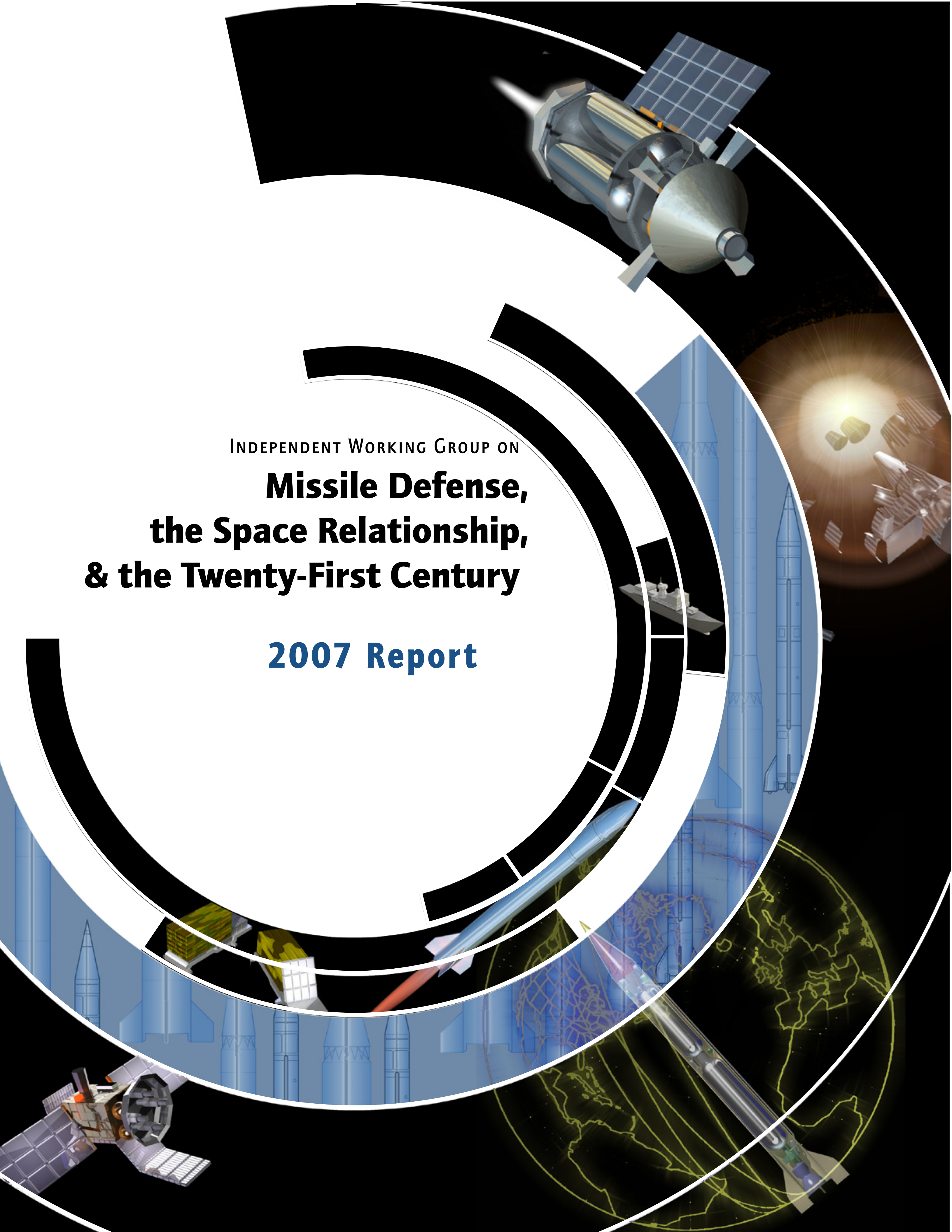

Independent Working Group on

Missile Defense, the Space Relationship, & the Twenty-First Century

2007 Report

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Sponsored by
American Foreign Policy Council
Claremont Institute
Department of Defense and Strategic Studies, Missouri State University
George C. Marshall Institute
The Heritage Foundation
High Frontier
Institute for Foreign Policy Analysis
Institute of the North

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Foreword

The Independent Working Group (IWG) on Post-ABM Treaty Missile Defense and the Space Relationship was formed in 2002. Our goals are severalfold: (1) to examine the evolving threats to the United States, its overseas forces, allies, and coalition partners from the proliferation of ballistic missiles; (2) to examine missile defense requirements in the twenty-first-century security setting; (3) to assess current missile defense programs in light of opportunities afforded by U.S. withdrawal from the ABM Treaty; and (4) to set forth general and specific recommendations for a robust, layered missile defense for the United States.

In pursuit of these objectives, the IWG has met several times a year beginning in early 2002. These meetings have provided an opportunity for the IWG not only to analyze issues directly related to missile defense, but also to identify a large number of additional topics for discussion. The IWG was structured to include members with technical expertise as well as participants familiar with the politics of missile defense. From these meetings drafts of each of the cornerstone papers contained in this Report as Sections 1 – 7 were produced, critiqued, revised, and refined for inclusion in this IWG Report. The Report also sets forth general and specific recommendations in the Executive Summary and in Section 8. In addition to its many plenary sessions, the IWG members organized panels for specific discussion of each of the cornerstone papers and to add new ideas, perspectives, and insights. Rapporteur reports are included, at the end of each section, together with the membership of each panel.

This IWG Report is intended as a living document, to be updated as necessary and to provide a basis for informed consideration of missile defense needs. Its contents will be reproduced in other formats in order to assure broader dissemination of the IWG's work.

Executive Summary

Missile defense has entered a new era. The decades-long debate over whether to protect the American people from the threat of ballistic missile attack has been settled – and settled unequivocally in favor of missile defense. The rigid constraints of the Anti-Ballistic Missile (ABM) Treaty, which made the construction of effective anti-missile capabilities impossible during the decades of the Cold War, are now a thing of the past. What remains an open question is what shape the American missile defense system will take in the years ahead.

Yet there is ample reason for concern. The threat environment confronting the United States in the twenty-first century differs fundamentally from that of the Cold War. An unprecedented number of international actors have now acquired – or are seeking to acquire – ballistic missiles and weapons of mass destruction. Rogue states, chief among them North Korea and Iran, have placed a premium on the acquisition of nuclear, chemical and biological weapons and the means to deliver them, and are moving rapidly toward that goal. Russia and China, traditional competitors of the United States, continue to expand the range and sophistication of their strategic arsenals. And a number of asymmetric threats – including the possibility of weapons of mass destruction (WMD) acquisition by terrorist groups or the decimation of American critical infrastructure as a result of electromagnetic pulse (EMP) – now pose a direct threat to the safety and security of the United States. Moreover, the number and sophistication of these threats are evolving at a pace that no longer allows the luxury of long lead times for the development and deployment of defenses.

In order to address these increasingly complex and multifaceted dangers, the United States must deploy a system that is capable of comprehensive protection of the American homeland as well as its overseas forces and its allies from the threat of ballistic missile attack. Over the long term, U.S. defenses also must be able to dissuade would-be missile possessors from costly investments in missile technologies, and to deter future adversaries from confronting the United States with WMD or ballistic missiles. Our strategic objective should be to make it impossible for any adversary to influence U.S. decision-making in times of conflict through the use of ballistic missiles or WMD blackmail.

These priorities necessitate the deployment of a system capable of constant defense against a wide range of threats in all phases of flight: boost, midcourse, and terminal. A layered system – encompassing ground-based (area and theater anti-missile assets) and sea-based capabilities – would provide multiple opportunities to destroy incoming missiles in various phases of flight. A truly global capability, however, cannot be achieved without a missile defense architecture incorporating interdiction capabilities in space as one of its key operational elements. In the twenty-first century, space has replaced the seas as the ultimate frontier for commerce, technology and national security.

The benefits of space-based defense are manifold. The deployment of a robust global missile defense that includes space-based interdiction capabilities will make more expensive, and therefore less attractive, the foreign development of technologies needed to overcome it, particularly with regard to ballistic missiles. Indeed, the enduring lesson of the ABM Treaty era is that the *absence* of defenses, rather than their presence, empowers the development of offensive technologies that can threaten American security and the lives of American citizens. And access to space, as well as space control, is key to future U.S. efforts to provide disincentives to an array of actors seeking such power.

So far, however, the United States has stopped short of putting these principles into practice. Rather, the missile defense system that has emerged since President Bush's historic December 2002 announcement of an "initial set" of missile defense capabilities provides extremely limited coverage, and no global capability. Instead, by the administration's own admission, it is intended as a limited defense against a small, rogue state threat scenario. Left unaddressed are the evolving missile arsenals of – and potential missile threats from – strategic competitors such as Russia and China as well as terrorists launching short-range missiles such as *Scuds* from off-shore vessels.

The key impediments to the development of a more robust layered system that includes space-based interdiction assets have been more political than technological. A small but vocal minority has so far succeeded in driving the debate against both space-based defense and missile defense writ large. The outcome has been that political considerations have by and large dictated technical behavior, with the goal of developing the most technologically-sound and cost-effective defenses subordinated to other interests.

A symptom of this problem is the fact that, for all of its commitment to protecting the United States from ballistic missile attack, the administration has so far done little to revive the cutting-edge technologies developed under the administrations of Presidents Ronald Reagan and George H. W. Bush – technologies that produced the most effective, least-costly ways to defend the U.S. homeland, its deployed troops and its international partners from the threat of ballistic missile attack. The most impressive of these initiatives was undoubtedly *Brilliant Pebbles.* By 1992, that system – entailing the deployment of a constellation of small, advanced kill-vehicles in space – had developed a cheap, effective means of destroying enemy ballistic missiles in all modes of flight. Yet in the early 1990s, along with a number of other promising programs, it fell victim to a systematic eradication of space based technologies that marked the closing years of the 20th century and still plagues the opening years of the 21st century.

The current state of affairs surrounding missile defense carries profound implications for the safety and security of the United States, and its role on the world stage in the decades to come. Without the means to dissuade, deter and defeat the growing number of strategic adversaries now arrayed against it, the United States will be unable to maintain its status of global leadership. The creation of effective defenses against ballistic missile attack remains central to this task.

Historically, it is evident that the major geopolitical options that become available have been exploited by one nation or another. Those nations that are most successful in recognizing and acting on such options have become dominant. Others who have failed or have consciously decided not to do so are relegated to inferior political status. A salient case-in-point is ocean navigation and exploration. The Chinese were the first to become preeminent in this retrospectively pivotal area during the early Ming dynasty. However, domestic politics – strongly reminiscent of missile defense politics in the United States of the past several decades – induced this great national lead to be dissipated, with historic consequences felt until the present day, a full half millennium later. The subsequent assumption by Portugal of this leading maritime role resulted in geopolitical preeminence that was eventually lost to other European powers.

In the twenty-first-century maintenance of its present lead in space may indeed be pivotal to the basic geopolitical, military, and economic status of the United States. Consolidation of the preeminent U.S. position in space akin to Britain's dominance of the oceans in the nineteenth century is not an option, but rather a necessity, for if not the United States, some other nation, or nations, will aspire to this role, as several others already do. For the United States space is a crucially important twenty-first-century geopolitical setting that includes a global missile defense.

As American policymakers look ahead, new momentum and direction is needed in the pursuit of a truly global missile defense capability that incorporates both sea- and space-based interdiction capabilities and addresses the current and expected threats of the early twenty-first-century security setting.

As the Independent Working Group (IWG) produced this Report, many general and specific recommendations emerged from our research and discussions. They are summarized and prioritized here in order to answer the fundamental question that the IWG asked itself and which members of the IWG themselves have been asked many times: What should be done in light of the IWG critique and analysis contained in the Report. Therefore, we provide a succinct list of recommendations whose purpose is to focus attention on missile defense requirements and provide a programmatic basis for action. They are designed to furnish an agenda that sets forth concisely what must be done, how it should be done, and who should do it if the United States is to deploy the robust, layered missile defense that will be essential for our national security in the years ahead. This Report contains a detailed examination, including the background, analysis, supporting documentation, and conclusions on which our recommendations are based.

Recommendations

General Recommendations

- Make deployment of a multilayered missile defense an urgent national priority against the growing missile threat to the United States, its deployed forces, and allies from hostile state and non-state actors.
- Develop broad public recognition that this threat encompasses missiles launched against populations and infrastructures as well as nuclear detonations above the earth, resulting in an electromagnetic pulse that could have devastating consequences.
- Build broadly based national consensus for a robust layered defense that includes sea- and space-based intercept capabilities able to defend against the growing missile threat.
- Reflect the urgency of the missile threat in new organizational structures for a missile defense program that breaks the existing bureaucratic mold.
- Raise the national profile of missile defense by direct involvement at the presidential level and by building greater bipartisan support in the U.S. Congress.
- Reaffirm and strengthen the U.S. commitment to primacy in space.
- Recreate and sustain the scientific and technology base including the workforce needed to assure U.S primacy in space and missile defense.

Specific Recommendations

Limit Ground-based Missile Defense (GMD) Deployments

- Complete the GMD sites in Alaska and California but do not expand the number of ground-based sites.
  – Instead direct funding to sea-based and space-based missile defense.

Expand Sea-Based Defenses

- Deploy a sea-based missile defense based on the U.S. Navy *Aegis* Vertical Launch System (VLS) and the *Standard Missile* (SM) by accelerating the current SM-3 Block 1 program to provide late-midcourse and boost-phase interception. Anticipated cost is an additional $100 million over current funding.
- Accelerate the U.S.-Japan SM-3 Block 2 missile program to provide interdiction capabilities beyond the SM-3 Block 1. An additional $300 million over three years would push initial operating capability forward by more than a year.
- Revive the *Brilliant Pebbles*-era light-weight Advanced Technology Kill Vehicle (ATKV) to improve the current U.S.-Japanese SM-3 Block 2 interceptor and for other applications such as a ground-based interceptor (GBI) with multiple independently-targetable kill vehicles. This would produce velocities far more advantageous for boost phase intercepts than achievable by other SM-3 variants and eliminate the costly plan now contemplated by the Missile Defense Agency (MDA) for a larger missile and new VLS configuration to attain a comparable capability.
- Fund the SM-2 Block IV to defend against a ship-borne *Scud* launched off the U.S. coast. Estimated cost is between $50 and $100 million.
- Integrate missile defense with homeland security plans to protect coastal cities and infrastructure such as key energy-producing and storage complexes.
- Equip additional U.S. vessels with the *Aegis* anti-missile system. Encourage U.S. allies equipped with *Aegis/SM* to do the same.

Develop and Deploy Space-Based Defenses

- Initiate a streamlined development program building on *Brilliant Pebbles* (and advanced technologies produced since then) for space-based interceptors for boost-, mid-course, and terminal-phase interdiction.
- Within three years test a space-based missile defense system. Anticipated cost is $3-5 billion.
- Begin operating a space testbed for space-based interceptors that would be integrated into U.S. Strategic Command's global architecture in three to five years.
- Utilizing an event-driven procurement strategy, deploy 1000 *Brilliant Pebbles* interceptors with the goal of an initial capability in 2010. Anticipated cost is $16.4 billion.

Reaffirm the U.S. Commitment to Space

- Invest in space-based technologies to protect existing space-based assets and commercial and national security uses of space.
- Because of the centrality of space to U.S. national security, reject efforts to counter U.S. primacy in space via restrictive legal regimes.

Strengthen Missile Defense Collaboration with Allies

- Encourage allied missile defense capabilities based on a suitable U.S.-allied division of labor, while strengthening allied participation, especially in sea-based and space-based missile defense.
- Identify technologies/assets of allies to speed the deployment of a global layered missile defense system.
- Facilitate international missile defense technology-sharing while safeguarding cutting-edge technologies.
- Ensure maximum interoperability, flexibility, adaptability, and affordability of U.S. and allied systems.
- Educate allied decision makers and their publics about the weapons of mass destruction/ballistic missile threat and the role of missile defense.

Develop New Organizational Structures for Space and Missile Defense

- Create a special task force with needed funding and political support, perhaps within the Defense Advanced Research Projects Agency (DARPA), to develop and test the space-based missile defense system. When possible, utilize scientists and engineers who worked on the *Brilliant Pebbles* program.
- Establish a special project initiative, again potentially within DARPA, to develop needed technologies and capabilities for U.S. space control, protection of space-based assets, situational awareness, and assured access to space.
- Assign responsibility, authority, and necessary resources to the U.S. Navy to develop, deploy, and operate a sea-based missile defense system.
- Given the inevitable technology overlaps and mission crossover applications within the proposed organizations, ensure formalized and frequent interactions/exchanges among the proposed organizational entities.
- Identify and increase the number of senators and congressmen cognizant of the centrality of space to U.S. national security, including missile defense as well as the need to thwart proposed legal regimes such as the Space Preservation Act and other efforts to restrict U.S. primacy in space.
- Establish a Congressional Caucus on Space and Missile Defense to build support for U.S. space primacy, space control, and assured access as well as missile defense in general and space-based anti-missile systems in particular.
- Reorganize the National Science Foundation to revive student and faculty interest in space and defense technology.
- Because of the Department of Defense's (DOD) competence to manage innovative high technology programs has significantly atrophied, reorganize the military education system to increase scientists and engineers in the uniformed military and civilian DOD workforce. This will require heightened focus on the physical sciences at our military undergraduate schools as well as incentives (pay and promotion) to military officers and civilian DOD officials to acquire advanced degrees in science and engineering.

Create a Vigorous, Innovative, and Sustainable Science and Technology Workforce

- Strengthen federal support and funding for physical science research and engineering. DOD science and technology (S&T) funding should constitute at least 3 percent of total defense spending.
- Increase funding of space security research to revive student and faculty interest in space and defense technology.
- Develop research funding solicitations and awards in missile defense-related S&T and support the missile defense component of space security research via advisory and peer groups as part of a new missile defense science and technology collegial community.
- Increase S&T in university curricula to strengthen the U.S. science, technology, and engineering base and research on missile defense and space security technologies.

Educate the American Public

In parallel with the steps outlined above:

- Expand the educational outreach program to inform the American public, Congress and our allies and friends about missile threats and the benefits of missile defense.
- Make clear that affordable, technologically mature sea- and space-based options are available which would supplement the current GMD system and provide necessary protection.
- Embed missile defense as a post-9/11 homeland security priority at the local and state level.
- Strengthen state and local participation in space and missile defense education and security policy development consistent with Department of Homeland Security state-federal partnerships and the recognition of threats to the common defense.

section 1

Twenty-First-Century Threats & the Role of Missile Defense

The Threat

Twenty-first-century threats to the United States, its deployed forces, and its friends and allies differ fundamentally from those of the Cold War.[1] An unprecedented number of international actors have now acquired – or are seeking to acquire – missiles. These include not only states, but also non-state groups interested in obtaining missiles with nuclear or other payloads. The spectrum encompasses the missile arsenals already in the hands of Russia and China, as well as the emerging arsenals of a number of hostile states.

The character of this threat has also changed. Unlike the Soviet Union, these newer missile possessors do not attempt to match U.S. systems, either in quality or in quantity. Instead, their missiles are designed to inflict major devastation without necessarily possessing the accuracy associated with the U.S. and Soviet nuclear arsenals of the Cold War.

The warning time that the United States might have before the deployment of such capabilities by a hostile state, or even a terrorist actor, is eroding as a result of several factors, including the widespread availability of technologies to build missiles and the resulting possibility that an entire system might be acquired. Would-be possessors do not have to engage in the protracted process of designing and building a missile. They could purchase and assemble components or reverse-engineer a missile after having purchased a prototype, or immediately acquire a number of assembled missiles. Even missiles that are primitive by U.S. standards might suffice for a rogue state or terrorist organization seeking to inflict extensive damage upon the United States. As the Rumsfeld Commission pointed out in its 1998 report:

> *Under some plausible scenarios – including re-basing or transfer of operational missiles, sea- and air-launch options, and shortened development programs that might include testing in a third country – or some combination of these – the United States might well have little or no warning before operational deployment.*[2]

The New Strategic Setting

Rogue States

Since the surprise launch of its three-stage *Taepo Dong* 1 missile over Japan in August 1998, North Korea has made substantial advances in its ballistic missile capabilities. Pyongyang is currently estimated to have deployed as many as 750 ballistic missiles, including some 600-800 *Scud*-type short-range rockets and between 150 and 200 medium-range *No Dong* missiles.[3]

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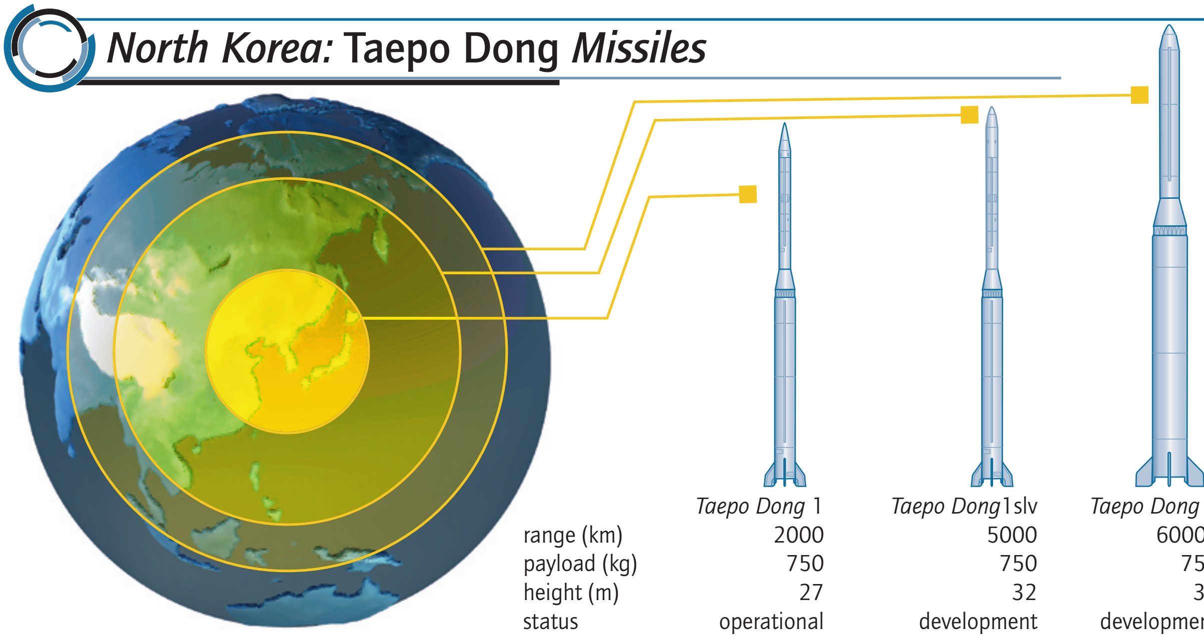
1 In its September 2002 *National Security Strategy*, the Bush administration acknowledged this radically different threat environment, declaring that "new adversaries, their determination to obtain destructive powers hitherto available only to the world's strongest states, and the greater likelihood that they will use weapons of mass destruction against us, make today's security environment more complex and dangerous." *National Security Strategy of the United States of America*, White House, Office of the Press Secretary, September 2002, 13, <http://www.whitehouse.gov/nsc/nss.pdf>.

2 "Executive Summary of the Report of the Commission to Assess the Ballistic Missile Threat to the United States," July 15, 1998, 3, <http://www.fas.org/irp/threat/bm-threat.htm>.

3 "North Korea: Missile Overview," Nuclear Threat Initiative,

North Korea: Taepo Dong *Missiles*



	Taepo Dong 1	*Taepo Dong* 1slv	*Taepo Dong* 2
range (km)	2000	5000	6000+
payload (kg)	750	750	750
height (m)	27	32	35
status	operational	development	development

In early 2003, North Korea hinted that its self-imposed 1999 moratorium on long-range missile testing was over, and issued an official memorandum to that effect in early March 2005.[4] While the Kim Jong-il regime has yet to test-fire another long-range missile, it has moved ahead considerably in the development of an extended-range variant of the *Taepo Dong*, the *Taepo Dong* 2. South Korean intelligence has indicated that the North is developing rocket engines for the *Taepo Dong* 2 that would give it a range of 6,700 kilometers.[5] In fact, according to Vice Admiral Lowell Jacoby, USN, Director of the U.S. Defense Intelligence Agency (DIA), Pyongyang's *Taepo Dong* 2 missile "could deliver a nuclear warhead to parts of the United States in a two-stage variant and target all of North America with a three-stage variant."[6] Admiral Jacoby has also declared that North Korea now has the ability to arm a missile with a nuclear device.[7]

Moreover, estimates indicate that North Korea may have as many as eleven nuclear weapons.[8] Pyongyang declared itself a nuclear power on February 10, 2005, marking its first official public acknowledgment of such a capability.[9] The brinksmanship continued in May 2005 when North Korea announced that it had finished unloading eight thousand spent fuel rods from its Yongbyon nuclear reactor, which can now be used to produce additional plutonium for nuclear arms.[10] The extent of North Korea's uranium enrichment program is not well-known, but Pakistani nuclear scientist Abdul Qadeer (A.Q.) Khan has admitted that he provided uranium enrichment equipment to Pyongyang.[11] An operational North Korean uranium program could have the capability to add as many as six additional nuclear weapons a year to Pyongyang's arsenal.[12] And although the Six-Party Talks have resumed a resolution to the North Korean nuclear weapons dilemma is far from likely.[13]

Iran has also made substantial progress in its missile program. In June 2003, the Islamic Republic marked a major milestone when it deployed its 1,300-kilometer-range *Shahab* 3 bal-

October 2005, <http://www.nti.org/e_research/profiles/NK/Missile/index_1667.html>; testimony of General Leon J. LaPorte, Commander, United States Forces Korea, before the Senate Armed Services Committee, Washington, D.C., March 8, 2005.

4 For the full text of the memorandum, see <http://missilethreat.com/news/ 200503030818.html>.

5 "NKorea Says No Longer Bound by Missile Test Moratorium, *Xinhua Financial Network News*, March 3, 2005.

6 Testimony of Vice Admiral Lowell E. Jacoby, USN, Director, DIA, before the Senate Armed Services Committee, March 17, 2005.

7 Bradley Graham and Glenn Kessler, "N. Korean Nuclear Advance is Cited," *Washington Post*, April 29, 2005.

8 "Summary of North Korea's Nuclear Arsenal," Center for Defense Information, May 31, 2005, <http://www.cdi.org/program/document.cfm?DocumentID=3032&from_page=./index.cfm>.

9 James Brooke and David E. Sanger, "North Koreans Say They Hold Nuclear Arms," *New York Times*, February 11, 2005.

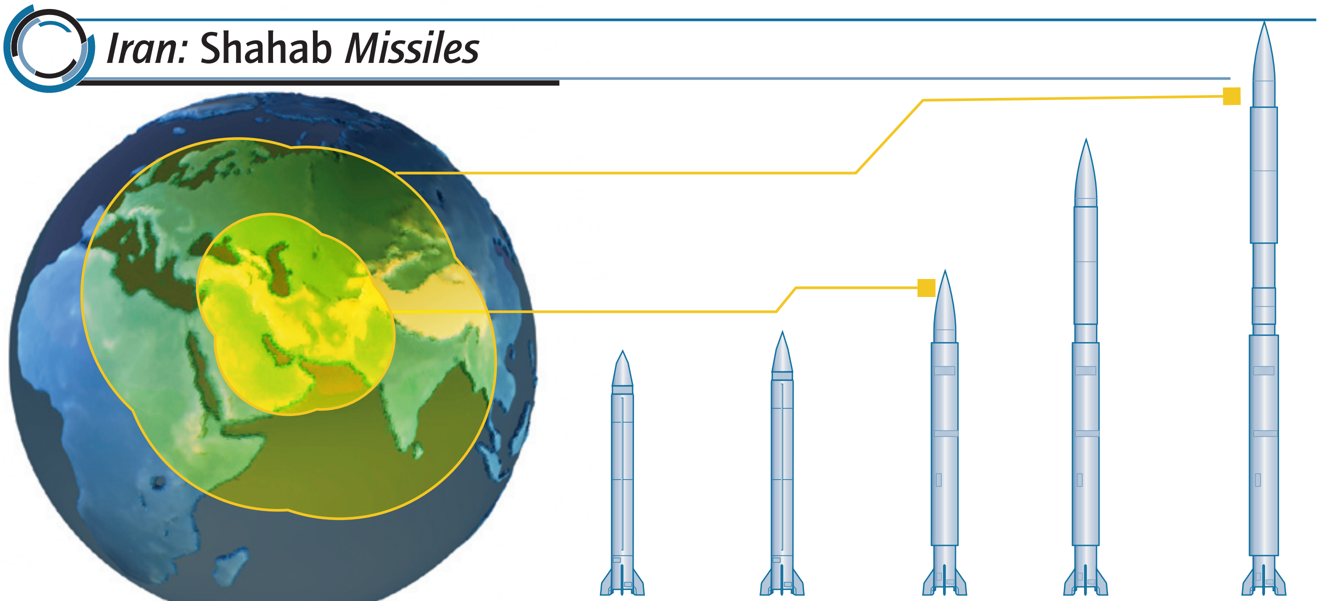
10 Paul Kerr, "North Korean Capabilities Remain Unclear," *Arms Control Today*, June 2005, <http://www.armscontrol.org/act/2005_06/North_Korean_Capabilities.asp>.

11 Leonard Weiss, "Turning a Blind Eye Again? The Khan Network's History and Lessons for U.S. Policy," *Arms Control Today*, March 2005, <http://www.armscontrol.org/act/2005_03/Weiss.asp>.

12 Glenn Kessler, "N. Korea Nuclear Estimate to Rise; U.S. Report to Say Country Has At Least Eight Bombs," *Washington Post*, April 28, 2004.

13 The Six-Party Talks consist of Japan, Russia, China, South Korea, North Korea, and the United States. The goal of the talks has been to dismantle Pyongyang's nuclear weapons infrastructure and materials in exchange for economic aid and security guarantees.

Iran: Shahab *Missiles*



	Shahab 1	*Shahab* 2	*Shahab* 3	*Shahab* 4	*Shahab* 5
Range (km)	330	700	1200+	2,000+	4,000+
Payload (kg)	985	700	1200	1000	1000
Height (kg)	11.2	12.3	16.6	25	32
Status	Operational	Operational	Operational	Development	Development

listic missile, capable of targeting American allies Israel and Turkey, as well as U.S. forces in the Persian Gulf.[14] Since then, the range for the *Shahab* 3 has been expanded considerably; in September 2003, at a military parade commemorating the anniversary of the 1980-88 Iran-Iraq war, the *Shahab* 3 was officially described as possessing a range of 1,700 kilometers.[15] In November 2004, Teheran stated that it had moved to "mass production" of the missile.[16] More recently, Iranian officials have indicated that they are developing a 2,000-kilometer-range variant of the *Shahab* 3.[17]

Further developments were announced in May 2005, when Iran declared that it had successfully tested a new solid-fuel engine for the *Shahab* 3, which will increase its accuracy and make it more durable.[18] Likewise, Iranian officials have confirmed that they have succeeded in expanding the range of the *Shahab 3* to 2,000 kilometers—making it capable of striking various targets in southeastern Europe.[19] And, despite Teheran's announcement of a moratorium on more advanced missile development, opposition groups have suggested that Iran is developing both the 4,000-kilometer-range *Shahab* 5 and a follow-on intercontinental ballistic missile (ICBM).[20] Iran is currently estimated to have the ability to develop an ICBM by 2015.[21]

Iran's nuclear effort has also grown exponentially. In August 2002, an advanced nuclear enrichment facility was uncovered at the central Iranian town of Natanz. Subsequent investigations by the International Atomic Energy Agency (IAEA), as well as statements by Iranian officials, have made clear that Teheran is aggressively pursuing a sustained atomic capability. This includes plans to install tens of thousands of advanced centrifuges at its Natanz enrichment facility, which would enable Iran to enrich uranium for manufacturing nuclear weapons at a far more rapid rate than earlier assumed.[22] Recent attempts by Britain, France, and Germany (the "EU3") to halt Teheran's nuclear program permanently in exchange for economic incentives have been unsuccessful. DIA Director Jacoby

14 Since the 1979 Islamic Revolution, Teheran has possessed two military forces: its regular standing army, the *Artesh*, and the *Pasdaran*, an elite paramilitary organization which serves as the Iranian regime's principal point of contact with terrorist groups like Hezbollah, Hamas and the Palestinian Islamic Jihad. The transfer of the *Shahab* 3 into the *Pasdaran*, in lieu of the *Artesh*, suggests that Iranian missile technologies could find their way into terrorist hands as part of Teheran's ongoing sponsorship of terrorist activities.

15 Agence France Presse, September 22, 2003.

16 "Iran 'Can' Mass Produce Missiles," BBC News, November 9, 2004, <http://news.bbc.co.uk/2/hi/middle_east/ 3997151.stm>.

17 Jacoby, testimony before the Senate Armed Services Committee, March 17, 2005.

18 Alon Ben-David, "Iran Tests Solid-fuel Engine for Shahab 3," *Jane's Defence Weekly*, June 8, 2005, 4.

19 "Iran Says It Has Missile With 1,250-Mile Range," Reuters, October 5, 2004.

20 *Middle East Newsline*, October 25, 2002.

21 Jacoby, testimony before the Senate Armed Services Committee, March 17, 2005.

22 Douglas Frantz, "Iran Preparing for Advanced Nuclear Work, Officials Say," *Los Angeles Times*, June 9, 2005.

has indicated that "Unless constrained by a nuclear non-proliferation agreement, Teheran probably will have the ability to produce nuclear weapons early in the next decade."[23] Furthermore, U.S. Undersecretary of State for Arms Control Robert Joseph has asserted that the recent Iranian election is unlikely to prompt any change in Teheran's pursuit of nuclear weapons, stating that "we have seen a commitment across the board to a nuclear program in Iran."[24] Indeed, in January 2006, Iran made the decision to resume its uranium enrichment program. A month later, the International Atomic Energy Agency (IAEA) voted to report Iran to the UN Security Council for suspected violations of the Nuclear Non-Proliferation Treaty.[25]

Other states as well are developing weapons of mass destruction (WMD) and ballistic missiles. They include:

- Syria, which maintains biological and chemical weapons capabilities and possesses a large collection of surface-to-surface ballistic missile systems, could deliver conventional and unconventional warheads to neighboring countries in the Middle East.[26] The Central Intelligence Agency (CIA) has estimated that Damascus possesses hundreds of Free-Rocket-Over-Ground (FROG) missiles, Scud missiles, and SS-21 short-range ballistic missiles (SRBMs).[27] Syria also possesses the indigenous capability to manufacture liquid-fuel Scuds.[28] In September 2003 testimony before the House of Representatives Subcommittee on the Middle East and South Asia, Under Secretary of State John Bolton outlined that Syria "is fully committed to expanding and improving its CW [chemical weapons] program" and "is continuing to develop an offensive biological weapons capability."[29] Syria's mobile missile force is capable of targeting much of Israel, as well as parts of Iraq, Jordan and Turkey, and has "developed a longer-range missile – the Scud-D – with assistance from North Korea" while simultaneously pursuing "both solid- and liquid-propellant missile programs."[30]
- Egypt, which is engaged in a clandestine effort to acquire WMD and ballistic missile technologies. In late 2003 and early 2004, in the wake of Libya's abrupt reversal of course on WMD, U.S. and British officials discovered signs that Cairo and Tripoli had established a WMD partnership that included the sharing of nuclear and ballistic missile expertise and components, based largely on "strategic weapons" acquired from North Korea.[31] Furthermore, inspections by the IAEA have uncovered plutonium traces at Egyptian nuclear facilities, increasing international concern about clandestine nuclear development efforts on the part of the Mubarak regime.[32] The IAEA has also recently criticized Cairo for failing to declare certain nuclear materials and sites, one of which was a plant used for separating plutonium that could be used in an atomic weapon.[33]
- Saudi Arabia, which may be pursuing a nuclear program. Under an agreement signed during the October 2003 visit to Islamabad by Saudi Crown Prince Abdullah, Riyadh reportedly gained access to Pakistani nuclear technologies in exchange for stepped-up energy cooperation and improved strategic relations with Pakistan.[34] While Saudi Arabia has denied that it is developing a nuclear weapons capability, it has also recently been granted "small quantities protocol" status from the IAEA, which removes strict oversight of its nuclear reactor and could potentially facilitate the clandestine pursuit of nuclear weapons.[35] It is reported that U.S. officials are investigating potential transactions between the A.Q. Kahn nuclear proliferation network and Saudi Arabia.[36] Riyadh, meanwhile, is also thought to be seeking modern replacements for its aging arsenal of Chinese CSS-2 missiles from the People's Republic of China (PRC).[37]

Strategic Competitors

China has as many as thirty *Dong-feng* 5 and *Dong-feng* 31 intercontinental ballistic missiles, approximately 110 intermediate range (*Dong-feng* 4, *Dong-feng* 3, and *Dong-feng*

23 Jacoby, testimony before the Senate Armed Services Committee, March 17, 2005.

24 Carol Giacomo, "U.S. Wary About Election Impact on Iran Nuke Program," Reuters, June 23, 2005.

25 "Iran reported to Security Council," BBC News, February 4, 2006, <http://news.bbc.co.uk/1/hi/world/middle_east/4680294.stm>.

26 "Syria: Missile Overview," Nuclear Threat Initiative, May 2005, <http://www.nti.org/e_research/profiles/ Syria/Missile/index_3958.html>.

27 Ibid.

28 Ibid.

29 Testimony of John R. Bolton, Under Secretary of State for Arms Control and International Security, before the House International Relations Committee, Subcommittee on the Middle East and Central Asia, September 16, 2003.

30 Ibid.

31 *Middle East Newsline*, March 30, 2004.

32 *Jordan Times*, November 7, 2004.

33 "U.N. Nuclear Watchdog Chides Egypt," *New York Times*, February 15, 2005.

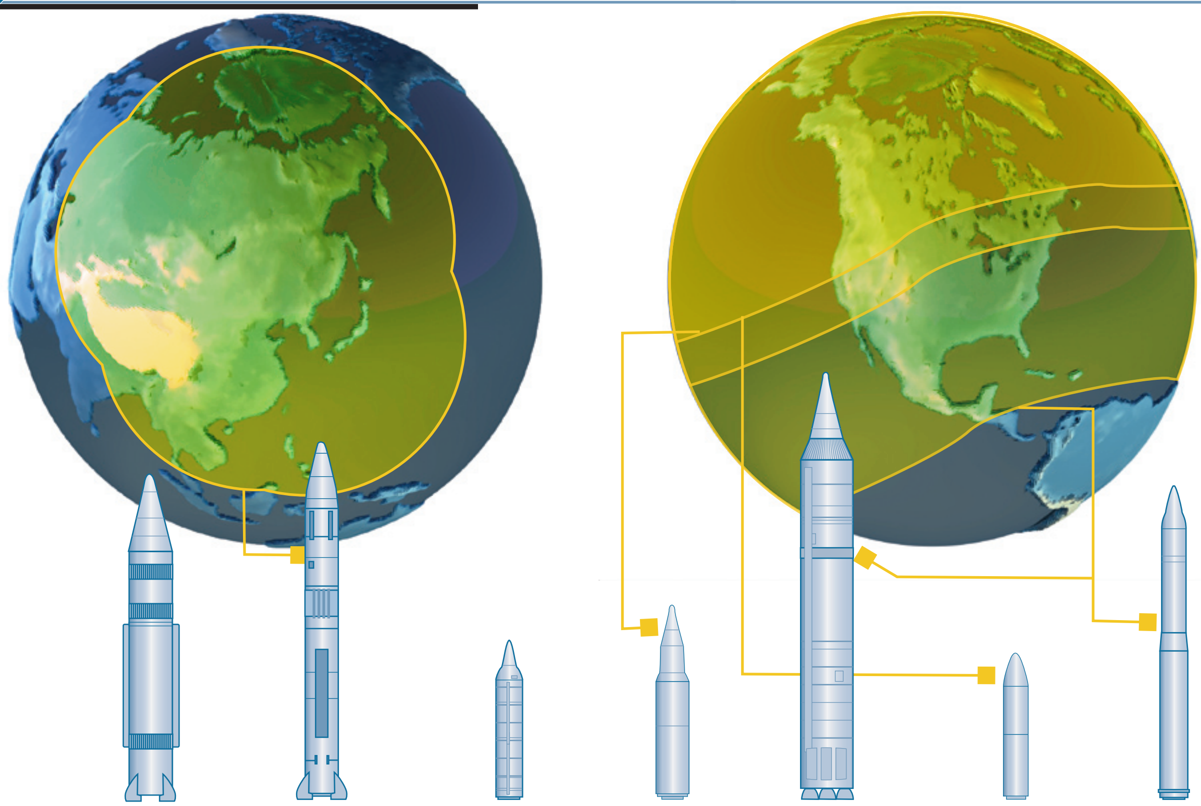
34 Arnaud de Borchgrave, "Pakistan, Saudi Arabia in Secret Nuke Pact," *Washington Times*, October 22, 2003.

35 "Saudi Arabia Exempt from Nuke Inspections," *Guardian Unlimited,* June 16, 2005, <http://www.guardian.co.uk/worldlatest/story/0,1280,-5079372,00.html>.

36 Bill Powell, "The Man Who Sold the Bomb: How Pakistan's A.Q. Kahn outwitted Western intelligence to build a global nuclear-smuggling ring that made the world a more dangerous place. The inside story," *Time*, February 14, 2005, 22.

37 Richard L. Russell, "Oil for Missiles," *Wall Street Journal*, January 25, 2006.

PRC: Ballistic Missiles



	Dong-feng 3	*Dong-feng* 4	*Dong-feng* 21	*Dong-feng* 31	*Dong-feng* 5	*Julang* 2	*Dong-feng* 41
Range (km)	2,650	4,750	2,150	8,000	12,000	9,600	12,000+
Payload (kg)	2,150	2,200	600	1,050+	3,900	1,050+	2,500
Height (kg)	21.2	28	10.7	13	36	13	21
Status	Operational	Operational	Operational	Operational	Operational	Development	Development

21) missiles, and hundreds of short-range rockets currently deployed.[38] The Office of the Secretary of Defense has indicated that between 650 and 730 SRBMs are deployed opposite Taiwan, and that roughly one hundred such missiles will be added each year.[39] At the same time, China is in the midst of a massive, multi-year military modernization program, encompassing air power, naval and land force capabilities, air defense, and electronic-, information- and space-warfare technologies.[40]

As part of this effort, China is upgrading its existing ballistic missile arsenal. This includes the deployment on its *Dong-feng* 31 ICBMs of multiple independently-targetable re-entry vehicle (MIRV) warhead technology designed to defeat primitive anti-missile systems, priority solid fuel propellant research intended to provide Beijing with immediate "launch on command" capabilities, and the transformation of its strategic offensive forces from large, stationary missiles to more versatile road- and rail-mobile variants. Notably, a successful flight-test of China's new submarine-launched version of the *Dong-feng* 31, the *Julang* 2, was conducted in June 2005.[41] The *Julang* 2 has a range of up to 9,600 kilometers and, according to the U.S. Air Force's National Air Intelligence Center, "will, for the first time, allow Chinese [missile submarines] to target portions of the United States from operating areas located near the Chinese coast."[42] These capabilities are even more troubling in light of remarks made by Chinese Major General Zhu Chenghu, who declared that nuclear weapons would have to be used if the United States intervened militarily in a conflict over Taiwan.[43]

38 *The Military Balance: 2004-2005*, International Institute for Strategic Studies, (2004): 170.

39 "Annual Report on the Military Power of the People's Republic of China," U.S. Department of Defense, 2005, <www.defenselink.mil/news/Jul2005/d20050719china.pdf>.

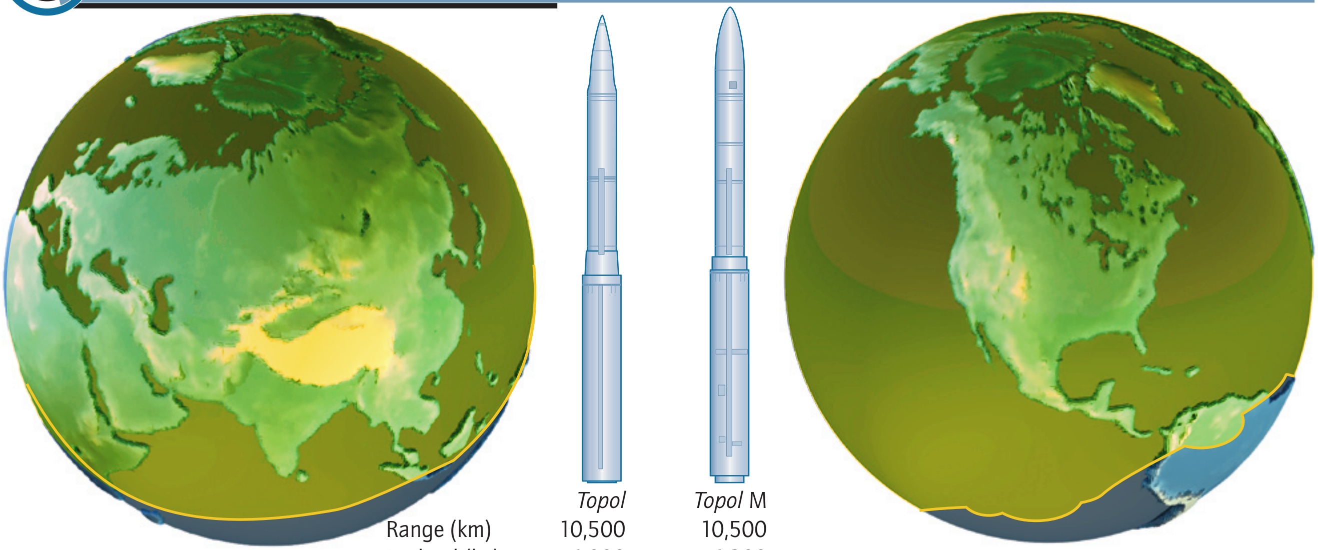
40 Ibid.

41 Bill Gertz, "China Advances Missile Program," *Washington Times,* June 22, 2005.

42 Ibid.

43 Joseph Kahn, "Chinese General Threatens Use of A-Bombs if U.S. Intrudes," *New York Times,* July 15, 2005.

Russia: Topol *Missiles*



	Topol	*Topol* M
Range (km)	10,500	10,500
Payload (kg)	1,000	1,200
Height (kg)	20.5	21.9
Status	Operational	Operational

China has also begun to erode American space dominance. In the wake of its successful October 2003 launch of the *Shenzhou* V spacecraft, Beijing is developing advanced military capabilities as part of an exo-atmospheric "deterrent" force even while Beijing warns against any U.S. weaponization of space. China's emerging space force will include both lasers and missiles capable of destroying satellites. It will incorporate the PRC's *Dong-feng* 31, *Dong-feng* 41, and *Julang* 2 medium- and long-range missiles.[44] China has also developed a range of "nano-satellite" technologies for space warfare, apparently for the purpose of crippling American space assets.[45] Other Chinese advances in space include the *Ziyuan* 1 and *Ziyuan* 2 remote-sensing satellites and the development, through a joint venture between China's Tsinghua University and the United Kingdom's University of Surrey, of a constellation of seven minisatellites (weighing between 101 and 500 kilograms) with 50-meter-resolution remote-sensing payloads.[46] Notably, Beijing launched the *Shenzhou* VI in October 2005, marking the second successful Chinese manned spaceflight.[47]

With the collapse of the Union of Soviet Socialist Republics (USSR), the Russian Federation inherited the sprawling Soviet ballistic missile apparatus, which includes medium- and long-range solid- and liquid-fueled missiles. And, despite the economic and political turmoil that has punctuated Russian affairs in the past decade, Moscow retains a formidable offensive strategic arsenal – the cornerstone of which is the SS-18 *Satan* ICBM, slated to remain in combat service for the next ten or fifteen years.[48] Russia's principal ballistic missile development project is the *Topol* ICBM, now in advanced testing. The Russian military has created a highly maneuverable variant, the *Topol* M, which can be outfitted with MIRV warhead technology.[49] Deployment of the first regiment of *Topol* M missiles, including between three and nine mobile launchers, is slated for 2007.[50] The Russian Navy has also announced that flight tests of its *Bulava* sea-launched strategic missile system, which has a range of at least 8,000 km and can carry ten or more MIRV warheads, will be completed in 2006.[51]

Over the past several years, Russia has substantially altered its strategic posture. In late 2003, Russia unveiled a new military doctrine lowering the bar on the use of nuclear force to protect Russian interests in its "near abroad" of Central Asia and the Caucasus.[52] Russian President Vladimir Putin has subsequently announced the end of force reductions, and launched

44 Deutche Press-Agentur, October 20, 2003.

45 For more on "nano-satellite" capabilities, see Appendix B.

46 "Annual Report on the Military Power of the People's Republic of China," U.S. Department of Defense, 2005, 35.

47 "China's *Shenzhou*-6 spacecraft lands safely after successful mission", *People's Daily Online*, <http://english.people.com.cn/200510/17/eng20051017_214689.html>.

48 "Russia Tests SS-18," *Missilethreat.com*, December 22, 2004, <http://www.missilethreat.com/ news/200412220853.html>.

49 "Missiles of the World: SS-27," *MissileThreat.com*, July 19, 2005, <http://www.missilethreat.com/missiles/ss-27_russia.html>.

50 Mark Galeotti, "Putin Puts Confidence in New Generation of Missiles," *Jane's Intelligence Review*, Vol. 17 no. 2, February 2005.

51 "Bulava Missile Flight Tests to be Over in 2006," RIA Novosti, July 6, 2005, <http://en.rian.ru/russia/20050706/40856300.html>.

52 *Russian Federation Ministry of Defense Brochure: Urgent Tasks of the Development of the Russian Federation Armed Force*, RIA-Novosti, October 3, 2003.

massive exercises of the country's strategic forces.[53] Moscow and Beijing also agreed to hold joint military exercises focused on counter-terrorist operations in August 2005.[54] These steps are seen by Moscow as a hedge against Western encroachment into its near abroad, and a means to blunt the emerging American missile defense system.

Asymmetric threats

The dangers to American interests posed by rogue states and strategic competitors have been compounded by a series of asymmetric threats.

WMD terrorism – A growing number of terrorist groups have made concerted efforts to acquire WMD.[55] As long ago as 1994, terrorists affiliated with Iran's Islamic Jihad Organization made a serious bid to buy an atomic bomb or fissile material from one of the Russian Federation's crumbling "nuclear cities."[56] More recently, the September 11 Commission explicitly warned that "Al Qaeda remains extremely interested in conducting chemical, biological, radiological, or nuclear attacks."[57] Al Qaeda is even rumored to have acquired nuclear and chemical materials on the European black market.[58] After the March 2003 arrest of 9/11 mastermind Khaled Sheikh Mohammed, investigations revealed that terrorists had obtained materials for producing botulin and salmonella toxins and cyanide.[59]

Lebanon's Hezbollah has also acquired menacing capabilities. The radical Shiite militia is believed to have received more than 1,000 missiles – including *Katyushas* and short-range rockets – in 2002 and 2003, courtesy of the Iranian, Syrian and Iraqi regimes, and now possesses some 12,000 missiles capable of striking targets within Israel.[60] Israeli officials have also indicated that the Syrian withdrawal from Lebanon in mid-2005 has led to an influx of weapons to Hezbollah from Iran's Revolutionary Guards.[61]

The ship-borne Scud *threat* - Among the threats outlined in the 1998 Rumsfeld Commission Report is the one posed by ballistic missiles launched from vessels such as freighters, tankers, or container ships close to the American coastline. Such a danger has only increased. In August 2004, Secretary of Defense Rumsfeld emphasized that: "one of the nations in the Middle East had launched a ballistic missile from a cargo vessel. They had taken a short-range, probably *Scud* missile, put it on a transporter-erector launcher, lowered it in, taken the vessel out into the water, peeled back the top, erected it, fired it, lowered it, covered it up. And the ship that they used was using a radar and electronic equipment that was no different than 50, 60, 100 other ships operating in the immediate area."[62] U.S. officials have suggested that Rumsfeld was referring to Iran, which tested a ship-launched missile in the late 1990s.[63]

Asymmetric proliferation – In 2002, writing in the *Financial Times*, Defense Science Board Chairman William Schneider described the mechanics by which North Korea has managed to acquire nuclear capabilities as the quintessential "twenty-first century template for proliferation." The rapid, clandestine acquisition of critical mass in Pyongyang's nuclear program, according to Schneider, reflects the existence of a vibrant, and self-sustaining, proliferation architecture in today's international system.[64] Schneider was referring to what has now been deemed "second-tier proliferation," whereby

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53 In February 2004, the Russian armed forces carried out the country's largest military exercises in two decades. As part of these drills, Russia's Strategic Rocket Forces are reported to have tested a next-generation, maneuverable "hypersonic" rocket specifically designed to penetrate missile defenses. Significantly, however, this does not appear to be an appreciable advance of Russian ballistic missile technologies, but an exploitation of existing MARV (maneuvering atmospheric reentry vehicle) or maneuverability capabilities. Nikolai Sokov, "Military Exercises in Russia: Naval Deterrence Failures Compensated by Strategic Rocket Success," *CNS Research Story*, Monterey Institute of International Studies, February 24, 2004, <http://cns.miis.edu/pubs/week/040224.htm>.

54 Mark Zavadsky, "Commonwealth-2005 Exercises Unprecedented," RIA Novosti, July 18, 2005, <http://en.rian.ru/world/20050718/40928131.html>.

55 For a collection of case studies of twelve terrorist groups or individuals who, during the 1945-98 period, sought to acquire or use chemical or biological agents see Jonathan B. Tucker, ed., *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* (Cambridge, Massachusetts: MIT Press, 2000). Graham Allison discusses terrorist efforts to acquire and use nuclear devices in the first chapter of *Nuclear Terrorism: The Ultimate Preventable Catastrophe* (New York: Henry, Holt and Company, 2004). For a survey of possible attempts by groups linked to al Qaeda to use biological and chemical toxins since early 2002, see Joby Warrick, "An Al Qaeda 'Chemist' and the Quest for Ricin," *Washington Post*, May 5, 2004.

56 Rensselaer Lee, "Nuclear Smuggling from the Former Soviet Union: Threats and Responses," *FPRI E-Notes*, April 27, 2001, <www.fpri.org/enotes/russia. 20010427.lee.nuclearsmuggling.html>.

57 "Staff Statement No. 15: Overview of the Enemy," National Commission on Terrorist Attacks Upon the United States, June 16, 2004, p. 12, <http://www.9-11commission.gov/staff_statements/staff_statement_15.pdf>.

58 *Khabrain*, March 12, 2004.

59 Michel Moutot, "Fears of Chemical, Bio Weapons Loom Over Anti-Terror Fight," Agence France Presse, March 8, 2005.

60 *Middle East Newsline*, July 6, 2004.

61 John C.K. Daly, *UPI Intelligence Watch*, May 12, 2005.

62 Briefing by Donald Rumsfeld, U.S. Secretary of Defense, at the Seventh Annual Space and Missile Defense Conference, Huntsville, Alabama, August 18, 2004, <http://www.defenselink.mil/transcripts/2004/tr20040818-secdef1201.html>.

63 Bill Gertz and Rowan Scarborough, "Inside the Ring," *Washington Times*, August 26, 2004, <http://washingtontimes.com/national/20040826-112559-5666r.htm>.

64 William Schneider, Jr., "Nuclear Bombing for the Beginner," *Financial Times*, October 29, 2002.

"states in the developing world with varying technical capabilities trade among themselves to bolster one another's nuclear and strategic weapons efforts."[65]

North Korea is a prime example of this trend. The Kim Jong-Il regime has become a principal supplier of ballistic missile components and associated technologies to the Middle East. A South Korean Defense Ministry report released in the fall of 2003 assessed that "[s]ince the middle of the 1980s, North Korea has exported 400-odd *Scud* missiles along with missile-related parts to the Middle East region."[66] In 2002 alone, according to the report, Pyongyang netted some $60 million from missile and missile component sales to Iran, Iraq, Syria and Yemen – representing the single largest source of revenue for the Stalinist state. The Democratic People's Republic of Korea (DPRK) has since expanded this trade, and is now believed to be offering technologies associated with its advanced *Taepo Dong* 2 ICBM to a number of regional client states, including Syria and Iran.[67] Moreover, North Korea has sold missiles to Pakistan in exchange for nuclear technologies – a trade facilitated in large part by A.Q. Khan's proliferation network (see below for more on A.Q Khan).[68]

The PRC has also used the transfer of nuclear and ballistic missile technologies as a tool of global influence and money making enterprise. Extensive Chinese assistance has been instrumental to North Korea's development of the *Taepo Dong* 2, and has played a central role in Pakistan's development of nuclear capabilities. Over time, regional experts believe, this cooperation has led to a trilateral "proliferation axis," one that has given Pakistan access to North Korean ballistic missiles and allowed Pakistani nuclear know-how to flow to North Korea.[69] Chinese defense companies have also been complicit in aiding Iran's progress on ballistic missile technology. The George W. Bush administration (hereafter referred to as Bush-43) has responded by imposing penalties on these companies for exporting to Iran high-performance metals and other components that can be used to extend the range of Teheran's missile arsenal.[70]

Furthermore, such activities are not confined to state actors. In late 2003, the discovery of the clandestine nuclear cartel headed by Pakistani scientist A.Q. Khan exposed an alarming web of WMD and ballistic missile proliferation. Khan has confessed that he provided Libya, Iran, and North Korea with technical assistance and components for manufacturing high-speed centrifuges.[71] The government of Pakistan has also revealed that he "gave some centrifuges to Iran."[72] Furthermore, U.S. intelligence officials believe that North Korea purchased high-speed centrifuges from the Kahn network and suspect that the deal may have included designs for nuclear warheads.[73]

The electromagnetic pulse (EMP) threat - According to the 2004 Report of the EMP Commission,[74] the United States faces a threat from EMP that could have catastrophic consequences based on even a single nuclear warhead. EMP is generated by any nuclear weapon burst at any altitude above a few dozen kilometers, with the height-of-burst being significant in determining the area exposed to EMP. The EMP threat arises from the ability, whether by terrorists or states, to launch relatively unsophisticated missiles with nuclear warheads to detonate at altitudes from 40 to 400 kilometers above the Earth's surface. The rationale for such action would be the high political-military payoff in the form of devastating consequences. An EMP attack would represent a highly successful asymmetric strategy against a society as heavily dependent as the United States on electronics, energy, telecommunications networks, transportation systems, the movement of inventories in our manufacturing sector, and food processing and distribution capabilities. As noted in the EMP Commission Report, EMP was an unintended result of a nuclear detonation at an altitude of about 400 kilometers during the Starfish nuclear weapons tests above Johnstone Island in the Central Pacific in 1962. The effects, felt some 1400 kilometers away in Hawaii, included "the failure of street lighting systems, tripping of circuit breakers, triggering of burglar alarms, and damage to a tele-

65 Chaim Braun and Christopher F. Chyba, "Proliferation Rings: New Challenges to the Nuclear Nonproliferation Regime," *International Security*, no. 2 (Fall 2004): 5-6.

66 United Press International, October 28, 2003.

67 *Worldtribune.com*, May 5, 2004; see also the "Annual Report of the U.S.-China Economic and Security Review Commission 2004," <http://www.uscc.gov/researchreports/2004/04annual_report.pdf>.

68 Leonard Weiss, "Turning a Blind Eye Again? The Khan Network's History and Lessons for U.S. Policy," *Arms Control Today*, March 2005, <http://www.armscontrol.org/act/2005_03/Weiss.asp>.

69 G. Parthasarathy, "Nukes, Missiles and Rogue States – China's Tools for Global Influence," *Business Line*, August 26, 2003.

70 David E. Sanger, "U.S. Punishes 8 Chinese Firms for Aiding Iran," *New York Times*, January 18, 2005.

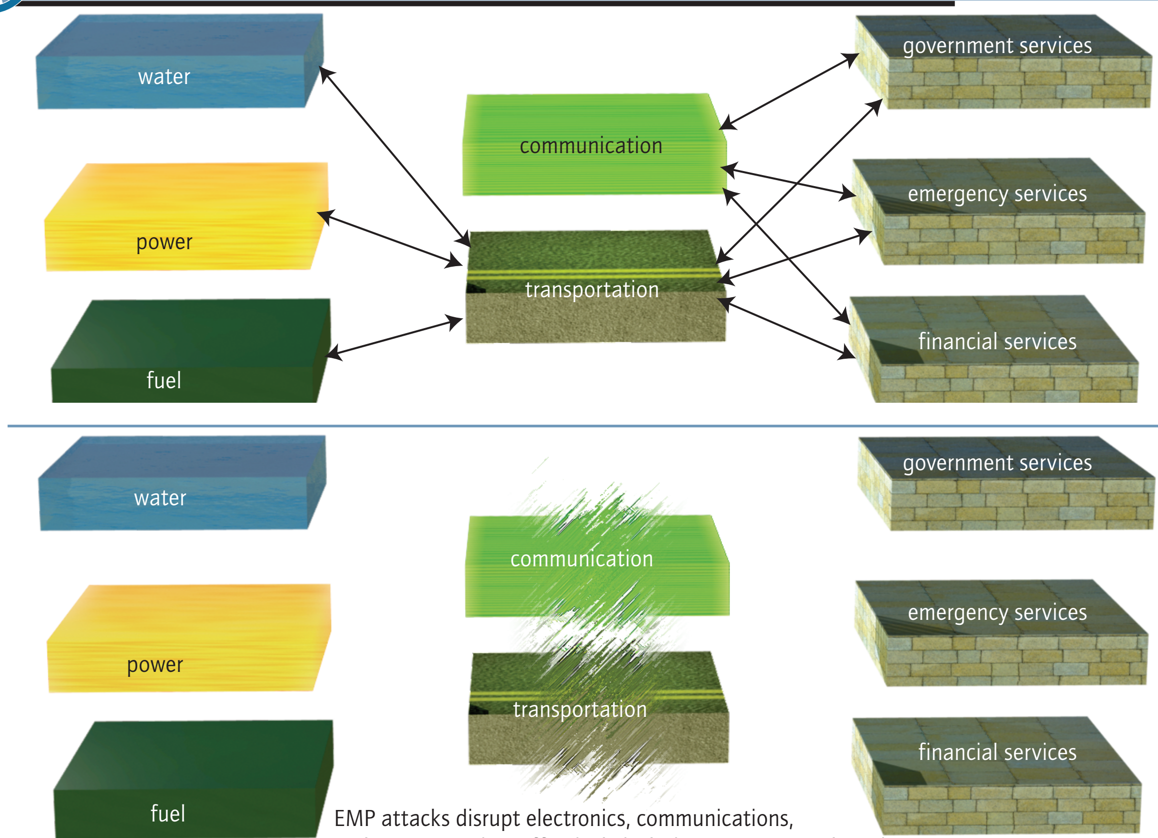
71 "Iran Bought Centrifuges, Pakistan Says," *Washington Post*, March 11, 2005.

72 Ibid.

73 Powell, *The Man Who Sold the Bomb,* p. 22.

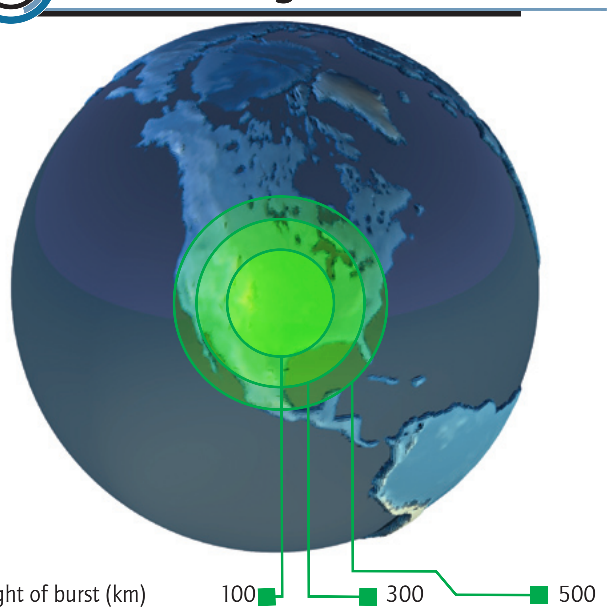
74 "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, Volume. 1: Executive Report 2004," <http://empcreport.ida.org>. According to the Report, a single nuclear weapon exploded at high altitude above the United States will interact with the Earth's atmosphere, ionosphere, and magnetic field to produce an electromagnetic pulse radiating down to earth and additionally create electrical currents in the earth. EMP effects are both direct and indirect. The former are due to electromagnetic "shocking" of electronics and stressing of electrical systems, and the latter arise from the damage that "shocked" – upset, damaged, and destroyed – electronics controls then inflict on the systems in which they are embedded.

