The Future of Homeland Missile Defenses

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Section 1. Introduction

Ten years have gone by since the United States declared an initial missile defense capability and established the baseline architecture for the current U.S. Ballistic Missile Defense System (BMDS). On 16 December 2002, President George W. Bush directed the Defense Department to field a missile defense system in 2004 and 2005 to protect the U.S. homeland against a sharply defined threat—rogue countries of concern, such as North Korea and Iran—recognizing that the first system in place would have a limited operational capability. That direction built on the 1999 National Missile Defense Act, which stated that we would deploy a "limited" homeland defense system "as soon as technologically possible."

Today, 30 operational Ground Based Interceptors (GBIs) belonging to the Ground-based Midcourse Defense (GMD) element of the BMDS stand on alert to counter ballistic missile attacks from North Korea to our West and Iran to our East. Iran does not yet have an intercontinental ballistic missile (ICBM) capable of reaching the United States, but the intelligence community believes it could demonstrate a capability by next year. Over the course of its developmental and operational life, the GMD system has demonstrated the ability to destroy target warheads in space, yet it has a mixed flight test record, and efforts are currently underway to improve interceptor performance and reliability, to include plans by the Missile Defense Agency to redesign the Exo-atmospheric Kill Vehicle (EKV). The currently emplaced operational GBIs are essentially 1990s prototypes. The decision to deploy an evolutionary system as quickly as possible, to provide capability where we have had none, led to the deployment of an interceptor that had not been fully tested and put through a rigorous systems engineering cycle. This problem has now been recognized by the Defense Department. Given the U.S. track record for developing and deploying some of the most advanced weapon systems in the world, and assuming the same level of steady political commitment to the missile defense program we have witnessed over the past decade, one can be confident that the country will succeed in its goal of ensuring that America's ground-based homeland missile defenses will attain the highest possible levels of reliability and performance.

There are many questions about the likely threat as well as questions about the current system that may be raised about the future of America's homeland missile defenses. Given ballistic missile and nuclear weapon proliferation trends, will the current system, even with the planned expansion to 44 Ground Based Interceptors by 2017 or perhaps even an East Coast missile field (which is not a part of the current program), be adequate against the projected threat? Would a different homeland defense architecture be more effective than the architecture of the current system? The current policy is to develop and deploy a system to defeat ballistic missiles launched from the territories of countries that have far fewer missile systems compared to countries such as Russia or China. What if North Korea or Iran were to double or triple its current ballistic missile inventory? What would we do if a nation in South or Central America were to acquire ballistic missiles and nuclear weapons? A medium-range ballistic missile launched from either Central or northern South America would be capable of reaching the United States. After a launch, we could strike back with nuclear retaliation to be sure (would we?) or a devastating conventional strike (more likely). But the cost of not having any defensive capability to counter an in-flight ballistic missile from a surprise location (i.e., other than from North Korea or Iran) would be agonizingly high. Defense against an accidental or

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unauthorized launch is no longer part of U.S. missile defense policy—is this a right approach? How might we configure the BMDS so that it is adaptable to a potentially dynamic threat? If changes in the strategic environment were such that U.S. leaders became concerned about missile launches from Russia or China against the U.S. homeland, could adjustments be made to the current system and program to strengthen missile defenses against missile launches from those two nations?

It is easy enough to assume we could rely on the "balance-of-terror" policy fashioned in the 1950s and honed in the 1960s, commonly referred to as Mutual Assured Destruction (MAD), to stop a nation from using nuclear ballistic missiles against us, because that is what we have known since the 1960s. Yet the policy only recognizes half the truth with its emphasis on offensive strikes. It is all offense and no defense. We have not experienced a nuclear strike by Russia or China on U.S. territory, and the likelihood of a nuclear attack by China or Russia remains very low, to be sure. Yet conflict often arises from unexpected causes.[1] Perhaps it could arise out of a misunderstanding. The cost of being wrong is great, especially if something could be done to prepare for the possible failure of deterrence that might result in a significant raid of (nuclear) ballistic missiles against the United States. We should not delude ourselves into thinking that because we have not been attacked with ballistic missiles since the 1960s that we will continue to be safe.

Familiarity breeds complacency and comfort with the current way of doing business. Yet change is constant, especially in the international arena. We must take another look at our missile defense policy to ensure it can address likely changes in the international security environment. In other words, we must reconsider how robust the American homeland missile defenses need to be over the next few decades.

There are no projections within the U.S. intelligence community showing a decline in the number of ballistic missiles in the world and no evidence at all that we will ever be without nuclear weapons. The threat is here and now, and it will be here in the decades ahead. The nation must plan, therefore, to improve and expand national missile defenses throughout the coming decade. This monograph will review the ballistic missile threat and the brief history of the U.S. missile defense program. It will then examine the political impediments to strengthening homeland missile defenses. After reviewing missile defense principles, it will review the options before the country. It will conclude with recommendations to policymakers.

Section 2. Strategic Defense and the Ballistic Missile Threat

It is impossible to address the entire universe of threats, each to the fullest extent. So leaders must make choices. One would presume catastrophic threats to the nation would be given serious consideration, but this obviously should not be the case for all possible catastrophic threats. An asteroid strike on Earth, for example, would be devastating, but given the likelihood of that occurring and the significant technological challenges countering such a threat would entail, it is understandable that no nation has made the concerted push for a comprehensive asteroid defense system. The likelihood of a threat materializing or being carried out is tied, not only to the existence of the means to carry it out, but also to judgments about probability of occurrence and intention.

One of the chief, potentially catastrophic threats we face as a nation today is the threat of ballistic missiles armed with nuclear weapons. Ballistic missiles have changed the traditional way those responsible for national defense and military operations view geography and the time required to execute a military operation, and they offer one way for adversaries to complicate the decision-making of U.S. officials, delay or derail American intervention in a regional crisis, separate the United States from its allies, and strike targets on U.S. territory. Coupled with a nuclear weapon, these long-range strike capabilities could pose a catastrophic threat to the United States and its way of life.

American dominance in conventional warfare has led nations that act against U.S. interests to seek alternative ways to apply force and influence Washington's foreign policy and global actions. Judging by the growth in ballistic missile inventories around the world, the ballistic missile, which can deliver one or more warheads against a target, increasingly serves that role.

While the bulk of ballistic missiles in the world today can fly anywhere from tens to hundreds of miles, there are growing numbers in the world capable of flying thousands of miles and "crossing the oceans" bordering the eastern and western United States. In the absence of comprehensive defenses against these weapons, which may be launched from anywhere in the world and strike targets anywhere in the world, these stand-off strike weapons offer one way to exploit U.S. vulnerability while circumventing U.S. military strengths—its large, precise land, sea, air, and space military forces and highly synchronized combined military operations. Without a defense, the country's leaders could be subjected to blackmail threats.

One expects to see an acceleration of ballistic missile and nuclear, biological, and chemical weapon proliferation as more state governments look for ways to overcome regional adversaries militarily or counter regional or great power activities and influence. Ballistic missiles also provide the capability to coerce, intimidate, deter or attack another, even a militarily or economically superior country, *without* launching them. This ability to blackmail, to heighten danger and uncertainty, could restrict American diplomacy and freedom of action. Moreover, we cannot rely on our ability to deter a missile attack. Should the survival of an adversarial regime be at stake, we should not pretend to know how its leaders would respond in a crisis.

There appears to be little doubt the threat from ballistic missiles, especially when mated with increasingly available and sophisticated nuclear technologies, will intensify over the next decades.[2] The proliferation of ballistic missile technologies, expertise, and whole systems undoubtedly will have an impact on the course of future wars and crises. Ballistic missiles and missile technologies are widely available on the global market.[3]

Regional powers such as Iran and North Korea continue investments in ballistic missile and satellite launch vehicle technologies, and the development and acquisition of systems capable of delivering highly lethal or mass destruction payloads to targets in the United States. Indeed, there has been a proliferation of short-, medium-, and intermediate-range ballistic missiles, which can fly up to 1,000 km, 3,000 km, and 5,500 km, respectively.[4] North Korea and Iran are not only increasing their respective ballistic missile inventories, but also evidently see tremendous value in developing more capable missiles. Pyongyang and Tehran desire to acquire longer-range ballistic missiles, that is, medium-, intermediate-, and intercontinental-range systems, missiles that will far over-fly their border regions.

North Korea continues development of the Taepo Dong-2 Space Launch Vehicle (SLV), which could reach the United States if developed as an ICBM. Following three launch failures since 2006, a December 2012 launch successfully placed a satellite in orbit, a major milestone in its ICBM development program. The launch demonstrated North Korea's ability to do multi-staging. Reportedly, it is also developing a road-mobile ICBM, called the KN-08, which could pose a serious threat to the US mainland.[5] It continues, moreover, to direct investments to the development of long-range missile capabilities.[6] According to U.S. intelligence, North Korea unveiled the new Hwasong-13 road-mobile ICBM in an April 2012 parade. This missile has not yet been flight tested.[7] Not only is Pyongyang testing for the purpose of demonstrating military effectiveness, which also can help deter potential aggressors, but is also hawking military wares to prospective buyer nations or groups.

Iran seems to be following a similar path, and it may be expected to continue efforts to acquire intermediate- and intercontinental-range systems capable of striking the territories of our European allies and the United States. Iran recently has demonstrated some success in placing objects in orbit using its Safir rocket technologies, stepping stones to longer-range capabilities. In 2010, Iran introduced the larger Simorgh space launch vehicle, indicating that it will likely continue to pursue more capable space launch vehicles, which could lead to the development of an ICBM system. The intelligence community believes by 2015 Iran could develop and test an ICBM or space launch vehicle capable of flying ICBM ranges and reaching the United States.[8]

China and Russia continue to make considerable investments in ballistic missile systems, improving range, lethality, and capability for evading U.S. missile defense systems. There is reportedly great interest in Russia and China in developing payloads that evade missile defenses, to include technologies for multiple reentry vehicles, maneuvering reentry vehicles, cruise missiles, and midcourse countermeasures, such as decoys.

Russia continues to modernize and test its very capable land- and sea-based ballistic missile forces and has a military doctrine that allows for the possibility of using nuclear weapons first in retaliation to a non-nuclear attack.[9] According to U.S. sources, Russia has about 1,200 nuclear warheads on ICBMs, most of which are capable of being launched within minutes of receiving a launch order. Moscow is expected to retain the largest ICBM force outside the United States, and its modernization efforts are ongoing. In 2012, the Russians tested the SS-27 Mod 1 ICBM, a new missile designed with countermeasures to ballistic missile defense systems, and it is now deployed in silos. Russia began deployment of the road-mobile version of the SS-27 Mod 1 in 2006 and, in 2010, deployed a MIRV version of the SS-27, the SS-27 Mod-2 (RS-24). In addition, reports indicate that Russia is developing a new hypersonic vehicle to penetrate missile defense systems. A new rail-mobile ICBM also is under consideration. Moscow also has a new heavy liquid-propellant ICBM under development to replace the aging SS-18 for deployment in the 2018-2020 timeframe.[10]

The modernization of China's strategic forces has been intense, with the development of new intermediate- and long-range systems as well as submarines that can strike targets from the open water some 5,000 miles away. China's ballistic missile force is growing and it continues to modernize its nuclear weapons. China reportedly has a small number of nuclear-armed, liquid-propellant CSS-3 limited range ICBMs and CSS-4 ICBMs capable of reaching the United States. It is also modernizing its nuclear forces by adding more survivable, road-mobile delivery systems. China is developing a new generation of mobile missiles and is undertaking efforts to maintain the viability of its offensive forces in the face of US strategic intelligence, surveillance, reconnaissance, precision strike, and missile defense capabilities. The People's Liberation Army has deployed new command, control and communications capabilities for its nuclear ICBM forces. China's nuclear arsenal currently consists of approximately 50-75 ICBMs, including the silo-based CSS-4 (DF-5); the solid-fueled, road-mobile CSS-10 Mods 1 and 2 (DF-31 and DF-31A); and the more limited range CSS-3 (DF-4). By 2015, China's nuclear forces will include additional CSS-10 Mod 2 and enhanced CSS-4 ICBMs. Beijing is also producing the JIN-class SSBN, with three delivered and up to two under construction to carry the JL-2 submarine launched ballistic missile (7,400 km range). China reportedly will continue to work on a range of technologies to counter U.S. ballistic missile defense systems, including maneuverable reentry vehicles (MaRVs), MIRVs, decoys, chaff, jamming, thermal shielding, and anti-satellite weapons.[11] China also reportedly is working on a hypersonic craft that appears designed to be launched atop one of its ICBMs and then glide and maneuver at speeds of up to 10 times the speed of sound from near space towards the target.[12] Couple these modernization efforts with China's strategy of access denial, and it is clear that the risk to the U.S. homeland and its interests in Asia Pacific could increase quickly to an unacceptable level.

One must be concerned about Chinese and Russian developments because the strategic and political circumstances that can lead to crises can quickly change. Moreover, Chinese and Russian ballistic missile development programs will ensure that the number of ballistic missiles available globally will increase, either through direct sales to other countries or by improving the capability of other nations to produce these systems indigenously on a shortened timeline. According to the 1998 Rumsfeld Commission to assess the ballistic missile threat to the United States, there are countries that are working hard to acquire ballistic missiles, and they have "increased incentives to cooperate with one another. They have extensive access to technology, information and expertise from developed countries such as Russia and China. They also have access through commercial and other channels in the West, including the United States."[13] Since the publication of this report, the spread of ballistic missile technologies that can lead to the acquisition and development of long-range systems through trade has become even more significant.[14]

Nuclear proliferation is also a concern for the United States. China, for example, already has provided a nuclear warhead design to Pakistan, and it is not inconceivable that others will acquire it. We know, in fact, that Libya did. Iran reportedly is focused on continuing its program of nuclear enrichment and nuclear weapon development.[15] In February 2013, North Korea conducted what many assess to be its most powerful nuclear weapon test to date (at least five kilotons), with earlier tests having been conducted in 2006 and 2009.[16] One may conclude that, barring a regime change, North Korea's nuclear forces will mature over time and that efforts will be made to tailor nuclear packages for missile delivery. According to the Pentagon's Defense Science Board, which issued a January 2014 report on "Assessment of Nuclear Monitoring and Verification Technologies," the world is entering a second nuclear age and may not have the technology required to understand when a nation has acquired a nuclear weapon. The pathways to proliferation are expanding as are the networks for cooperation, and many more nations that are hostile to U.S. interests will have access to the bomb.[17]

A ballistic missile delivering a nuclear payload to an American city would be truly devastating. The September 11, 2001 terrorist attack against the United States took over 3,000 lives. A nuclear attack on one of its major cities would be far more devastating and could potentially take millions of lives. The economic cost from a single nuclear attack against a major city, which would involve extensive decontamination activities and heavily impact the national economy, could rise above $4 trillion.[18]

An electromagnetic pulse (EMP) generated by a high-altitude nuclear explosion also could have a devastating impact on the entire country; indeed, its destructive consequences would reverberate around the world. A thorough understanding of what precisely would follow an EMP burst over the country, however, continues to be a point of debate among experts.[19] There is strong evidence to support the assertion that EMPs produced by a nuclear weapon could interact with the atmosphere and Earth's magnetic field and follow on a line of sight to Earth's horizons, potentially covering hundreds of miles at the speed of light. Indeed, some suggest that the United States could be affected in its entirety, should a burst occur more than 200 miles above its territory. The risk of not taking this threat seriously is simply too great to ignore, especially given what we have learned can happen to electronics in the wake of a natural "EMP" resulting from massive solar flares.[20] The Russians reportedly stated that their "brain-drain" helped the North Koreans to develop EMP weapons, which may be launched using a Scud missile from a freighter off the U.S. coast.[21]

The detonation of a single nuclear weapon over the United States, depending on the location and height of the burst, could destroy critical infrastructure and indirectly kill U.S. citizens. In a worst case scenario, the resulting electromagnetic shock could shut down or severely disrupt regional electrical power grids and force sections of the nation to rely on nineteenth century technologies.[22] The interdependent telecommunications, transportation, food production, banking and financial infrastructures and emergency services could be significantly damaged. This situation could jeopardize the very viability and political underpinnings of the nation and leave it exposed to follow-on, or new, threats and attacks. Simply put, a primitive ICBM launched from halfway around the world or from a ship off the coast of the United States resulting in EMP damage could bring the country to its knees.

Section 3. Ballistic Missile Defense System Evolution

The perceived need to acquire missile defenses began in the 1940s, and it has only grown over the past 70 years. Despite an investment of billions of dollars and the recognition among numerous political and military leaders that the United States requires an active defense system, inconsistent political support over the past decades has resulted in a situation wherein the United States now deploys an extremely limited homeland defense system.

Missile Defense: The Early Years

The U.S. missile defense program began in 1945 as military leaders grew concerned over the emergence of a new offensive weapon, the German V-2 ballistic missile. For nearly two decades there was steady support within the Defense Department for investigations into methods for actively defending against ballistic missile (a threat that starts on the ground but attacks its target from space or high in the atmosphere), beginning with U.S. Army Brigadier General William A. Borden, Director of the Army Staff's New Developments Division, and Major General Gilbert R. Cook. The Cook Board recommended in June 1945 the development of "high velocity guided missiles" capable of destroying "missiles of the V-2 type."[23] Cook argued that these defensive weapons should be developed at the earliest possible date. General Borden also recommended the development of missile defenses and countermeasures for missile defense. These findings were issued before the explosion of the first atomic bomb in August 1945, when new possibilities for using nuclear weapons in a missile defense role were opened up. The Army Air Force also weighed in to support a nuclear or hit-to-kill type missile defense system despite the anticipated cost.[24] US Army Air Force Projects Wizard and Thumper were the first attempts to develop an active defense system. Developers quickly recognized the development of an ABM system would be costly and face significant and complex technical challenges.

The emergence of the Soviet Intercontinental Ballistic Missile (ICBM) threat to the United States in the 1950s focused the Defense Department's attention on the development of ballistic missile defenses to protect U.S. cities. The Army used its experience with air defenses in World War II to develop the nuclear-capable Nike Zeus, an integrated system of interceptors, advanced radars for acquisition and tracking, and battle management and communications equipment. When Moscow launched the SS-16 ICBM in August 1957 and the first satellite, Sputnik, in October 1957, concerns grew among the U.S. public and leadership over a "missile gap" between the United States and the Soviet Union and the vulnerability of the United States to Soviet ICBMs. The National Security Council in January 1958 called for the development of an anti-ICBM weapon system "as a matter of the highest national priority."[25] The Army took the lead in advocating for an antiballistic missile system, and it would remain the principal advocate for missile defense until the establishment of the Strategic Defense Initiative Organization in 1984. Army Chief of Staff General Maxwell D. Taylor laid out before Congress the Army viewpoint regarding the defense of the nation against this emerging threat.

> We can see no reason why the country cannot have an antimissile defense for a price which is within reach. I am sure many of you have heard the statement that the dollar requirements for this kind of defense are astronomical and that the whole concept is

> beyond consideration. I can assure you that the studies which I have seen lead me to a different conclusion. We can have an antimissile defense.[26]

In the wake of Sputnik, the launch of which marked the Soviet entrance into space, in November 1957, H. Rowan Gaither, Jr., who led the Gaither Report on civil defense, made the case to President Eisenhower that the nation needed a capability to defeat Soviet ICBMs. This report, while recognizing the importance of deterrence until defenses of U.S. offensive forces and cities were in place, competed against the predominant U.S. defense policy of "massive retaliation" to deter Soviet aggression. The Gaither report saw the benefit of deploying a limited system that could be improved over time through the research and test process.[27] The Advanced Research Projects Agency looked beyond Nike Zeus for a solution and saw the important benefits of operating in space (Project Defender) for destroying missiles in boost phase, but plans for such systems as Ballistic Missile Boost Intercept (BAMBI) were viewed as too far term to pursue.[28]

After the Army's Nike Zeus missile intercepted an ICBM target warhead in July 1962, Army leadership pushed for the development and deployment of a nuclear system to defend the nation. A commission chaired by Lieutenant General Austin Betts and directed by Secretary of Defense Robert McNamara supported the move towards missile defense. It found that defensive technology had not lost ground to offensive technology, a BMD system would limit damage in the event of a nuclear attack, and that missile defense would not disrupt mutual deterrence, a set of findings that would become the center of debate for decades to come and, importantly, which never found a home with Secretary McNamara.[29]

Though McNamara never supported population defense, China's detonation of a nuclear weapon in October 1964 changed the playing field. The Defense Department pushed for the incremental deployment of the Nike-X system (involving the Zeus and shorter range Sprint interceptors as well as advanced phased array radars and fallout shelters), which could be expanded to meet other threats. With the cost of Vietnam weighing heavy and his inability to accept defense as the answer, in 1966 McNamara overrode the Joint Chiefs of Staff and declined to deploy the system in favor of further development of offensive weapons. The principal arguments by opponents of missile defense were that the deployment would disrupt the strategic balance and cause an arms race. Ultimately, McNamara made his decisions about missile defense within the strategic nuclear deterrence and strategic stability framework. Other systems considered in the late 1960s to counter the emerging China threat were sea-based anti-ballistic missile defenses, which involved the deployment of interceptors on ships and submarines and radars on ships in the northwest Pacific and north Atlantic (a concept for defense that was eventually realized with the development and deployment of Aegis Ballistic Missile Defense ships). The Air Force considered air-launched interceptors for use against low-trajectory attacks, but these never moved beyond the concept stage.

McNamara resisted missile defense deployment for as long as he served as Secretary of Defense until President Lyndon Johnson directed the deployment (in part as a response to the Soviet decision to deploy a missile defense system, and in part because of the popularity of missile defense in Congress). In the end, McNamara regretfully decided to support a "light deployment" of Sentinel missile defenses to address the growing threat to the U.S. population from China.[30]

President Richard Nixon initiated a review of U.S. strategic requirements after assuming office in 1969. Essentially Nixon used this review to refocus U.S. missile defenses to protect primarily U.S. ICBM and bomber forces (the "I-69" deployment). He renamed the Sentinel system Safeguard, and Congress approved its deployment in August 1969. Nixon argued that missile defense deployment would be consistent with the idea of nuclear sufficiency, i.e., being in a position to deny an aggressor the ability to impose its will on the United States and its allies. Nixon succumbed to political pressures to move defensive deployments away from populated areas.

