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By Steven Lambakis

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Modern-day u.s. defense strategy, of necessity, is global in scope, and it will likely retain this character for decades. Fundamental to maintaining this global awareness and presence are satellite operations.

National economic and commercial interrelationships thrive on the flow of invisible ones and zeros through space channels, so that timely, agile intercontinental trade is now taken for granted. U.S. and coalition forces routinely leverage earth-circling platforms to enhance military capabilities: the Global Positioning System for improved navigation and precision timing, reconnaissance and early warning sensors, and high-bandwidth communications. Space, moreover, is an open arena, a global commons increasingly used by many countries for military purposes. The proliferation of space technologies offers foreign governments and nonstate entities unparalleled opportunities to enhance diplomatic and military influence over the U.S. and

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strike with strategic effect. Potential enemies of the United States today have improved "vision" over the U.S. homeland and battlefield activities, a better sense of direction and geographic position, and an improved ability to mobilize forces and coordinate activities. With battle space now reaching up to at least 22,000 miles above the Earth — the orbital altitudes for early warning and communications satellites — protecting ourselves from future attacks will depend mightily on space power.

But the country lacks a unified, coherent approach to expanding the use of space to improve combat effectiveness, a problem that is compounded by a politically charged debate over weapons in space.[1] Critics contend that weapons in space would destabilize existing security relationships, precipitate an arms race, undermine U.S. foreign policy, and seed anti-American coalitions. Not only are such criticisms based on questionable assumptions,[2] but they also have not persuaded the country to forgo the advantages of space weapons. The most one could say at this stage is that the American people are indifferent, noncommittal, and confused.

Given the unpredictable global threats we expect to face, it makes sense to explore taking combat missions to space.

Yet given the efficiencies space offers, and given the unpredictable, catastrophic, and global nature of threats we expect to face, it makes sense to explore the possible benefits of taking other combat missions to space. Once the benefits of active space defense programs and operations are made plain, the support of the American people will be forthcoming.

There are several space combat mission areas of interest to the future defense of the United States, including space control,[3] offensive strike,[4] and ballistic missile defense. Each combat mission offers very different operational and strategic possibilities, and each should be evaluated separately and judged independently. Recognizing that weapons that leverage Earth orbits can make different contributions to national defense strategy, lumping them together in order to draw a general conclusion about the prudence of deploying "weapons in space" makes little sense. Our progress in this area will depend greatly on our ability to mature our rhetoric so that we can

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[1] See Steven Lambakis, *On the Edge of Earth: The Future of American Space Power* (University Press of Kentucky, 2001), for extensive discussion and bibliographies.

[2] I have addressed these criticisms in Steven Lambakis, "Space Weapons: Refuting the Critics," *Policy Review* 105 (February/March 2001), and Steven Lambakis, "Space Cops: Reviving Space Arms Control," *Astropolitics* 1:2 (Autumn 2003).

[3] Donald H. Rumsfeld et al., *Report of the Commission to Assess United States National Security Space Management and Organization* (January 11, 2001), 19–25.

[4] Air Force Space Command, *Strategic Master Plan FY06 and Beyond* (October 1, 2003); Ivan Bekey, "Force Projection from Space," in Air Force Science Advisory Board, *New World Vistas* (January 30, 1996), 83.

make meaningful distinctions. So I will focus here on the possible advantages of adding a space-based layer leveraging hit-to-kill interceptors to the newly deployed U.S. missile defense system. Highly effective missile defenses would appear to offer a very significant payoff over the long term when one takes threat and national vulnerability to catastrophic attack into consideration.[5]

Missile defense

The ballistic missile threat to the United States, its deployed forces, and allies and friends has been well defined.[6] This is a threat we downplay at our peril. Nations such as North Korea and Iran — which also have significant programs to develop nuclear, biological, and chemical weapons — as well as nonstate groups can pose significant, even catastrophic, dangers to the U.S. homeland, our troops, and our allies. Russia and China, two militarily powerful nations in transition, have advanced ballistic missile modernization and countermeasure programs. Indeed, despite the reality that trade relations with China continue to expand, its rapid military modernization represents a potentially serious threat. Whether these nations become deadly adversaries hinges on nothing more than a political change of heart in their respective capitals.

