km). The 4 July 2006 test of the Taepo Dong-2 failed moments after lift-off, demonstrating that the North Koreans have more work to do. There is every indication, however, they will continue to strive for a viable long-range strike capability in addition to producing and selling shorter-range systems that may be used to threaten its neighbors, such as Japan.

Iran also has a significant ballistic missile development program. Besides its numerous short-range systems, Iran is developing a medium-range ballistic missile (Shahab-3) based on North Korean No Dong technology. In its quest for longer reach, Iran is developing an extended range Shahab-3 (which can travel 1,300 km and threaten Israel) and a new medium-range system (which may travel 2,000 km and reach into portions of Europe). In November 2006, Iran showcased on television several ballistic missile launches, to include the Shahab-3, demonstrating for the world the importance Tehran places on its ballistic missile development program. Iran is believed to be working on intercontinental range ballistic missiles, which may be in its arsenal by 2015, that is if it does not import longer-range systems from proliferators like North Korea earlier than that.

Countries like China and Russia have done considerable work on ballistic missile and countermeasure technologies.[4] Having developed and deployed advanced ballistic missiles of all ranges and done extensive research on nuclear weapons, we are rightfully concerned, not only about the tremendous and devastating offensive potential of these foreign ballistic missile forces, but also about the willingness of these two governments to proliferate ballistic missile technologies abroad and sell their expertise to other countries.

In other words, there are significant technological and political uncertainties to weigh as we consider how to proceed with the development of US missile defenses. How China and Russia will play in the use and proliferation of ballistic missiles is no small part of this consideration. How will our adversaries fight today and tomorrow and with what capabilities? How can we technologically and operationally defend ourselves against an array of ballistic missile threats? The truth is, we cannot know for certain, so we must be ready for many contingencies.

How Space Can Help

Are we attempting the impossible? I believe highly-effective defenses against future ballistic missile threats will be a challenge to develop, but not impossible, especially if we find the political will to focus on the best ways to leverage the space environment to accomplish this mission.

With several successful hit-to-kill intercept tests in the bag and the proven combat performance of short-range land-based defenses, we have shown that we can "hit-a-bullet-with-a-bullet." We also have made great strides in component miniaturization and advances in materials, and over the past twenty years have improved performance in interceptors, sensors, and battle management. This technological progress is key to considering whether the operation of space-based interceptors is feasible, effective (as part of the overall US missile defense system), and affordable.

Yet progress in fielding the overall missile defense system has been slow. In part we can blame this on the technically challenging nature of the mission. Political disagreements over the years have also hampered progress. The Anti-Ballistic Missile Treaty of 1972 stood in the way of developing a fully integrated, layered system to defeat missiles of all ranges. This treaty forbade different basing modes for missile defense, including basing interceptors in space. After more than three decades of living within these legal constraints and living with homeland vulnerability, the United States withdrew from that treaty in June 2002 in order to strengthen homeland defense.

Today we are considering new sensor and interceptor basing modes at sea, in the air, and in space as part of a layered defense concept. The initial layered ballistic missile defense system fielded by the Bush administration will not at first be capable of addressing all missile threats. But at least something is out there in the field and available for emergency use today. The current system can address a portion of the threat spectrum, and we can enhance, augment, and upgrade that capability by building on it incrementally over time. It is better to field some capability, no matter how limited, than to have no capability at all in the face of a growing threat. The system's readiness during the July 2006 North Korea missile launches and the confidence this gave our leaders demonstrated the prudence of the "field-what-we-can-now-and-improve-it-as-we-go" approach. So how can world-circling missile defense assets improve what we have?

Flexibility

Today we have an aggressive missile defense development program to look at future basing possibilities for sensors and weapons as part of a layered defense concept. Weapons and sensors at sea, in the air, and in space would enlarge the engagement battle space and make it harder for an enemy to outflank the missile defense system. More platforms means greater flexibility and improved system robustness. Currently, the US has fixed sites at Fort Greely, Alaska and Vandenberg AFB, California for its long-range interceptors. There are also fixed sensors in Alaska, California, and the United Kingdom. These sites are optimized to defend against a limited threat posed by North Korea and Iran. But what if the threat country shifts and "out-flanks" this operational geometry?

Optimal orbits for engaging missiles from space would depend on the satellites' inclinations, which bound the orbital engagement zone between latitudes north and south of the equator at similar distances. With weapons on-orbit, missile defenders would have a capability to engage intercontinental- to medium-range ballistic missiles launched from any region within that zone. Intercepts in the boost and midcourse of that missile's flight could be possible. Essential work to demonstrate the feasibility of critical space-based interceptor functions has already been done (as part of the Brilliant Pebbles development program in the 1980s and early 1990s). The Missile Defense Agency (MDA), should it receive the support of the administration and Congress, could continue development efforts to perfect command and control of space-based assets and long-term storage of propellant, among other things.