Two years into the first round of Strategic Arms Limitation Talks (SALT) the United States and the Soviet Union agreed to the Anti-Ballistic Missile (ABM) Treaty of 1972, which limited the U.S. and Soviet Union to two missile defense sites, each one having no more than 100 interceptors. The 1974 protocol reduced the number of sites for each treaty signatory to one. It also meant that neither side could pursue sea-based, airborne (i.e., mobile), or space-based (i.e., persistent and global) missile defenses.

The Safeguard deployment consisted of an ABM-treaty compliant system of interceptors and a radar at the Mickelsen complex in Grand Forks, North Dakota. Its primary mission was to defend 150 Minuteman missiles. The system relied on the surveillance capability of two radars, the Missile Site Radar located at Mickelson that could look in all directions, and a phased array radar 25 miles away that could look only in one direction, which would cue the Missile Site Radar once the attack was detected over the North Pole.

Two independent nuclear-armed interceptor systems provided a layered defense. The Spartan missile destroyed its target at higher altitudes than the high acceleration Sprint, which operated at hypersonic speeds. Spartan would attack objects in the "threat cloud" of warheads, boosters and decoys, and Sprint would attack the surviving warheads, which became separated from their decoys by the atmosphere. Safeguard was limited by the fact that only 100 interceptors could be deployed and it was not designed to provide reliable point defense. As an area defense system, moreover, it relied on a radar system that would be vulnerable to the black-out effects of an electro-magnetic pulse (EMP) following a nuclear detonation.[31] Safeguard was operational from October 1975 to February 1976. Congress directed the termination of the system, with a majority of Members arguing that the U.S. missile defense system could be overwhelmed by a massive Soviet attack and impaired by EMP.

From the mid-1970s until the early 1980s, the Army's missile defense program sought to develop interceptors that did not require nuclear warheads. By the early 1980s, the Army had succeeded in developing the sensor and guidance technologies that would allow a defensive missile to destroy an attacking warhead by physically colliding with it using so-called hit-to-kill technologies. In June 1984, after three previous attempts, the Army demonstrated hit-to-kill in space in the Homing Overlay Experiment.

Despite the SALT arms control accord addressing strategic nuclear forces and the fact that the United States did not have a missile defense system, the Soviets were committed to improving and growing the number of their offensive missile capabilities, and concern grew among strategic analysts that the Soviets had achieved a first-strike capability, which meant they could destroy America's cities without fear of a devastating retaliatory strike from the United States.

This situation led the Joint Chiefs of Staff, in February 1983, to recommend to President Ronald Reagan that the United States pursue a national strategy that emphasized strategic missile defense. President Reagan's March 23, 1983 televised address to the nation launched a new era in missile defense development. In that speech, Reagan posed a question: "Would it not be better to save lives than to avenge them?" He then called upon the scientific and technical community "to give us the means of rendering these nuclear weapons impotent and obsolete" and directed "a comprehensive and intensive effort to define a long-term research and development program to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles." The United States was now on a course to pursue technology to develop a system to protect the country and ensure that its retaliatory forces would remain survivable. The inability to come up with a survivable deployment mode for the new MX ICBM missile, and the push for a morally acceptable response to a nuclear attack on the United States, formed the core of the justification for the new approach. Senator Malcolm Wallop's vigorous advocacy for a program to develop space-based lasers, General Daniel Graham's (retired U.S. Army) "High Frontier" proposal to deploy space-based rocket-launched projectiles to intercept boosters, and Dr. Edward Teller's push for the development of nuclear-driven directed energy weapons preceded Reagan's call for a new approach, but they were all concepts that would take many years to develop. The Soviet ICBM threat to the United States was urgent and needed an immediate response.

The Road to the Ballistic Missile Defense System

Under the leadership of its first director, Air Force Lieutenant General James A. Abrahamson, the new Strategic Defense Initiative Organization (SDIO) carried out a program of research and development, which led to a decision in 1986 to begin the acquisition of the Strategic Defense System Phase I Architecture comprising a space-based interceptor (SBI), a ground-based interceptor, a ground-based sensor, two space-based sensors, and a battle management system. SBI consisted of a large satellite housing 10 hit-to-kill interceptors and was replaced by a more affordable concept of several thousand Brilliant Pebbles interceptors in 1990. Whereas the large SBI was vulnerable to Soviet ASATs, the sheer number of much smaller independently operated Brilliant Pebbles would have made the use of ASATs highly ineffective. This architecture for defeating a massive Soviet attack was to be refined and improved in subsequent years. Critically, its deployment would require withdrawal from the ABM Treaty.

Following the end of the Cold War, President H.W. Bush reoriented the program so as to defeat limited attacks with his Global Protection Against Limited Strikes (GPALS). GPALS consisted of Brilliant Pebbles interceptors, ground- and sea-based theater missile defenses, and up to six ground-based national missile defense sites for protection of the entire United States, including Alaska and Hawaii (this technology would be the basis for the currently deployed Ground-based Midcourse Defense system). The emphasis by congressional leaders on a limited, near-term deployable, ABM-Treaty compliant system, however, embodied in the Missile Defense Act of 1991 (a compromise law between missile defense advocates and arms controllers), contributed to the demise of the GPALS effort. Moreover, GPALS depended on the success of Brilliant Pebbles, a missile defense element that did not receive the required political support. According to historian Donald Baucom:

> GPALS was radically dependent for its effectiveness upon Brilliant Pebbles, which provided an over-arching, space-based defensive layer that enhanced both theater and

> national defenses. It was the synergism between space-based and surface-based missile defense components that justified the integration of all three components into a coherent system through the design of the GPALS BMC^3 system, which embodied the very essence of this critical synergism.[32]

President William J. Clinton, whose Defense Secretary Les Aspin changed SDIO to the Ballistic Missile Defense Organization (BMDO), emphasized the threats from shorter-range systems, and so interest in the development of national missile defense waned. The Clinton Administration dealt the death blow to GPALS and Brilliant Pebbles (taking "the Stars out of Star Wars") and shifted national attention to theater range threats. The use of Scud missiles by Saddam Hussein's Iraq in the first Gulf War, to include an attack against a U.S. facility in Saudi Arabia that resulted in the deaths of 28 servicemen and injury to 100, further underscored the nature of the proliferation threat in the post-Cold War world.

During this time, the United States continued to make progress in the development of hit-to-kill technologies, which meant it would not have to rely on nuclear or conventional explosives to achieve a kill. The core of the hit-to-kill theater missile defense program in the 1990s was the Army's Patriot missile system (building on the Extended Range Interceptor), the Navy's Aegis air defense system that was being modified to intercept theater ballistic missiles, and a new Army missile defense system known as Theater High Altitude Area Defense (THAAD). THAAD was designed to destroy attacking missiles in space and in the atmosphere at a range greater than that of the Patriot system.

In 1996, new intelligence estimates revealed an emerging ballistic missile threat to the United States by rogue nations. These new intelligence estimates broke from previous estimates produced under the Clinton Administration, which argued that only the four other major nuclear powers at the time were capable of reaching the United States with a ballistic missile. With the unanimous findings of an independent and bipartisan Commission to Assess the Ballistic Missile Threat to the United States (also known as The Rumsfeld Commission), which highlighted the dangers of missile proliferation and the growing threats posed by North Korea, Iran, and Iraq, national missile defense again rose in priority, leading Congress to pass the National Missile Defense Act of 1999, which President Clinton signed into law. The defining feature of this law was not that the country would deploy a system "as soon as is technologically possible," but rather that it stipulated that U.S. policy was to deploy a national defense against "limited ballistic missile attack (whether accidental, unauthorized, or deliberate)." However, law and policy cannot shape the strategic circumstances the country may one day find itself in, which may involve more than simply a "limited" attack. Politics, and the need for consensus, was the driving need for this phrasing, and it is the source of our current weakness in this regard. In any case, this law and its focus on limiting national defensive capabilities, while opening the door for missile defense deployment in the United States, remains one of the political building blocks of opposition to the deployment of a robust, high performing system. Political opposition to deploy a system, continued support for the ABM Treaty, and test failures, led President Clinton to refuse to field the first National Missile Defense system of ground-based interceptors in Alaska in September 2000, which left the door open for President George W. Bush.

SDIO energized and mobilized the country's technology base and provided the United States with a measurable edge over all other nations. Since the days of the SDIO and BMDO, the United States has made significant advances in sensors, battle management, directed-energy weapons, and architectural concepts. Especially important was the development of hit-to-kill interceptors, which made possible the development of theater missile defense systems under President Clinton. Yet solving the ballistic missile problem demanded not only advances in technology, but also breakthroughs in policy.

The United States had its first significant policy change in missile defense when President George W. Bush entered the office in 2001; he was strongly committed to fielding a national missile defense system. Under Bush and the leadership of Lt. Gen. Ronald T. Kadish, USAF, the Director of BMDO, the country undertook a thorough review (unconstrained by the ABM Treaty) of the missile defense program. The President's guidance was to field an effective, *evolutionary* missile defense system (one that did not separate national from theater defense) in the shortest amount of time. The Bush Administration argued that the distinction between national and theater missile defense was artificial, as what might be considered a theater threat to the United States could be considered a national threat to a smaller nation. Indeed, some of the systems under consideration by the Bush Administration would have intercepted threat missiles in the boost phase, essentially blurring the distinction between theater and national defenses.[33] The administration contended that the country could not wait to build the "perfect" system. What emerged from this review was a proposal for an integrated, single system architecture that would attack all ranges of hostile missiles in all phases of flight. This remains the mission of the missile defense program today.

General Kadish pushed for a new approach to management to implement the new program. Defense Secretary Donald Rumsfeld provided the missile defense program manager new management authorities and, in January 2002, changed the name of BMDO to the Missile Defense Agency (MDA). In a dramatic step away from the normal way of doing business in the Pentagon, the Defense Department no longer applied operational requirements documents to the development of the system and made it possible for the program manager to pursue a capability-based, spiral development approach. The idea was to develop different missile defense elements within the single system architecture as quickly as possible and field them on expedited timelines. The Ballistic Missile Defense System (BMDS) was intended to be incrementally improved as component technologies matured and were integrated into the deployed system.

The developers of this new Bush strategy for missile defense saw that it was important for the United States to jump boldly and aggressively into the business of developing and fielding missile defenses so as to obtain an initial operational capability in the field; it could be expanded into a larger capability at a later date (somewhat similar to the decision in the late 1960s to deploy a "thin" defense to address the China threat, which many recognized could be expanded if required). Missile defense needed to demonstrate that it could crawl before it could be asked to walk, and it had to walk before it could run. Something deployed when the country remained vulnerable is better than nothing deployed, even if that something was a rudimentary, minimal system. By fielding an initial capability, the United States established an operating military organization and began development of essential doctrines as well as tactics, techniques, and procedures. Manufacturers of missile defense hardware and software rose up, and research within government and industry was undertaken. Focus came eventually on mission assurance and system reliability. Practical policy-making, operational, and acquisition experience ensured the likelihood that development of an even better system would later be possible.

Of course, critical to the success of the program was President Bush's decision to withdraw the United States from the ABM Treaty, which occurred in June 2002. Subsequently, Bush directed the deployment of a Ground-based Midcourse Defense system to defend the United States against anticipated rogue-state ballistic missile threats. The new program managed by General Kadish had a broad technical base, was "event-based" (vice schedule based) in terms of development, testing, and deployment, and it was joint. No one Service could lay a special claim to the missile defense mission. As a result of defense transformation and a streamlined process instituted by the Secretary of Defense in 2001 to enhance overall integration, the BMD system was managed as a single Major Defense Acquisition Program instead of a loose collection of Service-specific autonomous systems.

With the wide range of missile threats posed by potential rogue adversaries, and those threats constantly changing, the acquisition process could not be "threat-based" (i.e., some certainty exists among defense planners about what threats we face). Any Operational Requirements Document reliant on very precise definitions of a putative threat would be largely based on guesswork and would have hampered the missile defense development process due to the unprecedented engineering work it would require. An evolutionary, capability-based approach, on the other hand, would rely on continuing and comprehensive assessments of the threat, available technology, and proposed solutions. Missile defense developers, in other words, would test and learn from failures and successes. The establishment of a large test bed in the Pacific Ocean was a critical part of the program. According to General Kadish:

> The confidence we achieve through our entire test program is reinforced by the fact that many missile defense test articles fielded in the existing test bed are the same ones we would use in an operational setting. Except for interceptors, which are one-time use assets, we will use the same sensors, ships, communications links, algorithms, and command and control facilities. The essential difference between an inherent capability in a test bed and the near-term on-alert capability is having a few extra missiles beyond those needed for testing and having enough trained operators and logistics on hand and ready to respond around the clock. Once we field the system, we will be in a better position, literally, to test system components and demonstrate BMD technologies in a more rigorous, more operationally realistic environment. Testing will lead to further improvements in the system and refinement of our models, and the expansion and upgrades of the system will lead to further testing.[34]

The idea here was to test the system in its operational environment or one that approximated operational conditions. The system itself would be global in scope and utilize a plug-and-play approach that would enable each system element to operate with every other system element. This system would protect the United States, forces deployed to regions of conflict, and allies and friends.

The original conception of the BMDS architecture strove for a high probability of kill using layered defenses. Reliability, synergy, and effectiveness of the BMD system was to be improved by fielding overlapping, complementary capabilities that hit a missile in boost, midcourse, or terminal phase of flight. The battle management, command and control system had to engage or reengage targets as appropriate. Given the multiple opportunities to hit the target, the system was intended to make missile defense countermeasures more challenging to deploy.

By the early 2000s, hit-to-kill ballistic missile defense had proven itself technologically possible in flight tests and computer simulations. On 16 December 2002, President Bush directed that the Department begin fielding a limited operational missile defense system in 2004-05, and to improve that system over time. Bush's direction also acknowledged the 1999 National Missile Defense Act direction to field a capability "as soon as technologically possible."

The first midcourse elements of the BMDS to go on alert were the Ground-based Midcourse Defense for homeland defense, and Aegis Ballistic Missile Defense using the SM-3 Block IA interceptor for defense against short- and medium-range ballistic missiles. Forces placed on alert as part of the initial configuration for U.S. homeland defense included up to 20 ground-based interceptors at Fort Greely, Alaska and Vandenberg Air Force Base in California, an upgraded Cobra Dane radar on Eareckson Air Station in Alaska, and an upgraded early warning radar in the United Kingdom. The Early Warning Radar at Beale Air Force Base in California was also being upgraded for the missile defense mission. Aegis destroyers were modified with improved SPY-1 radars to provide long-range surveillance and track capability of ICBM threats by the end of 2005. In 2003, the Army sent Patriot Advanced Capability (PAC) 3 missile units for defense against shorter range ballistic missiles in the theaters of battle (and indeed this system performed very well during Operation Iraqi Freedom). Integration of the Patriot system into the BMDS was a top priority. MDA worked with the Combatant Commanders, the Joint Staff, the Military Services and the Director, Operational Test & Evaluation, to prepare for what was known as Initial Defensive Operations. A working relationship with the warfighter was considered to be a fundamental part of the program. General Kadish explained why it was important the system be incrementally improved over time and expanded:

> In a defense emergency or wartime engagement situation, more is better. A larger inventory of interceptors will handle more threatening warheads. Our planning beyond the Block 2004 initial configuration has this important warfighting objective in mind. There are no pre-conceived limits in the number of weapon rounds we should buy. We will build capabilities consistent with the national security objectives required to effectively deter our adversaries and defend ourselves and our allies.[35]

In 2004, General Kadish's successor, Lt. Gen. Henry A. "Trey" Obering, III, USAF, declared limited defensive operations. The operational system consisted initially of five Ground Based Interceptors (GBIs) in silos at Fort Greely, Alaska, Aegis BMD ships deploying SM-3 IA interceptors and the SPY-1 radar, and Patriot units with the advanced PAC-3 hit-to-kill interceptor. In March 2005, according to General Obering:

> (O)ur long-term strategy is to strengthen and maximize the flexibility of our missile defense capabilities. As we proceed with this program into the next decade, we will move towards a missile force structure that features greater sensor and interceptor mobility. In line with our multilayer approach, we will expand terminal defense protection and place increasing emphasis on boost phase defenses, which today are still early in development.[36]

Under General Obering, MDA also deployed the most powerful radar every built for the new test bed and as part of the operational force on a contingency basis. Sitting in the Chesapeake Bay, the mobile Sea-Based X-band radar is capable of seeing a baseball-size object in space over

San Francisco. General Obering also continued work with the Services and the warfighter, the operator of the BMDS. Looking to the future, General Obering thought it was important to continue fielding and expanding the system to stay ahead of rogue threats and to prepare for possible "asymmetric" threats, or launches from off the coast of the United States.[37]

Advanced technology work was critical to this work, to include investments in the development of an Airborne Laser (ABL) and investigations into the feasibility of space-based interceptors. The ABL and another boost-phase development effort, the Kinetic Energy Interceptor (KEI), were intended to deprive the adversary of opportunities to deploy midcourse countermeasures and, in a layered defense scheme, reduce the number of missiles and reentry vehicles having to be countered by midcourse and terminal defenses. With the Multiple Kill Vehicle program, U.S. missile defenses could attack multiple lethal objects in a cluster using a single interceptor. General Obering pushed for concept analysis and preparation for space-scale experiments demonstrating an integrated, space-based interceptor layer. He noted that "space systems could provide on-demand near global access to ballistic missile threats, minimizing limitations imposed by geography, absence of strategic warning, and the politics of international basing rights."[38] Expansion and upgrades of the networked Command, Control, Battle Management, and Communication infrastructure required to integrate the global BMDS also received significant attention under General Obering.

In the mid-2000s, in order to deal with the projected ICBM threat from Iran, the United States pushed to deploy the first truly layered defense of the U.S. homeland by involving European NATO allies in the deployment and operation of the BMDS. The so-called "Third Site" initiative in Europe involved fielding 10 two-stage ground-based interceptors in Poland, an X-band midcourse radar in the Czech Republic, and a forward-deployed radar in southern Europe along with the associated C2BMC infrastructure to attack hostile missiles in the ascent phase launched out of the Middle East. The planning and much of the political and technical groundwork for this was well underway when Barack Obama was elected President in 2008.

President Barack Obama essentially continued to support the continued development of the BMDS, but he made significant cutbacks to homeland defense investments. Nevertheless, under General Patrick J. O'Reilly, USA, and the current Director, Vice Admiral James D. Syring, the United States continued to upgrade and improve the deployed GMD system. The Administration initially directed that the projected number of Ground Based Interceptors (GBIs) deployed in Alaska be reduced from 44 to 30. In 2009, Obama also cancelled the Third Site initiative and implemented the European Phased Adaptive Approach (EPAA) to deploy U.S. "upper tier" sea- and land-based missile defenses in Europe in four phases to supplement NATO "lower tier" systems as short- and longer-range missile threats from the Middle East proliferated. Phase 4 of the EPAA featured the development and deployment of the high acceleration Standard Missile-3 Block IIB interceptor in Poland for early intercept of ICBMs launched from Iran toward the United States.

In 2013, Obama terminated the development and deployment by the end of the decade of the high acceleration Standard Missile-3 IIB interceptor (which was still early in development) in Poland. This program could have provided the United States with a forward deployed capability to counter ICBMs from the Middle East. When considering the decision to forego the deployment of the 2-stage GBIs in Poland, the United States (under the same Administration) twice abandoned plans that would have provided a truly layered defense to give the system a shot at ICBMs launched from Iran first from Europe and then, if needed, from the United States using the Ground-based Midcourse Defense system. The Obama Administration insisted that Russian objections to both European systems had no impact on their deployments; rather, technical and system performance challenges and the desire to focus on theater-range threats to our NATO European allies drove those decisions.[39]

Current investments in regional missile defenses, to include systems being deployed to defend European NATO allies as part of the European Phased Adaptive Approach, can play a role in protecting the U.S. homeland by helping to prevent war or escalate a conflict.[40] Yet, leading political figures have questioned whether the emphasis in the Obama Administration on regional defense has short-changed investments in homeland missile defense.[41] To be sure, regional systems may be used to intercept a ballistic missile heading toward the United States in the ascent phase, or as it is rising, making those homeland defense systems as well.

Currently, tinkering at the edges of the system, the Administration is planning to expand the number of GBIs deployed in Alaska from 30 to 44 to offset North Korean advances in the development of a very disconcerting road mobile ICBM and to counter potential Iranian ICBMs. The United States also is improving its sensor coverage to better view and track ballistic missiles launched from North Korea by deploying a second X-band radar to Japan. Plans are also in place to develop and deploy a Long Range Discrimination Radar to improve midcourse tracking coverage of threats coming towards the United States from the Pacific Theater. And recently, there has been a great deal of focus on development of a third Ground Based Interceptor site in the continental United States to expand homeland defense capabilities to improve protection again North Korea and Iran.[42] The Department of Defense has not yet made a decision on whether to pursue development of the third interceptor site.

Limitations of the BMDS

The Bush Administration's deployment of a ballistic missile defense system ended a bitter partisan battle and inaugurated a new defense era. There is a limited, fixed system now in place to defend the U.S. homeland against ballistic missile attack from specific regional powers, i.e., North Korea and Iran. Thirty GBIs are operationally available today at missile fields in Alaska and California. While the program is still in its infancy, it is beginning to develop a system to do "the impossible"—which is what many planners, policymakers, and opinion makers thought about "hit-to-kill" just a short time ago. Although a few critics of the U.S. missile defense program continue to maintain an effective system is technically impossible and the current program is a waste of money, significant successes in the test program have put the hit-to-kill technical feasibility issue to bed. Others claim that missile defense is a costly distraction from investments in other more pressing areas of national defense.[43] Most agree, however, that significant work still needs to be done in the area of discrimination.