The intelligence community's ability to provide timely and accurate estimates of ballistic missile threats is, by many measures, poor. Our leaders have been consistently surprised by foreign ballistic missile developments. Shortened development timelines and the ability to move or import operational missiles, buy components, and hire missile experts from abroad mean the United States may have little or no warning before it is threatened or attacked. There is no escaping the uncertainty we face.

And the stakes couldn't be higher. A ballistic missile delivering a nuclear payload to an American city would be truly devastating. For comparison, the Insurance Information Institute estimates total economic loss so far from Hurricane Katrina at more than $100 billion. By some calculations, it is going to take New Orleans 25 years to recover fully, and the cost of rebuilding the city is predicted to be as high as $200 billion. The direct cost to the New York City economy following the September 11, 2001, terrorist attacks was between $80 billion and $100 billion. These figures do not include indirect costs or the incalculable human losses. Now just imagine the

[5] See testimony of General James Cartwright, Commander U.S. Strategic Command, before the Strategic Forces Subcommittee of the Senate Armed Services Committee (April 7, 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."

[6] Donald Rumsfeld et al., *Executive Summary of the Report of the Commission to Assess the Ballistic Missile Threat to the United States* (July 15, 1998).

costs imposed by a ballistic missile nuclear strike against a U.S. city. The economic toll from a single nuclear attack against a major city, which would involve extensive decontamination activities and impact the national economy, could rise above $4 trillion.[7]

The economy could also be devastated by the electromagnetic pulse generated by a high-altitude nuclear explosion. The resulting electromagnetic shock would fry transformers within regional electrical power grids.[8] The interdependent telecommunications (including computers), transportation, and banking and financial infrastructures that people and businesses rely on would be significantly damaged. Such an event would leave us, in some cases, with nineteenth-century technologies. This situation could jeopardize the very viability of society and the survival of the nation. Moreover, the paralysis leaders would experience would leave the country and its allies exposed to highly lethal twenty-first century threats. The blackmail possibilities of these weapons are as mind-numbing as they are terrifying.

A nuclear attack against a major city could devastate our economy, with the toll rising above $4 trillion.

After more than 60 years of advances in ballistic missile technologies, we have only just begun to address our vulnerability to them. Missile defense is a policy and budgetary reality today, and it enjoys strong bipartisan support. Current U.S. efforts to dissuade other countries from investing in ballistic missiles, to assure U.S. allies, and to deter aggression put missile defense in a place of prominence. Bush Administration policy is to evolve the fielded system incrementally to defend against these threats. The system is intended to adapt to new threats as they emerge and integrate advanced missile defense technologies as they are introduced.

The fielded system today consists of space-based detection sensors, ground-based and seaborne early warning and tracking sensors, ground-based interceptors in Alaska and California for long-range defense, transportable ground-based Patriot Advanced Capability–3 units, and sea-based interceptors to engage short- and medium-range ballistic missiles. There are also several development programs to field new ground- and sea-based and airborne weapons to give the layered defense system new capabilities for engaging all ranges of ballistic missiles.

Multiple defensive layers, with system elements working together synergistically to enhance the capability of the whole, are central to the approach

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[7] See ABT Associates, Inc., *The Economic Impact of Nuclear Terrorist Attacks on Freight Transport Systems in an Age of Seaport Vulnerability*: Executive Summary (April 30, 2003); Pacific Northwest National Laboratory, "Thinking About the Unthinkable: Economic Consequences of Nuclear Attack," PNNL-SA-46083 (January 27, 2006).