The important point here is that, all at once, a space-based layer of weapons gives the current missile defense system a true global engagement capability. Without space, the only way to

Midcourse Space Experiment (MSX) satellite launched from Vandenberg AFB, California on 24 April 1996. The MSX satellite is used by the Missile Defense Agency to characterize ballistic missile signatures during the midcourse phase of missile flight against a variety of backgrounds.

deal with threat uncertainty is to populate the world with fixed and mobile sensors and radars (on ground and at sea). As you might imagine, the cost of doing so would be prohibitive, and would probably not be politically sustainable.

Without a space-based layer, missile defenses would continue to require numerous bilateral and multilateral agreements with our allies and friends to host various missile defense assets. And there would continue to be a risk that these assets would not be properly positioned to defend against a particular threat. Space-based interceptors introduce flexibility and a near-global coverage capability into the system, they can offer a very cost-effective and, from one perspective, politically-efficient option for dealing with an uncertain and evolving threat.

Boost Defense—"Get'em while they're hot!"

The current US approach to missile defense is to develop and field a single integrated system with defensive layers. What does it mean to have more than one layer? It means having more than just a terminal or midcourse capability against a particular threat. In the best of all worlds, a truly robust system will make available engagement opportunities in the boost, midcourse, and terminal layers.

To have multiple layers means having shot opportunities in more than one engagement phase (boost, midcourse, or terminal) against a threat, missile, or payload. To have layers is to have a capability to deal with an increased number of launched missiles and warheads. A layered defense system also makes it more difficult for the enemy to use countermeasures. Usually, a missile defense countermeasure that works well in one engagement phase will not work well or at all in another phase. And adding countermeasure capabilities comes at a price. A robust defensive system will force the enemy to consider using up valuable payload space that would otherwise be assigned to deadly munitions in order to install additional defensive countermeasures onto its offensive missile system. In one sense, the reduction in the size of the munitions payload is already a victory for the defense.

Boost phase missile defense capabilities create a defensive layer near the hostile missile's launch point. Engagement in this defensive phase of a ballistic missile's flight demands quick reaction times, high confidence decision-making, and high performance capabilities. This is the point in a ballistic missile's flight when it is traveling at slower (though accelerating) speeds and is most vulnerable. Currently, the US missile defense system does not have a boost defense layer, which requires development of high-power lasers, faster terrestrial-based kinetic energy interceptor capabilities, or space-basing of sensors and defensive weapons.

The MDA is putting in place the requisite command, control, battle management, and communication infrastructure, and is developing and demonstrating the technologies needed to operate an Airborne Laser (ABL), which uses directed energy to cause weakness and instability in the airframe of a ballistic missile. The ABL would be capable of engaging ballistic missiles of all ranges. Also in development is a high acceleration kinetic energy booster that, when mated with an exo-atmospheric kill vehicle, could be based on land or at sea and would be effective against longer-range ballistic missiles.

The disadvantage of these terrestrial options is that they must be in position to be effective. Technological marvel that it is, the ABL is limited logistically—it must be in the air (along with in-flight escort defenses) during missile boosting and within range of the threat launch site to be operationally effective. A transportable high-acceleration land- or sea-based interceptor would also require positioning within range of the missile launch (along with adequate sensor coverage for detection, tracking, and discrimination).

What this means is that launches out of the deep interiors of some countries might circumvent the terrestrial boost-phase defenses under development. Even if the ABL could operate along enemy borders, in other words, it may not be effective against threat missiles launched a thousand miles away. Missiles

YAL-1 Airborne Laser (ABL) in flight.

launched from far away and away from the positions occupied by the kinetic energy interceptors also could evade the early defenses, although midcourse defenses may be able to engage them (hence the value of a layered defense system). These terrestrial capabilities would be welcome additions to the system, but the question is, can we do better?

The ability to stage ballistic missile launches far away from their border areas makes it challenging for the defense for several reasons. Sensors can help discriminate and track the ballistic missile and payload and cue the missile defense system for possible engagement. To the degree we can place radars closer to the threat launch site, we are better off. The closer we are, the earlier we can look at the launching missile and the better and more accurate the information provided to the system will be. Launches out of deep interiors may keep that information away from missile defenders.

One way to overcome this disadvantage is to place advanced sensors in space. The country already leverages Earth's orbits to detect and warn of missile launches worldwide. The missile defense system will continue to leverage the Air Force non-imaging infrared Defense Support Program (which has been around since the mid-1960s) and the follow-on space-based infrared system–high satellites for threat detection and early warning.