National Infrastructure Vulnerability to EMP Attack



EMP attacks disrupt electronics, communications, and transportation, effectively isolating resources and services

EMP Coverage



communications relay facility." Nuclear tests conducted by the Soviet Union, also in 1962, produced damage to overhead and underground buried cables at distances as far away as 600 kilometers, together with surge arrester burnout, spark-gap breakdown, blown fuses, and power supply breakdowns.[75] The destruction/mayhem caused by an EMP explosion would be far more substantial today given the ubiquity of electronics and society's increased reliance on them to run critical infrastructures.

Several potential enemies either already have, or could soon acquire, the capability to attack the United States with a high-altitude nuclear explosion EMP that would cover a wide geographic region. Such a weapon need not be detonated directly over the United States itself to produce major damage to our critical infrastructures such as telecommunications, banking and finance, fuel/energy, transportation, food and water supply, emergency services, government activities, and space systems. U.S. satellites, both civilian and military, are vulnerable to a range of attacks that include EMP, especially in low-earth orbits. Again, as the EMP Commission concluded: "The national security and homeland security communities use

75 Ibid., 4.

commercial satellites for critical activities, including direct and backup communications, emergency response services, and continuity of operations during emergencies."[76] Such satellites could be disabled as a result of collateral radiation effects arising from an EMP attack on ground targets.

Thus it is obvious that an interdependence exists between the objects of a potential EMP attack. Disabling one of the infrastructures, such as telecommunications or electricity, would have severe consequences for others, with cascading effects from which an advanced, technologically dependent society such as the United States might not easily recover. An EMP attack mounted against the United States would have far broader international consequences, given the interdependence of the U.S. and other economies in an era of globalization. An EMP attack against other economies, for example, Japan or European countries, would have important effects in the United States. The services that would be essential to cope with the consequences of a terrorist attack themselves might be disabled and therefore would not be available when and where they were most needed. As Senator John Kyl has pointed out, "A terrorist organization might have trouble putting a nuclear warhead 'on target' with a *Scud*, but it would be much easier to simply launch and detonate in the atmosphere. No need for the risk and difficulty trying to smuggle a nuclear weapon over the border or hit a particular city. Just launch a cheap missile from a freighter in international waters – al Qaeda is believed to own about eighty such vessels – and make sure to get it a few miles in the air."[77]

Notably, Russia has considered attack options that include EMP. During the May 1999 NATO air campaign against Serbia, members of the Russian Duma, meeting with U.S. congressional counterparts, reportedly speculated about the paralyzing effects of an EMP attack on the United States.[78] Iran is reported to have tested whether its ballistic missiles, such as the *Shahab* 3 or the *Scud*, could be detonated by remote control while still in high-altitude flight. The most plausible explanation for such tests is that Iran is developing the capability to explode a high-altitude nuclear weapon that could destroy critical electronic and technological infrastructures.[79] Without an effective missile defense the United States will remain vulnerable to the EMP threat given its extensive dependence on high-tech, electronic infrastructure that cannot easily be hardened to withstand such an attack. The ability to launch an incapacitating EMP strike against the United States provides enemies with an asymmetric threat that would not only inhibit U.S. military action but would also strike a severe economic and psychological blow.

The Response

Given this multiplicity of ballistic missile threats, the United States must deploy a missile defense that deters hostile states from developing or acquiring missile capabilities that could threaten the United States, our allies and coalition partners, and our forces deployed abroad. Furthermore, our missile defense R&D programs, together with planned deployments, must be sufficiently robust so as to dissuade would-be missile possessors from attempting to challenge the United States. We must deter future enemies from acquiring ballistic missiles; just as in the past we dissuaded them from developing strategic bombers because of our ability to overwhelm such systems. Finally, our missile defense must be capable of defeating ballistic missiles, whatever their range and type, that could be launched against us.

As we dissuade future potential possessors, we must recognize that threats are increasing at a pace that no longer allows the luxury of long lead times within which a missile defense could be developed and deployed. Therefore, the United States must develop and deploy rapidly a missile defense with global reach, capable of coping with threats against the United States and our forces and allies *from any direction*, while we attempt simultaneously to dissuade hostile actors from acquiring missiles through our ability to render such investments a poor use of limited resources. Additionally, given the uncertainty in predicting where, when, and by whom missiles might be launched – and what their targets may be – there is a need for constant defenses capable of intercepting missiles irrespective of their geographic origin.

Other things being equal, it is preferable to intercept threatening ballistic missiles as far away from their intended targets as possible and as early in their flight trajectory as possible. Best of all would be to have the capability to destroy an attacking missile shortly after it is launched, while its rockets still burn and any perturbation will lead to its destruction – with, in many cases, the debris falling back onto the area where the attack was launched in the first place. The capability to interdict a missile and its warheads in any phases of their flight (boost, midcourse, and terminal) requires an ability to detect and intercept the attack within a very few minutes and to track and

76 Ibid., 44. The pertinent geometric relation says that EMP will be "seen" at a distance from "ground zero" of 110 km times the square-root of the burst-altitude measured in kilometers; thus, a nuclear weapon with a burst height of 100 km (whose square-root is 10) will expose an underlying area of 1100 km radius (or about 725 miles diameter) to the effects of its EMP. A burst-height of 400 km over Omaha is the usual "base case", as it suffices to cover most of the continental United States (i.e., approximately 2400 kilometers east-or-west) with its EMP.

77 Jon Kyl, "Unready for This Attack," *Washington Post,* April 16, 2005, p. A19.

78 Ibid., p. 2.

79 See Joseph Fareh's G2 Bulletin, *WorldNetDaily.com*, April 25, 2005.

destroy the attacking missile and its warheads during their longer midcourse traverse through space before they begin to reenter the atmosphere so that the debris will burn up on reentry. Finally, the last ditch defense would be to destroy the attacking missile as they reenter and pass through the atmosphere in the terminal phase enroute to their target. The best defense capability would be layered so that it could provide opportunities for destruction in all three phases of flight.

Only space-based defenses inherently have this global capability and permanence. While sea-based defenses can move freely through the two-thirds of the earth's surface that are oceans, their capability is limited by geography and by the specific operations of the fleet – including where the sea-based missile defense happens to be deployed at any given time, and how quickly it could be redeployed to meet a crisis situation. Air-based and ground-based defenses, meanwhile, can have global capabilities, but frequently take considerable time to deploy when and where needed and are also dependent on the cooperation of U.S. friends and allies in permitting the necessary supporting activities on their territories. Thus, only a space-based missile defense will possess both constancy and global availability, irrespective of allied support and agreement. As such, space-based missile defense constitutes the only truly global system, with all the rest being either "regional" or "local."[80]

In the case of sea-based systems, namely the *Aegis* program discussed in Section 2, we have a "regional" system capable of boost-phase, midcourse, and terminal intercept depending on where and how it is positioned, or vectored. It has a near-global application for *regional* operations, because it is sea-based and can be theoretically deployed over any portion of the earth's surface covered by water. A land-based system can theoretically be deployed anywhere over about one-third of the world and, depending on how it is vectored, under some limited conditions would be capable of boost-phase, midcourse, and terminal interception. Yet space-based missile defense alone is truly global in reach because of the medium in which it operates, unconstrained by overflight or territorial restrictions. It also offers inherent interdiction advantages described in greater detail below.

Like military transformation itself, considered to be a journey not a destination, deployment of a missile defense is not an end state. It is instead part of a process that must both anticipate emerging threats and take the fullest advantage of technologies that are, or could be made, available before such threats materialize. The missile defense that is deployed over time should benefit to the extent possible from the technological opportunities afforded by kinetic energy (hit-to-kill). Such a missile defense should anticipate and be capable of rendering obsolete the missile systems of potential enemies, even before such missiles are deployed.

In the mid-1980s the feasibility of kinetic energy intercept technologies was demonstrated, and subsequently became the choice of both the Reagan and the George H. W. Bush (hereafter referred to as Bush-41) administrations for building near-term defense systems of all basing modes, including in space. While it retained the focus on kinetic energy, the Clinton administration abandoned space-based architectures for intercepting and destroying ballistic missiles, concentrating instead almost exclusively on ground-based defense system concepts. As a result of this emphasis, kinetic energy technology provides the most mature basis for present-generation missile defenses. However, directed energy weapons – particularly lasers that can be precisely aimed and configured to deliver killing energy on targets at the speed of light – offer important potential for missile defense that, along with other technologies, should be exploited in the years ahead.

The Dynamics of Comprehensive Defense

Given the nature of the ballistic missile threat now arrayed against it, the missile defense system that the United States deploys in the years ahead must be layered in nature, capable of intercepting and destroying ballistic missiles in each of the three phases of their flight.

Ideally, the United States must have a missile defense that provides for destruction as early after the missile's launch as possible, while offering the opportunity for multiple shots as the missile and its warheads proceed from launch to target. Each of these phases – boost, midcourse, and terminal – furnishes intercept opportunities. But each also has inherent limitations that must be taken into account in the design and deployment of a missile defense architecture.

Boost Phase - Just after launch, the boosting missile is especially vulnerable as it rises from its launcher. The missile is relatively slow moving, not yet having achieved full acceleration, and it emits bright exhaust gases that are relatively easy for sensors to detect and track. Interception during the boost phase has the advantage of destroying the missile before it disperses its payload, which may consist of more than one warhead and/or countermeasures in the form of decoys. Intercepting a missile in boost phase has the additional advantage that the debris, including warheads, may, depending on how early interdiction occurs, fall on the country launching the missile – a reality that could have a substantial deterrent effect, if the launching state is faced with the likelihood of rendering serious damage to its own territory.

Boost phase, however, is relatively short in duration. For medium- and short-range missiles, the boost phase lasts at most only a couple of minutes, while for a missile of

80 By regional or local, we mean systems that can be vectored to cover different regions such as the Mediterranean or the Pacific, or parts of countries – such as Alaska or California in the United States.

intercontinental range it may be as long as three to five minutes.[81] Thus, the time for boost-phase interception is correspondingly limited.

Midcourse Phase - The midcourse phase provides a longer timeframe for interception of the missile or its payload. This phase may account for as much as eighty percent of the rocket's total flight time – some twenty minutes for the longest-range missiles – therefore offering multiple intercept opportunities. Midcourse interception, however, may require that the missile defense system distinguish between warheads and decoys, the latter being released in order to confuse sensors and waste interceptors against a false target. As the warheads and decoys reenter the earth's atmosphere, the decoys slow down considerably because they are likely to be lighter than warheads. Under these conditions, warheads may be distinguished more easily, although they may be more difficult to destroy if they have the capability to maneuver like high-speed aircraft.

Terminal Phase – The terminal phase provides missile defense systems with a last-shot opportunity. During this phase, the target array reenters the earth's atmosphere at an altitude of about 100 km, creating a bright infrared signature. While this segment is again shorter, atmospheric drag shreds away false targets and permits the defense to launch its interceptors against the exposed warheads with greater confidence. Reentry, however, also brings another difficult problem, namely that the warheads may maneuver to become very difficult targets to hit.[82]

The most effective way to maximize interception opportunities, therefore, is through a layered approach, one that affords multiple opportunities to destroy missiles and their warheads from launch through reentry and reduces the burden placed on any one of the layers of the defense.

Layered defenses have the additional inherent advantage of complicating the design of the offensive systems they are deployed to intercept and destroy. For example, a missile is especially vulnerable in boost phase because it carries explosive fuel. Yet if the missile is hardened in order to reduce the possibility of destruction in boost phase, the result is an increase in the missile's weight, possibly easing the task of subsequent interception. The corresponding reduction of payload also has the added benefit of diminishing the missile's destructive potential, and/or range.

In addition to providing the opportunity for multiple shots against a missile or its warheads, a layered approach also allows for the sharing of technologies between systems. Thus, technologies used in one intercept vehicle can be shared with intercept vehicles on other platforms resulting in cost-savings as well as other logistical and interoperability benefits. Furthermore, in a multi-tiered system, failures at any given layer can potentially be compensated for in other layers.

By contrast, each element of a single-tier defense must be close to 100-percent effective – a situation unlikely to be achieved, especially as the number of warheads to be intercepted increases. The multiple-shot opportunities afforded by a layered architecture ensure a more robust performance because the various engagement tiers offer mutually reinforcing advantages and synergies. In order to build an effective layered defense, it will be essential to develop and deploy systems that include space-based, as well as sea- and land-based, elements.

First Steps

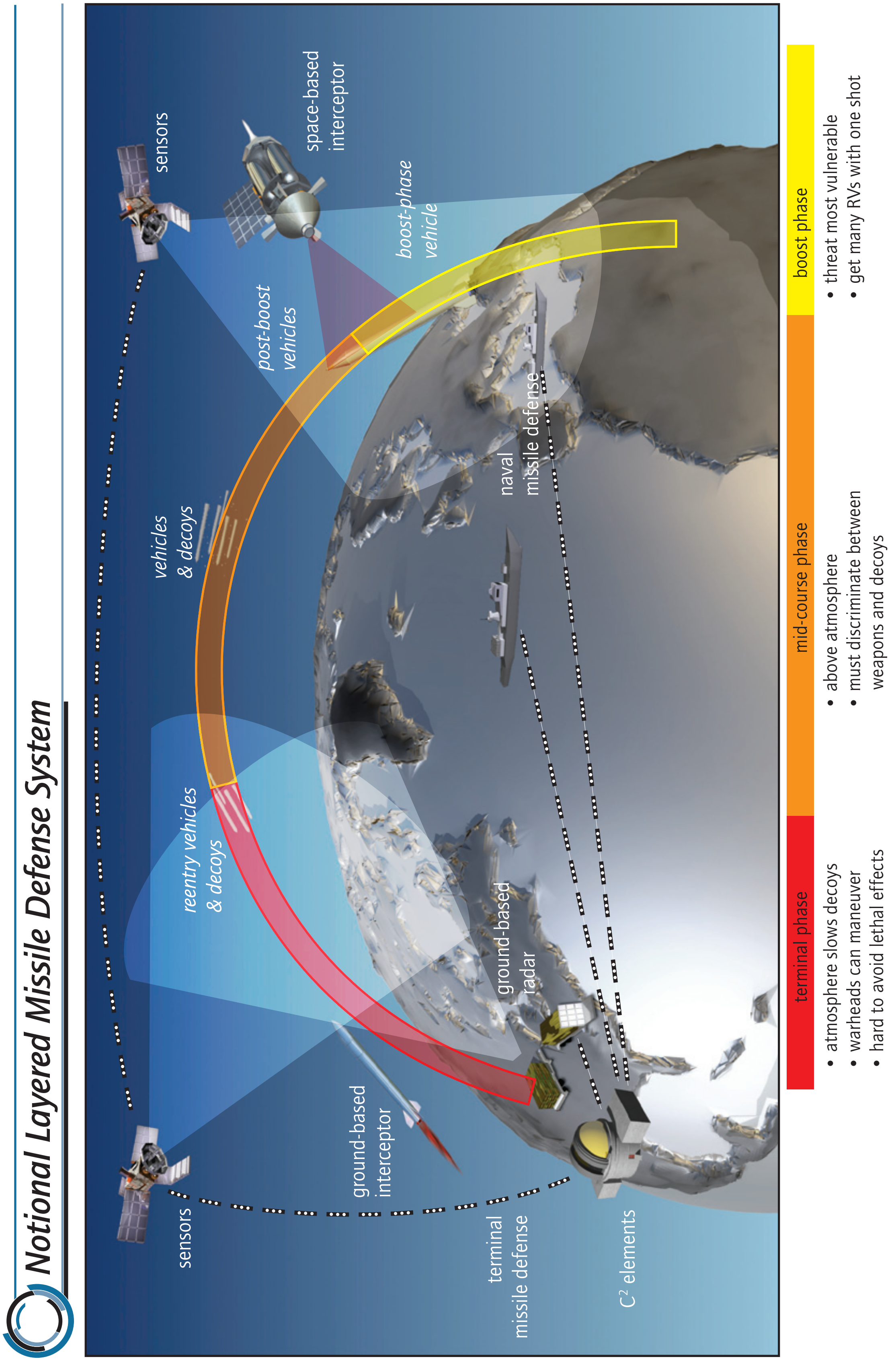
Under the Bush-43 administration's plans, the United States has begun to base up to twenty interceptors - capable of intercepting and destroying intercontinental ballistic missiles during midcourse of flight - at Fort Greely in Alaska, together with another four at Vandenberg Air Force Base in California. To date, eight interceptors have been installed at Fort Greely and two at Vandenberg.[83] These are ground-based interceptors specifically designed to counter long-range missiles such as the North Korean *Taepo Dong* 2. The Bush administration's initial deployment program also provides for land-, sea- and space-based sensors, including existing Defense Support Program early-warning satellites; an upgraded radar now located at Shemya, Alaska; and new sea-based X-band radar and other sensors now on *Aegis* cruisers and destroyers. Finally, the Bush administration's plan also calls for a limited sea-based defense capable of intercepting short and medium-range ballistic missiles – and Japan has joined with the United States to develop a sea-based capability to intercept long-range missiles.[84]

81 Whether a missile is solid or liquid fueled also impacts the duration of the boost phase: missiles with solid fuel produce greater propulsion (and therefore fly faster) than liquid-fueled missiles and will thus have a shorter boost phase.

82 It is instructive to recall that Iraq modified and extended the range of its *Scud* missiles during the 1991 Gulf War by welding sections of three *Scuds* together. As a result, upon reentry into the earth's atmosphere, the *Scud* missiles broke up and the warhead section became aerodynamically unstable, creating a corkscrew effect as they spiraled toward Israel and Saudi Arabia. This unintended countermeasure was quite effective because the *Patriot* anti-missile systems deployed by the United States did not have sufficient maneuverability to intercept the modified *Scuds*.

83 Lt. Gen. Henry A. Obering III, USAF, Director, Missile Defense Agency, *For Your Information,* MDA press release, December 20, 2005, <http://www.mda.mil/mdalink/pdf/05fyi0071.pdf>.

84 See "U.S. Navy Working With Japanese on Billion Dollar Missile Upgrade," *Inside the Navy,* March 14, 2005 and "Japan, U.S. Eye 1st Missile Interception Test Next March," *Kyodo News*, June 1, 2005.


Notional Layered Missile Defense System
sensors
space-based interceptor
boost-phase vehicle
post-boost vehicles
vehicles & decoys
naval missile defense
reentry vehicles & decoys
ground-based radar
ground-based interceptor
sensors
terminal missile defense
C2 elements
boost phase
• threat most vulnerable
• get many RVs with one shot
mid-course phase
• above atmosphere
• must discriminate between weapons and decoys
terminal phase
• atmosphere slows decoys
• warheads can maneuver
• hard to avoid lethal effects

As part of this system, the United States is also upgrading early-warning radars presently stationed in Greenland and the United Kingdom. The Bush administration's land-based missile defense architecture includes the deployment of *Patriot* Advanced Capability-3 (PAC-3) systems to intercept short- and medium-range ballistic missiles, together with the Terminal High Altitude Area Defense system (THAAD) to intercept short-and medium-range missiles at high altitudes.

The initial deployment was "modest," in the words of President Bush, and intended to provide only a limited defense against a threat of likely no more than five warheads – a very small, single rogue state rationale.[85] The Pentagon has begun surveying four European countries for a new interceptor site to detect and defeat possible missile launches from the Middle East.[86] Despite these welcome initiatives, our analysis suggests that land-based missile defense must be complemented with additional architectures to keep pace with these previously unaddressed threats as well as likely increases in the threat. For example, the United States will find it necessary to include space-based and additional sea-based missile defense in light of the existing and emerging threat from larger numbers of reentry vehicles, together with possible attacks from shorter-range missiles.

President Bush has announced that the current missile defense deployment represents merely "a starting point" for the development and deployment of improved and expanded capabilities.[87] The Director of the Missile Defense Agency has indicated that this expansion will include additional interceptors, sensors, and defensive layers, with a focus on greater terminal phase defense and "increasing emphasis on boost-phase defenses."[88] Yet in order to be effective, these follow-on capabilities must have the ability to defend against more than merely small "rogue state" threats. An effective missile defense should be designed to make it virtually impossible for any adversary to influence U.S. decisions or the course of a regional conflict by threatening to launch small numbers of nuclear weapons against the United States, its deployed forces, or its allies. It should also be sufficiently robust so as to create a significant degree of doubt regarding the effectiveness of a larger counterforce attack on U.S. deterrent forces.

Consistent with the President's pledge to "examine the full range of available technologies and basing modes for missile defenses" capable of "intercepting missiles of varying ranges in all phases of flight,"[89] we turn now to the basic question of what steps are necessary for the United States to acquire an increasingly effective missile defense capability as we move beyond the "initial deployment."

85 Missile Defense Deployment Announcement Briefing, Department of Defense, December 17, 2002, <http://www.defenselink.mil/news/Dec2002/t12172002_t1217missiledef.html>. More recently, officials have indicated that the ground-based system currently in place is a direct response to the "long range North Korean missile threat." See Obering, public statement on missile defense, spring 2005.

86 Ann Scott Tyson, "U.S. Missile Defense Being Expanded, General Says," *Washington Post,* July 22, 2005.

87 George W. Bush, White House press release, December 17, 2002, < http://www.whitehouse.gov/ news/releases/2002/12/20021217.html>.

88 Obering, public statement on missile defense, spring 2005.

89 *National Policy on Ballistic Missile Defense Fact Sheet*, White House, Office of the Press Secretary, May 20, 2003, < http://www.whitehouse.gov/news/releases/2003/20030520-15.html>.

Panel 1 Report

Members of Panel 1 addressed a series of questions that focused on the Cornerstone Paper entitled *Twenty-First-Century Threats and the Role of Missile Defense*. The summary of those discussions follows below.

Panel Members
Chair: Dr. Robert L. Pfaltzgraff, Jr.
Ambassador Henry F. Cooper
Mr. Ilan Berman
Mr. Brian Kennedy
Mr. Jeff Kueter
Mr. Baker Spring

I. What are the implications of the key issues raised in the Cornerstone Paper for missile defense, and specifically for space-based missile defense, as we look beyond 2005?

Given the missile threats currently facing the United States, the Ground-based Missile Defense (GMD) system being deployed represents only the first step required for a robust, global layered defense, capable of intercepting ballistic missiles in each phase of their trajectory. By itself, however, GMD is a limited midcourse defense that will be effective against only a few missiles with simple decoys.

Because GMD cannot adequately discriminate among midcourse threats, it may be prone to failure unless it becomes part of a layered missile defense. The United States must be prepared to deploy a missile defense sufficiently advanced that rogue states will be dissuaded from making the necessary investment in missiles. At the same time, the United States should also deploy a missile defense capable of deterring strategic competitors such as China or Russia.

More than a decade ago, the United States had vigorous space-based sensor and interceptor development programs underway such as *Brilliant Pebbles* which were terminated because they did not conform with the restrictions of the ABM Treaty. These technologies should be revived and incorporated, along with advances made since then, into a high-priority development program that not only draws on the lessons learned from *Brilliant Pebbles* program but also from other successful weapon development efforts such as those that produced intercontinental ballistic missiles, the *Polaris* nuclear submarine and missile, and stealth technologies.

The threat environment for missile defense includes the possibility that missiles could be launched against the United States from anywhere on the globe. We are increasingly vulnerable to both short- and long-range missiles from rogue states and non-state actors, as well as from strategic competitors such as Russia and China. Because we cannot know with certainty where or when a missile will be launched against the United States, our missile defense must be capable of handling a broad spectrum of threats. In short, the United States needs to deploy a global, multi-tiered missile defense system against an increasingly worldwide missile threat.

II. What are the implications of the key issues raised in the Cornerstone Paper for overall U.S. national security?

The United States faces a global security setting characterized by accelerating proliferation of weapons of mass destruction (WMD) and the means to deliver them. New actors are acquiring technologies ranging from individual components to complete systems resulting in such capabilities. Although Russia does not today pose a missile threat to the United States, despite its continuing possession of large numbers of delivery systems with sufficient range to reach American targets, it possesses technologies, including ballistic missile components and expertise, that are being actively proliferated. Furthermore, we have no assurance that a future Russian leadership will not threaten the United States with its extensive nuclear-armed missile inventory. Indeed, under President Vladimir V. Putin, Russia appears increasingly committed to the reestablishment of a neo-imperialist sphere of influence in the new states to its south and west. Putin has spoken of rebuilding a "Great Russia." Russia has also demonstrated a sustained and alarming drift toward authoritarianism. A U.S. missile defense must therefore be sufficient to counter a future threat from Russia.

China, meanwhile, is expanding both its ballistic missile capabilities and its space presence. China has benefited considerably from U.S. technology, including missiles, and now has an inventory of intercontinental ballistic missiles (ICBMs) capable of striking the United States. This capability is being improved by replacing China's existing arsenal of CSS-4 "Mod 1" ICBMs with the longer-range CSS-4 "Mod 2," together with the development of mobile and submarine-launched variants of the *Dong-feng* (DF)-31 ICBM. Estimates suggest that its arsenal could grow to as many as sixty ICBMs by the end of the decade. China seems determined to build a nuclear force designed to inhibit U.S. action in the event of a renewed crisis such as in the Taiwan Strait. At the same time, China is deploying between 650 and 730 short-range ballistic missiles opposite Taiwan, with roughly one hundred such missiles expected to be added each year.[1] These missiles could also be used to conduct strikes against Okinawa and Japan, including U.S. forces stationed there.

China also possesses an active space program designed to make it a military space power. With the launch in October 2003 of its first manned spacecraft, China became the third nation, after the United States and Russia, to send a manned vehicle into space. A second successful manned mission was completed in October 2005. China's space program is designed to demonstrate Beijing's achievements and potential in such areas as computers, space materials, manufacturing technology, and electronics, technologies with dual-use military and civilian space applications, as well as to challenge U.S. dominance in space.

At the same time, the United States faces threats from other states that are either the exporters of WMD technologies or the breeding grounds and training sites for terrorists. One such nation is North Korea, which launched a ballistic missile over Japan in 1998. In addition to missiles, North Korea now is able to export fissile material or even assembled nuclear devices, posing an additional and unacceptable threat to the United States. A nuclear-armed North Korea would also weaken deterrence in and around the Korean peninsula.

Moreover, many states, as well as terrorist groups, could launch short-range missiles from ships off American coasts. We currently have no missile defense capable of destroying such missiles. The devastation caused by short-range missiles such as *Scuds* armed with a nuclear warhead would be far greater than the 9/11 attacks. A comprehensive approach to homeland security, in which missile defense and efforts to identify, destroy, or change such regimes are priorities, is therefore needed.

III. What steps need to be taken in light of these issues to achieve space-based missile defense, both immediate and longer-term?

During the Cold War, it was clearly possible to identify the Soviet Union as the source of a potential nuclear attack against the United States and the object of retaliation on which Mutual Assured Destruction was based. The twenty-first century strategic environment differs fundamentally: missile threats to the United States can now be mounted from almost any point on the globe.

Given the nature of this missile threat, only a global missile defense is adequate. Moreover, such a defense cannot be achieved without a space-based interception component. In the near term, kinetic energy space-based intercept technologies developed more than a decade ago in the *Brilliant Pebbles* program could be revived at minimal cost (approximately $5-7 billion over a five-year period). A research program in directed-energy weapons based on technologies already developed for applications in space and on aircraft should also be pursued.

While less flexible than space-based defenses, sea-based anti-missile options should be vigorously developed and deployed. This includes upgrades to the U.S. Navy's *Aegis* system and *Standard Missile* to provide increasingly effective intercept capabilities. Both space-based and sea-based missile defenses are essential to a global layered missile defense.

IV. What are the key obstacles to space-based missile defense and how can they best be addressed and overcome?

While in effect, the ABM Treaty served as a critical impediment to U.S. deployment of space-based missile defense. With the Treaty's termination in 2002, new opportunities for space-based missile defense have emerged. However, the key obstacles to space defenses remain more political than technological in nature. For example, certain constituencies continue to voice vehement opposition to space-based missile defenses in the mistaken belief that they could result in the weaponization of space. This assumption is the result of the dubious logic that if the United States refrains from the deployment of space-based missile defense, other nations will behave in similar fashion. There is no empirical basis for expecting such international reciprocation, however. Whatever the United States chooses to do (or not to do), China, among other nations, seems determined to pursue space programs and, at least in the case of Beijing, to establish itself as a space superpower.

Another issue is the failure to connect the emerging global missile threat to an adequate understanding of the requirements for an effective defense against such threats. This means that confining a U.S. missile defense to a few fixed land-based interceptors, together with a small sea-based capability, pro-

1 "Annual Report on the Military Power of the People's Republic of China," U.S. Department of Defense, 2005, <www.defenselink.mil/news/Jul2005/d20050719china.pdf>.

vides extremely limited coverage without any global capability that would result from deployment of a space-based missile defense component.

Other political obstacles exist. Should U.S. public awareness of the threat environment increase the Bush administration could potentially come under criticism for having underestimated (or ignored) the growing threat. That same public will want to know why so little has been accomplished to date. Closely related are institutional barriers in which departments and agencies responsible for missile defense are understandably reluctant to see their efforts questioned or their roles changed. Furthermore, defense contractors often have strong financial interests in maintaining existing programs. Last but not least, China and Russia have adopted strategies designed to prevent or discourage the United States from pursuing space-based missile defense options. Both nations seek to undermine the position of the United States as the dominant space power and to keep it from developing space-based missile defense and other space capabilities.

V. Are there opportunities that can be seized to press forward with space-based missile defense?

Despite the political obstacles, there is a desire within the general American public to maintain space superiority, including the deployment of space-based missile defense. If the United States is perceived as no longer dominant in space, many people will want to know how and why such dominance was lost and what needs to be done to restore it.

By the same token, there is a broad, but mistaken, belief that the United States is already defended by missile defense (which underscores the public's support for missile defenses). Moreover, as noted above, China's increasingly prolific space program could offer another catalyst to building an American consensus on missile defense. The fact that other nations are manifestly interested in space and pursuing their own programs provides yet another important consideration for pressing forward with a robust U.S. missile defense program that prominently includes space.

Last but not least, the Bush administration has yet to define clearly its missile defense plans post-GMD deployment. Therefore, we have an important opportunity to shape the future and in doing so, to set forth the need for a global layered missile defense system that encompasses a space-interdiction component.

VI. What are the implications of key issues raised in Panel I for other panels?

The Cornerstone Paper raises a number of important issues including the global nature of the missile threat, the need for a correspondingly global defense and the role of space in that architecture, and existing obstacles and opportunities to the development and deployment of a layered global missile defense. Creating a robust, flexible, and expandable missile defense will have important implications for the U.S. scientific-technological base, including required investments, lead times, and ensuring that a cadre of trained personnel remain available. Such issues will need to be addressed as the United States moves forward with missile defense. They are discussed in greater detail in subsequent Sections of this report.

section 2

Requirements, Feasibility, & Timelines for Missile Defense R&D & Deployment

Beyond the "Initial Deployment"

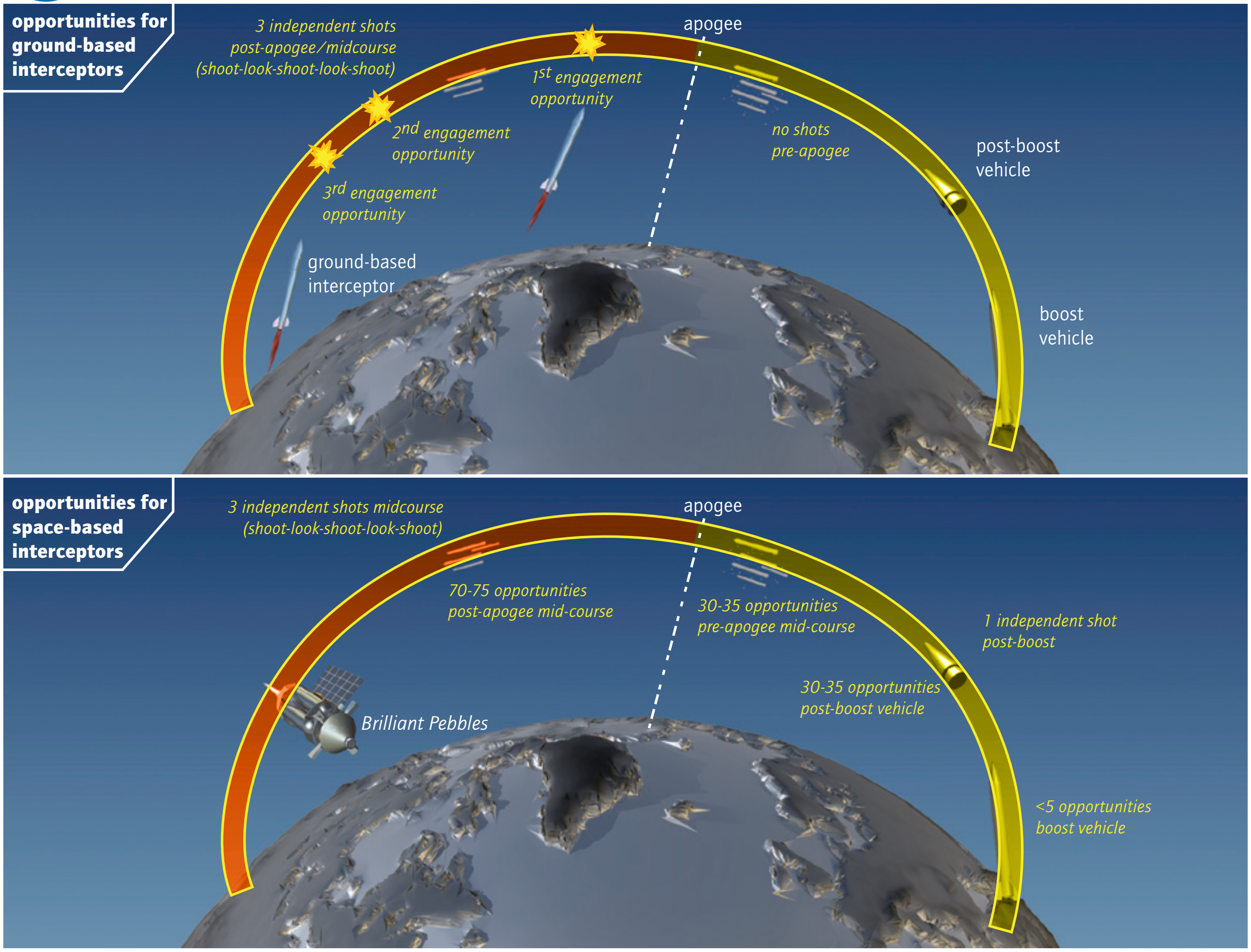
If the United States is to acquire an increasingly effective missile defense capable of intercepting missiles and warheads from wherever they are launched, it will be essential to jettison the mindsets framed by the Anti-Ballistic Missile (ABM) Treaty constraints that no longer officially restrict missile defense, but which persist in limiting current developments as discussed in Section 4. As part of this effort, we must build upon technical achievements that were set aside during the 1990s because they were at odds with the ABM Treaty. Specifically, the United States should revisit programs developed during the Reagan and George H. W. Bush (hereafter referred to as Bush-41) administrations in order to determine their relevance for a truly global layered missile defense for the twenty-first century. Those programs that produced technologies for boost-phase defense, together with today's even more advanced technologies developed in both the military and commercial sectors, should now be reviewed as a matter of highest priority by an independent outside group to determine which programs should be pursued. An examination of the potential of such capabilities, conducted free of prevailing bureaucratic and industrial interests, would provide the analysis needed to give new momentum and direction to the missile defense program. This report, in the meantime, provides a beginning and a direction to such an analysis.

The robust missile defense that the United States needs to deploy in the years ahead will necessarily include each of the intercept phases of a layered defense. Terminal defenses provide localized coverage designed to protect specific, high-value targets, but because they cannot be deployed everywhere, they must be part of a broader layered missile defense architecture. Midcourse defenses are important because this portion of a missile's trajectory provides the longest time for intercept, although it may also be necessary depending on the type of payload, to differentiate decoys from reentry vehicles – a significant discrimination challenge. Boost-phase defenses afford unique advantages. Specifically, the missile can be destroyed as it ascends from its launcher before it dispenses its warheads and decoys. Thus a boost-phase missile defense can be highly effective in severely blunting, if not even eliminating, an enemy missile attack. It is in boost phase that missiles are most vulnerable to attack as they rise against the earth's gravitational field. At this point the missile is relatively slow moving, has a large infra-red signature and cross section, and still-attached fuel tanks. Moreover, it is possible, depending on how early in the boost phase it is intercepted, that the debris, including possibly weapons of mass destruction (WMD) warheads, would fall on the territory of the country launching the attack. In addition, depending on the number of assets deployed, a boost-phase defense that is space-based could always be on station on a worldwide basis, unfettered by sovereignty issues of overflight and operations on another nation's territory.

Ground-based Missile Defense

Together, defenses that encompass each of the phases of a missile's trajectory afford the opportunity for multiple intercepts. Yet, as a result of programmatic decisions shaped by the restrictions imposed by the ABM Treaty, the United States is initially deploying a system that will not be able to destroy more than a few enemy warheads and will not provide for multiple hits. It is widely recognized that the initial capability being deployed, consisting of about twenty ground-based interceptors and twenty sea-based interceptors, will not be adequate to meet the growing challenges of ballistic missile proliferation, much less the more numerous and sophisticated threats of Russia and the People's Republic of China (PRC). (There is no current U.S. missile defense program to defend against the

Intercept Opportunities



	ground-based interceptor		space-based interceptor	
shot opportunities	pre-apogee	post-apogee	pre-apogee	post-apogee
long-range missile (9000km+)	0	3	85-99	70-75
mid-range missile (2500km)	0	2	20-25	30-35
short-range missile (600km)	0	0	0	10-15

missile forces of Russia or the PRC, which are growing in numbers and sophistication.)

Although ground-based missile defense (GMD) is presumed to be the most feasible because it has been under continuous development for over thirty-five years and receives far more money and attention than other options, it is also the most limited, especially when compared to the space-based systems discussed in this report. We are concerned that the growing costs of the GMD system will preclude sufficient funding and effort to develop, in a timely way, the more effective sea- and space-system boost-phase intercept systems. We therefore find ourselves today in a situation of deploying first the least capable and cost-effective systems and then later, if ever, developing for deployment systems that are potentially more capable and cost effective but which were "dumbed down" or even abandoned because they were prohibited by the ABM Treaty.[1] The 1991

1 This discrepancy is becoming apparent due to the relative success in testing of the ground-based and sea-based defenses. For example, as of spring 2005 the Navy had accomplished a five-out-of-six success rate using operational ships and crews, the ground-based defense record is five-out-of-ten in a very constrained testing configuration, with no successful test in over two years. See "Sea-Based BMD System Outperforming Land System," *Defense Today*, February 28, 2005. While the ground-based system receives almost an order of magnitude more funding, the sea-based system, which has an inherent global capability with ships currently deployed throughout the world, is proceeding at a funding limited pace. This suggests the Missile Defense Agency has made a less than optimum assignment of priority, based both on the performance and potential capability of these two programs.

Global Protection Against Limited Strikes (GPALs) architecture and programs, especially *Brilliant Pebbles*, were diluted by the 1991 and 1992 Missile Defense Acts and then set aside, postponed, and/or technically reduced in effectiveness by the Clinton administration. Since then, little progress has been made in developing and deploying the most effective missile defenses. In some aspects of missile defense, we are behind where we were heading in 1992.

It is disappointing that an administration purportedly dedicated to missile defense from the outset spent several years basically limiting itself to the missile defense program of the Clinton administration, utilizing essentially the same Pentagon organization. Not only was the truly strategic missile defense of the Reagan and Bush-41 administrations not resurrected – in favor of a very limited "spot" defense against a lightly armed rogue state – but the George W. Bush administration (hereafter referred to as Bush-43) chose to follow the Clinton administration in focusing its effort on relatively costly and largely ineffective ground-based systems rather than exploiting the most potentially effective technologies.

The U.S. GMD system currently being deployed remains highly vulnerable to criticism from both opponents and proponents of missile defense. With several interceptors now fielded in Alaska and California, the GMD system is beset with what Lt. Gen. Henry A. Obering III, USAF, Director of the Missile Defense Agency (MDA), called in July 2005 a "wide range of technical problems." In describing the current capability, LTG Obering stated: "We have a better than zero chance of successfully intercepting, I believe, an incoming warhead."[2] At this time, beyond improving its associated radars and their internetting, the major system improvement plan is to add interceptors, eventually up to a total of one hundred, with an additional ground site under consideration. The missile and interceptor may be improved, but only marginally.

The best alternative for system improvement, other than complementary space assets, would be revival of the Advanced Technology Kill Vehicle (ATKV) developed in the Strategic Defense Initiative (SDI) program. As discussed in the sea-based missile defense subsection below, the ATKV would significantly improve the missile's acceleration and final velocity and provide a better suite of sensors than the current kill vehicle (KV). Additionally, the ATKV would enable a successful Multiple Kill Vehicle (MKV) program, i.e., placing a number of KVs on a single interceptor, essentially creating a missile with multiple independently-targetable reentry vehicle capability to allow engagement of several targets. This would permit a more efficient and effective use of the limited ground-based interceptor inventory, and since a number of objects could be targeted might lessen the mid-course discrimination problem.

This analysis does not address short- and medium-range missile defenses due to their basic inapplicability to homeland defense. The *Patriot Advanced Capability*–3 (PAC-3) has a good test record and is attractive to many of our allies as well as U.S. forces in the field, but it is a point, not an area, defense against short-range missiles. To handle the threat of *Scud*-type missiles launched off the coastlines of the United States (the GMD system does not address this threat), many *Patriot* batteries would have to be deployed on the coasts. The Terminal High Altitude Area Defense (THAAD) system, designed to be both a high endo- and exoatmospheric system against medium-range missiles, has a dismal development and testing record. Due to test failures and systems problems, THAAD testing was halted in 2000 while the program was restructured. THAAD's track record does not support optimism for success, much less for upgrading and improvement.

Overall, as argued elsewhere in this report, ground based systems are the most costly missile defense options while their capabilities/growth potential are the most limited. Although ground-based systems can play an important role in a sensible architecture that includes space- and sea- based systems, priority should be placed on that overall architecture and not on the GMD system, which is inadequate to keep up with the existing, let alone developing threats.

Sea-based Missile Defense

Sea-based defenses can potentially intercept a missile in its boost or ascent phase[3] before warheads and decoys are deployed, provided the sea-based platforms are located in the necessary proximity to the launch point. Ships stationed farther away can intercept attacking warheads during their ascent and throughout the midcourse phase (provided the warheads can be distinguished from decoys) and into the terminal phase. This contrasts with the current GMD system which will be limited to intercepts late in the midcourse phase. Ground-based interceptors deployed on the territory of allies could also provide a degree of boost-phase intercept capability against intercontinental ballistic missiles (ICBMs) launched at the United States from some locations, but gaining such access would be more difficult than deploying ships in international waters that comprise over two thirds of the earth's surface.

A sea-based defense is advantageous because it can be fielded rapidly within one or two years, largely because the United States has already invested over $60 billion in the *Aegis* system and the *Standard Missile*. There are a large number of American *Aegis* ships deployed around the globe, which can be readily moved to trouble spots. The current *Standard Missile*-3 (SM-3) Block 1 program has achieved an impressive

2 Ann Scott Tyson, "U.S. Missile Defense Being Expanded, General Says," *Washington Post*, July 22, 2005, p. A10.

3 The ascent phase begins after the booster burns out, prior to the separation of the warhead[s] from the missile.

five of six successful testing record[4]. If it continues according to its current schedule, the SM-3 Block 1 will achieve a limited defense capability against medium-range ballistic missiles. This program could be given a late midcourse capability against ICBMs for $100 million more than currently allotted. This additional funding would cover a communication system and protocols to support SM-3 Block 1 engagements based on track data from remote sensors.

Such a capability could dovetail nicely with the joint U.S.-Japanese program to develop a larger diameter version of the SM-3 second and third stages,[5] referred to as the SM-3 Block 2. Like previous versions, this missile will fit in the Vertical Launch System (VLS) deployed on the U.S. Navy *Aegis-Ticonderoga*-class cruisers, *Spruance*- and *Arleigh Burke*-class destroyers, as well as on the ships of several U.S. allies. This jointly funded program could be accelerated with additional U.S. investments. For example, an added $300 million over the next three years could accelerate the schedule for an initial operating capability by more than a year.

The operating area within which a sea-based system can intercept a hostile missile increases significantly as the interceptor velocity increases. As noted above, a limited intercept capability against ICBMs is possible with the existing SM-3 interceptor, which has a velocity slightly over 3 kilometers per second (km/sec). The SM-3 Block 2 U.S.-Japanese joint program will lead to a capability of about five 5 km/sec. However, a velocity of 6 to 7.5 km/sec is needed to give a significantly larger global defense capability, especially in boost phase. This global defense objective can be accomplished for the least cost if 7.5 km/sec interceptors were made compatible with the existing U.S. VLS infrastructure and that of allies willing to participate in building a global defense capability (more below).

The fifty-three-centimeter-diameter SM-3 Block 2 will be the largest interceptor that can fit into the VLS. Fortunately, miniaturized light-weight SDI technology developed a decade ago can be used to achieve 6-7.5 km/sec with this VLS-compatible interceptor. (The lighter the kill vehicle on a given missile, the faster the missile will accelerate – and the higher its final velocity.) Several years ago, the Lawrence Livermore National Laboratory proposed the use of SDI technology to demonstrate an ATKV. Because of its light weight, an ATKV outfitted on the SM-3 Block 2 could achieve the desired 6-7.5km/sec velocity. Unfortunately, this ATKV has not been funded, and the laboratory and industrial teams with the experience for development and production have largely been disbanded. It is necessary to revive the entire program.

Regrettably, the Missile Defense Agency (MDA) has failed to follow this path. Instead, it has opted to build a new, much larger diameter interceptor, substantially bigger than what the existing U.S. and allied VLS infrastructure can accommodate. Initially, a seventy-nine-centimeter-diameter missile was the goal, but more recently its design diameter has grown to over eighty-nine centimeters. This approach will spawn an extensive program to build both a new missile and a new VLS, resulting in an expensive retrofitting program – one that will, in turn, lead to the creation of dedicated missile defense ships, "picket ships" that over time can be expected to turn the Navy against the effort. Instead, a better alternative would be to mate the SM-3 Block 2 being developed in the joint U.S.-Japanese program outlined above, using the ATKV light-weight kill vehicle based on technology developed during the Reagan-Bush-41 years (but held dormant for a decade) to achieve the desired velocity in a way compatible with the existing Navy VLS infrastructure.

The eighty-nine-centimeter-diameter Navy interceptor, apparently favored by some in the Pentagon, is clearly the wrong architectural choice. The Pentagon probably prefers this approach because of the emphasis placed on ground-based interceptors over the past decade and the fact that the exoatmospheric kill vehicle (EKV) on the current GMD interceptor represents the most developed capability. However, the GMD EKV is too heavy and large for use on the fifty-three-centimeter SM-3 Block 2. Despite these drawbacks, the Missile Defense Agency appears inclined to use the EKV technology for the Navy application, despite the fact that it requires a larger booster, has little or no boost-phase capability, and is likely to delay the Navy program by as much as ten years through the development of the new and larger (eighty-nine-centimeter) interceptor.

Fortunately, the Japanese, sensitive to the need to retain VLS and its associated infrastructure have insisted that the SM-3 Block 2 program focus on a fifty-three-centimeter-diameter missile – the largest diameter that will fit in the VLS. This has led to a reduced interest in the Kinetic Energy Interceptor (KEI) program, now centering on boost-phase intercept, and Congress has raised questions about the wisdom of maintaining both the KEI and the Airborne Laser (ABL) program, which also seeks to achieve a dedicated boost-phase capability.[6] In fact, KEI funding was cut significantly in the Department of Defense's (DOD) 2006 budget submission and by Congress, plummeting to $216 million (from the $1 billion forecasted just a year earlier in MDA budget documents), and delaying deployment from 2012 to 2013. Missile defense officials said the cuts reflected a decision to focus on programs closer to fielding.

Finally, it is worth mentioning that the United States could outfit two *Linebacker* cruisers with 110 SM-2, Block IV air defense interceptors in as little as nine months, there-

4 Frank J. Gaffney, "Commentary: Go Navy Missile Defense," *Washington Times,* March 1, 2005.

5 "U.S. Navy Working with Japanese on Billion-Dollar Missile Upgrade, *Inside the Navy,* March 14, 2005.

6 "HASC Endorses ABL Revamp, Seeks Comparison with KEI," *Aerospace Daily & Defense Report*, May 19, 2005.

by acquiring a boost- and terminal-phase defense capability against *Scuds* launched from ships off our coasts. Secretary of Defense Rumsfeld has reconfirmed the finding of the 1998 Commission on the Ballistic Missile Threat that such a threat exists today – and we have no defense against it. For less than $100 million investment, the Navy could rapidly test its existing system with modified software and begin initial operations in conjunction with the various sensors of the East and West Coast Test Ranges.

Space-based Missile Defense

For the United States, space represents an indispensable first line of defense. Almost since the beginning of the space age over forty years ago, the United States has utilized this arena for intelligence and defense support, including deploying sensors in space to provide early warning of a missile launch. Without space control, the United States cannot maintain dominance on the battlefield.

With the demise of the ABM Treaty, the United States can now legally develop, test, and deploy space- as well as sea-, air-, and mobile ground-based defenses. To build a missile defense with the global capability to protect its own territory and its overseas forces, friends, and allies, as President Bush has proposed, the United States will need to include space-based defenses. They possess a global capability because they can intercept a missile regardless of launch location, provided that the constellation is large enough to keep interceptors continually within range of possible launch locations. Of all basing modes, space-based defenses would provide the widest area of coverage and greatest number of shots against enemy warheads – and it would have the very desirable feature of always being present to destroy ballistic missiles launched from anywhere in the world.

Unfortunately, for most of the thirty years of the ABM Treaty, there was little or no experimental verification of the feasibility of space-based defense concepts that had been identified in the early 1960s, as the underlying empowering technology advanced. Then, President Reagan, who was interested in truly effective global defenses, included space-based defenses as a vital part of his missile defense vision. He thus challenged the American scientific community to determine whether the technology for such defenses had advanced to the point that effective defenses, including in space, could be built. And, by the end of the Reagan administration, creative experiments that avoided the specific restraints of the ABM Treaty had demonstrated that the answer was clearly in the affirmative.[7]

The Reagan–Bush-41 administrations developed a concept that, but for the political issues discussed in Sections 1 and 4, could have begun operating as early as the mid 1990s as part of a global missile defense, employing all basing modes against attacking missiles of every range. This missile defense architecture not only included *Brilliant Pebbles* as the space-based interceptor (SBI) component of GPALS, but also a layered defense consisting of ground- and sea-based national and theater defenses designed to intercept missiles launched from any point against the United States itself or its interests overseas. GPALS would have defended against ballistic missile launches and limited ballistic missile strikes launched from any part of the globe.[8]

In marked contrast to the more limited missile defense that evolved during the Clinton and current Bush-43 administration, GPALS was a global defense. The architecture provided for a multi-tiered defense beginning in boost-phase against missiles just after launch and extending through midcourse and into the terminal phase. By 1990, as a result of the technology investments of the preceding decade, the space-based elements were more technically mature and capable of rapid development than the ground-based components of GPALS.[9] Nevertheless, the promising space-based defense technologies developed more than a decade ago, whose maturity was demonstrated by the 1994 prize-winning *Clementine* mission to the moon, have remained ignored if not a priori rejected by the White House and Department of Defense (see Section 4).[10] In-

7 Key among these were the three *Delta* experiments conducted from 1986 through 1989 which demonstrated that largely off-the-shelf missile defense technologies should be able to track and intercept boosting, or accelerating, targets in space, including the capability to distinguish the target from the plume of its rockets. The first *Delta* experiment (*Delta* 180) was successfully carried out only thirteen months following funding.

8 In the January 29, 1991 State of the Union Address, President Bush announced the GPALS program which would afford protection against as many as 200 long-range missiles.

9 See Appendix C for the July 31, 2000 letter from former SDI Director Henry F. Cooper to Senator John Warner and other congressional leaders disputing the commonly held perception that the most mature technology of the Reagan-Bush-41 era was for ground-based defenses. He makes clear that the *Brilliant Pebbles* space-based interceptor system was considerably more mature, given that it became the first SDI program to achieve an approved Major Defense Acquisition Program status – well over a year ahead of the potential for a ground-based system.

10 Originally sponsored by the Strategic Defense Initiative Organization, the *Clementine* mission was designed to test new technology that would track and intercept hostile missiles, using celestial bodies such as the moon. The *Clementine* spacecraft was integrated by the Naval Research Laboratory, using hardware scavenged from Lawrence Livermore National Laboratories' *Brilliant Pebbles* program. It was launched in 1994, less than two years following concept definition in approximately half the time and at a quarter of the cost of comparable satellites. *Clementine* mapped the entire moon surface in thirteen spectral bands providing fundamentally new data well beyond the achievements of the *Apollo* program. The results from this

deed, President Clinton vetoed the *Clementine* follow-on mission in 1997 precisely because it involved the next generation of advanced technology beyond *Clementine*. President Clinton's principal National Security Council advisor on missile defense told the press that the President exercised his line item veto authority to kill this follow-on mission, which was supported by the scientific community, to send a probe to a deep space asteroid precisely because it involved SDI technology which would violate the ABM Treaty. Since the Treaty is now defunct, this criticism clearly does not apply today. Still, the current administration has not seen fit even to conduct such a demonstration or to revive the *Brilliant Pebbles* program, which would indeed move SBI technology ahead (more below).

There are essentially two basic approaches to space-based missile defense. The first is kinetic energy systems; the second is directed energy weapons.

Space-based kinetic energy missile defense

A space-based KEI is designed to hit a ballistic missile in its boost phase, when the warhead(s) has not yet separated from the missile and is most vulnerable, as well as in the midcourse and high-terminal phases. Kinetic kill vehicles would be placed in low-earth orbit, where they would remain until a hostile missile launch was detected. For intercepts in the boost or terminal phases, a kinetic kill vehicle would accelerate out of orbit toward the missile which would be destroyed by direct impact. Midcourse intercepts would occur in space.

Over a decade ago, the United States had developed technology for light-weight propulsion units, sensors, computers, and other components of an advanced kill vehicle. This concept, *Brilliant Pebbles*, consisted of a constellation of about 1000 satellites that combined its own early-warning and tracking capability with high maneuverability to engage attacking ballistic missiles in all phases of their flight trajectory. Each pebble was designed to identify the nature of the attack, which might include up to 200 ballistic missiles; and since it knew its own location and that of all other pebbles, each could calculate an optimum attack strategy from its own perspective and execute an intercept maneuver, while simultaneously informing the other pebbles of its action. This operational concept enabled a robustly viable, testable, operational capability that survived numerous scientific and engineering peer reviews in the 1989-90 time period, including by some groups that were hostile to the idea of missile defense in general, and space-based defenses in particular. Still, because of persistent policy preferences, the opposition eventually gained the upper hand politically, and the program which had been formally approved by the Pentagon's acquisition authorities was curtailed by Congress in 1991 and 1992 and then cancelled by the Clinton administration.[11]

But the technology was clearly established, supporting the Pentagon's approved acquisition plan that each of the pebbles would operate autonomously because each carried the equivalent of a Cray-1 computer and could do its own calculations for trajectory and targeting analysis. Each also had its own navigation sensors, allowing it to determine its location and the location of its neighbors – as well as to detect and track the target ballistic missiles and calculate a good approximation of what its neighbors saw.[12] These pebbles would act as sensor platforms until all or part of the constellation was authorized to intercept hostile missiles. In fact, their infrared sensors provided the warning and tracking capability needed to alert the *Brilliant Pebbles* constellation enabling it to intercept ballistic missiles in the boost and subsequent phases of flight. The constellation would provide a redundant, and for some applications, superior capability than the geosynchronous Defense Support Program satellites used since the early 1970s as a key element of the U.S. Early Warning and Tactical Assessment system. Their small size, meanwhile, made them difficult to target, while their relatively low cost made them easy to replace.

The autonomy of *Brilliant Pebbles* in detecting launch and undertaking interception complicated the use of countermeasures against their command and control. And because of the number of *Brilliant Pebbles* deployed in space, these defenses would have multiple opportunities for interception, thus increasing their chances of a successful intercept in either the boost or midcourse phases, or even high in the earth's atmosphere during reentry in the terminal phase. These characteristics stand in contrast to the current GMD interceptors which, in the limited numbers presently planned, may not provide more than one independent intercept opportunity.

Although there has been no formal program to develop the key technologies further, advances in the commercial, civil and other defense sectors over the past decade will now permit even lighter mass, lower cost, and higher performance than would have been achieved by the 1990-era *Brilliant Peb-*

mission filled an entire issue of the National Academy's Journal, *Science*. The small scientific team performed this mission for about $80 million and received prestigious awards from the National Academy of Science and the National Aeronautics and Space Administration (NASA). In addition to these scientific achievements, the *Clementine* mission also space-qualified all the first generation *Brilliant Pebbles* technology except for miniature propulsion units, which were demonstrated later in 1994.

11 See the record of this important program as recorded by the Missile Defense Agency's Historian, Donald R. Baucom, "The Rise and Fall of Brilliant Pebbles," *International Flight Symposium*, October 23, 2001. This piece was subsequently published in the *Journal of Social, Political and Economic Studies*, Volume 29, no. 2, (September 2004): 145-190. It is provided as Appendix D.

12 The title "Brilliant" refers to the use of powerful miniaturized computers and sensors allowing each independent interceptor to employ technology possessed previously only by large, expensive satellites.

bles technology base. Thus, lighter weight and smarter components can now empower a *Brilliant Pebbles* interceptor with greater acceleration/velocity making possible boost-phase intercept of even short- and medium-range ballistic missiles. If the necessary investments are made to upgrade *Brilliant Pebbles*-type technology for the twenty-first century, boost-phase intercept from space will also be feasible against high acceleration ICBMs that would have exceeded the capabilities of the 1990 *Brilliant Pebbles*.[13]

And as noted above, the same sensor and kill-vehicle technology can be used for ground- and sea-based interceptors – notably on the VLS-compatible, high-velocity Navy SM-3 interceptor. Reviving and building on the *Brilliant Pebbles* concept and related technologies is essential for the deployment of effective SBIs, as well as improved interceptors for use in other basing modes, especially at sea.

To move forward the United States must identify and exploit programs that were under development more than a decade ago. In other words, we should "go back to the future" as the point of departure for the increasingly robust missile defense that will be needed beyond what was initially planned for deployment in 2004-2005. Our engineers did it before, and can do it again to defeat the growing ballistic missile threat.

One feasible option for testing and initial deployment of a revived space-based interceptor system based on *Brilliant Pebbles* would be to deploy, say, 40 to 120 interceptors for a space-system test bed analogous to the ground- and sea-based test beds. After demonstrating feasibility by testing against missiles of all ranges in all possible phases of their flight, this test bed would have a limited capability and could be expanded to become a fully capable defensive constellation.

Based on the fully approved Defense Acquisition Board plan from 1991, an SBI system with as many as 1000 *Brilliant Pebbles* could be developed, tested, deployed and operated for twenty years with a low-to-moderate risk, event-driven acquisition program for $11 billion in 1990 dollars, or $16 billion when inflated to 2005 dollars. In 1991 initial operations were expected to be feasible in approximately five years; however at that time there was an in-place acquisition program with two competing contractor teams.

Still there is some confidence that an appropriate *Brilliant Pebbles* team could be reconstituted and meet an approximate five year target date for initial operations, at least for a space test bed, because Motorola used commercially available technology to build and begin operating its 66-satellite constellation *Iridium* communications system in roughly five years for approximately $5 billion. *Iridium*, now used by the Pentagon for communications to remote locations, exploited many of the technologies, operational concepts, and acquisition management approaches that had been planned for *Brilliant Pebbles* before it was cancelled in 1993. Consequently, the operational issues demonstrated by the *Iridium* experience would be valuable in reconstituting a viable *Brilliant Pebbles* acquisition program, provided personnel with that experience were included on the team.

Space-based directed-energy (laser) missile defense

Directed-energy defenses hold the potential in the longer-term to provide a boost-phase defense capability. The 1991-92 GPALS system included a follow-on space-based laser (SBL) layer after the *Brilliant Pebbles* deployment with capabilities that would complement it in two ways: (1) lasers operating at the speed-of-light assure the earliest possible boost-phase intercept capability, maximizing the likelihood that debris from the intercept would fall back on the launcher's territory; and (2) while lasers would not be effective in destroying nuclear warheads in space, they would be capable of the active discrimination of warheads from decoys thus enabling intercept by *Brilliant Pebbles* or other midcourse defense systems.

The SBL platform would intercept ballistic missiles by focusing and maintaining a high-powered laser on the missile while its rockets are burning and it is very vulnerable to even a small perturbation that could ignite the rocket fuel and destroy the missile. A missile that is struck early in its boost phase could dispense its deadly payload over the country of launch, thus creating in itself a possible deterrent to launching missiles against the United States and its forward deployed forces. (Countries contemplating the use of missile-delivered weapons of mass destruction would have to consider the possibility that the payload would fall within their own borders). If the missile were engaged near the end of its boost phase, it still might fly a ballistic trajectory, but one that would fall short of its intended target. And as noted above, SBLs could perform an active discrimination mission, aiding SBIs and other midcourse-capable defenses in intercepting the attacking missile before it re-enters the Earth's atmosphere.

Because any one space-based directed-energy platform may not be in view of the area from which its target missiles are launched at a particular time, a constellation of such platforms would be required to ensure that one or more of them will be in view of potential launch areas in time to engage the targets while they are vulnerable. A constellation of about twelve SBLs could provide global coverage against up to five ballistic missiles simultaneously launched from anywhere to anywhere else more than about 120 kilometers away. Against theater-class medium-range ballistic missiles, this constellation could destroy up to ten simultaneously launched ballistic missiles while in boost phase. Against ICBMs, whose boost phase lasts for three to five minutes, a minimum of fifteen to twenty-five simultaneous missile launches could be intercepted.

We recommend that a robust space-based defense consisting of KEIs should be developed and deployed as soon

13 See Gregory H. Canavan, *Missile Defense for the 21st Century*, Heritage Foundation Paper, 2003, particularly 96-111.

as possible. A twenty-first century *Brilliant Pebbles* capability as part of a layered global intercept capability would serve as a major disincentive to proliferation of ballistic missiles. A R&D program should be pursued to prove the requisite SBL technologies. When developed and fully tested, SBLs would significantly augment this capability. However, as noted above, there is no current program to provide a SBI capability, and the SBL Integrated Flight Experiment that was scheduled for 2012 has been cancelled.[14]

Air-based Directed-Energy Defenses

Another approach to directed-energy defense against ballistic missiles is the Airborne Laser, a Boeing 747 outfitted with a million-watt laser in its nose under development by the U.S. Air Force. If held on the target for a few seconds, the laser can melt a hole in the skin of a missile at distances of hundreds of kilometers. Circling overhead at an altitude of about 12,000 meters, a small number of 747s equipped with these megawatt lasers could destroy missiles launched from anywhere within a large target area. The ABL can detect, track, and intercept an attacking missile within its range while still in boost phase making it a particularly desirable missile defense, since it essentially eliminates the problem of decoys.

In a possible attack on the United States by North Korean missiles, for example, the attacking missiles would fly roughly parallel to the Chinese and Russian coastlines and a few hundred kilometers inland – well within boost-phase intercept range for ABL (as well as the upgraded *Aegis* with a bigger booster and/or smaller kill vehicle). This capability makes both ABL and *Aegis* attractive possibilities for the next level of ballistic missile defense (BMD) performance beyond that of the ground-based defense system which began deployment in 2004.

In November 2004, the ABL successfully produced a laser light on the ground for a fraction of a second for the first time using all six of its power sources. Current plans call for the integration of the ABL high-power laser component into the ABL weapon system test bed and ground testing in Fiscal Year (FY) 2006. This would be followed by integration of the high-power laser into the aircraft and a series of flight tests. Actual flight tests against targets are now scheduled for 2008. MDA earmarked $598 million for ABL in FY 2007 with a total of $3.1 billion planned from 2006 to 2011.

Long-range plans, to be implemented when testing is complete and the system is ready for deployment, call for seven laser-equipped 747s available on a continuous basis, circling over regions from which an attack on the United States and its allies is considered a serious possibility. The aim is to create a fleet of ABLs and the accompanying equipment/support team that could be at a crisis area within a few hours. Two or three planes would probably suffice to monitor the environs of one launching country, while an inventory of seven should be adequate to monitor more than one launching country.