[8] John Foster, Jr., et al., *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack,* Volume 1: Executive Report, report to Congress (2004).

adopted by U.S. defense leaders. No one layer or interceptor design can fulfill this global mission on its own. Several capabilities for intercepting a ballistic missile or its payload just after launch, or as it flies through its midcourse phase in space, or as it reenters Earth's atmosphere on a terminal trajectory will enhance overall system effectiveness by providing a defense in depth. Such a defense not only can enable several shot opportunities against an in-flight missile, but also can address the problem of missile defense countermeasures, which generally work in only one phase of flight. The current U.S. approach, in other words, is the right one.

Limits of the current system

Over the long term, will the currently configured and planned terrestrial-based missile defense system be sufficient to deal with increasingly sophisticated countermeasures and shifting threats? The answer, I believe, is no.

The system being deployed today is fixed firmly to Earth. Whether they are sea-based or land-based weapons, or even the boost-engagement Airborne Laser, we are essentially talking about terrestrial platforms for basing weapons. As we move into the future, there are plans to make those platforms, the sensors and interceptors, more mobile. Why? Because greater mobility can provide greater flexibility for dealing with unpredicted threats. Mobility also allows a commander to concentrate his forces or disperse them as the requirements of the battlefield demand.

It matters where we locate sensors and interceptors. It is important to put sensors close to the threat, because they will be in position to provide critical cueing and tracking data early in a ballistic missile's flight. These data can help enlarge the engagement battle space. To perform boost-phase intercept from the ground or sea, the weapons platforms must be very near the target launch site. These terrestrial boost-phase weapons can defend many targets around the globe by covering a single launch site. The disadvantage of such basing, a disadvantage that is mitigated somewhat with a mobile platform like the Airborne Laser, is that the threat launch site or region must be predicted.

Terrestrial-based weapons that engage in space, in the middle or midcourse of a missile's or warhead's flight, offer perhaps the greatest flexibility in terms of addressing possible flight azimuths, trajectories, and launch points. While ground-based midcourse interceptors may have to be oriented to large threat regions, they can defend against multiple launch points.

Conversely, ground interceptors that are near the target can defend only a small area, but they can potentially protect that point from launches anywhere in the world. Yet it is simply unaffordable to do a point defense for every place you want to defend in the United States, every place that U.S. forces go, or everywhere that our allies are. The ability to do area defense —

to defend against multiple launch points as opposed to doing point defense of a very limited area — is fundamental to successful missile defense.

Political, strategic, and technological uncertainties could change the missile defense scenario by causing a shift in the threat from one region to another. Given that it takes years to field, test, and make operational new fixed interceptor and sensor sites, a shift in the threat could leave the nation vulnerable. Because many of the interceptors and sensors in the current system are fixed to geographic points, we are limited in our ability to defend the homeland, for example, against missiles launched from surprise locations such as a ship off our shoreline. We also might face an adversary tomorrow that deploys tens or even hundreds of ballistic missiles or one that has more sophisticated countermeasure and reentry technologies. Those, too, would be expected to stress the current system, which is designed at the moment to deal with more limited threats.

Planned transportable land-based and mobile sea-based and airborne systems also suffer limitations. The need to base sensors and interceptors forward, closer to threat launch sites, in order to enlarge the engagement battle space makes our security dependent on political decisions by foreign governments. Projected boost defense systems, which may be deployed to the periphery or littoral of an adversary, would have very limited or no utility against a ballistic missile launched from several hundred miles inside a threat country's border. The inability to engage a missile in boost means we would be left with only midcourse or terminal intercept possibilities, if those are available, and this removes a layer from the effectiveness calculations.

It's all about position

Today we base missile-defense weapons on Earth, yet most engagements actually take place high above the Earth's surface, in space — unless, of course, those engagements occur very early in boost or late in terminal. Putting interceptors in space to engage ballistic missiles could offer efficiencies that go a long way towards improving national defense, protecting more areas around the world, and reacting more effectively to threat surprises.