The shorter-range systems, Patriot Advanced Capability-3 fire units, demonstrated under combat conditions in Operational Iraqi Freedom the major advances that have been made in hit-to-kill technologies. Defenses against intermediate- and intercontinental-range ballistic missiles are more challenging. Longer ranges mean operating in a battle space that potentially stretches over thousands of miles and has a depth in altitude that reaches from the lower atmosphere to hundreds of miles into space. Longer-range threats also are more challenging because of the high speeds of the attacking missile and interceptor. Yet, even here several tests have demonstrated the ability to intercept medium- to long-range missiles, from land and from sea. The United States continues to use space-based infrared satellites to warn of a launch and has developed a network of fixed, land-based sensors (upgraded early warning radars) deployed in the United States, United Kingdom, and Greenland to be the "eyes" of the system. Supplementing surveillance and tracking radars are forward deployed X-band radars (deployed in Japan, Turkey, and the Middle East) that will provide significantly more detailed information about the in-flight threat, which will enhance the performance of the system. The entire system is integrated by a very sophisticated global command, control, battle management and communication system, which is operated in Colorado Springs and Alaska.

The attraction of a midcourse defense system similar to the one currently deployed by the United States is that it can provide protection for the entire country against ICBM type threats launched from a point in the northern hemisphere over the oceans from just two, or a few, interceptor sites. It is adaptable to shifting threat locations, ideally within the northern hemisphere. By increasing the number of interceptors, the system can counter more long-range threat missiles.

With the current deployment of 30 GBIs, on the way to 44, the system has an obvious interceptor inventory shortfall against any country with more than just a handful of ICBMs. One way ostensibly to get around this idea that the country is vulnerable to possible ICBM attack is to turn a blind eye and not recognize as a potential threat, any adversary with more than just a handful of ICBMs in its arsenal. This is essentially what the United States has done.

In the current BMDS, the United States has demonstrated flexibility in its regional defense capabilities using Aegis BMD, which has demonstrated in numerous tests its ability to hit ballistic objects in the midcourse phase of flight. By the summer of 2014, Aegis BMD had destroyed its target 18 out of 21 times using the operationally configured interceptor. The system has the advantage of being housed on a ship, which is mobile, and thereby provides the system some flexibility; this is useful when the threat shifts locations. Also, in April 2011, the United States demonstrated the ability of the Aegis BMD ship to use "launch on remote" to destroy a long-range target. In that test, the Aegis BMD ship took cuing information from a forward-deployed AN/TPY-2 X-band radar to successfully engage and then hit an intermediate-range ballistic missile.

All systems have limitations. One limitation highlighted by critics concerns the ability of the BMDS (GMD in particular) to deal with midcourse countermeasures, a criticism that ignores significant technological progress made over the past decades in the development of discrimination technologies (sensors and algorithms). Moreover, the BMDS operates in such a way that all of the sensors of the system share information about the target, giving operators a fuller picture of what they face. In June 2014, the Missile Defense Agency demonstrated the ability of the second generation Exo-atmospheric Kill Vehicle to destroy the target after correctly discriminating, and then intercept the target reentry vehicle in the presence of realistic countermeasures.[44] Nonetheless, discrimination of the reentry vehicles from debris and countermeasures is universally recognized as a technical challenge, with some claiming that the challenge is insurmountable. To be sure, the development and operation of missile defense countermeasures is not easy, and critics give countermeasure developers, especially the makers of sophisticated countermeasures, far too much credit, to include precise knowledge of the BMDS and the way it operates. Adversaries, such as Iran and North Korea, have not tested their countermeasures and cannot have confidence they will work; they also have the difficult task of responding to BMDS counters to BMD countermeasures.[45] Nevertheless, any practical missile defense system must have a way to discriminate real from phony or non-threats.

The system must make adjustments for maneuvering reentry vehicles in midcourse, which could fool the system into thinking the target will be in one place when it will actually be in another. Also, the system, as with any system, could be overwhelmed. Multiple, near-simultaneous launches or the presence of multiple reentry vehicles in a target scene or spread out in an attacking corridor could overwhelm the ability of the sensors and the C2BMC to track and cue interceptors. Clearly, overwhelming numbers could also saturate the battle space and deplete the inventory of interceptors.[46]

The system must rely on fixed, land-based sensors deployed on allied territory. These sensor facilities and infrastructure are generally located closer to the threat. Currently, the United States operates Upgraded Early Warning Radars in the United Kingdom and Greenland (UEWRs are planned for activation in Clear, Alaska by 2017, and in Cape Cod, Massachusetts by 2018), and forward-based X-band radars in Japan, Turkey, and the Middle East. The current BMDS depends on continued host-nation approval for the use of these critical sensors.

The system's sensors are oriented to maximize viewing of missile threats launched from two countries, North Korea and Iran. In effect, we have set up the means to watch the flight of missiles within very specific corridors that track from the threat country to target areas in the United States.[47] Change the threat country, or move the ballistic missile launches outside the boundaries of the targeted country, and the missile defense mission becomes more challenging. This would include the launch of shorter-range ballistic missiles (which might carry a weapon of mass destruction) off ships that are close to U.S. shores. The United States has large population centers off both coasts, and the ship itself would have no immediate national return address (although the ship would be targeted by retaliation and counterforce strikes by the United States).

The ballistic missile defense system architecture relies on the integration into a single system of all missile defense elements no matter where they are in the world or whether the threats are long- or short-range. Multiple defensive layers, with system elements working together synergistically, are central to the approach for regional defenses (which integrates short- and medium-range land and sea-based systems). No one layer or interceptor design can do this global mission on its own. Moreover, regional missile defenses offer flexible architectures that can be moved from region to region depending on the threat. The question is: Can the United States do the same, use layers of systems and mobile weapon systems, for homeland defense?

Since President Bush directed the fielding of missile defenses, U.S. strategy has been one of deploying what we have shown can work to achieve a limited defensive capability for the United States against North Korea and Iran, and then expanding coverage to our allies and friends to address more robust regional threats. Many of the interceptors and sensors in the current system are fixed to geographic points to defend against a clearly identified threat. In the future, however, the United States may not have that luxury. The current fixed, land-based system of Ground Based Interceptors for long-range defense of the U.S. homeland clearly has limitations, especially in its ability to address unpredicted threats and its ability to deal with large numbers of threat missiles. This architectural rigidity results in inflexibility for addressing new, evolving threats to the homeland. Currently, the United States is not well-positioned to deal with threats from Russia or China. Moreover, its assets may not be well-positioned to defend against missiles launched from surprise locations, such as a ship or submarine off our shoreline or an attack from the southern hemisphere. Given what is at stake, and the potential of a single nuclear strike on U.S. soil to create catastrophic conditions across the country, this is clearly unacceptable.

Section 4. Policy Obstacles to Homeland Defense

While there is broad support in government and in the American public for a missile defense system, that political consensus breaks down over the future architecture and scope of the ballistic missile defense system. The current ballistic missile defense system deployed to protect the United States, and its future direction, are both built upon a static weapon system architecture, which itself is partially based on a static view of the strategic landscape. Fixed operational assets currently deployed (interceptors in silos, and large sensors based in the United States and on the territories of our allies) arose out of a plan to deploy a system as soon as technologically possible. Political developments since that time have narrowed the focus of the threat, limiting attention primarily to regional state powers, and restricted technological investments and developments. Today, the United States generally lacks a serious plan to improve missile defense system efficiency to counter more robust missile attacks.

Significant policy obstacles currently stand in the way of critical improvements to the BMDS. Certain defense architectures are dismissed out of hand owing to policy concerns (e.g., weapons in space), affordability concerns (e.g., again space systems), and technical concerns (e.g., directed energy or boost phase defense). Yet, given the history of conflict, the fact remains that potential ballistic missile adversaries over the next several decades could include nations with which we now have complex commercial and security relationships, such as Russia and China. These two nations have made considerable investments in ballistic missile forces, nuclear weapons modernization, and, in the case of Russia, its ballistic missile defense system. Several regional powers have significantly improved their ballistic missile forces.

Policy decisions made over a 70-year span (as opposed to technical or cost constraints) have put the United States in a position today where it lacks efficient defenses. Moreover, it does not appear to be moving toward a defensive capability to protect the nation against ballistic missile attacks from Russia or China. Of all the weapons known to man, the United States has made a deliberate choice not to attempt to actively counter one of them—ballistic missiles—at least in anything other than a very numerically limited contingency. Try to think of another weapon system for which the United States has deliberately refused to seek a counter? The arrival of the nuclear age certainly weighs in this consideration. The idea of catastrophic destruction turned thinking upside down and led decision makers and defense analysts to a dubious conclusion—homeland defenses against nuclear ICBMs are not possible and inherently bad, i.e., destabilizing. While military officials early on tried to convince the civilian leadership that defenses against these new weapons were technologically possible, they were eventually overwhelmed by new thinking in the seats of power.

Controversies over missile defense, which began in earnest back in the 1950s, have involved various debates over technological feasibility, affordability, and policy. The reason the United States does not have a more robust system in place today, however, is not technological. Is there any doubt that, given the intellectual capital that resides in the United States, the country could not have achieved a higher capacity, more capable, more efficient missile defense by 2014? Consider the great technological advances made over the past 70 years in computers, Global Positioning System satellites and user equipment, rockets and satellites, medical sciences and healthcare, artificial livers and hearts, smartphones, Internet, and advanced lightweight materials and fabrics. Given the right focus and commitment of resources over the past seven decades, the United States could be in a very different defensive posture today.

Nor is the reason for a diminished defense system economic in nature. Think of the tremendous wealth generated within the United States and the wasteful spending that has occurred over the past decade, with frivolous national spending on economic stimulus packages and expansionist welfare policies. The reason the United States is in its current position is primarily political.

The Threat—The View Through Rose Colored Glasses

The question before us is this: is it prudent to ignore and choose not to actively defend against the threat of catastrophic ballistic missile attack on the United States? One could respond that indeed the United States is not ignoring this threat, as ballistic missile defense development and deployment is in full-swing. Or is it? And, if it is in full swing, is it going in the right direction?

There are questions about how the United States should proceed with missile defense of the homeland in a century that promises to see the continued spread of, and improvements in, long-range ballistic missiles and weapons of mass destruction. Today it may be argued that the country wears blinders and ignores significant ballistic missile system developments and deployment realities that have taken place in Russia and China. This is the case despite the fact that many of our elected and defense leaders unabashedly recognize that the nation should deploy capabilities to defeat threats to the nation that may appear. According to the 2013 *National Security Strategy*, "Americans must adopt the view from within and without that we are a nation 'first among equals' to reflect the trends of demographics, global finance, and military power…. The United States will maintain the most capable armed forces in the history of the world, in order to pursue our tradition of peace through strength." U.S. defense leaders interpret this to mean, "our foremost priority is the security of the American people, our territory, and our way of life." To accomplish this, "the core task of our Armed Forces remains to defend our Nation and win its wars. To do so, we must provide capabilities to defeat adversary aggression." As a nation, we "must ensure access, freedom of maneuver, and the ability to project power globally through all domains."[48]

One interesting fact about such high-level strategy and defense documents is that they tend to talk around the military power of China and Russia; other nations such as North Korea and Iran are dealt with by name and to a rather extensively degree. In fact, the Obama Defense Department goes to great lengths to dismiss the Russian and Chinese ballistic missile threat as one that is worth addressing actively with defenses. According to the February 2010 *Ballistic Missile Defense Review* report:

> Today, only Russia and China have the capability to conduct a large-scale ballistic missile attack on the territory of the United States, but this is very unlikely and not the focus of U.S. BMD. As the President has made clear, both Russia and China are important partners for the future, and the United States seeks to continue building collaborative and cooperative relationships with them. With Russia, the Administration is pursuing an agenda aimed at bringing the strategic military postures of the two countries into alignment with their post-Cold War relationship—no longer enemies, no significant prospect of war between them, and cooperating when mutually advantageous. The

> United States will continue to engage with Russia's neighbors as fully independent and sovereign states, and looks forward to a peaceful and prosperous Russia that makes contributions to international peace and security as a global partner. The Administration is closely monitoring China's continuing buildup of military capability, including its missile forces. While the United States will ensure that we can defend our interests in the region, we remain committed to a relationship that is positive, cooperative, and comprehensive and do not believe a hostile or adversarial relationship with China is by any means inevitable.[49]

The use of the phrase "is very unlikely" leads one to ask, compared to what? Surely it is not as unlikely as the Earth being struck by a catastrophe-inducing meteor. And, within our predictions of the future, are not most conflicts deemed "unlikely" at some level? Have not many conflicts in history surprised us? Nevertheless, as indicated by the primary national security documents listed above, U.S. strategies are designed to prepare the nation for such unlikely events. If the country were only to prepare for what is likely, would it not leave itself open to being blindsided by unforeseen developments?

Moreover, the February 2010 Ballistic Missile Defense Review (BMDR) report does not see fit to address threats to the homeland in its discussion of future "trends." The focus in that section is on regional threats and non-state actors. While the BMDR stresses the country must be "well hedged" to defend against unpredicted threats to the homeland, that universe of threats does not include Russia or China. China's regional threat is discussed, but not the possible threat it could pose to the territories of the United States. "Moreover, China has upgraded programs for command and control, communications, intelligence, and other related force capabilities, and continues to develop new SRBMs, MRBMs, and IRBMs. These missiles are key components of Beijing's military modernization program." Curiously, the BMDR does not address China's ICBM or SLBM modernization activities.[50]

Given Chinese offensive missile developments and rhetoric from Chinese leadership, one must ask whether it is wise to ignore the possibility of a Chinese threat. In November 2013, Chinese state-run media for the first time revealed how China's nuclear submarine force can attack the United States to counterbalance the U.S. deterrent. The *Global Times* reported that "the 12 JL-12 nuclear warheads carried by one single Type 094 SSBN can kill and wound 5 to 12 million Americans." Also, the state-run media reported, "if we launch our DF 31A ICBMs over the North Pole, we can easily destroy a whole list of metropolises on the East Coast and the New England region of the U.S., including Annapolis, Philadelphia, New York, Boston, Portland, Baltimore and Norfolk…."[51]

Despite expressions of hostility by prominent Russian and Chinese officials, and their development of advanced military forces, the Obama Administration views both Russia and China as "important partners," and therefore obviates the need to build missile defenses to defeat their forces. Under such circumstances do we really want to put them in the category of "ally," the same term we apply to states such as Japan, United Kingdom, France, Australia, and Germany? Nevertheless, the topline objective of U.S. missile defenses currently is to preserve strategic stability with Russia and China.[52]

Clearly the United States has prepared its conventional forces for possible engagements with large armies and hostile sea powers (as is evidenced by U.S. investments in land, sea, and air forces), but why are its defense leaders confident that these conflicts will not escalate to involve ballistic missile warfare? U.S. leaders appear to justify their lack of attention to adequate missile defenses by stating we are no longer enemies of Russia and China and, rather, look forward to building peaceful and prosperous relations with them. Clearly, we all wish for that and want to work toward that objective. However in accordance with defense planning tradition, war plans are developed with the idea that unanticipated events can occur. One might also understand the position of the Administration to be one of throwing up its arms and declaring "we can't do it," which means in the end that "we won't do it." And since "we won't do it," is it not better to talk about a rosier picture, one where leaders talk themselves into believing they do not need a formidable missile defense capability to either deter or defeat ballistic missile strikes from either Russia or China because such conflicts are unthinkable? While the Obama Administration does "not believe a hostile or adversarial relationship with China is by any means inevitable," its position is one that clearly does not have (missile) defense as the highest concern. Confrontations are seldom inevitable; rather they emerge out of the gray area between "impossible" and "inevitable."

The George W. Bush Administration, which initiated the development and fielding of the current BMDS, similarly focused on "new adversaries" such as North Korea. In National Security Presidential Directive 23, issued in 2002, the Bush Administration argued that the dynamics of deterrence are different than in the Cold War when the United States sought to keep the Soviet Union from expanding outward. Administration officials argued that post-Cold War adversaries sought to keep us out of their region, leaving them free to support terrorism and pursue aggression against their neighbors. By their own calculations, rogue leaders may have believed they could do this by holding a few of our cities hostage. Such adversaries seek enough destructive capability to blackmail the country from coming to the assistance of friends who would then become the victims of aggression. In 2002, the United States also formally withdrew from the 1972 Anti-Ballistic Missile Treaty with the Soviet Union, overcoming standard objections from Moscow and those leaders and opinion shapers in the United States who argued that the world would tumble inexorably into chaos if the United States went through with the withdrawal. Those dire predictions did not come to pass (leaving one to consider whether dire predictions concerning improvements to the current BMDS might ever materialize).

In 2000-2001 the U.S. focus on rogue state ballistic missile capability was based on a sound rationale. Bush Administration officials believed that the context for deterrence at that time was markedly different from the era of the Cold War. The motivations and calculations of leaders in North Korea, Iran, and Iraq were viewed as being based on very different premises than those of the Americans or Russians. In fact, leaders of these countries could have made decisions that were irrational. Had Saddam Hussein possessed ballistic missiles capable of reaching the United States at the time he faced the total destruction of his regime, why would he not have considered attacking a then-defenseless United States? There was, of course, deterrence through the threat of offensive retaliation, but in an "end of days" scenario, deterrence might have failed, as it did in the dire circumstances present in 1775 when the American colonies took on the mighty British military forces; when Austria-Hungary attacked Russia (1914); when Japan attacked the United States (1941); when Hitler set out to conquer Russia (1942); when North Vietnam took on the United States superpower (1960s and early 1970s); when Saddam Hussein attacked Kuwait (1990); or when the Syrian regime used chemical weapons against rebel forces and its own population (2013), despite the "red line" declaration of the United States. During the Bush Administration and its consideration of the role missile defense could play in the defense of the country, officials conceived of the possibility that the conventionally superior United States could be deterred from acting in its own best interests by a country wielding a ballistic missile armed with weapons of mass destruction (WMD).[53]

One could argue that the United States was in a period of transition out of the Cold War and, therefore, it made sense not to direct the nascent missile defense program, which would necessarily be limited, against Russia. Moreover, in 2002 the Administration saw in North Korea a more urgent threat and lacked any missile defense capability whatsoever. In other words, rather than wait to deploy a highly robust system perhaps it was better to get some capability out into the field, however rudimentary, than to continue in a state of complete vulnerability to a state such as North Korea. One could conclude that the United States operated under the doctrine of Mutually Assured Destruction vis-à-vis Russia and China, and, in fact, continues to do so today. Even while building missile defenses to counter other states that are building ICBM strike capabilities and are projected to expand those ICBM forces and improve them to make them more capable against our missile defenses, the United States continues today to rely primarily on its offensive nuclear forces to ensure its security against a nuclear attack from Russia or China.

Despite the fact that the United States currently deploys no missile defense capability against Russian ICBM forces, Russia's political and military leaders continue to develop the RS-26 MRBM/IRBM, which it is calling an ICBM, circumventing the 1987 Intermediate Nuclear Forces Treaty and, potentially, the 2010 New Strategic Arms Reduction Treaty (START).[54] The RS-26 reportedly has multiple supersonic, maneuvering warheads designed to defeat U.S. missile defenses in Europe. To be sure, these countermeasures could also be used on ICBMs.[55]

Nevertheless, the Bush Administration differed fundamentally from the Obama Administration in at least one important respect. The GMD element of the BMDS was viewed as a building block for the development of more robust capabilities in the years ahead. In fact, the "Blocks" featuring greater improvements over time were a key part of the Bush acquisition strategy. The initial capability fielded in 2004 was a "starting point" for deploying improved and expanded capabilities later to meet the changing threat. The compositions of missile defenses, in number and location, were to change over time and would be capable of intercepting all ranges of missiles in boost, midcourse, and terminal phases of flight. The threat would drive change in the system. For a while, at least, Bush Administration officials privately raised China as a possible adversary (while Russia was ruled out). China, they argued, deployed a handful of strategic ballistic missiles and was a nation against which the United States should be prepared to defend itself.[56] The early architects of the system envisioned the development of boost and midcourse interceptors, as well as sensors based at sea, on the ground, and in the air, and eventually in space.

Indeed, the "defense against limited attack" has been a consistent mantra since the National Missile Defense Act of 1999, although the authors of this law also recognized the importance of defending against accidental or unauthorized launches from countries such as Russia or China. So, one can argue that the desire not to focus our missile defense efforts on Russian and Chinese ballistic missile forces was a reasonable decision at the time. Whether out of practical necessity or because of political estimations that steps to counter those larger ballistic missile forces would be diplomatically or even strategically counter-productive, one is still faced with the question: is it prudent today to take steps to actively counter a possible ballistic missile attack from either Russia or China?

The United States has the military ships, aircraft, personnel (forces), and associated defense infrastructure to fend off challenges to U.S. power at sea, in the air, and on the ground. That strength outmatches weaker countries, and also takes into account the possible aggressive exercise of military power by countries such as China and Russia. The rationale is not that the United States is likely to be engaged in a battlefield struggle with these two powers, but that political events may change over time to the point where it would want forces in place to either deter or defeat their possible aggression. U.S. defensive capabilities exist to match, more or less, the foreign offensive capabilities that may be deployed against it. The country does not do this to provoke or anger China or Russia, but because it is a prudent thing to do to enhance national security. Moreover, the United States maintains stable relationships with China and Russia despite the deployment and operation of very capable military systems that may be used against them. One may question why the United States cannot do the same with its missile defenses? Why would the deployment of a strictly defensive robust system be viewed as provocative?

In the case of homeland missile defenses, a review of country by country inventories of ballistic missile forces reveals a clear imbalance of foreign offensive forces to U.S. defensive forces. U.S. leaders resolve this imbalance by narrowing down the list of countries that possess, or are projected to possess, capabilities to strike the United States with ballistic missiles—essentially, North Korea and Iran (and Iraq before 2003). In the context of this small field of adversaries, the current homeland missile defenses appear adequate to the task. U.S. officials also assert that the current BMDS may be upgraded and expanded to meet the projected expansion of ballistic missile capabilities by these two countries.

This is important because uncertainty prevails in international strategic relationships. Circumstances that bring peace or incite war change over time, sometimes dramatically, and sometimes even overnight. Who could have seen the U.S.-led invasion of Iraq in 1991 following a humiliating withdrawal of the United States from Saigon in 1975, considering that the legacy of the very unpopular Vietnam War was still firmly in the minds of most American leaders? In February 1989, following the withdrawal of Soviet forces from Afghanistan, who would have thought the United States and its allies just a little more than 12 years later would engage in military operations to invade that country? This, of course, was precipitated by a critical underestimation of Al-Qaida and the historic attacks of September 11, 2001. The point here is not to argue that the country may eventually go to war with ballistic missile powerhouses such as Russia and China. Rather, it is to underscore the fact that history has a way of surprising leaders, and U.S. planners need to be cautious about projecting trends; they must prepare defenses that will be adequate even in uncertain times.