There are notable logistical and operational problems and enemy countermeasures that could diminish the impact of airborne lasers, however. For example, ABL operations during crisis or war will depend on the ability to provide relatively safe operations via protective escort (similar to that given the Airborne Warning and Control System [AWACS] and the Joint Surveillance Target Attack Radar System [JSTARS] aircraft) and air superiority. Whether an enemy would allow this to happen making his ballistic missiles more vulnerable, or have the incentive to launch the missiles before ABLs were deployed, is not clear. An adversary could also elect to wait out a crisis believing that the ABL fleet could not sustain 24-hour patrols for a protracted period. Apart from the extensive assets and support team needed for protective escort and air superiority, in order to remain on station for extended intervals the ABL would also require nearby facilities for the storage and production of chemical laser fuel, unique maintenance capabilities (e.g., for laser and beam control, and fire control components), and specialized ground support personnel. Such a support/logistics tail could well result in sovereignty issues including overflight and basing concerns.

Another problem confronting the ABL is atmospheric turbulence, which produces small, irregular, constantly moving pockets of air, or "cells." Each cell has a density and temperature slightly different than the average in the beam. Since air has a refractive index that depends on density, and bends a beam of laser light by differing amounts depending on the density, the passage through the turbulent atmosphere tends to send parts of the laser beam in different directions. This spreads the laser beam and reduces its intensity, weakening the laser beam's ability to penetrate the skin of the missile.

However, a relatively new technology called adaptive optics – increasingly used in astronomy to produce sharper and more detailed images of astronomical objects – is included in the ABL to prevent such atmospheric blurring.[15] The key element in adaptive optics is a mirror (some-

14 Based on the 1995-99 estimates provided by the Heritage Foundation's Team B, a fully funded acquisition program could lead to an initially operating SBL capability within a decade for $30-35 billion which includes ten years of operating costs. See "Defending America: A Near- and Long-Term Plan to Deploy Missile Defenses," report by the Missile Defense Study Team, The Heritage Foundation, 1995; "Defending America: Ending America's Vulnerability to Ballistic Missiles," update of the report of the Missile Defense Study Team, The Heritage Foundation, 1996; and "Defending America: A Plan to Meet the Urgent Missile Threat," report of the Heritage Foundation's Commission on Missile Defense, 1999.

15 This adaptive optics technology was pioneered in the SDI program during the late 1980s and transferred to the private sector in 1992 to enable ground-based telescopes to obtain Hubble-quality space imagery.

times called a rubber mirror) that can change its shape about a thousand times a second, redirecting the various parts of the laser beam to keep it tightly focused on the oncoming missile. The rubber mirror corrects much of the effect of atmospheric turbulence, although it does not remove it entirely. Because of this circumstance, the Airborne Laser can be more effective against ICBMs than it is against shorter-range theater-type missiles, including *Scuds*: long-range missiles rise to a greater altitude than the medium-range missiles, and at higher altitudes the air is thinner and the effect of atmospheric turbulence is not as troublesome. The ABL constitutes a potentially important contribution to boost phase defense and continued investment is advised.

Addressing the Ship-borne *Scud* Threat

The United States is also faced with the problem of defending against the launch of short- or medium-range missiles from ships off our coasts. In fact, it is imperative that we view the WMD threat as encompassing containers that might be brought into our ports, as well as the possibility of the launch of short-range missiles armed with nuclear or even conventional warheads from ships off our shores. The ship-based threat includes *both* container ships that enter our ports *and* vessels near our shores but outside our territorial waters from where *Scud*-type missiles with 200-600 kilometers ranges could be launched with devastating effects against our coastal cities.

One response to such a threat is to deploy *Patriot* systems along U.S. coasts. However, achieving significant effectiveness would require fielding a large number of systems which could create a public relations/interface problem. A more politically viable, less intrusive approach would be sea-based interceptors (based on modified U.S. Navy SM-2 Block 4 missiles described earlier) on ships that operate in waters near our coasts. This capability could easily be adapted from the Pacific Test Range, where all Navy missile defense tests are currently conducted, providing protection for the population living on the West Coast. In addition, the existing sensor and communications capability along the East Coast could be incorporated into an East Coast Test Range to demonstrate and aid in the operations of a sea-based defense of the eastern seaboard.

The SM-2 Block 4 missiles could be used to achieve quickly a limited boost-phase defense against a *Scud*-type missile launched from a surface ship 160-320 kilometers off the U.S. coast. Radar software modifications would allow the SM-2 Block 4 to intercept missiles in boost phase within approximately twenty kilometers from where they were launched. Still needed, however, would be an operational concept involving the Navy and Coast Guard, ship identification and tracking procedures, and sensor netting. Nevertheless, with the requisite radar software modifications (estimated to cost under $100 million) the SM-2 Block 4 could have an operational capability within a few months. While this would not constitute the optimum defense, it would be superior to relying solely on the *Patriot*.

The United States should also develop other missile defense capabilities against the threat posed by a missile launched from a surface ship. For example, this threat could be countered in the near-term with technology enabling boost-phase interception of short- to medium-range missiles by an unmanned aerial vehicle (UAV). The SDI version of this technology was called *Raptor-Talon* (*Raptor* was the UAV and *Talon* was the airborne interceptor based on lightweight *Brilliant Pebbles* technology). The *Raptor-Talon* should be revived and developed for the coastal defense mission.[16]

Bottom Line

As set forth in this Section, the key to a missile defense that meets twenty-first-century challenges lies first in reviewing, reviving, and building on technologies, especially *Brilliant Pebbles*, that were initially developed in the Reagan and Bush-41 SDI program, but later halted because they were not ABM Treaty compliant. At the same time we must rid ourselves of a mindset that shapes even the post-ABM Treaty strategic culture if we are to build the global missile defense capable of multiple intercepts described in this Section. Having outlined technologies and concepts that provide for an increasingly robust missile defense with far greater priority assigned to space-based and sea-based systems, we turn next to a discussion of space as an essential geopolitical setting for twenty-first-century missile defense.

16 During the George H. W. Bush administration, SDI pressed for a nearer-term UAV capable of boost phase intercept. The *Raptor-Talon* program was an inexpensive UAV (developed by Lawrence Livermore National Laboratory [LLNL] with two built by Bert Rutan's Scaled Composites Company), that was approaching the testing stage in 1993. The idea was that UAVs would orbit on the edges of a battle area to detect launches of short-range tactical ballistic missiles and perform boost phase intercept utilizing extremely fast hypervelocity interceptor missiles. The Clinton administration aborted the program, transferring it to NASA. There have been no signs of reviving the *Raptor-Talon* effort during the current Bush administration. A solar-powered version (which charged the batteries during the day and flew on battery power at night), also developed under LLNL management, was transferred to NASA and has set high altitude records.

Panel 2 Report

A meeting of Panel 2 to discuss the Cornerstone Paper entitled Requirements, Feasibility, and Timelines for Missile Defense R&D and Deployment produced a series of conclusions based on an elaboration and refinement of issues raised in the paper.

Panel Members
Chair: Dr. William R. Van Cleave
Ambassador Henry F. Cooper
Dr. William R. Graham
Mr. Jeff Kueter
Dr. Charles M. Kupperman
Vice Admiral J.D. Williams, USN (Ret.)
Dr. Lowell Wood

I. What are the implications of the key issues raised in the Cornerstone Paper for missile defense, and specifically for space-based missile defense, as we look beyond 2005?
Several missile defense implications and recommendations were discussed by the members of Panel II. They include the testing and deployment of sea-based, space-based, and air-based defenses in a missile defense architecture that includes, but moves beyond, the initial deployment of the ground-based missile defense (GMD) presently under way. This encompasses the updating of *Brilliant Pebbles* technology that was successfully demonstrated in the early 1990s to create a space-based kinetic energy missile defense that could be deployed in the next three to five years. It also includes continued research of directed-energy weapons technologies for applications in space and on aircraft. A robust missile defense based on the requirements set forth in the Cornerstone Paper would place increased emphasis on the deployment of sea-based defenses utilizing current technology as quickly as possible, together with ongoing improvements in revived *Brilliant Pebbles* technology.

The Panel members also proposed adding $50 million for modifications to the Navy's *Standard Missile* (SM)-2, Block 4 to enable interception of ship-borne *Scuds* that might be launched off our coasts. Moreover, the Panel concluded that we should upgrade rapidly the current SM-3 Block 1 to give it the capability over the next two to three years to intercept intercontinental ballistic missiles (ICBMs) in late-midcourse and perhaps boost phase. It also recommends accelerating the joint U.S.-Japanese SM-3 Block 2 program and further modifying it with advanced light weight kill vehicles (more below) to allow expanded boost phase intercept capabilities. The United States, it was suggested, should also revive the *Raptor-Talon* unmanned aerial vehicle (UAV) program for coastal defense applications in the next three to five years.

II. What are the implications of the key issues raised in the Cornerstone Paper for overall U.S. national security?
Without a serious effort to develop and deploy effective boost-phase defenses, it is only a matter of time before the very limited defense being developed by the Bush administration will face countermeasures by adversaries. We may already see the signs of such developments in China's transfer of technology to "rogue states," where terrorists are more likely to gain access to knowledge and resources that can be used against the United States and its deployed forces and allies abroad. The Pentagon's known programs are not sufficiently responsive to the likelihood of such technology transfers designed to defeat the limited GMD system now being deployed. When and if that fact becomes apparent, the political fallout will strengthen the hand of missile defense opponents.

It was noted that the current U.S. missile defense program leaves American cities vulnerable to *Scuds* launched from ships a few hundred miles off our coasts. This possibility could become attractive to terrorists, especially for launching short- or medium-range ballistic missiles armed with weapons of mass destruction that could kill millions of Americans in our urban areas. This vulnerability, which has been pointed out by

Defense Secretary Rumsfeld and others, should not be allowed to continue. Yet the current architecture for missile defense fails to address this growing threat even though the Missile Defense Agency (MDA) decided in 2005 that it plans to consider this threat.

III. What steps need to be taken in light of these issues to achieve space-based missile defense, both immediate and longer-term?

Technologies developed in the 1990s as part of the *Brilliant Pebbles* program (such as lightweight kill vehicles) would prove extremely useful to the eventual deployment of space-based missile defense and to the planned/potential modifications of current sea-based missile defenses to augment intercept capabilities. Moreover, such modifications could also serve as a testbed for technologies for a future space-based missile defense. However, the MDA appears to be establishing requirements for sea-based missile defenses that will not produce such benefits. For example, contemplated changes to the *Aegis* Vertical Launch System (VLS) infrastructure will lead to greatly increased cost and delays in building an effective sea-based defense.

The only major counterpressure to this undesirable course comes from Japan, which has been a consistent advocate for an improved SM-3 Block 2 interceptor that fits in the existing VLS on Japanese *Aegis* cruisers. Because of Japan's persistence, the U.S. has agreed to provide such an option, thereby creating the possibility of redirecting the U.S. program. But MDA's reluctance to initiating efforts to provide the enabling lightweight kill vehicle technology is undermining progress toward that objective. Our goal should be to have a missile defense interceptor deployable on any ship (possibly all) outfitted with the *Aegis* VLS system thereby making these platforms missile-defense capable. Such an operational concept would provide major global defense capability without interfering with the Navy's normal operations.

Furthermore, the timeline for the deployment of advanced sea-based systems is promising. An estimated three years are necessary to fix known problems, with possibly another two to three years required to rectify problems that may arise in the future. Between $2 and $3 billion would be needed for SM-3 upgrades. SM-2 Block IV improvements to provide an anti-*Scud* coastal defense are estimated to cost between $50 and $100 million.

The panel also made specific recommendations regarding a space-based missile defense architecture including most importantly the establishment of a streamlined development initiative based on the late-1980s/early-1990s *Brilliant Pebbles* program and advanced technologies produced since then to demonstrate the feasibility of a constellation of space-based interceptors capable of interdiction in the boost, midcourse, and terminal phases. Such a capability would provide the most effective missile defense and the foundation for a global layered defense network.

IV. What are the key obstacles to space-based missile defense and how can they best be addressed and overcome?

The principal obstacles confronting space-based defense are political rather than technological. Neither do the questions facing space-based defense relate primarily to cost or schedule. Instead, the problem lies principally with the politics of missile defense. Polls suggest that there is broad public support for deployment of such systems. Many apparently believe that the United States has long had a deployed missile defense. Nevertheless, a small but vocal minority has so far succeeded in shaping the debate against space-based defense and against missile defense in general. Greater involvement in missile defense at the highest levels of the executive branch is thus necessary if we are to move ahead.

Compounding the problem is the fact that the technologies used in the space systems of the late 1980s and early 1990s now lag behind the state of the art as a result of political decisions taken more than a decade ago. A new space defense initiative thus will have to incorporate new technologies and "requalify" the integrated system. Among the primary political obstacles is the fact that the Bush administration has done little to revive those SDI technologies that produced the most effective, least expensive ways to defend the nation and our overseas military forces as well as friends and allies.

A closely associated political problem is the administration's focus on the Clinton legacy ground-based defense that was designed more to be consistent with ABM Treaty constraints than as an effective defense. When it is learned how limited this defense is – and that there is no alternative being pursued – Congress could likely cut missile defense funding significantly. The fact that we could have produced a viable layered system incorporating proven space-based *Brilliant Pebbles* technologies will be lost, known only by a shrinking number of technologists purged from the missile defense program since 1993.

V. Are there opportunities that can be seized to press forward with space-based missile defense?

As noted earlier, modifications to the sea-based system represent an incubator of sorts for space-based missile defense technologies. To exploit this opportunity the joint U.S.-Japanese fifty-three-centimeter-diameter SM-3 Block 2 system should be upgraded with the light-weight Advanced Technology Kill Vehicle (ATKV) developed for space-based applications over a decade ago as part of the *Brilliant Pebbles* program. This would allow the SM-3 Block 2 to achieve velocities of 7.5 kilometers per second which are much more advantageous for boost phase intercepts. Using that as a goal will push space-related technologies along indirectly, provided this action is accompanied by an insistence that the sea-based interceptor fits in the current VLS tubes. MDA accepts the fact that

7.5 kilometers per second is needed but is promoting a seventy-nine- to eighty-nine-centimeter-diameter interceptor that would require an expensive and time-consuming retrofit of the entire *Aegis* VLS infrastructure. Consequently, the Panel strongly recommends development of the ATKV/SM-3 Block 2 combination which eliminates the costly need for a larger missile and new VLS configuration to achieve a comparable capability.

American missile defense should become sufficiently robust to encompass both rogue state threats and the requirements for countering larger missile forces such as those of China. Although America faces no immediate threat from a resurgent Russia, the missile defense deployed by the United States should also possess the capacity to counter such threats if and when they emerge. A greater understanding of emerging ballistic missile capabilities around the world is necessary if U.S. missile defense architecture choices are to be adequate.

Finally, greater public awareness of past space-based missile defense research and development would help dispel the widely-held notion that such technologies are either unattainable or decades away. Such a review, undertaken by an independent commission outside the U.S. government, could also counter claims that a missile defense that includes space-based interceptors would be prohibitively expensive, for it would reveal the extent to which technological advances more than a decade ago could be revived and built upon to provide a missile defense for the twenty-first century.

VI. What are the implications of key issues raised in Panel II for other panels?

Brilliant Pebbles technology was developed with a sophisticated and evolving threat in mind. The review process in place at that time demanded capabilities to meet a large-scale Soviet threat. By contrast, the current GMD system was designed to confront only the most rudimentary threats, and therefore lacks many of the sophisticated elements developed to counter Soviet missiles. Prudence dictates that the ground-based system should, at minimum, be improved to account for the fact that advanced capabilities known to exist in the Soviet Union more than a decade ago may since have “leaked out” to rogue states. Moreover, advances in China and Russia over the past decade, both in new ICBMs such as mobile systems and countermeasures technology, could also become available to states hostile to the United States. It follows that future U.S. missile defense architectures will need to hedge against such developments.

Finally, too little attention has so far been paid to the possibility that more sophisticated threats to U.S. security could emerge, or are already emerging. The existing ground-based missile defense system will leave us ill-prepared to respond to such eventualities unless it becomes part of a layered missile defense with sea- and space-based intercept components.

3 section

Missile Defense and Space Relationships

American Security and the Geopolitics of Space

Access to a secure space environment is indispensable if the United States is to deploy a robust, layered missile defense. It is essential not only to assure that the United States will be able to use space for missile defense, but also to develop the means to protect other space-based assets and infrastructure. Space represents an arena of crucial importance to the United States both for commercial purposes and for national security. Just as it must maintain capabilities to defend its interests in the air, at sea, or on land, the United States needs to defend its space-based assets. At the same time we must deny the hostile use of space by our enemies. Just as land, the seas, and the air have been conflict arenas, space is changing how wars are fought, and where they will be fought.

This Section addresses the role of space in twenty-first-century U.S. national security strategy and its essential role in future missile defense. The Anti-Ballistic Missile (ABM) Treaty, as stated in Section 1, prohibited the United States from deploying space-based missile defense. With the end of the Treaty, the United States is legally able to build on space-based missile defense concepts that were demonstrated to be feasible more than a decade ago, including a constellation of small, advanced kill vehicles in space capable of destroying enemy ballistic missiles, particularly in the boost and mid-course phases of flight. Space offers unique opportunities for a global missile defense. The obstacles to space-based missile defense lie primarily in the political arena rather than in technological limitations. This Section sets forth principal political issues that must be addressed if the United States is to deploy a truly global missile defense that includes space-based interdiction capabilities.

Because it is more dependent than any other nation on space, the threat to and from space is greatest to the United States. Space systems such as those deployed by the United States have various vulnerabilities. They include strikes that could be mounted against ground stations, launch systems, or orbiting satellites. Our space systems are vulnerable to disruption or actual destruction, as well as to efforts on the part of an adversary to deny use of them. Such efforts could include interference with satellite systems, detonation of a nuclear weapon in space causing electromagnetic pulse (EMP) effects, or use of micro-satellites to attack our satellites. Just as control of the seas has been essential to the right of innocent passage for commerce, the ability of the United States to maintain assured access to space will depend on space control. Given the already extensive importance of space for commercial and military purposes, as well as its prospective role in missile defense, the United States must maintain control of space in the twenty-first century.

As noted in Section 1 of this report, the electromagnetic pulse effects of even a single nuclear weapon exploded at high altitude above or near the United States would disrupt the electrical power systems, electronics and information systems on which we vitally depend, producing catastrophic damage from which recovery would be protracted, painful, and potentially impossible. Space systems could be vulnerable to EMP effects resulting from one or more nuclear detonations at high altitudes.[1] Satellites in low-earth orbit are considered to be especially at risk from the collateral radiation effects resulting from an EMP attack. Commercial satellites are vitally important to support such governmental services as weather forecasting and communications, emergency response services, and military operations. The destruction or disabling of such satellites would have possibly catastrophic implications for homeland security and for the U.S. military. The ability to prevent an EMP attack being launched against

1 See the "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack, Volume 1: Executive Report," 2004, <http://empcreport.ida.org>.

such assets must become a national priority. Missile defense should form an essential part of a strategy to deter and interdict an EMP attack.

Although it is already extensively used for military purposes, the notion that space differs fundamentally from land, sea, or air with regard to the deployment of weapons has not only received a sympathetic hearing in some quarters but has also led to proposals and other efforts to restrict access to space. This includes the contention that the weaponization of space is, or should be, prohibited or drastically limited by international treaties.[2] The result can be seen in efforts – such as the Space Preservation Act, first introduced in the U.S. House of Representatives in 2001 and recently reintroduced in May 2005[3] – that, if enacted, would have the effect of prohibiting the United States from developing, producing, or deploying space-based weapons and their components and would pave the way for an international treaty impeding or preventing U.S. use of space for national security purposes, including missile defense – enacting once again prohibitions against space-based missile defense that were removed with the termination of the ABM Treaty.

It has been argued speciously that, since some space-based weapons could be used to attack targets in the atmosphere, at sea, or on the ground, they should be banned. Such reasoning, if it had been applied to maritime forces, would have excluded naval vessels with the ability, like space-based systems, to attack targets thousands of kilometers away. These naval systems include surface vessels and submarines armed with missiles and weapons of mass destruction (WMD) warheads. They have vast, over-the-horizon destructive capacity, just as space-based systems could destroy far distant targets. For example, directed energy weapons would be able to destroy targets either in space or on earth at great speeds.

However, whether directed energy weapons are offensive or defensive, like surface ships and submarines, depends on how they are used. Space-based directed energy missile defense systems, deployed to destroy ballistic missiles launched against the United States, cannot be deemed offensive systems. To argue otherwise is to equate those who would launch such an attack using missiles armed with WMD warheads with those who seek to defend themselves from such an attack. Equally absurd is the notion that the United States can, and should, take the lead in banning space-based systems and thus provide an example to the international community. Here the assumption is that the United States can establish global regimes that will strengthen or create international norms against the weaponization of space. The burden of proof that such an American approach would achieve its objectives is not supported by the history of conflict. The ability of states and other actors to utilize new geographical arenas, whether at sea, on land, or in the air, has led to conflict and competition based on available technologies in these diverse settings. At the same time, it is suggested that a decision by the United States to forego the deployment of space-based assets will lead to comparable restraint on the part of others. It may be equally plausible to suggest that such self abnegation by the United States will only encourage others to fill the resulting political vacuum. This debate is discussed in greater detail in the next two Sections of this report.

Moreover, the drive to restrict U.S. access to space, whether for missile defense or for broader missions, is fundamentally flawed not only because space has been used for military purposes for several decades but also because space has become an arena for conflict regardless of U.S. policy. It was Nazi Germany, not the United States, that was responsible for the initial transit through space represented by the V-2 rocket. The weaponization of space began in the closing months of World War II in

2 Several groups and organizations have proposed a variety of legal regimes and treaties that seek to block the "weaponization of space." For instance, in May 2003 the Pugwash Workshop on Preserving the Non-Weaponization of Space suggested several legal options, such as the passage of two UN General Assembly resolutions, the first endorsing a non-interference policy with all satellites currently in space, and the second prohibiting the testing of anti-satellite weapons (ASATs); a protocol to the 1967 Outer Space Treaty that explicitly bans non-weapons of mass destruction (WMD) space weapons (the Treaty currently prohibits the space deployment of WMD); and a separate, stand-alone treaty that would ban the development and deployment of space weapons. See the "Pugwash Workshop Report on Preserving the Non-Weaponization," 2003, <http://www.pugwash.org/reports/sc/may2003/space2003-report.htm>. Also, the Federation of American Scientists' (FAS) Panel on Weapons in Space called for an international treaty banning ASATs, and for research to determine the verification parameters (i.e. intrusive inspections on the ground, at launch sites, and potentially in orbit) of a workable space treaty. See the report entitled "Ensuring America's Space Security," September 2004, <http://www.fas.org/main/content.jsp?formAction=297&contentId=311>. It should be noted that the terms "militarization" and "weaponization" are distinct concepts, the first referring to preventing the use of space for "military purposes" and the second – a subcategory of the first – to preventing the basing in space of military weapons. In their report, the FAS Panel acknowledged that space has been "militarized" ever since the launching in 1957 of the *Sputnik*, since the satellites and whole orbital formations launched and fielded by both the United States and the Soviet Union since then can be described as "general-purpose military space systems" (see the section entitled Background: The Debate over Weaponizing Space within the FAS report). But the FAS Panel claims that space has not yet been "weaponized," since these systems are not intended to engage hostile targets, nor do they pose an offensive threat in or from space. However, as noted in this section, space has already been weaponized because it has been utilized in the transit of ballistic missiles, which fly a portion of their trajectory through space.

3 See The Space Preservation Act of 2005, <http://www.space4peace.org/articles/space preservation_2005.htm>.

Europe. German V-2 rockets passed through the edge of space en route to their targets. More than a decade later, in 1957, the Soviet Union, not the United States, launched the first orbiting satellite, *Sputnik*, ushering in a space age in which nearly all space platforms have some potential military use. Space-based satellites, critically important to U.S. national security in the twenty-first century, have civilian as well as military applications. Although the United States is at the forefront of space technology in the early twenty-first century, this clearly was not always the case, nor is it inevitable that such dominance will continue. Like the early V-2, today's ballistic missiles fly a part of their trajectory through space en route to their targets. Furthermore, both the Soviet Union and the United States tested anti-satellite (ASAT) systems as far back as the 1960s. Russia continues to operate ASAT systems initially deployed by the Soviet Union. As noted later in this Section, other countries are developing space programs to interdict U.S. space capabilities. In addition, technologies capable of destroying/disrupting U.S. space operations will increasingly be available to terrorist groups as well.

The United States must protect its critically important space systems, which are clear targets for future adversaries who will seek to eliminate the edge those assets give our forces on the ground, at sea, in the air, and in space. This asymmetric U.S. advantage is well known to even limited powers who confront U.S. interests, and they will inevitably strive to reduce that advantage if they seek to attack the United States – and today's technology makes that possibility a serious concern. Perpetuating the well known vulnerability of U.S. space assets is, therefore, an unacceptable security risk. The crucial importance of space was clearly highlighted in the early 1990s by the results of the first Gulf War – which then Air Force Chief of Staff General Merrill McPeak called the first "space war."[4] More recently, space-based assets, including communications and surveillance systems and sensors, again were essential to the rapid and decisive military victory in Iraq. Operation Iraqi Freedom would have been impossible to conduct with lightning speed and low casualties in the absence of space-based assets providing for unprecedented connectivity among internetted military systems.[5]

The overriding importance of space to our national security was underscored in January 2001 by the "Report of the Commission to Assess United States National Security Space Management and Organization" (the Space Commission) headed by Donald Rumsfeld. How the United States develops space for civil, commercial, defense, and intelligence uses will have profound implications for national security in the next several decades. The Commission emphasized that the United States has key national security interests in:

(1) promoting the peaceful use of space;
(2) using space to support U.S. domestic, economic, diplomatic, and national security objectives; and
(3) developing and deploying in space the means to deter and defend against hostile acts against U.S. space assets and against the use of space for activities hostile to U.S. interests.

Therefore, the United States should develop a national space policy designed to speed the transformation of the U.S. military into a force better able to deter and defend against a spectrum of evolving threats against the U.S. homeland and in space. Space is essential for the collection of intelligence for crisis management. The nexus between commercial and military uses of space is close. The U.S. government depends vitally on the commercial space sector to provide essential national security services. The growing importance of space for the United States makes space systems especially attractive targets to our enemies who may in the years ahead acquire the means to deny, disrupt, or destroy U.S. space systems. This could include attacks against our satellites in space as well as communications links to and from the ground. The Commission concluded that "the present extent of U.S. dependence on space, the rapid pace at which this dependence is increasing, and the vulnerabilities it creates, all demand that U.S. national security space interests be recognized as a top national security priority."[6]

Nevertheless, as the Space Commission warned, the United States is not developing the military space cadre that will be needed in the years ahead. Despite the growing national security importance of space, the United States is not putting adequate resources into military space programs. Many of the approximately one hundred U.S. national security satellites presently in orbit for military and surveillance operations are approaching obsolescence. Successor-generation models based on new and improved technologies have been delayed because they are over budget, behind schedule, and facing technical difficulties.

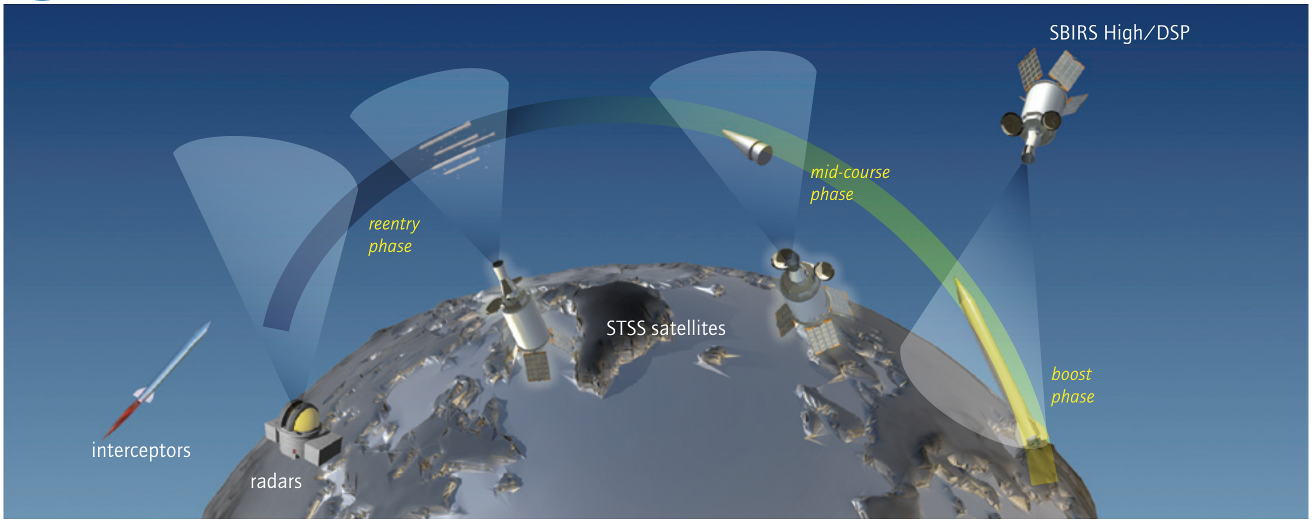
The Space-Based Infrared System (SBIRS)-High and the Space Tracking and Surveillance System (STSS) are two cases in point. While both are key parts of the missile defense system to be deployed by the United States, they have had to be restructured because of large cost overruns, schedule delays, and technical problems. For example, SBIRS-High, which will replace the current Defense Support Program (DSP) satellites and provide rapid early warning and ballistic missile trajecto-

4 Cited in Craig Covault, "Desert Storm Reinforces Military Space Directions," *Aviation Week & Space Technology*, April 8, 1991, 42. See also Robert L. Pfaltzgraff, Jr., and Richard H. Shultz, eds., *The Future of Air Power in the Aftermath of the Gulf War* (Montgomery, Alabama: Air University Press, 1993).

5 James W. Canan, "Iraq and the Space Factor," *Aerospace America Online*, August 2003, < http://www.aiaa.org/aerospace/Article.cfm?issuetocid=393&ArchiveIssueID=41>.

6 "Report of the Commission to Assess United States National Security Space Management and Organization," January 11, 2001, 19, <http://www.defenselink.mil/pubs/space20010111.pdf>.

Notional Configuration of STSS and SBIRS



ry data, is now projected to cost approximately $10 billion, well over twice the amount of earlier estimates.[7] Costs increases in excess of 25 percent during the last quarter of FY 2005 forced the Pentagon to recertify the program in December 2005. For FY 2007, DOD requested $669 million for the program. It was recently reported that the Air Force is currently exploring a potential alternative or early replacement for SBIRS-High.[8]

The STSS program, formally known as SBIRS-Low, will include up to thirty infrared satellites in low-earth orbit designed to detect and track missiles. In 1997 and 2001 reviews of the SBIRS-Low, the General Accounting Office (GAO) noted that the program was entering the product development phase with immature critical technologies and with an optimistic deployment schedule.[9] However, in March 2005, the GAO determined that four of the STSS program's five critical technologies are mature, and that it saw no evidence that the Missile Defense Agency (MDA) will be unable to launch two demonstration satellites in 2007.[10] MDA requested nearly $392 million for STSS for FY 2007, and the first fully developed satellite is expected to be launched in early 2012.[11]

Although the United States remains at the forefront of space technology and exploration, our continued preeminence is not assured. Other states are engaged in programs designed to enable them to become twenty-first-century space powers capable of challenging the United States. At least thirty-five countries have space research programs designed to augment existing space capabilities or lead to their first deployments in space. For example:

- India is currently developing a variety of satellites for uses ranging from navigation to reconnaissance, and planning an unmanned mission to the moon to showcase its scientific capabilities and position itself for future planetary missions.
- Japan has launched two surveillance satellites that mark its first military use of space.
- Russia plans to use its *Soyuz* rockets for commercial space launches by 2006.[12]

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7 *Space Acquisitions: Stronger Development Practices and Investment Planning Needed to Address Continuing Problems,* Statement of Robert E. Levin, Director, Acquisition and Source Management, U.S. Government Accountability Office, GAO-05-891T, July 2005, 2, 6. Air Force officials are currently exploring the potential for a new program to serve as an alternative to the SBIRS-High program.

8 See "USAF Ordered to Redirect FY-06 Dollars to Fund SBIRS Alternative," Inside Missile Defense, January 18, 2006; Michael Sirak, "Air Force Begins Search for SBIRS Alternative, Decision Planned by '08," Defense Daily, January 10, 2006; and Jefferson Morris, "Pentagon Certifies SBIRS High, Moves Forward with New Plan," Aerospace Daily & Defense Report, December 16, 2005, 1.

9 *Missile Defense: Alternate Approaches to Space Tracking and Surveillance System Need to be Considered*, U.S. General Accounting Office, GAO-03-597, May 2003, 6, <http://www.gao.gov/new.items/d03597.pdf>.

10 *Defense Acquisitions: Assessments of Selected Major Weapons Programs,* U.S. Government Accountability Office, GAO-05-301, March 2005, 109-110, <http://www.gao.gov/new.items/d05301.pdf>; *Defense Acquisitions: Status of Ballistic Missile Defense Program in 2004*, U.S. Government Accountability Office, GAO-05-243, March 2005, 108, <http://www.gao.gov/new.items/d05243.pdf>.

11 *Missile Defense Agency Fiscal Year 2007 (FY07) Budget Estimate*, February 2006, 20, 24, <http://www.cdi.org/pdfs/Final%20Budget%20Overview%20FY%202007%20MDA.pdf>.

12 As a result of its participation in the International Space Station, Russia's space program gained new importance following the February 1, 2003 disaster of the U.S. space shuttle *Columbia*

- The countries of the European Union have entered into a collaborative agreement with the European Space Agency to build a satellite navigation network, called *Galileo*, that – with possible participation from China and other countries – has the potential to rival the U.S. global positioning system. *Galileo* is scheduled for deployment before the end of the decade.
- With the help of the Russian military, Iran will place two spy satellites, the *Mesbah* and the *Sinah-1*, in geostationary orbit, which could potentially provide Iran with strategic intelligence that could be used in a future attack against Israel.[13] In January 2005 Iran and Russia signed a $132-million deal for Russia to manufacture and launch a telecom satellite, the *Zohreh*, within the next two years.[14]

As these examples suggest, knowledge about space systems, including the means to counter them, is becoming more widely available on a global basis. Therefore, the ability to disrupt U.S. space systems is growing.

Whether or not the United States moves forward in space, other countries will do so. For now, China is developing or acquiring technologies for space-based military purposes in order to leapfrog the present U.S. technological dominance of space. This includes microsatellites (weighing less than 100 kilograms) for remote sensing and for networks of electro-optical and radar satellites, and it has shown interest in electronic/signals intelligence reconnaissance satellites.[15] China hopes to have in excess of 100 satellites in orbit by 2010, and to have launched an additional 100 satellites by 2020. In another example of its burgeoning space capabilities, China launched its first manned spacecraft into orbit in October 2003 and a second manned flight in October 2005.[16] Furthermore, it hopes to conduct space walks and docking missions with a space module by 2010, and to have a full space station by 2020.[17] Even as it attempts to restrict U.S. efforts, Beijing maintains an obvious strategy designed to make China a twenty-first-century space power.

China is also reported to be researching anti-satellite weapons, such as a ground-based laser capable of damaging and destroying satellites.[18] This capability could paralyze U.S. civilian and military space systems that are crucially important for a variety of commercial and national security purposes. The loss of space-based satellites would have a dramatic effect on communications, whether for business or pleasure or for military purposes. Wireless telephones, pagers, and electronic mail would be disrupted. In addition, satellites that provide automated reconnaissance and mapping, aid weather prediction, track fleet and troop movements, give accurate positions of U.S. and enemy forces, and guide missiles and pilotless planes to their targets during military operations would have their services curtailed or terminated. In short, our commercial, intelligence, and military satellites, vital to twenty-first century national security, could themselves become the object of attack. As the Rumsfeld Space Commission pointed out: "[i]f the U.S. offers an inviting target, it may well pay the price of attack… The United States is an attractive candidate for a 'Space Pearl Harbor.'"[19]

America's growing dependence on space-based assets increases the possibility that it will be attacked in space. If it is to remain a space power, the United States must be able of not only detecting and deterring such an attack (i.e. situational awareness, a capability that does not presently exist in most U.S. space assets) but also possessing the means of defending against an attack, identifying the source, and quickly recovering and reconstituting vital assets. This means that the United States must be able quickly to replace those disabled or destroyed space-based assets that it cannot easily defend.

For many nations, the opportunity to acquire space weapons is growing as technologies become available on a global basis. Several countries already have ongoing space programs designed to provide a high-leverage response to U.S. military power. Their incentives to deploy space weapons are extensive; such capabilities could threaten present and future U.S. dominance, both in space and in the terrestrial arena. Space-based weapons in the hands of hostile states constitute an asymmetric capability designed to undermine U.S. strengths, including not only American maritime power projection assets, but also vital space-based sensors and communications satellites. Unless the United States chooses to abandon its superpower status, continued access to space as well as a growing U.S. presence in space, based on advancing technologies, will remain indispensable to national security.

The ability to threaten the United States in space will only grow in the years ahead. Small nations, as well as groups or even individuals, are increasingly able to acquire technologies and knowledge that could disrupt or destroy space systems and ground facilities. The United States could be surprised by the speed with which such capabilities are acquired by our enemies. Such adversaries, especially if they are rogue states

and the subsequent grounding of the U.S. shuttle fleet.

13 Leslie Susser, "Iranian Spy Satellites Worry Israel," *The Jerusalem Post,* March 7, 2005, p. 6

14 "Iran, Russia Sign 'Zohreh' Satellite Deal," *GlobalSecurity.org*, January 31, 2005, <http://www.globalsecurity.org/space/library/news/2005/space-050131-irna03.htm>.

15 Ibid., 35.

16 "Report: China Hopes to Launch Second Manned Space Mission in October," The Associated Press*,* July 15, 2005.

17 "Annual Report on the Military Power of the People's Republic of China," U.S. Department of Defense, 2005, www.defenselink.mil/news/Jul2005/d20050719china.pdf, 36.

18 Ibid., 36.

19 "Report of the Commission to Assess United States National Security Space Management and Organization," 23.

or terrorist groups, are unlikely to be bound by international agreements or global norms against the weaponization of space.

International Law and Space Geopolitics

Nearly two generations ago, as the United States and other nations recognized that space was becoming an important arena for national security, an effort was made to regulate the utilization of space for military purposes in the form of the Outer Space Treaty.[20] This treaty contains several provisions directly related to military activities and weapons in outer space – none of which, however, would preclude the United States from deploying space-based missile defense.[21] Specifically, the parties agreed not to place in earth orbit any object carrying nuclear weapons or other types of WMD, and not to install such weapons on celestial bodies or station them in outer space. The treaty further prohibits the establishment of bases, installations, and fortifications, the testing of weapons, and the conduct of military maneuvers on the moon or other celestial bodies. However, because the Treaty does not place prohibitions on the use of space for the transiting of ballistic missiles that fly part of their trajectory through space, it follows that the Treaty does not prohibit the United States from building a space-based defense against ballistic missiles. Likewise, there is nothing to suggest that the United States would be prevented by the Outer Space Treaty or by customary international law from defending itself on earth or in space so long as these activities fall within its inherent and longstanding right of self-defense. As laid out in a 1985 report by the UN Secretary General, "military activities which are consistent with the principles of international law embodied in the Charter of the United Nations, in particular with Article 2, paragraph 4, and Article 51 [the right of individual and collective defense] are not prohibited by the Convention on the Law of the Sea."[22]

The preamble to the Outer Space Treaty refers to "use of outer space for peaceful purposes." This has been widely interpreted to mean that defensive, as opposed to aggressive, activities are permitted. "Peaceful purposes" refers to "nonaggressive activities" undertaken in compliance with the United Nations Charter, which clearly emphasizes the inherent right of nations to provide for their self-defense and is so noted in the Outer Space Treaty itself. To assert otherwise – that the term "peaceful purposes" bans defensive systems such as space-based missile defense – would be analogous to banning military vessels from the high seas based on the same principle. Article 88 of the United Nations Convention on the Law of the Sea, however, states that "the high seas shall be reserved for peaceful purposes." This may include the deployment of armed vessels whose purpose is not the conduct of aggressive warfare but for defensive purposes. As one of the most widely accepted international agreements, this Treaty does not prohibit navies from operating on the world's oceans.

Equally important, the Treaty does *not* prohibit the testing, development or deployment of space-based missile defenses because such systems do not constitute weapons of mass destruction. In fact, they are the opposite: systems to provide defense *against* weapons of mass destruction. Instead, it was the ABM Treaty that constituted the specific legal mechanism prohibiting space-based missile defense. In turn, the withdrawal of the United States from the ABM Treaty removed any legal obstacle to building a missile defense that includes space-based elements.

Next Steps toward Space-based Defense

In the post-ABM Treaty era, the United States can and should take several steps to assure its continued military and commercial access to space, including the deployment of space-based missile defense interceptors. While reaffirming the "peaceful uses of space" requirement set forth in the Outer Space Treaty, the United States should reject efforts to counter our present advantages in space by agreements that would further restrict the use of space. These include periodic proposals from countries such as Russia and China intended to prohibit the use of space for missile defense.[23]

Furthermore, the United States should reject bilateral efforts that would have the tangential effect of restricting American space activities. One example, highlighted by the Space Commission, is the December 2000 Pre- and Post-Launch Notification System (PLNS) accord signed by the United States

20 The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 610 UNTS 205, entered into force October 10, 1967.

21 For a detailed discussion of the legal arguments that have been advanced against defense of U.S space-based assets, as well as a critique of such arguments, see Robert F. Turner, "International and National Security Law: The Campaign to 'De-Weaponize' Space: Why America Needs to Defend our Space Assets and our Right to Deploy a Space-Based ABM System," *Engage,* Volume 5, Issue 1, April 2004. Included as Appendix E.

22 See the "Report of the Secretary General," (A/40/535), para. 188, 40, U.S. Government Accountability Office, annexes, agenda item 68 (b) (1985, mimeo).

23 These include a January 2003 "strategic stability" agreement put forth by the Russian foreign ministry and a bilateral "framework" on military-technical cooperation under discussion in the summer of 2003, as well as repeated joint calls by both Moscow and Beijing for a comprehensive international ban on the deployment of weapons in space – an effort aimed at preventing the deployment of space-based interceptors and other anti-ballistic missile technologies designed to protect the United States from ballistic missile attack. See RIA Novosti, January 20, 2003; Interfax, July 16, 2003; and Reuters, July 31, 2003.

and Russia.[24] Its entirely legitimate purpose is to minimize the consequences of a false missile attack warning by requiring at least a twenty-four-hour advance notice of a planned missile launch. This agreement, however, should not be expanded to an interpretation that regulates space launches to such an extent that it is applied to systems now being designed to provide "better, faster, cheaper" access to space.

Both for missile defense and for space more generally, the United States will need to make major new investments in the years ahead. As the Space Commission concluded, since the 1980s there has been a dramatic decrease in the aerospace sector's share of the total national R&D investment, shrinking from 20 percent to less than 8 percent. Compounding this decline, U.S. companies are investing more heavily in efforts to win modernization contracts based on existing technologies, rather than investing in "leap ahead" technologies that would dramatically transform our space program. A concerted effort is needed to assure that the U.S. space industry can produce systems at least one generation ahead of its international competitors.

For example, if the United States is to remain dominant in space, new approaches that reduce the cost of building and launching space systems by emphasizing the miniaturization of those systems must be found. New sensors capable of detecting and tracking smaller, moving, and concealed targets, together with advanced surveillance and defensive and offensive technologies for space control and information operations, will be needed. Although the ABM Treaty has ceased to exist, the United States has yet to revive the research and development (R&D) programs of the Reagan and George H. W. Bush administrations that will be needed for a multi-tiered missile defense that includes space. In recent years, funding for boost-phase intercept space-defense programs has been only a miniscule portion of the total missile defense budget. The funding sought by the George W. Bush administration, extremely limited to begin with, has been further reduced by the Congress.[25] The result is a major shortfall in the R&D needed to sustain space-based missile defense and other aspects of the U.S. space presence.

As will be discussed in greater detail in Section 6, a global missile defense should be open to other countries predicated on the assumption that space, like the high seas, represents an arena for common security. The United States should reaffirm the recognition contained in the Outer Space Treaty that there is a common interest in the use of outer space for peaceful purposes – with missile defense representing one of these peaceful purposes.

Indeed, far from producing a costly and deadly arms race, the deployment of a robust, global, space-based missile defense is likely to make it more expensive, and therefore less attractive, for other states to build missiles or to engage in regional arms races based on the deployment of missiles. There is no empirical or historical basis for the contention that such an effort will lead other states to step up their missile-related programs, leading to an escalating race to deploy missiles designed to overcome whatever missile defense is deployed by the United States. In fact, following the ABM Treaty in the 1970s, the Soviet Union nevertheless deployed large numbers of advanced missile systems, negating the logic that the ABM Treaty reduced the incentive or need to deploy new generations of missiles designed to defeat deployed missile defenses. The ABM Treaty codified a strategic relationship of mutual vulnerability in which the Soviet Union nevertheless built large numbers of additional intercontinental ballistic missiles and nuclear warheads whose purpose was to increase U.S., not *mutual*, vulnerability – and to assure that, in the event of nuclear war, the Soviet Union would have had strategic superiority.

Contrary to the assertions of many of its proponents, the lesson of the ABM Treaty is that in the *absence* of a U.S. missile defense capability, other states have been developing missile programs without having to take into account an American defense. This has provided an array of competitors with a relatively cheap option of developing even primitive missiles in order to acquire an asymmetrical advantage over the United States.

The thirty-year experience of the ABM Treaty, together with other efforts to restrict weapons proliferation and deployment by international agreement, does not lend credence to efforts now underway to impose new international legal prohibitions against space-based missile defense. If past experience is any

24 *Memorandum of Understanding on Notifications of Missile Launches*, U.S. Department of State, December 16, 2000, <http://www.state.gov/t/ac/trt/4954.htm>.

25 For FY 2006, MDA requested nearly $230 million for the Kinetic Energy Interceptor (KEI) project (whose technologies would have application for a space-based interceptor), and it ultimately received $216 million from Congress. In 2005, Congress trimmed MDA's budget request for the KEI program due to concerns over the land- and sea-basing plans for the interceptor. Furthermore, the program's space-based component, designed for research and concept work for an exo-atmospheric interceptor missile, will not receive funds until FY 2008. In its 2007 budget request, MDA is seeking $386 million for FY 2007, $400 million for FY 2008, $852 million for FY 2009, $1.15 billion for FY 2010 and $1.65 billion for FY 2011. In addition, In the 2006 budget, MDA requested $673 million between fiscal years 2008 and 2011 for designing, developing and testing a space test bed, with the goal of fielding a system of spaced-based kinetic energy interceptors housed within 50 to 100 satellites. However, it has been reported that MDA has reduced FY 2007 funding for the space-based interceptor test bed by $312 million. The project now appears that it will be delayed for an unspecified amount of time. See Marc Selinger, "Major Missile Defense Agency Programs Dodge Budget Bullets," *Aerospace Daily & Defense Report*, November 10, 2005, 1.

indicator, such efforts are more likely to place onerous restrictions on the United States, as happened with the ABM Treaty, than to provide universally-accepted norms to govern the peaceful use of space. Furthermore, access to space, as well as space control, is key to future U.S. efforts to provide disincentives to states and terrorist organizations seeking WMD and their delivery systems. As such, space control is crucial to U.S. national security in the twenty-first century, together with space-based missile defense.

Historically, leading powers have been superseded by aspirant nations. The major geopolitical options that become available have been exploited by one nation or another, by some, but not by others. Those nations that are most successful in recognizing and acting on such options have become the dominant powers of the age. Others who have failed or have consciously decided not to do so have been relegated to inferior political status. A salient case-in-point is ocean navigation and exploration. The Chinese were the first to become preeminent in this retrospectively pivotal area during the early Ming dynasty. Almost a century before Columbus sailed to the Americas, the Chinese made a total of seven voyages as far as the east coast of Africa.[26] However, this lead was allowed to be dissipated, with historic consequences for China still felt half a millennium later. The subsequent assumption by Portugal of this leading maritime role, followed by Spain, resulted in geopolitical preeminence that was eventually lost to other European powers, including Great Britain.

In the twenty-first-century maintenance of its present lead in space is indeed pivotal to the geopolitical, military, and economic status of the United States. Consolidation of the preeminent U.S. position in space akin to Great Britain's dominance of the oceans in the nineteenth century is not an option, but rather a necessity for the United States, for if not the United States, some other nation, or nations, will aspire to this role, as several others already do. For the United States space is a crucially important twenty-first-century geopolitical setting that includes a global missile defense.

We turn next to the political setting that has shaped the domestic debate in the United States about missile defense.

26 For a recent account of China's maritime exploration, see Frank Viviano, "China's Great Armada," *National Geographic*, July 2005, 24-46. "All of the ships of Columbus and da Gama combined could have been stored on a single deck of a single vessel in the fleet…". According to some maritime experts, " the Chinese ships may have been up to 400 feet in length and 170 feet across the beam, with nine masts and a displacement of at least 3,000 tons, ten times the size of Vasco da Gama's flagship.", 35.

Panel 3 Report

With the Cornerstone Paper entitled *Missile Defense and Space Relationships* as background, Panel 3 discussed space-related missile defense issues.

Panel Members
Chair: Dr. Robert Jastrow
Dr. Gregory Canavan
Mr. Jeff Kueter
Dr. Robert F. Turner
Dr. Lowell Wood

I. What are the implications of the key issues raised in the Cornerstone Paper for missile defense, and specifically for space-based missile defense, as we look beyond 2005?
There is a continued need to raise awareness of the primacy of space, not only as the most effective option for missile defense, but also for its critical role in other aspects of U.S. defense operations. Space must be recognized as a vital and central component of overall U.S national security. Commentators, politicians, and even some in the military too often view space as a desirable addition to existing weapons systems, but fail to sufficiently appreciate either its current or likely future contributions.

The U.S. has exploited primacy in space to great effect through the use of communications, reconnaissance, surveillance, navigation, and weather satellites. These capabilities, when combined with conventional superiority, have been demonstrated with great effect in recent military campaigns. Yet, highlighting the importance of these systems in the successful projection of U.S. power also makes them an attractive target for offensive action by hostile powers.

Given its reliance on these systems, an offensive strike against U.S. space assets can be expected to exact a disproportionate price on U.S. forces. Furthermore, two other related facts render this a particularly acute situation. First, the source of an attack on U.S. space assets may not be readily identifiable, as most U.S. space systems lack the capacity for situational awareness of their immediate environments. Assigning blame for the purposes of retaliation, diplomatic or otherwise, may therefore be exceedingly difficult. Second, the weakening of the nation's aerospace infrastructure, diminished space launch resources, and a waning capacity for innovation make it exceedingly unlikely that these capabilities could be reconstituted quickly.

II. What are the implications of the key issues raised in the Cornerstone Paper for overall U.S. national security?
Space – and the threats to, and vulnerabilities of, U.S. space assets – remains of the utmost significance to U.S. national security. The American public, however, has so far been misinformed about the role space plays in safeguarding the United States and its interests, either because it has not been made aware of the potential threats or because it operates under the assumption that the U.S. government has programs in place to defend against those threats. Improving the level of public dialogue would help correct this situation, as would a comprehensive strategy designed to alter public perceptions on these issues.

Furthermore, the threats to U.S. space assets from China and other actors highlight the need for space control. In particular, if the Chinese pose an increasing threat to satellites supporting U.S. forces in the Pacific, then that capability, together with China's efforts to improve its long-range nuclear armed ballistic missiles, could threaten U.S. strategic capabilities significantly impeding our ability to protect national security interests in the Pacific.[1] Hence, the capacity of the United States to protect its space assets is a matter of great strategic importance.

III. What steps need to be taken in light of these issues to achieve space-based missile defense, both immediate and longer-term?
Several steps dealing with both space control and missile defense can immediately be undertaken by the United States. The first is to identify systems that could improve situational

1 China is reported to be researching anti-satellite weapons, such as a ground-based laser capable of damaging and destroying satellites. This capability could paralyze U.S. civilian and military space systems that are crucially important for a variety of commercial and national security purposes.

awareness in space. These capabilities do not presently exist in most U.S. space assets which were deployed at a time when such requirements were perceived as unnecessary. Such capabilities are being embedded in new systems, but the timescale to turn over the current asset base is decades long. Additionally, upgrades of existing systems with situational awareness may prove difficult, if not impossible. A complete analysis of the options to improve situational awareness, including the possibility of placing them on the next generation early warning and tracking satellites (i.e., Space-Based Infrared System-High and Space Tracking and Surveillance System), is necessary.

Secondly, the United States should avoid legal regimes that may curtail its ability to act in space, or which would cordon off space as a unique environment. Legislation, such as the Space Preservation Act, introduced in the U.S. House of Representatives in 2001 and again in May 2005, that pursues such ends should accordingly be opposed. Space control and missile defense advocates additionally should publicize the arguments and rationale against such legislation in order to generate backing for governmental decisions and counter the actions of think tanks and academics opposed to a U.S. missile defense capability. If the Missile Defense Agency is not prepared to support a space-based initiative, then such a program should be located elsewhere, perhaps in the Defense Advanced Research Projects Agency.

Third, the Missile Defense Agency should fully exploit its proposed space test-bed. Given MDA's retreat from space-based defense, this initiative remains the only viable space program in the MDA portfolio, and holds the potential to provide assets to link both the missile defense and space control missions. However, reports indicate that MDA has reduced FY 2007 funding for the space-based interceptor test bed by $312 million. The project now appears that it will be delayed for an unspecified amount of time.[2]

Finally, a campaign to educate the public about the increasing threats to U.S. space assets would greatly facilitate changing the political landscape. Steadfast leadership represents a major factor in the success of such an effort, but the required level of commitment is not in place. Clearly, what is needed is a sustained, focused, and effective government–private sector public relations program that underscores the applicability Strategic Defense Imitative-era technologies not only to viable space- and sea-based missile defenses but also to the space control mission.

IV. What are the key obstacles to space-based missile defense and how can they best be addressed and overcome?

Two principal obstacles must be overcome in the pursuit of space-based missile defense. The first is the argument that either the deployment of a missile defense in space or explicit recognition of space control would prove destabilizing. The second is the perception that space assets are an additive, rather than central, feature of U.S. conventional (and strategic) military power. Overcoming both requires altering public perceptions and refuting those who advance such claims.

V. Are there opportunities that can be seized to press forward with space-based missile defense?

The panel felt that the release of the *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack*[3] and a related Central Intelligence Agency (CIA) National Intelligence Estimate provided opportunities for raising awareness of the threats to the United States in space. These documents offer a pessimistic depiction of the U.S. situation in space. Further, they validate the assertion by the Rumsfeld Commission that the United States can expect to have little to no early warning of threats before they materialize. More recently, greater attention to space control concerns appears to be emerging within the Air Force. However, the actual level of U.S. commitment to this principle is unlikely to be known until the Bush administration releases the new "National Space Policy."[4]

VI. What are the implications of key issues raised in Panel III for other panels?

There is a clear case for a robust program to develop space systems for the missile defense and space control missions. It is also obvious that overcoming longstanding political obstacles is essential to establishing such programs. In particular, a public affairs agenda to educate U.S. citizens and their representatives regarding the essential role of space to our national security and economic interests is required. This should emphasize that the proliferation of advanced technologies are providing potential adversaries, including rogue states and terrorists, with a capability to threaten our space systems (e.g., via an EMP attack), and that the United States needs a focused program to assure the ongoing viability of those systems as well as the capability to reconstitute them. Since such a program will employ technology that is common to the space control and missile defense missions, both these efforts should be pursued in a coordinated fashion.

2 See Marc Selinger, "Major Missile Defense Agency Programs Dodge Budget Bullets," Aerospace Daily & Defense Report, November 10, 2005, 1.

3 See the *Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack,* Volume 1: Executive Report 2004, <http://empcreport.ida.org>.

4 The Air Force has sought Presidential approval of a national security directive to support the fielding of offensive and defensive weapons in space, and has already made progress toward that end. In April 2005, the Air Force launched the XSS-11 microsatellite, which can disrupt other nations' communications, and has been developing a new strategy known as Global Strike that includes a military space aircraft equipped with precision-guided weapons able to hit targets "halfway around the world in forty-five minutes." Tim Weiner, "Air Force Seeks Bush's Approval For Space Weapons Programs," *New York Times*, May 18, 2005.

section 4

The Politics Against Missile Defense: Historical Analysis

What are the political arguments that currently impede unfettered missile defense development and how should they be refuted? In addressing these questions, several observations need to be made.

To begin with, the nature of political opposition that has ranged against missile defense over the years has been unique. One is hard pressed to think of anything in the history of American defense development that – even remotely – has been more upset and turned on its head by the dominance of political considerations at the expense of technical considerations.[1]

There have always been questions about what constitutes a "good" defense and how much we should pay for it and whether it is really necessary; questions continuously raised as part of our political tradition. But most always, technical reasons, rather than political reasons, have been at the base of such questions, which then in turn drive the political debate and decisions to deploy or not deploy or to build or not build.

In the case of providing an effective missile defense for the American population, it has been essentially the reverse: political considerations by and large have driven technical behavior that far too often has been designed to achieve certain predetermined political ends, in which the goal of developing the most technically sound and cost-effective missile defense is subordinated to other interests.

In military, defense, and space-related matters particularly, straight-line logic is essential to the efficient application of technology to their materiel. One does not design a portable bridge to carry tanks with political dictates as the guiding force; rather the straight-line logic of disciplined technology determines the bridge's utility. Otherwise, the bridge is likely to fall down. So technical considerations come first to build a good bridge; political considerations come later, i.e. how to use the bridge but not how to make it.

This is probably one of the most widely understood concepts in the American culture, which has led the world in applying technological innovation to the making of things: If it isn't built right, it won't work properly or it falls apart. Everyone who has built a fence, bought a car, flown in a jet, or followed a space shuttle flight understands this as part of a natural logic flow – often referred to as common sense.

Not so well understood is how politics can interdict the straight-line logic of technology to determine different ends in public policymaking. The generally accepted rule of logic – and public expectations – is that political considerations in major settings should drive technology toward achieving better use of itself. However, there are times when political considerations drive technology away from achieving better use of itself which can lead to distorted outcomes, some Orwellian in nature. These opposing circumstances can be expressed in the following propositions:

There are two landmark examples that epitomize these propositions: one is the Lunar Landing Program; the other is *Brilliant Pebbles* (BP). While a generation separates their beginnings, the impetus for each came from the same source – the Cold War. President Kennedy launched one; President Reagan authorized the other. However, the political dynamics were quite different, as were the outcomes.

Proposition A – The Lunar Landing Program

The Lunar Landing Program began in May 1961 with Kennedy's daring declaration before a joint session of Congress to land a man on the moon before the end of the decade. With the possible exception of the Manhattan Project, technology had never been so brutally challenged. The world's first satellite, *Sputnik*, launched in 1957 and visible to nearly every

1 In this discussion, the term "technical" includes sound science and factors governing purpose, performance, cost-effectiveness, feasibility, and timelines.

Proposition A

Technological Considerations [Means] *Justify* Political Considerations [Ends] → Unfettered Outcome

Proposition B

Political Considerations [Ends] *Justify* Technological Considerations [Means] → Distorted Outcome

backyard in America, had flashed a warning that awakened the nation to its vulnerabilities to the Soviet race into space and its nuclear intercontinental ballistic missile (ICBM) development efforts.

By 1961 competition with the Union of Soviet Socialist Republics (USSR) had become vital to U.S. geopolitical interests. In April, Soviet cosmonaut Yuri Gagarin pulled ahead as the first to orbit the Earth. In May, astronaut Alan Shepard followed with the first U.S. suborbital flight, which was wildly celebrated by the American public. Kennedy took heed and responded three weeks later with his challenge, a stunningly bold move to put the nation ahead in space via the moon.

Thus, the political dynamics were in place to drive technology toward a maximum outcome, i.e. taking a supportive role by letting technology determine the outcome. The now two-year-old National Aeronautics and Space Administration (NASA) took the charge with straight-line logic: how to get from here to there and back as efficiently and safely as possible.

To achieve this, the *Mercury* missions were given new challenges, with *Gemini* following to pioneer new achievements as the bridge to the *Apollo* moon program. Each phase contributed synergistically to the other components also being worked on, so that the sum of the whole (the lunar landing mission) at any given time was greater than its parts.

Spacecraft designs begat new spacecraft designs; guidance systems begat new guidance systems; living one day in space begat 14 days; and on and on into a myriad of thousands of components of human intellect and endeavor, and materiel designs and functions that were all pointed to one declared mission.

There were tragic deaths, other dangerous moments, and discouraging failures along the way. There were also hundreds of useful spin-offs which helped to give the United States its commanding lead in technology. But the mission point was never lost and scores of heroes abounded, as on July 20, 1969 – eight years after Kennedy's challenge – the *Eagle* landed at Tranquility Base.

Of singular significance to this discussion is that throughout the Lunar Landing Program, each component and phase had its own place in the continuity and integrity of the *overall* mission. Remove one component and the entire mission would fail. Therefore, the Program could not be arbitrarily cut in half or more in a Solomon-like gesture and still be expected to succeed. The significance is that the same applied to *Brilliant Pebbles*; it was cut and it died.[2]

Proposition B – *Brilliant Pebbles*

If one were to hand pen and paper to a couple of intelligent laypersons and ask them to line out the requirements for defense against an intercontinental ballistic missile, they likely would first determine the nature of the problem: to deal with a missile (ICBM) fired from somewhere perhaps 8,000-13,000 kilometers away that angles up into space (in about four-six minutes) then arcs through space (for maybe fifteen to twenty minutes) then heads more or less straight down for another sixty seconds to hit the target (you) just like a bullet (which is why they call it "ballistic").

The laypersons would certainly make a rough sketch of this action, showing an extended arc from launch to impact and noting the arc had three natural segments: missile rising over its own territory, missile in space probably over someone else's territory, and missile descending over *your* territory. A helpful tutor would supply the eminently logical technical terms: boost, midcourse, and terminal. And then the questions would be put: How would you go about it? The lay reply likely would be to "shoot the thing down as far away from us as you can."

That essentially was the straight-line logic which as early as 1960 persuaded the Department of Defense's Advanced Research Projects Agency (DARPA) in its review of missile defense technologies, called *Project Defender*, to state: "A ballistic missile is more vulnerable in its propulsion or boost phase than any subsequent part of its trajectory... These circumstances immediately suggest an early intercept system as an ideal solution to the defense problem... So far, the only promising defense system concept has been a space based or satellite borne interceptor... Such a system requires many thousands of interceptors in space... The economic feasibili-

2 For a succinct but well-prepared historic overview of the lunar mission, see Andrew Chaikin, "Greatest Space Events of the 20th Century: The 60s," *Space and Science*, December 27, 1999, <www.space.com/news/spacehistory/greatest_space_events_1960s.html>. This document is in Appendix F.

ty of such systems is heavily dependent upon equipment reliability and upon enemy countermeasures."[3]

Thus, nearly a year before Kennedy issued the lunar challenge, DARPA's highly technical, multi-volume *Project Defender Review* laid out fundamental guideposts to point the way for the development of effective defense systems in which each must consist of three basic components: sensors to detect and track missiles and their warheads; weapons to intercept and destroy missiles and warheads; and battle management systems to integrate sensors and weapons into a coherent system. *Project Defender* favored hit-to-kill (HTK) interceptors or kinetic kill vehicles (KKV).

Since the kill vehicle can only hit what it sees, the higher the "eyes" (sensors) above the horizon the better – and the view from space gives an optimum perspective. Likewise for the kill vehicle; space basing provides the greatest flexibility (agility) for moving quickly in a 360° field to strike a missile with a good chance of destroying it in the boost phase or, if not, early enough in its midcourse to hit it before it can deploy independently targeted warheads (MIRVs) should it be carrying them – with land-or-sea-based systems used as a "last resort," should boost and midcourse defenses fail (hence the term, "layered defense").

Project Defender's work, in significant part, recognized that the centerpiece of an effective missile defense should be space-based systems to "look down" upon a hemisphere horizon to provide maximum "reach" away from American cities, and in so doing to buy as much time as possible to strike down an incoming missile – provided that they could be proved out; and as an equally important corollary, space-based systems could provide operational components to aid in the development of the more regional land-and-sea-based systems for theater or terminal defense.

While politics were urging technology to extend itself unfettered in the Lunar Landing Program, no such thing was occurring in missile defense. Political considerations were moving quickly in the other direction. As described in the Introduction, Mutual Assured Destruction (MAD) had become the focal point of a sustained and consistently well-organized push that was to drive the United States into an agreement with the Soviet Union to hold all American cities hostage to an ever-growing number of Soviet missiles even as the Soviets were to hold their cities hostage – the "Balance of Terror." The Anti-Ballistic Missile (ABM) Treaty, as an enabler of MAD, would forbid the defense of the American population.