The Exoatmospheric Kill Vehicle (EKV), deployed on top of a long-range ground-based interceptor in Alaska and California, is really a euphemism for "space weapon." Space is the only environment in which the EKV will operate. In order to perform the missile defense mission, it must be boosted into space where it is "based" for a short time and operates semi-autonomously to put itself onto a collision path with a hostile warhead. In other words, the EKV is a "space weapon" that just happens to spend most of its time on the ground. The Standard Missile–3 interceptor, while it is carried on Aegis ballistic missile defense ships, also executes the intercept endgame in space against short- to medium-range ballistic missiles using a sensor-propulsion package designed to collide with the target.

Thus, despite the fact that space is the recognized battleground in many missile defense engagements, we are deploying "space weapons" that are restricted to terrestrial launching just prior to operation. They must fight a space war from Earth. So, in a sense, these terrestrial-based interceptors are out of position before the battle even begins. At the very least, they are not in the most advantageous position to accomplish the mission for which they were designed.

Before we can even begin the launch sequence, battle managers must wait for the attacker to make his move. The attacker has a head start and the ability to pre-position before the defender can get to the point where he must engage, especially if we are talking about engagement in the midcourse phase of flight. These engagements take place over a matter of minutes, of course, so any time wasted getting into position could lead to a failed intercept and possibly devastation for a city. By not basing interceptors in space, by not pre-positioning assets in the environment where we know intercepts will take place, the defense is surrendering a fundamental positional advantage. On this point, there is relevance in Carl von Clausewitz's observation that a "benefit [of defensive action], one that arises solely from the nature of war, derives from the advantage of position, which tends to favor the defense."[9] To give up this advantage is detrimental to the cause.

While space assets generally follow predictable orbital paths, they do provide a unique form of mobility — they can be present and persistent over many places on the globe. Indeed, in 2007, the Missile Defense Agency will begin demonstrations with two satellites hosting sensors designed to provide very fine surveillance and tracking data on in-flight ballistic missiles and payloads. A constellation of these satellites would become the sensor backbone of a global missile defense capability and would make possible the global mission endorsed by the Bush administration: the protection of the United States, its deployed forces, and allies and friends. Similarly, a space-based interceptor layer would enable a global on-call missile defense capability and a timely response to rapidly evolving threats, even threats emanating from unpredicted locations with very different azimuths from those we plan to be able to defeat today.[10] A space-defense capability also would allow the country to engage longer-range threats originating from deep within the interior of a threat country.

It is also known that enemies of the United States can put a nuclear

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[9] Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret (Princeton University Press, 1984), 358.

[10] Lt. General Henry A. "Trey" Obering, Director of the Missile Defense Agency, testimony before the Strategic Forces Subcommittee of the Senate Armed Services Committee (April 4, 2006): "If you think that you can predict with certainty what threats that we're going to face over the next 20 or 30 years, then we can certainly keep populating the world with terrestrial-based and fixed site interceptors and sensors. If we believe that we're not going to be able to do that very accurately, then we believe that a very modest space-based layer may be the way to go there."

weapon over U.S. territory using a ballistic missile. The detonation of this weapon at a high altitude could unleash an electromagnetic pulse that would wipe out satellite and airborne navigation, intelligence, and communications systems and impede any U.S. military response to the aggression. Such a pulse of energy would disable or destroy the unprotected technological infrastructure of a region or the nation. According to the EMP Commission, "a regional or national recovery would be long and difficult and would seriously degrade the safety and overall viability of our nation. . . . [A]t some point the degradation of infrastructure could have irreversible effects on the country's ability to support its population."

Space-based interceptors may be the only effective way to counter this threat and mitigate the effects of an electromagnetic pulse resulting from the intercept. Engaging the missile close to its launch point would release the resulting explosion of gamma rays closer to the attacker's territory. Relying on an intercept in space, in the midcourse of a missile's flight, risks damaging unprotected satellites (i.e., just about all commercial and civilian satellites), regardless of who owns them.