BMD Is "Destabilizing"—The Ultimate Logic Pretzel

Balance-of-terror thinking is alive and well and remains the most compelling reason for the U.S. decision not to deploy highly efficient missile defenses designed to counter possible missile launches from Russia or China—or in the future, rogue states with more sophisticated and numerous ICBM forces. Mutually Assured Destruction determines what is "provocative," "destabilizing," what "works" and what does "not work." One has faith such an overwhelming ballistic missile attack will never occur, because one believes in the strategic stability argument put forth by Thomas Schelling in the 1960s, put into practice and developed as a catechism by Defense Secretary Robert McNamara, and enshrined into law by President Richard Nixon, who continued the McNamara approach and reaffirmed and codified the balance-of-terror thinking in the 1972 Anti-Ballistic Missile Treaty.

Schelling recommended a "stable balance-of-terror" be achieved with the Soviet Union by keeping the nation vulnerable—mutual vulnerability would ostensibly ensure safety. The United States could deploy a modest set of nuclear capabilities, enough to threaten Soviet society with destruction, and this would create a strategic environment wherein neither side would believe it could successfully attack the other side without suffering a devastating retaliatory strike. Thus, both sides were compelled to avoid a damage limitation strategy that featured costly active missile defenses. Defenses, Schelling argued, would contribute to the fear of surprise attack, because the country that struck first could then defend against a retaliatory strike.[57] Missile defenses could work to support a stable strategic balance, but only by protecting offensive strike forces, not populations. Hence, the logic pretzel: Keeping U.S. cities open to attack by nuclear forces is good and "stabilizing," while protecting American lives from nuclear attack is bad or "destabilizing." This led to a national policy of maintaining the country's vulnerability by holding the American population hostage to a possible catastrophic attack from nuclear ICBM forces.[58] MAD precepts have been repeated so often that the nation's leaders have been conditioned to reflexively respond to the assertion that defenses against nuclear powers are undesirable.

The so-called "destabilizing nature" of BMD also was raised as an argument for failure to deploy even a limited missile defense system. In 2004, prior to the activation of the BMDS by President Bush, 49 Generals and Admirals denounced the controversial move in an open letter, calling it ill-considered and unnecessary. Specifically, the former flag officers had in mind the limited homeland defensive capability provided by the ground-based midcourse defense system. Retired military leaders led by Admiral William J. Crowe contended that the system had not been operationally tested and that the cost would be prohibitive. They believed that the homeland would be sufficiently protected even against a state terrorist group, citing the protection offered by MAD: "U.S. technology, already deployed, can pinpoint the source of a ballistic missile launch. It is, therefore, highly unlikely that any state would dare to attack the United States or allow a terrorist to do so from its territory with a missile armed with a weapon of mass destruction, thereby risking annihilation from a devastating U.S. retaliatory strike." The authors of the letter also criticized the priority the President had placed on missile defense, writing that it was not a militarily responsible course of action when steps should be taken to prevent terrorists from smuggling a weapon of mass destruction into the United States.[59] Of course, states like North Korea and Iran continue to build long-range missile forces.

Clearly, North Korea and Iran were investing in long-range ballistic missile development long before the United States activated its limited homeland missile defenses. Nevertheless, there are still those who contend that Pyongyang and Tehran should build offensive systems because the United States is building defensive systems. Consider, e.g., Yousaff Butt: "Fielding a missile shield may even encourage adversarial countries to build up missile and warhead stockpiles to ensure that some make it through unstopped. A good way to encourage the North Koreans to build more missiles would be to surround them with missile-defense interceptors."[60] This is classic balance-of-terror reasoning.

Some analysts assert that the United States also should not build missile defenses to protect its citizens against a missile attack from China. China has a smaller force than Russia, and a U.S. missile defense system would upset the "strategic balance" the nation has with that state. According to Stephen Walt, China currently has "a modest strategic nuclear force," "only about 240 nuclear warheads," and "only a handful of ballistic missiles" capable of reaching the United States. By comparison, he writes, the United States has over 2,000 operational nuclear warheads. According to the tenets of MAD:

> Given its modest capabilities, China is understandably worried by U.S. missile defense efforts. Why? Chinese officials worry about the scenario where the United States uses its larger and much more sophisticated nuclear arsenal to launch a first strike, and then relies on ballistic missile defenses to deal with whatever small and ragged second-strike the Chinese managed to muster. (Missile defenses can't handle large or sophisticated attacks, but in theory they might be able to deal with a small and poorly coordinated reply).[61]

Walt points out that "the [Chinese] goal is to ensure a secure second-strike capability that could survive in the worst of worst-case conflict scenarios, whereby an opponent would not be able to eliminate China's nuclear capability by launching a first strike and would therefore face potential retaliation." Sound familiar? He concludes, "what China is doing is a sensible defensive move, motivated by the same concerns for deterrent stability that led the United States to create a "strategic triad" back in the 1950s." It is "sensible," of course, according to the Schelling/Balance-of-Terror precepts. The best way to "cap or slow" Chinese nuclear modernization, Walt further argues, the "smart way," is to "abandon the futile pursuit of strategic missile defenses" (read homeland defenses) and begin negotiating an arms control accord with Beijing. It is a little unclear why Walt is so certain of this "sensible" line of reasoning. The United States tried the exact approach during the 1970s, even signed an ABM accord codifying the stability logic, and failed monumentally to restrain Soviet nuclear modernization. From 1971 through 1985, the growth in Soviet strategic offensive forces included: four new types of ICBMs (SS-17, 18, 19, and 25), five new types of ballistic missile carrying submarines, four new types of submarine-launched ballistic missiles (SLBMs), five improved versions of existing SLBMs, and long-range cruise missiles. During that same period, U.S. strategic offensive forces declined significantly in both number and quality.[62] Despite that absolute failure and the fact that this logic (however flawed) seems fitting only for the special circumstances presented during the Cold War, Walt continues to insist on applying the MAD argument to a very different strategic environment.

Before its demise, the ABM Treaty was often described as the "lynchpin of strategic stability." In fact, these exact words were used repeatedly by Clinton Administration officials during the years when there was a serious push in Congress and parts of the Administration to deploy a National Missile Defense system in the late 1990s, which never materialized. The treaty's key restrictions: the country could deploy only one ABM site (following the 1974 agreement); no more than 100 ground-based interceptors could be deployed at the site; there could be no development, testing, or deployment of sea, air, space, or mobile ABM systems; there must be no deployment of systems based on other physical principles (e.g., lasers or particle beams); and, there would be speed and testing parameters for Theater Missile Defenses. Essentially, neither party could deploy a missile defense that covers its entire territory. Each party's defense could protect a single site, with no more than 100 interceptors deployed. Indeed, Russia has such a system today to defend Moscow that features nuclear interceptors;[63] the United States deployed one site to protect missile fields in North Dakota in the 1970s, but shut it down five months after it was made operational.

The ABM Treaty hindered the type of missile defense activity, research, and deployments desired by President Bush to protect the country against future terrorist or rogue state missile attacks. Consequently, on December 13, 2001, he announced the legal U.S. withdrawal in accordance with the process outlined in the treaty; the formal withdrawal took place six months later. Bush's critics at home and abroad argued that this action (the first such withdrawal from a major nuclear arms accord)—called an "abrogation" by critics—would incite a new arms race and undermine other major accords, including the Nuclear Nonproliferation Treaty. Despite dire warnings by those who pushed MAD to restrain U.S. BMD deployments, the sky did not fall. In fact, President Putin, on the day of the withdrawal, said that this was not a threat to Russian security, and that Russia planned larger reductions in its offensive nuclear forces. The bottom line is that the treaty failed to perform as advertised. Balance-of-terror adherents argued that the prohibition of missile defenses for homeland defense would prevent a nuclear arms race and help ease tension between the two countries. However, the treaty appeared to be inconsequential to U.S.-Soviet relations; more importantly, it did nothing to stop the nuclear missile race in the 1970s and 1980s. U.S.-Russian relations have changed since 2001-2002, as have Russian talking points on missile defense. In the case of China, its opposition to U.S. withdrawal from the treaty and its homeland defense plans is reflected concern expressed by Chinese leaders that U.S. plans would severely undermine China's "small" strategic deterrent capability.[64]

What all this means is that Russia and China essentially have made themselves players in the development and deployment of the U.S. missile defense system. Criticisms by Russian and Chinese leaders of U.S. missile defense plans are a club grabbed by U.S. domestic critics of missile defense to pummel U.S. BMD supporters. As sensitive as they are to every Russian and Chinese voice of opposition and concern about the "destabilizing" nature of U.S. plans, and as concerned as they are about "complicating" our relations with those two nations, domestic critics often appear to pay more heed to the policy and strategy priorities of Beijing and Moscow than to the strategic needs of the United States. Russian and Chinese detractors of the U.S. missile defense program will be there to denounce any enhancement. Therefore, U.S. leaders must come to grips with this strategy employed by foreign powers to insert themselves in to U.S. policy-making. Russian and Chinese leaderships will always object to U.S. progress on missile defense and will always promote adherence to the arms control process. And, as a diplomatic/propaganda tool for enhancement of their own national power, it makes perfect sense to do so.

The treaty did ensure, however, that the people of the United States remained absolutely defenseless against a launched ballistic missile for more than 30 years. A case may even be made that the absence of U.S. defenses has encouraged other states in the proliferation of offensive missiles and weapons of mass destruction. After all, countries like Iran, North Korea, and China are not likely to wage a war with the conventionally stronger United States. Asymmetric means to circumvent U.S. conventional strength might appear very attractive.

On the other hand, defenses could help discourage proliferation due to the increased cost of acquiring and maintaining ballistic missiles in greater numbers. When facing another country deploying missile defenses, an aggressor also could not be sure that the attack would be successful. Missile defenses raise the risks of an attack, and therefore are themselves a deterrent enhancement.

The theories of deterrence that predominated during the Cold War cannot be proven to have maintained the peace and stability during that time. The absence of anything cannot be used to prove why an event did not happen—one cannot prove why war did not occur. We can only know something about why deterrence has failed. Consequently, statements about what is stabilizing and destabilizing are essentially academic, and many critics of missile defense have grown comfortable with the notion that stability in the nuclear age can only come through mutual vulnerability, i.e., the deliberate decision not to have active defenses.

Why is a nation that takes steps to defend itself viewed as provocative or destabilizing? Where is the historical evidence that shows, "this is how wars begin?" Are there not intentions and strategic plans to consider as well? It would make perfect sense, to take a more cynical view, for an adversary to protest the destabilizing action of a nation to defend itself if in fact that adversary wanted to keep that nation in an inferior position. Ironically, the Soviet/Russian pursuit of ballistic missile defense seems to have never really factored into the strategic thinking of U.S. planners, while U.S. plans for missile defense are central to the strategic debate. On the one hand, a true ally of a nation wishing to defend itself would not view the building of missile defenses in the same light (as an aggressive, provocative action). An adversary, on the other hand, could use the "instability" cudgel to disarm his opponent and convince him to remain vulnerable.

Clearly there is some benefit to a deterrent strategy that promises instant and devastating retaliation. However, what if the other side is not deterred and launches an attack? The functioning of deterrence is not predictable and could fail. If an adversary launches, what if the country cannot defend itself? Should not responsible leaders anticipate this and then prepare for it?

President Bush, with his deterrence plus insurance approach, offered the country a different path forward when he stated in a speech on May 1, 2001 that the United States needed "new approaches for deterrence" that relied on offensive and defensive forces.[65] He ended the speech by saying that "we must all look at the world in a new, realistic way, to preserve peace for generations to come." When deterrence does fail, the nation will not only want to have a missile defense system in place; it will want the very best system possible to defend against an attack.

All along, policymakers and defense planners can be seen straining their necks to peer around the elephants standing in front of them. U.S. leaders and opinion shapers have accepted a vulnerable position to the nuclear ICBM forces of both Russia and China. The leaders of both those nations have made strategic choices to modernize not only their ballistic missile forces, but also their nuclear forces and missile defenses. Somehow, Russian and Chinese ICBM and nuclear modernization efforts are not deemed to be destabilizing, but U.S. missile defenses are. Currently, the United States maintains a de facto MAD relationship with those two nations. To paraphrase Ronald Reagan, is there not a better way? If enough elements of the MAD/balance-of-terror doctrine can be considered to be illogical, why should one buy into the premise of the doctrine, that, when it comes to major, potentially adversarial nuclear powers, only mutual vulnerability can keep the country safe?

Operations in Space

Ballistic missiles, unless they are very short range, and their reentry vehicles, travel through space before they reenter the earth's atmosphere on the way to the target. Thus, there are opportunities to attack a threat missile in the space environment. In fact, a ballistic missile will spend most of its time traveling through space. So why not deploy platforms in space, not only to track and provide a discrimination capability of ballistic missile objects in space, but also to intercept them in that environment? Space-based deployment could make missile defense operations more efficient and effective.

While many of the politically themed criticisms (as opposed to the more technical criticisms) of space-based interceptor deployment have not been heard for the past 10 years or so (since the Defense Department considered the development of a Space-Based Interceptor Test Bed during the first term of President George W. Bush), missile defense critics could revive arguments dating back to pre-SDIO days should the United States seriously consider the more active use of space platforms to intercept ballistic missiles. Chief among those arguments is the claim that "weaponizing space" would create global tensions and be provocative.[66] Space-Based Interceptor (SBI) deployment, critics charge, would open the door to weaponizing space and could prove extremely destabilizing.

Similar to the arguments underlying balance-of-terror thinking, deploying interceptors in space could lead the country into a chain of mechanical action-reaction responses. "If the United States decides to deploy weapons in space, then it is guaranteed that other countries will follow." Other countries will "grow uneasy if the United States aggressively pursues space hegemony."[67] There will be a "snow ball effect," and U.S. space assets will face new dangers. We will face new ASAT threats, something the U.S. military (which relies heavily on space assets for its operations) cannot afford. It follows that "space-based weapons would be high-value but highly vulnerable military assets, thus imparting a 'use it or lose it' mentality on their operators." Then once you get to space weapon use in a conflict, we would inexorably enter a conflict scenario where opposing sides would be compelled to use nuclear weapons.

Moreover, should the United States ever decide to deploy weapons in space, critics argue, U.S. intentions on the global stage would be placed in doubt among our foes and friends. Many nations would worry about the U.S. "dominating the ultimate high ground," something that would be "indicative" of an aggressive, unilateral posture by the United States. The consequence of SBI deployment is that many nations would view the United States as "not being a supportive player in the international system."[68]

SBI deployment could also promote an arms race in space. "The [missile defense] Test Bed's anti-satellite capability is certain to be recognized by other nations. This could encourage them to develop their own destructive ASAT weapons, which would threaten U.S. satellites and produce huge amounts of space debris that could hinder the use of space for decades."[69] To support their assertion that U.S. missile defense platforms in space would spark an arms race, critics typically cite Russian reactions (as if Russian leaders have not figured out what to say in order to provoke the arms control and anti-BMD lobbies); they contend, for example, that

Russian development of the maneuver reentry vehicle is a direct response to U.S. missile defense activities. "This whole new class of weapons is being developed to make sure that Russia is still relevant in the face of missile defense deployment." How might the Russians react to the development of space-based defenses? So goes the argument.[70]

With action-reaction, use it or lose it, the critics insist on viewing the U.S. defense leadership and military operators and their counterparts in other nations as unthinking, reactive automatons incapable of taking actions to win an engagement or to avoid Armageddon. When the United States withdrew from the ABM treaty in June 2002, the restrictions on deployment of missile defenses in the air, sea, and space environments went away. This action effectively eliminated the single greatest obstacle to the deployment of non-nuclear space arms, although this was not the reason cited by officials for the withdrawal. Nevertheless, despite years of dire warnings that if the dominoes ever started falling terrible things would happen on the international stage, the world survived the withdrawal. There are good reasons to doubt that reactions to possible U.S. SBI deployment would automatically lead to increased tensions and weaponry responses to match the United States. Grand assumptions about how the "international community" will react are always suspect in the absence of a strategic-diplomatic context. As is the case with any weapons development decision, the United States national security leadership must judiciously balance defense, foreign policy, and economic considerations. There will always be attempts by leaderships in foreign lands to influence U.S. arms procurement decisions through arms control and public rhetoric, because it costs so little and the potential gains are so great.[71]

Critics also contend that deploying SBI will cause the development of ASAT weapons by the enemy and put the United States in a losing "hair-trigger" situation during combat. Yet were an adversary to prepare to shoot our eyes out in space to render the country blind in the wake of an SBI deployment decision by the United States, why would they not prepare to do so in any case, given that the potential military advantage it would create would be so great? Does not such a strategy make sense without or without space-based defenses? Indeed it does. There was an analogous situation in the 1970s when the Soviets continued to build up their offensive nuclear forces despite the fact that the United States had halted its missile defense development (remember the ABM Treaty). Currently, China and Russia are investing in the development of anti-satellite and space control capabilities even though the United States does not deploy space-based defenses. China today is engaging in the development of space weapons despite the fact that the United States lacks a similar program. Critics continue to maintain, however, that the only reason a country such as China would engage in space weapon development is in response to U.S. military space programs.[72] The United States has neither a BMDS architecture with space-based interceptors, nor an SBI concept design or development program in place. Hence, dire "reactions" by potential adversaries of the United States actually do not occur as a response to U.S. weapons programs; they occur because the military leaders in foreign nations understand there is a military advantage in their development. Russia and China continue to modernize nuclear and space forces, and develop missile defense countermeasures despite the fact that the current BMDS can in no way negate their missile forces.

Space operations are vital to the performance of key strategic systems, especially global integrated systems like the BMDS. The United States simply could not perform the missile defense mission without space, and there is good reason to believe that if it were to make greater investments in space elements that it could improve the overall effectiveness of the system. The engagement sequence, or kill chain from detection to engagement, to defend against a possible attack against this country involves interceptors and sensors, and a command, control, and battle management network spread across the globe. Our missile defense system today relies on early warning Defense Support Program and SBIRS High satellites, communications and Global Positioning System satellites, and other space sensor assets.

From the moment the United States launched warheads through space and assigned military purposes to satellites, space became a battle arena. Indeed, "weaponization" aptly characterizes many of the activities countries have undertaken in space over the past half century. With growing financial and political support within the U.S. government over the past two decades (and no international backlash as a result), the United States has already deployed a sensor-propulsion package called the *Exo-atmospheric* Kill Vehicle to counter long-range ballistic missiles. It deploys the EKV on the GBIs currently on alert at Fort Greely, Alaska and Vandenberg Air Force Base, California. EKV, with roots extending back to the technology development programs of the 1980s, matured within the old Global Protection Against Limited Strikes (Bush-Quayle) and National Missile Defense (Clinton-Gore) programs, and became operational under the Bush-Cheney Administration. The EKV is also currently being upgraded (Capability Enhancement II) to be even more effective, and will undergo a complete redesign in the coming years. The upgraded EKV had its first successful intercept in June 2014. Though never talked about as such, this is a "space weapon" that spends most of its time on the ground. When performing the missile defense mission, it launches into space, where it is "based" for seconds or minutes and operates semi-autonomously to put itself onto a collision path with a hostile warhead. Similarly, the Standard Missile-3 variants deployed on Aegis BMD ships and planned for deployment at Aegis Ashore sites (with the first operational site in Romania in 2015) are midcourse interceptors, i.e., they are designed to kill their targets in space.

The above decisions to expand the military uses of orbits were not taken for the purpose of "weaponizing" space. This is similar to characterizing previous decisions to deploy mine sweepers and battleships or U-2s and bombers as decisions to "weaponize" the sea or air. Policy, strategy, defense requirements, and economics constitute the rationale for deployment of all weapons, whether they are based on platforms that circle the earth at 300 miles altitude, fly through the air, or ply the vast ocean waters.

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 arena for more than 60 years. As progress in this area continues, U.S. leaders still find it challenging just to talk about the issue of space weapons in a public forum. This attitude must change, however, as the consequences of not protecting the American people from (nuclear) ballistic missile attack using the most efficient systems possible are too great.

It is sometimes argued that increased orbital debris would result from a greater military presence in space. Critics have taken to using the highly improbable yet dramatic action scenario in the very popular movie *Gravity* to show the pressing dangers posed by satellite debris (in the movie the presence of humans as space walkers significantly increased the conflict and raised the life and death stakes—this was much more exciting to watch than a collision of metal chunks). Film producers and space weapon critics used the story to drive home the point that even small pieces of debris can damage or destroy multi-million dollar satellites and spacecraft.[73] This is true enough. Metal fragments travelling at 18,000 m.p.h. can be very destructive. The greatest threat from debris is in low earth orbit, where half of the world's active satellites circle the earth.

Yet like all objects in orbit, they must, and do, come down to earth. And while en route, most pieces burn up in the atmosphere. The 2007 Chinese ASAT test created more than 4,500 pieces of debris, and reportedly 3,000 of those pieces remain in space today (with 1,500 pieces, it stands to reason, vaporized by reentry or fallen to earth).[74] However, even given the presence of many satellites in orbit the amount of we debris caused by routine space launches (viz., fragmented stages, explosive bolts, and other parts needed for mechanical operations), the very rare collision of large objects, and events such as the Chinese ASAT test, spacecraft damage from space debris appears to be minimal. For one thing, the high space volume around earth comprising billions and billions of cubic kilometers, significantly reduces the chances of collision. Additionally, the United States is able to track orbiting space junk and, for the most part, avoid it. The U.S. Strategic Command's Joint Space Operations Center tracks space objects over 10 centimeters in size, a benefit not only to the United States, but also to other countries, whose leaders routinely receive notifications about possible space collisions. To be sure, the risk is there, and when a collision cannot be avoided, the country may take a costly hit. Such is the cost of doing business in space. Much as the country must cope with the risk of being a sea-faring or an air-faring nation, that is, losing an occasional ship or aircraft, so it must cope with, and plan for, losing an occasional spacecraft, which typically do not directly involve loss of life.