Thus, *Project Defender* and its findings became an orphan in the world of high-stakes space technology. No one wanted it. But it was the impetus for *Brilliant Pebbles*, because here and there, quietly within the labs and tech centers of government, bits and pieces of what *Project Defender* had looked at were looked at some more, though only under strict political rules not to violate Treaty provisions, especially concerning space systems. There could be few synergisms in these efforts and no pointed, declared mission to work toward, so that the sum of the whole was far less than its parts.

By 1982, the political climate began to shift away from the comfortable notion that the nation was better off to defend itself by keeping itself naked and defenseless from missile attack – instead, relying on our offensive weapons to keep the Soviets in line. Except, things were not looking all that good. The high hopes of arms control with the Soviets were at best a mixed bag, particularly with the continuing buildup by the USSR of huge arsenals of ICBMs, most targeted on the United States. Other countries, China among them, were developing missile technology, so that the term "proliferation" had become part of the geostrategic vocabulary.

More and more policymakers and experts in geopolitics and strategic weapons were now expressing public concerns about America's growing vulnerabilities. One among them was Lt. General Daniel O. Graham, USAF, who, following his retirement as long-time head of the Defense Intelligence Agency, produced some of the first authoritative "laymen-oriented" reports advocating missile defense, which sparked considerable public attention, including oftentimes heated denunciations by long-established idealistic arms control and peace groups, as well as pacifists from the scientific and religious communities. But at least missile defense was becoming a visible issue now out of the closet.[4]

Another among them was Ronald Reagan, who as early as 1968 while Governor of California, stated: "He (a governor) also has a role to play when national decisions affect his state... (and) surely has the duty to speak up... He might well participate in the discussion about an anti-missile defense system, or he might advocate a crash program aimed at advances in that field. The argument has been advanced, by ex-Secretary McNamara and others, that the stability of the world is enhanced if the two super-powers are able to hold one another's civilian population as hostages, and that to protect our own

3 Harold N. Beveridge, "Defender Introduction," *Ballistic Missile Defense Program of the Advanced Research Projects Agency, A Review of Project Defender for the Director of Defense Research and Engineering,* Vol. 1, July 25-29, 1960, 8-9.

4 In 1981, the late General Graham, under the sponsorship of the Heritage Foundation, created "High Frontier" to educate the public-at-large on the need for and feasibility of missile defense. High Frontier became a free-standing organization in 1982. Other independent think tanks and research centers were directing more and more of their work toward missile defense; for example, the Institute for Foreign Policy Analysis, Inc. and the Center for Defense and Security, University of Southern California (generally favorable), and the Union of Concerned Scientists and the Center for Defense Information (generally unfavorable) – with increasing numbers of other institutions looking at bits and pieces, sometimes "pro," sometimes "con," but looking all the same. The subject would not go away.

population against nuclear attack, by means of shelters and by means of an anti-missile system, would actually have a destabilizing effect. It would be difficult to think of an argument which bears more directly upon the welfare of the citizens of any state. A governor surely ought to express his views on the plausibility of such an argument."[5]

So even before the advent of the Nixon-Kissinger era of arms control that was to be based on MAD and the 1972 ABM Treaty, Reagan had serious questions concerning the protection of the population. In the years following until his election as President, he never lost interest. Through his radio broadcasts and newspaper columns that reached twenty million Americans each week (1975-1979), he expressed strong reservations about how the inequities and vulnerabilities brought on by the Strategic Arms Limitation Talks (SALT) I and SALT II created an asymmetrical condition in the "Balance of Terror."

Specifically, he pointed to the failure of the United States to count certain Soviet offensive strategic weapons a danger to the nation, while at the same time canceling some of our own (for example, *Backfire* vs. B-1 bombers) and he also contended that the Soviet Union did not believe in Mutual Assured Destruction. He further observed in 1979: "There once was the beginning of a defense; an anti ballistic missile system which we had invented and which the Soviets didn't have. We bargained that away in exchange for nothing."[6]

Reagan carried these decade-long concerns into office and in March 1983 made *his* stunningly bold announcement: He would launch an expanded research and development (R&D) program to determine if strategic (missile) defenses were feasible.

Dubbed "Star Wars" by long-time opponents of missile defense, a firestorm of controversy erupted in which the now-twenty-year-old arguments against defending the population in favor of MAD resurfaced. This time the ABM Treaty proved its effectiveness by muting those favoring missile defense (because of "Treaty constraints") but could not prevent proponents from proceeding with R&D to determine the feasibility of such defenses.

Feasibility rather than production or deployment thus became the operative word. While it imposed a number of unwanted headaches, still the Strategic Defense Initiative Organization (SDIO) was chartered in 1984 as part of the Department of Defense (DOD) to resolve the feasibility issue, with Lt. Gen. James A. Abrahamson, USAF, as its first director. The first step was to pull together R&D work already ongoing as part of the legacy of *Project Defender,* plus other space technologies and hardware that might prove useful in proof-of-concept exercises.[7]

The sequences of inquiry and application would thus demand looking at the feasibility of striking hostile missile launches in their boost phase through the development of space-based systems. While other elements involving theater and terminal (last resort) missile defenses already were being looked at by the Army (land-based) and the Navy (sea-based), these by their nature were limited in both range and scope; so that – even by 1983 with massive nuclear proliferation going on – there was no coherent, overarching global system being considered to which sea-and-land assets could be linked, so as to develop a robust, layered defense against any launch point in the world.

Conceptually, these linkages can be described in terms of a logic pyramid. The base of the pyramid is comprised of space-based systems, because they are global and, thus, can do the most; they can see farther and strike farther. Sea-based systems are next best, because they are flexible for surface deployment (theoretically over two-thirds of the earth) and, therefore, superb for sophisticated regional operations. Finally, at top of the pyramid – supported by space-and-sea-based capabilities to maximize their effectiveness – are the fixed and vectored land-based terminal defenses systems.

Each component (space, sea, land) is important in its own way, but without space at the base, the other systems are limited in what they can do. In this pyramid, there is no "best" any more than an aircraft carrier is "best" over a cruiser, which is "better" than a destroyer. All are equally important, but only in terms of their particular functions. When they act together, they can provide a formidable defense. When they are forced to act alone, they can be overwhelmed. Space allows them to act together.

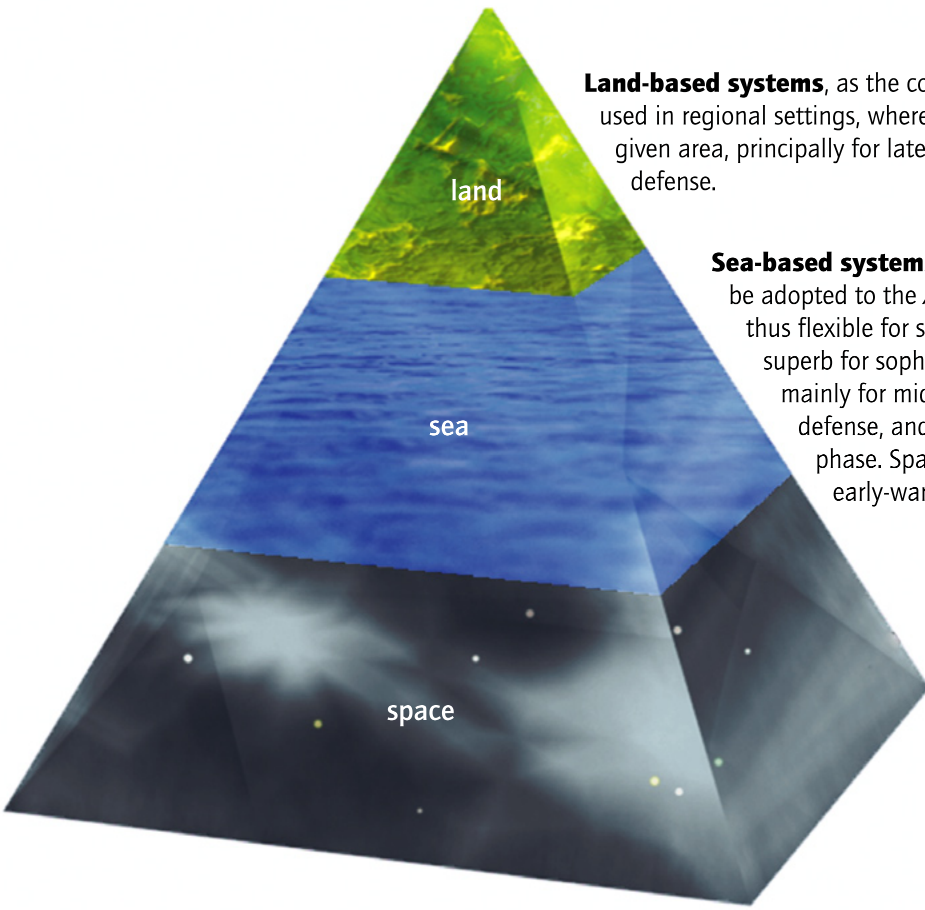
In 1983, the critical base of the pyramid was missing and SDIO was tasked to find ways to provide it. Over the next three years, a spate of technical and strategic studies produced an architectural concept that included, as its centerpiece, space-based interceptors (SBIs) held in an orbital constellation that would be able to destroy Soviet ICBMs in their boost phase,

5 Ronald Reagan, *A Governor's Role in National and Foreign Policy*, Ronald Reagan Collection, Box 3713, Archives of the Hoover Institution on War, Revolution and Peace, 1968, 4-5.

6 Kiron K. Skinner, Annelise Anderson, and Martin Anderson, eds., *Reagan In His Own Hand* (New York: Simon and Schuster, 2002), XV, 74, 79, 120.

7 It should be remembered that at all times during the life of the ABM Treaty, both the United States and the Soviet Union had the right to withdraw unilaterally without cause on six-months notice, a very simple procedure under Article XV. With nuclear proliferation growing even then at very alarming rates, it was becoming increasingly clear to a growing number of policymakers and opinion leaders that the U.S. policy not to defend its population as a means to slow the arms race was not working; indeed, it was likely creating incentives for some nations to accelerate their nuclear development efforts. The Strategic Defense Initiative was to be an insurance policy, so that the United States would have a running start to move quickly to defend its people should circumstances dictate Treaty withdrawal.

Logic Pyramid, 1960-1993



Land-based systems, as the concept evolved, are most logically used in regional settings, where they are vectored to cover a given area, principally for late-midcourse and terminal-phase defense.

Sea-based systems, as the concept evolved, would be adopted to the *Aegis* cruisers and/or picket ships, thus flexible for surface deployment, and could be superb for sophisticated regional operations mainly for midcourse- and terminal-phase defense, and some limited use for boost-phase. Space-based systems would give it early-warning and tracking data.

Space-based systems, as the concept evolved, would rely on 1,000-2,000 small, autonomous interceptors (SBIs) orbiting 290 kilometers up in one or more constellations and acting ("talking together") in concert could: (1) be on 24-hour "alert"; (2) "see" across a 360-degree space-earth horizon to spot firings globally; (3) dispatch the nearest SBIs to strike the ballistic missile while still in boost-or-early-midcourse phase; (4) issue instantaneous warnings throughout all other defense systems and – in case the missile gets through – provide long-range tracking data to guide sea-or-land-based interceptors to engage the incoming warhead in its midcourse-or-terminal phase.

thus destroying all the warheads and decoys before they could be deployed in space.

Further refinements by 1987 brought the Strategic Defense System Phase I Architecture, in which the space-based interceptor remained the centerpiece of six components comprised of both space-based and land-based surveillance and tracking systems, a battle management/command and control and communications system, and a land-based interceptor system for terminal or last-resort defense. Thus, with the exception of sea-based assets not yet conceptualized, both the base and top of the logic pyramid were to be combined synergistically as integral parts, so as to form a multi-tiered defense that could attack Soviet missiles and warheads throughout their flight.

However, two principal problems needed resolution: vulnerability and costs. The Phase I Architecture design, with its several space-based components, would present a large vulnerability profile, inviting attack by anti-satellite systems (ASATs) that the USSR might develop. And the interceptors (SBIs) would be quite expensive and also highly vulnerable, because they would be berthed together in multiples, battle ready, in large satellite "garages" parked in space like "sitting ducks."

According to Donald R. Baucom, historian at the Missile Defense Agency (MDA), "The solution to these difficulties emerged from the work of Dr. Lowell Wood, a physicist from Lawrence Livermore National Laboratory... (who) concluded that small, autonomous interceptors might offer a solution to the vulnerability and cost problems associated with a space-based interceptor system... and concluded the autonomous interceptors could be produced using 'technology that could be bought off-the-shelf'... A few months later (in 1988), Wood introduced the public to the new interceptor concept and coined its name... a miniaturization process that would lead to the emergence of *Brilliant Pebbles* from existing 'smart rocks' like the Army's Homing Overlay Equipment vehicle and SDIO's *Delta* 180 test vehicles."[8]

What made the concept of *Brilliant Pebbles* so convincingly feasible as a workable SBI was that each pebble would be completely autonomous, small, agile, and positioned in orbit 290 kilometers above the earth and hundreds of kilometers apart from neighboring pebbles, thus hard to hit. Each would be about the size of a traditional South Carolina watermelon and weigh between 1.4 and 2.3 kilograms. Each would be housed in a modest-sized protective cylinder or "life jacket" providing solar power, communications, surveillance, thermal and altitude controls, navigation and survivability (in all about 102 centimeters long with a total weight about 45 kilograms) until such time as a missile attack. Then the pebble (watermelon) would be armed for combat and shed its covering to go after the attacking missile for a kinetic kill. The pebbles could be so deployed in a powered-up mode for ten to twenty years. Costs would be relatively low because of the use of off-the-shelf commercial technology and mass production techniques.

The concept originally called for as many as 100,000 jacketed pebbles – each spaced between 400 and 800 kilometers apart – in a Northern/Southern Hemisphere constellation designed to defend against an Armageddon-like Soviet missile attack of thousands of warheads. Wood estimated 7,000 would be more reasonable and continued to refine the *Brilliant Pebbles* concept. SDIO also was looking at other space and related land-base systems and applications, so that the spate of technical and strategic studies continued – one exercise or project review folding into another and another. By 1988, unclassified elements had reached public discussion, sparking continuing controversy by missile defense detractors. The world was watching with mixed emotions, except the Soviet Union which was not mixed at all.

Then the Berlin Wall came down and with the demise of the Soviet Union a new post-Cold War era was dawning. Armageddon-like strikes were no longer seriously relevant. But limited strikes from accidental or unauthorized launches within the former Soviet Union (FSU) were of real concern, given the turmoil of command/control security measures. Also of growing concern was the proliferation of ballistic missile technology involving nations beyond the FSU with the potential of entering world-power nuclear geopolitics (China, India, Pakistan) with offensive nuclear missile arsenals and encompassing disquieting developments within "rogue states" (North Korea, Libya, Iran) all of which presented new defense, security and foreign policy considerations involving either political blackmail or an out-and-out limited strike from somewhere against the American people.

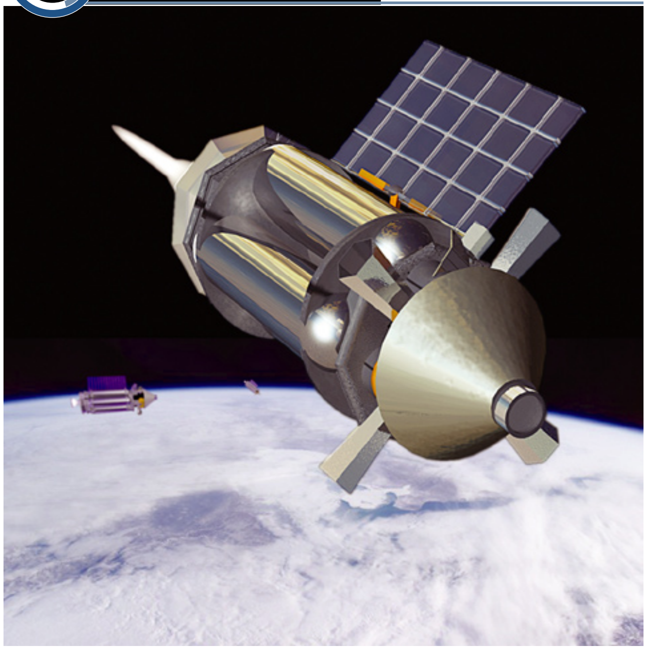
Thus, the focus altered to consider how to defend against limited strikes from anywhere in the world. *Brilliant Pebbles* remained the centerpiece to a multi-layered system. President George H. W. Bush endorsed the idea[9] and Ambassador Henry F. Cooper gave the new concept its "legs" in his *SDI Independent Review*, March 15, 1990.

"(The) Cooper report," according to Baucom, "laid out a new vision for missile defenses in the post-Cold War era... to fo-

8 Donald R. Baucom, "The Rise and Fall of Brilliant Pebbles," *The Journal of Social, Political and Economic Studies,* Vol. 29, no. 2 (Summer 2004): 146-149. Also, the reference to "smart rocks" is significant in explaining that there was nothing really exotic or mysterious or technically impossible about *Brilliant Pebbles*, which missile defense opponents kept suggesting, because the military already was far along in developing bombs and cruise missiles that, through sophisticated electronics, could unerringly find and hit targets. By the time of Desert Storm in 1991, "smart rocks" had become a pop culture term. *Brilliant Pebbles* was simply another application of proved technology. See Appendix D for the full text of this well-documented history that merits close attention.

9 President George H. W. Bush, Remarks by the President to National Employees of Lawrence Livermore Laboratory, San Francisco, California, February 7, 1990.

Brilliant Pebbles



cus on providing protection against limited missile strikes (PALS)... with three main components... a space-based system... (to) provide an overarching defense layer… that was to be underpinned and complemented by… a (U.S.) ground-based interceptor system... (plus overseas ground systems) to complement the global element..."[10]

In July 1990, Cooper became SDIO director and pursued the concept which ultimately would involve only 1,000 *Brilliant Pebbles* as the centerpiece to the overall architecture, with each of the jacketed "watermelons" stationed between 800 and 1,600 kilometers apart in orbit with the ability to defend against an unauthorized or accidental launch of up to 200 warheads, the number carried by the arsenal of MIRVed missiles under the control of one FSU submarine. The constellation of pebbles would also defend against limited strikes of single-warhead-tipped missiles fired from "rogue" states, as well as deter such states from nuclear blackmail or discourage them from investing huge sums to get into the ballistic missile game in the first place.

Shaped into a new Strategic Defense Initiative (SDI) program now known as GPALS for Global Protection Against Limited Strikes, the controversy surrounding it intensified, particularly in Congress, where SDI budget cuts were directed most especially to slow or stop work on the space-based elements. Then came the Gulf War and Desert Storm and the *Scuds* and the *Patriot* antimissile missiles. Suddenly, millions of Americans and others worldwide understood the meaning of "missile defense."

10 Baucom, "The Rise and Fall of Brilliant Pebbles," 164-165.

Not unlike Kennedy, who seized on *Sputnik* to announce the Lunar Landing Program, Bush also assessed the American mood and in his State of the Union Address on January 29, 1991 announced: "I have directed that the SDI program (GPALS architecture) be refocused on providing protection from limited ballistic missile strikes – whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas, and to our friends and allies."

The GPALS architecture was now formally refined to include four major components: *Brilliant Pebbles* that could protect any place globally against attack; a land-based national missile defense system; a land-and-sea-based system to defend deployed U.S. forces and populations of allies; and a battle management/command and control system to integrate the other three components – so that the pebbles not only would function autonomously to go after boost-phase and early-midcourse targets but also would provide early warning and trajectory data to land-and-sea elements for close-in (late-midcourse and terminal) defenses.

Thirty years after *Project Defender,* the logic pyramid had been set definitively in place, where technology – once it was allowed to flow unfettered like water – sought its natural place with the same clarity of purpose as the Lunar Landing Program: to be truly effective, each component was integral to the other, so that in both cases, the whole was greater than the sum of its parts.

But within three years, the logic pyramid would be turned precisely upside down on its tip, with space-based eradicated, sea-based shoved aside, and land-based restricted to *one* terminal defense system (metaphorically and in actual fact not a very stable base) – this as the only means to be granted by government to defend the nation against missile attacks.

The conditions that brought this about were political, not technical, the epicenter of which was Congress, pitted against SDIO and the Bush administration. On the surface, it might appear that this was the continuation of some long-standing traditional Democrat-Republican partisan fight. Superficially, perhaps, but only for tactical convenience.

The real flashpoint centered around whether or not the American people were *still* to be held hostage to potential strikes as the means to achieve "global stability" *a la* the ABM Treaty (the traditional mantra of the pro-Mutual Assured Destruction advocates) vs. the increasingly assertive argument that the post-Cold War aftermath and growing nuclear proliferation demanded effectively layered, technologically serious missile defenses soon.[11]

11 Tensions between Congress and both the Reagan and Bush-41 administrations on missile defense issues were not new; in the still-existing Cold War environment, they were more muted, even when Reagan vetoed the Defense Authorization Act of 1988, which capped spending on space-based interceptors. But

Indeed it was the end of the Cold War that seemed to energize Congress, led by a small but powerful group of pro-MAD advocates, to become increasingly vocal and hard-line against SDIO programs, especially *Brilliant Pebbles*. At a time when the Soviet Union had become extinct (which raised serious questions about the legality and standing of the ABM Treaty) and the doctrine of "massive retaliation" now a relic of the past, one might have expected more harmonious relationships, given that the danger and source of contention had been considerably altered.

Even the Bush administration and SDIO had recognized this and accordingly greatly scaled back its proposed missile defense systems away from protecting against "massive strikes" (100,000 *Brilliant Pebbles*) to offering GPALS – protection against limited strikes (1,000 *Brilliant Pebbles*). Even the newly emerging Russian Federation in 1991 had expressed interest in mutual missile defenses through a series of working group meetings with the United States in part aimed at alleviating the ABM Treaty constraints for both nations, which was to culminate in Boris Yeltsin's proposal in January 1992, to build a Joint Global Defense, i.e. replacing Mutual Assured Destruction with Mutual Assured Survival (MAS).[12]

But Congress, acting as an institution and as the dominant enabling body of the federal system,[13] actually increased its hostility. However, it did so with circumspection. Faced with growing public support for serious missile defense efforts on the one hand and, on the other, the increasing internal pressure of the pro-MAD advocates (supported by their outside special interests), Congress "split the baby" when it enacted the Missile Defense Act of November 1991.

It was an artfully drawn compromise document. First, it advocated setting specific deployment goals for both theater and national missile defense, including Section 232 implying an expectation that the ABM Treaty would be altered, and Section 234(a) which called for "robust funding for research and development for promising follow-on anti-ballistic missile technologies, including *Brilliant Pebbles*." This was widely heralded by missile defense advocates.

Then the Act turned around to include uncompromising language requiring missile defense deployments to comply with the now-20-year-old ABM Treaty – which in its totality allowed the United States only one single land-based ABM system comprised of no more than 100 interceptors at Grand Forks, North Dakota, to protect its own offensive nuclear missiles but not the American population. Further, in another Section, entitled "Exclusion From Initial Plan," the Act specifically barred Brilliant Pebbles from the initial plans for a limited national defense. The pro-MAD advocates were comfortable with these restrictions, which gave them what they needed.

Not surprisingly, the ambivalence of the law provided incentives for both sides to dig in by allowing each to justify its positions with righteous intensity, which paradoxically they could both do and be "correct." Collision was foreordained: missile defense proponents pushing for an all-out effort to protect the American population from global strikes and the pro-MAD and arms control advocates vowing to protect the ABM Treaty, now in serious jeopardy with the demise of the Soviet Union.[14]

The battleground was the hearing rooms of Congress beginning in the spring of 1992, particularly those of the Senate Armed Services Committee. In sum, SDIO was pursuing what it considered to be an evenhanded course to develop the single land-based system but in concert with continuing "acquisition-ready," next-phase work on space-and-sea-based elements of GPALS, particularly *Brilliant Pebbles*. The pro-MAD Senate leadership had a different take, essentially that the land-based system should be given highest priority and developed independently without regard to GPALS or any thought of integration; indeed, the space aspects (such as *Brilliant Pebbles*) were to be subordinated once again as a continuing, long-range research program as it had been for over twenty years.

The clincher was the date Congress had picked to deploy an "ABM Treaty-compliant anti-ballistic missile (land) system at a single site…" which was to be no later than 1996. Pro-MAD advocates accused SDIO of foot-dragging by diverting funds to "excessive spending" on space-based elements. SDIO countered with evidence that it was operating within its budget au-

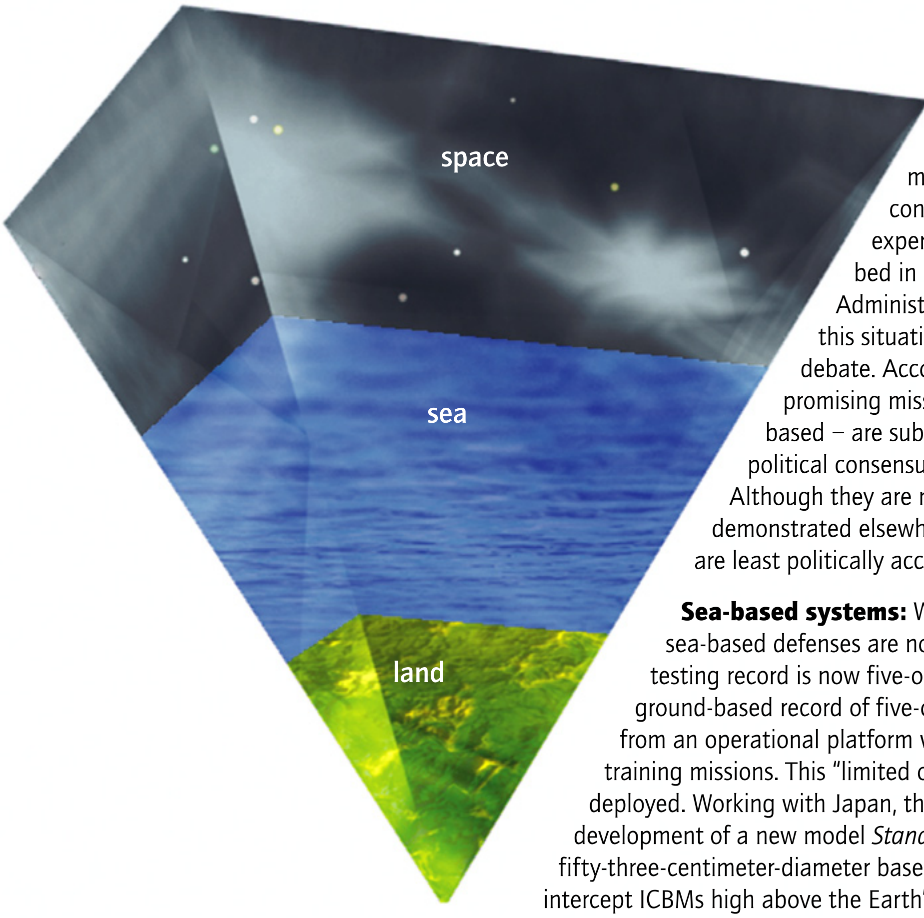
when the Berlin Wall came down, the intensity of the pro-MAD efforts increased almost exponentially, roughly at the beginning of 1991 through most of 1993 when it became clear that GPALS was essentially dead.

12 Henry F. Cooper, presentation at the conference entitled *Defending the Northeast, the Nation, and America's Allies from Ballistic Missile Attack*, Institute for Foreign Policy Analysis, Inc., Valley Forge, Pennsylvania, June 28-29, 2001, and Henry F. Cooper's briefing to the Independent Working Group, August 18-19, 2003.

13 Of the three "separate but equal" branches of government, Congress is "more equal" than the executive or judicial, because it has the "power of the purse" (appropriations) and can impeach, which the others cannot do. Thus, Congress makes or breaks the executive in most policy and program undertakings.

14 The demise of the Soviet Union posed a very real problem for the pro-MAD advocates, because if the ABM Treaty was scrapped or found to have no legal standing, then there also would be no legal standing or provisions to enforce the doctrine of Mutual Assured Destruction, which for twenty years had been operationally secured within the ABM Treaty. With the Treaty gone, the whole subject of MAD likely would have to be debated again as a public and defense policy matter, in order to have it reincorporated into a new treaty of some sort, but a treaty that would be designed (as was the ABM Treaty) to house the MAD doctrine for future enforcement – not an easy subject to discuss before the American people, who were growing increasingly suspicious about their continuing role as nuclear hostages. Hence, the forceful determination to keep the ABM Treaty in full effect.

Logic Pyramid, 1993 - Present



Space-based systems: There is little prospect that space-based missile defense will be revived. At most, consideration is being given to limited experiments in the near future and a test bed in 2008, the last year of the Bush Administration. The most likely explanation for this situation lies in the "weaponization of space" debate. According to the logic pyramid, the most promising missile defense technologies – space-based – are subordinated to the requirements of a political consensus against "weaponization of space." Although they are most technologically feasible, as demonstrated elsewhere in this report, such technologies are least politically acceptable.

Sea-based systems: With the end of the ABM Treaty, sea-based defenses are now moving ahead steadily. The *Aegis* testing record is now five-out-of-six, considerably better than the ground-based record of five-out-of-ten. The Navy tests have been from an operational platform with operational crews, in effect on training missions. This "limited operational capability" is now deployed. Working with Japan, the U.S. Navy is now committed to the development of a new model *Standard Missile* (SM)-3 that will have a fifty-three-centimeter-diameter base. The new missile will be designed to intercept ICBMs high above the Earth's atmosphere. Thus, the principal political obstacle to developing a robust sea-based missile defense has been removed. With the abrogation of the ABM Treaty, technical development can now proceed unfettered by Treaty constraints. Sea-based missile defense programs are moving ahead, although not as fast as they could with greater funding

Land-based systems: Until the ABM Treaty withdrawal, development work was carefully restricted for limited (in terms of "reach") terminal- and mid-course-phase defense. In the post-ABM Treaty environment, development has focused on enhancing late-midcourse-and-terminal-phase defense, i.e. extending the reach but still for regional use, vectored to cover a given area. The ground-based systems are proving to be more expensive than sea-based or space-based missile defense. The ground-based missile defense program has experienced several test failures under highly ideal conditions. In spite of official Pentagon assertions that a "limited" defense capability exists in the ground-based interceptors being based in Alaska and California, congressional skepticism is growing as costs mount and test failures surpass successes. Again, as the logic pyramid suggests, the least effective missile defense technology is being pursued because is most politically acceptable.

thorizations and that Congress had failed to provide sufficient funds for the land system and also asserted the 1996 deadline "had never really been possible."

While SDIO moved to accommodate Congress by delaying *Brilliant Pebbles* development for thirty months, Congress had other ideas. It would remove the ambivalences. As Baucom states in quoting remarks by the then-Chairman of the Senate Armed Services Committee, Sam Nunn, to SDIO director, Henry F. Cooper:

> *"It is clear Mr. Ambassador, just by the numbers, it's absolutely clear, that your priority is not – maybe it's the right priority but it's not the priority of Congress – your priority is not to meet an early deployment date on an ABM (Treaty)-compliant (land) system." The fact that SDIO was in the process of spending $2.6 billion on the BP program made it was clear (sic) that Cooper's priority was "still Brilliant Pebbles." Therefore, Nunn continued, "it is very clear" that Congress will have to make "a more definitive statement" of its goals for the SDI program in this year's (1992) authorization law.*[15]

True to these words, Congress did just that. Approved just days before the 1992 presidential election, the National Defense Authorization Act for Fiscal Year (FY) 1993 removed most of the ambivalences by: (1) clearly stipulating that the missile defense goal must be ABM-Treaty compliant by not developing or testing or deploying any system or component considered in Treaty violation; (2) further reducing funding (never very high) for all SBI elements; (3) deleting the required 1996 deployment deadline for the land-based site; and (4) directing SDIO to focus on near-term deployment (single land-based system) and to divest itself of projects involving what Congress considered to be "far-term technology," such as *Brilliant Pebbles* and nearly everything concerned with space-and-sea-based systems.[16]

As a result, SDIO in December 1992 transferred *Brilliant Pebbles* to the Air Force as a now-downgraded "advanced technology demonstration" program. Under the new Clinton administration, DOD in February 1993 first further reduced *Pebbles* to a technology-based program and then cancelled it entirely.

On December 1, 1993, the Ballistic Missile Defense Organization (BMDO) – formerly SDIO – issued a stop work order ending the program. The logic pyramid now officially was turned precisely upside down on its tip, confirming the validity of Proposition B.

The Consequences

"What did we get for our $30 billion?" It was the question asked regularly by critics and advocates alike, particularly during the final days of SDIO and *Brilliant Pebbles*, and the most definitive answer came from an unlikely source – *Clementine.*[17]

In major technological undertakings, concepts comprise the beginning point, where ideas are shaped by the slide rule, technical tables, formulas, research results, and the behavior of relevant applications in other uses – all of which are bundled into software and screened on the computer (today's "drawing board"). To see if concepts work, they are first put into computer designs and if that looks good, into computer simulations and if that looks good, into three-dimension models (mock ups) and if that looks good, into proof-of-concept applications (components of models actually built and performance tested separately) and if that looks good, into prototypes, real-life working models – to be bent, twisted, shot at, swallowed, driven, flown or otherwise performance tested. Only then can the best determination be made about getting "your money's worth" and even then, use "in the field" or the marketplace is the final determinant.

Broadly speaking, the development of the *Brilliant Pebbles* architecture had successfully achieved the simulation stage and by 1991 was ready to move into the proof-of-concept, prototype, and performance testing stages, which was Congress' dilemma when it enacted its compromise Missile Defense Act of 1991. It also is what sparked the Senate's heated opposition in 1992 to further work on pebbles and other SDI space-related projects.

Indeed, the Senate tasked the General Accounting Office (GAO) to review SDIO's analysis of *Brilliant Pebbles*. By this time, SDIO had either conducted, itself, or cooperated with other government agencies and review boards to conduct examinations of every facet in the evolution of pebbles and other supporting (or competing) components. In all, eleven major reviews and studies had taken place over a three-year period, not counting dozens of ancillary studies, and the bottom line was that no technical reasons had yet been found that would

15 Baucom, "The Rise and Fall of Brilliant Pebbles," 177-178.

16 Ibid., 181-183.

17 James A. Abrahamson and Henry F. Cooper, two of the three SDI Directors from the Reagan and Bush-41 administrations (George C. Monahan, SDIO's second director, was deceased) answered this question in "What Did We Get for Our $30-Billion Investment in SDI/BMD?," Report of the International Study Group on Proliferation and Missile Defense, National Institute of Public Policy, September 1993. Their answer, provided before the extraordinary success of *Clementine* described below, was that much of the $30 billion would have been spent on the same technology under existing DARPA and service programs had there been no SDI, but without a focused objective as President Reagan's SDI provided. The existence of that focused program provided technical, management and geopolitical dividends – not the least of which was the early demise of the Soviet Union, which led to a substantial reduction in defense spending several times the $30-billion invested in SDI. Subsequently, *Clementine* was a clear demonstration of the technical and management innovations produced by the SDI program.

Clementine

Photo by Bob Craddock, National Air and Space Museum, Smithsonian Institution.

Clementine as displayed in the National Air and Space Museum, Smithsonian Institution, Washington, D.C.

rule against *Brilliant Pebbles* proceeding to the next levels of development.

The GAO's own report appeared to have found no particular dispute with SDIO, except to point out that while computer simulations offered the only method of analysis available at such an early stage, they should not be confused with reality – a self-evident observation or "given" that applies to most any product or system under development. SDIO responded in an appendix to the report that its simulations were well within the bounds of sound engineering practice and cited authoritative references – the point being that the next steps logically involved refining these simulated performance assumptions by the only means available: through proof-of-concept and prototype work – which is exactly what SDIO was hoping Congress would support.[18]

Congress responded in October 1992 by defunding *Brilliant Pebbles*, so that there was to be no further development work, no proof-of-concept, no anything.

Except.

During this period, SDIO had realized that its space-based programs likely would never be proved out. Unless. Was there a way to move to proof-of-concept and prototype levels without offending Congress? Some way to demonstrate or perhaps even to build and fly the many lightweight components that had been developed for space-based interceptors and surveillance systems? Maybe some low-cost space mission outside the defense field and away from ABM Treaty constraints?

There was. For some sixteen months, NASA had been exploring with SDIO possibilities of using DOD technologies in its space exploration program. So that early in 1992, SDIO formulated the concept for a space probe mission based on *Brilliant Pebbles* technologies. In addition to NASA, the Naval Research Laboratory provided the spacecraft and overall system integration, and Lawrence Livermore National Laboratory provided the sensors, propulsion, computers and the like, using hardware gathered up from *Brilliant Pebbles* demonstration programs that it was handling.

The mission: Return to the moon, map its surface, fly by the earth and slingshot past a near-earth asteroid (Geographos) on a planned near-miss and continue out into deep space. Hence the space probe's name, *Clementine* ("lost and gone forever," per the old ballad). Authorized in the waning days of the Bush administration, preparations were allowed to continue under the new Clinton administration, so that the *Clementine* mission was launched aboard a *Titan* II rocket on January 25, 1994 and was completed in August.

What, then, was the mission performance outcome? While it was unable to complete the asteroid flyby, *Clementine* was "spectacularly successful" in the lunar portion of its mission, completing about 350 lunar orbits in two months and taking almost 1.8 million multi-spectral images of the moon (using fifteen spectral bands). *Clementine* was the first high fidelity photometric survey of an extraterrestrial body and its data indicated the existence of water at the lunar poles. It delivered more data and more information than the entire *Apollo* program, with a total mission program cost of $80 million. The small mission team won awards from NASA and the National Academy of Sciences and results of the surveys and mission were widely (and favorably) reported. A replica of *Clementine* now hangs in a place of honor in the Smithsonian.

In terms of the mission performance of *Brilliant Pebbles* technologies, everything worked. As Baucom records:

> *Clementine served as a highly successful test bed for twenty-three lightweight SDI technologies, all of which performed properly. A number of these technologies were directly related to the Brilliant Pebbles program. Specifically, Clementine's cameras and sensors had been developed for BP. Clementine also verified the autonomous operational mode that was to have been employed with Brilliant Pebbles... (and) lent support to the philosophy*

18 "Strategic Defense Initiative: Estimates of Brilliant Pebbles' Effectiveness are Based on Many Unproven Assumptions," U.S. Government Accounting Office, GAO Report NSIAD-92-91, March 1992, 2-4, 11, appendix.

> *that had initially guided the Brilliant Pebbles development and acquisition process – the maximum use of commercial off-the-shelf components and a minimum reliance on hardware designed to military specifications.*

Thus, the by-product of the *Clementine* mission was to space-qualify all of the first generation of *Brilliant Pebbles* technologies, except for the miniature propulsion elements for the space interceptor, which were subsequently tested with "very efficient" results in the *Astrid* launch experiment in February 1994, thus completing the qualification requirements.[19]

Clementine notwithstanding, the stop work order issued approximately five months earlier on *Brilliant Pebbles* and other space-related projects continued the dismantling process without interruption. Little, if any, of the SBI technologies survived – not even for use in the land-based system which SDIO had been working on per instructions from Congress. It was to have been an agile, fast, and lightweight land-based interceptor to harmonize with other GPALS components for a layered defense and thus drew heavily on these technologies (most of which *Clementine* had proved); known as the GBI-X KV, it was to weigh about twenty kilograms (44 lbs.) but was abruptly cancelled.[20]

What was occurring was that, with the change of administrations and sanctioned by Congress, there was an immediate move to redirect missile defense efforts away from anything that even in theory would be potentially useful – then or in the future – in the development of any system or even a component that might threaten the integrity of the most narrow and strict interpretation of the ABM Treaty (the Russian Federation notwithstanding). So that it was not just a case of canceling programs but became a matter of destroying or disbursing the knowledge base, or "dumbing down," which reveals a very high degree of political dedication to this particular cause and issue.

The new Ballistic Missile Defense Organization, for example, directed the destruction of the entire SBI technology-base and threw away all of its own SDIO-era records. Even the SDIO's *Raptor/Talon* program was cancelled early in the Clinton administration[21] – a high altitude unmanned aircraft which was to bring *Brilliant Pebbles* capability down into the atmosphere for near-term boost-phase defense against short-range missiles that could be fired, for instance, from the decks of freighters close in to U.S. shores. Also, development work for a sea-based ballistic missile defense (BMD) system was "dumbed down" by restricting its tracking/targeting radar to a single site, which could not see beyond the horizon – this when the Navy's aircraft and cruise missile defenses already were developing widely spread networks of radars and other linked sensors to provide "far vision" and reach for those interceptors, but forbidden for ballistic missile defenses.[22]

On the Russian Federation front, the Ross-Mamedov talks that followed Yeltsin's January 1992 proposal for a Joint Global Defense using SDI and Russian technologies were discontinued. As Dr. Gregory H. Canavan, Senior Fellow and Science Advisor at Los Alamos National Laboratory, states in a study:

> *The Clinton Administration… reversed course, reaffirmed the primacy of the ABM Treaty, and decimated the GPALS program. When President Yeltsin offered to continue the high level talks at his first meeting with President Bill Clinton in Vancouver in April 1993, apparently no one in the U.S. delegation was familiar with the concept. The Russian factions who had supported the initiative for cooperation were undercut; they lost ground with their colleagues who had consistently opposed defenses – or at least U.S. defenses. The opportunity for joint defenses was lost in first (sic) two years of the Clinton Administration while it concentrated on the domestic economy.*[23]

The final notable casualty was *Clementine* II. The first *Clementine* mission, as noted, was highly successful, so that a follow-on mission was planned immediately thereafter. It was to be a deep-space asteroid visit to finish the original mission, using even more advanced technology than before. Midway through mission preparations, President Clinton exercised his line-item veto in September 1997 to cancel *Clementine* II because, as the senior White House spokesman told the press at the time, of its SDI heritage and its potential to enable a space-based defense.[24]

In all, it was a remarkable political achievement: a $30-billion investment in a technologically feasible and verifiably needed national defense project stopped dead in its tracks; stopped with an effort powerful enough not only to prevent

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19 The above mission performance outcome summary draws upon two different but complementary sources. See Baucom, "The Rise and Fall of Brilliant Pebbles," 188; and Henry F. Cooper, "Defending America from Offshore Missile Attack," presentation at the Washington Roundtable on Science and Public Policy, George C. Marshall Institute, October 1, 2002.

20 Cooper, the Institute for Foreign Policy, Inc. Ballistic Missile Conference.

21 The only Unmanned Aerial Vehicle (UAV)-based interceptor concept evaluated subsequently was an Israeli initiative, mostly paid for by the American taxpayer. In time it morphed into a "pre-boost phase interceptor" intended to destroy a threatening launcher before it could move after it launched a missile at Israel and disclosed its location – *Arrow* was designated to defend against the first shot.

22 Lowell Wood and Henry F. Cooper, briefings to the Independent Working Group, August 18-19, 2003.

23 Gregory H. Canavan, *Missile Defense For The 21st Century*, Ballistic Missile Defense Technical Studies Series, The Heritage Foundation, 2003, 54.

24 Op. Cit., Theresa Hitchens, President of the Center for Defense Information, recently reaffirmed that the Clinton administration canceled the follow-on *Clementine* effort because it was intended to experiment with space-based weapon technology to defend against enemy missiles. See "Space Weapons Seen as Possibility," *The Boston Globe,* May 19, 2005.

even the salvaging of some truly innovative technologies for use in other applications (such as a second *Clementine*) but with a deep enough reach to expunge much of the knowledge base and scatter the residual technological fragments and components to widely dispersed areas – with the added effect of dismembering the critical mass of engineers and scientists who had been embedded in the knowledge base and who were now seeking other pastures, since ballistic missile defense no longer was a terribly attractive career path.

Thus, in this instance, the technological clock had been turned back a full decade by political fiat which decreed that the knowledge gained was to be forgotten or not to be used in matters concerning space-based defenses and their spin-offs, a behavioral pattern usually practiced in the more closed societies.

While the outcome was satisfying to missile defense opponents, it was nevertheless for them a close call. Had the political balance been less weighted in their favor, things arguably might have gone the other way. Because, by the early 1990s, various components of GPALS were in the major defense acquisition program with deployment cycles forecasted to include: (1) *Brilliant Pebbles,* with an initial operational capacity in 1996 and with full operational capacity (deployed in constellations) in 1998; a deployed sea-based system (small but fully functional) in 1996; the land-based system GBI-X KV, referred to earlier, operational by 2000 – which was the year targeted to begin the integration and deployment of the entire GPALS system.[25]

But there still remained the problem of dealing with growing public concern and rising expectations about missile defense. Evidence of increasing proliferation in other countries, including China, along with nagging questions about the capability of the new Russian Federation to guard against rogue or accidental launches among its deteriorating nuclear forces had found increasing currency in the national media. It was an issue that still would not go away. The problem was to accommodate these expectations by "showing progress," but rigidly and starkly within the confines of the ABM Treaty, so as not to send any ambivalent signals to the international community.

Accordingly, the Clinton administration – right about the time when the second *Clementine* mission was being cancelled – announced a new program in 1997 for another land-based system to replace the previously cancelled GBI-X KV. It was known as the "3 + 3 plan," i.e. to involve three years of R&D, three years of "acquisition," followed by deployment either during or following 2004, not in North Dakota but in Alaska. It was not to use any of the faster, lightweight technologies developed in the 1980s. Rather, the designs were to use other technologies in an architecture unequivocally well within the bounds of "Treaty constraints," that would produce a slower, heavier and bigger interceptor, so as "to offend no ballistic-missile owner."[26]

However, two unintended consequences took the edge off the effort to balance "Treaty compliance" with public expectations: the 1995 National Intelligence Estimate (NIE) and in 1996 the People's Republic of China (PRC). The NIE, the official threat assessment body of the United States, which declared there would be no immediate missile threat to the United States for fifteen years, had neglected to consider Alaska and Hawaii in the threat analysis. The PRC, in the heat of the 1996 elections in Taiwan, had made a nuclear threat against Los Angeles, should the United States choose to interfere.

Not surprisingly, opinion leaders in Alaska, Hawaii, California and other western states were not particularly uplifted by these events and along with various state legislators began making inquiries concerning the federal government's intentions about its plans to defend its citizens.

In 1998, the State Legislature of Alaska by resolution petitioned the federal government to fulfill its constitutional obligation to provide for the common defense – believed to be the first resolution of its kind ever directed by a state to the government of the United States. (See Appendix A.) The Alaska resolution is credited with contributing to the formation in 1998 of the bipartisan *Commission to Assess the Ballistic Missile Threat to the United States*, i.e. the Rumsfeld Commission.

The Commission's report was a sobering one and doubtlessly, along with other factors, helped to encourage a different Congress now to enact – by an overwhelming bipartisan majority in both chambers – the National Missile Defense Act of 1999, which was signed by President Clinton in July 1999. The law stated that: "It is the policy of the United States to deploy as soon as is technologically possible an effective National Missile Defense system capable of defending the territory of the United States against limited ballistic missile attack (whether accidental, unauthorized or deliberate)."

GPALS was back. Or was it?

25 Wood and Cooper, the Institute for Foreign Policy, Inc. Ballistic Missile Conference, Valley Forge.

26 Initially, the site for the "Treaty-compliant" land-based system (essentially a terminal phase, "last resort" defense with no space-based "eyes" to help) was to be in North Dakota; however, in 2001, it was moved to Fort Greely and Kodiak, Alaska, where it is still under construction. Original cost was $5 billion (1997). The program was continued by the George W. Bush administration with essentially the same basic architecture and performance characteristics, which by 2001 had reached a cost of $46 billion "and climbing" with deployment moved to 2010. See Wood, the Institute for Foreign Policy, Inc. Ballistic Missile Conference, Valley Forge, 2001. By comparison, in 1990 DOD had estimated that about 2,000 *Brilliant Pebbles* could support a 99 percent effective two-layer defense (twice as many pebbles as discussed earlier) against the "most stressing GPALS threat" from anywhere in the world and that it could be deployed and operated for a decade for about $11 billion (1990 dollars = $16 billion in 2005). See Canavan, *Missile Defense for the 21st Century,* 55.

With the 2000 elections approaching, there was no discernible movement within DOD to alter the pace and direction of the Treaty-compliant land-based program, a status that carried over into the new administration of President George W. Bush. While Bush in both his campaign and early presidential speeches was an unequivocal advocate of effective, layered missile defenses,[27] little of program substance changed (except the organization name to Missile Defense Agency); this as the new administration settled in to deal with a politically fractured Congress – a strong incentive to minimize partisan conflicts and controversial issues, which by its nature included missile defense.

Then came September 11, 2001 and all that that event implied, and on December 13, the Bush administration declared the U.S. intention to withdraw from the ABM Treaty six-months' hence (June 13, 2002). His declaration stated in part:

> *As the events of September the 11th made all too clear, the greatest threats to both our countries (Russia and the United States) come not from each other... but from terrorists who strike without warning... The United States and Russia have developed a new, much more hopeful and constructive relationship... The grim theory was that neither side would launch a nuclear attack because it knew the other would respond, thereby destroying both... We're moving to replace mutual assured destruction with mutual cooperation.*[28]

The effect of this action was as dramatic as it was important in its implications. Consider the drama: Secretary McNamara was one of the principal architects of the doctrine to hold populations hostage to foreign powers through Mutual Assured Destruction; President Nixon started the process (MAD) with the creation of the ABM Treaty; Presidents Ford and Carter supported the Treaty and the doctrine; Presidents Reagan and George H. W. Bush "pushed the envelope" to stretch the Treaty "allowables" to the maximum, looking to amendments or withdrawal; President Clinton said no way and adopted the Nixonian intent; and President George W. Bush said enough and stopped the process. Elapsed time: thirty years and fifteen congresses dodging in and out of the presidential shadows, with the relevant bureaucracies moving throughout at their own stately paces and unflappable in the pursuit of their own interests.[29]

Each administration and each congress has had its reasons, its pros and cons to fit both the temper and circumstances of its time. But the bottom line was that for whatever reasons – righteously justified or not – the nation's missile defenses had been hobbled by a treaty which by 2000 already was an *old* relic of the Cold War and George W. Bush ended it.

It was important because: (1) it cleared the way for technology to be used logically and efficiently unconstrained by law, and (2) those who, for whatever reasons, were still against a global, multilayered defense could no longer cite "the Treaty" in stentorian pronouncements, rather they would have to bring forth other reasons why the population should not be defended, which is where we are today.

As significant as the Treaty withdrawal was, it is still just a point of departure for work yet to be done – not an end point without further resolution. While there has been movement toward scheduled deployment (although delayed from its 2004 target date) of the Alaska land-based system, with another one in California, and while there has been discussion of the importance of boost-phase interceptors (a post-Treaty breakthrough), but with focus confined to land and/or sea systems, as well as airborne lasers, there has been little if any encouraging public discussion concerning the development and deployment of SBIs.

Thus, the order of priority still appears to remain little changed from what it has been since 1993 (land, maybe sea). One change, though, has been the addition of the "newly emerging" concept of "surface-based" interceptors (land or sea) that theoretically can be deployed quickly (via ground, air cargo or ship) for positioning and able to fly fast enough up from the ground, through space and back down to kill a hostile missile in its boost phase located in some as-yet-to-be defined parts of the world. But SBIs are not part of this idea and this particular non-space boost-phase kill vehicle appears at least eight years away from the proof-of-concept stage (a stage which *Brilliant Pebbles* achieved in four years).[30] This creates

27 "The Secretary (Rumsfeld) has identified near-term options that could allow us to deploy an initial capability against limited threats... We also recognize the substantial advantages of intercepting missiles early in their flight, especially in the boost phase... We have more work to do to determine the final form the defenses might take... When ready, and working with Congress, we will deploy missile defenses to strengthen global security and stability." See "Remarks by the President to Students and Faculty at National Defense University," White House press release, May 1, 2001, <http://www.whitehouse.gov/news/releases/2001/05/20010501-10.html>.

28 "President Discusses National Missile Defense," The White House press release, December 13, 2001, <http://www.whitehouse.gov/news/releases/2001/12/20011213-4.html>.

29 Dr. James M. Buchanan, 1986 Nobel Laureate (Economics for "Public Choice Theory") states: "Recent developments in public choice theory have demonstrated the limits of legislative control over the discretionary powers of the bureaucracy... the bureaucracy can manipulate the agenda for legislative action for the purpose of securing outcomes favorable to its own interests. The bureaucracy can play off one set of constituents against others, insuring that budgets rise much beyond plausible efficiency limits." See James M. Buchanan, "Politics without Romance: A Sketch of Positive Public Choice Theory and its Normative Implications," in James M. Buchanan and Robert D. Tollison, eds., *The Theory of Public Choice – II* (Ann Arbor: University of Michigan Press, 1984), 19.

30 See J. Lynn Lunsford, "Pentagon Awards Antimissile Pact to Northrop Team," *Wall Street Journal*, December 4, 2003, p. A12.

a paradox in that current policies now seem to recognize the imperative of building boost- and midcourse-phase interceptors on the one hand but – on the other hand – preclude the logical development of the means to do so.

In sum – at least in the near term – the logic pyramid, in terms of practical application, remains upside down on its tip, with two land-based systems (Alaska and California) to serve as the base for the only national missile defense capability the United States is likely to have for at least the next decade; unless sea-based interceptors emerge sooner to take some of the "last resort" burden off the land units (assuming details are finalized and deployment is funded) – but even with that, without space as a major actor, the whole logical concept of effective global, layered and economically efficient missile defenses still remains essentially reversed and upside down in what could well be very complex and excessively costly undertakings.[31]

Points that tend to support these assessments are found in the Summary and Conclusions of Canavan's study, excerpts from which are quoted below:

- Navy [missile defense] programs survived the Clinton administration with congressional help, but the current administration's actions have undercut them. The Navy now faces the choice of building the modest systems left from the Clinton administration or shift-

"Northrop Co. Grumman and Raytheon Corp. won a Pentagon contract, valued at as much as $4.5 billion over the next eight years, to develop a rocket capable of intercepting and destroying a hostile ballistic missile within five minutes of its launch... the eight-year contract covers development and testing of the first 10 interceptors, which would be grouped in pairs and transported by tractor trucks..." Note: There are striking similarities that suggest this program may be an effort to recreate 40-year-old *Sprint* interceptors, developed in the 1960s as part of the *Safeguard* system. Over the past 18 months, this Kinetic Energy Interceptor (KEI) program has been sharply curtailed by the administration and Congress seems poised to cut it even further. For example, see "HASC Endorses ABL Revamp, Seeks, Comparison with KEI," *Aerospace Daily & Defense Report,* May 19, 2005.

31 Reversed and upside down: Rather than returning to the technological logic that was presented in *Project Defender* in 1960 and proved out by 1994, the trend still continues to focus major attention on land-or-sea systems by following more convoluted paths of R&D with greatly extended timelines. The current guiding concept of U.S. missile defense doctrine (if there is one) appears to be the *reverse* of the GPALS concept which uses spaced-based interceptors as the unifying element, i.e. instead of starting "large" in space and simultaneously "filling in" with land and sea components (GPALS), the post-ABM-Treaty concept appears to be continuing the idea of starting "small" on land, and later sea, and then "backing into" the development of evermore far-reaching capabilities. The quest seems to be an attempt to develop adequate means to strike a hostile missile in its boost-or-early-midcourse phase but pointedly without the use of space-based interceptors. This approach arguably increases both costs and technical and logistical problems significantly over GPALS projections. The principal problems in going after boost-phase kills are *time, speed* and *location*, ones common to all phases but in this case considerably more acute. Because the boost phase lasts only while the rocket is firing which, depending on its range (short or ICBM), could be anywhere from one to five minutes, and the interceptor must be close enough to get to the rocket while it is still burning, so that its basing location and speed are critical to success. Under certain conditions, technically-able land-based systems might be used if they could be positioned closely enough to fixed hostile launch sites or able to "stalk" mobile launchers (there are hundreds of both around the world). But logistics and costs rule against their being deployed in sufficient numbers to provide effective global protection against limited strikes; they would need to be stationed everywhere throughout the Eurasian landmass, and basing rights, construction, maintenance, as well as twenty-four-hour alert status would be clearly unacceptable by any standard, either logistically or economically. This is why land-based systems have a much more logical use in regional settings, where they are vectored to cover a given area, i.e. the Alaska system vectored for late-midcourse-and-terminal phase defense against missile strikes aimed at the United States from North Korea or Iran. Much is the same with sea-based systems, except they have more flexibility to come and go over two-thirds of the earth without being concerned about basing rights and would require far less complex system operations. In certain settings (Sea of Japan, South China Sea, Indian Ocean, Mediterranean) they could be used effectively for limited boost-phase interception (North Korea, Iran, Pakistan) but inland launch sites would be out of range. To deploy enough *Aegis* cruisers to offer even partial global protection would be exceedingly costly. Even if both land and sea were combined for GPALS, the logistics and costs would be prohibitive. And neither land nor sea systems can deal effectively in the boost phase where a surprise missile attack is launched either from a submarine or the deck of a freighter or, indeed, from a covert mobile land missile – all three highly credible threats. That leaves the SBI which – as *Clementine* demonstrated for *Brilliant Pebbles* – is significantly closer to achieving concept development for wide-ranging boost-phase kill capabilities than either land or sea systems. Arranged in at least one constellation of 1,000-2,000 interceptors (watermelons in "life jackets") placed in orbit 290 kilometers above the earth (each deployed between 800 and 1,600 kilometers apart), the SBIs acting in concert could: (1) be on "alert" at all times; (2) "see" across a 360-degree space-earth horizon to spot firings from either fixed, mobile or submarine platforms and issue instantaneous warnings within the entire constellation and to all other defense systems; (3) dispatch appropriate SBIs out of the constellation to swoop down, streak out or climb to meet the ballistic missile while it is still "hot" or in its early midcourse trajectory before it can deploy its warheads, and (4) in the event of mission failure, enhance the long-range tracking capabilities of land- or sea-based interceptors to engage the incoming warheads in the midcourse and terminal phases of the missile strike – hence, the term "layered defense." But that is not happening. (Note: See footnote 26 for relevant cost figures.)

ing to big missiles on dedicated picket ships, neither of which has been endorsed.

- Boost-phase defense development programs are uneven. Surface-based concepts are early in development and years from testing, let alone deployment.
- Space-based interceptors were the most mature elements and were designated the "first to deploy" during SDI and GPALS, but were deliberately delayed for the last decade.
- The current MDA program is effectively a single, midcourse system and is likely to remain so until well into the next decade... It is as described "better than nothing," but primarily represents protection in extremis. As the protection it affords could fail catastrophically with the development of more sophisticated decoys or countermeasures, it would not represent a reliable military capability.
- The current program has both a lack of options and too narrow a focus...
- [*Brilliant Pebbles*] was about halfway through [engineering and manufacturing development] before it was cancelled, which suggests that SBI could be developed and deployed [in a timely manner]... Doing so would provide a capable and affordable boost layer that would reduce the threats reaching midcourse to levels that [ground-based interceptors] could address.
- The current program does not develop SBI [in a timely manner], which suggests that MDA does not grasp the limitations of midcourse, does not understand the positive impact of SBI on stability, or implicitly respects the ABM Treaty.[32]

The Missile Defense Agency's (MDA) 2006 budget authorized by Congress continues to offer credence to these assessments and to Canavan's conclusions. The bulk of the $9.4 billion is devoted to land-based (or sea-based) systems. The primary goal is fielding the Ground-based Missile Defense (GMD) system with eight interceptors at Ft. Greely, Alaska and two at Vandenberg Air Force Base, California. By the end of 2007, MDA hopes to have up to twenty interceptors in Alaska, with the number in California unchanged.[33] Much of the rest of the budget is for a wide range of projects dispersed across a broad horizon of concept development and research – significant portions of which focus on making land-based and/or sea-based interceptors capable of boost- or early-midcourse-phase interdiction. For fiscal year 2006, MDA requested nearly $230 million for the surface-based Kinetic Energy Interceptor (KEI), with the program narrowing its focus to a 2008 flight test of the interceptor booster. Congress ultimately appropriated $216 million for the program for FY 2006. MDA is seeking $386 million for KEI in FY 2007.[34] A ground-based version of the interceptor is still years away, with 2014-15 projected as the earliest possible date.

MDA requested $484 million for the Airborne Laser (ABL) for 2006, and received $491 million from Congress. For FY 2007, the administration requested $598 million. In 2008, MDA hopes to test whether the ABL can shoot down a target missile, and by that time MDA expects to determine which program, ABL or KEI, better meets its needs for a boost-phase system.[35]

In FY 2006, the U.S. Navy received over $915 million for the *Aegis* ballistic missile defense program; although, as Canavan has pointed out, apparently there is some ambiguity and indecision about whether the Navy would use picket ships and/or *Aegis* cruisers, and the deployment timeline has been moved to 2014 or later. In FY 2007 the administration requested slightly more than $1 billion for *Aegis* BMD.[36]

Since North Korea launched a ballistic missile over its territory on August 31, 1998, Japan has had a growing interest in a sea-based missile defense system compatible with their *Aegis* cruisers (see Section 6 for a discussion of this and other international missile defense issues). By 2004, this interest had reached a stage where Japan sought a formal joint program with the U.S. Navy to provide such a capability, and this was a very positive development during 2004 and early 2005 – as was Japan's insistence on a fifty-three-centimeter-diameter interceptor missile which will fit in the existing Vertical Launch System (VLS). It now appears, thanks in part to a major Japanese investment in a joint U.S.-Japanese program to develop such interceptors and deploy them years earlier than 2014, the United States will also have a more robust sea-based defense, without the need for a picket ship role, within the next several years. This development, in conjunction with an impressive five-out-of-six successful test record, has given the sea-based defense option a much more prominent role in the Pentagon's missile defense architecture.[37]

One dog, however, is not barking: the space-based interceptor. Funds allocated: zero.

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32 Canavan, *Missile Defense For The 21st Century,* 109-111. Also, see footnote 26 re: the bureaucracy.

33 *Missile Defense Agency Fiscal Year 2007 (FY07) Budget Estimate,* February 2006, p. 15, <Found online at http://www.cdi.org/pdfs/Final%20Budget%20Overview%20FY%202007%20MDA.pdf>.

34 Ibid., 15.

35 "Obering: 2008 'Flyoff' Between ABL, Kinetic Energy Interceptor," *Inside Missile Defense*, March 16, 2005.

36 *Missile Defense Budget Request for FY 2007: $11.1 billion*, Center for Defense Information, <http://www.cdi.org/friendlyversion/printversion.cfm?documentID=3301DI>.

37 See for example, "Sea-based BMD System outperforming Land System," *Defense Today,* February 28, 2005; "U.S. Working with Japanese on Billion-Dollar Missile Upgrade," *Inside the Navy,* March 14, 2005; and "Japan, U.S. Eye 1st Missile Interception Test Next March," *Kyodo News,* June 1, 2005.

In its 2004 budget request, the Missile Defense Agency requested $14 million for SBI-related research, or about 1/643 of total funds requested. Congress approved the $14 million. Subsequently, MDA "decided not even to spend that much, deferring any space-based interceptor work until 2005 at the earliest."[38] The administration then decided against including funds for space-based defenses in its 2005 budget request to Congress. In the 2006 budget, MDA requested $673 million between fiscal years 2008 and 2011 for designing, developing and testing a space test bed, with the goal of fielding a system of spaced-based kinetic energy interceptors housed within 50 to 100 satellites. Testing could extend to fiscal year 2015, at which point a decision on whether to build this system would occur. However, it has been reported that MDA has reduced FY 2007 funding for the space-based interceptor test bed by $312 million. The project now appears that it will be delayed for an unspecified amount of time.[39]

Thus, fifteen years after BMDO under President Clinton cancelled the *Brilliant Pebbles* program (December 1, 1993), there may be 2008 funds to initiate a space test bed with no significant capability in space before 2015 – twenty-five years after *Brilliant Pebbles* was formally approved as a major defense acquisition program. Clearly, the MDA under President George W. Bush plans to continue the Clinton ban on a space-based interceptor until the last year of his second term, giving credence to Canavan's suggestion that the MDA still "implicitly respects the ABM Treaty." Since budgets reflect real policy sought by an administration, it is difficult to avoid the question: How long will America operate under the dictates of Mutual Assured Destruction?

U.S.A. watchers from around the world – particularly those who specialize in looking for clues (as in congressional budgets) about America's military and defense capabilities, intentions and vulnerabilities – most surely already have noted the SBI void to their political leaders. And for those who think ill of the United States and are looking at ways to enhance nuclear blackmail opportunities (or worse), the news must be especially intriguing and for them raises yet another question: "Where is their SBI? It is not on any of their lists..."

38 "Missile Defense Briefing Report No. 126," American Foreign Policy Council, November 20, 2003.