Because the missile defense system is "layered" and 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 would allow the entire system to work more efficiently. The massive constellations projected back in the heady days of the Strategic Defense Initiative, in other words, do not seem to be necessary, especially when the targeted adversaries have very limited ballistic missile inventories. By attacking even just a portion of the threat missiles in boost and midcourse, the space layer has the effect of thinning out the number of attacking missiles so that the other elements of the system, which are based on the ground or at sea (midcourse and terminal systems), can be more effective.

International law and arms control

National indecision over how to regard the space environment has paralyzed successive administrations over what to do in space. The United States has conducted research and development in the space-weapon area for more than 40 years without a strategic vision. As progress in this area unfolds, U.S. leaders find it challenging just to talk about the use of space for combat purposes in a public forum.

In August 2006, the Bush Administration issued a major, high-profile pronouncement about space arms control. The administration rightfully reminds us that arms control is not an end in itself, but rather a tool to help the nation realize its national security strategy. Officials believed the 1972 Anti-Ballistic Missile Treaty posed a danger to security, impeding the development, testing, and deployment of effective missile defenses to defend the country and U.S. troops, allies, and friends. When Washington withdrew from the treaty in June 2002, the restrictions on deployment of missile defenses in the air, sea, and space environments went away. We effectively got rid of the single greatest obstacle to the deployment of non-nuclear space arms, although this was not the reason cited by officials for withdrawal.

It is plain that the U.S. government believes there is no need today for new outer-space arms-control agreements. There are a number of standing agreements that already sufficiently regulate military activities in outer space. And so Washington supports the existing space law regime and the development of the rule of law in that environment.

Unhindered access to space and freedom to navigate are accepted ideas in most countries today. Customary practice and international treaties and conventions have supported and promoted the idea that space is a great "commons," analogous to the high seas, and ought not to be subject to national restrictions or governance. The United States has always considered the space systems of any nation to be national property with the right of passage through and operation in space without interference, so long as those systems do not threaten U.S. security.

We see space as a great "commons," analogous to the high seas and not subject to national governance.

Washington supports exploration and use of outer space by all nations for peaceful purposes. "Peaceful purposes," states U.S. policy, allow defense and intelligence-related activities in pursuit of national security and other goals. Determining peaceful purposes, in other words, is done not by looking at whether an activity is military or nonmilitary. The determining factor, rather, is more directly tied to aggressive intent.

The 1967 Outer Space Treaty enshrines the principle that outer space shall be free for exploration and use by all states in accordance with international law. The United States has consistently endorsed and abided by this treaty. Washington was among the first to endorse plans for a treaty banning weapons of mass destruction in space. This treaty puts celestial bodies off-limits to nuclear weapons and other weapons of mass destruction, and it prohibits the stationing of such systems in orbit.

The United States also sponsored in 1963 a treaty to ban nuclear testing in space, the Limited Test Ban Treaty. Nuclear tests in space simply posed too many risks to our own communications and reconnaissance satellites, so it made sense to ban them. Space debris can create hazardous conditions for astronauts and hinder access to space, so Washington also has been an advocate of establishing responsible practices that minimize the impact of debris, although we must balance this too with the obligation to ensure national security.

Our love of freedom, in other words, does not mean we have a love of anarchy. The United States has long recognized that freedom of action in space is not without limitation. Yet there are some who believe that the current space law regime is insufficient — insufficient, that is, for constraining U.S. arms development in that arena.[11]

The bottom line is this: There are currently no legal restrictions on developing and deploying space-based interceptors that rely on hit-to-kill technologies to execute the missile defense mission.

Policy consequences

The policy benefits of a space-based missile defense layer are straightforward. A more effective missile defense system that fully leverages space would provide a true on-call global defensive capability, and this could lead to increased stability in the world. Defenses deter attacks by reducing confidence in the success of any attack. The more effective the missile defense system is, the greater will be its deterrence value, and the less likely will we be to have to use it at all.

At some point, when the system is seen by other governments as highly effective, they could recognize a diminishing marginal rate of return in their own ballistic missile investments. As more allies invest in missile defense, U.S. space-basing activities could build on current missile defense cooperative activities and open up new avenues for international collaboration, both to develop elements of the space-based layer and to participate in operations.