In fact, hit-to-kill engagements already occur in space. Space weapons used to accomplish the intercepts are based, however, on earth. With current terrestrial-based missile defense operations, the collision causes the warhead and interceptor to disintegrate, so that an intercepted warhead produces very little debris in space. The closing speed between a typical interceptor and warhead is more than 7 km per second. Intercepts in space occur at different altitudes, but typically well outside the earth's atmosphere. The resulting kinetic energy vaporizes much of the reentry vehicle, warhead, and kill vehicle and disburses the debris; any remaining chunks of metal burn up in the atmosphere. In fact, U.S. flight tests have shown that very little debris resulting from these collisions in space reaches the earth.[75] One could surmise that it would be a similar case with the use of space-based interceptors. While it is true that some pieces can remain in orbit for decades, nature has its way of cleaning out the spaceways.

As an offshoot of this discussion, many of the same arguments for not deploying weapons in space will be used for not basing missile defense assets in the Arctic.[76] Of course, the United States already deploys critical BMDS assets in the far north, including GBIs at Fort Greely, Alaska, and early warning radars at Shemya, Alaska and Thule, Greenland, and it is upgrading another early warning radar at Clear, Alaska. There is also discussion underway about the development and deployment in the northern regions of a Long Range Discrimination Radar to pass precise tracking data on Pacific theater threats to the BMDS. Conceivably, sea-based or Aegis Ashore assets may be deployed to the Arctic to be in a position to intercept ballistic missiles flying over the North Pole toward U.S. cities. Some critics at home and within friendly countries oppose such deployments, believing that such a move would further generate mistrust with the Russians and Chinese. Similar to criticisms of U.S. military involvement in space, BMD in the Arctic is said to undermine the urgent spirit of international cooperation and derail positive developments in the Arctic.

Affordability

With more than $150 billion spent on missile defense thus far (since SDI), critics have been saying for years that missile defense is not affordable.[77] They contend that homeland missile defense is not needed (what nation would be crazy enough to launch against the United States?), and, if the country did have to use it, the system probably would not work. Money is a finite resource, they continue, and the United States would be better off spending it on fighting poverty or other defensive systems. Critics view spending on missile defense as engaging in an arms race, and hence a bottomless pit of spending.

The affordability argument might have more bite were it not for the fact that so many countries are investing in and acquiring offensive ballistic missile forces, and those forces put the United States within reach. The reason we are spending money for protection is clear (an operational homeland missile defense force has been maintained by both political parties since its inception in 2004); it is even more rational given the interest that so many countries now have in these weapon systems. So it really comes down to the question of the technical feasibility of missile defense and making the case for why nuclear deterrence alone does not offer an adequate defense of the nation.

Nevertheless, the affordability question persists. Can the United States afford to continue the missile defense program? The easiest way to answer that is to look at the overall U.S. federal budget. It reveals that a missile defense program is very affordable, especially when considering the enormous amount of wasteful spending that occurs at the federal level annually. According to the White House Office of Management and Budget's own report, in 2012 the United States wasted more than $100 billion in its handling of disbursements for the federal government's many welfare programs. That is not $100 billion spent, but rather *wasted*. Medicare fee-for-service, Medicare Advantage, and Medicaid combined accounted for $61.9 billion in improper spending. The country has engaged in such wasteful spending for years, and it continues to this day.[78] The various economic "stimulus" initiatives that occurred under Presidents Bush and Obama over the past decade were extremely wasteful ventures. In spite of the 2009 Obama stimulus package of $862 billion dollars, joblessness (the target of the stimulus) continues to be a problem as the number of fulltime jobs and the number of people participating in the workforce continues to decline.[79] The American government has access to significant wealth, even as it runs historic deficits and the national debt climbs. It really is just a matter of priorities.

Missile defense received high priority in the George W. Bush Administration, and the Missile Defense Agency program received budgets approaching $10 billion. The Obama Administration has continued to identify missile defense as an important program, even as it has cut the missile defense budgets for homeland defense and science and technology development by 30 percent from 2009 to 2014. Current investments in regional missile defenses, to include systems being deployed to defend European NATO allies as part of the Obama Administration's European Phased Adaptive Approach, can play a role in protecting the U.S. homeland by helping to prevent war or escalate a conflict.[80] Yet leading political figures point out that the emphasis in the Obama Administration on regional defense has harmfully short-changed investments in homeland missile defense.[81]

Missile defense received a top-line 10 percent cut in the first year of the Obama Administration, and it has cut the budget in subsequent years. Even in these few years, this difference in the budget may have significant implications for the development of future missile defense capabilities for defense of the homeland. Development efforts terminated during the Obama Administration were: the Airborne Laser and the Kinetic Energy Interceptor for boost phase defense; the Space Based Test Bed (Space Based Interceptor), the European Site Initiative (GBIs in Poland) and the Standard Missile-3 IIB interceptor for ascent and midcourse phase defense; and, the Multiple Kill Vehicle program for improved capability against decoy countermeasures and increased raid size.

Yet here is the problem. To field the current system and put it on alert in 2004, the United States leveraged the technology development programs of the 1980s and 1990s. Developmental interceptor programs (ERINT, LEAP, and GBI prototypes) led to the eventual deployment of Patriot Advanced Capability-3 (used during Operation Iraqi Freedom in 2003), the successful Standard Missile—3 Block IA and IB, and the currently deployed ground-based interceptor. Significant investments during those years were also made in component miniaturization and improvements to computer processing, materials, and sensors. The country would not have been able to deploy even the very limited system deployed today without those early and very significant investments. So where does the lack of investment in advanced technologies leave the United States in the future?

The pressures that a fiscally constrained environment place on a defense budget will directly impact the willingness to start new programs to bolster homeland defenses. Yet the affordability question must be viewed in the threat context. Policymakers must understand the *true* range in possible threats—that threats may range from pinprick attacks using missiles against valuable U.S. targets on the territories of allies, to threats that are the equivalent of having a “lights out” or catastrophic result, to include a nuclear attack on U.S. soil or a high altitude EMP burst that knocks us back to the 19th century in terms of technology. Critics should not be comparing the cost of ballistic missiles to the cost of defensive interceptors; they should be comparing the cost of defensive interceptors to the cost of rebuilding American cities. They need to look at the cost of what need defending. The challenge for any future administration and Congress will be to convince policymakers that steps need to be taken now, and not after a catastrophe (similar to 9/11) has occurred.

A ballistic missile delivering a nuclear payload to an American city would be truly devastating. The direct cost of the September 11, 2001 attacks on New York City has been estimated to be between $100 billion and $130 billion. Add in the indirect costs, and some estimates shoot up to as high as $4 trillion.[82] The economic cost 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.[83] An electromagnetic pulse generated by a high altitude nuclear explosion, the effects of which we do not fully understand, also could have a devastating impact on the entire country and its destructive consequences would reverberate around the world.[84]

Technical Feasibility

Another politically charged barb frequently thrown at the missile defense program is that it is not technologically feasible; the systems engineering required by the mission is just too hard to do. For decades the challenge was to determine how the armed forces could actually intercept a fast moving ballistic target in space or in the atmosphere. For a while, the answer was to develop and deploy an interceptor that would carry a nuclear weapon into the vicinity of the target and detonate it. There were significant technical and political challenges associated with this approach, and it was scraped with the termination of the Safeguard program. By the 1980s, the Army was demonstrating primitive hit-to-kill technologies, which have since evolved and are the basis for conducting intercepts today. Consequently, so the criticism that the United States cannot achieve hit-to-kill, or hit a bullet with a bullet, has lost a great deal of its punch as the Defense Department has demonstrated multiple times from the land and from the sea that it can do hit-to-kill.

The country has made significant technical and scientific advances across the ballistic missile defense spectrum over the last 30 years. It has proven through robust testing that hit-to-kill technology works. MDA has developed sensors and discrimination technologies that can locate and precisely identify a threat-representative warhead and hit it near the chosen aim point. The nation has fielded very precise operationally-capable, short- and long-range missile defenses. Since the 1980s, ballistic missile defense technology has evolved considerably. Moreover, since 2001, the Defense Department has conducted (through June 2014) 65 of 81 Terminal and Midcourse hit-to-kill intercepts in the atmosphere and space from the land and from the sea. The Defense Department is now focused on enhancing the performance of the BMDS by conducting increasingly complex, end-to-end intercept tests. To accomplish this goal, MDA, in cooperation with independent operational testers and the Director for Operational Test and Evaluation, is using threat-representative targets, operational sensors and communications systems, operational crews, and operationally configured interceptors and launch platforms. The nation's leaders have more certainty about the technological performance of missile defense than they did when Reagan announced the Strategic Defense Initiative in 1983. There is less and less discussion about missile defense "feasibility" and more discussion today about how effective it can be.

Although considerable work needs to be done to show the system can execute reliably, missile defense developers have demonstrated in tests that the nation can effectively defend against long-range threats. It is not easy. There are numerous moving parts; millions of lines of computer code are required; and, the speeds at which the system must operate are very rapid. Nevertheless, developers are showing with each successful test that it is possible to defend against real-world threats of all ranges. Over time, the country will likely continue to demonstrate the capability of the system to defeat more complex threats.

Recently, critics have turned their attention from the basic hit-to-kill challenge to other technical challenges facing ballistic missile defense. The missile defense system, they contend, will have to perform at a near 100 percent success rate in defense of the homeland; otherwise it is useless. Moreover, they add, the inability to attain near perfection will encourage adversaries to simply obtain more missiles in order to ensure one will get through to cause massive devastation:

> The United States will still need to be just as worried about Iran's missiles, since the destruction of even one U.S. city or region is simply too high a cost to bear. For that security equation to change, national missile defense would need to intercept 100 percent of incoming nuclear warheads—an unattainable goal for any piece of machinery. Fielding a missile shield may even encourage adversarial countries to build up missile and warhead stockpiles to ensure that some make it through unstopped. A good way to encourage the North Koreans to build more missiles would be to surround them with missile-defense interceptors.[85]

According to Butt, this "false confidence" that they are protected by a system that is not effective "may also embolden future U.S. political leaders to stake out policies that they otherwise wouldn't have risked," in the same way that hurricane insurance works to convince people to "endanger their lives and property on a regular basis by building on unsafe ground in the knowledge that they are 'covered' for catastrophic events." Indeed, Butt contends, building a missile defense system is a "fool's errand."

It is always going to be cheaper for opponents to come up with ways to override a missile defense. Why? Because given how destructive nuclear weapons are, a missile defense system has to work almost perfectly in order to prevent massive damage. If an adversary fired 100 warheads and 95 percent were intercepted—an astonishingly high level of performance—that would still let five warheads through, and that could mean losing five cities. And, were an opponent convinced that your defenses would work perfectly—a highly unlikely proposition—there are plenty of other ways to deliver a nuclear weapon. Ballistic missile defense never made much sense either strategically or economically—so say the critics—except as a make-work program for the aerospace industry and an enduring component of right-wing nuclear theology.[86]

Unless critics are willing to argue the presence of missile defenses would cause an adversary to launch nuclear weapons against the United States, the argument that imperfect missile defenses are not worth deploying is baseless. If the strategic circumstances are such that another nation would launch nuclear weapons, there likely would be a lot more at play than simply the balance of forces, to include strategic motivation for launching an attack in the first place. And were the United States ever under attack, the nation would prefer to have some defenses in place, moreover imperfect. In many cases, however, the presence of defenses will act as a deterrent, because an adversary (who is not privy to the classified system performance data) can never be certain how those defenses will perform. Couple missile defenses with offensive retaliation forces, and that deterrent becomes even stronger. Its BMDS test record gave the U.S. leadership confidence in July 2006, when the North Koreans launched several missiles, including a long-range *Taepo Dong* II. The Pentagon presented the President the option of activating a limited defensive system that would have been capable of engaging a ballistic missile launched by North Korea.[87] Fortunately, U.S. officials did not have to follow the advice of two former Pentagon officials to launch a preemptive strike against North Korea; consequences of doing so would likely have been viewed quite unfavourably by China and Russia, and probably would have negatively impacted stability on the Peninsula.[88]

On the one hand, critics contend that missile defense will not work (and how the Russians and Chinese believe it will negate their strategic deterrent); on the other hand, they express concern about the technical prowess of adversaries to build countermeasures to circumvent it.[89] The assumption is that developing countermeasures is simple (how hard could it be to inflate balloons in space to fool the sensors?). Reportedly, however, it is not so easy to develop and deploy "simple" countermeasures. Building missiles is not easy; there are significant booster, guidance, navigation and control, and reentry vehicle engineering challenges. Neither is it easy to design, engineer, and operationalize countermeasures.[90] Countermeasures add non-trivial cost as well as engineering and operational complexity for the user. It is not certain whether countries like North Korea and Iran have mastered the technical challenges associated with countermeasures. The hundreds of single warhead systems deployed around the world today are highly representative of a "real-world" threat and, intelligence reports suggest most, if not all, do not have countermeasures. There is a vast technological gulf between the United States and every potential adversary it faces today. A prospective attacker will not "know" the BMD system well enough to respond to it, and the Department of Defense does not release the performance data associated with the system. Uncertainty here is a friend of the defense.

Nevertheless, the midcourse countermeasure challenge is a real one, and the United States will have to continue to invest in improving the discrimination capabilities of the BMDS. Countries such as Russia will have a greater proficiency in the development of countermeasures; the United States cannot dismiss this challenge. Yet, the United States has already met many other technical challenges to effective missile defense. It has made advances in sensors and algorithms required to improve the ability of the system to discriminate threat objects from decoys. These technological advances will be tested in the years ahead. Indeed, these technologies were successfully tested in the June 2014 intercept test of the Ground-based Midcourse Defense system. The system reportedly correctly identified and destroyed the lethal object in the presence of countermeasures. Adversaries will continue to search for countermeasures to missile defenses, and so this battle is never-ending. There are also operational solutions to the countermeasures problem. The U.S. capability against countermeasures is significantly greater when one considers that the BMDS employs layered defenses, a redundant network of advanced land-based and sea-based sensors (at least at the regional level in the current BMDS), and advanced discrimination algorithms. The country's ability to defeat countermeasures will be further improved in the future once it introduces a capability to destroy multiple credible objects with a single interceptor, or introduces ascent phase or boost phase defenses. So, the work of missile defense is not impossible. It is just not complete.

The current approach to thinking about homeland missile defense is, in part, a holdover from the Cold War. Politics still blinds many critics to the progress the United States has made in missile defense and forces them to ignore significant ballistic missile system developments and deployment realities that have taken place in Russia and China. Even though Russia and China generally are not considered threats to the U.S .homeland today (despite their deployed arsenals of nuclear long-range ballistic missiles), regimes change, accidents and misunderstandings happen, and tensions can arise along the peripheries of these two nations that could draw the United States into a conflict. Historical evidence suggests that threats do not necessarily diminish when regimes change; when the USSR transitioned into Russia, its nuclear forces remained intact. Conversely, a regime change tonight could create an enemy tomorrow. The concern is that there appears to be an unwillingness to seriously consider all possible threats. There is also a frightening unwillingness to shake off ideological shackles and old mind-sets (which rely on a sort of idealism when it comes to international relations) that allow decision-makers to dismiss out of hand new deployment possibilities for missile defense.

Tactical flexibility in missile defense is firmly linked to strategic flexibility. Until policy-makers can understand and accept the full range of threats to the homeland, missile defenses will not evolve adequately to protect the nation.

Section 5. Missile Defense Principles

Without consideration of politics or cost, key features or architectural principles should be considered in order to construct the most efficient and effective missile defense system possible to counter current and future threats.

Architectural Flexibility

The system should be generally flexible, not fixed. It should be adaptable, able to be changed in the face of evolving or surprise threats. A weapon system should be adaptable in a dynamic threat environment that will likely change over time (given history, there is a 100 percent certainty the threat environment will change); also, a system must perform at the highest level. A flexible missile defense system must remain relevant to the geo-strategic situation and should continue to be a useful tool of defense strategy and operations over time. Consequently, the system should be mobile, capable of shifting locations to meet shifting threats and changing geographic environments (i.e., from ground, to sea, to space) as needed, since missile defense probability of success hinges on the geographic position the defender has relative to an attacking missile.

The consequence of reliance on architectural/tactical inflexibility can be severely negative. The system may become vulnerable to surprise attacks because the defender's ability to redeploy assets would be restricted. Moreover, the limitations of fixed assets can more readily become known by the adversary (given the geographic restrictions at play—and missile defense is all about geography, positions, azimuths, and altitudes). Fixed missile defense assets that are studied, observed, and, with this knowledge applied to overcome defensive countermeasures, may be more reliably defeated.

The presence of flexible assets means there are a greater number of variables that must be known before countermeasures can be devised, thus increasing the risks to any attacker and potentially increasing the reliability and performance of the system in the eyes of the defenders and the attackers. Changes in the system (the deployment of mobile assets) may be made even during the course of battle. Improved reliability (increased uncertainty for the attacker) can help provide a more robust deterrent.

Flexible can also mean a wiser use of taxpayer dollars, investments, and sunk costs. Today's deployed weapons which are capable of being adapted to address new threats are more likely to be relevant tomorrow. Flexible not only connotes potentially greater utility, but also entails a more efficient use of resources invested in a very expensive system.

It may also be possible to rely too heavily on flexible assets. After all, fixed assets can offer a permanent, 24/7 on alert, always-ready capability. Mobile sensors and interceptors (further highlighting the value of flexible assets) can be massed in appropriate geographic locations to counter surprising or unforeseen threats (i.e., possible enemy mobile ICBMs) as soon as indications and warning are received, thereby supplementing defensive capabilities brought by fixed-based assets to the battle field. Thus, in some cases a mix of flexible and fixed assets would seem to be the most appropriate configuration.

Layered Defenses

Layered defenses for homeland protection should be part of a unified, integrated system. A truly layered defense system would create intercept opportunities in boost or ascent phase, the midcourse phase, and the terminal phase of a ballistic missile's flight. Boost defenses attack a ballistic missile as it powers up through the atmosphere, a time in a flight trajectory when the missile's velocity is the slowest and it is most vulnerable. At this point it also emits a very large infrared signature, making it very visible to the defender. By attacking the missile in the boost phase of flight, it is possible to defend the entire world from a launched missile. Intercepting a missile in the ascent phase (the early part of midcourse), immediately after boost phase and prior to reaching the middle part of the flight, can also protect an area thousands of miles across. Midcourse defenses are set up to attack a missile during the longest portion of its flight, as it travels through space. Midcourse defenses can protect broad areas that are hundreds, even thousands of miles across, much as the current Ground-based Midcourse Defense system protects the entire United States from a limited threat. Terminal defenses are point defenses, capable of providing focused protection of high-value targets. Layered defenses provide at least two benefits: 1) they can increase the probability of system success; and 2) they can reduce the risk posed to the system by the failure of one of the missile defense elements.

Layered defenses can provide improved "vision"—the ability to see and discriminate—by deploying sensors in multiple environments along the path of the threat missile. The current BMDS relies on space-based (Defense Support Program, space-based infrared satellites), sea-based mobile (Aegis BMD ships and Sea-Based X-band), and ground-based (Cobra Dane, Upgraded Early Warning Radars, AN/TPY-2 radars deployed in Japan, the Middle East, and Turkey) sensors to provide detection, tracking, classification, and hit assessment information.

Multiple layers made up of fixed and mobile interceptor assets can mean multiple chances to intercept a missile carrying a devastating payload. Ideally, a layered system would have several opportunities to attack a threat missile in boost phase, midcourse phase, and terminal phase. Not only would such a system have more chances to attack an in-flight missile; it could severely hamper deployment of countermeasures. Midcourse countermeasures, for example, may be taken out with a boost or ascent phase intercept. Terminal phase countermeasures may not have the chance to deploy if the warhead bus is destroyed in boost or midcourse. And boost phase countermeasures may work to allow the threat payload into the midcourse phase, but because of space constraints in the reentry vehicle the threat missile or warhead will not likely be equipped with midcourse countermeasures to help it through that phase. While countermeasures may be developed to degrade the performance of autonomous missile interceptor systems, it is much more difficult to develop countermeasures that degrade fundamentally different missile defense interceptor systems operating together in different phases of a ballistic missile's flight. Thus, the most operationally effective missile defense architecture is a layering of endo-atmospheric and exo-atmospheric missile interceptor systems with ground and space sensors connected and managed by a robust C2BMC infrastructure.

Layered defenses significantly increase the level of difficulty for the attacker. They also increase the cost of deploying offensive missiles by forcing an adversary to design a variety of countermeasures into their offensive missile system. This would increase the weight of the missile system, which could also affect or limit performance and limit payload volume for the warhead. Complex countermeasures required to work in different phases may also require testing to ensure they work as intended, it may be observed by U.S. intelligence assets and that knowledge could be applied to the integration of new technologies to defeat those countermeasures. Complex countermeasures also require the attacking country to either have an independent technical base to design and produce and deploy countermeasures, or access to countries that have those capabilities.[91]

Geography

Missile defense is all about what geographic position the defenders have relative to an attacking missile. Since ideally one would want a missile defense system capable of having an effect along the entire path of the threat missile, layered defenses exploiting multiple geographic environments would make the system most effective. Ideally, missile defense assets would be deployed on land, at sea, in the air, and in space. The assets would be placed in close proximity to the target, or at least have access to the large interiors of some countries through positioning in space. Midcourse systems are also sensitive to geographic location and must be placed along likely threat missile corridors—a system set up to defeat ballistic missiles flying over the North pole, for example, might not be capable of countering missiles launched over the South pole. While the interceptors deployed at current fixed interceptor sites might be able to provide protection against attacks from the south, it is clear the system would need to have "eyes" pointing toward the southern hemisphere to feed cuing and tracking data into the system. In order to provide more intercept opportunities, there also may need to be missile fields deployed to the south. The system might also feature fixed terminal systems for maximum layered protection of high-value assets. Hence, geography matters.