39 See Marc Selinger, "MDA Defends Renewed Interest in Space-Based Interceptors," *Aerospace Daily and Defense Report,* April 12, 2005. If this plan is pursued, the 50-100 satellites called for would be a small fraction of the 1000 *Brilliant Pebbles* constellation of the 1990 plan – almost twenty-five years after the initial operations capability date that had survived the scrubbing of numerous technical groups, including the 1990 Defense Acquisition Board, which approved *Brilliant Pebbles* as SDI's first major defense acquisition program. See also See Marc Selinger, "Major Missile Defense Agency Programs Dodge Budget Bullets," *Aerospace Daily & Defense Report*, November 10, 2005.

Government Failure

What then is the future of missile defense in light of all of the paradoxes that have dogged it over the past forty years? The answer is both simple in its expression and complex in its meaning: Americans will get effective defenses when they *demand* them but not likely before then.

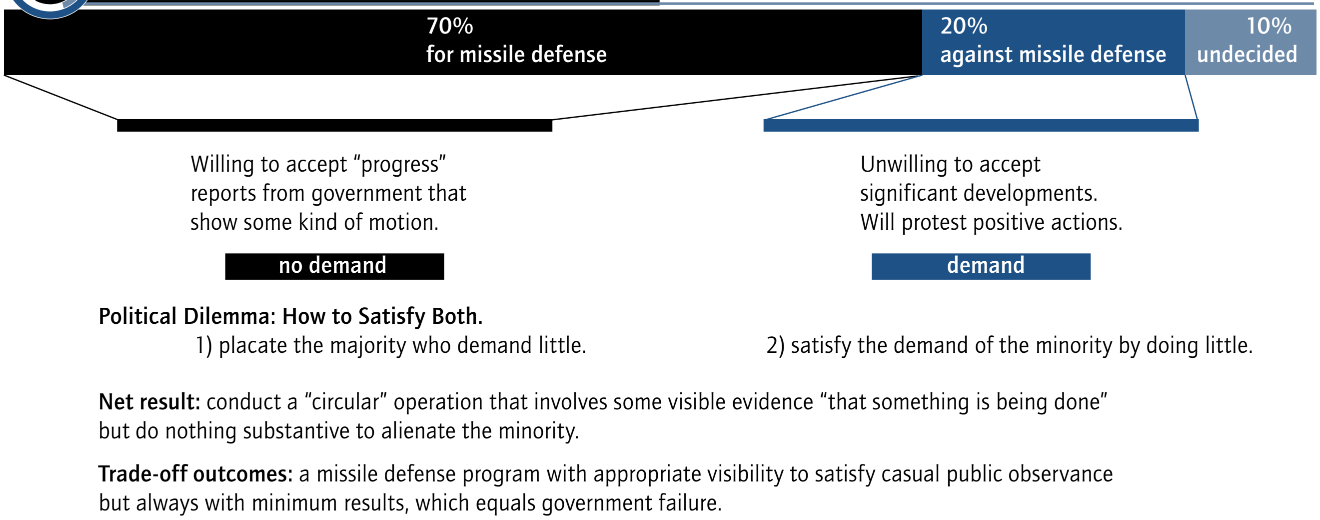
There is yet another paradox here. Over the years, opinion polls have consistently shown a significant majority of Americans who want themselves defended against possible ballistic missile attack (indeed, a respectable number believe we already have missile defense) and a very clear but small minority who are strongly against this idea. In an idealized version of what "government ought to do," conventional wisdom would have "government" (mindful of this significant majority and ever alert to the security needs of its people) long since humming along to supply a pretty decent system. But that has not yet happened.

It is not just a matter of a president or a congress or the eternal bureaucracies "not doing the job," it is all the above – plus. Because taken together, they all are inseparable components of the single corporate entity of our federal system: the government of the United States of America. Thus far, there has been a failure of this government to see to the needs of its people concerning the matters discussed here, a concern which is clearly reflected in the texts of the state resolutions found in Appendix A, i.e. to petition the federal government for protection against foreign aggression, a procedure, it is believed, never before used for this purpose.

The paradox continues in the sense that the government has failed to provide effective missile defense largely because the demand for it has not been strong enough to overcome the demand against it. In this context demand is proactive behavior and is not the same as "want" or "in favor of," which is passive behavior. This is explained in Dr. James M. Buchanan's work in public choice theory, for which he was awarded the 1986 Nobel Prize in Economic Sciences. Applying certain economic terms as a means to focus political analysis, most particularly "supply" and "demand," public choice theory offers a "theory of government failure" that

> *...has been the avenue through which a romantic and illusory set of notions about the workings of governments and the behavior of persons who govern has been replaced by a set of notions that embody more skepticism about what governments can do and what governors will do... the analysis attempts to relate the behavior of individual actors in the governmental sector... persons in their various capacities as voters... as elected representatives, as leaders or members of political parties, as bureaucrats (all of these are "public choice" roles) to the composite of outcomes that we observe... Public choice theory attempts to offer an understanding... of the com-*

Government Failure on Missile Defense Versus Public Support



> *plex institutional interactions that go on within the political sector.*[40]

As Buchanan explains, in a democracy, government exists to supply "goods and services" demanded by the voter (citizen). Government breaks into roughly two parts: the "agents" or elected representatives (president, legislators) and the "suppliers" (the nonelected bureaucracy). These "basic units are choosing, acting, behaving persons rather than organic units such as parties, provinces, or nations"; so that individual preferences and interests compete and are always present in the political marketplace.

Thus, "political exchange" is a constant and defines "a set of possible trade-offs among alternatives for potential choice, whether the latter be those between apples and oranges at the fruit stand or between peace and war for the nation." At any given time, then, government functions include a constant exchange of who's doing what, how and where to whom, so that the outcomes usually will be "that one which best satisfies... the voter who is median (in the middle issue-wise) among all voters."

What this means is that compromise is a natural state of democratic government and when the differences are narrow, the median produces an outcome most of the time that is satisfactory among all voters, i.e. a strong consensus exists based on broadly shared interests. But where differences are so diverse and possibly hostile, the median is watered down so "there is no stable group decision attainable by majority rule; the group cannot make up its collective mind; it cannot decide."[41] Nowhere is this particular state of government failure more stunningly revealed than in the previously discussed account involving SDIO and Congress in the enactment of the Missile Defense Act of November 1991 (the split-the-baby-compromise) and its aftermath which ended work on the space-based interceptor.

This phenomenon essentially is what has plagued this issue, particularly since the 1980s, which still continues: the overwhelming passive majority "wanting" missile defense and "expecting" government to provide it "as soon as it is able" versus a small proactive minority demanding, sometimes in nerve-racking choruses, that no such thing will be tolerated – with the government responding in this "political exchange" by supplying contradictory outcomes that have left missile defense in a techno-political cul-de-sac.

The above model helps explain this: Assume a reasonably well-estimated 15-year average of 70 percent of Americans polled as favoring the idea of missile defense, 20 percent against and 10 percent undecided (not relevant here).[42] The 70 percent are not particularly focused on the subject, because they are busy with other preferences dealing with domestic issues (home, school, jobs) and are quite willing to accept "progress" as defined by government; this without knowing too much about the subject or its political implications, i.e. passively without demand. The 20 percent have a focused preference against missile defense, in part motivated by strong political and philosophical reasons (such as pro-MAD advocates), and are engaged in "public outcries," i.e. proactive demand.

Both groups can do political damage to the legislature and the bureaucracy. The government's dilemma is how to satisfy both.

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40 Buchanan, *Politics without Romance*, 11 and 13.

41 Ibid, 13-18.

42 Polls conducted in several states in 2003-04 are close to this pattern. For instance, a January 2004 poll in New Hampshire sponsored by the Missile Defense Advocacy Alliance shows 75 percent of 600 registered voters favor missile defense and 21 percent opposed. The Pew Research Center for the People & the Press in January 2003 released data for the preceding three years which averaged 74 percent favorable and 9 percent unfavorable.

The past is past and the question is what can be done to fix it? Insights can be found by looking at September 11, 2001, which "changed forever America as we knew it." It is essentially the same lament that defined Fort Sumter, the Archduke assassination, Pearl Harbor and other such defining moments impacting American history.

In each instance, the voters, elected representatives and the bureaucracy had struck a median between remote "forces of darkness" and the "demands of peacetime and domestic tranquility." People were "aware" of such dangers but – quite reasonably – content to keep a wary eye on these outside events, while getting on with the business of tending to their own business.

Then – wham! The American mentality shifted with the "surprise" advent of the Civil War, World War I, World War II and other events that can be cited.[43] And the median also shifted from benign watching to demanding that something be done now.

In the case of 9/11, the American mentality regarding terrorism was at one level (call it "pale yellow") at 6:00 a.m. and by 6:00 a.m. on September 12 leaped to another level, "flaming red." The nation learned with a high tuition payment.

The matter, thus, to be determined is whether or not the majority of American voters will demand an effective missile defense before the fact – or after the fact, where some estimates calculate a huge loss of life and extreme infrastructural damage that could occur.[44]

To try to deal with the missile defense impass before the fact, the voter must do these things:

1. Understand the basic requirements for an effective missile defense.
2. Understand the nature of the political opposition.
3. Understand the nature of the threat, i.e. the continuing problem of weapons of mass destruction proliferation.
4. Insist, absolutely insist, that the nation's elected officials and bureaucrats be transparent in their views about missile defense, and for those who oppose, the voter must insist that they explain why the defense of their constituents takes second place over whatever else is on their agendas.

Whatever may be written or said in the future about whether or not the American people chose to defend themselves against ballistic missile attack, it will not be that "The people were never told."

43 Dr. John Norton Moore, Director, Center for National Security Law, University of Virginia, has dealt comprehensively with the subject of war and peace and government failure. His latest book, *Solving The War Puzzle*, (North Carolina: Carolina Academic Press, 2004), covers the subject extensively.

44 The Independent Working Group has looked at a number of scenarios. One involves al Qaeda, or a similar group, outfitting five "tramp" freighters or possibly container ships with nuclear tipped (15-kiloton, Hiroshima size) *Scud*-B missiles. The number five was selected because the pattern of mounting "the mother of all" attacks, at least on September 11, involved at minimum five commercial jets, three of which succeeded. Were such a cataclysmic event to be contemplated, it seems reasonable to assume that five vessels likely would be involved, with, say, three deployed off the East Coast (New York, Washington, Norfolk and the Atlantic fleet) and two off the West Coast (San Francisco, San Diego and the Pacific fleet). The combined death toll projected by reliable data could be as high as 3,729,000 not counting a like number of injuries, plus extreme damage to infrastructure. While not attempting here to assess the probability, it should be stressed that the capability is realistically available and, thus, deserves to be factored into homeland defense planning. See "Scenarios Involving Various U.S. Cities Attacked by Al Qaeda Terrorists with Sea-launched *Scud* Nuclear Missiles," The Institute for Foreign Policy Analysis, Inc., 2002.

Panel 4 Report

What follows is a summary of the discussion among members of Panel 4 which addressed political issues confronting the development and deployment of a robust missile defense.

Panel Members
Chair: Dr. Daniel I. Fine
Mr. Ilan Berman
Mr. Brian Kennedy
Mr. R. Daniel McMichael
Dr. Kiron Skinner
Dr. Robert F. Turner

I. Can the "failure of government" model help explain the history of missile defense policy formulation, and is it a constructive roadmap for space-based missile defense advocacy?

The nature of the political problem surrounding missile defense is a systemic one which has transcended individual administrations and politicians. From the 1960s onward, the government of the United States has systematically failed to protect its population from the threat of ballistic missile attack, despite having both the political means and the resources to do so. Much of this can be attributed to an ideological embrace of Mutual Assured Destruction (MAD), a doctrine which intentionally left the population of the United States vulnerable to nuclear attacks.

Another explanation for the political deadlock over missile defense is that of a failure of government. From this perspective, the low priority given to missile defense by successive administrations is a response to the political priorities of the electorate itself. The low priority afforded defense issues has only partially been reversed since 9/11, and that reversal has yet to penetrate the missile defense debate.

The foregoing analysis suggests that politicians and decision-makers must be engaged, raising the missile defense issue in the proper political context. Nevertheless, certain systemic constraints to progress exist. Institutionally, both the U.S. military and the civilian bureaucracy are rooted in routine, with innovation occurring only in response to a major external incident (such as the 9/11 terrorist attacks) or one from within, such as a new leader or a realignment of budget priorities. The result is that successive administrations are content merely to "satisfice" – that is, to fulfill minimally the political requirements with regard to missile defense. Reinforcing this situation is a strategic culture based largely on MAD that informs the worldview of America's political elite.

A potential counterweight exists in the American public who want the United States defended from ballistic missile attack. However, this segment of society is not sufficiently politically aware, and does realize that a problem exists. It is this constituency that must be addressed directly with the issue the U.S. government has so far failed to raise: that protection against ballistic missile attack is a matter of national survival.

II. Does MAD exist in de facto form as the underlying basis of missile defense and indeed to nuclear modernization and space development?

Much progress has been made by the current administration in moving beyond Mutual Assured Destruction. As a matter of governmental policy, the United States is no longer extending a willful choice for vulnerability to ourselves, our allies, or our adversaries.

Yet this transition is still incomplete. While a paradigm shift has been instituted vis-à-vis rogue states, a corresponding change has not yet taken place in U.S. relations with countries like China. This is evident in the fact that the ground-based missile defense (GMD) system being deployed now does not address the more sophisticated ballistic missile threats emanating from China.

The real problem, some panel members suggested, lies beyond MAD, deriving from a negative perception of the United States. In this view, war stems from U.S. provocation, moral deficiency, and technological momentum. The question of whether you trust the United States represents a deep cultural and political division, both within American society and among nations abroad. Many Americans do not. They view the United States as morally deficient, not to be trusted with power and technology.

III. What issues comprise the next political battlegrounds on matters relating to missile defense?

The principal domestic problem that obstructs needed missile defense development and deployment is an inadequately informed Congress and general public. This has enabled MAD to remain a powerful concept, particularly as a watchword for stability, preserving the fallacy that peace can be achieved without missile defense, nuclear weapons, or the requisite defense expenditures. An alternative to MAD, meanwhile, has not been adequately presented or "sold" to the American public.

At the same time, however, a constituency receptive to such a worldview is emerging. The events of 9/11 have had a catalytic effect on American approaches to defense, and have brought awareness of homeland security issues to the town level. This development is visible today in the creation of local committees, the growing political activism of veterans groups, and the blurring of state and federal lines with regard to homeland security planning. This new grassroots constituency represents an unexpected opportunity paving the way for the empowerment of a cadre of missile defense advocates.

On the international front, two overlapping challenges exist: how to optimize the current GMD rogue-state model, and how to evolve it into a comprehensive architecture comprising space- and sea-based anti-missile components. With regard to the former, the White House itself has made clear that the initial deployment now underway is oriented against a limited, single-state rogue threat. Yet the dynamics of contemporary proliferation, as demonstrated by Pakistan's nuclear network, and rapid ballistic-missile and nuclear-weapon advances on the part of North Korea and Iran, demonstrate that space-based defense has an important role to play in combination with ground- and sea-based missile defenses. Further underpinning the need for space defenses is the fact that Russia and China remain antagonistic to American missile defense development that includes space-based interceptors and are both, albeit in varying degrees, strategic competitors of the United States.

At the same time, as discussed in Section 6, significant progress has been made in missile defense cooperation between the United States and several of its allies. This foreign constituency represents a positive development, making it more difficult for both the government bureaucracy and the U.S. Congress to ignore missile defense, or for critics to claim that missile defense efforts are driven by American exceptionalism. The United States should continue to explore opportunities for increased cooperation on missile defense with allies.

IV. How important is consensus building (strong bipartisanship) in support for these missile defense-related issues?

Congress wields critical decision-making power. As a result, promoting missile defense, as well as space and nuclear modernization, requires the active engagement/participation of the legislative branch. However, approaches to Congress must be informed by an understanding of the changes that have taken place on Capitol Hill. These include the ascendancy of "appropriators" to positions of policy-making authority, as well as the decline of institutional knowledge relating to missile defense because of the departure of key experts and staffers. As a result, the issue of missile defense in general, and space-based defenses in particular, often does not receive a sympathetic hearing in either congressional chamber, even among conservative and defense-minded members. Over time, this has led the Department of Defense to a pragmatic policy choice regarding which programs will be selected for favorable authorization and approval consideration from Congress. This choice has largely excluded space-based missile defense.

Consequently, a pressing need exists for a cadre of sympathetic members and staffers as well as for increased understanding of missile defense issues throughout the House and Senate. Simultaneously, greater awareness of the weapons of mass destruction/missile threat at the grassroots level is essential to coalescing support for American defense priorities and missile defense, in effect, making concerns "local" for policymakers on Capitol Hill.

V. What are the avenues through which consensus hopefully can be built?

As noted earlier, the current state of missile defense principally reflects a failure of government, while the actual development of defenses has been stymied by bureaucratic institutions. Consequently, four groups need to be targeted to build a missile defense consensus:

The bureaucracy – The non-elected governmental bureaucracy remains the main stumbling-block to innovation in, and the requisite evolution of, the missile defense program. Several near-term steps, ranging from fostering multiple paths of technological development to the optimization of existing systems, are available as means of generating momentum within the government. Yet the ongoing resistance of the government bureaucracy to innovation necessitates an indirect policy approach – one targeting lawmakers and the general public intended to generate critical mass within the government for a greater focus on missile defense.

Congress – As described in detail above, showcasing the urgency of the ballistic missile threat facing the United States – both to the members themselves and to their constituencies – is an important means of generating support for missile defense on Capitol Hill. Also crucial is education and coalition building relating to missile defense among key congressional staff.

The President - Raising the profile of missile defense at the presidential and cabinet level requires both bipartisanship and consensus building. The degree of attention paid to this issue, however, remains deeply dependent on the policy priorities of individual presidents. Within the administration itself, the creation of an intellectual linkage between missile defense and space is essential to capture the attention and backing of the president for a space-based missile defense.

The public - This represents the most immediate and promising avenue. The new state and local institutions that have emerged in the wake of 9/11 represent a pivotal development in the public's engagement on issues of security and defense. At the same time, a coherent mobilization plan, together with adequate resources, is needed to capitalize fully on the burgeoning interest in missile defense now evident at the state and local levels. It is also possible to broaden this coalition to include the media and business communities, who have yet to be engaged effectively on missile threats and response options.

section 5

The Politics Against Missile Defense: Current Opponents

Which is why we are here. We want to get something going on the East Coast quickly – before we lose something else – and we want to see more purposeful and forthright action in moving toward at least a limited global protection system, which requires inclusion of a space-based system.

But there is something amiss that's holding us back that is neither technical nor economic. It is the lingering ghost of MAD.

In spite of the ABM Treaty withdrawal, the doctrine of Mutual Assured Destruction still remains the driving intellectual force upon which much of the opposition constructs its several different public arguments as to why missile defense is "unworkable" or "dangerous" or "provocative" or "threatening" or "destabilizing" or "wasteful" or "imperialistic" or "unnecessary" or "selfish" or "immoral."

Right now MAD is being held in place by the cultures it has created, rather than by some legal instrument – this as a consequence of over 40 years of application in which its basic precept – that of holding the American population hostage to someone else's weapons – has been a constant in the calculus of both the political and the strategic cultures that have driven significant parts of U.S. foreign, security and defense policies for so many years.

Ronald C. Tocci, Co-Chair
New York State
Armed Forces Legislative Caucus
From Summary Statement on East Coast
Missile Defense at Hearings
Albany, New York, May 25, 2004

The above statement places in sharp relief the essence of why missile defense still has not gotten off the ground both figuratively and in actual point of fact. Mutual Assured Destruction (MAD) was shaped initially by pacifist impulses of the 1960s, which then evolved over the decade into a de facto policy of creating national vulnerability through population hostage holding, and finally became fixed policy when it was codified for another thirty years in the Anti-Ballistic Missile Treaty (ABM) Treaty.

And thirty years is a long time for a new societal behavioral pattern to be held in a legal straitjacket – long enough to force the reorientation of the habits and reflexes of countless hundreds of military strategists, diplomats, presidents, congressmen, layer upon layer of bureaucrats, academics, researchers, pundits and gurus – all of whom have passed in steady streams through the innards of the American body politic from one generation to the next right into the twenty-first century.

It was, indeed, *reorientation*, because until this period in American history, it was unthinkable that the government of the United States would ever make a political decision that *by design* would keep its own people vulnerable to someone else's weapons, thereby knowingly putting them in harm's way. The whole notion not only ran counter to what Americans believed to be government's first responsibility – to protect and to keep safe – it also challenged the legitimacy of the government, itself. This reality was obscured by the drama of the times that swept through the fifties and sixties, as America was spun dizzily into a new era of geopolitics that was little understood and not particularly wanted.

The Korean stalemate without victory, the emerging Soviet political offensive against the United States and NATO, the McCarthy-era charges and countercharges, and the specter of a giant mushroom cloud looming over mankind (by then the oft-repeated poster symbol of the new antinuclear and antiwar movements) – all were combined in a whirlwind in which the edges of reason and rational action were blurred or lost altogether. Add to this, the Cuban debacle and continuing escalation of the Southeast Asian war, and the nation had a very full plate of international troubles, so that the resulting volume of white noise obliterated public thoughts about missile defense.

After all, the United States was clearly the dominant nuclear power, against only one other nation – and surely we would stay that way. Besides, it was common knowledge that the United States was actively engaged in missile defense development that used small nuclear warheads to destroy incoming missiles (*NIKE*, *Sentinel* and *Safeguard* systems, mid-1950s through the advent of the ABM Treaty). It was something a huge majority of Americans expected their government to provide as a matter of course.

But there was a discordant note of protest that shadowed this majority. It was remnants of the surviving arms control community, largely made up of pacifists and idealists, who had failed dismally in their disarmament schemes of the early 1900s and again in the 1920s and 1930s to prevent both World Wars I and II, and were still smarting from the humiliation.[1] They had found a new cause with new allies: to prevent a nuclear Armageddon.

America had acquired two post-WWII complexes that simmered just below the surface of daily events. One was a lingering unease about using "the bomb" on Hiroshima and Nagasaki. The other was growing dislike of being disliked – stemming from the American characteristic of "openness," of wanting to be liked, of not wanting to offend.

Both complexes made much of the nation especially sensitive about our global conduct and, thus, vulnerable to the mounting Cold War propaganda offensive against the United States, one particular strain of which hammered incessantly on two themes: (1) the United States had unleashed nuclear horror upon the world and must be prevented from doing so again; and (2) the U.S.-led NATO was clearly a belligerent act against the Soviet Union and Eastern Europe and thus was the true prosecutor of the Cold War. World peace and stability could only come if the United States withdrew from NATO and disarmed itself of nuclear weapons.

This was pacifism's new message. It was compelling and powerful, because the very future of mankind's survival was at stake. No more concerns about too many artillery pieces and battleships to cause one of those mere "conventional" wars, but this time, the BIG ONE, nuclear annihilation of the world – as Nevil Shute's stunning and gut-wrenching novel, *On the Beach*, made perfectly clear, in its mushroom-shrouded horror, to untold millions around the world, first as a book and then as a motion picture (1957-59).

End-of-the-world stories have been around for a long time, but the for-real, actual existence of "the bomb" created a level of credibility and terror among audiences of *On the Beach* that no other such story had achieved, at least in the twentieth century. The reaction was as ecumenical as it was electrifying, in that it provided a common ground for all sorts of personal and public sentiments, which included a heavy dose

1 The international landscape of the years leading to each of the two World Wars is strewn with examples of failed treaties and conferences designed to limit weapons and thus prevent war. Notable examples include the 1899 and 1907 Peace Conferences at The Hague that, among other things, banned aerial bombardment from balloons and the use of poison gas, both of which were employed nevertheless during World War I; the Covenant of the League of Nations in 1919 establishing provisions for reducing world armaments and calling for limits on the manufacture of weapons and munitions, which failed to prevent the rearmament of states leading to World War II; the 1922 Washington Naval Treaty limiting capital ships of the major powers but excluding aircraft carriers, which became the capital ships used by Japan to attack Pearl Harbor; the Geneva Protocol of 1925 banning the use of biological or chemical weapons, which were employed nevertheless by Japan against China in the late 1930s; the Kellogg-Briand Pact of 1928 that renounced war as an instrument of foreign policy; the 1930 Treaty for the Limitation and Reduction of Naval Armaments that, among other things, sought but ultimately failed to regulate submarine warfare; and the London Naval Conference of 1936 that reaffirmed limitations on capital ships but failed to reduce Nazi-German and Japanese naval programs and was the last major arms control conference before World War II. Needless to say, none of these efforts prevented the World Wars that followed them. All of this was a huge embarrassment to some of the more ardent arms controllers, as Walter Lippmann opined at the height of World War II: "And though I knew, and had often argued, that British-American sea power combined was necessary to our own security and to the maintenance of peace, nevertheless I was too weak-minded to take a stand against the exorbitant folly of the Washington Disarmament Conference. In fact, I followed the fashion, and in editorials for the old New York World celebrated the disaster as a triumph and denounced the admirals who dared to protest. Of that episode in my life I am ashamed, all the more so because I had no excuse for not knowing better." From Walter Lippmann, *U.S. Foreign Policy: Shield of the Republic*, (Boston: Little, Brown and Company, 1943), xii.

of Soviet "interest in preserving peace." The universal cry: We cannot allow a nuclear holocaust![2]

Who would quarrel with preventing nuclear war? Not very many, but the pacifists, supported by growing bands of political idealists, had ideas other than building missile defenses and maintaining a strong nuclear deterrent. Their solution, first proposed in the fifties and gaining support in the sixties: unilateral and total nuclear disarmament by the United States to remove the "threat of aggression," thereby pacifying the Union of Soviet Socialist Republics (USSR) away from an arms race, so that world peace would thus be achieved.

Not surprisingly, the Soviets provided support to a new "common ground dialogue" with the West that could "open the way to peace." To give an international reach to the "breakthrough effort," the *World Peace Council* was formed in Stockholm in cooperation with the Soviet government. Created about the time of *On the Beach*, the Council spawned an impressive array of adjunct organizations that became active in dozens of countries in Europe (east and west), the United States and other states in the hemisphere, as well as Asia and the Middle East. The *World Peace Council* and its adjuncts still continue today.[3]

The resulting synergism between the Stockholm connections and domestic antinuclear pacifists and their arms control allies, along with emerging antiwar groups, created a drumbeat that reverberated across the nation. Those who just a few years before – the traditional majority of Americans seeking protection by their government – were gradually marginalized as "hawks bent on destroying the world."

Thus, by the mid-sixties, Secretary of Defense Robert S. McNamara and others in the political world were proposing Mutual Assured Destruction, i.e., the United States and USSR having a like number of nuclear weapons ("parity") to strike back against each other's citizens, were either nation attacked by the other; each would hold its own people hostage to the other. It was a neat idea. The "hawks" would get their way (no

2 Nevil Shute, *On the Beach*, (Melbourne and London: Heinemann, 1957). Story: Set in Australia some time after nuclear World War III has devastated the northern hemisphere (the movie has it in 1964), only one part of the planet is habitable, far to the south of the globe. The survivors of the region await death by nuclear fallout. Most of the Australians choose government-promoted suicide instead of waiting to die. The story was remade into a 2000 television movie. Following comments are from "Books and Writers," Nevil Shute (1899-1960) - original name Nevil Shute Norway, <www.amazon.com>, 1, 4. and <www.kirjasto.sci.fi/nshute.htm>: "The picture became one of the most celebrated anti-Bomb films, and attracted much attention in Moscow because it was the first full-length American feature to have a premiere in the Soviet Union… Stanley Kramer wanted to make a picture that 'reflects the primary hopes and fears on the minds of people today'… Gregory Peck is the commander of a U.S. nuclear submarine [fleeing the fallout by going to Australia]… [and] has a desperate affair with [Ava] Gardner… Fred Astaire plays a disillusioned scientist who encapsulates the film's theme: if we have nuclear weapons, they will be used, intentionally or by accident… The Pentagon refused to lend the use of an atomic submarine. Nevil Shute boycotted the entire (movie) venture… *The New York Daily News*, December 18, 1959, condemned the film: 'This is a would-be shocker which plays right up the alley of a) the Kremlin and b) the Western defeatists and/or traitors who yelp for the scrapping of the H-bomb . . .See this picture if you must (it seems bound to be much talked about), but keep in mind that the thinking it represents points the way toward eventual Communist enslavement of the entire human race.'" The theme of the film quickly became "Better Red Than Dead," a slogan that was widely used into the 1970s.

3 The World Peace Council (WPC), a prime international conduit for communist propaganda and covert action, was conceived by the USSR's politburo in 1949 and emerged as an organization in 1950. Its evolution in the succeeding years included adjuncts also established by the USSR: Afro-Asia People's Solidarity Organization (AAPSO); International Association of Democratic Lawyers (IADL); International Federation of Resistance Fighters (FIR); International Organization of Journalists (IOJ); International Union of Students (IUS); Women's International Democratic Federation (WIDF); World Federation of Democratic Youth (WFDY); World Federation of Scientific Workers (WFSW); World Federation of Trade Unions (WFTU); and the Christian Peace Conference (CPC). WPC's first major initiative was to launch the 1950 Stockholm Peace Appeal which declared that *"the first government to use the atomic weapon against any country whatsoever would be committing a crime against humanity and should be dealt with as a war criminal."* This theme was promoted by leaders of every U.S. disarmament drive. In 1974, the WPC set up a new body, the "Conference of Representatives of National Peace Movement," to meet annually and coordinate building up local WPC affiliates, particularly in the non-Communist countries. Continuing in 1975, the WPC launched a new disarmament effort, called the New Stockholm Campaign, calling for "ending the arms race through peace and nuclear weapon-free zones." In addition to WPC's national affiliates, other attending organizations included the Women's International League for Peace and Freedom (WILPF), the Stockholm International Peace Research Institute (SIPRI), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Federation of United Nations Associations (WFUNA). The WPC was, at least until 1994, a creature of the Kremlin. During the next decade, the WPC was relatively quiet but in May 2004, the World Peace Assembly, the governing body of the WPC, met in Greece and elected Orlando Fundora, 77, a Cuban, as its president. Fundora criticized Russian leadership as "*bland, odorless, colorless council – an organization that would not upset anyone.*" He added, "*It was visible that the collapse of the socialist camp debilitated the Council very much at the time.*" At this Athens meeting there were 134 delegates from 62 organizations from 47 countries. (Orlando Fundora's figures were 150 delegates, 60 member-organizations and 50 countries.) The newly energized WPC plans follow-up meetings on a regular basis. See Memorandum to the Independent Working Group, The Maldon Institute, 18 August 2004. This document is in Appendix G.

unilateral disarmament) and the "doves" would get a "balance of terror," in which the United States would be "contained" from any notions of grandeur and the Soviets would be given their "place in the world" without resorting to belligerence.

But wait a minute. What happens if the United States proceeds with its missile defenses? Everything goes out of balance, because the United States might prevent a strike against it and then could strike back at its own choosing. The resulting "power advantage" would guarantee America's permanent position as the world leader – leading, of course, to instability. The answer was the ABM Treaty, brought forth under the Nixon administration. Hostage holding was never discussed or debated in any meaningful way as a defense policy matter.

The ABM Treaty did not do what it was supposed to do: the prohibiting of missile defense was designed to create a stable environment which would prevent a nuclear arms race, ease tensions, and bring stability to East-West relations. By every standard of measurement, the ABM Treaty proved irrelevant to the whole geopolitical landscape right from its ratification to its demise thirty years later. It did not stop the arms race. It did not ease tensions. It did not bring stability.

The only thing the ABM Treaty did achieve was to provide a level of unilateral vulnerability to the American population, because right from the start, Moscow violated treaty provisions again and again, without meaningful protest from Washington, and the United States in turn repeatedly chose "narrow interpretations" of ambiguous parts of the Treaty to hobble further the limited missile defenses that were permitted for our military assets (but not our population). Meanwhile, the Soviet SS-10s and SS-12s, short-range ballistic missiles which were never officially counted as missile defense assets but were (and are) used as such, plus other permitted "point defense" deployments around Moscow, gave far more protection to the Soviet military and parts of its population than anything the United States had – or has. Thus, no "level playing field" ever occurred.

Some will argue that the ABM Treaty, as flawed as it was, helped to prevent nuclear war. This again is wrong by any measure. It was the continuation of the U.S. nuclear deterrent, as part of the "Balance of Terror," that did what it was supposed to do to keep the peace. That is still the case. We still cannot defend but we can strike back if someone hits us.

Perhaps, MAD could have gone on indefinitely if it were just two nations (like two guys at the poker table with their Colt .45s cocked and pointed at each other, OK for cardplaying but not for becoming pals) but this kind of continuing standoff makes any realistic hope of achieving some kind of lasting rapport virtually impossible. Add to that the growing nuclear proliferation – now so clearly evident – and the idea of holding "cocked .45s" at the people of twenty or so nations becomes absurd on its face.

The ABM Treaty now is gone but as Ronald C. Tocci (quoted above) observes: This is because the arguments against missile defense (discussed below) have been used for so long within this thirty-year legal straitjacket. They have been repeated again and again with such intensity that the nation's reflexes long have been conditioned to reflect the rules of the Treaty and nothing else – so that American policymakers have been responding in a Pavlovian mantra and with slogans, often mouthed without thought.

Consequently, the chanting rhythms generated by MAD have caused a kind of defense and foreign policy addiction, like smoking. The U.S. government has been smoking MAD for over thirty years and has yet to kick the habit.

The evidence of this still is inarguably clear. Recent examples cited by Tocci in his Summary about missile defense include two significant references: forty-nine retired generals and admirals who wrote to President Bush on March 26, 2004, and the comments of a senior U.S. official who visited Canberra, Australia in February 2004.

The retired generals and admirals called for postponement for technical reasons of ground-based strategic midcourse ballistic missile defense and they then went on to state: "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… thereby risking annihilation from a devastating U.S. retaliatory strike."[4]

This obviously is a continuation of the "Balance of Terror" status enabled by MAD, i.e.,, we leave our people defenseless, essentially as a dare for someone to try something and assume that no one will.

The Tocci Summary then cites a report in a major Australian newspaper, *The Australian*, on February 10, 2004:

> *. . . The frank insights into the US plans to develop a missile shield over the US came in a briefing with senior US officials who are visiting Canberra. US State Department Bureau of Arms Control senior advisor for missile defence Kerry Kartchner [after discussing U.S. restricted missile defense plans against only rogue states]… said China and Russia were the only powers that could trigger an "offensive-defensive" arms race. "(But) we have taken steps in both cases to assure China and Russia that the limited modest missile defence the US plans to deploy is not aimed at them . . ."*[5]

4 See "49 Generals and Admirals Call for Missile Defense Postponement," <www.wagingpeace.org/articles/2004/03/26_generals_admirals_postponement> for the full text of the March 26, 2004 letter to President George W. Bush signed by Admiral William J. Crowe, USN (Ret.), General Alfred G. Hansen, USAF (Ret.), General Joseph P. Hoar, USMC (Ret.), and forty-six other retired officers.

5 Ronald C. Tocci, *Summary Statement on East Coast Missile Defense*, presented at hearings of the New York State Armed Forces Legislative Caucus, May 25, 2004, 8-9. Note: See Appendix H for entire text of the Tocci Summary.

Additionally, the Tocci Summary notes that so far no definitive actions have been taken to restart efforts regarding a space-based system and quotes a statement reported in the April 2, 2004 *Missile Defense Briefing Report* which explains itself:

> *Space-based capabilities are not on the American agenda for the near future, according to the Pentagon's top missile defense official [speaking before a missile defense conference on March 22]… Missile Defense Agency (MDA) director Lieut-Gen. Ronald Kadish said that the contemporary ballistic missile threat does not currently warrant a space-based anti-missile capability… "From the standpoint of threats we face… we don't need to put weapons in space . . ."*[6]

Finally, the Tocci Summary concludes with these policy points:

> *It is pretty clear that our government continues a policy of selective hostage-holding… It is a policy that must be brought out into the full light of day to be examined openly and candidly by the people of the State of New York and of the rest of the nation. This can be done by asking ourselves, as citizens, and, most pointedly, also asking our political leaders – elected and pretenders alike – this one critical question: Should it be the policy of the United States Government deliberately to hold its own citizens hostage or otherwise vulnerable to the offensive weapons of another nation or terrorist group?*
>
> *The answer is vital to our future. If we choose to hold ourselves, our families, our friends, our neighbors deliberately defenseless to someone else's weapons, then it should be publicly recognized as a conscious American decision and then we should be prepared to accept the consequences.… If we choose not – then we will want a very good missile defense.*

And for those who are against missile defense for New York and other states, there's a question for them: Why do you not want to defend us from a missile attack? What is it that makes you so terribly hostile to the idea? However all of these questions may be answered – or even if they are never asked because people don't care all that much – whatever – Americans will get their missile defense. The question here is when? Will it be before the fact – or after the fact… Will there be, at some point, another sort of 9/11 inquiry? Let us hope not.[7]

If we are to kick the MAD habit, elected officials, policymakers and citizens alike need first and foremost to understand not only who the opponents of missile defense are but why they believe what they believe. Only in this way can the vitally needed public discussions and debates be conducted rationally and with constructive purpose. It is, therefore, important to understand the basic themes currently being used to try to persuade the nation to keep essentially what it still has: a continuing policy of population vulnerably.

Missile defense opponents base their arguments on one or more of five broad themes: missile defense of the U.S. population (1) is wasteful and ineffective; (2) is provocative and destabilizing; (3) will weaponize space; (4) will give America too much unilateral power; and (5) is morally wrong.

Missile Defense is Wasteful and Ineffective

Much of the work of the Independent Working Group (IWG) has focused on systems, technologies and cost factors that clearly make the case that the American people can have cost-effective global protection systems against limited missile strikes; moreover, systems that can also protect the citizens of our allies and other friendly countries, and even the people of nations unfriendly to us (if they would so choose).

Yet, the mantra of the MAD culture still exists, in that significant elements of this technology (and the economic efficiencies it can provide) still are not being used that could be used – such as nano and other lightweight technologies – so that even those critics who are looking more at performance rather than politics at times have well-founded concerns that deserve to be vetted and answered.

How does this occur? It has to do with how knowledge is used and the political and cultural climate that governs how well that knowledge is used.

For example, a July 2004 Congressional Budget Office (CBO) report, called "Alternatives for Boost-Phase Missile Defense," estimates that costs could reach upwards of $78-billion for the most effective option (out of five options studied) for a twenty-year space-based operating system – very expensive because of the weight of the components assumed in the study, i.e., the heavier the kill vehicle (KV), the bigger the booster required to deliver the KV into space and the greater the cost. This compares with $16.3 billion (in 2005 dollars) for a Global Protection Against Limited Strikes (GPALS) system discussed extensively in Section 4.[8]

The 50-page CBO report, which drew heavily on a 400-page 2003 boost-phase study by the American Physical Society (APS), doubtless is essentially correct in its $78-billion cost projections in terms of the technology it looked at. And therein lies the rub: the design assumptions used in both the CBO and APS calculations include heavier components than those used in the GPALS system, which was technologically feasible over a decade ago. When combined with the rocket equation and the fundamentals of orbital mechanics, the use of available lightweight technologies – including significant progress in miniaturization during the past decade – should

6 "Missile Defense Briefing Report," American Foreign Policy Council, No.139, April 2, 2004.

7 Tocci, *Summary Statement on East Coast Missile Defense*, 12-13.

8 See Section 4 of this report, in particular footnote 23, and related discussion.

reduce the CBO/APS cost estimates by over 80 percent to a figure consistent with the 1990 GPALS estimate.

Thus, calculations using different assumptions may be technically accurate in every respect, but the outcomes very often are quite different. A design assumption for a new portable camp stove based on cast iron rather than an aluminum alloy will give different cost/performance readouts – and still be a legitimate study – but pointed in a direction not terribly suitable for a product to be lugged through the woods. Wags sometimes call this "design for failure," a technological state that far too often exists to achieve political ends by generating negative self-fulfilling prophecies. This has been one of the principal reasons for government failure, thus far, in defending the American people from missile attack.

And government still appears – even in this post-9/11 era – to be held captive to the MAD culture that sees population hostage-holding as a preferred instrument of American defense and foreign policy. It is a government state of mind that continues to drive the instinctive behavioral patterns of many of its policymakers, design engineers and program managers away from maximizing the existing lightweight technologies now available for effective missile defense. What used to be "is it Treaty compliant?" has become "is it MAD compliant?" The question remains unerased, an indelible reflex.

This is not to say that there have not been good studies, based on good science and leading-edge technology that look at missile defense harshly. But they do so with a bias to seek out and evaluate designs that hope to succeed, rather than ones prone to failure. Fortunately, such work has been ongoing throughout the last half-century and still continues.[9] The problem, however, still is this: Since the advent of the ABM Treaty, continuing through to the present, these kinds of efforts more often than not have been systematically marginalized by government as "not relevant to the problems of the day."

Thus, to a disturbingly large degree, the trend line of policy thinking and government research and management still center on the analytical perspectives arising from reports and studies that continue to shape their formulas toward cast iron stoves, such as the particular ones referenced here from CBO and APS, as well as from the commentaries of other "authoritative" bodies who very openly oppose missile defense.

Meanwhile, Clementine gathers dust in the Smithsonian.

How is this matter to be dealt with? There can be only one way: The technology affecting missile defense requires the highest degree of professionalism in advocating fully cost-effective systems, if the trust and confidence of the American public are to be earned and if the critics who rely on "bad" science and inferior technology are, finally, to be sent from the field of play. Absolute technical honesty and application and complete transparency in the motivations of designers and policymakers are critical imperatives – if the nation ever hopes to have effective global missile defense systems before America is faced yet again with an even worse 9/11 tragedy.

But the national voice will have to be very loud and very clear for this to happen.

Missile Defense is Provocative and Destabilizing

Nowhere is the rationale and justification for the MAD culture of hostage holding stronger than in the declaration that missile defense is provocative and destabilizing.

American missile defense will cause an arms race; will cause nuclear proliferation in such places as North Korea and Iran; will threaten the military "integrity" of China and Russia and, thereby, challenge their places in the world, and will, as a consequence, be destabilizing to world peace. America must not be allowed to acquire missile defense.

These are the screeds of a community of missile defense opponents that daily pepper the media and public policy worlds. They have been part of the nation's rhetorical landscape for over forty years, and for thirty of those years these pronouncements were protected and made valid by the ABM Treaty's prohibition of missile defense. They have been repeated so often for so long that for some Americans these utterances have become conventional wisdom that carry the ring of truth to be accepted as a matter of course, without challenge.

Therefore, these arguments must be taken seriously. Until the U.S. withdrawal from the Treaty, it had been a losing proposition to refute them, not because they are difficult to refute, but because any serious challenges to them have been irrelevant. What would be the point of challenging the "evils" of missile defense when the ABM Treaty was in place to prevent missile defense? With the Treaty gone, this changes. Refutation should be vigorously pursued.

The flaw in these views is that they have little or no basis in fact. They are, instead, based on philosophy, emotion, and, for some, political advantage, where fact, itself, is irrelevant. The fact that there is no real basis in fact is obvious and to deny this is clear evidence of the dogmatic nature of missile defense opponents who use these arguments.

9 Missile defense historian Donald R. Baucom in *The Rise and Fall of Brilliant Pebbles* (See Appendix D) cites an impressive number of studies and reports of high professionalism, circa 1960-1990, from various research centers and agencies, including those of JASON of the MITRE Corporation, the Defense Science Board, the American Institute of Aeronautics and Astronautics, the BDM Corporation, and the Department of Energy national laboratories, as well as work in the Department of Defense (DOD), i.e., the three services and SDIO. Also, over the last twenty-five years continuing quality work has come from specially convened study groups sponsored by organizations such as the Heritage Foundation (which also spawned High Frontier in 1981 as the first public missile defense advocacy group), the George C. Marshall Institute, the Institute for Foreign Policy Analysis, Inc., and the Center for Security Policy.

To begin with, arms races stem from competition for offensive weapons and while it is true that some of these are designed in part to overcome someone's defenses, the converse that no defenses breed no offensive weapons is without historical basis. Indeed, this proposition is supported by irrefutable evidence that the United States never has had missile defenses for its population, much less its military installations (save for selective use of limited "point" defense, such as the Patriot). But that reality has not prevented either nuclear proliferation or nuclear arms buildups; it has in all probability been the reverse.

The evidence also is clear that the past forty years, most especially the last decade, have seen relentless buildups and bold moves to spread the use of nuclear and other weapons of mass destruction, as witness evolving events in Russia, China, North Korea, and Iran (discussed elsewhere in this report). One of the few times there has been a significant slowing of momentum was in the brief period 1985-1993, which was the height of missile defense development in the United States.

In other words, if anything, a credible missile defense – even in development stage – is much more likely to help slow an arms race and discourage proliferation, because it raises the costs and lowers the chances of success for aggressor nations or terrorist groups to try to find ways to overwhelm an effective missile defense system with their offensive weapons. In this sense, it can become a deterrent and thus contribute to stability. Arguably, there is some evidence of this likelihood, in that at least some of the reasons for the Soviet Union collapse was due to an inability to keep up with U.S. technological developments in this field, and even as the USSR was scaling itself down, it was engaging in ways to share missile defense technology and use – an effort that was discontinued by the U.S. government after 1993.[10]

To close the loop in this logic train: if America has never had missile defense, how come the Soviet/Russian and Chinese nuclear arms buildups have continued unabated over these many years, as has the growth of proliferation? According to the MAD culture, one would have thought arms races and proliferation would have long since slowed – thus making a case based on fact that America, indeed, should continue to forego missile defense. But there is no fact to substantiate such a claim.

To the contrary, while certainly some arms control initiatives have proved useful – paradoxically because of U.S. arms buildups during the Cold War[11] – if history is any example, effective missile defense capabilities could actually help to strengthen and enhance responsible arms control efforts, rather than to foster arms races and proliferation, as opponents so vigorously maintain.[12]

If there is one sliver of fact at all in these assertions, it probably protrudes from the notion that an effective global missile defense system will threaten the military "integrity" of such evolving powers as China and Russia, by challenging their places in the world and, hence, be "destabilizing" to "world peace" – but perhaps not in the way most people think about world peace.

Instead, such a system could well be destabilizing to any expansionist ambitions these or other countries (or terrorist

10 See discussion in Section 4 of this report, especially footnote 23.

11 Armaments, whether nuclear or conventional, are the manifestations of political differences. As international tensions and conflict increase, armaments also increase. In contrast, when tensions and conflict subside, as at the end of the Cold War, disarmament and arms control become relatively easy, as we saw with the Intermediate Nuclear Forces Treaty, the Strategic Arms Reduction Treaty, and the Conventional Forces in Europe Treaty, none of which would have been possible in an era of rising tensions between the United States and the Soviet Union. Far from producing a nuclear Armageddon, armaments increases by the United States proved to be stabilizing factors in the relationship with the Soviet Union, ultimately leading the Soviet leadership, under Gorbachev, to conclude that the Soviet Union simply could not compete with the United States. The collapse of the Soviet Union, faced with the Reagan buildup, including the Strategic Defense Initiative (SDI), contrasts sharply with the failure of the democracies in the 1930s to check Nazi Germany and Imperial Japan, whose buildup of arms far exceeded that of the democracies at this time. Thus, World War II came about in the absence of an arms race, while the end of the Cold War coincided with accelerated U.S. armaments under the 1980s Reagan military buildup. The lesson is that armaments themselves are neutral instruments that can be used for offensive purposes as in the case of Nazi Germany and Imperial Japan or for defensive purposes against an expansionist power as in the U.S. 1980s buildup that successfully countered, contained, and defeated the Soviet Union without war. In the 1930s a preponderance of armaments in the hands of the democracies could have prevented World War II.

12 The dilemma for a nation such as the United States is that history has shown repeatedly that lack of military and defense preparedness more often than not becomes the chief cause of triggering wars – not preventing them. Lack of preparedness and misjudging intentions and capabilities generate wars through miscalculation, which for instance has been the chief source of U.S. conflicts throughout its history. (See Donald Kagan's *On The Origins of War And The Preservation of Peace*, Doubleday, 1995.) Thus, it can be argued that by failing to adopt missile defenses, the United States may suffer the unintended consequences of helping to fuel yet another arms buildup, ultimately leading to war by miscalculation, i.e.,, where the capabilities and intentions of other nations and terrorist groups are underestimated, which in turn creates an incentive for a potential aggressor to increase and ultimately use offensive weapons, "to go for it." The George W. Bush administration's current nuclear modernization program recognizes this reality. Not only is it updating U.S. offensive nuclear weapons as a continuing deterrent against the offensive weapons of other potentially hostile nations, as well as terrorist groups, but it also has added missile defense formally as a part of this deterrent system.

groups) might entertain but only if theirs were covetous ambitions toward other nations, such as the United States or its friends or allies. But short of that, why would any nation object to another nation wanting to defend itself? There is no rational answer, save one: it would be only if someone seeks an aggressive edge over someone else and hopes to achieve that edge "peacefully."

At this point, the sliver of fact dissolves into missile defense objections that are based on philosophical, ideological or political beliefs and resulting emotions, where factual evidence is largely irrelevant. There is no known evidence even to suggest that an arms race or instability occurs simply because a nonbelligerent nation chooses to erect defenses against offensive weapons.

This question was debated hotly in the 1930s, when British pacifists and appeasers objected violently to the idea of building the *Spitfire* and fielding antiaircraft weapons against the growing armada of Hitler's bombers and fighters. But as delay was heaped upon delay and as Hitler's air and land forces grew and grew and started their assault on their European neighbors, it finally dawned on the Brits that with or without the *Spitfire* and antiaircraft weapons, Hitler was out to get them. So Britain hustled – and barely survived.

There is a clear lesson here. A would-be aggressor state will object to another nation wanting to defend itself for nonbelligerent reasons mainly because it could impede whatever designs the aggressor may have regarding the other nation. Those nations who wish America no harm will not object to its missile defenses. Those nations and their sympathizers who would like to marginalize the United States will, indeed, object.

Clearly, it is not factual evidence but philosophical and ideological beliefs, coupled with political agendas, that are used to support the declaration that missile defense is provocative and destabilizing.

It is the apex of pacifist thought, in that it seeks to pacify Americans against the idea of defending themselves from missile attacks. It is a declaratory mantra that – even after fifty years – still plays heavily upon the continuing effects of the two post-WWII American complexes: the still-lingering unease about using "the bomb" and the still-growing dislike of being disliked, which combine to create a chronic oversensitivity about how Americans think of themselves as good-versus-bad actors for "the better good of mankind."

For pacifist purists, it has an alluring poetic beauty because of its ultimate altruism, by offering – openly, for all the world to see – the safety and lives of themselves, their families, and their neighbors in return for the good will of those real and potential adversaries who acquire weapons of mass destruction. It is a powerful form of altruism and is a close relative to both "passive resistance," born in Scandinavia fifty years ago (if they shoot enough people, they will become ashamed and quit), and nihilism (finding satisfaction in generating the risk of self-destruction).

For anti-American political strategists and activists worldwide, the declaration that missile defense destabilizes provides a ready means to advance parts of their own agendas. This is done by telling the pacifists and their other allies what it is they want and, indeed, need to hear so as to verify the rightness of their concerns: "Yes! American missile defense is an act of aggression and will be met with new weapons to overwhelm it, resulting in a more dangerous world."

It is easy to go to the next step: "We must put aside our differences and work together to stop this aggression." Thus, the loop from prophecy to prophecy fulfilled is closed – without the benefit of either history or factual evidence. Hence are built willing allies for antithetical reasons which benefit both in seeking to drive public acceptance toward the common goal of stopping missile defense development. It is in this environment, for example, that the World Peace Council was so warmly welcomed in the 1950s and is still welcome today (see footnote 3 and Appendix G).

For the ambivalent – those who for a variety of reasons are mixed about what to do – the constant drumbeat of "global instability" creates an emotional brake on supporting something that both reason and logic says the nation needs. But "not now."

Sure, we probably need missile defense, but there is too much going on to stir up another hornet's nest… terrorism… keeping good relations where we need them… delicate negotiations, accords, deals… the realpolitiks of logrolling… fear of alienating constituencies and of losing the known status quo for the unknown… not now… later when things are better.

The result: inertia which cedes the field of play to the pacifists and anti-Americanists. Thus, inertia, which in and of itself is not necessarily pacifism, nevertheless, has the effect of being a pacifistic impulse which contributes significantly to the critical mass of missile defense opposition.

The three taken together – pacifism, anti-Americanism, and inertia – clearly indicate the continuing dominance of the MAD culture of hostage holding in U.S. daily policy thinking. Only through public insistence for openness and transparency about security issues by political leaders and policymakers can this cultural construct be broken.

Missile Defense will Weaponize Space

A shield against a sword will weaponize land. A *Patriot* missile against a *Scud* will weaponize a region. An antiaircraft missile will weaponize air space. An antimissile missile will weaponize space.

The same reasoning links all of these declarations: Defending one's self is an offensive act of aggression, because it tells the adversary that you mean to survive to strike back, thus "forcing" the adversary to acquire weapons – hence, "weaponizing " the environment (which becomes the defender's fault). It ignores every human instinct of self-defense and discounts the centuries of legal tradition that codifies this as a natural right.

While pacifists often use such reasoning, the most successful practitioners are generally those individuals and states who have a vested interest in seeing their neighbors defenseless and who work ceaselessly to persuade them to remain so. Recorded history offers stark evidence of how this upside-down approach to war and peace leads to tragedy. It is, likewise, the line of reasoning that led to the MAD doctrine of hostage holding which was codified in the ABM Treaty – thereby overruling all other laws, natural and man-made, concerning the right of self-defense. But it is also the sense of impending tragedy that later saw U.S. withdrawal from the Treaty.

This reversal of policy direction has created, once again, a major problem for missile defense opponents, for there is no longer any legal impediment to missile defense and this takes them back to where they were in the 1960s.

Then – as now – natural law supports self-defense. The UN Charter (Article 51) supports the right of a nation to defend itself and, indeed, the 1967 Outer Space Treaty places no restrictions on using nonnuclear space-based means to shoot down somebody's incoming nuclear ballistic missile as it moves up and through space.[13] Thus back then, the absence of any legal restrictions left a big hole in the rationale of the opponents' arguments.

One could not hope to get very far with the American people if – in order to sell no missile defense – one had to describe the MAD doctrine of population hostage holding; better to bury the details in the fabric of something that would legally prevent missile defense "for everyone." The ABM Treaty was the answer and, once it was advocated by President Nixon and Secretary of State Kissinger and ratified by a Democrat-controlled Senate in 1972, one did not need to explain anything except that missile defense was "illegal under the Treaty." Americans would and did abide by the decision of their bipartisan political leadership, so that missile defense proponents were quickly marginalized and ultimately deemed largely irrelevant in the grand scheme of things.

But when the nuclear arms buildup still continued and nuclear proliferation ballooned well beyond the Soviet arsenals, the flaws in MAD doctrine became increasingly evident, leading to U.S. Treaty withdrawal in 2002. Now, it is the opponents who are being marginalized, not surprisingly and the search is vigorously underway to find another means to outlaw missile defense.

The notion of a new ABM treaty is no longer feasible, with some twenty nations now involved (an enforcement nightmare), and land- and-sea-based missile defense systems are too far out of the development box to stop in their entirety.

However, there is another avenue still open, still essentially untouched, where deployment of missile defense assets can be outlawed – space, through a new space treaty. And that is still the big one. Because space-based interceptors are critical to linking together land-and-sea-based components for a workable and cost-effective layered global defense system.

As discussed extensively in Section 4, the space-based interceptor (SBI) – which *Clementine* demonstrated for *Brilliant Pebbles* – is significantly closer to achieving concept development for wide-ranging boost-phase kill capabilities than either land or sea systems. Arranged in at least one constellation of 1,000-2,000 interceptors (watermelons in "life jackets") placed in orbit 290 kilometers above the earth (each deployed between 800 and 1,600 kilometers apart), the SBIs acting in concert could: (1) be on "alert" at all times; (2) "see" across a 360-degree space-earth horizon to spot firings from either fixed, mobile or submarine platforms and issue instantaneous warnings within the entire constellation and to all other defense systems; (3) dispatch appropriate SBIs out of the constellation to swoop down, streak out or climb to meet the ballistic missile while it is still "hot" or in its early midcourse trajectory before it can deploy its warheads; and (4) in the event of mission failure, enhance the long-range tracking capabilities of land-or-sea-based interceptors to engage the incoming warheads in the midcourse and terminal phases of the missile strike – hence, the term "layered defense."

But that is not yet happening. The logic pyramid discussed in Section 4 – which was turned upside down on its tip in 1993 – still remains upside down after twelve years of geopolitical logrolling. Space-based capabilities still are not on the American agenda for the near future. MAD compliance is still in place with the major nuclear-weapon powers.[14] Not surpris-

13 See Robert F. Turner, "International & Security Law: The Campaign to 'De-Weaponize' Space: Why America Needs to Defend Our Space Assets and Our Right to Deploy a Space-Based ABM System," *Engage: The Journal of the Federalist Society's Practice Groups,* Vol. 5, Issue 1 (April 2004), found in Appendix E.

14 In what some might regard as nervous reassurance to missile defense foes that the George W. Bush administration plans no awkward surprises, Rick Lehner, Director of Communications, Missile Defense Agency, issued these two back-to-back statements shortly after election day: The first, an op-ed appearing in the *Kodiak Mirror*, November 17, 2004, was in response to a local critic about deploying space-based systems and he states: "Not the least bit true. We closed our space-based laser research and development office more than three years ago, and there is absolutely nothing even contemplated at MDA to launch any space-based 'lasers and interceptors aimed at targets anywhere on Earth.'" The second, a November 18, 2004 dispatch from Agence-France Press, reports on Russian plans to deploy a new generation of ballistic missiles to overwhelm any U.S. defenses and also describes the U.S. ground-based missile defense projects in Alaska and California to protest against rogues like North Korea, as well as reveals plans to build a similar site in Europe to protect against a Middle East strike. The French news

ingly, then, missile defense opponents are resurfacing their standard arguments, but this time honed on why space-based systems simply cannot be allowed to happen; that missile defense will weaponize space, and that a new international regime (treaty) is needed.

The logic of this newly minted position of missile defense opponents is as simple as it is transparent: (1) If a new space treaty can be negotiated to outlaw missile defense in space, the United States cannot acquire an effective global protection, which is necessary to guard against the overwhelming preponderance of offensive nuclear missiles presently deployed or being developed all over the world (land-and-sea-based systems cannot deal with this alone). (2) Thus, a highly significant level of population vulnerability is *assured*, i.e., this preponderance of offensive nuclear power stays able to strike an unprotected American people, just as permitted under the old ABM Treaty (Mutual *Assured* Destruction). (3) By constraining the United States from going full measure to protect its people, the MAD doctrine of hostage holding once again is guaranteed in a new era of the "Balance of Terror" and pacificism's successful 40-year legacy of denying protection to the American people is preserved.

Perhaps one of the best expressions of these views is presented in an October 2003 paper by Theresa Hitchens, Vice President of the Center for Defense Information and Editorial Board member of *The Bulletin of Atomic Scientists*:

> *Emerging Bush administration plans and policies are clearly aimed at making the United States the first nation to deploy space-based weapons. There are several drivers behind this goal, including… vulnerability of space assets that are increasingly important to how the U.S. military operates, and the administration's decision to pursue missile defense… The Pentagon's just-revised missile defense plans include… the potential for space-based systems, in particular for shooting down enemy missiles in their boost phase as they begin to ascend… Although it is unclear if these plans are a deliberate foot in the door to the weaponization of space, their implementation would have that effect. A decision to move forward with space-based missile defense systems would end today's policy of restraint… It is imperative that the missile defense program not be allowed to solely drive a decision to weaponize space, especially in absence of serious consideration of the potential strategic, military and economic consequences.*[15]

It is instructive to note that "serious consideration" presumably does not include the consequences of not protecting the American population from ballistic missile attacks by forces already in place, ones who would use space through which to launch their existing weapons. This omission, though perhaps unintentional, nevertheless suggests that space-based missile defense is an impediment to protecting against oth-

agency also observes that the U.S. system is not designed to protect against long-range attack from either China or Russia and then quotes Lehner that "This missile defense system [the proposed European system] being deployed is not a threat to either the Russian or the Chinese strategic deterrent force." [The meaning: that both nations will continue to be able to conduct a first strike anywhere in the world before there would be any response. By every definition this is a continuation of the doctrine of Mutual Assured Destruction, which President Bush has disavowed on several occasions.] Also: *Aerospace Daily & Defense Report*, December 13, 2004, quotes Terry Little, chief of the MDA's Kinetic Energy Interceptor (KEI) program: "We're going to continue, as money allows, to try to work light-weighing [and] miniaturization, but we're not, in the near term, going to undertake any major… development activity to actually provide a space-based interceptor capability." As noted in "U.S. Shelves Move Toward 'Star Wars' Defense," Reuters, February 10, 2005, Lehner continued into 2005 his reassurances that there was no interest in "weaponizing space" and that the Missile Defense Agency was awaiting orders from Congress and the administration on whether to pursue space-based technology, stating "Right now, the debate has not taken place on space-basing missile defense capability." Reports on the adminstration's budget plans suggested a new initiative for space-based defenses (e.g., see "Administration Sketches Out Space Interceptor Program," *InsideDefense.com,* April 5, 2005) – though no funds were provided before 2008. But in response to questions on this new direction, White House spokesman Scott McClellan told reporters, "Let me make that clear right off the top, because you asked about the weaponization of space, and the policy that we're talking about is not looking at weaponizing space." (See "White House Says It Is Not Looking at Weaponizing Space," Agence France-Presse, May 19, 2005.) Thus, the administration invites a debate on weaponization of space but without taking an advocacy position, backed up by a serious proposal. So far, there has been little indication of interested advocates.

15 Theresa Hitchens, "Weapons in Space: Silver Bullet or Russian Roulette? The Policy Implications of U.S. Pursuit of Space-Based Weapons," *Space Weapons. Are They Needed*?, John M. Logsdon, Gordon Adams, eds., Space Policy Institute, Security Policy Studies Program, Elliott School of International Affairs, The George Washington University, October 2003, 87-88, 95, 114. The same old themes continue a drumbeat with increasing frequency in a variety of publications, among the most prominent of which was a May 24, 2005 *New York Times* editorial entitled "Weapons in Space" which among other things claimed that "Nobody knows how well the new weapons might work, and there is concern, even in military circles, that basing weapons in space might trigger an arms race that would leave the United States, with its undeniable advantage in conventional forces, worse off than it is now. Another problem is cost. With virtually all weapons systems busting their budgets, the Pentagon should think hard before putting hundreds of billions of dollars into new space technologies. Congress and the administration need to assess whether a multilateral treaty to ban space weapons might not leave the nation far safer than a unilateral drive to put the first weapons in space." Never mind the long-forgotten 1989-90 studies and critical reviews that showed space-based defenses were the most cost-effective and nearest term missile defense options.

er consequences deemed more important than addressing the possibility of a sneak attack that could result in severe civilian casualties, one that would occur before the United States would in theory respond with a retaliatory strike, i.e., the MAD doctrine is clearly evident here – you nuke us and we'll nuke you.

The use of the term "restraint," as it is specifically applied here to a defense system against an aggressor's offensive weapons, likewise, is instructive. Because it pointedly implies that defending one's self is provocative and destabilizing, which is the apex of pacifistic thought and a close relative to both "passive resistance" and nihilism.

The question, though, is exactly how would space-based missile defense drive a decision to weaponize space? The answer is thin at very best.

First of all, space already is weaponized.[16]

Like the sea, space is a "medium," which Webster describes as "a means of effecting or conveying something." It could be life; it could be things, natural and man-made.

The sea is finite to the earth. It is fungible so that the medium, itself, has no boundaries as a substance but remains limited by its environment. It is a medium through which or in which weapons can be passed or stationed. Webster describes weapons as "an instrument of offensive or defensive combat… a means of contending against another." Therefore, following these definitions, a fixed radio buoy transmitting data for military use is a weapon, as is a torpedo which is made to pass through the sea, as is an aircraft carrier specifically designed to exist in the sea.

The sea has been weaponized for thousands of years and efforts to control that weaponization effectively through treaties have been quite limited, mainly through extending the sovereign shorelines of littoral states to include an agreed-upon area of contiguous seabed (which one nation occasionally steals from another). The one such effort in modern history to prevent weaponization of the seas was the failed 1922 Washington Naval Treaty limiting capital ships of the major powers but excluding aircraft carriers, which became the capital ships used by Japan to attack Pearl Harbor.

The medium of space is infinite in which is housed everything known so far to man. Within it reigns the cosmos (or under the quantum theory, chaos), generally speaking an unfriendly place for unprotected living creatures.