Moreover, because no state can have sovereignty over the space above its territory, we could operate up there free of political constraints. The need for negotiating basing rights to locate sensors or interceptor fields would become less pressing.

Improved system performance would give the U.S. leadership a better array of options. In the face of attempted blackmail, for example, the president and his advisors would have confidence in the nation's capabilities to defeat a missile, which would make it possible to avoid more destabilizing moves, such as offensive preventive attacks on enemy territory. It is equally true that strong defenses would support necessary offensive action. Effective defenses can buy time to understand the strategic consequences and overall impact of military action.

Our choices are fundamental to making moral judgments. The moral issues surrounding a national security crisis are tied to considerations of operational effectiveness. Are we doing our best to provide protection against some of the worst weapons imaginable? What would the consequences of not acting be, or of not being able to act because of a blackmail

[11] See, for example, Michael Krepon and Christopher Clary, *Space Assurance or Space Dominance: The Case Against Weaponizing Space* (Stimson Center, 2003); CNS Occasional Paper No. 7, "Missile Proliferation and Defences: Problems and Prospects" (July 2001).

threat? What would be the result if Washington were unable to respond to increased terrorist activity worldwide or an upswing in the global weapons of mass destruction trade? A space-based layer would reinforce American strength, which in turn would allow the U.S. to better defend its interests and pursue its foreign policy goals. A powerful and influential United States is good for world peace, stability, and enforcing the rule of law internationally.

Clearly, cost must be addressed too, but it is not the show-stopper that one might imagine. This, after all, is more of an affordability question. And matters of affordability are driven mainly by whether the system in question is a priority or key element within the desired national security architecture. We cannot know the full impact of a space layer on overall system effectiveness, deployment requirements, and cost until we have defined a space architecture. We cannot predict what the cost would be, even in ballpark terms, with any confidence without this top-level information. Much will depend on the role our defense leadership sees for space-based interceptors and the determination regarding how such a layer would enhance overall system effectiveness. We also need to factor in technological progress, especially as it enables interceptor weight reductions and drives down the cost per pound to orbit. Without taking these factors into account, we cannot determine how many satellite platforms we will need in a constellation or how many space launches we will need to populate it.

As no state has sovereignty over the space above its territory, we could operate up there free of political constraints.

Congress should push the Bush Administration to begin studying the feasibility of integrating a space-based layer into the missile defense system. Experiments must be conducted if we are to determine whether space basing makes sense from an overall system point of view. Perhaps we will not get as much out of a space-based layer as we thought, or perhaps the cost will be too great. We need to settle these questions. We also need to take some of the technical challenges off the table. Can we do proper command and control? Can space-based sensors provide the data needed to discriminate target objects? How long can we keep interceptors loaded with solid propellant on-station in space? There are strong arguments for going to space, but we need to find out where truth lies. Once the technical questions are answered, it will be up to the critics of expanding military uses of space to explain why it is that the Earth's orbits ought to be exempted from the logic of war and military competition that otherwise govern military behavior on land, at sea, and in the air.

No nation has a right to deny our access to space to defend this country or promote economic prosperity. This has been understood for over 45 years, but I believe that the consequences of this statement have yet to be fully comprehended. With a debate in Congress over space-based missile defense interceptors, I believe we will finally be able to bring some clarity to the discussion of weapons in space. The positions we take in this argument will have consequences for space control and offensive strike weapons. The nation's leaders should welcome this opportunity to grapple with an issue that is certain to affect the influence and power of the United States for the remainder of this century and beyond. There will be ambiguity and vacillation in our public discourse and lawmaking until we define a clear vision for the use of space and have established the right policies to support it.

There is a strong case to be made for clarifying the options before us and for determining whether it makes sense to invest more in space defenses. Evolving the ballistic missile defense system to incorporate a layer that will allow us to better protect ourselves is logical. Should it become clear that space defenses would deliver an improved missile defense system, pursuing this course of action would also be a strategically prudent and morally desirable step to take.