There are other sensing functions that can be optimally executed from space. Beginning in 2007, the US will experiment for several years with Space Tracking and Surveillance System (STSS) satellites. Space-based sensors would have a global footprint, improve situational awareness, and help shorten the track detection timeline and improve track accuracy, which means improving performance for all elements of the system (space-based and terrestrial). These satellites will also provide faster cues to other radars and weapons elements of the system and provide better information on threat missiles, including position, velocity, and acceleration estimates. Until the STSS satellites are launched and operational, though, we will be limited to terrestrial tracking sensors with their attendant drawbacks.

A space-based interceptor layer would help take away the geographical advantage held by the offense, since space-based assets would be on-call 24/7 and would have near-global access to launch points. Missile defense operations from space not only would allow the system to address a very large set of possible threat launch points around the globe, but they would also allow the US to engage ballistic missiles launched from deep within enemy interiors.

Robustness and Synergy

We must recognize that improving the performance of the ballistic missile defense system means adding mobility (flexibility to meet unforeseen threats or to defend against a known adversary), layers (to increase engagement redundancy), and inventory (more interceptors or shots in the system to deal with larger raid sizes). Space-based interceptors can make a significant contribution in each of these areas. While interceptor platforms will travel in a relatively "fixed" orbit, the movement of even a constellation as small as 100 interceptor platforms (with, for example, four interceptors per platform) will act like a mobile defense asset and be ready to engage at multiple points around the world at a time.

Because the missile defense system has more than one layer, it will have multiple elements working together synergistically, sharing information, sharing existing sensors, communicating as a single system worldwide. Even a small constellation of space-based interceptor platforms leveraging existing terrestrial sensors and the extensive command, control, battle management, and communication network would allow the entire system to work more efficiently. As mentioned above, a capability to strike in boost and midcourse from space would thin out the number of attacking payloads, and thereby increase the probability of engagement for other midcourse and terminal defenses and improve overall system synergy.

Ironically, when one considers the emotional and at times hyperbolic debate over deploying weapons in space, much of the missile defense battle involving ground-based or sea-based interceptors already takes place in space.[5] The exoatmospheric kill vehicle (EKV) mated to booster stacks are designed to collide with the target in low Earth orbit. The EKV is a "space weapon"—it just spends most of its time on the ground. The attacker, therefore, has an ability to preposition before the defender can get to the point where he must engage. The currently deployed terrestrial-based interceptors, in other words, are not in the most optimal position to do battle with high-speed offensive missiles and payloads in the midcourse phase of the missile's flight. By surrendering this fundamental positional advantage, we are fighting a space war with our bellies in the mud. Why not pre-position assets in space, where we know the battle is going to take place?

The on-call, persistent defensive capabilities made available by space-based assets would improve missile defense response times, expand areas of engagement, provide better information on offensive missile events, and generally improve the worldwide integration of the system. The improved flexibility space offers would allow the US to better defend against emerging threats. This would allow it to improve crisis response times and enable US military forces to be more agile and protected on the battlefield. The US would be in a better position to defend its interests and more readily able to meet the defense commitments of its allies and friends. The confidence of the leadership would also improve, and the leadership, in turn, would have greater freedom of action to defend US interests and populations from a wider range of missile threats.

Will there ever be a time when we will need the powerful capabilities discussed above? Robust missile defenses, at a minimum, could further the defensive goals of dissuading our allies from investing in ballistic missile programs and deterring aggressive missile behavior. Yet there are instances imaginable too when we would want to have the strongest, most reliable, most effective defenses possible.

What if, for example, a hostile country decided that the best military option it had available, an option that would inflict maximum damage on the US, would be to launch and then detonate a nuclear weapon several hundred kilometers above the US? Although nobody would die, not immediately at least, and no buildings would be destroyed, the resulting explosion would send out an invisible electro-magnetic pulse that would disable or destroy the electrical, financial, communications, and transportation infrastructures of part or all of the country. The impact

on the economy and the health and safety of citizens would be felt worldwide. According to a recent report by a congressionally chartered commission to look at the electromagnetic pulse threat, "a regional or national recovery would be long and difficult and would seriously degrade the safety and overall viability of our Nation."[6] Indeed, our vulnerability might invite such an attack.

The stakes, in fact, are that high, and the possible threat posed by a nuclear-tipped ballistic missile is that chilling. A robust missile defense system may be the only recourse we have to defend ourselves against such a threat.