It is, thus, extremely difficult to seek ways to control weaponization through regimes, agreements and treaties. In space everything moves, so that there are no fixed boundaries, save what could be staked out on celestial bodies, like the moon which also moves.[17] Thus, verification and enforcement of treaty conditions is highly complex at best. This reality dictates the imperative that the United States must exercise the greatest care in any discussions or actions relative to another space treaty, for the question arises: Who will control whom and what and how?

Using Webster's criteria, space has been weaponized since 1944, when the U-2, the first ballistic missile, was launched by Nazi Germany against targets in Southern England. Space was the necessary medium through with the U-2 had to travel to strike its earthly target hundreds of kilometers away. The first orbiting object, *Sputnik* (1957), could be classified, at minimum, as a potential weapon, capable of relaying data back to military command posts, which it doubtlessly did.

Since then, space has become a very busy place for civilian and military alike. Anyone with a cell phone or a global positioning system (GPS) unit or access to the internet knows, as does anyone who watches the news. Most particularly, U.S. troops with "boots on the ground" and combat pilots with their smart bombs and cruise missiles know. The commingling of orbiting technology has become virtually seamless as a centralizing constant in our lives, civilian and military alike, so that:

> *Distinctions among military, national intelligence, civil, and commercial programs are being increasingly blurred and in some cases are virtually seamless. The same overhead imagery used by an analyst inside the beltway could be downloaded and exploited by a soldier in Afghanistan. The same global positioning system (GPS) satellites providing a navigation signal to fighters on patrol over Iraq could guide hikers in the Rockies or provide timing to an electrical power grid… Commerce relies on (space capabilities) for the swift flow of*

16 The discussion here is on "weaponization" of space, not "militarization" of space. Nearly everyone who looks at this issue agrees that space has been "militarized" at least since *Sputnik* in 1957 and the human ascent into space a few years later. Some would trace the weaponization of space to the V-2 of World War II which traversed the lower reaches of space on its way to targets in England. It is the matter of *what comprises weaponization* of space that is being examined here. Many missile defense opponents argue that space has not yet been weaponized and that space-based missile defense would "cross the threshold" to plunge the world into terrifying new weapons unique in their capabilities to do harm to other space vehicles or earth targets. It is this proposition that is being analyzed here. Note also that there are likewise some military and other analysts who routinely use "weaponization of space" in the future tense, which suggests they are thinking a very narrow definition of a "weapon" as a device that can physically and directly attack someone else's assets or personnel. This discussion argues (1) that the use of this narrow definition of space weaponization is too restrictive and (2) that a more inclusive definition is needed in order to assess properly the assertion that missile defense will *drive* a decision to weaponize space.

17 Admittedly, 200,000-or-so years from now there may well be a real "Star Trek" world, in which the forces of good or evil lay claim to whole solar systems or galaxies which have certain fixed cosmic boundaries and, thus, could be subjected to far-reaching space laws and meaningful enforcement. But until then, from earth's current vantage point, everything moves and how high is high or how far is east or west or north or south is infinity.

information and transactions, and the national security arena depends on them for joint warfighting and protection of the homeland.[18]

So, the problem of identifying space weaponization in terms of just exactly where and under what conditions it exists is highly complex, particularly as to how space weaponization can be defined in terms of international/space law. In this regard, Robert A. Ramey, who has been chief of space and international law at the U.S. Air Force Space Command, writes:

(The) basic term space weapon lacks definition in international law. As a result, the concept it represents, which broadly speaking includes any implements of warfare in space, is difficult to isolate. Without this foundational definition, one cannot define phrases on which it might rely. The difficulty comes into particular focus by observing that any comprehensive definition of space weapons will include space systems equally used for nonmilitary, nondestructive, and nonaggressive purposes. Though space weapons may seem to include only a discrete class of armaments with easily definable characteristics, a closer examination "reveals a less obvious and more inclusive set of systems."[19]

Ramey then goes on to quote Bhupendra Jasani, an authority on legal space issues, as offering one proposed definition of space weapon that "illustrates the challenge":

A space weapon is a device stationed in outer space (including the moon and other celestial bodies) or in the earth environment designed to destroy, damage, or otherwise interfere with the normal functioning of an object or being in outer space, or a device stationed in outer space designed to destroy, damage, or otherwise interfere with the normal functioning of an object or being in the earth environment. Any other device with the inherent capability to be used as defined above will be considered as a space weapon.[20]

Based on these observations and definitions, the proposition that spaced-based missile defense will drive a decision to weaponize space is a false assertion that should be rejected in any serious discussion about how such a system will affect the weaponization of space.

Rather, the proper question is: how will (or should) something – including missile defense – further weaponize space beyond the current space environment? Thus, the dynamics of discussion shift from suggestions of a dire new, first-ever "doomsday close upon us," with all that implies, to one that addresses with careful analysis an already existing condition that would be altered by another orbiting device.

This is easier said than done. Because many of those who express concern that the United States might unilaterally precipitate an unnecessary international crisis by being the "first to weaponize space" appear reluctant to address such a question. To acknowledge that space already is weaponized understandably weakens their arguments that the United States should not be the first in space with such "armaments." It further blunts their arguments against space-based missile defense. Hence, a narrow, arbitrarily drawn definition suits their arguments best.

For example, William L. Spacy II, writing as a career Air Force officer in 2003, states:

Space-based weapons have been proposed for ballistic missile defense (BMD), space control, and attacking terrestrial targets… To narrow the discussion to the most contentious issues, this paper considers space-based weapons to be only those systems for which the destructive component resides in orbit. Systems that rely on space-based assets for information collection, weapon cuing and guidance, as well as weapons that only transit space on the way to their target, are not considered to be space-based weapons.[21]

By setting the space weaponization "counter" to zero (eliminating existing space assets from the weaponization calculus) a heightened sense of crisis emerges driven by three thoughts: (1) "weaponization of space" must be prevented; (2) if the United States "sets the standard" by not "weaponizing space first," no one else will; but (3) if the United States proceeds, an arms race will ensue. Since space-based missile defense would be one such weapon, its deployment will cause an arms race; thus, to maintain "stability" space-based missile defense must be banned.

These were essentially the same arguments used in the sixties that missile defense would cause an arms race and that the ABM Treaty was needed to prevent this.

Spacy appears to share many of these views, although in a somewhat ambivalent manner:

Space has long been treated as something of a sanctuary and kept free of weapons … (Today, because of our increasing reliance on space-based assets to provide enabling information to the military), a space sanctuary strategy may benefit the United States now more than ever… Boost-phase ballistic missile defense, using either lasers or KE [kinetic energy] weapons, is the one area where orbital weapons appear to be the only alternative; however these weapons do not appear to be practical. Even if an effective system could be created; doing so could prompt adversaries to re-direct their weapons development into other areas (away from effective bal-

18 Peter B. Teets, "National Security Space Enabling Joint Warfighting," *Joint Force Quarterly,* (Winter 2002-2003), 32-33.

19 Robert A. Ramey, "Outer Space Law," *National Security Law*, John Norton Moore and Robert F. Turner, eds., (Durham: Carolina Academic Press, 2005), 2nd Ed., 769-770.

20 Ibid., 770. Note: Ramey's citation for the above is: Bhupendra Jasani, "Introduction" to *Peaceful and Non-Peaceful Uses of Space: Problems of Definition for the Prevention of an Arms Race*, Bhupendra Jasani, editor, (United Kingdom: Taylor & Francis, 1991), 13.

21 William L. Spacy II, "Assessing the Military Utility of Spaced-Based Weapons," *Space Weapons. Are They Needed?,* John M. Logsdon, Gordon Adams, eds., Space Policy Institute, Security Policy Studies Program, Elliott School of International Affairs, The George Washington University, October 2003, 122.

> *listic missiles)... The question becomes whether or not removing ballistic missiles as a viable option for potential adversaries is worth the extremely high cost of an orbital defensive system. It is entirely possible that a ground-based BMD system would provide enough of a disincentive without space-based weapons. If we need a defense against ballistic missiles, then it makes more sense to put the sensors in space and keep the weapons on the ground.*[22]

What Spacy apparently is saying is that we do not need to worry about boost-phase missile defense; that ground-based systems, which cannot be effectively used for this purpose, nevertheless, will provide enough of a "disincentive" to protect the U.S. population from a strike from somewhere.

This assumption – that if the United States does not "weaponize" space no one else is likely to do so – is widely used in varying configurations. A representative example is recent work by co-authors Bruce M. DeBlois, Richard L. Garwin, R. Scott Kemp, and Jeremy C. Marwell. The far-ranging analysis, entitled "Space Weapons," gives its purpose as examining "the possible roles for space weapons in addition to missile defense – for protecting satellites, controlling space, and projecting force – in terms of capabilities and cost."[23] Note that population protection is not mentioned.

However, the authors do offer these asides in both their introduction and conclusions:

> *At the same time (as the utility and inherent political risks of space weapons are being evaluated), the United States should seriously consider the gains to national security to be found in an international regime banning space weapons and should work to encourage other states to join a regime opposing the deployment of space weapons, although the details of such considerations are beyond the scope of this article... An aggressive campaign to prevent the deployment of weapons by other nations might best be implemented as a U.S. commitment not to be the first to deploy or test space weapons or to further test destructive antisatellite weapons. A unilateral U.S. declaration should be supported by a U.S. initiative to codify such a rule, first by parallel unilateral declarations and then perhaps a formal treaty. A treaty would have the added benefit of legitimizing the use of sanctions or force against actions that would imperil the satellites of any state.*[24]

So what, then, are the primary dangers that drive certain members of the arms control community and their allies in seeking, with a sense of urgency, to ban the "weaponization of space"? Leaving aside that space already is weaponized by generally accepted definitions, their question really becomes "what are the specific threats inherent in the further weaponization of space?"

22 Ibid., 163-165.

23 Bruce M. DeBlois, Richard L. Garwin, R. Scott Kemp, and Jeremy C. Marwell, "Space Weapons. Crossing the U.S. Rubicon," *International Security*, Vol. 29, No. 2 (Fall 2004): 50-56.

24 Ibid., 51, 84.

Since the 1967 Outer Space Treaty already prohibits weapons of mass destruction (WMDs – nuclear, chemical, biological) either in orbit or celestial-based, the potential for so arming vehicles and objects, such as space shuttles and space stations, does not appear to be of immediate concern. The belief is that the treaty will continue to be honored by the nearly 100 signatory countries.[25] Thus, the unleashing of WMDs from space currently is not deemed a threat.

Rather, the specific threats, as perceived by space-weapons-ban proponents, boil down to just two main possibilities involving nonnuclear devices, principally using either kinetic energy or lasers in offensive, direct-attack modes: (1) space-to-earth weapons designed to strike terrestrial targets and (2) space-to-space weapons designed to attack hostile satellites, i.e., antisatellite weapons (ASATs), or protecting U.S. satellites, so as to maintain "space control."

Space-to-earth weapons would strike targets, such as military force projection missions (bunkers in Iraq or a surgical strike on a nonsanctioned nuclear processing installation).

One kinetic weapon examined is the "long-rod penetrator," long tungsten or uranium rods falling vertically from orbit at 460-kilometer-altitude to penetrate ground targets to a depth approximate to their length, creating the effect of a conventional explosion. Dubbed by some as "rods from God," the concept has been generally rejected – spears having been similarly rejected as the weapon of choice sometime ago.

The other is a space-based laser to strike earth targets with precision accuracy. However, the currently evolving airborne laser could likely perform essentially the same function, and, of course, there are several other nonspace alternatives already developed and used, such as cruise missiles, "smart" bombs, "bunker busters," and artillery. Other future nonspace possibilities include potential use of guided nonnuclear intercontinental ballistic missiles (ICBMs) or submarine-launched intermediate-range ballistic missiles (SLIRBMs).

In sum, there is little by way of uniqueness (in doing something nothing else can) in developing kinetic or laser space-to-earth weapons, where there already are nonspace weapons to do the job. Here, even proponents for a new space treaty acknowledge this; indeed, some go to great lengths to point this out.[26]

That leaves essentially only one serious area where further weaponization of space has yet to occur and that involves protecting U.S. satellites from attack by ASATs – and, on the flip side, worry by other powers and anti-Americanists that the United States, as an aggressor, might develop its own ASATs not only to protect its own but to attack other satellites, not an

25 See Robert F. Turner Memorandum in Appendix E.

26 DeBlois, et al, "Space Weapons," *International Security*, 67-74. The discussion here focuses particularly on space-to-earth points noted above, citing (on page 73) that "even (space-basing) enthusiasts admit that space-based lasers would be a specialist, 'leading-edge' tool for attacking a narrow class of targets. They would not replace conventional military means."

attractive possibility to pacifists and arms-control extremists. Such space weapons by and large would be lasers and possibly kinetic energy devices, where the function – at least from the U.S. perspective – is to exercise "space control."

Therefore, the cosmic issue of creating a new space treaty or other regime to ban the "weaponization of space" – so urgently called for by so many in the arms control community – actually is reduced primarily to a single issue, that of seeking international control over the use of space-based ASATs belonging to the United States and presumably other countries, that also by implication links to space-based missile defense. This is not quite the same cosmic issue as one seeking to ban all space weapons because they have the unique capability to do harm in ways no other weapons can.

Usually, treaties or regimes concern something that is unique and of critical importance, i.e., the UN Charter (that altered geopolitics), the 1967 Outer Space Treaty (which banned orbiting weapons of mass destruction), and the ABM Treaty (which outlawed missile defense for populations).

But even here, the uniqueness of banning a nonnuclear, space-based antisatellite weapon is not as dire as this sense of urgency for a new treaty suggests – for the very good reason that if someone wants to "take out" an enemy satellite, they can do it already, using existing or near-to-development terrestrial-based or airborne means.

These include: jamming satellite signals, physical attacks on satellite ground stations, dazzling or blinding sensors, ground-fired hit-to-kill missiles, high altitude nuclear explosions, and, in the not-too-distant future, pellet-cloud attacks, and microsatellite space attacks (see discussion in Section 1 about the China-Surrey microsatellite projects).

Here again, proponents for a new space treaty acknowledge this.[27] They also point out in at least one extended discussion that "the development of space weapons would not significantly mitigate" many of the above threats.[28] Rather, technologies such as radiation hardening and shielding of U.S. satellites, command and data encryption, limited orbital maneuvering, and antijamming measures would be preferred. Also, destroying ground-based enemy ASAT laser sites could better be accomplished by conventional weapons. And while not rejecting space-based lasers to defend U.S. satellites, they take the view that the "cost and limited effectiveness of a weapon-based satellite defense must be weighed against those alternative approaches… (which are) preferable to a weapons-based solution with a known low probability of success."[29]

It is here that many new-space-treaty proponents find themselves in a muddle. On the one hand, they devote much effort to establish that the United States can maintain its global military force projection capabilities without "weaponizing space," without "resorting" to space-to-earth weapons, and, similarly, to point out that the United States can maintain adequate space control to protect its satellites also by using nonspace assets, rather than "crossing the line" to develop space-to-space weapons.

On the other hand, these proponents move seamlessly into firm declarations that it is imperative that the United States unilaterally should declare its "commitment not to be the first to deploy or test space weapons" and also should take the "initiative" leading "perhaps to a formal treaty."[30]

In other words, with a new space treaty the United States would be practicing an advanced version of "unilateral disarmament" that was used as the centerpiece for the nuclear disarmament arguments of the 1950s-1960s, i.e., if the United States disarms itself, the Soviet Union will surely follow – the argument that led ultimately to the MAD doctrine of hostage holding and the subsequent ABM Treaty, which, of course, did not prevent a huge nuclear arms race. A new space treaty would become an advanced version in that it would be unilateral disarmament before the fact, not even progressing to a point where there would be something to disarm.

The ramifications of this new application of unilateralism are staggering, for they would preclude the United States from making full use of its science and technology to stay on the cutting edge of space development of both offensive and defensive means to protect current and future space assets, as well as the American people. It would leave the way open to be perpetually vulnerable to the weapons that other nations might develop in the absence of any conceivable viable means of treaty enforcement that would serve U.S. vital interests (discussed elsewhere in this report). As Portugal and later Spain both lost dominance of the seas during the middle of the last millennium, so would the United States be edged out of any leadership role in space development.

The muddle occurs because new-space-treaty proponents do not make the case of uniqueness much of anywhere in the foregoing discussion that would call for a new space treaty at this time, thus obfuscating the reasons why such a new regime is presumably so necessary.

After all, even with a new space treaty, protection of U.S. satellites – or anyone else's – initially would not be made necessarily more secure. Similarly, a new space treaty, some proponents agree, would not at this time blunt U.S. global power-projection capabilities, even with space-to-earth weapons (the United States would simply use other existing terrestrial and airborne assets). And there is general agreement that the 1967 Outer Space Treaty is already effective in banning weapons of mass destruction.

So why a new space treaty?

27 Ibid., 55-67. The extended discussion here primarily focuses on both protecting U.S. satellites and space control.

28 Ibid., 56-57.

29 Ibid., 61.

30 Ibid., 84.

At least two reasons present themselves. The first is that were the United States unilaterally to eschew "weaponization of space," the long-standing quest of pacifists and arms control devotees would in part be realized: The United States by standing aside would thus inspire and motivate other nations to do likewise so as to achieve space peace in our time, while doing what is best for America.

This certainly would be unique but new-space-treaty proponents do not beat that drum too loudly, because the uniqueness would be in the permanent codification of U.S. unilateral disarmament before the fact – a first in American history. It is not a subject most Americans would warm to. So the matter is approached with somewhat softer edges than reality demands in assessing this fundamental change in defense doctrine.

One of the more measured approaches is expressed by Michael O'Hanlon, writing as a Senior Fellow at the Brookings Institution, who stresses voluntary unilateral restraint as a prelude to any new space treaty, but the effect is still the same, i.e., holding back until a threat is imminent, which O'Hanlon presumably does not see as being near term:

> *By racing to develop its own space weapons, the United States would cause two unfortunate sets of consequences. Militarily, it would legitimate a faster space arms race than is otherwise likely – something that can only hurt a country that effectively monopolizes military space activities today. Second, it would reinforce the current prevalent image of a unilateralist United States too quick to reach for the gun and impervious to the stated will of other countries (as reflected in the huge majority votes at the United Nations in favor of negotiating bans on space weaponry)... By the same token, the categorical opposition to space weapons... is too optimistic... So a moderate and nuanced policy, rather than an absolutist or ideological one, is the right path ahead for the country... But any U.S. policy to pursue the actual weaponization of space in the near term would be a mistake... military space competition will occur regardless of American policy... Certain (nonspace) missile defense systems, together with laboratory research (is adequate for the moment but) no dedicated ASAT programs are needed or desirable. [Note: In this essay, space-based missile defense is treated as a latent ASAT.]*[31]

There is a second, more compelling reason that is highly time sensitive and therefore urgent: A new space treaty is needed to keep the United States – and other nations if one wanted to be ecumenically fair – permanently MAD-compliant in its security and geopolitical behavior toward most of the international community particularly toward Russia and China.

It is this MAD-compliant element that would make a new space treaty genuinely unique, which is to prevent the development and deployment of a space-based device that no other defensive weapon or system could do on a coherent global basis – a device that could strike down a ballistic missile in its boost phase or early trajectory from virtually anywhere in the world. It is space-based missile defense.

A new space treaty would replace the now-defunct ABM Treaty, if not to ban missile defense generally, then at least to ban missile defense where it counts the most: to preserve much of the existing nuclear powers first-strike capabilities without a "defensive threat" against them, theoretically relying on retaliation by the United States to deter a nuclear attack: hence, the recodification of the doctrine of Mutual Assured Destruction and its key tenant, population hostage holding.

Here again, proponents do not beat that drum too loudly. The subject of population vulnerability as the best means to protect that very same population by denying them effective missile defense is no more popular today than it was forty years ago. Indeed, their use of the term "missile defense" most of the time these days is referred to as simply a self-explanatory object that requires no real definition and no discussion of consequence as to its need and purpose.

Rather, missile defense is regarded by most new space-treaty proponents as just one more component in the complex and extremely broad spectrum of strategic arms and their delivery systems, a component of dubious value in the near term and perhaps of some value in the distant future – but in any event destabilizing to the grand scheme of things. With this collective mind-set, then, missile defense therefore has been and still continues as a kind of pawn on some huge arms control chessboard that can be easily bargained away as it was in the 1970s.

Yet, few if any of these proponents say they are "against" missile defense. They merely argue its irrelevance in terms of being technically unsound and thus wasteful and ineffective and "destabilizing" – always "destabilizing." What is never addressed is the paradox of this mantra: If missile defense will not work, how is it destabilizing?[32]

The persuasive evidence points the other way: Space already is weaponized; therefore, missile defense will not drive the weaponization of space; It will defend space and earth, itself, from hostile missiles; It will save lives, not take them; It will help stabilize, not destabilize.

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31 Michael O'Hanlon, "Preserving U.S. Dominance," *Space Weapons. Are They Needed*?, John M. Logsdon, Gordon Adams, eds., Space Policy Institute, Security Policy Studies Program, Elliott School of International Affairs, The George Washington University, October 2003, 187, 204-205.

32 For those who wish to review in more detail this summary of the views of new-space-treaty proponents, the following articles, already cited in this discussion, should be reviewed in their entirety: Hitchens, Spacy, O'Hanlon in *Space Weapons. Are They Needed?*, and authors DeBlois, et al, "Space Weapons," *International Security.*

Missile Defense will give America too much Unilateral Power

As discussed earlier in several places, defending one's self, as with a nation defending its people, is a natural right, so long as it does not encroach on the peaceful pursuits of others. To argue otherwise, that this natural right of defense gives someone "too much power," is one of the oldest art forms in which one nation seeks to lure another into complacency – one of the more dramatic examples being the destruction of Carthage by Cato's Rome.

This reality should be self-evident: A would-be aggressor state will object to another nation wanting to defend itself for nonbelligerent reasons mainly because it could impede whatever designs the aggressor may have regarding the other nation. Those nations who wish America no harm will not object to its missile defenses. Those nations and their sympathizers who would like to marginalize the United States will, indeed, object.

The "too much power" in this case is fairly transparent. Certain nations, such as Russia and China, have invested huge sums in their offensive nuclear programs (strategic forces) and other emerging nuclear powers and wannabe rogue states are making similar investments.

If the United States (or any other nation) deploys an effective, layered global missile defense system with space-based interceptors as the unifying element (see Figure 4.1 in Section 4), it throws into question the functional integrity of any other nation's first strike capability and, thereby, raises the risk of mission failure and also the loss of credibility that any would-be aggressor must have to carry out its agenda effectively for political intimidation.[33]

It is understandable that emerging powers such as Russia and China (and some other states) are uneasy that the United States "just might pull it off," so that any political means to slow U.S. progress in space, particularly missile defense, has its own logic – even as both of these nations proceed with offensive nuclear missile buildups and their own ASAT programs without apology, matters reviewed elsewhere in this report.

The following observation reflects this concern:

> *China and Russia long have been worried about possible U.S. breakout on space-based weaponry. Officials from both countries have expressed concern that the U.S. missile defense program is aimed not at what Moscow and Beijing see as a non-credible threat from rogue-nation ballistic missiles, but rather at launching a long-term U.S. effort to dominate space.*[34]

More obscure to grasp, however, is understanding what drives others – arms control extremists, pacifists, realpolitik practitioners, anti-Americanists – to protest so strongly about incorporating effective missile defense systems into the general mix of the global military environment that is ever-present.

One reason, at least, is based on the fundamental pacifist argument that defensive weapons breed arms races and that – particularly in the nuclear age – "stability" is achieved by negotiating, through the political powers and wisdom of arms controllers, a "balance of terror" of carefully proscribed offensive weapons in which no one nation has too much power over the others. In other words, it is the continuation of the doctrine of Mutual Assured Destruction, updated to include space and the twenty-first century.

Based on this view, space-based missile defense gives the United States too much power, because its vulnerability to the offensive nuclear weapons of other states or terrorist groups would be reduced significantly. Rather, it and other nations must remain vulnerable; otherwise, how are the major powers, particularly America, to be kept in line?

A March 2005 newspaper article describing a report on Pentagon space doctrine and a recent Geneva arms control conference, makes a useful reference to this view about U.S. power:

> *Arms control advocates in the United States and abroad are expressing concern with the Bush administration's push for military superiority in space... Michael Krepon, president emeritus of the Henry L. Stimson Center and an arms control official in the Clinton administration, said the United States is moving toward a national space doctrine that is "preemptive and proactive"... Krepon said (at the Geneva conference) a new treaty is needed because "if the U.S. proceeds to weaponize space, anyone can compete, and that makes sure everyone loses."*[35]

If there are some in this world who want to limit U.S. power, then do it through honest, forthright competition in responsible self-government and economic and social advancement to earn the merits of leadership among the nations – but do not ask Americans, or any other people, to give up their right to defend themselves as the means for others to declare victory over their ways.

Missile Defense is Morally Wrong

Ever since the beginning of the nuclear age, the belief has persisted among some that a defense against nuclear missile attack is "morally wrong." Its genesis came with the grim aftermath of the atomic destruction of Hiroshima and Nagasaki, in which the United States was roundly criticized from several different quarters, most particularly, elements of the religious community.

The fact that both the Soviet Union and, more particularly, Nazi Germany, were well on the way to developing their

33 In the spring of 1996 during political elections in Taiwan, the People's Republic of China (PRC) threatened to use nuclear weapons against Los Angeles if the United States "interfered" with China's "internal affairs."

34 Hitchens, *Space Weapons. Are They Needed?*, 104.

35 Walter Pincus, "Plans By US To Dominate Space Raising Concerns," *Washington Post,* March 29, 2005, p. 2.

own atomic weapons was quickly dismissed as "irrelevant" by many ardent pacifists and others with related interests. That Germany was on the verge of producing the Bomb to end World War II in its favor was of little significance, since it was the United States alone that unleashed this new scourge upon mankind and thus held to be morally irresponsible.

As discussed earlier, the theme that the United States must be prevented from ever "doing so again" was a dominant factor in the rise of the nuclear disarmament movement, in part fostered by the Soviet-sponsored *World Peace Council* (see footnote 3), and the campaign for unilateral disarmament – all of which gave way to continued Soviet nuclear buildups and the doctrine of Mutual Assured Destruction, resulting finally in the 1972 ABM Treaty.

During the 1950s, the first direct application of the immorality of nuclear self-defense came with U.S. civil defense programs practiced then, in which, among other things, Americans were drilled in schools, homes and offices to "take cover" in the event of an atomic attack. They were also instructed as to how to survive for up to a month in fallout shelters (until radiation, which has a half-life, would expend itself to safe levels).

It was the shelter program that certain church leaders and other "moralists" seized upon. It was a version of the old "lifeboat dilemma": What happens if there is no room in the lifeboat for everyone, do you take everyone aboard until it sinks with everyone lost, or do you sacrifice the lives of those which the boat cannot carry, in order to save the lives of the rest?

In this case, the anti-shelter moralists' message was: If the shelter program could not protect everyone, better that all perish. The program, which was never popular (who wants to dig up their backyard?) atrophied, but the arms control debates continued to carry with them the subtext that missile defense is morally wrong, because it is an act of aggression that builds tensions and thus is provocative. The "solution" was to get rid of all nuclear weapons, which was a view pushed particularly by a number of prominent religious leaders and church bodies. This leadership was vague as to how this was to happen (as it still is).

With the advent of MAD and the ABM Treaty, the moral issue largely became moot, until the 1980s when it looked as if missile defense was back again. Bishops of the Catholic Church once more raised the issue that the answer was not missile defense but nuclear disarmament.

The morality pot bubbled along with varying intensity, until the spring of 2001, when bishops of the United Methodist Church, meeting in Arizona as the church's top legislative body, and involving representatives from the United States, Africa, Europe and the Philippines, authorized the following statement (in part):

> *United Methodist bishops are calling upon President Bush and the U.S. Congress to refrain from development and deployment of a national missile defense system, which they call "illusionary, unnecessary and wasteful"... In their resolution, the bishops are adamant about the defense system but commend Bush for his commitment "to persuade Russia to join the United States in reducing arsenals to the lowest number of nuclear weapons consistent with our... national security needs and to lead by example by making substantial unilateral reductions if necessary"... Each bishop is asked to work with leadership in his or her respective area and with United Methodist and ecumenical groups to "resist development and deployment of the defense system."*[36]

This view would strike many as a profound testimony to the serenity and unwavering faith of these members of the clergy; namely, that by the United States foregoing such defense would-be aggressors against the United States will depart in peace. Since the tragedy of September 11, 2001, however, when some would-be aggressors did not depart in peace, church groups and other "moralists" have moved on to other matters but likely will return to this issue as the missile defense debate continues.

Missile defense today remains a moral issue for some but it is seldom invoked as a mainstay in serious discussion. Indeed, it never has been. Except for the specific arguments concerning fallout shelters, it has been treated as a kind of appendage in the continuing debates on moral issues governing just wars, unjust wars, social justice, and the like.

Thus, there has been no serious challenge to or definition of the idea that missile defense is morally wrong. When it is referred to, it is usually as an aside, a flat pronouncement made without elaboration or explanation – just *there*, an as-everyone-knows reflex in the rhetoric that still remains as part of the MAD culture.

One of the more recent examples of unexplained reference to the immorality of missile defense comes from William Spacy. In his discussion on how missile defense might be decentralized, he accurately quotes Dr. Lowell Wood's description of *Brilliant Pebbles* as each having its self-contained ability to respond swiftly, so that it could perform its purely defensive mission with no external supervision or coaching. Spacy then goes on to say: *"Aside from the moral reluctance of many to give any weapon so much autonomy*, a major problem with this concept is to devise a computer/software combination small, cheap and smart enough to do the job."[37]

Here, Spacy seems to have himself, or recognizes in others, a moral problem with a weapon "smart enough" to respond to a hostile missile attack quickly enough to shoot it down to save lives – this without "reporting" to anyone in advance before taking what in effect is a real-time defensive response.

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36 "Church's leaders oppose U.S. missile defense plan," *United Methodist News Service*, Nashville, Tenn., May 4, 2001, <http://umns.umc.org/01/May/224.htm>.

37 Spacy, *Space Weapons. Are They Needed?*, 130.

Further, he does not elaborate. He simply notes "moral reluctance" as an aside, as a "given" requiring no further explanation and moves on.

Yet, this point is important to any serious discussion about missile defense. Near-real-time responses are critical if a layered system is to work; so that if there is a moral problem, then it should be examined in detail. And in this particular matter Spacy is comparing apples to oranges by applying a set of concerns about one kind of weapon to another kind of weapon with a different function and mission.

First, nuclear weapons designers properly have long been concerned about how much of a "hair trigger" should be incorporated into missile firing and command/control systems. Too much automation without fail-safe supervision could lead to accidental or unauthorized launches, where megaton-size nuclear missiles could be sent screaming down upon millions of people with little warning – a nuclear Armageddon.

Hence, the use of complex firing codes and "black boxes" and "footballs" that most heads of nuclear-power nations (certainly the United States) always carry with them to guard against such an event. But these are offensive nuclear weapons, ones calculated to destroy lives and property. These are the apples.

The oranges are different. They would be space-based interceptors, defensive weapons, designed to save lives and property. They would be small and compact defensive weapons, in this case *Brilliant Pebbles* (BP), that would use, not explosives, but their own body weight to provide kinetic energy. This would occur when the device (pebble) first "sees" the hostile nuclear weapon as it is launched, and locks on to the ascending missile. The device, powered by a mini-rocket, then would streak down or out or up to strike the missile (like a large pebble) and knock it out of commission.

Obviously, seconds count, because once the pebble "sees" the missile firing, it must respond instantly or it is too late and the hostile missile is well on its way to its target. The problem of accidental activation, however, would be virtually eliminated, because the autonomous system – like cruise control on an automobile – would be designed to be switched off as the BPs pass over friendly or nonhostile territory and turned on again over potentially hostile territory and programmed to do so automatically.[38]

A reasonable comparison is the average home security system, which must be real-time automated, i.e., to activate its alarms the second an unwanted intruder shows up, so that law enforcement can respond effectively. Obviously, a prudent owner will turn off the alarm when moving about the premises or when expecting guests, but otherwise the owner wants the system armed to be able to respond quickly when needed.

An automated SBI, whether kinetic, like BPs, or laser energy, would have the same quick-response capability, otherwise its function would be reduced to that of an early-warning radar and would be unable to make an interception. In this context, it is difficult to find the same kind of moral dilemma with *Brilliant Pebbles* or other SBI as one associates with a fully automated offensive nuclear strike weapon.

If the morality of missile defense is to be questioned, then the entire proposition must be put on the table. The entire proposition, in fact, is: If missile defense is morally wrong, it follows that it is morally right for government not to provide missile defense.

This, then, raises another dimension of the question posed by Ronald C. Tocci, which "moralists" opposing an effective missile defense system must answer forthrightly, completely and convincingly, if they are to preserve their credibility:

Is it a moral act for the government of the United States deliberately to hold its own population hostage or otherwise vulnerable to the offensive weapons of another nation or terrorist group?

Summary Conclusions

Sections 4 and 5 have looked at much of the history, politics, facts, realities and myths that has been the saga of missile defense for more than forty years, as nation after nation has built and continues to build nuclear armaments that can be used against Americans and people of other countries.

There are three inescapable conclusions.

The first is that there has never been anything in America's military history to compare with the political efforts that have been made by the government of the United States over this forty-year period to forestall the process of defending its population from a known threat from the offensive weapons of another state, and while some progress has been made since the ABM Treaty withdrawal, this reluctance continues as a political drag on the whole missile defense effort, particularly the deployment of space-based interceptors.

38 Further, even if a BP "got away" to "run wild," it would quickly burn up in the atmosphere. And in the case of an accidental shoot-down involving the mistaken identity of someone's "innocent" missile (such as one carrying a communications satellite), *Brilliant Pebbles* and other SBIs would fall under the same protocols and international notification procedures that have long governed an unwarranted response by *offensive* nuclear weapons against another nation, i.e., when a country plans to launch a nonthreatening rocket – such as for a weather or communications satellite or to ferry astronauts and supplies to the international space station or the moon or to send robots to Mars or to orbit telescopes – those powers possessing *offensive* nuclear weapons are notified well in advance, so as to avoid a terrible misunderstanding that could trigger a massive retaliatory nuclear strike against the country of origin. *Brilliant Pebbles* and other SBIs would fall under the same protocol of advanced notification and, of course, their automated systems would be switched off, even as *offensive* nuclear weapons would be taken off hair-trigger alert and ordered to "stand down."

The second summary conclusion is that time is not on America's side. Immediacy, too often, is deemed not especially important, given all the other make-or-break things going. on. After all, the reasoning goes, the United States has survived these many years without missile defense, so what are a few more months or years?

But there is one nagging detail that is not easily dismissed. In this emerging twenty-first century of dependency on electronic automation brought about through the High-Tech Age, it only takes one low-grade nuclear weapon and only one nation or terrorist group to act and America's clocks literally stop. Whether a sophisticated or "homemade" missile, just one of these devices exploded 400 kilometers above, say, Columbus, Ohio would change the life pattern of every living American – without regard to ethnic origins or political beliefs or religious views or age or economic status.

The explosion would not be noticed by most people. The lights would simply go out, elevators would stop, computers and air conditioners would fall silent. Not a brownout or a blackout but a burnout. Not for days but for months upon months and in some instances perhaps years.

The phenomenon, known as electromagnetic pulse (EMP), is described in Section 1. It is generated by the explosion of a nuclear weapon and is a consequence detected in the 1962 tests at Johnston Island in the Central Pacific and subsequently carefully examined through other tests by nuclear physicists off and on for years – particularly U.S. and Soviet/Russian scientists.

EMP is a subsidiary by-product of a nuclear detonation, the better known and understood products being extreme blast damage and devastating radioactive fallout that are associated with low-altitude or ground-level detonations. While certainly of interest, it was not particularly central in the continuing calculus of Mutual Assured Destruction, where physical mass destruction was the factor in the "Balance of Terror."

But in recent times, world dynamics have changed, and the relevance of EMP itself, with the capacity of burning out electronic devices of all sorts, has changed with it. This has given rise to an intriguing concept of using EMP as a stand-alone weapon, where blast damage and nuclear fallout do not really count; rather, to launch a low-yield nuclear missile to a selected high altitude (40 to 400 kilometers), detonate it and then watch somebody's lights go out. It is also eminently doable at relatively low cost requiring fairly uncomplicated logistics, as compared with other, more sophisticated efforts in the world of nuclear weapons. One will do the trick for most large countries or regions, although three or four backups likely would be used, since they would be not too difficult to rig (as was demonstrated in the 9/11 attack).

There are two basic reasons why an EMP attack would be a highly effective means to mount an attack that could be devastating against an electronically sophisticated nation, such as the United States.

The first is the growing value of "asymmetrical warfare," in which one country attacks the vulnerabilities of another to "level the playing field" or to try to defeat it.[39] As the 2004 commission report on EMP states:

> *Several potential adversaries have or can acquire the capability to attack the United States with a high-altitude nuclear weapon-generated electromagnetic pulse (EMP)... one of a small number of threats that can hold our society at risk of catastrophic consequences... It has the capability to produce significant damage to critical infrastructures and thus to the very fabric of US society... Our vulnerability is increasing daily as our use of and dependence on electronics continues to grow. The impact of EMP is asymmetric in relation to potential protagonists who are not as dependent on modern electronics.*[40]

The second reason concerns existing protagonists who have already declared their extreme hatred of the American people, in particular, and disdain toward Western Civilization and its friends in general. We know them principally through the War on Terrorism and we know of their affinity for the violent dispensation of death. They are not very dependent on modern electronics for quality of life but make clandestine use of computers, cell phones and electronic detonation to destroy the quality of life for others.

As their fortunes worsen – and the indications point in that direction – they are very likely to become desperate in their search to regain their footing and momentum; so that the possibility of mounting an EMP attack most surely has entered their minds, as some intelligence sources indicate, and, from their perspective, the sooner the better, for time is not on their side.

What better way to strike two blows at once than by putting "The Great Satan's lights out" – to deal a terrible blow both to Americanism and to electronic modernism in one grand, mother-of-all feat.

Such a feat could involve a ballistic missile fitted with even a low-yield nuclear warhead, timed to detonate over the target

39 British Singapore fell in February 1942, because "the guns of Singapore" were pointed seaward to forestall a naval attack. The Japanese army of 200,000 slithered through the dense Malayan jungle to attack from the land side. The French boasted the impenetrable Maginot Line, impervious to the German tanks. Hitler agreed and sent his panzers and infantry through Belgium and the forested Ardennes to drive across the Meuse into northern France, thus flanking the Maginot to make it essentially useless. The Trojan Horse which was presented by the Greeks as a peace offering to Helen of Troy probably is the most classic example of asymmetrical warfare. The vulnerabilities of electronic infrastructures to EMP presents another, simpler means to wage such warfare. However, this vulnerability can be corrected and is well within America's means to do so – if it so chooses.

40 "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack," Dr. William R. Graham, Chairman, Volume 1: Executive Report, 2004, from the Abstract.

at, for example, a 400 kilometers altitude. It could be launched via a long-range missile from land or one of shorter range – even a *Scud* – from a submarine or deck of a freighter.

The EMP effect occurs when the resulting gamma rays "interact with the atmosphere to produce a radio-frequency wave of unique, spatially varying intensity that covers everything within line-of-sight of the explosion's center point." The EMP Report selected a point above Columbus, Ohio to demonstrate its scenario. The exposure radius would be about 1,600 kilometers reaching east well past New York City and Washington, south to Miami, over to Dallas–Houston, westward past Omaha and northward running from Winnipeg to Quebec.[41]

The consequences of such an event would be grim. Seventy percent of the total electrical power load of the nation is within this radius. The EMP impact would be virtually instantaneous over the region. It would produce three electromagnetic pulses, each microseconds apart with a cumulative effect of instant burnout in spots that then "cascades" into successive equipment and system failures which are dependent on electricity.

Thus, electric power and their grids fail; telecommunications and computers go, along with banking and other financial systems; pumps to run gas stations and lift water from wells and rivers quit; virtually all transportation stops; avionics and navigation systems cease; frozen foods rot; heart-lung machines die, and on and on. It is not a condition that gets fixed quickly, since equipment and components first must be replaced or repaired which obviously takes considerable time.

Three factors govern the seriousness of the threat: capability, opportunity and probability. In terms of capability and opportunity, the EMP Report summarizes:

> *What is different now is that some potential sources of EMP threats are difficult to deter – they can be terrorist groups that have no state identity, have only one or a few weapons, and are motivated to attack the US without regard for their own safety. Rogue states, such as North Korea and Iran, may also be developing the capability to pose an EMP threat to the United States, and may also be unpredictable and difficult to deter… China and Russia have considered limited nuclear attack options that, unlike their Cold War plans, employ EMP as the primary or sole means of attack. Indeed, as recently as May 1999, during the NATO bombing of the former Yugoslavia, high-ranking members of the Russian Duma, meeting with a US congressional delegation to discuss the Balkans conflict, raised the specter of a Russian EMP attack that would paralyze the United States.*[42]

There are a number of indicators that both the capability to develop low-yield nuclear weapons suitable for an EMP attack and the opportunity to deliver them are expanding beyond the major nuclear-weapon powers. Intelligence, security policy and news sources have revealed several developments.

North Korea, reportedly, is moving toward deployment of new land- and sea-based ballistic missiles that can carry nuclear warheads, with the sea-based missile potentially more threatening.[43] Also, North Korea may be developing a miniature nuclear warhead to arm a type of missile that could reach the United States.[44]

As noted in Section 1, Iran appears to be actively pursuing a nuclear weapon capability to go with its evolving missile arsenal. And Chinese, Iranian, North Korean navies, and possibly others, are developing small, silent diesel-powered submarines that either are or will be able to operate and strike in shallow coastal waters.

Additionally, Russian Interfax news agency quotes a former deputy commander-in-chief of the Russian Strategic Missile Forces as saying that nuclear warheads with small yields may well be employed in future wars… "I believe that those will be low-powered nuclear warheads, employed in certain terrain areas." [45]

The probability of an EMP attack is determined in significant part by whether the capability and opportunity can be thwarted, if not outright, then by clearly providing evidence in advance of an attack that effective intervention would occur to cause mission failure or terrible post-attack consequences to the aggressor.

Currently, the probability of an EMP attack is at least as high as it was for anticipating the 9/11 attacks – not very high to most minds. But they did occur, which means al Qaeda had a different read on probability than did American leadership. Therefore, probability always should be firmly linked to capability, especially with known adversaries. As has been said: "If they can do it, assume that they will and defend accordingly."

At the moment there are three options to deter an EMP attack. One is by diplomatic agreement, but for this particular situation, where rogue states and terrorist organizations are involved, this is impractical by any measurement.

Another is through intervention, of which there is currently only one means. It is a preemptive strike by U.S. forces against a known EMP attack site, which obviously should be utilized if circumstances clearly warrant. But it is still limited as a viable option, since a single-missile EMP strike preparation could be highly difficult to detect if it is a covert attack from land or anonymously from the sea.

The threat of massive retaliation is the other possible deterrent, which worked during the U.S./USSR "Balance of Terror." Then, both had a stake in surviving to live another day in some compromise setting, a feeling presumably still shared by the major nuclear-weapon powers.

41 Ibid., see discussion and figures 2 and 3, 4-6.
42 Ibid., 2.

43 Joseph S. Bermudez, "North Korea deploys new missiles," *Jane's Defence Weekly,* August 4, 2004, 6.
44 David E. Sanger, "CIA Said to Find Nuclear Advances by North Koreans," *New York Times,* July 1, 2003.
45 BBC Worldwide Monitoring, December 29, 2004.

But would the threat of retaliation work with those rogue states and terrorist groups which have a much different set of incentives, where survival is second to hatred, and death either is noble or irrelevant to a higher cause? In this setting, retaliation might even be welcomed, in the belief that a crippled America in striking back might further earn the "condemnation" of the world, the very world it would be "begging for food and water to feed its starving people."

Two more options are available – should America choose to exercise them. Both could effectively deter or thwart an EMP attack, especially if they were brought on stream simultaneously. Both are well within the nation's means and resources to develop in a timely manner.

The first is to reduce significantly the vulnerabilities of America's most critical infrastructure systems, either by "hardening" them or redesigning them away from the effects of EMP. There are two such "high-leverage systems" upon which all other electronic infrastructures and related critical functions are dependent: electric power and telecommunications.

Therefore, immediate steps must be taken both to prepare and protect these two systems, which under the best of circumstances would take at least three to five years to reduce their vulnerabilities below the level that would likely invite an EMP attack, so that:

> *By protecting key elements in each critical infrastructure and by preparing to recover essential services, the prospects for a terrorist or rogue state being able to achieve large-scale, long-term damage can be minimized. This can be accomplished reasonably and expeditiously.*[46]

However, these measures would not guarantee in and of themselves that if an attack were to occur, there would be no damage. In all probability there would, but not catastrophic enough to plunge the nation back into the nineteenth century, so that the United States could recover and remain a major power.

But with the exercise of the second remaining option, the possibility of even this level of damage could be further reduced, and significantly so. And that, of course, would be to shoot down the EMP-strike missile in its boost- or early-midcourse trajectory phase whether fired from land or sea.

While an *Aegis* cruiser with its anti-missile missiles might succeed in certain restricted situations, it would need to be on high alert and close enough to the launch site, so that it could respond seconds after the launch. The Sea of Japan, close in to North Korea, would be one such location, but to deter effectively, the ship would have to be on station there more or less permanently.

The more efficient way traces back to only one system that could be quickly deployed to do this: SBIs that could be on constant alert and could "see" a firing instantly and move to strike the missile before it could make it into its midcourse trajectory, where even if it were exploded there could harm orbiting communication satellites.

As discussed previously, the only SBI that could be quickly available at this time is something based probably on a new version of *Brilliant Pebbles* and according to some sources would be lighter, quicker, faster and cheaper than the older BP technology could have provided. As Taylor Dinerman writes in *The Space Review*:

> *Since Brilliant Pebbles was canceled in 1993, the Department of Defense has made some limited progress on technology that is directly applicable to space-based boost phase systems. More important has been the ongoing improvements in computer processing power and in the ability of uncooked thermal imagers to detect targets. A 2005 model of a Brilliant Pebble would be smaller and have a better electronic brain than the 1993 one. Not only that, but there are now cheaper and more reliable in-space propulsion systems, such as pulsed plasma thrusters, which would keep the BPs in orbit and operation for far longer than the older version.*[47]

The probability of an EMP attack by a rogue state or terrorist group at this point in time is in all likelihood higher than a smaller attack by a more advanced nuclear-weapon powers. For instance, it is not currently envisioned that there would be any immediate advantages for either Russia or China to mount such an attack, though they might threaten one, as Russia did in 1999 over Yugoslavia and China did in 1996 over Taiwan.

The possibility of using SBIs for the EMP threat now appears to have occurred within the Bush administration, which is encouraging news. The only rub is timeliness, if at all. It is difficult to posit that anyone contemplating an EMP strike against the United States would not be thinking in terms of launching it at the earliest possible moment, and given the already-proliferated technology and means available, capability and opportunity grow by the day. Yet, as the "Missile Defense Briefing Report" states:

> Inside the Pentagon *(April 7) reports that the Bush administration is considering the deployment of a limited constellation of space-based kinetic energy interceptors to protect the United States, as well as American troops and allies abroad, from ballistic missile attack. Plans for such an initial capability, at the cost of some $673 million, are included in a set of Missile Defense Agency long-term budgetary assessments recently made public. The projections call for the deployment of a limited space-based interception capability aboard between 50 and 100 satellites to create a "thin boost/ascent defense against intercontinental range ballistic missiles." If funded by Congress, the initiative would commence space-based testing beginning in 2008, with an initial deployment of defenses to take place in 2016.*[48]

46 Op. Cit., 9.

47 Taylor Dinerman, "The Bush Administration and space weapons," *The Space Review*, May 9, 2005, <http://www.thespacereview.com/article/368/1>.

48 "Missile Defense Briefing Report," American Foreign Policy

It is a stretch to suggest that anyone contemplating an EMP strike against America would not be prepared well in advance of 2016. Therefore, the timeline for SBI deployments requires radical adjustment, if necessary on a crash basis similar to that of the Manhattan Project.

A third summary conclusion is that the consensus for missile defense is largely dysfunctional. It is not working as it should. Unless it is fixed, it is unlikely that the 70 percent or more of Americans who want missile defense will get it when they need it the most – which is today and tomorrow, not decades in the future.

Meanwhile, missile defense opponents continue their campaigns, both domestic and foreign, to keep the United States tied to a MAD-compliant policy, particularly as concerns space-based interceptors. Their continued dedication to this task should not be taken lightly, particularly among foreign sources with vested anti-American sentiments. A May 1, 2005 statement from the Communist Party of Canada reflects this sentiment:

> *Dear Comrades: On behalf of The Central Committee and Central Executive Committee of the Communist Party of Canada we greet you and salute you on the occasion of the 19th Congress of your Party, the Communist Party of India (Marxist)... We, as all communists, are very concerned with the deteriorating international situation and the increasing danger of the escalation of Imperialist violence led by the major Imperialist power the United States of America.... The Communist Party of Canada believes that the danger of war is increasing which adds a heightened importance of the forces for peace in the world of which the Communist Parties are a part of... We have been working very hard in Canada as an important part of the forces rebuilding a mass anti-imperialist peace movement. So far there have been some significant victories. Just last month the minority liberal government was forced by public pressure to withdraw from the Ballistic Missile Defense plan of the Bush government. This was widely celebrated recently by Canadians as a part of the Global Day of Action where tens of thousands of Canadians participated in over 45 communities in our Country.*[49]

The consensus among Americans wanting missile defense clearly must be fixed by transforming it to fit Dr. James M. Buchanan's definition of demand, which mandates direct citizen participation in demanding necessary government action.

This means that before this will happen, action must first occur in mounting broad educational efforts involving: citizens groups; local governments; state governors and legislators, including the attorney generals; members of Congress, both houses and both sides of the aisle; the president and the secretary of defense, whomsoever, and the professional military.

The common bond that holds this active consensus together must be made unequivocal: It is the common defense of the American people themselves, where danger knows no boundaries among them, that is the business at hand and must be attended to quickly.

The message should be honed down to a single word with a clarity everyone understands: *Enough*.

Council, No.173, April 11, 2005.

49 *People's Democracy*, <http://pd.cpim.org/2005/0501/05012005_greeting-canada.htm>. *People's Democracy* is the weekly organ of the Communist Party of India (Marxist).

Panel 5 Report

Members of the IWG met several times during 2003-2005 as a panel to assess the implications of continuing political opposition to missile defense as described in Section 5. They offer the following observations and recommendations.

Panel Members
Chair: Dr. Daniel I. Fine
Mr. Ilan Berman
Mr. Brian Kennedy
Mr. R. Daniel McMichael
Dr. Kiron Skinner
Dr. Robert F. Turner

The forty-year-old culture upon which the doctrine of Mutual Assured Destruction (MAD) has been based must be eliminated – that of population hostage holding by one country to the offensive ballistic missile weapons of another country – which was the centerpiece of the Anti-ballistic Missile (ABM) Treaty.

While the Treaty is gone, leaving the United States free to develop defenses against such weapons, the MAD doctrine still influences significant parts of U.S. foreign, security, and defense policies. This culture impedes rational and low-cost applications of the technology needed to provide fully effective missile defense systems. The "lingering ghost of MAD" still dominates the halls of government, the research labs and the classrooms of academe.

The opposition to an effective missile defense is enormously strong and widespread, ranging through varying elements of the political, public policy, intellectual, and academic communities. Even though their numbers are relatively small compared with the 70 percent of Americans who want and expect their government to provide effective missile defense, opponents' arguments need to be met head-on and refuted one-by-one.

Further, international opposition, some of it very intense, such as from China and Russia, must be firmly answered by the United States that it reserves the right to defend its own people from ballistic missile attacks; even as it fully respects and expects other nations of the world to exercise their right to so defend their own people. That is why the truly peaceful nations of the world should welcome the kind of global defenses that protect at least against limited strikes from hostile states or terrorist groups. That is also why global missile defense should be a world standard to be achieved, rather than an anathema to be shunned.

These conditions will not change until the majority of those who want effective missile defense become actively involved in challenging the still-lingering MAD culture. The most effective way to achieve this, indeed the only effective means to reshape the terms of debate in this country, is to demand of policymakers, opinion leaders, and educators forthright answers to two questions:

> *Should it be the policy of the United States Government deliberately to hold its own citizens hostage or otherwise vulnerable to the offensive weapons of another nation or terrorist group?*

For those who maintain that this form of population vulnerability in some way benefits the nation and should be continued as part of its defense, security and foreign policies, a second question needs to be answered in understandable detail:

> *Why do you not want to defend us from a missile attack; what is it that makes you hostile to the idea; what higher calling is there than helping to protect your fellow citizens?*

Missile defense opponents base their arguments on one or more of five broad themes: missile defense of the U.S. population (1) is wasteful and ineffective; (2) is provocative and destabilizing; (3) will weaponize space; (4) will give America too much unilateral power; and (5) is morally wrong.

In the matter of being wasteful and ineffective, historical evidence exists that during the thirty years of the ABM Treaty, available technology was hobbled for political reasons, so that the smothering of efforts to produce some missile defense systems either in concept or prototype were “dumbed down” or doomed to failure, so as to conform to the crippling restraints of the Treaty. This kept the U.S. out of space defense and other efficient applications.

Today, ample lightweight technologies exist that could achieve desired results for effective missile defenses, but continuing political pressures thus far have largely blocked such efforts.

In the matter of missile defense being provocative and destabilizing, and will thus cause an arms race and destabilize world order, it has no substantive basis in fact. This was the argument originally used to justify the ABM Treaty, so that there has yet never been an effective ballistic missile defense system (save limited use of the *Patriot* missile during the 1990 Gulf War). Yet, the historical evidence is pointedly clear that ballistic missile arms races have continued in more than a dozen nations throughout the life of the Treaty and still continue.

In 1950 Paul Nitze wrote in National Security Council Document-68 that when the Soviet Union obtained 200 nuclear warheads (with 100 deliverable on target), America would be in severe danger. Yet, a quarter century of arms control – and almost two decades of arms control with ABM constraints intended to damp down the arms race – actually massively increased Soviet warheads to over 30,000. The sad truth is that with respect to the ideology driving arms control – with its central fixation on eliminating defensive systems – the emperor had no clothes.

If opponents had been correct, the absence of missile defenses should have played a major role in actually stabilizing world order; instead, tensions surrounding nuclear and would-be nuclear powers have been steadily increasing, so that growing proliferation of weapons of mass destruction still continues. Thus, the converse more likely is true: additional evidence exists that effective missile defense capabilities could actually help to strengthen and enhance responsible arms control efforts, rather than to foster arms races and proliferation, as opponents so vigorously maintain.

In the matter of missile defense weaponizing space, the reality is that space was weaponized in 1944, when the first ballistic missile (the U-2) was launched by Nazi Germany. Since then, hundreds of satellites have been placed in orbit, many for particular military and intelligence uses, such as spy satellites and other command-control-communication assets, all of which are central to virtually all U.S. military operations. Additionally, the same cell phone, navigation and internet systems that serve commonplace civilian needs likewise serve the military, i.e., weekend hikers in the mountains as well as troops on the ground, or directing SUVs and rescue units as well as smart bombs and cruise missiles to their respective destinations.

The real question is: How will placing a defensive weapon into space drive the weaponization of space, which already is the medium through which offensive ballistic missiles must travel in order to destroy their targets? The answer is that it will not. Missile defense will defend space and earth, itself, from hostile offensive missiles. It will save lives, not take them; It will help stabilize, not destabilize.

In the matter of missile defense giving America too much unilateral power, the answer is found in the biases of individuals and groups comprising the American publics. For those who believe that the United States should be kept vulnerable to the ballistic missiles of other powers, so as to “keep the U.S. in line” from “reckless international adventurism,” then effective missile defenses would give America too much power to “dominate” the wishes of other nations and, thus, should be discouraged. Others who believe that the first duty of government is to defend its citizens from hostile actions of other states without exception, of course, take the opposite view.

The answer, then, resides in the majority of Americans to choose decisively which way their government is to act. One of the guidelines to follow: Those nations who wish America no harm will not object to its missile defenses. Those nations and their sympathizers who would like to marginalize the United States will, indeed, object.

In the matter of missile defense being morally wrong, the notion stems from various strains of pacifism and appeasement doctrines, such as: (1) by showing “peaceful intentions” the aggressor will be dissuaded from inflicting harm, and (2) a “defensive weapon” is really an “offensive weapon,” because the defending survivor then is able to strike back, hence, a “shield” is really an offensive weapon. This line of reasoning played a significant role in the creation of the MAD doctrine.

If the morality of missile defense is to be questioned, then the entire proposition must be put on the table: If missile defense is morally wrong, it follows that it is morally right for government not to provide missile defense. This, then raises another dimension of the question already posed, which “moralists” opposing an effective missile defense system must answer forthrightly, completely and convincingly, if they are to preserve their credibility: Is it a moral act for the government of the United States deliberately to hold its own population hostage or otherwise vulnerable to the offensive weapons of another nation or terrorist group?

If Americans are to succeed in demanding effective missile defense before another 9/11 catastrophe, then several things must happen:

- Americans must insist on bipartisanship at all levels.
- The states (the governors, legislators, adjutant generals, homeland security directors) must become actively involved and not wait for the federal government to take

the initiative. The states, too, have the primary responsibility of defending their citizens.

- The federal response should be to welcome the states as partners and incorporate missile defense of the American population as an integral part of the Department of Homeland Security, not just for post-disaster efforts, but to give active support to the national government in bringing about the kind of missile defense the nation needs.
- State participation is necessary because the executive branch and Congress must be fortified to resist the enormous pressures that will come from certain foreign powers and terrorist groups who will do everything possible to thwart missile defense development. The international community must have it made clear that Americans will exercise the right to defend themselves against a missile attack.
- This same dynamic between state and federal levels will also serve as a powerful incentive to enlist the cooperation and participation of friends and allies.

This kind of citizen-state support must, in turn, be effectively led by appropriate policymakers and technical personnel in the federal system who are charged with missile defense, and from this should emerge the following:

A. The surviving MAD culture that resists missile defense, development and deployment must be subordinated within the relative departments of government, i.e., the Department of Defense (DOD) and Department of State in particular. This responsibility falls to the senior professional military and senior statesmen.

B. Such steps and resolve must be led by the president, whomsoever, and the Congress in close cooperation on a bipartisan level.

C. Among other things, missile defense must be taken out of its current DOD structure and put in appropriate line-operating settings or stand-alone environments, such as under navy command for sea-based systems or one or more of the government laboratories for specialized work in space-related systems.

D. The entire missile defense effort should report directly to the president via the secretary of defense and relevant congressional committees.

To complement this process, indeed to bring it about, several different educational programs from both private and public sectors must be mounted. Research materials, "laymen's guides," articles, and other kinds of presentations must emerge from the technical and intellectual communities, so that the American people are well educated and so that they may better play their indispensable role in building the citizen infrastructure upon which the state and federal governments can build the kind of missile defense the American people want and need at a price they can afford.

section 6

Missile Defense: International Dimensions

Missile defense has important international dimensions. First, as set forth in this Section, the basis exists for broad international participation and even for a division of labor with U.S. emphasis on space-based components and international partners, along with the United States, deploying sea-based and ground-based systems. As this Section points out, there are already a number of missile defense programs and efforts underway outside the United States. Second, as also discussed in this Section, the United States faces opposition from Russia and China, both of which seek to derail U.S. missile defense efforts and to lock the United States into a strategic posture compliant with the concept of Mutual Assured Destruction (MAD). For the United States, missile defense can be vitally important in strengthening its alliances and coalitions as well as providing cost savings and performance/testing data that could help serve as building blocks for an interoperable, internetted international layered defense system. In other words there are opportunities for international cooperation to build a missile defense, just as there are obstacles, including allied opposition in some cases to U.S. space-based missile defense, that must be understood and overcome.

In meeting the threats posed to the United States and its friends and allies, there is a strong reinforcing relationship between the established concept of extended nuclear deterrence and the relatively new defensive deterrence. The two concepts were brought together by the Bush administration's 2002 Nuclear Posture Review, which established a new triad. This includes: (1) a mix of nuclear and non-nuclear strike forces; (2) missile defenses; and (3) a revitalized research and development (R&D) and industrial infrastructure, to deter attacks on U.S. territory as well as against U.S. friends and allies. Missile defenses will not be a replacement for the nuclear forces that bolster the policy of extended deterrence. Instead, extended deterrence will include a defensive element designed to increase its flexibility and adaptability in an era when international political developments are much less predictable. Missile defense that encompasses allies and coalition partners will reinforce extended security relationships.

It has been longstanding U.S. policy to discourage the possession of nuclear weapons by those who are not designated nuclear weapons states under the Non-Proliferation Treaty (NPT). This policy has not prevented would-be enemies of the United States as well as friends and allies from obtaining nuclear weapons and ballistic missile capabilities. Missile defense provides an outlet for military cooperation with those allies that, despite U.S. preferences, have opted to obtain nuclear weapons. At the same time, missile defense can deter states from acquiring nuclear weapons and missile capabilities, or at least make the acquisition of such weapons costly and less attractive to would-be nuclear states who are enemies or potential adversaries of the United States.

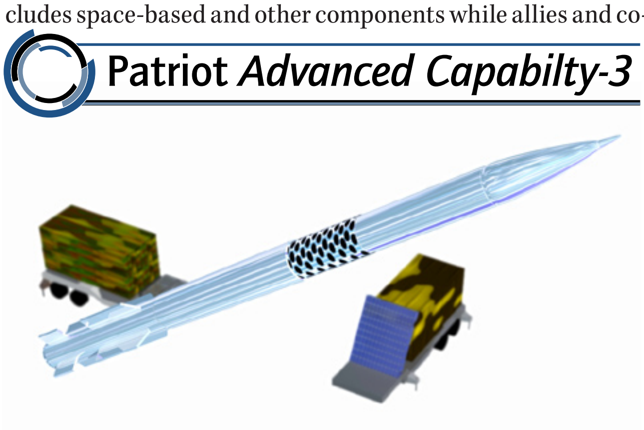
In the years ahead the United States should deploy a missile defense for the U.S. homeland and our forward deployed forces and to include allies and coalition partners wherever feasible. The ability of the United States both to defend itself and to protect its overseas forces, together with allies and coalition partners from missile attack, can reinforce U.S. security guarantees and provide reassurance to friendly countries in regions such as the Middle East and the Asia-Pacific area. An America vulnerable to missile attack by regional aggressors may be an America reluctant to take appropriate military action to defend its friends, allies and regional interests. At the same time missile defense will reduce the incentive to take hostile action against the United States and its allies by increasing the risk that aggressive moves will be successfully countered. The stronger the U.S. commitment to allies and coalition partners, reinforced by missile defense, the more limited will be the opportunity on the part of aggressive powers to split friends from the United States.[1] A U.S. missile defense that is global in reach

1 For an extensive discussion of missile defense and alliance relationships, see *Hollywood Standoff: A Political Military Game*, the Heritage Foundation, 2005.

will contribute greatly to the credibility of U.S. overseas commitments, interests, and relationships.

For reasons discussed elsewhere in this report (see Sections 1 and 2), a layered defense that includes a space-based capability affords the maximum opportunity to destroy a ballistic missile early in its trajectory from wherever it is launched, and it provides continuous coverage on a global basis for both the United States and its allies and coalition partners. With a space-based missile defense system, the United States would not be dependent on ground-based installations deployed overseas – perhaps in locations controlled by states or groups hostile at the time to U.S. interests. Sea-based systems would also afford greater flexibility than a ground-based missile defense (GMD) system because they may be moved more easily to crisis regions where they are needed to protect U.S. or allied interests. Provided sea-based systems are in place or rapidly deployable, they furnish a capability for regional missile defense and thus can help prevent or limit escalation. As noted below, the growing number of nations with *Aegis* missile-defense capabilities on their ships (e.g., Japan and South Korea) will mean defenses are already in place putting less strain on getting U.S. missile defense assets to the region.

Ground-based systems can protect a spectrum of civilian and military facilities and other targets. As noted in this Section, there is substantial interest in Europe in ground-based theater missile defense (TMD), and Israel has developed with U.S. assistance the *Arrow* missile defense system while Japan is working with the United States to acquire the *Patriot* Advanced Capability-3 (PAC-3) system as well as sea-based missile defense based on *Aegis*. Thus there are an increasing number of allied and coalition countries that possess both sea-based and ground-based missile defenses (several of which are U.S. systems) that will, among many other benefits, augment U.S.-allied interoperability and the internetting of ground- and sea-based sensors and systems to provide a more effective defense. The list of these nations will continue to grow in the years ahead. Thus U.S. and allied missile defense efforts will create a basis for a "system of systems" in which the United States deploys a layered missile defense that includes space-based and other components while allies and coalition partners place primary emphasis, in their respective programs, on sea-based and land-based systems.