Integration

The ballistic missile defense system must be able to integrate assets deployed in different environments and across a wide geographic expanse. An integrated system allows diverse sensors and interceptors to function together and synergistically as a single system as opposed to operating as a disparate collection of systems that must be made "interoperable" or complementary. A truly integrated system implies unity of operation and command. This is a physical asset deployment challenge as well as a software challenge, a challenge for command, control, battle management, and communication.[92]

A C2BMC system integrates the BMDS elements into a well-functioning, unified and synergistic layered defense system. There are key functions within the C2BMC system currently being developed, and they represent the elements needed to deploy a high performing system. These functions allow Combatant Commanders to automatically and manually optimize sensor coverage and interceptor inventory to essentially run the missile engagement battle. *Communications* (terrestrial and satellite) connect and support the C2BMC and ensure missile defense operators can effectively execute the defensive mission. *Sensor Registration* improves the overall accuracy of the network of sensors and enables the integration of different sensor measurements in ballistic missile engagements. *Correlation and System Track* functions create a single track of an object using multiple BMD sensors (land, sea, and space), necessary to complete target information handover to the weapon system kill vehicle. *System Discrimination* uses inputs from multiple sensors to determine whether objects are lethal or non-lethal. Different sensors can provide different features about objects associated with a ballistic missile attack and create highly accurate discrimination information (more accurate than a single sensor can provide). *Battle Management* identifies sensor and weapon systems that can enable the Combatant Commander to most efficiently implement weapon engagement plans. *Hit and Kill Assessment* uses all available sensor observations to confirm a successful hit-to-kill engagement, assess payload type, or identify surviving objects rapidly enough so that, if needed, additional interceptors may be launched to defeat the threat.

Independence

Allied involvement in the deployment and operation of the missile defense system has many positive strategic and political effects, to include rallying other nations and providing a common objective. The drawback of a strict dependence on foreign country involvement is that national security (homeland defense) relies on powers outside the control of the United States. While the United States should strive to deploy a high performance system that involves its allies, there must also be a way to operate that system in extreme situations such as the loss of allied support or of assets deployed on allied territory. In other words, there needs to be a way for the United States to be able to operate the system on its own.

Independence will require that the United States not rely exclusively on host nation support for land-based and sea-based radar and interceptor deployments. Land-based assets may be particularly troubling; withdrawal of support for the operation of those assets would be much harder to deal with. Sea-based assets that depend on foreign support, such as basing arrangements or stationing within territorial waters, may be redeployed, although they may no longer be in prime position to engage in battle. Space-based assets do not require host-nation approval and have the potential for access to most areas on the globe, to include the interiors of large countries. They seem to represent the most promising avenue for providing the ability to operate the missile defense system independently if required.

Speed

Ballistic missiles travel at high velocity, as do hit-to-kill interceptors, and things happen quickly. With a directed energy system, the system would operate literally at the speed of light. Speed is a fact of life in the world of missile defense. The boost phase of a missile launch is over in three-to-five minutes. ICBMs travel on average seven kilometers a second once they get through this phase and into space. The midcourse, or middle part of the flight, can last 25 minutes, while the terminal or reentry phase is over in about two minutes. Reentry vehicles can reach Mach 25 when reentering the atmosphere. Closing velocities in a head-on missile defense engagement can exceed 25,000 miles per hour. It is clear that missile defense calculations must happen in seconds, and actions must occur in minutes and seconds. A BMD system capable of responding quickly is critical.

Resilience (Fault-Tolerance)

The missile defense system should be resilient against catastrophic failure. While the system would likely suffer setbacks during wartime involving ballistic missile engagements (such is the natural course of war), the system should be constructed so that it may degrade gracefully. Hardening components and the system against EMP would appear to be a requirement when we are concerned about the employment of nuclear weapons. System components also should be capable of operating independently, so that the failure of a land-based sensor does not impact the ability of the system to receive information, or the failure of a portion of the C2BMC network does not cause the entire C2BMC network to crash and render the entire system inoperable. The country should also be concerned about possible failures resulting from deployment of only a single kind of interceptor or sensor. Different interceptors and sensors complicate life for the attacker, who must figure out the operation of multiple elements of the system, each of which is designed to operate differently from the others. One would also want the system to be capable of 24/7 operations, thereby avoiding "down-time" (perhaps required for maintenance or testing) that might be exploited by the attacker.

Advanced Technology

The system should be designed so that it is capable of being upgraded, and so new BMD technologies can be integrated into the system over time. Developers need to be able to not only develop, but also integrate, in a timely manner BMD technologies as they emerge so that the evolving system can track or outpace the threat. New technology should also make the system simpler to build, maintain, and operate. With thousands of parts in an interceptor, things can go wrong. Advancement requires that steady investments in science and technology research and development efforts are maintained over the life of the system. System improvement is evolutionary in nature and must never stop; it also demands that defense planners keep an open mind about what the system should look like and invest in technologies that have the potential to make a revolutionary leap forward.

Section 6. Deploying a Better Ballistic Missile Defense System

With an understanding of policy obstacles, the principles behind effective missile defense, and U.S. policy and strategic imperatives, the country must come to grips with what the U.S. missile defense architecture should look like to address threats outlined in the opening of this monograph. Today, despite commitments to evolving ballistic missile defense technologies and a lengthy history of investment in missile defense development that dates back to the 1940s, the BMDS, apart from offensive counter-responses by the United States, has a limited chance of success today against an attack involving a sizeable raid of ballistic missiles from nations other than North Korea or Iran, or against a terrorist missile strike off the nation's shoreline (that is, an unanticipated attack from an unanticipated location). Of course, any defensive plan must include both offensive and defensive responses to be successful. The BMDS should not be evaluated as a stand-alone system. Yet today any offense-defense package pulled together in such an extreme scenario would lack the serious defensive components needed to minimize damage to the country.

A missile strike from Cuba could take five minutes to reach Washington. A raid from Russia, China, or a nation such as North Korea or Iran, could involve tens or hundreds of missiles or warheads. Is it realistic to think the missile defense system under development today, and its projected configuration in the future, could protect us sufficiently in any of these situations? After all, beyond the development of a long-range discrimination radar and other discrimination improvements (critical activities that need to be undertaken), the current long-range homeland missile defense plan favored by Washington involves simply growing the number of GBIs (current plans are to grow the fleet to 44, the original plan under President Bush, whose defense plans saw possible growth to beyond 100 GBIs, depending on the threat), and possibly adding a missile field on the east coast.

Outside of a few important advanced technology efforts, the program today is not funded to grow the technology seed corn for the coming decades and evolve the BMDS to improve protection against the larger or unanticipated threats the nation could face. In fact, the United States has backed off our modest commitments to deliver advanced technology to the system. The Obama Administration effectively terminated even the very limited avenues that were being paved during the George W. Bush Administration for evolving the system (Multiple Kill Vehicle, Kinetic Energy Interceptor, Space Based Interceptor Test Bed) and even Obama's own hedge capability, the SM-3 IIB—a high acceleration interceptor for possible basing on land and at sea. So one must ask, does the United States want protection against an attack involving more than a handful of ballistic missiles? Should it strengthen the defensive side of its offensive-defensive response to an attack, or is it content to entrust its national survival to strictly offensive military responses embodied in MAD?

In order to regain control over U.S. national security and survival, it is imperative to improve missile defenses and the ability to protect the national interest in the event deterrence fails. To do so will require a radical change in policy direction as well as a commitment to the deployment of a more robust and flexible missile defense architecture. This will necessitate a major shift in U.S. policy and a firm commitment to a new technology development path.

The current fixed, land-based system of Ground Based Interceptors for long-range defense of the US homeland clearly has limitations, especially in its ability to address unpredicted threats and to deal with a great number of threat missiles. This architectural rigidity results in inflexibility for addressing new, evolving threats to the homeland. Not only is the country not well-positioned to deal with new or surprise threats from Russia or China; its assets are not well-positioned to defend against missiles launched from surprise locations, such as from a ship or submarine in U.S. coastal waters or an attack from the southern hemisphere. The country also has an immediate requirement to defend far-flung territories and bases. In the spring of 2013 the U.S. territory of Guam, home to more than 150,000 American citizens as well as critical U.S. military bases, needed protection from a possible North Korean attack. (Guam is closer to North Korea than San Francisco is to Washington, D.C.) In April 2013, the United States decided to position a regional defense system, THAAD, a system capable of defending a small area (relative to what an Aegis BMD ship can defend, for example) to defend against a possible IRBM assault. Needless to say, such deployments require significant planning and lead-time, and are a very costly way to expand the areas that require defense.

The current ballistic missile defense system architecture relies on the integration into a single system of all missile defense elements no matter where they are in the world. Multiple defensive layers, with system elements working together synergistically, are central to the approach for regional defenses (which integrates short- to intermediate-range land and sea-based systems). No one layer or interceptor design can accomplish this global mission on its own. Moreover, regional missile defenses offer flexible architectures that can be moved from region to region depending on the threat. The challenge now is whether that same architecture, with its layers of systems and mobile weapons can defend the American homeland.

The ability to conduct area defense, i.e., to defend a broad area against multiple launch points (which is what the current Ground-based Midcourse Defense is designed to accomplish), is fundamental to successful and cost-effective missile defense. GMD interceptors can be oriented to threat regions to defend a large area. The United States is continuing investments in the missile defense program to ensure that these defenses are increasingly capable of handling midcourse countermeasures and multiple objects. Currently, the Administration is planning to expand the number of GBIs deployed in Alaska from 30 to 44 to offset North Korean advances in the development of a very disconcerting road mobile ICBM, and to counter future Iranian ICBMs. The United States is also improving its sensor coverage to better view and track ballistic missiles launched out of North Korea by deploying a second forward-based X-band radar to Japan. The Administration plans to further improve the discrimination capability of the system with its proposed development and deployment of a Long Range Discrimination Radar. This midcourse, precision tracking radar would enhance defensive coverage of the homeland against long-range North Korean ballistic missiles. Current plans also are to redesign the EKV initially deployed with the operational prototype interceptors, which were originally deployed in 2004 as part of limited defensive operations. The redesigned EKV will improve the performance and reliability of the GBI. In addition, recently there has been a great deal of focus on the development of a possible third interceptor site in the continental United States to expand homeland defense capabilities to improve protection again North Korea and Iran.[93] To date, no decision has been made by the Department of Defense to proceed with a third interceptor site.

Since 2002, the United States has made two failed attempts to forward deploy interceptors in Europe in order to counter long-range threats from the Middle East. Those interceptor sites were designed to attack Iranian ICBMs in the ascent phase of flight, providing layered defense when coupled with the midcourse GMD defenses. There was a recognized need within two politically different administrations for layered defenses. They recognized, in other words, the advantage of hitting hostile missiles early in flight. President Bush committed to constructing a Third GBI Site in Poland, an architectural evolution of the BMDS. Though limited in the number of GBIs that could be fielded, the Third Site would have given the system a shot at ICBMs launched by Iran first from Europe and then, if needed, by the U.S.-based GMD system. Within the first year of his first term, the Obama Administration terminated the Third Site in favor of deploying Phase 4 of the European Phased Adaptive Approach, which featured the deployment in Poland of a new (as yet undeveloped) high acceleration Standard Missile-3 interceptor (the SM-3 IIB) by the end of the decade. In the first year of his second term, President Obama abandoned his own plan to forward base the new interceptor, keeping the plans for the deployment of regional defense systems in Europe, and once again abandoning a plan that would have provided a layered homeland defense.

There is recognition among many in leadership positions that U.S. homeland defenses are inadequate, even in the face of possible future threats posed by states such as North Korea and Iran. If the United States is to have truly meaningful improvements in the performance of the system against a dynamic and increasing threat, however, there will have to be fundamental changes in policy and strategy. First and foremost, the nature of the prospective threat must be revisited. Who are potential enemies (bearing in mind that the United States currently may have a very stable and non-hostile relationship with those countries)? Policy-makers must wrestle with unsettling evidence about possible new threats to the U.S. homeland, to include Russia (Russian aggression in the Ukraine in 2014 represents a serious source of instability in the international system), a globally and regionally ambitious China, terrorism, and the possible use of EMP by a nuclear and ballistic missile nation.

It is fallacious to assume that a buildup of defenses capable of countering a significant percentage of Russian or Chinese ballistic missile launches against the United States would be provocative in nature. Interestingly, that same fear of provoking conflict or attack does not apply to discussions of dominance in other military areas. During the height of the Cold War, for example, when the United States competed for strategic influence and conventional superiority with the Soviet Union in Europe and other parts of the world, little credence was given to such reasoning and the United States built defenses against Soviet aircraft, tanks, special operations, and infantry. Today the United States strives to have the best fighters to achieve air superiority and the most advanced ships to ensure military prowess on the high seas. Military competition is a fact of life and being prepared offensively and defensively for war is a virtue. For reasons discussed in the fourth section of this monograph, the United States has not applied this idea that it is reasonable for a country to build up defenses to protect itself from ballistic missiles.

It is not as though this possible threat from Russian and Chinese ballistic missile forces does not exist or is not recognized in current policy making and defense planning circles; it is acknowledged and factored into U.S. strategic thinking. Many U.S. officials seemingly have refused to address it in the conventional sense (from an active defense standpoint) and, instead, have grown content to "counter" the existence of these offensive forces by deploying

"MAD-think"—they won't hurt us because we can hurt them. However, would not security and deterrence be strengthened by improving defenses along with offensive strike capabilities?

It is the duty of the government to prepare its military forces to be in the best possible position to ward off all probable threats to the country. Simply stated, the fact is that Russia, China, North Korea, and Iran continue to invest significantly in their offensive ballistic missile forces and missile defense countermeasures, making each one of these countries worrisome to defense planners. In today's strategic environment, being prepared means building a ballistic missile defense system that is not only capable of countering nascent ballistic missile powers like North Korea and Iran, but also significant ballistic missile powers such as Russia and China, as part of a strategy involving offensive and defensive forces. To do so is not to invite conflict or to beg for the suspension of successful foreign policy, commercial, and security relationships. In a world where being unprepared can come with very steep, even catastrophic costs, to prepare is prudent.

Offense-Defense Integration

Any ballistic missile defense operation will be performed in concert with offensive operations. BMD operations should never be viewed apart from the total plan for strategic defensive operations. Offensive forces, to include cyber warfare and kinetic and non-kinetic campaigns to disrupt the enemy command control, are critical elements of that plan. Thus, the United States should *never* have to plan to defend against the entire ballistic missile force of an enemy country. Considerable efforts will be made to disrupt the enemy's "kill chain," to deal with the ballistic threat *before* the launch. If nuclear weapons are involved, all military muscle in the United States would be flexed and considerable damage done to the attacking country. Missile defenses will be needed to counter those missiles that the enemy is able to fire before the United States responds militarily. This is all important for estimating the likely performance of the BMDS.

It is worth noting that there are widening concerns over the aging U.S. nuclear triad and the U.S. commitment to maintaining strategic force levels (which also undercuts its commitment to nuclear deterrence and the balance-of-terror approach).[94] Reduction in resources and waning political commitment toward these ends leave open the question as to whether the U.S. strategic posture can continue to assure allies and deter adversaries. Given its synergistic relationship with missile defense, any slide in nuclear or conventional prompt global strike offensive force capability also would necessarily impact U.S. ability to respond to conflicts involving ballistic missiles.

A military strategy and plan that fully integrates offensive and defensive operations in a conflict environment featuring the use of ballistic missiles would offer the strongest possible defensive package. Initially, offense-defense integration efforts would signal a will to realize strategic objectives in a conflict. It would represent an attempt to increase the adversary's understanding of the U.S. ability to prevail. This, in turn, would enhance deterrence and reduce the likelihood that war would occur. Despite the estimation of some that defenses against Russian and Chinese ballistic missile forces are not practical, a strong defensive capability, integrated with powerful offensive responses, is essential for a national defense strategy.[95] Wars do not happen in a vacuum. During a war, offense-defense integration will enhance the performance of the BMDS by preventing the enemy from having total use of its ballistic missile forces.

Additionally, there will be counter responses that change both how the United States and the ballistic missile launching state view and approach the unfolding conflict.

Counterforce strikes before or after the start of a conflict would remove offensive forces from the battlefield and sow confusion among the adversary's leadership and the civilian and military operators of the enemy's ballistic missile forces. The U.S. ability to penetrate enemy territory with missiles and aircraft to destroy silos and mobile launch platforms, and to destroy command and control nodes and channels, will reduce the enemy's ability to respond with a second wave of ballistic missiles against the United States. If a ballistic missile cannot be launched, there is no need to defend against it. Counterforce, counter C2, and cyber warfare operations would have the highly beneficial consequence of helping missile defense operators preserve defensive resources, thereby reducing the likelihood that the enemy's actions would force the United States to deplete its inventory before the battle is over. In addition to saving lives, missile defenses can provide leaders more time and flexibility to plan a military response (the absence of missile defenses could lead otherwise to an immediate escalation of conflict marked by ferocious, preemptive, and early military responses). To the extent the United States can involve its allies and missile defense partners in plans and operations, so much the better. More allied participation in the missile defense battle not only could increase interceptor inventory, but could provide geographic proximity to the threat by allowing forward deployment of sensors and interceptors to improve overall BMDS performance. These same allies and partners should be integrated into offensive operations to obtain the highest levels of efficiency.

Applying Missile Defense Principles

To achieve maximum flexibility, the system should feature **mobile, transportable shooter, and sensor elements**. That is not to say the system should not rely on fixed missile fields or sensors. There is a clear advantage to being able to move system elements around the nation or globe in order to enable the defense to achieve a positional advantage and avoid a Maginot Line scenario where the missile defense system is outflanked. Aegis BMD ships, relocatable Aegis Ashore sites, THAAD batteries, and orbiting sensors or shooters would appear to offer advantages.

To provide a layered defense the system should have **a global footprint** and feature system elements capable of intercepting ballistic missiles across their trajectories, from boost to terminal. It might also feature different types of shooters and sensors, perhaps assets deployed in different geographic environments. Because the system is global, that system would leverage the military capabilities and territorial advantages of international partners. Furthermore, it would take advantage of geographic environments that provide global access, especially space. The air and the sea also encompass the globe (land is divided by oceans and seas), yet physical limitations (travel time from point to point using current transportation technologies) reduce global accessibility provided by these geographic environments. Space is limited by orbital constraints, but the expansion of constellation size can reduce that limitation. In the end, a truly global BMDS would take advantage of all geographic environments. Fixed and relocatable sensors and missile fields on land would help lock down specific threat corridors. Military prowess in each of the geographic environments would provide maximum advantage and layered defense capability.

To achieve integration, the system should feature **a highly reliable, precise, prompt, and cutting-edge C2BMC system** to provide seamless operations and highly rapid (instantaneous or near-instantaneous) processing. It should have a global infrastructure and be capable of integrating land, sea, air, and space assets. The system should also be capable of leveraging international partner systems. In the interest of achieving independence as required, it would feature **space and sea-based assets controlled by the United States**, which do not require the cooperation of a foreign power to be operated (forward based land forces and air and sea forces may be subject to control by other nations, whose leaders may veto operations).

To achieve operations at high speed (ensuring the fastest response time possible to the launch of threat missiles), the system should have **sensors and shooters capable of reaching within the territories of adversary states** and **leveraging speed-of-light technology** to improve kill capabilities, sensors, and communications. While ground-based, sea-based, and airborne platforms, given the right geographic proximity to the launch sites, would be capable of boost- and (more probably) ascent-phase intercept, only space-based assets offer the opportunity to reach deeply and routinely within the interiors of larger countries. Missile defense lasers mounted on platforms in the air, at sea, on the ground, or in space would have the advantage of reaching the target in a split second, potentially offering a high number of shot opportunities, which would be ideal in raid situations.

To achieve system resiliency, the system should have EMP-protected **redundant capabilities** comprising independent systems (defense layers) to reduce the chances of a "death blow" to any one part of the system, capabilities that could be **controlled by the United States** as required, and capabilities that would **withstand catastrophic nuclear attack**. A system open to the integration of advanced technologies would achieve resiliency and the highest levels of performance efficiency over time.

Sensors

Sensors are the "eyes" of the Ballistic Missile Defense System. Continuously available, transportable, and mobile, BMDS sensors provide real-time detection and tracking data to the system and the war fighter through C2BMC. Sensors also can provide discrimination (to overcome BMD countermeasures) and hit assessment data (to determine whether a target needs to be reengaged). Today, the BMDS relies on space-based (Defense Support Program, space-based infrared satellites), sea-based mobile sensors—Aegis BMD ships and Sea-Based X-band—, and ground-based radars—Cobra Dane in Shemya, Alaska, Upgraded Early Warning Radars (UEWRs at Beale AFB, Fylingdales, and Thule)—and forward based AN/TPY-2 X-band radars in Japan, Turkey, and the Middle East to provide detection, tracking, classification and hit assessment information. AN/TPY-2 provides early surveillance and tracking information to the BMDS to support shoot-look-shoot opportunities. Multiple sensors, and multiple views of the target object or objects are desirable and more advantageous for defensive systems. Multiple sensors can provide overlapping sensor coverage and expand the BMDS battle space, and thereby complicate an enemy's ability to penetrate the defense system. Different missile defense interceptors "netted" together by an advanced command and control and battle management network provide cuing and tracking information from BMDS sensors to optimize ballistic missile engagements.

Improvements to BMDS discrimination and sensor capabilities are needed to provide cost-effective improvements to homeland missile defenses. Moreover, they would increase coverage areas and available ship operation areas. Indeed, "there is no practical missile defense system that can avoid the need for midcourse discrimination."[96] Presently, the Department of Defense is evaluating potential sensor enhancements that could be pursued to improve the BMDS kill chain, improve coverage, and increase threat discrimination. Specific options are being examined in the context of radar type, location, and technical performance and improvements to the GMD exo-atmospheric kill vehicle. This evaluation will serve to inform decisions on our future BMDS architecture and budget requests. In any case, improved precision tracking and discrimination capability to counter evolving threat countermeasures and significantly enhance the lethality of the BMDS is needed. Improved discrimination may be expected to increase system performance by enabling missile defense operators to know what threat objects need to be attacked and which threat objects have been successfully attacked. Discrimination radars, such as the Sea-Based Radar or the planned Long-Range Discrimination Radar, can keep the shot doctrine manageable.[97] The system would have to reengage target objects that survived the initial salvos. Given the possibilities for global persistence, a high performing system would leverage space to improve space tracking and discrimination capabilities.