Now who is in favor of having the most efficient, most effective missile defenses in place? And if most of us favor strengthening defenses to improve our ability to kill long-range missiles early enough in their trajectory (that is, from boost phase to early midcourse phase), why would we not be in favor of a vigorous program to develop and deploy interceptors that provide on-call, worldwide reach, and a boost phase layer within the currently deployed ballistic missile defense system? Why, in other words, would we not want to investigate more fully the performance possibilities of space-based interceptors?

Military Space and Politics

The Bush administration's commitment to deploying a ballistic missile defense system ended a decades-old and bitter partisan battle and inaugurated a new defense era. There is a limited system now in place to defend the US homeland, its allies, and its deployed troops against ballistic missile attack. There also are plans in place to improve the system incrementally to address current and emerging threats. Yet at the moment, those plans shy away from a full-fledge investigation of the space option.

Policy makers in favor of the space option have not done the political spadework required to push it forward. The current administration has not been willing to take it on, despite the heady language in the 2006 National Space Policy. Congress also has a few space proponents, but the groundswell of support required to authorize and fund this approach will be impossible to build on Capitol Hill without leadership from the administration.

Other reasons: domestic and international political correctness movement against "weapons in space" has gained momentum since the inauguration of President George W. Bush. There is a vigorous arms control lobby that views space as the last regulation frontier as well as "think tanks" and other advocacy organizations that are generously funded to oppose military programs that would lead to "weaponizing space." Without question, the arms control faithful look to leverage what they can from the political correctness crowd. And, in the end, the adversaries of the United States no doubt seek to exploit ideas and political inroads constructed by arms control and political correctness.

It all comes down to one question—how effective do we want to be against an evolving ballistic missile threat? If you can agree that American cities face a serious, potentially catastrophic threat in the future (whether that threat be from a nuclear strike or an electromagnetic pulse event), the answer ought to be that we should make our missile defense system as effective as possible. And to do that, we must be prepared to march confidently along the high ground surrounding Earth.

Notes:

[1] "US National Space Policy," fact sheet, White House, US Office of Science and Technology Policy, released October 2006, www.ostp.gov/html/US%20National%20Space%20Policy.pdf (accessed on 23 January 2007). Space policy since President Eisenhower has been remarkably consistent with respect to national goals in space, with each iteration respecting the need to use force in space to defend US freedom of action. The real differences among the various administrations may be found in the budget submissions and justifications for defense space activities. As I argued in 2001 in Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (Lexington, KY: University Press of Kentucky, 2001), 207, "Fragmentary spending on military space programs, a decentralized defense space organization, and the unbalanced rhetoric of public officials on military space matters indicate that this country is deeply divided on this subject, the tough words in the National Space Policy notwithstanding."

[2] General James Cartwright, Commander US Strategic Command, before the Strategic Forces Subcommittee of the Senate Armed Services Committee, testimony, 7 April 2005, "If the nation needs it (missile defense), we have a thin line. We have an emergency capability. But the focus needs to be on increasing the depth of the sensors, the command and control and the weapons and realistic operational testing."

[3] Donald Rumsfeld, et al., *Executive Summary of the Report of the Commission To Assess The Ballistic Missile Threat To The United States*, 15 July 1998, http://www.house.gov/hasc/testimony/105thcongress/BMThreat.htm; "Ballistic and Cruise Missile Threat," National Air and Space Intelligence Center, NAIC-1031-0985-03, August 2003, 9; "The Iranian Ballistic Missile and WMD Threat to the United States Through 2015" NIO Robert Walpole, 21 September 2000.

[4] "Current and Project National Security Threats to the United States," Testimony of Director, Defense Intelligence Agency, Vice Admiral Lowell E. Jacoby before the Senate Select Committee on Intelligence, 17 March 2005, 11; "Annual Report on the Military Power of the People's Republic of China 2005," Department of Defense Report to Congress, 28 (China Annual Report); "Proliferation: Threat and Response," Office of the Secretary of Defense, January 2001, 17.

[5] I have addressed these criticisms in Steven Lambakis, "Space Weapons: Refuting the Critics," *Policy Review*, February/March 2001, no. 105, 41-51, and Steven Lambakis, "Space Cops: Reviving Space Arms Control," *Astropolitics 1*, no. 2 (Autumn 2003): 75-83.

[6] Dr. John Foster, Jr., et al., *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack*, vol 1: Executive Report, report to Congress, 2004, 1, http://www.globalsecurity.org/wmd/library/congress/2004_r/04-07-22emp.pdf (accessed 24 January 2007); see also Curt Weldon and Roscoe Bartlett, "Counter the Mega-Threat: EMP Attack," in Frank Gaffney, et al., *War Footing: 10 Steps America Must Take to Prevail in the War for the Free World* (Annapolis, MD: Naval Institute Press, 2006), 00-112.

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