The result could be a layered, multi-tier system of systems defense. The United States would have primary responsibility for missile defense in the boost and midcourse phases, with allies and coalition partners playing a relatively more equal role in the terminal phrase. In the case of sea-based missile defense, allies and coalition partners will have an important role, particularly if they have ships with *Aegis* systems or similar capabilities. Such systems could also intercept missiles in the boost phase, depending of course on where the launch takes place and where the missile defense system deployed by allies and coalition partners is located. In coalition operations in which missile defense was required to protect forward deployed forces against short-range missiles, the United States would have principal responsibility, especially if the United States was the leading contributor to the particular coalition operation.

The United States would have the primary role in financing, developing, and deploying space-based missile defense systems for boost-phase and midcourse interception among allies and coalition members. Other issues to be resolved would include command, control, and communications systems, although a mutually satisfactory arrangement would have to be worked out in advance for determining how, when, and where missile defenses would be launched in response to a missile attack against allies or coalition members. This would require extensive preplanning, joint testing and exercises. However, it would represent a logical extension of what is already occurring as countries, for example in NATO-Europe, develop cooperative programs among themselves and with the United States. Such testing, planning, and exercises will have important implications for interoperability as well as conducting joint coalition missions other than missile defense.

As the United States and its allies develop their respective architectures, missile defense should be seen as a seamless web. Each segment of the architecture should reinforce and be related to the other parts as a system. Therefore, the overall architecture of such a missile defense would include intercept capabilities from boost phase to terminal phase. The key to developing missile defense architectures that provide for alliance/coalition needs lies in sufficient flexibility and adaptability. In practice, this means an ability on the part of U.S. partners to plug into missile defenses based on such factors as enhanced interoperability between current and planned U.S. and allied systems, joint U.S.-international planning of new missile defense technologies, and affordability.

As it develops missile defenses for itself and broadens international cooperation, the United States faces obstacles, including opposition in particular from China and Russia, even though the limited missile defense now being deployed and planned by the United States is not designed to be effective against larger and more sophisticated missile forces, such as those of Russia and China. In this respect, the U.S. missile defense is MAD-compliant, that is to say that the United States has chosen in effect not only to continue to hold itself hostage to Russia, but also not to counter China's growing offensive missile capabilities with a missile defense. Only in MAD logic is the United States obligated to underwrite the success of missile attacks against itself. Our Independent Working Group conclusion is that the United States should deploy a missile defense capable not only of defending against the smaller missile forces of rogue states and a terrorist launch, but also against the missile forces of states such as Russia and China. We make this recommendation with the assumption that the emerging security setting will contain multiple actors in possession of missiles who may be members of rapidly shifting coalitions. For example, the ability of the leading member of a coalition opposed to the United States, such as Russia or China, to threaten the United States (as China did during the 1996 Taiwan Strait crisis and more recently in July 2005) can diminish U.S. extended security commitments and possibly contribute to miscalculation and crisis escalation. We turn next to a discussion of Russia and China, both of which have opposed U.S. missile defense programs.

Russia

With the collapse of the Soviet Union and the disintegration of much of Moscow's once formidable conventional forces, Russia placed increased emphasis on nuclear weapons. Even as Russia has dismantled aging missiles and warheads, it has been maintaining and modernizing its nuclear forces. For example, it has deployed the *Topol* M intercontinental missile at a rate of about ten per year and removed from storage other intercontinental missiles. Because of its extensive reliance on nuclear weapons, Russia continues to discourage the United States from deploying missile defenses. Nevertheless, Russia itself has long had a missile defense program based on hundreds of surface-to-air (SAM) systems capable of defense against mid-range and perhaps intercontinental-range missiles, together with a missile defense system around Moscow. In addition, by the 1980s the Soviet Union had deployed approximately 10,000 dual-purpose SAMs that in effect came to serve as a national missile defense in violation of the Anti-Ballistic Missile (ABM) Treaty. Since the collapse of the Soviet Union at the end of 1991, battle management radars continue to cover the primary threat sectors internetted with the nearly one hundred nuclear-tipped defensive missiles. Combined with the numerous SAM systems still operating around Moscow, Russia maintains far more interceptors compared with the U.S. missile defense system currently being deployed.

In addition, Russia is developing the S-400 (SA-20 *Triumf)* surface-to-air air-defense and theater anti-missile system. The S-400 will be able to destroy aircraft, cruise missiles, and short- and medium-range ballistic missiles at a distance of up to 400 kilometers. This system incorporates a new missile that is reported to have twice the range of the *Patriot* PAC-3 and well over twice the range of the S-300 missile it replaces. Russia has been marketing the S-400 aggressively to China and in the Middle East. There have also been reports that Moscow has plans for an even more advanced missile defense system, the S-500. And while the S-500 has not moved into development due to reported financial constraints, development of the S-400 (and concept planning for the S-500) further underscores Russia's strong interest and motivation to deploy robust missile defenses as a key component of its national security.[2]

In February 2001, President Vladimir Putin unveiled a Russian missile defense concept for Europe. He called for a European "non-strategic" missile defense limited to threats with ranges less than 3,500 kilometers. Putin set forth a four-step process providing for: (1) evaluating missile threats against European states, (2) developing a missile defense concept, (3) determining development and deployment of anti-missile units, and (4) establishing a joint early-warning center. The Russian proposal, which contained no cost estimates, development timelines, or organizational structures, represented a theoretical framework for a European-based TMD system that could be developed with Russian technology. This was clearly a gambit to assuage Europeans and forestall a cooperative U.S.-led theater defense; yet by the fact that he made the proposal Putin acknowledged a growing missile threat to Europe.

Building on Moscow's February 2001 missile defense concept for Europe, in 2003 Kremlin officials moved forward with cooperative theater, or "non-strategic," missile defense interception and monitoring efforts with their NATO counterparts – both bilaterally with the United States and as part of the theater missile defense working group set up under the NATO-Russia Council. As part of this cooperation, NATO and Russia held command post exercises to test operational coordination in March 2004 in Colorado Springs and in March 2005 in the Netherlands. A third exercise will be held in Russia in the first half of 2006.[3] Bilateral United States-Russia missile

2 Very little is known about the S-500 system. However, it has been reported that Russia has not started development of the program due to lack of funding. For more information, see <http://www.missilethreat.com/systems/s-500.html> and http://www.globalsecurity.org/wmd/world/russia/s-500.htm.

3 "Command-Staff Exercise of Russia and NATO on Anti-Missile Defense to Begin," RIA Novosti, March 14, 2005, < http://www.globalsecurity.org/military/library/news/2005/03/mil-050314-rianovosti12.htm>. Collaboration between NATO and Russia on missile defense was initiated at NATO's Rome Summit in 2002, where both sides agreed to cooperate in theater missile defenses. The purpose of this collaboration, and of the associated joint exercises, is to develop and implement a concept of operations that would permit the effective use of both NATO and Russian missile defenses in a future crisis outside of NATO territory (i.e. a non-Article 5 operation). For more information, see Stephen G. Rademaker, "America's Cooperative Approach to

defense exercises were held in April 2005 in Russia, with the next stage of these exercises in the United States in April 2006.[4] The Russian interest in missile defense, including international cooperation with NATO-European countries, underscores that Moscow continues to favor missile defense, while seeking to restrain the type and scope of U.S. missile defense deployments. It is only U.S. missile defense, not missile defense in general, that Russia opposes. Because of the greater range requirements for a U.S. missile defense system, Putin's plan could also be viewed as an effort to deepen transatlantic divisions and to separate Europe from the United States on missile defense.

Despite the political changes that have taken place in the U.S.-Russian relationship, some positive and others negative, a robust U.S. missile defense effort is viewed as inimical to Russian national interests. Putin indicated that U.S. withdrawal from the ABM Treaty was "not unexpected," adding that Russia had the means to overcome the limited missile defense planned by the United States. While opposing U.S. missile defense, Russia is again able to put greater resources into the military sector. Russia now possesses greater financial resources than at any time since the collapse of the Soviet Union. Russian foreign reserves now exceed $100 billion.[5] With rising oil prices, Russia has emerged as a petro super-power state. In addition to tax revenues from oil exports, Russia has begun to re-nationalize its petroleum natural resources after a brief period of private shareholder ownership following the collapse of the Soviet Union. With state control and ownership of oil revenues from exports, the Russian government will have an income stream undiluted by private shareholder dividends that it can plow back into the energy industry and at the same time divert to missile technology and deployment as well as other military programs. This could open a new period of Russian missile defense and space technology in which there is a direct connection between high oil prices and military modernization.[6]

Meanwhile, the expanded diplomatic contacts between Moscow and Washington have provided an unprecedented opportunity for Russia to attempt politically to limit American missile defense efforts and to retain with the United States a MAD-compliant strategic relationship. Through a series of proposals and diplomatic overtures, Russia has sought to engage the White House in a constricting, post-ABM Treaty missile defense framework designed to constrain future American space-based missile defense.[7] Through such efforts, Moscow has attempted to leverage its bilateral ties with Washington to influence the parameters of the emerging American missile defense system.

China

China is likely to grow in importance for the United States in the years ahead. The two central goals of the People's Republic of China's (PRC) foreign policy include: (1) the absorption of Taiwan; and (2) the diminution of U.S. influence and the expansion of China's geostrategic position in and beyond the Asia-Pacific area. China has deployed between 650 and 730 mobile short-range ballistic missiles opposite Taiwan as part of its strategy of political intimidation against Taipei.

Missile Defense," Remarks to the American Foreign Policy Council's 2004 Conference on Missile Defenses and American Security, Washington D.C., December 17, 2004, <http://www.state.gov/t/ac/rls/rm/2004/39920.htm>.

4 "Russian and U.S. Servicemen Jointly Practice in Missile Defense," RIA Novosti, April 18, 2005, < http://www.globalsecurity.org/space/library/news/2005/space-050418-rianovosti01.htm>. The April 2005 exercise represented the fourth stage of anti-ballistic missile defense exercises jointly held by the United States and Russia. Of the three prior exercises, two were held in the United States, and one in Russia. The purpose of the fourth stage was to develop techniques to coordinate operations in providing protection to third countries from theater-range ballistic missile attacks. For more information, see "Russia, U.S. to Hold Joint ABM Exercise in U.S. in April 2006," ITAR-TASS, April 18, 2005, and "Russia Wants to Make Russian-U.S. Missile Defense Exercises Routine," RIA Novosti, April 12, 2005.

5 "Country Report: Russia," *Economist Intelligence Unit,* June 2005, 40.

6 For a discussion of rising Russian oil exports, see Steven Rosefielde, *Russia in the 21st Century: The Prodigal Superpower* (New York: Cambridge University Press, 2005): 88-89. "With petroleum production surging to 8 million barrels per day in 2002 and heading toward 10 million barrels (eclipsing Saudi Arabian production), the OPK (Russia's Defense-Industrial Complex) doesn't have to sell nuclear technology to Iran and China, participate in European Union national missile defense, be self-financing (*khozraschyot*), or depend on the 'kindness of strangers.' The government merely has to match its defense priorities with a willingness to prevent capital flight and tax the natural resource base." Rosefielde also points to Russian aspirations to develop "full spectrum, fifth generation armed forces significantly larger than America's in almost every category, including national missile defense." Whether such aspirations will be realized, of course, as Rosefielde acknowledges, remains to be seen. What is evident, however, is what he terms "industrial militarization," a large and embedded military-industrial sector, a legacy of the Soviet era, capable of persuading Russia's leaders of the utility of using military capabilities to deal with worst-case security threats.

7 These include a January 2003 "strategic stability" agreement put forth by the Russian foreign ministry and a bilateral "framework" on military-technical cooperation under discussion in the summer of 2003. See January 20, 2003, RIA Novosti; and July 16, 2003, Interfax. Additionally, in May 2005 the foreign ministry revealed that it was preparing a draft resolution for the UN General Assembly to prevent the weaponization of space, see "Russia to Submit UN Resolution on Weapons Ban in Outer Space," Xinhua Online, May 25, 2005, < http://news.xinhuanet.com/english/2005-05/25/content_3002680.htm>.

This number is increasing at a rate of approximately 100 missiles per year.[8] China also plans to modernize its inventory of intercontinental ballistic missiles (ICBMs). Over the next several years, China will place into operation a new, solid-propellant mobile ICBM, the DF-31 (7,250+ km), an extended range DF-31A (11,270+ km), and a new submarine-launched ballistic missile, the JL-2.[9] The growth of short-range ballistic missiles and ICBMs is only one portion of a massive, multi-year military modernization effort pursued by Beijing to support its growing international role and its ability to project military power.[10] Overall, this effort encompasses a major expansion in its air, naval, land, and asymmetric warfare capabilities. There have been annual double-digit increases in Chinese defense expenditures over the past decade and a half.[11] In March 2005, China announced a $29.9 billion defense budget, a 12.6 percent increase over the previous year.[12]

This growth has occurred in an era in which the United States deployed no missile defense. Today the Chinese oppose even the limited U.S. missile defense deployment currently underway. U.S. assurances that its missile defense is not designed against it may lead China to believe that it can threaten the United States, as Beijing did in the 1996 Taiwan Straits Crisis. In July 2005, a senior Chinese military official threatened the use of nuclear weapons against the United States in case of American military intervention in a conflict over Taiwan.[13] If China represents a rising power that will challenge U.S. interests, it makes no strategic sense for the United States to deploy a missile defense that fails to address the threat posed by China. Instead, the United States should move toward a missile defense that affords a future U.S. president maximum flexibility in managing a crisis with Beijing.

Europe

In their thinking about missile defense, Europe and the United States, broadly speaking, have come from opposite sides of the spectrum. Defense against aircraft was a major NATO-European Cold War preoccupation leading to the development of an air defense belt across the NATO central front. In the United States, the debate has historically focused on defense against intercontinental ballistic missiles especially after President Reagan's March 23, 1983 speech calling for a concerted effort to develop a missile defense. The discussion of missile defense in Europe has evolved from defense against aircraft to defending also against short-range missiles (extended air defense). In the United States, faced with the growing threat of missiles armed with weapons of mass destruction (WMD), the debate has increasingly emphasized defense against missiles of varying ranges. The effect of 9/11 was to bring into the U.S. discussion a greater appreciation of the destruction that could be wrought by an aircraft used as a weapon. In Europe the implications of 9/11 include a greater recognition of vulnerability from terrorist action. European support – in so far as it exists – for the development of missile defense systems represents a logical evolution from air defense. In the United States the effect of 9/11 was to reinforce the need for defense against a broad range of threats. The extent to which there will be a narrowing of the transatlantic gap in this spectrum leading to consensus strong enough to support transatlantic missile defense remains to be seen.

To the extent that Europeans have considered missile defense, the emphasis has been on TMD systems. This is the focus of NATO efforts based on the TMD feasibility studies approved by the Alliance in October 1999. The need for a unified, interoperable NATO-wide TMD architecture has become more urgent in light of coalition operations and the multiplicity of tasks for missile defense. Such systems would form the terminal defense against shorter-range missiles and could become part of a broader architecture providing for a layered missile defense, thus creating the basis for a transatlantic division of labor or at least greater specialization of effort between NATO Europe and the United States in defense against ballistic missiles.

In addition to ongoing work on programs such as the Medium Extended Air Defense System (MEADS),[14] the United

8 "Annual Report on the Military Power of the People's Republic of China," U.S. Department of Defense, July 2005, <http://www.defenselink.mil/news/Jul2005/d20050719china.pdf>.

9 Ibid., 4. In June 2005, China successfully tested the JL-2, firing it from a submarine near the port of Qingdao to a location in China's western desert several thousand kilometers away. According to U.S. intelligence, the JL-2 will allow Chinese submarines to target the United States from operating bases near the Chinese coast. See Bill Gertz, "China Advances Missile Program," *Washington Times,* June 22, 2005, p. A4.

10 Ibid., 12-14.

11 In the year 2002 alone, this figure rose by almost 18 percent from 2001 levels. Associated Press, March 6, 2002.

12 Information available at <http://www.globalsecurity.org/military/world/china/budget.htm>. Most outside estimates indicate that China understates its defense expenditures to a considerable degree.

13 Joseph Kahn, "Chinese General Threatens Use of A-Bomb if U.S. Intrudes," *The New York Times,* July 15, 2005. "If the Americans draw their missiles and position-guided ammunition on to the target zone on China's territory, I think we will have to respond with nuclear weapons…We Chinese will prepare ourselves for the destruction of all the cities east of Xian. Of course the Americans will have to be prepared that hundreds of cities will be destroyed by the Chinese."

14 The project, pursued trilaterally by the United States, Germany, and Italy, is designed to produce a tactical, mobile terminal-phase theater missile defense complement for deployed American and European troops. The United States and Italy signed the MEADS Design and Development Memorandum of Understanding in September 2004, allowing the two countries to proceed with the project on a "limited basis." In May 2005, the Bundestag approved entry into the design and develop-

States has also moved forward with plans for a larger regional anti-missile architecture. This includes agreements to upgrade two crucial radar bases, the Fylingdales Royal Air Base in northern England and the Thule facility (expected to be finished by 2007) on the Danish autonomous colony of Greenland – for missile defense duties, as well as institutionalizing an ongoing ABM dialogue with both Copenhagen and London. The upgrades will give the radars the capacity to track and establish the flight trajectories of the missiles and their payloads, making the two radars more capable of guiding U.S. missiles to intercept ballistic missiles launched from the Middle East.[15] U.S. officials state that the ABM dialogue does not currently include discussions on deployment of interceptors in either the United Kingdom or Greenland.

A substantial diplomatic campaign launched by the White House beginning in mid-2002 also elicited positive preliminary responses from a number of Eastern European countries – including Hungary, Poland, and the Czech Republic – on a broad range of possible anti-missile roles, ranging from early warning to the basing of terminal-phase defenses. In 2004 and 2005, the United States held exploratory discussions with these three nations on the possibility of basing a third GMD interceptor site (beyond those in Alaska and California) on one of their territories. No decision has yet been taken. However, such a site could defend much of Europe while also supplementing the capability to defend the United States. U.S. officials indicate that such discussions underscore America's commitment to protecting U.S. allies and deployed forces.[16]

This focus has been matched within NATO. The November 2002 NATO Prague Summit produced an unprecedented consensus regarding the growing ballistic missile threat confronting Alliance members. The final communiqué emphasized that NATO had reached an Alliance-wide commitment to examine "options for addressing the increasing missile threat to Alliance territory, forces and population centers."[17] Following up on this commitment, in January 2004 NATO commissioned a study to explore the feasibility of a strategic missile defense system that would protect the alliance from a ballistic missile attack. The classified report was completed in early July 2005, and it reportedly addressed a variety of issues, including the location of interceptor sites and sensors, management of debris (from intercepts of incoming missiles), the rules of engagement for an allied ballistic missile system, the sensors needed for an early warning system, cost estimates, and a threat analysis.[18] This report will form an input into a final report from NATO's Conference of National Armaments Directors, which will serve as the basis for all future consultations on this system. This latter report is expected in 2006.[19]

In addition, NATO is moving ahead with the development of a deployable Alliance Theater Missile Defense System that would be used to protect NATO troops during operations and to defend territory/troops from short- and medium-range missile threats in certain regional settings.[20] In July 2005, NATO authorized $480 million for this purpose, and the final system will incorporate member countries' TMD components in an overall system that will target a missile in its boost, midcourse and terminal phases.[21] For instance, for the boost phase, NATO expects to employ armed unmanned aerial vehicles or, if available, airborne lasers, and for the midcourse phase, it may employ the Terminal High Altitude Area Defense (THAAD) system. For the terminal phase, NATO may utilize *MEADS* or the PAC-3 system, or perhaps the Franco-Italian *Surface Air Moyenne Portée/Terre* system. A program management organization has even been established to develop management and technical capacities so that the Alliance TMD System can establish an initial operating capability by 2010.[22]

ment phase of MEADS, allowing Germany to become an official signatory. See "Germany Approves Involvement in MEADS Missile," *Defense Industry Daily*, May 2, 2005, < http://www.defenseindustrydaily.com/2005/05/ germany-approves-involvement-in-meads-missile/index.php>.

15 Agreements on these upgrades were formalized with Britain and Denmark in February 2003 and August 2004, respectively. For more information, see Mike Rance, "U.K.-U.S. Missile Defense: Would British Accept Missile Emplacements?," *DefenseNews.com*, May 15, 2005, <http://www.defensenews.com/story.php?F=854800&C=commentary>; Matthew Lee, "US, Denmark, Greenland Sign Agreement to Modernize US Base," Agence France Presse, August 6, 2004; Wade Boese, "Greenland Radar Cleared for U.S. Missile Defense," *Arms Control Today*, July/August 2004, <http://www.armscontrol.org/act/2004_07-08/GreenlandRadar.asp>; and Baker Spring, *Executive Memorandum: Congress Should Commend Britain on Missile Defense Radar Upgrade*, The Heritage Foundation, February 21, 2003, <http://www.heritage.org/Research/NationalSecurity/em861.cfm>.

16 "Iran Minister Tells Hungary USA 'Fanning Flames' of Iranian Nuclear 'Threat'," BBC Monitoring International Reports, February 16, 2005; "Opposition Head Demands Briefing on Hungary – USA Talks on Missile Network," BBC Monitoring International Reports, January 12, 2005; see also Wade Bose, "U.S. Eyes Missile Defense Site in Europe," *Arms Control Today,* July/August 2004, <http://www.armscontrol.org/act/2004_07-08/MDSite.asp>.

17 *Prague Summit Declaration*, Prague, Czech Republic, November 21, 2002.

18 "Industry Study Weighs Feasibility of NATO Strategic Missile Defense," *Inside Missile Defense*, July 20, 2005.

19 Ibid.

20 NATO Briefing, "Countering Weapons of Mass Destruction," March 2005, p3, <http://www.nato.int/docu/briefing/wmd-e.pdf>.

21 "NATO Releases First Batch of Theater Missile Defense Funds," *Inside Missile Defense,* July 20, 2005.

22 Ibid.

Middle East

The United States has continued to expand its missile defense dialogue with Israel – a partnership that now includes, in addition to the highly-successful jointly-developed *Arrow* theater missile defense system, substantial work on next-generation missile defense concepts such as high-energy lasers and boost-phase interception. It has also made efforts to expand this bilateral partnership into a regional effort by engaging Turkey, both as a developmental partner for European defenses and as a possible basing location for defenses against regional ballistic missile threats from the Middle East.[23]

The impetus for such cooperation has not waned in Israel following the removal of Saddam Hussein. Mounting regional threats – chief among them Iran's expanding nuclear ambitions – have spurred a renewed focus on missile defense in Israel, including the deployment of additional radars and the creation of a comprehensive national missile defense command. Israeli officials have intensified advanced testing of the jointly developed Israeli-American *Arrow* system, and have approached the United States regarding participation in the U.S. High Altitude Airship program[24] – aimed at creating a solar-powered, unmanned high-altitude airship for long-term surveillance and threat detection – as a means to monitor regional threats. Israel has since proceeded with development of the airship, and hopes to have an operational prototype by 2008.[25]

Israel has also conducted joint missile defense exercises with the United States. For example, in March 2005 Israel test-fired *Arrow* 2 interceptors against *Scud*-type targets in conjunction with the U.S. Army's *Patriot* air defense system.[26] Together these missile defense systems provide a tiered terminal-phase missile defense for Israel. The *Arrow* has an intercept altitude range between 40 kilometers to 100 kilometers, a maximum altitude three times higher than the *Patriot*. Together, the *Arrow* and *Patriot* could form a part of the global system of systems concept set forth earlier in this Section.[27]

Similar concerns are now evident among the countries of the Persian Gulf. Over the past two years, the members of the six-nation Gulf Cooperation Council (GCC) – Saudi Arabia, Kuwait, Oman, Qatar, Bahrain, and the United Arab Emirates – have begun to explore a range of individual and collective defense options as a response to Iran's growing ballistic missile capabilities. This has fostered closer cooperation with the United States on the part of several GCC countries, most notably Saudi Arabia and Kuwait, both of which have shown interest in upgrading their respective missile defense capabilities with the PAC-3 system.[28]

Asia-Pacific Area

Japan's missile defense cooperation with the United States – begun in the wake of North Korea's surprise launch of a two-stage *Taepo Dong* missile over the Sea of Japan in August 1998 – has taken on a new urgency as a result of growing concern over the nuclear program of North Korea, which announced

23 Notably, such cooperation has cooled considerably since the assumption of power by the Justice and Development Party (AKP) in Ankara in the fall of 2002 and the fall of Saddam Hussein's Iraq in the spring of 2003. However, Turkey is now said to be working on a national system of medium- and high-altitude air defense projects.

24 Barbara Opall-Rome, "Israel Eyes Solar-Powered Airship Abilities: Seeks Entry In U.S. Test To Explore Missile Defense Role," *DefenseNews.com,* July 14, 2003, <http://www.defensenews.com/sgmlparse2.php?F=archive2/20030714/atpc6710301.sgml>. In June 2005, the Missile Defense Agency decided to pursue the High Altitude Airship as a prototype project and not as an advanced concept technology demonstration (ACTD) initiative. The latter are designed to demonstrate maturing technologies, and several reviews of the High Altitude airship determined that it would not be ready within the three- to four-year window required for ACTD projects. The Missile Defense Agency hopes to have a flight test for a prototype in fiscal year 2008, although the U.S. House of Representatives passed a fiscal year 2006 defense authorization bill that eliminates funds for the project due to weight concerns. See "MDA Shifts High Altitude Airship Program from ACTD to Prototype Project," *Inside Missile Defense,* June 22, 2005.

25 Abraham Rabinovich, "Airship to Keep Eye on Mideast; 'Nothing Like it in the World,'" *Washington Times,* March 4, 2004, p. A15.

26 Barbara Opall-Rome, "Israel, U.S. Test Compatibility of *Arrow*, *Patriot* Units," *Defense News* 21, March 2005. The exercises were "intended to demonstrate the ability of the *Arrow's* ground-based radar and battle management center to work with the *Patriot* system elements to define incoming targets, determine a plan of attack, and assign specific launchers and missiles for intercept missions."

27 U.S.–Israeli military collaboration was threatened by Israeli arms exports to China, and especially by Israeli plans to upgrade the *Harpy* drones that Israel sold to China in the 1990s. For example, in May 2005, the United States suspended cooperation with Israel on the *Arrow* 2, which followed earlier American decisions to drop Israel from involvement in the J-35 Joint Strike Fighter, and to cancel funding for the joint Mobile Tactical High-Energy Laser project (a short-range missile and mortar defense system). However, in late June 2005, Israel agreed to cancel the *Harpy* deal, and agreed to sign a memorandum of understanding with the Pentagon concerning future Israeli arms exports. These moves should pave the way for enhanced U.S.-Israeli military cooperation in the future. See Caroline Glick, "Our World: Our Friends the Chinese," *Jerusalem Post*, May 16, 2005, p. 16; and Scott Wilson, "Israel Set to End China Arms Deal Under U.S. Pressure," *Washington Post*, June 27, 2005, p. 12.

28 Jeremy Singer, "Lockheed PAC-3 Contract Includes International Sales," *Space News,* January 31, 2005, <http://dev.space.com/spacenews/militaryspace/PAC_013105.html>. Saudi Arabia operates two to four PAC-2 batteries, and Kuwait operates five PAC-2 batteries. See *The Military Balance, 2004-2005*, The International Institute for Strategic Studies (2004).

in February 2005 that it possesses nuclear weapons, and less publicly by the increasing threat posed by China. The Japanese government has moved decisively toward a limited national deployment of anti-missile defenses built around the U.S. *Patriot* and *Aegis/Standard Missile* (SM)-3 systems. Japan expects to begin deploying PAC-3 units by March 2007, and it expects to refit one *Aegis* destroyer with SM-3 missiles by the end of 2007.[29] By March 2011, it expects to have deployed three PAC-3 units, and refitted four *Aegis* destroyers.[30] Given the threat, the Japanese government is considering advancing the deployment schedule of some systems.[31] Also, as noted previously, Japan is contributing financially to the development of a new missile, the SM-3 Block II, with a fifty-three-centimeter-diameter base that is expected to have a greater velocity and range than the current thirty-six-centimeter model SM-3.[32] As demonstrated in early 2005, the current SM-3 can intercept short-range ballistic missiles while the Block II will have the capability to shoot down ICBMs and as well as short-range ballistic missiles.[33]

At the same time, Japanese lawmakers have begun to revise the nation's defense laws, formulating new legal protocols designed to facilitate prompt political responses to ballistic missile launches by regional adversaries and proposing amendments to its constitution that would allow Japan to intercept missiles targeting third countries (including the United States) overflying its territory. Japan has even begun deliberations regarding cooperative work with the United States on an airborne directed-energy anti-missile project – one similar to the Airborne Laser now being developed by the U.S. Air Force. Most recently, in December 2004, Japanese and American officials signed a new memorandum on missile defense cooperation, laying out procedures for information-sharing and technical cooperation and establishing a new supervisory committee to oversee the missile defense partnership between Tokyo and Washington. The two countries are currently scheduled to conduct a missile intercept test in 2006 using their jointly-developed sea-based ballistic missile defense (BMD) system.[34] Such tests and exercises will help the two nations develop a joint concept of operations for the missile defense mission as well as increased interoperability.

South Korea has sharpened its focus somewhat on missile defense. Construction was begun in November 2004 of the first of three *Aegis*-equipped KDX-III destroyers.[35] The first destroyer is expected by the end of 2008, with the remaining two to be completed in 2010.[36] The destroyers will be equipped with the *Aegis* Combat System, which will permit the ships to perform search, tracking and missile guidance functions on over 100 targets simultaneously,[37] The KDX-III will have anti-air, anti-surface, and anti-submarine warfare capabilities, as well as the capacity to shoot down certain categories of tactical ballistic missiles.[38] Furthermore, in July 2005, South Korea discussed with Germany the potential purchase of U.S.-made PAC-2 missiles for intercepting North Korean missiles and aircraft.[39] South Korea had planned to acquire forty-eight PAC-3 missile defense units, but in 2002 decided against this purchase, given cost concerns.[40]

Taiwan, threatened by China's military modernization and its massive build-up of missiles along the Taiwan Strait, is building a missile defense that includes the development of indigenous land- and sea-based ABM capabilities, as well as stepped-up efforts to acquire a range of advanced U.S. ABM systems such as radars, the *Patriot* and *Aegis*-capable *Arleigh Burke*-class destroyers. In June 2005, Raytheon was awarded a $752 million contract to provide Taiwan with an early warning surveillance radar by Sep-

29 "Japan May Advance Missile Shield Date," *Washington Times,* July 24, 2005.

30 Ibid.

31 Ibid.

32 Tokyo has agreed to contribute roughly $600 million over five years (beginning in 2007) to upgrade the SM-3 interceptor. Bill Gertz and Rowan Scarborough, "Inside the Ring," *Washington Times*, May 20, 2005. The United States and Japan initiated the joint research effort to upgrade the SM-3 interceptor in 1999 following North Korea's test of the *Taepo Dong* in August 1998. The larger interceptor will include an enhanced nosecone, infrared sensor and kinetic warhead.

33 In a February 2005 test, a short-range target missile was launched from the Hawaiian island of Kauai, and the SM-3 interceptor missile was launched from an *Aegis*-equipped cruiser 160 kilometers from the island. The interceptor scored a direct hit on the ballistic missile outside of the atmosphere. See "U.S. Navy Announces Successful Intercept of Ballistic Missile," Deutsche Presse-Agentur, February 25, 2005. The United States and Japan is scheduled to conduct the first interception test of the enhanced SM-3 interceptor in March 2006. This test will also involve intercepting a mock target with an interceptor fired several hundred kilometers away from an *Aegis*-equipped cruiser. The interceptor will use a jointly researched nosecone to evaluate its performance in protecting the interceptor from frictional heat. See "Japan, U.S. Eye 1st Missile Interception Test Next March," *Japan Economic Newswire*, May 31, 2005.

34 "Japan, U.S. Plan Missile Interception Test," *The Korea Times*, June 3, 2005.

35 Hyung-jin Kim, "S. Korea Begins Building Aegis-Equipped Destroyer," *Yonhap,* November 11, 2004.

36 "Navy to Launch Stealth Destroyer Wednesday," *The Korea Times,* May 2, 2005; "Hyundai Heavy Wins Order to Build S. Korea's First Aegis Destroyer," *Yonhap*, November 26, 2004.

37 Hyung-jin Kim, "S. Korea Begins Building Aegis-Equipped Destroyer," *Yonhap,* November 11, 2004.

38 For more information on the KDX-III, see <http://www.globalsecurity.org/military/world/rok/kdx-3.htm>.

39 "German Defence Official Visiting South Korea to Promote Patriot Missile Sales," BBC Monitoring Asia Pacific, July 13, 2005.

40 "Seoul Officially Scraps SAM-X Project," *The Korea Times,* May 2, 2002.

tember 2009.[41] However, in March 2005 a $15 billion arms procurement package that includes six PAC-3 batteries, eight conventional submarines, and twelve anti-submarine aircraft, failed to receive approval by the Taiwan legislature.[42] Despite the fact that the Taiwan government trimmed $4 billion from the original bill that was defeated by the legislature in December 2004, opposing legislators cited cost concerns as well as the lengthy fifteen-year period of the deal.[43] The Taiwan legislature has still not approved this procurement package.[44]

India, spurred by Pakistan's ballistic missile capabilities and its missile partnership with China, has begun work on a hybrid domestic missile defense system to provide an area missile defense covering a radius of over 200 kilometers and incorporating Israeli *Green Pine* radars and upgraded variants of India's *Prithvi* ballistic missile.[45] India has also acquired from Israel several units of the *Barak* ship-based anti-missile system which is capable of intercepting incoming missile threats at a range of seventy kilometers. As part of the June 2005 U.S.-India defense pact,[46] the United States offered to sell India the PAC-3 system.[47]

The Australian government has steadily drawn closer to American missile defense plans since its official announcement in late 2003 of a program to counter ballistic missile and WMD proliferation threats. As part of this effort, Canberra has signed a bilateral memorandum on naval warfare with the United States, paving the way for closer technology and communications cooperation between the two countries' navies. In July 2004, the two countries signed a memorandum of understanding (MOU) calling for cooperation on missile defense development over the next twenty-five years.[48] For instance, both countries are interested in determining whether Australia's ground-based *Jindalee* radar, which was developed to detect aircraft and ships, could also be used to track ballistic missiles during the early boost phase. Australia's Defense Minister Richard Hill also indicated in June 2004 that ballistic missile interceptors may one day be deployed near Australian cities given the growing threat associated with the proliferation of ballistic missiles.[49] To implement the MOU, U.S. and Australian defense officials in January 2005 held consultations regarding cooperative work on intensified defense R&D of anti-missile capabilities.[50]

The Limits of, and Potential for, Cooperation

As it moves forward with missile defense the United States should embrace as an overall strategic goal the creation of a layered, multi-tier, system of systems defense that affords protection to all or as many allies as possible. Such an approach is based on several key premises: (1) that the United States will be engaged in operations in which coalition support and participation will be useful, if not critically important; (2) that as a result of increasing vulnerability, missile defense will loom as a greater part of an overall strategy both to deter and defend against the use of missiles; and (3) that contributions from coalition members and allies to missile defense will reflect the differing situations facing the various countries as well as the competition between missile defense and other budgetary priorities. The result of such an approach will be varying levels of protection against missiles of differing ranges. It will be possible to provide protection for national territory and defense of forward deployed assets.

As noted earlier, common to all of these developments is a newfound consensus regarding the gravity of the threat posed by ballistic missiles, and the centrality of missile defense as a strategic response. This trend has begun to reverse old stereotypes of BMD, and increasingly indicates the potential for international engagement in the creation of a layered global system to protect the United States and its allies against ballistic missile attack.

Such a focus is logical. In the contemporary international security environment, the ability to ensure the security of its foreign partners against ballistic missile attack and the associated threat of WMD blackmail has become an increasingly important component of America's ties with its allies abroad, and a key determinant of continued coalition solidarity.

Several important problems would need to be addressed in collaborative programs between the United States and its al-

41 Jim Wolf, "Taiwan to Get U.S. Early Warning Radar," Reuters, June 24, 2005, <http://www.defensenews.com/story.php?F=936058&C=asiapac>.

42 "Taiwan Parliament Stalls 15.2 Billion Dollar Arms Package," Agence France Presse, March 29, 2005.

43 "Taiwan Leader Calls for Arms Build-Up to Counter China's Threat," Agence France Presse, June 8, 2005.

44 Rich Chang, "Pentagon committed to weapons package: MND," *Taipei Times,* January 4, 2006, <http://www.taipeitimes.com/News/taiwan/archives/2006/01/04/2003287326>.

45 *Hindustan Times*, February 13, 2005. India is hoping to deploy a working version of this missile defense shield between 2010 and 2012.

46 Jo Johnson and Demetri Sevastopulo, "India and US Sign New Formal Defense Pact," *The Financial Times,* June 30, 2005, p. 11.

47 Sharon Weinberger, "India-U.S. Defense Cooperation Could Lead to P-3, PAC-3 Sales," *Defense Daily International*, July 8, 2005; and Neelam Mathews, "U.S. Approves Sale of PAC-3 to India," *Aerospace Daily & Defense Report,* June 17, 2005, 5.

48 David McLennan, "Hill Meets Rumsfeld, Signs 25-Year Missile Defense Agreement with US," *The Canberra Times*, July 8, 2004, p. 3.

49 Tom Allard, "Home Bases for Missile Defense: Hill," *Sydney Morning Herald,* June 23, 2004.

50 "Australia, U.S. Talk on Missiles," *CNN.com,* January 20, 2005, <http://edition.cnn.com/2005/WORLD/asiapcf/01/19/australia.us.defense/>.

International Collaboration on Missile Defense

focus on
combined exercises
joint studies
BM/C4I
controlled concept development
shared early warning (SEW)
research and development programs
advanced technology experimentation

to realize
operational missile defense network
enhanced existing capabilities
improved allied interoperability
new crisis management options
allied reassurance

lies. These include the sharing of information as well as technology transfer and the allocation of contracts. Because of the cutting-edge nature of technologies being developed in the United States, there would inevitably be concerns about technology security, particularly in the area of command, control, communications, computing, intelligence, surveillance, and reconnaissance. Consequently, the bulk of these technologies are likely to be developed largely if not exclusively in the United States with allies purchasing whole systems or co-producing them under appropriate licensing arrangements.

Because of drastically lower overseas spending levels, the potential for contributions from international partners to R&D for missile defense may be limited. As a result, advanced technologies, particularly those related to space, are likely to be registered more in the United States than overseas. Nevertheless, there are several arguments in favor of international missile defense cooperation. First, the essential issue is the mutual political and technological benefits that could result from cooperative technology programs at the international level. Among the benefits for overseas partners could be the opportunity to work with the United States in developing new technologies. In addition, technologies and other assets that would shorten the development time and perhaps make less costly the fielding of a U.S. missile defense may sometimes be available outside the United States. Such cooperation will enhance the interoperability of U.S. and allied systems, a development that will provide military benefits beyond the missile defense mission. In addition, training and preplanning with allies who already possess – or which will shortly – U.S. missile defense systems such Aegis-equipped ships and the Patriot will enhance U.S. flexibility, interoperability, and the internetting of communications/sensors, as well as help generate common U.S.-allied concepts of operations for the missile defense mission in future regional contingencies. This will allow some specialization (an allied focus on ground and sea-based defense while the United States provides space-based defenses) and in certain circumstances relieve or minimize the burden of the United States to make costly and time consuming deployments of its ground- and/or sea-based assets during regional crises. Where practical and when they possess relevant expertise, allies should also participate in the development of sea- and space-based assets, particularly given that they provide far greater missile defense capabilities than ground-based systems.

However, what overseas partners often lack is the level of investment necessary to move technologies from the drawing board to actual systems that could be deployed. Politically, the United States could strengthen its overall relationship with its allies by cooperative programs where the United States and its allies and coalition partners share threats and interests, and can benefit mutually from pooling their resources to produce a truly global missile defense.

Panel 6 Report

Members of Panel 6 discussed alliance issues related to missile defense with the Cornerstone Paper as background. The questions set forth below were addressed.

Panel Members
Chair: Dr. Robert L. Pfaltzgraff, Jr.
Mr. Ilan Berman
Ambassador Henry F. Cooper
Dr. Daniel I. Fine
Mr. Brian Kennedy
Mr. Mead Treadwell

I. What are the implications of the key issues raised in the Cornerstone Paper for missile defense, and specifically for allied cooperation to develop and deploy a global missile defense, as we look beyond 2005?

As the Cornerstone Paper notes, U.S. allies have differing needs based on a spectrum of threats, including missiles of shorter and longer ranges. At the same time forces deployed overseas by the United States are also vulnerable to a missile attack. No less than the United States, our technologically advanced allies are vulnerable to the major societal threat of electromagnetic pulse or EMP that could result from a nuclear detonation over or near their respective territories, possibly launched from a ship-borne *Scud* near our coasts or those of allies. An EMP attack against the United States would have cascading effects in other countries and major international economic consequences. By the same token such an attack mounted against technologically advanced allies and other countries of economic importance would have potentially devastating effects in the United States. It might also disable much of our command and control assets, together with other effects on our weapons systems and supporting infrastructure in a region of importance to the United States during a crisis which would negatively impact our ability to conduct military operations.

Several political and technological benefits may result for the United States and its allies from cooperative missile defense programs. They encompass: the opportunity to work with the United States in developing new technologies; technologies/assets that could shorten deployment of a U.S. missile defense may reside with American allies; missile defense preplanning, joint testing, and exercises will help the U.S. and its allies develop common concepts of operations and facilitate interoperability; cooperation may facilitate future access and basing of missile defenses on allied territories; and the United States could strengthen its overall relationship with its allies via such cooperative programs.

Moreover, the fact that an increasing number of U.S. allied and coalition partners possess sea-based and/or ground-based missile defenses (several of which are U.S. systems such as the *Aegis* and *Standard Missile* systems and the *Patriot*) will provide cost savings and augment U.S.-allied interoperability and the internetting of ground- and sea-based sensors and systems to provide an integrated layered defense. When combined with space-based missile defenses that can intercept ballistic missiles in all three phases of its trajectory, these systems provide the starting point for a missile defense that could target, track, and destroy hostile short- or medium-range ballistic missiles launched against the U.S. overseas troops or our allies.

Such U.S. and allied missile defense efforts will create the foundation for a "system of systems." And although the United States will contribute to each layer of a global missile defense system, it is likely that a logical division of labor will evolve in which the United States focuses primarily on space-based components while allies and coalition partners emphasize sea- and land-based systems. A system of systems will make it extremely difficult for an adversary to undermine U.S. crisis decision-making by threats to launch ballistic missiles against either the United States, U.S. forces forward deployed, or our allies/coalition partners. Such an approach will reassure allies who otherwise might feel increasingly vulnerable to weapons of mass destruction (WMD)/missile threats, including EMP attacks from ship-borne *Scuds*, as well as help dissuade states from developing nuclear weapons and their delivery systems by reinforcing U.S. extended deterrence.

II. What are the implications of the key alliance issues for overall U.S. national security?

There are numerous implications for national security that arise from the alliance issues raised in the Cornerstone Paper. For example, regions of vital importance to the United States, particularly the Asia-Pacific area, the Middle East, and Europe, are becoming increasingly vulnerable to missile attack. North Korea and Iran are in the process of deploying nuclear weapons that will threaten other countries within and beyond their respective regions. Japan's decision to move forward with missile defense is directly attributable to the North Korean *Taepo Dong* ballistic missile test in 1998. Moreover, Israel faces the threat of hundreds of Syrian short-range missiles. The United States seeks to prevent such proliferation and counter it.

To achieve this goal the United States, preferably with the support of allies, needs to deploy missile defenses as part of a broader non/counterproliferation strategy. As noted earlier, a global missile defense would also contribute to crisis management in these regions by demonstrating a capability to prevent a ballistic missile from reaching its target. Ideally, such a capability should be space-based in conjunction with the ground- and sea-based missile defense assets supplied by both our allies and the United States and deployed to the crisis area. The space-based element, however, provides the greatest flexibility since in most cases it would already be in place, ready to provide boost-phase intercepts. The result would be a dampening effect on the crisis because an adversary would be unsure if his missiles would reach their targets. Thus a U.S.-allied system of systems would make it extremely difficult to undermine U.S. crisis decision-making by threats to launch ballistic missiles against either the United States or our forces deployed abroad, or against the territory or forces of our allies or coalition partners.

III. What steps need to be taken with allies in light of these issues to achieve a global missile defense, both immediate and longer term?

Several steps must be taken to foster broader U.S.-allied collaboration on missile defense. This includes building upon the existing ground- and sea-based missile defense capabilities of our allies to develop a global layered defense with an appropriate division of labor for U.S.-allied missile defense cooperation. For example, the jointly funded Japanese-U.S. effort to develop an interceptor compatible with existing *Aegis* infrastructure, particularly the 21-inch-diameter *Standard Missile* that fits in the existing Vertical Launch System deployed on about 100 U.S. and allied ships around the world could be expanded to include other allies beyond Japan. Moreover, Australia plans to purchase three *Aegis*-class destroyers equipped with the latest combat systems. If it chooses, Australia could upgrade the system to participate in an international missile defense system. In addition to the sixty *Aegis*-class ships in the U.S. Navy, other countries, including Spain, South Korea, and Norway, operate the combat system. The United States needs to provide incentives to its allies to undertake modifications that allow anti-ballistic missile capabilities.

Another important step in this effort could include an international command and control system as well as allied financial contributions to the development and maintenance of a missile defense system. In addition, while facilitating technology-sharing with international partners on key missile defense systems is necessary for successful collaboration, it is also critical to make certain that structures/procedures are in place to safeguard U.S. cutting-edge technologies.

However, the feasibility of such an approach remains to be seen, given the budgetary limitations of allied defense allocations and other issues (discussed below). The numerous issues of command and control, technology transfer, and burden sharing would have to be resolved and therefore represent issue areas for more detailed consideration. To the extent that allies have technological capabilities that can contribute to missile defense, the basis exists to build an international consensus for missile defense.

Finally, simultaneous with the above efforts, the United States needs to educate allied officials and decision makers, and their publics about the growing threats posed by WMD/ballistic missiles, the role missile defense systems can play to counter them, and why it is important to collaborate with the United States on anti-ballistic missile systems.

IV. What are the key obstacles to global missile defense, and how can they best be addressed and overcome?

Over the past several years, a general consensus has emerged among many U.S. allies regarding the severity of the ballistic missile threat and that missile defenses represent a logical response. As described above, this trend has helped foster international cooperation in the development of a layered global system to protect the United States and its allies against ballistic missile attack. Joint cooperative missile defense efforts presently exist between the United States and several nations including Germany, Italy, the United Kingdom, Denmark, Turkey, Israel, Japan, South Korea, Australia, and several Gulf Cooperation Council states. NATO is also exploring missile defense options.

However, other key obstacles to broader allied participation in global layered missile defense apart from those highlighted above include a political mindset in allied countries against space that is an extension of such thinking in some influential quarters in the United States. The sources and nature of this opposition are discussed in greater detail in Sections 3 and 4. Among the arguments is the assertion that by its own abstention from space-based missile defense the United States can somehow influence other nations to forego the opportunity to deploy capabilities in space. This is an argument that is largely without foundation. There is no historical evidence to support the proposition that a decision by the United States to abstain from space-based missile defense would lead to comparable actions on the part of others.

In fact, the contrary may be the case. In the absence of U.S. activity, space may seem increasingly attractive to other states, who might conclude that they could use space for their own purposes without fear of U.S. competition or retaliation. As pointed out elsewhere in this report, space has long been used for the transit of ballistic missiles, the first of which was developed by Nazi Germany, not the United States. In 1944, the V-2 rocket, a ballistic missile that eventually provided the basis for later-generation U.S. and Soviet missiles, was launched against targets in Southern England, traveling part of its trajectory through the edge of space. Similarly, the first orbiting satellite was deployed not by the United States but by the Soviet Union in 1957. This suggests that, regardless of what the United States does, other states will exploit space for their own interests. As detailed in Section 3, a growing number of countries already have space programs. If it moves to develop space-based missile defense, the United States should be aware that international opposition is focused more on *American* programs than on missile defense per se.

V. Are there opportunities that can be seized to press forward with a global missile defense?

Opportunities to press forward with a global missile defense lie in the emerging threat environment that poses dangers not only to the United States, but also to our allies. In many cases we both face similar vulnerabilities, not only from missiles armed with WMD or even conventional warheads, but also from EMP, as set forth above and in Section 1. This is a threat that will increase in the years ahead and against which a missile defense will be necessary as an important counterproliferation capability. We should be proactive in educating the public, in the United States and overseas, about the threats posed by ballistic missiles and the technologies that are already available, or which could be produced, to counter such threats in a timely fashion. This effort should emphasize the need to avoid arms control and other inhibitions that might limit, politically or technologically, our ability to take fullest advantage of the means to protect the United States and our overseas interests from ballistic missile attack. As described earlier, the deployment by other countries of ground- and/or sea-based missile defenses represents the basis for a layered global missile defense. We should encourage and build on this foundation for allied missile defense cooperation.

7 section

Requirements to Revitalize Science and Technology

Innovative development of technology to achieve significant and difficult goals requires visionary and persistent leadership, competent scientists and engineers, and the necessary resources to prove that new ideas can and will work – often in the face of repeated setbacks along the way. As discussed in Section 4, these ingredients were present in sufficient quantities for the National Aeronautics and Space Administration's (NASA) *Apollo* program to fulfill President Kennedy's vision – a non-partisan, politically viable goal. However, programs to develop, test and deploy space-based defensive interceptors have not been viable – even though such programs also were consistent with a president's vision – President Ronald Reagan – and technology challenges were met in the 1980s, in time to realize his vision in the 1990s.[1]

Furthermore, sustaining such excellence over extended periods is difficult even when initial efforts are successful – many would argue NASA today needs a revival of visionary leadership and innovative scientific and technical talent. It is virtually impossible when, as in the case of *Brilliant Pebbles*, conflicting political visions prevent a consistent sustaining science and technology effort. If innovation is desired, new talent must periodically be added and consistently supported in an environment that is set apart from the normal development and acquisition bureaucracy. The squeezing out of innovation is a fact of life in the evolution of all programs as management structures and technology mature.

On the Rise and Fall of Innovative Science and Technology

It has ever been thus in the field of military-technological affairs. Innovation has usually come because of focused efforts on the part of a very few extraordinary people – and as they pass from the scene, innovation has given way to the usual risk-averse ways of bureaucracy. The history of science and technology (S&T) within the U.S. Air Force illustrates this evolution.

The legacy of General Henry H. (Hap) Arnold, unquestionably the father of the U.S. Air Force though it came into existence administratively after his retirement, was a major commitment to S&T. He gave top priority to research, development and innovation. He established a strong alliance with famed aeronautical engineer Professor Theodore von Karman, who led the 1944 *Toward New Horizons* study that formed and documented the vision of the Air Force – notably including a major role for USAF S&T personnel. In his lead essay, which became the new service's blueprint in 1947, von Karman famously stated, "Scientific results cannot be used efficiently by soldiers who have no understanding of them, and scientists cannot produce results useful for warfare without an understanding of operations."

Key to meeting this challenge in the 1950s and 1960s was General Bernard Schriever, USAF, who led the development of intercontinental ballistic missiles and many of the nation's early military space systems.[2] Notably, General Schriever did not rely upon the existing Air Force systems acquisition organization, then centralized at Wright Patterson Air Force Base, Ohio, when undertaking the top priority ballistic missile program in 1954. Instead, he created a new West Coast organization; brought in a carefully selected, highly talented group of Air Force officers and contractors – often hired right out of college – and proceeded to build the first operational intercontinental ballistic missile (ICBM) in less than five years.[3]

1 The challenge of building a viable space-based interceptor system was – and is – far less daunting than were the obstacles overcome in landing an American on the moon and returning him to Earth in eight years.

2 General Schriever's protégé, Lt. Gen. Sam Phillips, USAF, employed the skills he developed in directing the Air Force's ballistic missile and space programs to manage NASA's highly successful *Apollo* manned space-flight program.

3 See Jacob Neufeld, *Ballistic Missiles: The Development of Ballis-*

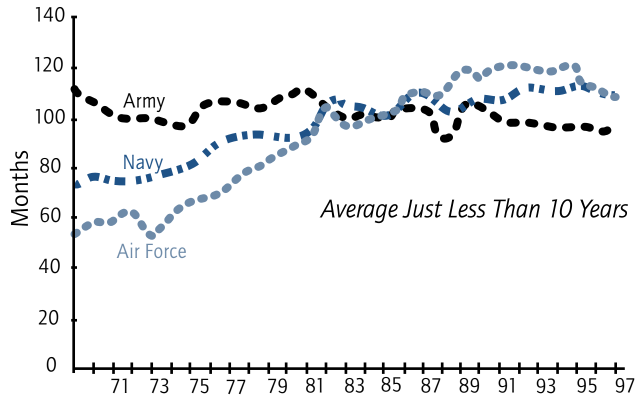
In many ways, accomplishing this feat at that time was more impressive than would be rapidly building an effective space-based interceptor system today.

General Schriever went on to apply an innovative approach to the development of all Air Force weapons systems. Key to his success was his creation of Air Force Systems Command, which led development of all Air Force systems until it was merged with Air Force Logistics Command in 1992. With its demise was lost an unambiguous "seat at the 4-star table" for S&T interests, and more importantly a clear career path to the highest ranks for the most capable and accomplished S&T officers. This downgrading of S&T interests by Air Force leadership was not lost on junior officers planning their careers. And it exacerbated the trends toward longer and longer development times between system definition and initial operational capability (IOC) as illustrated in the accompanying graph.

By the 1980s, the USAF innovative edge over the other services had vanished – and by the 1990s, the USAF was taking even longer than the other services to develop its weapons systems. The time after USAF system definition to initial operations more than doubled between the late 1960s and the early 1990s. Since 1999, these trends have worsened as schedules have slipped and costs have grown. General Greg Martin, USAF, Commander, Air Force Material Command, blames the Air Force's dismal acquisition record on decisions in the wake of the end of the Cold War, which passed program management from government hands to prime contractors who in turn were squeezed through the 1990s by downsizing and early retirements of research and development (R&D) and acquisition experts.[4] While this explanation certainly has merit – and the graph shows an increased time to IOC in the 1990, the major growth in development time from the heydays of the 1960s was in the 1970s as the acquisition process became more bureaucratic.[5]

An important June 12, 2005 House Armed Services Committee (HASC) hearing focused on these problems for space systems in particular. Among the many pertinent comments by the various participants, Dr. Peter Rustan, S&T Director for the National Reconnaissance Office and former Program Manager of the Strategic Defense Initiative (SDI) *Clementine* Program, emphasized the key need for robustly funded and flexibly managed S&T efforts with substantial demonstration testing programs.[6] Thomas Young, former Lockheed Martin CEO and Chairman of a 2003 Defense Science Board Task Force

Average Time: Program Start to Initial Operational Capability



that examined space acquisition problems, emphasized the need to restore within government a systems engineering capability, "which had atrophied to basically zero."[7]

Of interest is that the Navy also lost its innovative edge over the Army – no doubt influenced in the early 1960s by the development of the *Polaris* submarine-launched ballistic missile in about four years – following many of General Schriever's management and technology innovations. Although such speculation may not be entirely justified, the suggested lack of innovation in Army systems might be correlated with the fact that the Army's elite technical cadre in building rockets was taken over by NASA and was instrumental in the historic and rapid *Mercury*, *Gemini*, and *Apollo* achievements of the 1960s.

A General Deterioration of Defense S&T Programs

Beyond these trends in eroding innovation in programs to build new military systems, there is on the horizon a serious problem in sustaining S&T excellence in the Defense community. In his critique of a seriously deteriorating situation at the Naval Research Laboratory in particular and in general at Defense Laboratories, Don J. DeYoung concluded:

> *Should present trends continue, the Defense Laboratory will lose its competence as a performer of long-term, high-risk work. When that happens, the risks to future military operations will grow because its abilities to provide for America's defense and respond quickly to crises will have passed quietly into history. Lost competence will also still the Pentagon's strongest voice for independent, authoritative technical advice. The yardstick will be broken. The Nation's interests will have been traded for corporate interests, with public sector service sold for private gain.*

tic Missiles in the United States Air Force – 1945-60, Office of Air Force History, 1990.

4 See Vargo Soar and Michael Fabey, "USAF Revamps Acquisition Force," *Defense News,* July 25, 2005, 1.

5 It is notable that during that time, special programs – e.g., stealth, cruise missiles, *Pershing* II – markedly beat these timelines, but they were managed outside of the normal acquisition process.

6 Hearing on Space Acquisition, Strategic Forces Subcommittee, the House Armed Services Committee, July 12, 2005.

7 "Acquisition of National Security Space Programs," Defense Science Board Report, May 2003.

> *From that moment on, to use Hamlet's final words . . . the rest is silence. Our country's future takes a darker path, one marked by the silence of the labs.*[8]

DeYoung's concerns were not overstated, as was made clear by the above mentioned recent HASC hearing on Space Acquisition. For the past fifteen years, key defense activities have been "out-sourced," allegedly to save money or because needed competence no longer existed within the Department of Defense (DOD).[9] In many cases, such outsourcing has been justified – in others it has been of dubious value and may have had costly consequences, as DOD's competence to manage S&T efforts has atrophied. Increasingly, the Pentagon leadership is losing its ability to tell the difference between sound and unsound decisions on innovative technology and is outsourcing key decision-making as well.[10] General Lance Lord, USAF, Commander of Air Force Space Command, acknowledged these problems at the HASC hearing on Space Acquisition and indicated that the Air Force is taking actions to reverse these trends.

"Outsourcing" government management responsibilities has not worked because America's defense-industrial base is in trouble, too. Perhaps Stan Crock, *Business Week*'s chief diplomatic correspondent, overstated when he claimed in 2003, "While hardly anyone was watching, the infamous American military-industrial complex died," and "Without a seismic change, the industry is headed into a death spiral." But his numbers sounded an alarm:[11]

- During the 1990s, the aerospace-defense workforce shriveled from 1.3 million in 1989 to 689,000 at the end of 2002.
- Industry handed pink slips to 10 percent of its workforce since September 11, 2001.
- Between 2002 and 2008, nearly half the industry's workforce - what remains of the *Apollo* generation - will be eligible for retirement. This will mean the loss of unparalleled skill and experience, and potentially America's technological edge.
- Between 1999 and 2000, aeronautical engineering degrees dropped from 4269 to 2042.
- The defense budget is about 3 percent of gross domestic product – about half the low-point of the Cold War.

The impact of these concerns is exacerbated as America's high tech supply chain, seemingly at an accelerating rate, moves off-shore in the non-defense sector – the source of the commercial-off-the-shelf technology upon which many key defense programs have come to rely. More and more U.S. companies are closing plants and relying on overseas cheap labor in China, Mexico, Eastern Europe, Malaysia, the Philippines, India, etc. And increasingly, manufacturing and high tech scientific jobs are moving off-shore as well.[12] And, as discussed below, American universities, while still the world's leaders, may not produce the needed scientists and engineers to retain U.S. global technological leadership into the indefinite future – demographic trends suggest a looming problem of strategic proportions.

The Pentagon's ability to exploit innovative technology to build effective defenses is at grave risk because of the trends mentioned above – and because of a lack of institutional memory given the political disruption to the cutting edge SDI developments a decade ago. This lack of continuity is particularly troublesome because the most advanced technology is increasingly commercially available to friend and foe alike, even though the Pentagon apparently judges it to be too risky to be applied to develop U.S. missile defenses.

Innovation Needs for Future Missile Defenses

A lack of institutional memory regarding the state of fundamental technology was illustrated by delays in the minimally funded space-based boost-phase interceptor program, because of alleged "major technology challenges" including a claimed need to learn how to miniaturize satellite components.[13]

8 Don J. DeYoung, "The Silence of the Labs," *Defense Horizons,* Number 21, Center for Technology and National Security Policy, National Defense University, January 2003.

9 That outsourcing program management is based on an unjustified presumption of industry's ready competence was recently demonstrated by the failure of the "so-called National Team" to deliver on the ground-based missile defense system. After sequential test failures in a relatively relaxed test program (by standards established in the 1950s), internal and external reviews pointed to numerous failures in quality control and related disciplines mastered in the 1950s and 1960s. These lessons must be relearned – in a much more risk adverse environment.

10 For example, the skill mix of officers managing the acquisition of Air Force systems has changed dramatically since the heyday of Air Force Systems Command of the mid-1960s. Even in 1974, over half of those managing the acquisition of Air Force systems held engineering degrees as a primary specialty, many with advanced engineering degrees. By 2001, that percentage had dropped to only 14 percent. Today, officers with liberal arts degrees manage development of Air Force systems; the main prerequisite has become attendance of classes on acquisition management, leading to a "process orientation" rather than hands-on scientific and engineering experience. It is not surprising that the Air Force has lost its innovative edge that was prevalent in the heyday of General Schriever's watch (see figure on previous page).

11 Stan Crock, "An Arms Industry Too Big For The Task," *Washington Post,* August 31, 2003, p. B1.

12 See Indrajit Basu, "Indians Returning Home for Better Jobs," *Washington Times,* September 6, 2003, p.A8.

13 See "Missile Defense Agency Slowing Space-Based Interceptor Effort," *Aerospace Daily*, July 3, 2003; and Randy Barrett, "Pentagon Backpeddles On Schedule For Space-Based Interceptors," *Space News,* July 7, 2003,1.

But as discussed in Appendix B, the Chinese are building miniaturized micro- and nano-satellites – exploiting the SDI technology base developed and demonstrated in space during the Reagan-George H. W. Bush (hereafter referred to as Bush-41) era. Nigeria launched its first satellite in 2003, using micro-technology from Surrey Satellite Technology – also a source of technological advances in China.[14] Furthermore, all of the key technologies to support building a space-based interceptor system available over a decade ago, were demonstrated to the whole world in the prize-winning *Clementine* mission of 1994, and could be revived and deployed as a force-in-being within five years.[15] Needed is an innovative technical team of the sort assembled by General Schriever in the 1950s to overcome much more daunting technical challenges and build the first ICBM in less than five years.

The remarkable thing is that such a team existed a decade ago, thanks to earlier visionary leadership by President Ronald Reagan and Defense Secretary Caspar Weinberger – and to the decision of the Bush-41 administration, executed by then Defense Secretary Dick Cheney, to continue to press toward building a global defense against ballistic missiles.

President Reagan's March 23, 1983 speech launched the Strategic Defense Initiative, and Secretary Weinberger assembled the resources to press toward the president's goals. In particular, he selected Lt. General James A. Abrahamson, USAF, an aeronautical engineer who had successfully managed development of the F-16 and the early flights of the Space Shuttle, to lead SDI. General Abrahamson assembled a first class technical team and challenged them to answer President Reagan's call to evaluate the national technology base and determine how to build upon it truly effective defenses against long-range missiles.

At Secretary Weinberger's direction, General Abrahamson formed the initial SDI effort from existing technology programs (funded at ~$1.5 billion in 1984), previously managed by the Defense Advanced Research Project Agency (DARPA) and the armed services. Drawing on advice and support from the nation's top technologists, he molded these existing S&T efforts into a ballistic missile defense "mission-focused" SDI program. SDI technologists maintained this focus through the Bush-41 administration even as their budget tripled to include additional S&T efforts aimed at demonstrating technology needed for effective defenses and to initiate serious military-acquisition programs as the technology was proven.[16]

But in 1993, the incoming Clinton administration renamed and reoriented the SDI program, cut its budget by 50 percent and purged the Clinton Ballistic Missile Defense program of the most advanced technology and those who were its advocates – Defense Secretary Aspin boasted they were "taking the stars out of Star Wars."[17] The space-based interceptor effort and its supporting S&T programs were scuttled entirely – and the most advanced technology produced by the $30 billion investment of the SDI era was lost. In particular, the baseline ~$1.5 billion per year investment in demonstrating key defensive technology was cut to ~$50 million per year, dead-ending steady advances of many DARPA and armed services programs that SDI had absorbed a decade earlier.

Most of the "technically elite" missile defense cadre then in government and industry left for "greener pastures," and "administrators" rather than S&T technologists ascended to power in the Pentagon's missile defense programs. Reviving cutting edge technologies demonstrated at least a decade ago is impeded by a near total lack of institutional memory, a pervasively risk-averse attitude, and the legacy of over three decades of the Anti-Ballistic Missile (ABM) Treaty-related political constraints that sharply circumscribed engineering possibilities and even basic concepts – as discussed in Section 4.