Aside from improvements in discrimination, defense planners need to accept the reality that homeland defense is necessarily a global mission, and that to perform the global missile defense mission adequately, the United States needs to be in space. A regionally defined threat with defined axes of attack can almost always be more effectively handled with terrestrial based assets. In regional scenarios, only limited, defined areas need to be defended. The global threat currently presented to the U.S. homeland, however, presents a different challenge. With a globally defined threat, there are numerous, undefined azimuths of attack that require space systems to be effective. Should the United States attempt to focus on possible ballistic missile strikes from either Russia or China, basing assets in space is the only way to address them efficiently; space-basing has become an integral part of the way the U.S. armed forces fight wars and is a true force multiplier. The major benefit of space systems today is that they can provide persistent coverage around the clock, particularly when it comes to enemy territories otherwise denied to terrestrial based sensor systems.

Today many countries possess ballistic missiles and several of them have an adversarial relationship with the United States. Currently, it is possible to have good radar coverage during the terminal phase of a ballistic missile's trajectory. It is also possible to have good radar and space coverage during boost phase, provided the launch sites are not deep within a country's borders. A space sensor network, composed of satellites like the current demonstrator Space Tracking and Surveillance System (STSS) satellites (there are only two in operation today, with none planned for the future), and the recently cancelled Precision Tracking Space System (PTSS) program, would fill that critical sensor gap between boost phase and the terminal phase when the enemy today is most likely to deploy countermeasures and decoys to try and confuse the radars during the terminal and midcourse phases of flight. The primary mission of STSS satellites is to demonstrate midcourse coverage of a ballistic missile's trajectory and provide fire control quality data to enable an intercept based on STSS track data (as has been demonstrated in FTM-20 in February 2013 when an Aegis BMD ship used C2BMC system tracks based on data received from STSS satellites to intercept an MRBM using a Standard Missile 3 Block IA interceptor).

Space systems free the BMDS sensor network from geographic limitations. In other words, a ground-based radar's ideal location may not be on the territory of a host nation friendly to the United States. Even when that location is in the territory of a friendly host nation, one is confronted with a host of complex negotiations and political debate over whether to deploy radars that provide adequate coverage against a single threat country using terrestrial based assets. Coincidentally, since a space launch and a ballistic missile launch have similar characteristics, the precision tracking from a BMDS space sensor network would also be able to help determine whether a foreign launch event were a space launch or a ballistic missile launch.

CubeSats may offer a promising way to be in space by expanding the possible number of satellites, significantly lowering the cost to orbit, and improving the response time to orbit. They would assist surge operations to concentrate sensors during a crisis, or make constellation replenishment during the lifetime of the system more affordable and effective. The National Reconnaissance Office is one governmental organization now experimenting with small satellites, 10 cm cubes with a total mass of 1.33 kg. Cube sizes can be increased in height by increments of 10 cm to add greater functionality, more power, better reaction wheels, more capable subsystems, and better propulsion systems. These satellites have been launched on various platforms, with up to 29 launched to date at a single time. Technologists envision launching as many as 50 at a time.[98] If technical developments allow the miniaturization of the infrared and visible sensors, and the power sources needed to do the ballistic missile defense mission, significant efficiencies and benefits to system performance are likely.

Aegis BMD (Ashore and At Sea)

A layered BMDS capable of defending the homeland against a ballistic missile raid from anywhere on the globe is needed to counter the threats identified early in this monograph, to include potential large ballistic missile raid sizes from countries such as Russia and China, and ballistic missiles launched from ships off the U.S. shoreline. The first step should be to reexamine the possible roles that one of our most successful missile defense assets can play in the homeland defense mission. Aegis BMD ships stationed around Japan already provide Long Range Surveillance and Track inputs into the BMDS for defense of the United States from North Korean ballistic missiles. These forward based platforms provide early ascent phase data on in-flight missiles. Clearly, Aegis BMD can play a larger role in our homeland missile defenses.

U.S. Navy ships have the capability to travel over most of the earth's surface and consequently can provide a ballistic missile defense capability for many regions throughout the world. Ship stationing has the added benefit of not requiring negotiation with foreign countries to acquire basing rights for ground-based interceptors or the right of passage into inland seas. Sea-based missile defenses provide the most promising near-term opportunity over the next several decades for expanding the current system. This system can provide improved regional missile defense over time, and has the flexibility to contribute to the increased protection of the United States and its territories by augmenting currently deployed and expanding Ground-based Midcourse Defenses.

Aegis BMD ships may be positioned in more advantageous locations (relative to the GMD missile fields) to counter threats that the GMD system might not be capable of countering. Though limited by the speed and range of the Standard Missile, Aegis BMD missile defense may be used to supplement GMD coverage. Given the right conditions, ships may be placed near threat launch sites from locations at sea to achieve boost or ascent phase kills. As the Independent Working Group notes, ships stationed some distance from the threat can hit the target in all phases—ascent, midcourse, and, given its position, in terminal—and that this contrasts sharply with the GMD system which is designed to strike in midcourse. Positioning shooter platforms at sea has a critical advantage: "Ground-based interceptors deployed on the territory of allies could also provide a degree of boost-phase intercept capability against ICBMs launched at the United States from some locations, but gaining such access and deployment rights would be more difficult than stationing ships in international waters, which comprise over two-thirds of the Earth's surface."[99]

The Aegis BMD weapon system and the SM-3 IA and IB interceptors together have a proven track record against short-, medium-, and intermediate-range ballistic missiles—18 out of 21 attempts using the operationally configured interceptor since June 2006. Yet what makes Aegis BMD especially relevant is "launch-on-remote," or the ability of an Aegis BMD ship to use sensors external to the ship to acquire, track, and launch against a target. Launch-on-remote allows the ship to use radars external to the Aegis BMD ship to detect and target a long-range threat target well before the ship's own SPY-1 radar would be capable of picking it up. This technology allows the ship to launch its interceptor before it would be able to do so relying on its own SPY-1 sensor, which allows the missile defender to enlarge the battle space. It can also enhance the performance of the system by permitting multiple shots against a long-range target.

In February 2008, in a special one-off mission, the Department of Defense leveraged Missile Defense Agency and U.S. Navy expertise to shoot down a failing U.S. government satellite that still carried toxic fuel. The successful intercept mission demonstrated for the first time launch-on-remote using numerous sensors external to the Aegis BMD ship. The satellite actually was moving at orbital velocity, a speed faster than an ICBM. MDA was able to modify the weapon system and the SM-3 interceptor for this one-time intercept mission. In April 2011, Aegis BMD demonstrated launch-on-remote in a missile defense test using a forward-based AN/TPY-2 radar to intercept an IRBM, essentially demonstrating the ability to intercept a fast moving missile launched out of Iran towards Europe. In February 2013, Aegis BMD used high quality tracks provided by the Space Tracking and Surveillance System demonstrator satellites, and passed through the C2BMC system to conduct another successful launch-on-remote engagement. This test, according to MDA, proved the value of an integrated command and control and sensor network and the use of satellites to expand the missile defense battle space.[100]

In addition to the SM-3 IAs and IBs currently deployed and in production, the United States is also co-developing with the Japanese the SM-3 IIA, which is scheduled to come on line in 2018. The SM-3 IIAs are designed for basing on Aegis BMD ships as well as at Aegis Ashore sites at the Pacific Missile Range Facility in Hawaii (currently a test site), and in Romania by 2015, and Poland by 2018. These land-based sites will also be capable of firing the SM-3 IB. The SM-3 IIA flies faster and farther than the SM-3 IAs and IBs, and, therefore, is capable of defending a larger area. SM-3 IIAs deployed in Europe would be capable of hitting Iranian ICBMs launched against the United States in the ascent or early midcourse phase of flight. Any threat missiles that made it through that first threat layer could be targeted by the GMD system on the back end. According to the National Research Council, SM-3 Block IIA interceptors based on ships with launch or engage on remote, "together with the THAAD and PAC-3 systems and their elements will provide, where appropriate, adequate coverage for defense of U.S. and allied deployed forces and of Asian allies."[101]

With the U.S. Navy fully invested in the missile defense mission, the United States plans to put 43 Aegis BMD ships into service by 2019, which means the ability of the United States to address emerging threats with some flexibility will grow along with its fleet of ships, should the decision ever be taken to expand the number of ships. These seaborne missile defense platforms (which are also capable of performing other military missions as needed for the Navy) will meet tactical missile defense requirements as they evolve, and their number can be expanded as the threat warrants. The Navy, writes Vice Admiral J.D. Williams, USN (Ret.), seeks qualitative improvements in the BMD system, to include: "Navy concept of operations for missile defense that increases the responsiveness of the fleet to rising ballistic missile threats"; improvements in system reliability and effectiveness against short- to intermediate-range threats; and "the most important improvement," making it capable against long-range missiles, including ICBMs.[102]

According to Williams, improvements in command and control and the fielding of smaller, lighter kill vehicles atop the SM-3 IIAs could give Aegis BMD a worthy anti-ICBM capability. Though clearly it would be a technical challenge to develop it (given that the propulsion system needed to steer the kill vehicle into the path of the target necessarily will be a significant factor in determining its overall weight), an even lighter kill vehicle could give the interceptor even greater range. Aegis BMD would have to leverage forward based sensors, such as the AN-TPY-2 radars deployed in Japan and Turkey, to accomplish the homeland defense mission using launch-on-remote technologies to hit the target in the terminal phase of flight. He argues that MDA and the Navy could continue their highly collaborative relationship to develop and improve the command and control structure "external to the Navy in a way that permits the timely provision to Navy system of the sensor data generated by non-Navy systems." MDA and the Navy are already collaborating to develop a new Navy communications architecture in the various theaters.

The idea of deploying SM-3s on land as an operational system arose during General Obering's time at MDA and was made part of a vigorous development and deployment plan under the Directorships of General O'Reilly and Admiral Syring. At the White Sands Missile Range test site in New Mexico, the missile defense program had deployed the nation's sea-based BMD technology on land. Aegis Ashore systems can provide a more fixed defense (although the system is relocatable and could be repositioned given sufficient lead time to address an evolving threat). Aegis Ashore sites, which will have the SPY-1 radar and the Aegis Weapon System, will be capable of firing 24 SM-3 IBs and SM-3 IIAs. In 2014, the first flyout test involving Aegis Ashore technology and the SM-3 IB took place at the Pacific Missile Range Facility in Hawaii.[103] Current plans are to place operational Aegis Ashore batteries at sites in Romania in 2015, and Poland in 2018, to protect European NATO populations from long-range Iranian ballistic missiles.

One could make the case the Aegis Ashore test site on Hawaii could, if required, provide a terminal defense of the islands, a de facto defense capability for Hawaii. In other words, the Aegis Ashore site on Kauai could serve a dual purpose, and be pressed into service in extreme situations to defend the 50th state against ship-launched ballistic missiles and even ICBMs launched from North Korea or China. Given that these platforms may be disassembled and reassembled (the Aegis Ashore deckhouse destined for Romania was constructed first in Moorestown, New Jersey), Aegis Ashore batteries may be moved from location to location. In other words, they may be placed along the coasts of the United States to provide a defense against ship-launched missiles or from longer-range ballistic missiles launched from the Caribbean or Gulf of Mexico, Central America, or South America. This threat was recognized in the Fiscal Year 2014 National Defense Authorization Act (Sec. 238, 5G), which directed the Secretary of Defense to provide a report on the future improvement of homeland defenses, to include an examination of the enhancement and deployment of the SM-3 IIA to defend against missiles launched from the sea or from territories to the south of the United States, should such a threat arise in the future.

An architecture with an Aegis Ashore southern tier in the United States could also address a fractional orbital attack. Such a weapon would use an orbital trajectory (and not necessarily make a complete orbit) to gain extremely high velocities before falling out of their orbital assist to strike targets in the United States. A fractional orbital bombardment system (FOBS) might also be used to detonate a nuclear weapon over the United States, releasing an Electro-Magnetic Pulse. North Korea and Iran have demonstrated a capability to launch payloads into low earth orbit over the South Polar regions.[104] The United States demonstrated it could hit an object in very low earth orbit with the February 2008 satellite shootdown, when it used an interceptor (the SM-3 IA) that is less capable than the SM-3 IIAs currently being developed. The United States had excellent intelligence for that shootdown mission (since orbiting satellites are highly predictable), and would need excellent intelligence to be able to defeat a FOBS. When fired vertically, the SM-3 can reach targets as high as 310 miles.[105] A Ground Based Interceptor from Vandenberg or an SM-3 IIA with an even lighter kill vehicle would be needed to reach higher altitudes within low earth orbit.[106]

To intercept an ICBM coming over the North Pole the system would require a forward based radar, such as a transportable AN/TPY-2, the upgraded early warning radars currently operational in Alaska, Greenland, and the United Kingdom, or the Long Range Discrimination Radar now in development. Those radars would provide a track to the crew on an Aegis BMD ship along the east or west coast and give the Aegis BMD ship sufficient time to accomplish an intercept in the terminal phase of flight. Aegis BMD ships, or Aegis Ashore batteries, may also be positioned to stop attacks over the South Pole or from countries that lie to the south of the United States. For optimal performance, terrestrial based radars would have to be placed to the south, or the United States would have to invest in a constellation of space-based sensors similar to the Precision Tracking and Space System satellites cancelled by President Obama. Also, Aegis BMD ships could be deployed to the south and their SPY-1 radars used to cue the GMD system and the launch of GBIs from either Vandenberg AFB or Fort Greely, Alaska. Aegis BMD ships, or Aegis Ashore sites, might also be deployed off U.S. coasts to provide a limited defense against ballistic missiles launched from vessels near the United States.

Whereas elements of an expanded Aegis BMD architecture could be ready 24/7 to be activated to counter attacking missiles, Aegis BMD ships might not be in the right locations and on-station in the event of a short-notice threat launch. Nevertheless, bipartisan political support for Aegis BMD is very high and, therefore, it represents the path most likely to succeed, especially in the near-term.

Space-Based Interceptors

A space-based missile defense layer, unlike a fleet of missile defense ships, would have a persistent, on-call global presence. While missile defense weapons are entirely based on earth today, most of the engagements actually take place in space. In other words, the United States is fighting what is essentially a space war from earth. In a sense, today's terrestrial weapons are starting this battle out of position. They have to be exceptionally fast and highly advanced technologically to get into the game quickly. The attacker has the advantage in battle, which could take place in a matter of minutes, because the attacker launches before the missile defense system can be cued and activated. By pre-positioning defensive weapons in the environment where the battle will take place, space-based interceptors could offer efficiencies for the entire BMDS by improving overall operations and protecting more areas around the world. On call around the clock, a space-based interceptor system would be available and in position to counter a surprise attack. [107]

According to former MDA Director, General Obering, the United States must be concerned: "about future threat uncertainty and worldwide ballistic missile proliferation. I believe the performance of the BMD system could be greatly enhanced by an integrated, space-based layer. Space systems could provide on-demand, near global access to ballistic missile threats, minimizing the limitations imposed by geography, absence of strategic warning, and the politics of international basing rights. A space layer would apply pressure on launches from land or sea, depriving the adversary of free rides into midcourse with advanced countermeasures."[108] Space assets can be present and persistent over many places on the globe. That being the case, an advantage space-based interceptors have over terrestrial-based interceptors is the ability to counter targets launched from deep within the interior of a large country, such as Russia, China, or Iran. Space-based interceptors also offer the advantage of conducting an intercept early in a ballistic missile's trajectory, so that a nuclear detonation resulting from the intercept would be less likely to happen over U.S. territory; in such a case the United States would be able to limit or completely avoid the impacts of an electro-magnetic pulse, which would destroy its unprotected technological infrastructure.

Space-based interceptors can be attractive for several additional reasons. The current BMDS is limited in its ability to intercept ballistic missiles heading toward the United States to engaging in the midcourse phase of flight. This is the period of flight when midcourse countermeasures such as balloons, decoys, and chaff can be deployed to confuse the system. Using terrestrial based shooters, boost phase or ascent phase intercept would require locating interceptors in geographic proximity to the threat launch site, which would make them more vulnerable to counter-attack by the enemy. There might also be severe political barriers to basing missile defense systems so close to enemy territory. Moreover, in scenarios involving countries with deep interiors, terrestrial based interceptors would be ineffective in the boost and ascent phases.

Space-based interceptors have a significantly wider area of coverage; because they provide a forward based defense, when combined with the other layers of the BMDS, space-based interceptors would enable more shots against threat missiles. Depending on the type of space-based interceptor deployed, and its orbit and altitude, it may even be possible for the space-based element of the BMDS to have shot opportunities in all phases of flight—boost, ascent, midcourse, and even high terminal.[109]

The National Research Council report on *Making Sense of Ballistic Missile Defense* chose to discount space-based defenses for boost-phase defense claiming that such a system would have to be too large and too costly (this report discounted all boost-phased capabilities). However, in making that argument, the Council recognized that "space-basing for boost-phase defense would in principle solve the problems of geographic limits that make surface-based boost-phase defense intercept impractical."[110] Given the importance of a highly effective missile defense system to the safety of the nation, size and cost are two things that are workable. If space-basing would achieve a boost phase capability, it makes sense to consider this addition to our architecture. Effective layers could enable the warfighter to execute a battle plan that has the highest probability of conserving interceptor inventory, since only the interceptors with the highest probably of success would be used.

A disadvantage of a constellation of space-based interceptors is that a concentration of hit-to-kill assets in space against a particular threat corridor is not possible. The constellation is global, which means that most of the orbital interceptors are out of position relative to the launch point and midcourse engagement zones, with many on the other side of the globe. In an extended fight, these assets might be useful in follow-on battles. Yet space-based interceptors would not be the only element in the BMDS, a stand-alone system; rather, they would complement other land- and sea-based shooters.

One of the most promising designs for a space-based interceptor was Brilliant Pebbles, announced during the President H.W. Bush Administration and, subsequently, a Defense Department Program of Record. SDIO planned to deploy up to 1,000 "pebbles," which were designed to have independent early warning and tracking capabilities and operate autonomously, determining which interceptors were best positioned to intercept.[111] Also, it was believed at the time that the Brilliant Pebbles interceptors were capable of destroying Soviet ICBMs in the boost phase, which would in effect destroy ballistic missiles carrying up to 10 warheads as well as midcourse countermeasures. Some observers believe that had the United States stayed the course laid by Presidents Reagan and H.W. Bush in the Strategic Defense Initiative, not only would it have been possible to deploy a space-based layer by now, but that system would have been affordable.[112] As former historian Donald Baucom relates it:

> A few days after his retirement, Abrahamson submitted an end of tour (EOT) report that strongly endorsed Brilliant Pebbles. He was convinced that BP was the key to an effective, affordable space-based architecture and believed that BP could be operational in five years at a cost of less than $25 billion. Therefore, he recommended pushing Brilliant Pebbles aggressively. "This concept," he wrote, "should be tested within the next two years and, if aggressively pursued, could be ready for initial deployment within 5 years." Moreover, "once deployment has begun and a competitive industrial base is established, the system could be scaled to higher levels of effectiveness forever decreasing incremental costs."[113]

Before its cancellation by President Clinton, Brilliant Pebbles had made considerable progress as a maturing system within the Defense Department acquisition process as part of the Global Protection Against Limited Strikes system, having survived numerous, highly critical scientific and engineering reviews in 1989 and 1990. With almost 25 years having passed since that time, technological changes in computer processing, miniaturization, sensors, and materials would have enhanced Brilliant Pebbles' performance capability over that time, probably making it even more attractive today.

For more than two decades the United States conducted extensive research on space-based interceptor technologies. While Director of the Missile Defense Agency, from 2004 to 2008, General Obering insisted on the need to investigate the feasibility and practicality of a space-based interceptor layer.[114] Numerous aspects of a space-based interceptor need to be explored from a technical perspective, and so experiments made sense. Issues dealing with command and control of a constellation, interceptor affordability, and BMDS performance with a space-based layer would have to inform the decision-making process. Unfortunately, new program direction under the Obama Administration halted movement toward a space-based layer investigation. Yet such analysis and demonstration would be required to determine whether a space-based missile defense layer integrated into the existing system could significantly enhance overall system performance.

There are significant political concerns about the deployment of a constellation of space-based interceptors, as discussed in Section 3. All these concerns need to be addressed. Nevertheless, there are no treaty limitations to prohibit the deployment of a space layer. Political issues arising from cost concerns also must be considered. When it comes to doing anything in space, weight is a major cost driver. In this case, the cost of the space-based interceptors is likely to determine overall cost of the system, and political leaders will have to perform a cost-benefit analysis. It is possible that a space-based layer could be competitive with other deployment options, especially with recent advancements in technology. Should a space-layer be determined to make significant performance improvements in the BMDS, one could make the argument that even a space-based system with an "exorbitant" price tag is cost-effective when it comes to protecting the nation against catastrophic attack.

Directed Energy

Common sense dictates that the simpler the weapon, the more reliable it can be. Kinetic kill interceptors are complex weapons comprising thousands of parts that, should any of them fail, could mean mission failure. Hit-to-kill interceptors also have a fairly high cost to kill ratio. Ground Based Interceptors cost northwards of $70 million each, and a Standard Missile-3 interceptor can cost anywhere between $7 and $24 million. However one looks at it, the cost for one of these highly advanced interceptors is high—a price worth paying if it saves lives and protects cities. The question is, as it always should be, can costs be streamlined? In order to have a more robust homeland defense, the United States requires many interceptors. The laws of physics also place a barrier in front of interceptor speed—they can only go so fast. The country has made significant strides using hit-to-kill technologies, and probably will be able to take that technology even farther, addressing tomorrow many of the limitations in the current fleet of interceptors.

However, even with the impressive strides made in the development of hit-to-kill technologies, one cannot deny the truly game-changing possibilities of directed energy weapons. Aside from the deployment of a robust space-based interceptor capability, directed energy weapons on airborne or space-based platforms can offer the capability and opportunity to destroy offensive missiles when they are most vulnerable, in the boost phase soon after launch. Boost phase intercept puts pressure on adversary payload deployment timelines, thins out attacks that can then be addressed by the midcourse and terminal layers, and offers an opportunity to defeat complex midcourse countermeasures before they can be deployed. By destroying the missile in boost, the missile and warhead debris may fall within the hostile country's territory instead of on friendly territory. A platform deployed in the air or in space could attack targets at the speed of light, and speed of engagement is critical to the success of boost phase engagement. A mobile platform would be capable of deploying to any area of interest worldwide and provide an immediate deterrence and defensive capability. Depending on the "shots" available, a directed energy platform would have the capability to negate a salvo of multiple missiles. In the future, directed energy weapons deployed for boost or terminal defense could be an important part of a layered system.

The challenges of using directed energy in a ballistic missile defense role are daunting. Ballistic missiles travel many times the speed of sound, and the targeting laser system has to find the target before it can fire. Once it has acquired the target, it must hold the directed energy beam on the target long enough to burn through and destroy the integrity of the missile body. The harder the target (and reentry vehicles are designed to withstand the high temperatures of atmospheric reentry, so the best chance is against the booster rocket), the longer the beam must remain on the missile body. This is why using lasers for missile defense in the boost phase of flight, when the missile is moving relatively slowly and the warhead is still attached to the rocket booster, appears to be the most promising application of this technology. The challenge with boost phase, of course, is that the defender must be within close range of the boosting missile (line of sight), which means getting to the launch site and then defending the directed energy platform against attack.

Significant work on directed energy weapons is being done not only by the Missile Defense Agency, but also by the Services and our international partners. Both the Army and Marine Corps are testing a high energy fiber optic laser for use against rockets, artillery, and mortars. The Navy is planning to deploy a 100-150 KW prototype solid state laser on the USS Ponce in 2014 for ship defense, with an operational weapon system as early as 2016; this will be the first time a laser weapon is used in active service. The Air Force plans to further investigate the use of lasers on aircraft.[115] Speed of light weapons could accomplish some tactical engagements at a cost-savings by minimizing use of kinetic energy missiles and projectiles.

Israel also is investigating the role of directed energy air and missile defense systems to add to its layered defense architecture. The new capability under development, Iron Beam, would protect communities and military installations from very short-range systems, missiles or aerial threats. Iron Beam, a solid-state laser interceptor, is a mobile High-Energy Laser Weapon System developed by RAFAEL that would destroy targets by heating up the object until it explodes. The system is intended to intercept targets that cannot be intercepted by the current Iron Dome, a hit-to-kill rocket and missile defense system, which has destroyed hundreds of rockets launched by Hamas.[116]

The United States has had no boost phase missile defense program since 2009, when the Obama Administration terminated the Airborne Laser (ABL) and the Kinetic Energy Interceptor programs. Pentagon officials cited technology and cost challenges with both systems. However, despite the cancellations, there were significant successes with the ABL development.

Prior to its cancellation by the Obama Administration, the ABL accomplished two historic intercepts at a California test range. The Airborne Laser tested was a massive chemical oxygen iodine laser integrated into a Boeing 747-400F platform that demonstrated the ability to not only track, but also fire on and destroy, a boosting ballistic missile. In 2010, the Airborne Laser Test Bed, renamed from the Airborne Laser, completed preparatory tests that ultimately led to two successful experimental shoot-downs. The first success was against a solid-fuelled rocket on February 3, 2010. Then, on February 11, 2010, using only the power of directed energy, the Airborne Laser caused the collapse of a boosting, liquid-fueled, Foreign Material Acquisition target. Those test campaigns were not only successful in achieving their primary objectives, demonstrating the viability of directed energy for the missile defense mission, but the Airborne Laser Test Bed also collected data on tracking and atmospheric compensation, system jitter, and boundary layer effects on propagation for future directed energy applications.[117]

The government subsequently shut down the program to pursue other directed energy routes. The Defense Department deemed the ABL to be operationally hamstrung. Its range was limited by the power of the beam; as a result, it would have to fly very close to enemy borders to have a shot at hitting a boosting missile. A very large and chemically hazardous platform (the Boeing 747), the ABL would have been a very vulnerable target requiring a significant escort of fighter aircraft for the mission.

One cannot help but imagine that the successes of the ABL have provided us a glimpse of the future of BMD systems. It is reasonable to continue to investigate speed-of-light technology. The Missile Defense Agency has been investigating light-weight, high-efficiency solid-state lasers using the resources offered at Lawrence Livermore National Laboratory, MIT Lincoln Labs, and the Defense Advanced Research Projects Agency. According to Admiral Syring, who testified before Congress in April 2014, we "achieved record power levels within the last year. MDA will continue high energy efficient laser technology development with the goal of scaling to power levels required for a broad spectrum of speed of light missile defense missions." Power levels need to be reached to be able to destroy ballistic missiles from an airborne platform, for example, which is also under investigation by MDA.[118]

Further development of Aegis BMD, development of space-based sensor and interceptor layers, and the experimental pursuit of directed energy are all options offering near-term and far-term paths for evolving the BMDS for homeland defense. These evolutionary developments would be integrated into a BMDS that features upgraded and potentially expanded fixed GMD missile fields, transportable missile defense batteries (Aegis Ashore and THAAD), and sea-mobile platforms (Aegis BMD ships). Fixed, mobile, transportable, and orbiting sensors would provide the global network required to gather data needed to operate the BMDS against a threat emanating from anywhere in the world to protect the U.S. homeland by bolstering deterrence and providing a robust active defense capability.

Section 7. What Direction Homeland Missile Defenses?

Today there are many technical missile defense challenges to address. Under the current missile defense posture, homeland defenses may be overwhelmed numerically. Significant work remains, especially in the area of discrimination, to counter BMD midcourse countermeasures. While we do not fully understand the magnitude of the problem, homeland missile defenses also are subject to sabotage via an EMP burst that could potentially degrade the electronics in our systems.

More significant than the technical challenges are the shortcomings in policy imagination. Even 12 years after the ABM Treaty withdrawal, there are too many in positions of power who have accepted as creed the idea that weakness (i.e., defenselessness) is strength, and that military strength can only lead to instability and apocalypse. However, history has shown that weakness is provocative (witness the 2014 resurgence of organized terror in Iraq following an untimely withdrawal of U.S. forces that projected a weaker U.S. presence in that country), and that lack of defenses invites aggression. In the case of missile defense, it may be that the lack of a robust missile defense has only encouraged those who wish to challenge the United States by acquiring or maintaining an arsenal of ballistic missiles, weapons against which the United States has only limited defenses (indeed the country was completely defenseless as recently as 10 years ago).

The burden of explaining the need to act forcefully falls on our leaders. As President Franklin D. Roosevelt said, “Government includes the act of formulating a policy” and “persuading, leading, sacrificing, teaching always, because the greatest duty of a statesman is to educate.”[119] In a similar vein, Abraham Lincoln observed that political speech is required to shape and feed public opinion by identifying with the principles and sentiments that define U.S. political life, and that “in this and like communities, public sentiment is everything. With public sentiment, nothing can fail; without it, nothing can succeed.”[120]

Policy-makers can influence the culture by changing how they discuss missile defense and its relative contribution to national security. Balance-of-terror thinking has essentially precluded a rational assessment of the implications of the already bloated and expanding Russian and Chinese ballistic missile forces. That needs to change. Political rhetoric in this country must acknowledge that the country is vulnerable to ballistic missile attack from nations that could literally put an end to the United States as we know it. Russian aggression towards Ukraine in 2014 underscores the importance of having a strong deterrent, and the ability to reassure allies, defend national commitments and interests, and protect the homeland. Defenses, particularly including missile defenses, are critical to each one of these objectives.

Admiral C. D. Haney, Commander of U.S. Strategic Command, reminded his audience in his March 2014 Congressional hearing that, despite the fact that an attack by major nuclear powers such as Russia and China remains remote, the threat these two nations pose to the United States remains an “existential” one—a threat to our very way of life. In his statement, he painted a sobering picture.

> Nation states such as Russia and China are investing in long-term and wide-ranging military modernization programs to include extensive modernization of their strategic capabilities. Nuclear weapons ambitions and the proliferation of weapon and nuclear technologies continues, increasing risk that countries will resort to nuclear coercion in a regional crisis or nuclear use in future conflicts.[121]

Indeed, even the U.S. State Department has been sending alarms about Russia's large-scale build-up of nuclear forces over the past 10 years, a build-up that appears to be aimed at achieving nuclear superiority over the United States.[122]

This is not to say that war with Russia or China is likely; it reminds us, however, that the United States is in fact vulnerable to ballistic missile attack today, despite more than 70 years of investment in missile defense technologies. Even though the nation continues to wrap itself in the cloak of MADness, like Harry Potter using his cloak of invisibility to hide from a threat, it is not invisible from the threat and remains, in the rawest of terms, vulnerable. And, unless leaders take the threat of missile attack from large-scale nuclear and ballistic missile powers more seriously, and make investments in missile defense technology, development, and deployment like they mean it, they are not defending the country. They may even be at risk of opening the country up to attack or coercion by regional powers such as North Korea and Iran, should these two states continue to make significant investments in their offensive ballistic missile forces.

Currently, the United States is incapable of mounting an active defense of the homeland against a large raid of in-flight ballistic missiles launched from mature ballistic missile powers. One may even question whether it is protected from an accidental or unauthorized launch (or launches) from either Russia or China. Such protection was, at one time, a requirement of national missile defenses. It is no longer, and current events in Russia and the Ukraine should foster rethinking in this regard. The absence of a stout defense—the ability to parry a significant salvo of ballistic missiles—weakens the ability of the United States to defend its vital interests. Clearly, when the country has no real defense, a U.S. President will feel significant pressure to back down in the face of a threatened attack when the geopolitical stakes are the highest.

Political leaders need to talk forthrightly about the threat posed by ballistic missiles, regardless of where they are in the world. While Russia and China today do not demonstrate the intent to use these highly dangerous systems against the United States, the old axiom that intent can change overnight means one cannot ignore these developments and must continue to make investments in effective defenses if the country is to maintain security at home and protect global interests.[123] The fact is that political opposition to missile defense deployments, nurtured over the past decades from seeds planted in the 1960s, remains strong, despite the bipartisan support for the current system, which is capable of handling only a limited strike from states such as North Korea and Iran. This MAD-centered opposition has been grafted onto the very fabric of the policymaker's thinking about defense and it has imposed significant restrictions on technological development and funding for missile defense. So, despite extraordinary technological advancements since the 1960s, America's missile defenses continue to be based on outmoded systems, and its technical horizons are focused mainly on the ground-based systems in operation today. Moreover, they have not been designed to address ballistic missile forces deployed by Russia (the Soviet Union) and China. As a result, the nation may lack the appropriate system architecture, and many seriously lag behind in the "numbers game," the highly unbalanced ratio of few defensive interceptors to many offensive ballistic missiles and payloads.

Weakness in U.S. missile defenses has been rationalized over the decades as beneficial to security. This is nonsense and must be countered. While much progress has been made over the past decade to counter irrational ideological opposition to deploying defense systems in the nuclear age, there is still work to be done, especially when it comes to considering the use of space, more extensive use of ballistic missile defense ships, and directed energy to improve overall missile defense effectiveness. Policy-makers must still come to terms with what deters a rational mind, how missile defense plays in that mix, and whether deterrence can even apply in some threat scenarios.

Policy-makers need to revisit current policy. The National Missile Defense Act of 1999 establishes that it is the policy of the United States to deploy a national defense against "limited ballistic missile attack (whether accidental, unauthorized, or deliberate)." As noted in Section 2, this is rather odd phrasing when one considers that law and policy cannot necessarily shape the strategic circumstances the nation may one day find itself in, which may involve more than simply a "limited" attack. One could make the case that the country is worse off than even this law suggests, because it is no longer concerned ourselves with "accidental or unauthorized" launches, which could come from anywhere in the world, including Russia and China, two countries that deploy nuclear-tipped ICBMs. This language has fallen out of policy usage, yet its inclusion is important. By including accidental and unauthorized launches in the potential threat set, defense planners have direction to begin thinking about possible launches out of Russia and China, which, in turn, could have a significant impact on how the country builds the system, where it places sensors and shooters, and whether those defenses should be more fixed or more mobile. The Administration and the Congress need to revisit the self-limiting policy on missile defenses for the homeland, which continues to be influenced more by Cold War thinking and ABM Treaty-style strategic stability. The United States is the only nation constrained by this policy, and there is no available evidence that Russia, China, or any other nation would limit its national defenses in this way. Policymakers need to first determine the true threats facing this nation and, based on a determination of what the nation needs to do to protect the homeland, fashion a new policy that will guide the missile defense program.

Once policy-makers have determined which course the nation should be on and which threats it needs to confront, they need to develop a budget that provides the resources to fund the development of the appropriate system. It would be hard to justify a space-based layer, for example, if the only ICBM threats to the United States came from North Korea and Iran. If the threat is from a larger ballistic missile power, then an extensive space-based architecture becomes more attractive and more affordable when compared to other deployment options. Moreover, affordability must always be viewed in context. The United States is a very wealthy country, so wealthy that it apparently can throw away more than $260 billion a year, which is an admission straight from the Obama Administration. This waste, fraud, and abuse equals about 7 percent of all federal spending.[124]

Under the Obama Administration the United States has decreased spending on missile defenses by approximately 30 percent. Undoubtedly there is a great need to increase the missile defense budget significantly from its current $10 billion a year (which includes funding for MDA and the U.S. Army Patriot system). To do more requires that the nation spend more on this critical investment. When one considers the extraordinarily high cost of a nuclear strike on an American city, doubling or even tripling our current budget for missile defense is not only a drop in the bucket when one looks at the entire defense spending. It is also a paltry amount when one considers the potentially catastrophic dangers to the nation's well-being and its existence. That said, it is important that these investments be measured and the missile defense program grown at a pace that is feasible for the type of work involved. The fielded systems should be improved over time, incrementally adding capacity and capability; this would ensure that the required technology leaps were feasible and that solutions were in hand before fully investing large dollar amounts. To do this, it is necessary to expand the program and bring in more engineers and scientists to undertake new development and research work even as we continue to expand and build on the current system. Ultimately, the answer to this question depends on what we want to deploy, at what cost, and on what timeline.

Currently the United States relies on a single system to protect the homeland. That element of the BMDS is deployed at two sites and there are questions about the reliability of the interceptors currently on alert (although many of those concerns were set aside following the successful June 2014 GMD intercept test). The United States needs to continue its investment to improve and enhance its fixed defenses, the Ground-based Midcourse Defense element of the BMDS. Fixed defenses will give the country an assured 24/7 capability against a limited threat. Investments would be used to enhance, expand, and sustain the current GMD and Aegis BMD systems, improving their capabilities for defense of the homeland. A strong case must be made for continuing to develop the sensor and discrimination technologies required for the system to see the in-flight threat. With added investment, the United States should also strive to expand the number of sites with on-alert GBIs, increasing the inventory of interceptors and placing them in locations most advantageous for countering threat missiles. Clearly, the addition of an East Coast site, currently under evaluation by the Department of Defense, would be a positive step for homeland defenses. Deployment of surveillance and tracking sensors in the south to keep an eye on possible attacks from the south would also enhance the country's fixed defense capability.

Given the technical challenges of protecting the United States against ballistic missiles, it makes sense to avoid reliance on a single system. Hence, increased funding could be used to undertake the necessary research and development to expand and enhance the Aegis BMD capabilities for homeland defense as well as to insert into space ballistic missile defense sensors and, next, shooters. Policy-makers then must look hard at pushing the technology envelope for the eventual deployment of game-changing boost/ascent phase directed energy defenses.[125]

The United States requires surge capabilities to supplement fixed defenses and fill gaps. On-station Aegis BMD ships would be capable of destroying targets in the midcourse and terminal phases of flight. Transportable Aegis Ashore batteries would be capable of hitting ballistic missiles in the midcourse or terminal phases of flight, and would be deployed in the United States to protect cities from possible impending threats. Policy-makers should also look for ways to improve performance of the existing Aegis BMD capabilities.[126]

The exploitation of space can give the system a significant advantage by ensuring that the infrared sensors required to detect and cue the system and track the threat are always close to the threat launch point. With terrestrial-based sensors, we must wait to launch the interceptors until the threats have been acquired by the system. This not only means we are entering the battle late, depending on the scenario, but it also means we need to deploy terrestrial-based interceptors that are exceptionally fast and agile. Space-based sensors can help give the system a leg up in the battle.

The limited presence of the United States in space today is perhaps the greatest defense-related concern, especially when one considers threats posed by global powers. To achieve positional advantages in a battle involving ballistic missiles, a strong case may be made that the system should feature orbiting interceptor platforms. During the Reagan and George H.W. Bush Administrations, significant investments were made in the development of several critical BMD technologies for strategic defense of the United States, including space weapons and sensors. According to two former Directors of the Strategic Defense Initiative Organization:

> From a technical perspective, remarkable hardware advances, including ones in electronics, sensors and detectors, computers, propulsion, communications, and power, have resulted from SDIO's emphasis on integrating the research activities to maximize overall system performance by increasing critical element performance, miniaturization, producibility, survivability, and overall robustness. Unit size, weight and costs have been reduced, in many cases by orders-of-magnitude, while operational performance characteristics have also increased dramatically, in many cases also by orders-of-magnitude. These advances, which have numerous spin-off applications as well, were integrated into field demonstration experiments that improved the engineering state-of-the-art sufficiently to move into the serious acquisition programs now being pursued to provide active defenses to our military forces.[127]

The Clinton Administration cancelled these promising programs, and they have not since recovered. Had the country stayed the course and continued these advanced technology investments, we would be in a very different position today.

Space-based interceptors would contribute to U.S. fixed defenses because they provide an on-orbit capability around the clock. Tracking ballistic missiles from space is necessary regardless of the architecture U.S. leaders choose to deploy. Space-based interceptors would offer critical advantages against global ballistic missile powers. These defenses would be capable of addressing all long-range launches out of all countries of concern, including ballistic missiles launched from the deep interiors of large countries such as Russia, China, and Iran. Former Directors Cooper and Abrahamson have stated that "the space-based interceptor program cancelled in 1993 was the best product from the SDI era (1983-1993)" and that such defenses are the most-cost effective defenses that we can build "by a large margin."[128] Such defenses not only would help us deal with a possible threat from the South, but also deal with China's and Russia's growing strength and aggressive behavior. It would be worthwhile opening up this investigation once again.

Policymakers need to work with allies and partners early on in order to convince adversaries that they would not fare well should they initiate a ballistic missile attack. No country has a monopoly on advanced technology, and the United States should continue to leverage and expand its international partnerships to develop missile defense technologies and leverage partner resources. More partners also can translate into an expansion of the missile defense assets used for homeland defense and for the defense of our partners, such as the AN/TPY-2 radars deployed to Japan, Turkey, the Middle East, and Israel. The strong U.S. partnership with Japan on the co-development of the SM-3 IIA could lead to a greater role of the SM-3 IIA in homeland defense.

Strategic defense requires a holistic view of the threat to the nation, one that takes into account foreign military capabilities (the ability of other nations to do harm to the United States) and politics (the intent of other nations to do harm to the United States). Statesmen will take this broader picture into account and not shy away from speaking openly about the potential threats and the remedies needed to deal with them. Critically, it is imperative that policymakers reenergize the missile defense technology base by significantly increasing the science and technology, and research and development budgets. By putting missile defenses on an improved footing vis-à-vis the offensive ballistic missile forces that are proliferating around the world, the nation would enhance its deterrent against plans by potential adversaries to acquire and rely on their ballistic missile forces and to launch a ballistic missile attack against the U.S. homeland.

Notes

[1] See for example, Tom Nichols, "Five Ways a Nuclear War Could Still Happen," *The National Interest*, June 16, 2014, http://nationalinterest.org/feature/five-ways-nuclear-war-could-still-happen-10665.

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[3] 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, http://www.house.gov/hasc/testimony/105thcongress/BMThreat.htm.

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[109] Independent Working Group, *Missile Defense, the Space Relationship, and the Twenty-First Century: 2009 Report*, p. 26, 27.

[110] National Research Council, *Making Sense of Ballistic Missile Defense*, p. 9. Despite the implications in this report that space-based interceptors are not practical, there is a core truth that the authors cannot ignore: "In principle," they write, "a constellation of satellites equipped with boost-phase interceptors could be configured so as always to be geographically in range for an intercept. The number of satellites required depends, in part, on the burn time and

altitude of the threat missiles. Shorter powered flights of solid-fueled threat missile require many more satellites for coverage." The authors assert that such a constellation would have a total life-cycle cost of at least an order of magnitude greater than that of any other alternative. Yet, I would argue, that a high cost system would pay for itself many times over if it prevents even one nuclear-tipped ICBM from reaching U.S. territory. Given the stakes, we need to consider the question, what is the best defense we can deploy?

111 Independent Working Group, *Missile Defense, the Space Relationship, and the Twenty-First Century: 2009 Report*, pp. 26, 27.

112 Donald R. Baucom, "The Rise and Fall of Brilliant Pebbles," Paper presented at "They Taught the World to Fly: The Wright Brothers and the Age of Flight," an International Flight Symposium Sponsored by the North Carolina First Flight Centennial Commission, 23 October 2001; Greg Canavan, *Missile Defense for the 21st Century* (Washington, D.C.: The Heritage Foundation, 2003), pp. 96-98. Independent Working Group, *Missile Defense, the Space Relationship, and the Twenty-First Century: 2009 Report*, pp. 27-30 ("When considering the 20 year life cycle cost for Brilliant Pebbles, cited a cost estimate approved by the acquisition leadership at the time of roughly $19 billion in 2008 dollars").

113 Donald R. Baucom, "The Rise and Fall of Brilliant Pebbles," Paper presented at "They Taught the World to Fly: The Wright Brothers and the Age of Flight," an International Flight Symposium Sponsored by the North Carolina First Flight Centennial Commission, 23 October 2001. Baucom sites Former SDIO Director Abrahamson, James A. Abrahamson, Memorandum for Deputy Secretary of Defense, Subject: "'End of Tour Report,'—Information Memorandum," February 9, 1989, Attachment 1, "*Lt General Abrahamson's Recommendations*: *SDI Breakthrough Architectures*," pp. 1-1 through 1-3.

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122 Bill Gertz, "Admiral Warns that Risk of Nuclear Conflict is Growing," *The Washington Free Beacon*, April 3, 2014.

123 Keith B. Payne, "Survival Matters: The Cold War is over. Let's defend the population," *The Weekly Standard*, June 4, 2012, Vol. 17, No. 36, http://www.weeklystandard.com/author/keith-b.-payne.

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