For example, *Brilliant Pebbles* technology was developed in the late 1980s and early 1990s. As discussed in Section 4, *Brilliant Pebbles* was the first SDI program to be approved as a Major Defense Acquisition Program by the Pentagon's acquisition bureaucracy in 1991. After the program was scuttled in 1993, all first generation *Brilliant Pebbles* technology was space qualified in 1994 on the award-winning *Clementine* mission to the moon and an *Astrid* flight. (See Appendix I) For over twelve years, there has been no sign of efforts to use those technology innovations even to enhance sea-based or other missile defenses, let alone to revive the *Brilliant Pebbles* space-based interceptor program.

With little institutional memory and few directly relevant technological credentials to develop independent judgments regarding even decade-old cutting-edge technology, current

14 "Nigeria Launches First Satellite," *Colorado Springs Gazette,* September 28, 2003.

15 The *Brilliant Pebbles* space-based interceptor program became SDI's first fully approved Major Defense Acquisition Program in 1990, and had it been fully supported without the political burdens from those opposed to "weapons in space," it could have been operational as early as 1996. See Donald R. Baucom, "The Rise and Fall of Brilliant Pebbles," *Proceedings of the International Flight Symposium*, sponsored by the North Carolina First Flight Centennial Commission, October 23, 2001.

16 The S&T developments during the Reagan-Bush 41 SDI era were discussed by former SDI Directors, James A. Abrahamson and Henry F. Cooper in *What Did We Get for Our $30 billion Investment in SDI,* National Institute for National Policy, September 1993. See also Henry F. Cooper, "End of Tour Report," January 20, 1993 for an accounting of the state of affairs at the outset of the Clinton administration, including the then approved budget throughout the rest of the 1990s.

17 Fully approved acquisition programs absorbed much of the budget cut – e.g., the congressionally mandated program to build ground-based interceptors to protect the U.S. homeland was cut by 80 percent. The Clinton administration's designated "top priority" theater defense programs were cut by 20 percent.

Kelly Johnson's Recipe for Operations of The Lockheed Skunk Works

- Program manager must be delegated practically complete control of his program in all aspects. He should have authority to make quick decisions regarding technical, financial or operational matters.
- Strong but small program offices must be provided by the military and industry.
- The number of people having any connection with the project must be restricted in almost a vicious manner. Use a small number of good people.
- Very simple drawings with great flexibility for making changes must be provided in order to make schedule recovery in the face of failures.
- There must be a minimum number of reports required, but important work must be recorded thoroughly.
- There must be monthly cost review covering not only what has been spent and committed, but also projected costs to the conclusion of the program. Don't have the books ninety days late and don't surprise the customer with sudden overruns.
- The contractor must be delegated and must assume more than normal responsibility to get good vendor bids for subcontract on the project. Commercial bid procedures are often better than military ones.
- The inspection system as currently used by the Skunk Works, which has been approved by the Air Force and the Navy, meets the intent of existing military requirements and should be used on new projects. Push basic inspection responsibility back to the subcontractors and vendors. Don't duplicate so much inspection.
- The contractor must be delegated the authority to test his final product in flight. He can and must test it in the initial stages.
- The specifications applying to the hardware must be agreed to in advance of contracting.
- Funding a program must be timely so that the contractor doesn't have to keep running to the bank to support government projects.
- There must be absolute trust between the military project organization and the contractor with very close cooperation and liaison on a day-to-day basis. This cuts down misunderstanding and correspondence to an absolute minimum.
- Access by outsiders to the project and its personnel must be strictly controlled.
- Because only a few people will be used in engineering and most other areas, ways must be provided to reward good performance by pay and not based on the number of personnel supervised.

(LtCol J. Douglas Beason, *DoD Science and Technology for Post Cold War: A Case for Long-Term Research*, Industrial College of the Armed Services, National Defense University, May 28, 1996.)

missile defense administrators rely on a "business school" mentality and essentially have turned advanced thinking over to industry – which in turn is focused on the poor health of their "bottom line," as discussed above, and the moment-to-moment satisfaction of their government customers.

Principal elements of the Clinton program – which gave priority to preserving and strengthening the ABM Treaty that banned effective ballistic missile defenses of all types – undeniably remain the primary focus of the Pentagon's missile defense programs. Such ground-based defenses are the most expensive and least effective way to attempt to defend against ballistic missiles – hence, industry will resist efforts to move to less expensive systems (even when they are more effective) because that reduces their profits. Unless management steps like those of the Air Force in the 1950s are taken, this recipe will lead to a "death spiral" for creating effective defenses.

Needed: A New Effort for Innovative Missile Defense Technology

Persistent visionary leadership is what is now needed to change course. The enabling technology is viable – it was space-demonstrated a decade ago. President George W. Bush (hereafter referred to as Bush-43) has freed the Pentagon from the shackles of the ABM Treaty. Needed now is a classic small, highly competent government and industry effort charged with rapidly reviving and deploying that technology after the fashion that has so often succeeded in the past – and epitomized by the recipe for successful operations defined over fifty years ago by Kelly Johnson of Lockheed "Skunk Works" fame (see table above) and exploited by General Schriever in his ballistic missile and space programs. Of particular importance is a very small, empowered, technically competent management and engineering team from government and industry, fully supported with needed funds and "high cover" to minimize the bureaucratic kibitzing and mission creep.

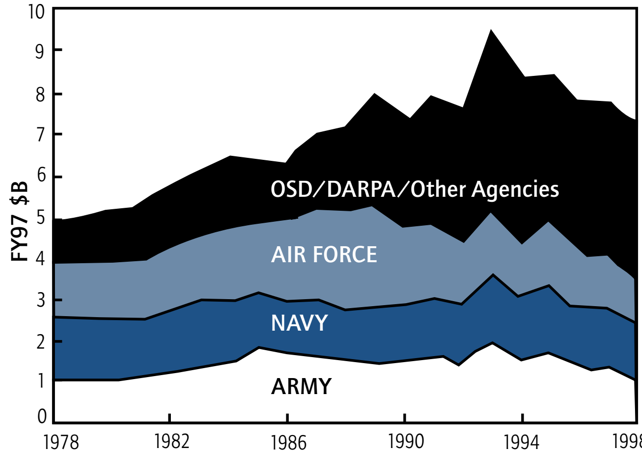
Just as General Schriever started fresh with his innovative effort that led to the first ICBM in under five years, a new organization should be given the task of developing space-based interceptors by employing technology and engineering skills not currently evident within the Missile Defense Agency (MDA). A special project office should be formed and manned with personnel skilled in developing innovative technology, perhaps under DARPA, working closely with the Air Force Space Command to frame a comprehensive program to revive key technology and concepts demonstrated over a decade ago.

As illustrated in on the following page, this level of funding would be a significant percentage of the DARPA budget, which has been growing in recent years at the expense of the service S&T budgets. But it would not be out of line with other DARPA projects that have led to major improvements in defensive capabilities, especially if conducted jointly with and partially funded through the Air Force. Another point to be made from Figure 7.2 is associated with the overall reduction in Defense S&T investment beginning in the mid-1990s, a related matter of concern to Congress that could be at least partially rectified by the above suggested initiative. The Defense Science Board sounded an alarm in 1998 about the negative impact of this reduction.[18] The Board found that, on average, high technology companies invest 3.5 percent of their total sales in R&D, but the president's budget invested in defense S&T was less than 3 percent of the overall DOD budget – which the Board recommended as a goal. General Hap Arnold would no doubt have supported a return to his vision that recognized major S&T investments as crucial to the nation's defense.

While officials in the Bush-43 administration have stated 3 percent as their goal,[19] their budget requests have not met this stated goal – indeed, the first Bush budget requested only 2.7 percent, a decline from the last Clinton year. Congress added $1.5 billion to the president's Fiscal Year (FY) 2003 budget request to bring it to 3 percent[20] to meet the DOD's stated goal in FY 2003.[21] Then, the president's FY 2004 budget request cut the FY 2003 appropriations by 8.3 percent[22] – and Congress again increased the FY 2004 defense S&T account, this time by 12 percent over FY 2003 appropriations and 22.2 percent over the president's FY 2004 request.[23] Congress appropriated $12.6 billion for S&T, up from $11.2 billion in FY 2003 and $2.3 billion above the president's request.

Congressional support continued in FY 2005. DOD S&T funding climbed to $13.6 billion in FY 2005, an increase of $993 million or 7.9 percent. The final congressional appropriation was nearly $3 billion more than the $10.6 billion requested.[24]

DoD S&T Funding Record



*Note: OSD and agencies **not** "tasking" service S&T funding: instead the services are cutting S&T funding*

The defense S&T account suffered substantial cuts in the president's FY 2006 budget with a request of $10.7 billion, which makes it just 2.54 percent of the overall DOD budget, well short of the 3 percent goal.[25] Untimely however, Congress allocated $13.8 billion.[26] For FY 2007, the administration requested $11.2 billion for DOD S&T.

Providing the Scientists and Engineers for the Future

The exodus of human capital from the aerospace industry is further exacerbated by broader trends in the science and engineering education sector. From 1993 to 2001, graduate enrollment in science and engineering declined 1.4 percent and that trend would have been more pronounced without a strong upsurge in 2000-2001.[27] Another disturbing trend is the decreasing percentage of U.S. citizens pursuing these degrees. Over the 1993-2001 period the share of U.S. citizens in graduate science and engineering studies declined 7 percentage points, from 76 percent to 69 percent. Enrollment for students with temporary visas increased 9 percent in 2001 and those students were concentrated in engineering (up 11 percent) and computer sciences (up 16 percent). Foreign students now make up almost half of the graduate students in computer scienc-

18 "Report of the Defense Science Board Task Force on Defense Science and Technology Base for the 21st Century," Office of the Under Secretary of Defense for Acquisition and Technology, June 30, 1998.

19 *The American Institute of Physics Bulletin of Science Policy News*, No. 50, April 26, 2002, reported that Under Secretary of Defense Pete Aldridge testified that the DOD's 5-year plan projects an increase in the S&T budget "to approach 3 percent of the DOD budget."

20 In April 2002, fourteen members of the Senate Armed Services Committee wrote to the Chairman and Ranking Member: "It is imperative, therefore, that we act to fund S&T at 3 percent of the total defense budget. In the same letter they noted that rather than meeting or tending toward the 3 percent goal stated by Under Secretary Aldridge, "current trends indicate that the S&T budget will decrease to 2.28 percent by 2007. This trend, if allowed to continue, will substantially undermine our military and technological capabilities in the long-term." As noted above, the FY 2004 budget request continued the DOD's trend to cut the S&T budget to be consistent with this prior trend.

21 *Congressional Action on Research and Development in the FY 2003 Budget,* American Association for the Advancement of Science, 2003, 12.

22 Kei Koizumi, "Federal R&D in FY2003 and FY2004," AAU Council of Federal Relations, American Association for the Advancement of Science, March 5, 2003, http://www.aaas.org/spp/rd.

23 *DoD Receives Record R&D Portfolio, 12.6 Billion for S&T Programs,* American Association for the Advancement of Science, September 29, 2003; and Congressional Appropriations Tracker 2004.

24 *Congressional Action on the FY 2005 Budget,* American Association for the Advancement of Science, December 15, 2004.

25 *R&D Programs Face Another Rough Year in 2006*, American Association for the Advancement of Science, February 10, 2005.

26 *Congressional Action on Research and Development in the FY 2006 Budget,* American Association for the Advancement of Science, January 2006, http://www.aaas.org/spp/rd/ca06main.htm.

27 Joan Burrelli, "Graduate Enrollment Increases in Science and Engineering Fields, Especially Engineering and Computer Sciences," *InfoBrief*, National Science Foundation, NSF-035, April 2003.

es and engineering, according to the National Science Foundation (NSF).

These trends look even more troubling when juxtaposed with astonishing increases in advanced degrees being awarded in some foreign countries. For example, between 1991 and 2001, science and engineering Ph.D.s in China and South Korea rose by 535 percent and 150 percent, respectively.[28] Foreign students who for years have composed a major percentage of U.S. graduate school classes now increasingly obtain their advanced degrees at home, as illustrated in Figure 7.3 from a recent *Fortune* magazine article.[29] In particular, China's burgeoning store of advanced S&T capability is sobering, from both economic and military perspectives – and not only at the graduate level.[30] China will graduate over 600,000 engineers this year; the United States about 70,000. *Fortune* notes that "Our universities are still excellent, but the foreign students that come to them are increasingly taking their educations back home. As other nations multiply their science and engineering graduates – building the foundation for economic progress – ours are declining."

These sobering trends, coupled with the aging and atrophy of the base of scientists and engineers upon which viable military space programs rely, suggest a requirement to reenergize our colleges and universities to support these future needs.[31] Efforts to do so now – in a new situation where the U.S. government is committed to reinvigorating its space and defense technology programs – would be met with approval on our campuses, unlike in the not-so-distant past.

The important role of space technology in the post-9/11 world is easily understood in terms of practical military missions and integrated into a vision of a needed systems' "brilliance" that can capture the interest and imagination of today's science and engineering students and their professors. While x-ray lasers from space may have once excited engineering and science students in the first years of SDI promise, today's counterpart is stimulated by space and land-based "smart" weaponry in operations from Kabul to Baghdad. There was no 9/11 when SDI was launched. The new defense requirements stimulated by 9/11 provide a new incentive for university science and technology graduates to choose careers that include missile defense and space security.

Our universities represent a vast source of talent and other resources to help meet the technology innovation challenges of the twenty-first century. Efforts should be made to revive federal support of physical science research and engineering, which has sharply declined relative to biological research in the last decade. Restoring a comparable level of such funding is imperative if we are to remain on the cutting edge of innovative defense technologies.

Summary Conclusions and Recommendations

Innovative development of technology to build effective ballistic missile defenses, especially those based in space, requires visionary and persevering leadership at the political level. That leadership existed for the *Apollo* program; it did not for the SDI program – even though popular presidents of the United States initiated both and both produced the needed technology to pursue the initial vision in a timely way.

The history of major technological developments has repeatedly demonstrated that such creative development can be achieved by establishing a new organization – separate from the normal development process, staffing it with competent scientists and engineers, and giving them the necessary resources to make needed investments without interference from excessive bureaucratic oversight. This worked with the Manhattan Project – which produced the atomic bomb in less than 4 years, *Corona* – the project which produced America's first spy satellites, the ICBM and the submarine-launched ballistic missile (SLBM) programs, NASA's *Apollo* program, the "stealth" programs, the cruise missile, *Pershing* II, and a host of other efforts of national importance.

History also shows that when the groups that produce such creativity either become or are infused into large bureaucratic institutions, their impact diminishes and is often lost after a limited period of time as the administrative processes of acquiring and operating major systems dominate in the pursuit of resources and careers. From time to time, enlightened leadership must infuse new talent with needed resources in new organizations if new ideas are to prevail. Such an infusion of new talent is needed today to provide the innovation required to build highly effective missile defenses.

Thus, we recommend such a Special Project Office be established, perhaps as part of the Defense Advanced Research Projects Agency, to revive the innovative technology that will enable development and deployment of an operating constella-

28 Norman R. Augustine and Burton Richter, "Our Ph.D. Deficit," *Wall Street Journal*, May 4, 2005.

29 Geoffrey Colvin, "Can America Compete?" Fortune, July 25, 2005, 70-85.

30 For a more academic study of these disturbing global trends, see Richard B. Freeman, "Does Globalization of the Scientific/Engineering Workforce Threaten U.S. Economic Leadership?," National Bureau of Economic Research, June 2005. Undoubtedly, the U.S. share of the world's scientists and engineers will shrink according to these demographic trends. The critical strategic question is whether the Unites Stats and its allies will retain an edge in their quality of engineers and scientists sufficient to offset the capabilities of potential adversaries.

31 Op. cit. Furthermore, the source of America's problems runs deeper into our educational system than to our universities – to primary and secondary education, as pointed out in the *Fortune* article. Recent test scores have demonstrated that America's math and science students rank extremely poorly among the nations of the world with fifteen year-olds ranking twenty-eighth in mathematical achievement.

tion of space-based interceptors within five years. Based upon the technology developed and the system concept critically reviewed and approved by numerous critical groups during the SDI era – including formally by the Defense Acquisition Board – such an operating defensive constellation of one thousand space-based interceptors could be developed, tested, built, and operated (for twenty years) within a three- to five-year period for $11 billion in 1990 dollars, or $16.4 in 2005 inflation-adjusted dollars.

This same technology will undoubtedly provide block improvements to ongoing missile defense development activities. For example, the light-weight kill vehicles enabled by the cutting edge work on space-based interceptors can enable more cost-effective sea-based and ground-based interceptor systems. Thus, while this new Special Project Office should focus on building space-based interceptors, it should maintain a liaison with the MDA and the armed services – but should not be distracted from building a space-based interceptor system as quickly as possible.

A related matter is the need to revive the interest in space and defense technology in our colleges and universities – and even in our primary and secondary educational system – to assure a viable cadre of engineers and scientists into the indefinite future. It is recommended that the NSF be reorganized to support funding of space security research under specific budgetary authority. This follows the successful NSF history in materials research. Similar to materials science research, a program of research funding solicitations and awards in missile defense-related S&T should be developed at the NSF. The missile defense component of space security research should be supported by evaluation advisory and peer groups with expertise that would evolve with the technology as part of a new missile defense science and technology collegial community.

Panel 7 Report

With the Cornerstone Paper entitled *Requirements to Revitalize Science and Technology* as background, members of Panel 7 discussed the status of the U.S. science and technology (S&T) base and its implications for America's ability to develop, deploy, and evolve a layered missile defense encompassing space-, sea-, and ground-based intercept capabilities.

Panel Members
Chair: Ambassador Henry F. Cooper
Mr. John H. Darrah
Dr. Daniel I. Fine
Dr. William R. Graham
Dr. Jack Hammond
General Benny Schriever, USAF (Ret.)†
Dr. William R. Van Cleave

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I. What are the implications of the key issues raised in the Cornerstone Paper for missile defense, and specifically for space-based missile defense, as we look beyond 2006?

The scientific and technical base on which rests the development of truly effective missile defenses is steadily eroding. In particular, the critical knowledge and expertise available fifteen years ago in programs to develop and deploy an effective space-based defense have essentially disappeared. No significant space-related program has been completed expeditiously in recent memory.

Because of the erosion of the S&T funding base in general, the quality of human capital in the aerospace sector is lower than it was a decade ago, leading to a decline of innovative government, industry, and the capabilities of universities in the defense and space sectors. As the competence of government management has declined, streamlined and accountable management has been replaced by a "process" oriented bureaucratization of the S&T and acquisition process. Highly successful programs in the 1950s and 1960s were managed by small, technically competent teams with authority and responsibility to develop, test, and deploy major systems in significantly less than half the time of today's intended schedules. Present day programs are too often run by individuals lacking the necessary technical credentials to manage such accelerated programs.

As a result, there is a low probability that space-based defenses will emerge without external intervention. This would involve conducting a space-based defense development program within an organization such as the Defense Advanced Research Projects Agency (DARPA) more inclined than the Missile Defense Agency (MDA) to innovation. Such an initiative might also encourage basic research on missile defense- and space-related technologies at university campuses, which are now less ideologically opposed to "militarization of space" arguments that carried so much weight when the Strategic Defense Initiative program began over twenty years ago.

II. What are the implications of the key issues raised in the Cornerstone Paper for overall U.S. national security?

As stated in earlier sections, space-based defenses are essential if the United States is to have a truly effective defense against ballistic missiles. Until there is an initiative to restore the key S&T base, it is unlikely that space-based defenses will be developed and deployed.

In general, the erosion of the defense community's S&T base undermines the prospects not only for effective ballistic missile defenses, but also for innovative improvements in other defense capabilities such as space control, assured access to space, miniaturization, etc. The decline of our S&T base creates a serious national security problem in government, in the defense industry, and in our universities.

III. What steps need to be taken in light of these issues to achieve space-based missile defense, both immediate and longer-term?

As an immediate action, the United States should reconstitute the cadre of scientists and engineers who worked on the *Brilliant Pebbles* program, provide them with the necessary resources, and "let them get back to work." Unfortunately, such a development is unlikely in the current political climate.

To break the existing mindset, a sense of urgency is needed, inspired by greater recognition of the nature of threats facing the United States, and articulated by the uppermost levels of government. Presidential level direction is an important element in this calculus. As was demonstrated by President Eisenhower's successful development of intercontinental ballistic missiles, only leadership from the highest levels is sufficient to:

1) Break through the bureaucratic impediments at the Missile Defense Agency to initiate development of a space-based defense, and;
2) Educate the public about the threats posed by ballistic missiles, the consequences of failing to erect a defense, and the importance of space-based defense in the missile defense system.

Presidential leadership, therefore, is needed to raise the priority of space-based defense. This priority must also be amplified by additional spokespersons at the federal level. Since the MDA does not appear willing to embrace space-based defense, government entities should take the lead including the Air Force Space Command, the Office of Science and Technology Policy, and the Office of Management and Budget which could provide policy and resource leadership. In addition, innovative programs at DARPA could play a key role in reviving space control and space defense programs.

IV. What are the key obstacles to space-based missile defense and how can they best be addressed and overcome?

The primary obstacle to establishing a viable program for space control and space-based defenses is political, not technical, even though much must be done to revive the technology base that was available fifteen years ago to support building such systems.

Since the primary obstacle is political, it must be met in the political arena, preferably before a disaster makes our vulnerability apparent forcing the United States to deploy effective space-defenses. The initiatives suggested above could exploit the increasing efforts among state legislatures to raise awareness of the threat posed by ballistic missile proliferation, the vulnerability of the American people to this threat, and the viable options to defend against that threat. An informed general public will be far more likely to voice support to politicians for the development and deployment of effective missile defenses, including a space-based component.

V. Are there opportunities that can be seized to press forward with space-based missile defense?

Several opportunities exist for advancing the case for space-based defense. The first is the growing appreciation of the importance of space to U.S. national security. The exemplary performance of the U.S. space-based assets during U.S. campaigns in Afghanistan and Iraq can and should be leveraged into a public policy opportunity. Notably, the critical role of space assets in the success of those engagements has so far not been valued in their own right, but rather for their complementary roles in support of other systems or mission tasks. Nevertheless, the opportunity exists to promulgate the centrality of space to U.S. national security and the role space-based defenses will have to play.

There is also an opportunity to develop certain technologies synergistic with a future space-based defense. Small lightweight technologies needed to build viable sea-based defenses also have direct application to a space-based defense. To make this happen, however, the U.S. Navy will need to demand a missile compatible with its existing Vertical Launch System (VLS) infrastructure, rather than acquiescing to MDA's current plan to build a larger interceptor, requiring a new VLS tube and an expensive Navy retrofit program in order to develop enhanced capabilities, e.g., boost phase intercept.

The 9/11 terror attacks have changed attitudes on college campuses among students. The anti-defense stances frequently found among faculty members are not as prevalent among students today. In fact, students are increasingly patriotic and eager to make a contribution to the defense of the country. This suggests that if the U.S. government were to organize a new research and development program focused on developing innovative ideas to exploit space and space defense, an eager cadre of students would be interested in working in those areas. Such a program would help to replenish the badly-deteriorating workforce of scientists and engineers in the aerospace sector.

More specifically, the United States needs to restore federal support for, and funding of, physical science research and engineering at least to the level currently received by biological research. At a minimum Department of Defense S&T funding should reach three percent of total defense spending. In order to revive interest among students and faculty in space and defense technology in U.S. colleges and universities, the National Science Foundation (NSF) should be reorganized to support funding of space security research under specific budgetary authority following the NSF model for materials science research. Similar to the materials science model, a program of research funding solicitations and awards in missile defense-related S&T should be developed. Moreover, the missile defense component of space security research should be supported by advisory and peer groups with expertise that would evolve with the technology as part of a new missile defense science and technology collegial community.

On U.S. campuses, we need to increase emphasis on S&T in the curricula as a way of strengthening the U.S. science, technology, and engineering base and offer research on the development of missile defense and space security technologies to emerging scientists. Finally, we should more actively encourage the publication of S&T research in a way that fosters a sustainable and vibrant academic research community but safeguards sensitive data from improper dissemination. For example, sensitive research could follow the private sector industrial sponsored research model of establishing parameters on a "black box" (no identification) in which critical measurements are performed.

section 8

Conclusions & Recommendations

The United States today stands at a crossroads. The threat environment facing America at the start of the twenty-first century is radically different and more complex than that of just a decade ago. A multitude of dangers have emerged to threaten the United States. The proliferation of ballistic missiles and weapons of mass destruction constitutes a grave and growing threat to the security of the United States, its deployed forces, and international partners. This concluding Section first summarizes the ballistic missile threat. It then sets forth a series of recommendations for missile defense to address this threat. Finally, it discusses the elements of a strategy designed to enable the United States to deploy a missile defense adequate for the challenges ahead.

The breath and sophistication of this threat requires an equally complex and effective response – one that is capable, in the words of the Bush administration's strategic documents, of deterring aggression, dissuading potential adversaries, assuring our allies, and defending the United States against undeterrable dangers.[1] So far, however, the United States has stopped short of applying these principles to the creation of a comprehensive layered system capable of both global monitoring and global defense against ballistic missile attack. Instead, the missile defense system that has emerged since President Bush's historic December 2002 announcement of an "initial set" of missile defense capabilities to protect the U.S. homeland, troops, and allies remains beholden to inferior technologies and failed organizational concepts.

Even with the U.S. withdrawal in 2002, the ghost of the Anti-Ballistic Missile (ABM) Treaty (and the doctrine of mutual assured destruction or MAD) continue to impact negatively our ability to develop and deploy the most effective options available for missile defense. The Ground-based Midcourse Defense (GMD) system currently being deployed is a single, midcourse system based largely on technologies developed before the ABM Treaty was abrogated. This initial capability will not be adequate to meet the growing challenges of ballistic missile proliferation, much less the more numerous and sophisticated threats of Russia and China. The harmful vestiges of the Treaty and MAD are particularly apparent with regard to space-based missile defense which is the most promising and technologically feasible option, one which would serve as the centerpiece of a truly effective global layered missile defense. The leverage offered by boost intercept from space is no secret: it was first identified in the Defense Advanced Research Projects Agency's (DARPA) seminal study of missile defense entitled *Project Defender* as long ago as 1960.

This state of affairs has disturbing implications for our national security and our international role in the decades ahead. Without an effective means to dissuade, deter, and defeat a growing number of threats, the United States will be unable to maintain its global leadership. The creation of effective defenses against ballistic missile attack is central to this task. New momentum and direction are needed in the pursuit of a truly global layered missile defense capability that incorporates sea- and space-based interdiction capabilities. Such an approach encompasses a series of concerted and concurrent political, technical, and organizational measures.

The Problem: An Existing and Escalating Threat

The proliferation of ballistic missiles and weapons of mass destruction (WMD) and their possession by growing numbers of adversaries, ranging from traditional strategic competitors to terrorist organizations, pose a serious and growing threat to the United States, its civilian population and deployed military forces, and friends and allies. This threat encompasses:

1 These strategic goals are articulated in the Pentagon's September 2001 and February 2006 Quadrennial Defense Reviews and the Nuclear Posture Review of 2002.

- States such as North Korea and Iran are working hard to acquire (or already possess) WMD and the means to deliver them. North Korea may already possess up to eight nuclear weapons and has made major advances in the development of its ballistic missile capabilities. North Korea is also a proliferator of WMD/ballistic missile know-how as well as technologies and components. Iran is increasing the range of its *Shahab* ballistic missiles and is aggressively pursuing a nuclear program designed to produce nuclear weapons. In addition, Iran is reported to have test-launched a *Scud* from a surface ship.
- Strategic competitors, Russia and China, also are extending the sophistication of their strategic arsenals in terms of warhead accuracy, countermeasures, and delivery systems. For example, Moscow is developing the *Topol* intercontinental ballistic missile (ICBM) with several variants including models with a multiple independently-targetable re-entry vehicle (MIRV) capability as well as a sea-based version. Beijing is developing MIRV technology designed to defeat anti-missile systems for use on the *Dong-feng* 31 ICBM. Moreover, in 2003 China became the third nation with a manned space flight program, underscoring its objective to challenge the United States in space.
- A number of terrorist groups are making concerted efforts to obtain WMD that would enable them to conduct chemical, biological, radiological, or nuclear attacks. Al Qaeda is reported to be seeking nuclear and chemical weapons to attack the United States. For example, a *Scud* missile armed with WMD could be launched by terrorists (or other U.S. adversaries) from ships off U.S. coasts. This threat, which would not be countered by the GMD system presently being deployed in Alaska and California, puts at risk the U.S. population living within several hundred kilometers of our coastline.
- A nuclear detonation over or near the United States launched by a missile designed to explode its warhead at an altitude between 40 and 400 kilometers would create electromagnetic pulse (EMP) that could shut down all or a major portion of the U.S. power grid, communication networks, and other critical infrastructure dependent on sophisticated electronics and computers. This might include our financial markets, transportation systems, and food distribution networks. An EMP attack would create havoc resulting in major national and international economic consequences. U.S. satellites, both civilian and military, are vulnerable to such attacks, especially in low-earth orbits. The current GMD deployment does little to address this threat.
- Finally, these threats are increasing at a swift pace. The United States no longer has the luxury of lengthy timelines to develop and deploy a missile defense against them. The ballistic missile programs of nascent missile possessors – or would-be possessors – are chiefly designed to inflict major devastation without necessarily possessing the accuracy associated with the U.S. and Soviet nuclear arsenals of the Cold War. This means that missiles primitive by U.S. standards may be adequate for a rogue state or terrorist organization to inflict extensive casualties or to launch an EMP attack. Consequently, the warning time that the United States might have before the deployment of such capabilities is quickly eroding for several reasons including: the widespread availability of technologies to build missiles and their key components and/or the purchase of a prototype missile which could then be reverse engineered for indigenous production; and the possibility that a number of assembled missiles might be purchased outright. Such missiles need not be highly accurate to inflict mass casualties on their intended targets – defenseless civilian populations.

The Solution: A Global Layered Missile Defense with Sea- and Space-based Elements

A global layered defense capability is necessary to counter these threats. Near-term options exist for developing viable sea- and space-based defenses within the next decade resulting in a comprehensive, global layered missile defense system. This option would complement the GMD system currently being deployed but afford superior coverage at less cost than expanding the number of GMD sites. Layered defenses provide multiple opportunities to destroy attacking missiles in all three phases of flight from any direction regardless of their geographic starting point. Furthermore, a layered defense makes the countermeasures available to the offensive systems much less effective than would be the case if interdiction was only possible in one (or two) phase(s) of the missile's flight. Boost phase intercepts, most efficiently conducted by components deployed in space, are particularly desirable because a missile is most vulnerable during this segment since it is relatively slow moving, presents a readily identifiable target (bright rocket plume), and has not released any of its warheads or countermeasures which would complicate interception in subsequent phases. Boost phase interception has the added advantage that the missile's payload may, depending on how early interdiction occurs, fall back on the attacking nation. This situation could deter the launching state if it is confronted with the likelihood of serious damage to its own territory. In addition, depending on the number of assets deployed, a space-based boost-phase defense could always be on station on a world-wide basis, unfettered by sovereignty issues of overflight and operations on another nation's territory.

Layered defenses might also dissuade adversaries in possession of ballistic missiles, or would-be possessors, from seeking costly investments to acquire ballistic missiles that could not easily penetrate such a defensive shield. As a result, the United States would retain maximum flexibility in a crisis situation in which the threat of ballistic missile attacks would be minimized. In order to build a global layered missile defense, the United States must take several important steps in parallel.

Going "back to the future"

Given that of all possible basing modes, space-based defenses offer the widest coverage and largest number of intercept opportunities, and the fact that little if anything has been done to take advantage of space defense technologies that were mature fifteen years ago, a new initiative is required to bring that technology and its potential up to date. We recommend a streamlined technology-limited development program based on the *Brilliant Pebbles* program to demonstrate within three years the feasibility of a constellation of space-based interceptors to intercept ballistic missiles in all phases of flight – boost, midcourse, and terminal. To avoid conflicts with existing acquisition programs focused on ground- and sea-based defenses while moving forward as rapidly as possible, this effort should be undertaken by a special task force of competent technical personnel experienced in developing pioneering technology. Consequently, the United States should:

- Fund DARPA, which specializes in the innovation of defense systems via advanced technology, to assemble a small team charged with rapidly reviving and deploying a modern space-based kinetic-energy interceptor system in the manner of past successful programs such as the development of the first ICBM and the *Polaris* missile. Of particular importance is a small, empowered, technically competent management and engineering team from government and industry, fully supported with needed funds.
- Building on the *Brilliant Pebbles* technologies created in the late 1980s and early 1990s as well as advanced technologies produced since then in both the military and commercial sectors, the DARPA team should develop and rigorously test within three years a space-based system to perform boost, midcourse, and terminal interception tests against ballistic missiles of several ranges. The anticipated cost of this three-year effort, which could leave in place a space testbed with limited intercept capability, is $3-5 billion.
- Direct the Air Force Space Command to work with DARPA to develop the operational concept for a constellation of space-based interceptors, with an anticipated handoff to the Air Force in three to five years of an evolving capability that can be integrated into U.S. Strategic Command's global architecture.
- Utilizing an event-driven procurement strategy deploy a *Brilliant Pebbles* twenty-first century space-defense system with the goal of an initial capability in 2010. Because of the number that would be deployed, *Brilliant Pebbles* would have multiple opportunities for interception, increasing chances of a successful kill in either the boost or midcourse phase, or even in the early terminal phase. These characteristics stand in sharp contrast to the GMD ground-based interceptors which, in the limited numbers presently planned, may not provide more than one intercept opportunity. Moreover, *Brilliant Pebbles* interceptors are small (1.4-2.3 kilograms and approximately the size of a watermelon) making them difficult to detect and thus target; they also contain an inherent self-defense capability further adding to their survivability. *Brilliant Pebbles* was approximately midway through engineering and manufacturing development before it was cancelled, suggesting that with the needed political will, an updated system could be developed and deployed in a timely fashion. For example, based on the fully approved Defense Acquisition Board plan from 1991, 1000 *Brilliant Pebbles* could be developed, tested, deployed, and operated for twenty years in a low-to-moderate risk event-driven acquisition program for $11 billion in 1990 dollars, or $16.4 billion in inflation-adjusted 2005 dollars.

Enhancing existing sea-based defenses

With the proper direction, the sea-based missile defense program now under development can become a highly effective component of a global layered defense as well as serve as an incubator for several technologies that will eventually be used in space. Moreover, due to mature technologies and the considerable investment already made in the U.S. Navy *Aegis* and the *Standard Missile* systems (some $60 billion to date), sea-based defenses constitute an established and advantageous near-term missile defense option for the United States. For example, such defenses provide flexible deployment options on U.S. ships operating worldwide in international waters that comprise over two-thirds of the earth's surface. This capability for worldwide operations and rapid transit to potential crisis spots also eliminates the often difficult negotiating process needed to field ground-based defense systems on foreign territory. Maximizing the unique benefits of sea-based defenses requires that the United States:

- Make organizational changes within the Missile Defense Agency to allow the U.S. Navy to mange its missile defense activities more effectively. In addition, increase funding for the *Aegis* ballistic missile defense program, including the *Standard Missile* system, to enable pursuit of upgrade projects at a technologically limited pace as compared to the current fiscally constrained pace.

- Accelerate the current *Standard Missile*-3 (SM-3) Block 1 program to provide the capability for late-midcourse and, depending on where deployed, boost-phase interception of ICBMs. This effort would require $100 million more than is currently allocated to the program by the Department of Defense (DOD).
- Expand existing areas of coverage by outfitting additional U.S. (and allied) vessels with boost- and terminal-phase anti-missile capabilities. For example, the SM-3 Block 1 (and its variants) which is launched from the U.S. Navy's Vertical Launch System (VLS), can be deployed on several U.S. ships outfitted with VLS including *Aegis-Ticonderoga*-class cruisers and *Spruance*- and *Arleigh Burke*-class destroyers. In addition, a number of ships in the fleets of U.S. allies also have VLS.
- Harness *Brilliant Pebbles* technologies in support of current work on sea-based defenses. For example, revive the technologies for the light-weight Advanced Technology Kill Vehicle (ATKV), developed for space-based applications over a decade ago. The ATKV, mated to the enhanced SM-3 Block 2 (a joint U.S.-Japanese program), could achieve velocities providing a boost phase intercept capability far greater than that offered by the current SM-3 noted above. The ATKV/Block 2 combination would also have the cost-saving advantage of being compatible with the existing U.S. Navy's VLS infrastructure (and that of several allied nations) thus eliminating the need to develop a larger missile and new vertical launch system to achieve a comparable capability.
- Fund the SM-2 Block 4 to defend against a ship-borne *Scud* launched off the U.S. coast (more below). The estimated cost is between $50 and $100 million.

Augmenting U.S. missile defenses to address the ship-borne *Scud* threat

As noted in the 1998 Rumsfeld Commission Report, the real and growing danger posed today by the possibility of a short- or medium-range missile launched from ships off the coasts of the United States warrants the deployment of missile defenses as a component of homeland security. The current GMD missile defense program, however, leaves American cities vulnerable to attacks from close-in threats from the sea such as ship-borne *Scuds*. To address this vulnerability, the United States should:

- Immediately authorize development of a naval component that utilizes the U.S. Navy *Aegis* and the *Standard Missile* systems described above. Specifically, the United States could outfit several Navy ships with a modified SM-2 Block 4 within a year providing a terminal-phase and possibly a limited boost-phase defense capability against sea-launched *Scuds*.
- As an interim measure if necessary, deploy the *Patriot* missile defense system to provide rudimentary anti-missile capabilities for major American cities against a ship-borne *Scud* attack. Because of the large number of *Patriots* that would need to be deployed, this is a temporary solution until sea-based missile defense capabilities become available.
- Develop and deploy supplemental missile defense assets/technologies capable of providing near-term boost-phase interception, including the revival of the *Raptor-Talon* unmanned aerial vehicle program for coastal defense applications developed in the early 1990s.

Limiting deployment of the Ground-based Missile Defense system

- Ensure that the current GMD system has incorporated the most advanced technologies available and is utilizing operational procedures that may have been restricted by the now defunct ABM Treaty.
- Given its limited capabilities focused on small-scale attacks by rogue states, and the fact that it does not address shorter-range threats from ship-borne *Scuds* off the U.S. coastline let alone the more sophisticated threats emanating from China and Russia, the GMD system should not be expanded beyond current deployment sites in Alaska and California. Instead, the United States should move forward expeditiously to develop the sea- and space-based missile defense architecture outlined above to create a global layered missile defense system capable of countering the threat environment of the early twenty-first century.

Committing to space

The importance of space to the United States extends beyond missile defense. Space represents an arena of crucial importance to the United States for civil, commercial, and national security purposes. As such, it is essential that the United States not only be able to use space for missile defense, but also to have assured access to space as well as the means to protect our other vital space-based assets, including improved situational awareness in space. And even though the United States remains at the forefront of space technology and exploration, our continued preeminence is not assured. At least thirty-five countries (several of which are hostile to the United States) have space programs designed to lead to the deployment of assets in space.

Yet the United States is not providing adequate resources for its military space programs. This is dangerous because the ability to attack and disrupt U.S. space assets, launch systems, and associated ground support stations is expanding on the part of states and even non-state actors. For example, China is developing advanced capabilities for space warfare, including lasers capable of destroying/disrupting American or other satellites. In addition, as discussed earlier, several states – as well as terrorist groups – currently possess or are pursuing the capability to launch an EMP strike which would render useless many critical U.S. national security, civilian, and commercial space assets.

Therefore, if it is to remain a space power – and indeed a global power – the United States must not only be capable of detecting and deterring such attacks, but also of possessing the means to defend against them, identify their source, and quickly recover/replenish vital assets. This means that the United States should:

- Articulate a commitment to space dominance by immediately making major new investments in the research and development of space-based technologies to counteract the decline (20 percent to less than 8 percent) in the U.S. aerospace sector's share of total national research and development investment since the 1980s. The increased funding should support efforts to protect existing space-based assets and field technologies to enhance/safeguard the commercial and national security uses of space such as situational awareness. In addition, given that numerous U.S. national security satellites are approaching obsolescence, successor generation systems are urgently needed. This includes the capacity to replace disabled or destroyed space assets rapidly and underscores the need for robust, low-cost U.S. space launch capabilities.
- Acknowledge the centrality of space to the development, testing, and deployment of a missile defense system capable of protecting the United States, its overseas forces, and its allies. Missile defense, together with space control and assured access, are capabilities central to U.S. efforts for creating disincentives to states and terrorist organizations seeking WMD and their delivery systems.
- Reject efforts to counter current American primacy in space through legal regimes and arrangements. The experience of the ABM Treaty, together with endeavors now underway to restrict weapons proliferation and deployment by international agreement, does not lend credence to efforts to impose new international legal prohibitions against space-based missile defense. Such actions are more likely to place burdensome restrictions on the use of space by the United States, rather than deterring others from developing their own space programs.

Creating a science and technology workforce for the future

The U.S. science and technology (S&T) base must be resuscitated. In American universities today, graduate enrollment by U.S. citizens in S&T fields is steadily eroding. The total number of advanced degrees earned in science and engineering by Americans has declined from 75 percent in the mid 1960s to less than 60 percent today. In 2004, the proportion of the U.S. college-aged population earning degrees in science and engineering was lower than that for sixteen countries in Asia and Europe. The increasing decline in new S&T personnel with U.S. citizenship entering the work force at our national laboratories, in defense aerospace, and the commercial sector (increasingly the breeding ground for technologies for defense applications) means that there is a major concern about the aging and atrophy of the base of scientists and engineers upon which viable military space programs and the development of enabling technology rely.

These trends have serious ramifications for America's capacity for S&T leadership in the twenty-first century. As a result, the United States needs to reenergize its support for the creation of a future cadre of scientists and engineers. Efforts to do so would be largely met with approval on the nation's campuses because, unlike in the not-so-distant past, students today are generally less anti-military and are impressed by the operational performance of military technology, including the role of space assets, in both Afghanistan and Iraq. Consequently, the United States should:

- Restore federal support for, and funding of, physical science research and engineering at least to the level currently received by biological research. At a minimum Defense Department S&T funding should reach 3 percent of total DOD spending.
- To revive interest among students and faculty in space and defense technology in U.S. colleges and universities, reorganize the National Science Foundation (NSF) to support funding of space security research under specific budgetary authority following the NSF model for materials science research. Similar to the materials science model, a program of research funding solicitations and awards in missile defense-related S&T should be developed. Moreover, the missile defense component of space security research should be supported by advisory and peer groups with expertise that would evolve with the technology as part of a new missile defense science and technology collegial community.
- Increase emphasis on S&T in curricula as a way of strengthening the U.S. science, technology, and engineering base and offer research on the development of missile defense and space security technologies to emerging scientists, who are now uniformly less averse to work in national security-related fields.

- Encourage the publication of S&T research in a way that fosters a sustainable and vibrant academic research community but safeguards sensitive data from improper dissemination. For example, sensitive research could follow the private sector industrial sponsored research model of establishing parameters on a "black box" (no identification) in which critical measurements are performed.

Broadening missile defense collaboration with U.S. allies

Missile defense already constitutes a growing part of U.S. national security strategy. In order for missile defense to contribute as fully as possible to this strategy, however, it must have global reach. This includes both the ability to protect allies and coalition partners and to work with them as contributors to a global missile defense system. Over the past several years, a general consensus has emerged among many U.S. allies regarding the severity of the ballistic missile threat and that missile defenses represent a logical response. This trend has helped foster international cooperation in the development of a layered global system to protect the United States and its allies against ballistic missile attack. Joint cooperative missile defense efforts already exist between the United States and several nations including Germany, Italy, the United Kingdom, Denmark, Turkey, Israel, Japan, South Korea, Australia, and several Gulf Cooperation Council states. NATO is also exploring missile defense options.

There are several political and technological benefits that may result for both parties from cooperative technology programs at the international level. They encompass: the opportunity to work with the United States in developing new technologies; technologies/assets that could shorten deployment of a U.S. missile defense may reside with American allies; missile defense pre-planning, joint testing, and exercises will help the United States and its allies develop common concepts of operations and facilitate interoperability; cooperation may facilitate future access and basing of missile defenses on allied territories; and the United States could strengthen its overall relationship with its allies via such cooperative programs. Moreover, the fact that an increasing number of U.S. allied and coalition partners possess both sea-based and ground-based missile defenses (several of which are U.S. systems such as the *Aegis* and *Standard Missile* systems and the *Patriot*) will provide cost savings and augment U.S.-allied interoperability and the internetting of ground- and sea-based sensors and systems to provide an integrated layered defense. Together they provide the starting point for a missile defense that could target, track, and destroy hostile short- or medium-range ballistic missiles launched against U.S. troops overseas or our allies.

Such U.S. and allied missile defense efforts will create the foundation for a "system of systems." And although the United States will contribute to each layer of a global missile defense system, it is likely that a logical division of labor will evolve in which the United States focuses primarily on space-based and other components while allies and coalition partners emphasize sea- and land-based systems. A system of systems will make it extremely difficult for an adversary to undermine U.S. crisis decision-making by threats to launch ballistic missiles against either the United States, U.S. forces forward deployed, or our allies/coalition partners. Such an approach will reassure allies who otherwise might feel increasingly vulnerable to WMD/missile threats – including EMP attacks from ship-borne *Scuds* – as well as help dissuade states from developing nuclear weapons and their delivery systems by reinforcing U.S. extended deterrence.

However, several potential issues also need to be addressed if collaborative missile defense activities between the United States and its allies are to occur such as information sharing, the security of information transferred, especially related to command, control, and intelligence, and the allocation of contracts. To move forward with mutually beneficially collaboration on missile defense with our allies the United States should:

- Encourage and build on the deployment/upgrading by U.S. allies of their missile defense capabilities (ground- and sea-based) in order to develop a system of systems global layered defense with an appropriate division of labor for U.S.-allied missile defense cooperation. At the same time strengthen allied participation where feasible in sea- and space-based missile defenses.
- Identify the technologies/assets resident in allied nations that will encourage the development and deployment of a layered missile defense system.
- Facilitate technology-sharing with international partners on key missile defense systems while making certain that structures/procedures are in place to safeguard such cutting-edge technologies.
- Ensure that sufficient interoperability, flexibility, adaptability, and affordability exist between current and planned U.S. and allied systems as well as in joint U.S.-allied planning of new missile defense technologies. This approach will enable U.S. allies to "plug into" our missile defense systems (and vice-versa).
- Recognize that contributions from coalition members and allies to missile defense will reflect the differing situations facing the various countries as well as the competition between missile defense and other budgetary priorities.
- Educate allied officials and decision makers, and their publics in an outreach program about the growing threats posed by WMD/ballistic missiles, the role missile defense systems can play to counter them, and the

opportunities for collaboration with the United States on such systems.

The Political Solution: Rectifying Outdated Mindsets, Misconceptions, and Mistaken Beliefs

The nature of the political opposition arrayed against missile defense over the past five decades has been unique. It is difficult to cite another example in the history of U.S. defense development that has been marked by the dominance of political factors at the expense of technical considerations. Although there have always been questions about what constitutes an effective defense and how much to pay for it, technical rather than political reasons have usually driven the debate about whether or not to develop and deploy a particular system.

In the case of missile defense, however, it has been essentially the reverse: political considerations have primarily shaped technical behavior that far too often has been designed to achieve certain predetermined political ends, in which the goal of developing the most technically sound and cost-effective missile defense has been subordinated to other interests. Specifically, the ABM Treaty and the doctrine of mutual assured destruction made virtually impossible the deployment of effective anti-missile systems. The demise of the ABM Treaty in June 2002 cleared the way for technology to be used more logically and efficiently, and forced missile defense opponents to set forth other reasons why the United States should not defend itself apart from the facile statement that the Treaty outlaws it.

While the *Technical Solution* section above outlines the needed layered architecture and the programmatic, technical, organizational, and budgetary measures required to develop and build it, political action is also essential if such a system, incorporating sea- and space-based capabilities, is to become a reality. The United States must undertake an outreach program designed to remedy missile defense misconceptions and demonstrate convincingly that technical solutions exist to address the real and growing threat of WMD and ballistic missiles.

Empowering the American public

In light of the continuing debate over the importance and effectiveness of ballistic missile defenses, and especially in the context of the growing debate about the weaponization of space, a proactive educational outreach program is essential to inform the American public, Congress, and our allies and friends about the threats posed by ballistic missiles and the potential to counter them in a timely fashion. Most importantly, this effort must emphasize the need to avoid arms control and other inhibitions that could limit the ability to take full advantage of advanced technology to protect America, our overseas troops, and friends and allies from ballistic missile attack. As a result, the United States needs to:

- Make clear that affordable, mature sea- and space-based options are available which would supplement the current GMD system but provide significantly greater protection.
- Raise the profile of missile defense at the highest echelons of the U.S. government through bipartisan consensus building.
- Persuade the nation's elected officials to move decisively to protect the American people against ballistic missile attack.
- Foster a cadre of sympathetic members and professional staff in the U.S. Congress through outreach designed to educate such decision-makers regarding the capabilities of missile defense and the gravity of the current and growing threat of ballistic missiles and WMD.
- Engage the emerging, post-September 11 national security and homeland defense constituency now visible at the grassroots and state level of the United States.
- Promote innovation within the government bureaucracy through emphasis on multiple paths of technological evolution and optimization of existing systems.

Glossary of Terms

accidental launch. An unintended launch of a ballistic missile which occurs without deliberate national design as a direct result of a random event, such as mechanical failure, a human error, or an unauthorized action by a subordinate.

Aegis. The U.S. Navy's shipboard anti-air warfare area defense system. *Aegis* is an element of the Ballistic Missile Defense System (BMDS) and is being developed to provide a rapidly deployable, highly mobile defense capability. The missile launchers of the *Aegis* system are being modified to fire a new missile that will have the capability to intercept a ballistic missile. See also ***Standard Missile***.

airborne laser (ABL). The ABL system consists of a high-energy, chemical oxygen iodine laser mounted on a modified 747-400F aircraft to shoot down ballistic missiles in their boost phase. See also **boost phase** and **directed energy weapon**.

anti-ballistic missile. A term used for ballistic missile defense weapons developed to negate the ballistic missile threat. See also **interceptor.**

Anti-Ballistic Missile Treaty (ABM). The ABM Treaty, signed and ratified by the Soviet Union and the United States in 1972, initially limited deployment on each side to two sites each comprising 100 interceptors, 100 launchers, and several ground-based radars. In 1974, the Treaty was amended to limit each party to one site. The ABM Treaty prohibited the development, testing, and deployment of sea-based, air-based, space-based, and mobile land-based ABM systems. The Treaty also regulated ABM development and testing. The United States withdrew from the Treaty in June 2002.

anti-satellite weapon (ASAT). A weapon designed to destroy satellites in space. The weapon may be launched from the ground, from an aircraft, or from space.

Arrow. A joint U.S.-Israeli program started in 1988 designed to meet Israel's requirements for area missile defense of population centers against tactical ballistic missiles. See also **tactical ballistic missile**.

assured kill. This option requires missile defense segments (boost, midcourse, and terminal phase) to employ tactics that produce the highest probability of kill consistent with the available number of defensive resources (interceptors).

ballistic missile. A ballistic missile follows a prescribed course that cannot be significantly altered after the missile has burned its fuel. To cover large distances, ballistic missiles are usually launched high into the air or in space, in sub-orbital spaceflight. When powered flight has ended the missiles are in freefall to their target. Ballistic missiles, which can carry conventional and WMD payloads, are often divided into categories based on range. See also **short-range ballistic missile (SRBM), medium-range ballistic missile (MRBM),** and **intercontinental ballistic missile (ICBM).**

ballistic missile defense. All active and passive measures designed to detect, identify, track, and defeat ballistic missiles, in both strategic and tactical roles, during any portion of their flight trajectory (boost, midcourse, or terminal) or to nullify or reduce the effectiveness of such missiles.

block. A biennial increment of the Ballistic Missile Defense System (BMDS) that provides an integrated set of capabilities which have been tested as part of the BMDS Test Bed. Once tested, elements and components are available for limited procurement, transition to production, or for emergency deployment as directed. See also **test bed.**

booster. An auxiliary or initial propulsion system that travels with a missile or aircraft and that may or may not separate from the parent craft when its impulse has been delivered. A booster system may contain or consist of one or more units. See also **boost phase**.

This glossary draws on the Missile Defense Agency glossary, together with other sources. For a more extensive list of missile defense-related terms, see the Missile Defense Agency's glossary at: http://www.mda.mil/mdalink/pdf/glossary.pdf.

boost defense segment. The portion of the ballistic missile defense system that defeats ballistic missiles in the period of flight prior to the termination of powered flight. See also **boost phase**.

boost phase. The first phase of a ballistic missile trajectory when it is being powered by its engines. During this phase, which usually lasts three to five minutes for an intercontinental ballistic missile, the missile reaches an altitude of about 200 kilometers whereupon powered flight ends and the missile begins to dispense its reentry vehicle(s).

Brilliant Pebbles. Small, space-based kill vehicles capable of autonomous interception of enemy missiles that travel within its range. The vehicles have no warheads, relying instead on the kinetic energy from their mass and speed to destroy the incoming missiles. See also **global protection against limited strikes (GPALS).**

bus. The platform sometimes referred to as a post-boost vehicle, on a single missile, which carries all the warheads on that missile. It may also carry penetration aids, decoys, etc. See also **reentry vehicle** and **warhead**.

bus deployment phase. That portion of a missile flight during which multiple warheads are released on different paths to different targets. The warheads on a single missile are carried on a platform or "bus." See also **bus.**

carrier vehicle. A space platform whose principal function is to house the space-based interceptors in a protective environment prior to use.

Command, Control, Communications, and Computer (C4) Systems. Integrated systems of doctrine, procedures, organizational structures, personnel, equipment, facilities, and communications designed to support a commander's command and control capability through all phases of operations.

commercial satellite. A satellite used for civilian purposes, such as for navigation or communications.

Commission to Assess U.S. National Security Space Management and Organization. The Commission (also known as the Rumsfeld Space Commission) was established by Congress in 2000 and headed by Donald Rumsfeld to study U.S. space strategy and technology requirements for the twenty-first century.

decoy. A dummy warhead launched from a missile that also carries one or more real warheads. The purpose of the decoy is to confuse and divert interceptors from destroying real warheads.

defense support program (DSP). A system of satellites in geo-stationary orbit with fixed and mobile ground-processing stations, one multi-purpose facility, and a ground-based communications network, whose primary mission is to provide warning and assessment of a ballistic missile attack.

directed energy. Energy in the form of atomic particles, pellets, or focused electromagnetic beams that can be transmitted great distances at, or nearly at, the speed of light. See also **airborne laser.**

directed energy weapon. A system using directed energy as the primary means to damage or destroy assets. An example of a directed energy weapon would be a laser such as that which would be deployed within the Airborne Laser System. See also **airborne laser**.

discrimination. The ability to identify the reentry vehicle among the various decoys and debris accompanying it. See also **decoy**.

electro-magnetic pulse (EMP). EMP is generated by a nuclear weapon detonated at any altitude above a few dozen kilometers. The height of the nuclear burst determines the extent of the area affected by EMP. A nuclear weapon detonated above the earth will interact with the atmosphere, ionosphere, and magnetic field to produce an electromagnetic pulse radiating down to the earth's surface and additionally create electrical currents in the earth. EMP effects are both direct and indirect. The former are due to electromagnetic "shocking" of electronics and stressing of electrical systems. The latter arise from the damage that "shocked" – upset, damaged, and destroyed – electronics controls then inflict on the systems in which they are embedded.

endoatmospheric interceptor. An endoatmospheric interceptor reaches its target within the atmosphere which is generally considered to be altitudes below 100 kilometers. See also **interceptor.**

exoatmospheric kill vehicle. An interceptor designed to interdict enemy missiles outside the earth's atmosphere. See also **interceptor.**

geostationary orbit (GEO). A direct, circular orbit at an altitude of 19,323 nautical miles above mean sea level that lies in the plane of earth's equator. A GEO satellite always appears at the same position in the sky and its ground-track is a point. Such an arrangement is ideal for some communication satellites and weather satellites since it allows one satellite to provide continuous coverage of a given area of the earth's surface. See also **low-earth orbit** and **medium-earth orbit**.

global protection against limited strikes (GPALS). GPALS was an anti-missile architecture designed to provide protection against limited ballistic missile strikes. It was composed of three interrelated segments: (1) theater ballistic missile defenses to protect U.S. forces deployed abroad, and U.S. friends and allies; (2) ground-based defenses with space sensors to protect the entire United States against long-range ballistic missiles; and (3) *Brilliant Pebbles* space-based interceptors capable of providing continuous, global coverage by intercepting enemy ballistic missiles. See also ***Brilliant Pebbles***.

ground-based interceptor. A kinetic energy exoatmospheric interceptor that provides, where possible, a multiple engagement capability for defense of the United States. It is designed to engage post-boost vehicles and/or reentry vehicles in the midcourse phase of flight and is part of the ground-based missile defense (GMD) system currently being deployed in Alaska and California. See also **kinetic energy, exoatmospheric kill vehicle,** and **land-based missile defense**.

hit-to-kill vehicle (HTK). A kill vehicle that destroys a ballistic missile by using kinetic energy. The hit-to-kill concept entails colliding with (as opposed to exploding in the proximity of) the incoming warhead. See also **interceptor** and **kinetic energy**.

interceptor. A missile that contains a booster and a kill vehicle designed to engage an offensive missile.

intercontinental ballistic missile (ICBM). A ballistic missile with a range of 3,000 to 8,000 nautical miles. The term ICBM is used only for land-based systems to differentiate them from submarine-launched ballistic missiles. See also **submarine-launched ballistic missile (SLBM).**

kill vehicle. The warhead carried by an interceptor missile. It may operate either by exploding in the vicinity of the enemy missile or, as in hit-to-kill systems, by striking the target at high velocity. See also **kinetic kill vehicle.**

kinetic energy. Energy from the momentum of an object.

kinetic energy weapon. A weapon that uses kinetic energy, or energy of motion, to destroy an object. Examples of weapons which use kinetic energy are a rock, a bullet, a hit-to-kill vehicle that is an interceptor missile that strikes and destroys another missile or its warhead. See also **kinetic kill vehicle.**

kinetic kill vehicle. A weapon using a non-explosive projectile moving at very high speed to destroy a target on impact. The projectile may include homing sensors and on-board rockets to improve its accuracy, or it may follow a preset trajectory. See also **kill vehicle.**

Kwajalein Missile Range (KMR). Located in the Kwajalein Atoll, approximately 2,100 miles southwest of Hawaii, KMR has been the site of U.S. missile testing for more than 40 years. The first successful space intercept of an ICBM was conducted at the KMR and testing continues for such systems as the GMD program.

land-based missile defense (LMD). A missile defense based on interceptors launched from land. Such a missile defense may be designed to intercept long-range or short-range missiles. The missile defense system that is currently being deployed in Alaska and California is land based. See also **ground-based interceptor.**

launch debris. Debris that accompanies reentry vehicles during the exoatmospheric portion of the flight path. Debris can include items such as the booster, the expended bus, springs that help to detach reentry vehicles from the bus, and assorted explosive bolt parts. See also **booster** and **bus.**

launch detection. Initial indication by any one of a variety of sensors that a booster has been launched from some point on the surface of the earth. See also **sensor.**

launch verification. Confirmation of a detection of a booster launch by receiving a report from a sensor separate from, and independent of, the sensor that initially detected a specific booster launch. See also **sensor.**

layered defense. A defense that consists of multiple opportunities to destroy a missile and its warhead in any phase of its flight whether it be the boost, midcourse, or terminal phase. This approach significantly increases the probability of a successful intercept. See also **assured kill** and **tiered defense**.

leakage. The allowable missiles or warheads passing through a BMD system expressed as a percentage of the threat. To ensure overall system performance, permitted leakage is "budgeted" among individual BMD phases and functions.

low-earth orbit. An orbit at an altitude above the earth between 100 and 400 nautical miles. See also **medium-earth obit** and **geostationary orbit**.

maneuverable reentry vehicle (MARV). A reentry vehicle capable of performing preplanned flight maneuvers during the reentry phase. The reentry vehicles deploy fins or other aerodynamic surfaces when they enter the atmosphere, allowing them to turn and dodge rather than fall ballistically. Such reentry vehicles have no ability to maneuver in space.

medium-earth orbit. An orbit at an altitude above the earth between 400 and 19,323 nautical miles (i.e., between low-earth obit and geostationary orbit). See also **low-earth obit** and **geostationary orbit**.

medium-range ballistic missile (MRBM). A ballistic missile with a range of 600 to 1,500 nautical miles.

midcourse defense segment. The portion of the Ballistic Missile Defense System that defeats ballistic missiles during the period of flight between the boost phase and atmospheric reentry.

midcourse phase. That portion of a ballistic missile's trajectory between the boost phase and reentry phase when reentry vehicles travel at ballistic trajectories above the atmosphere. During this phase, a missile releases its warheads and decoys and is no longer a single object, but rather a swarm of reentry vehicles falling freely along present trajectories in space.

multiple independently targetable reentry vehicle (MIRV). A collection of reentry vehicles each containing warheads carried on a single ballistic missile. MIRV allows a single launched missile to strike more than one target. See also **reentry vehicle.**

mutually assured destruction (MAD). A doctrine based on the premise that any use of nuclear weapons by either of two opposing sides would result in the destruction of both the attacker and the defender based on the ability of the attacked country to retaliate against the attacker. The doctrine assumes that each side has enough weaponry to destroy the other side and that either side, if attacked for any reason by the other, would retaliate with equal or greater force. The expected result would be escalation to the point where each side brought about the other's total and assured destruction. Developed during the Cold War, MAD was seen by many as helping to prevent any direct full-scale military conflict between the United States and Soviet Union.

nanosatellite. A satellite weighing less than ten kilograms constructed at low cost and designed to open up new possibilities for space exploration and the development of offensive weapons.

nuclear weapons proliferation. The process by which nations or non-state actors come into possession of, or acquire the technology to develop and deploy nuclear weapons.

Outer Space Treaty of 1967. A multilateral treaty signed and ratified by both the United States and the former Soviet Union. Article IV of the Outer Space Treaty forbids basing nuclear weapons or other weapons of mass destruction in space.

parasitic satellite. A micro-satellite designed to attach itself to the body of enemy satellites so as to go unnoticed, then rendering them ineffective through jamming when activated. See also **anti-satellite weapon**.

penetration aid. Any countermeasure designed to help a warhead penetrate ballistic missile defenses.

pre- and post-launch notification system. A bilateral Memorandum of Understanding (MOU) between the United States and the Russian Federation on notifications of missile launches that establishes a pre- and post-launch notification system for ballistic missiles and space launch vehicles. The objective is to reduce the risk of inadvertent nuclear war.

proliferation. The spread of weapons technology and know-how to other countries or non-state actors. The most serious forms of proliferation include nuclear, biological, and chemical weapons.

reentry vehicle. The reentry vehicle, or warhead, released from the last stage of a booster rocket or from a post-boost vehicle early in the ballistic trajectory. See also **bus** and **warhead**.

rocket exhaust plume. The cloud of hot, chemically active gas ejected from the nozzle of a rocket motor on a missile.

sea-based missile defense. The U.S. Navy missile defense program based on the capability of the Aegis system to create a mobile and flexible missile defense system that could easily be reconfigured to counter changing missile threat environments. See also ***Aegis***.

sensor. A sensor is a physical device that detects, or senses, a signal emanating from some object. In terms of missile defense there are numerous types of sensors, both passive and active, that can be located on the ground, at sea, and in space on a variety of platforms. An active sensor such as a radar is designed to illuminate a target producing return secondary radiation, which is then utilized to track and/or identify the target. A passive sensor, e.g., an infrared sensor (such as those on the Defense Support Program to spot ballistic missile launches), detects naturally occurring emissions from a target for tracking and/or identification purposes.

short-range ballistic missile (SRBM). A ballistic missile with a range of 30 kilometers to 1,000 kilometers.

space-based infrared system (SBIRS). An infrared system that will provide surveillance and warning capabilities well into the 21st century. SBIRS is intended to be an integrated system including multiple space constellations and an evolving ground element.

space-based interceptor (SBI). A distributed set of low-earth orbit satellites containing an interceptor that not only provides launch detection and booster tracking of enemy ballistic missiles, but also serves as a kinetic energy interceptor to engage and destroy such enemy missiles. See also ***Brilliant Pebbles.***

space-based kinetic energy weapon. A space-based kinetic energy interceptor designed to hit an enemy ballistic missile in its boost phase when the warhead has not yet separated from the missile and is most vulnerable. See also **kinetic energy weapon, interceptor,** and **boost phase.**

space-based directed energy weapon. A space-based satellite positioned in low-earth orbit that utilizes a high-energy laser to destroy enemy ballistic missiles.

space-based interceptor test bed. A program proposed to develop a test bed in space consisting of several satellites that would study the use of kinetic energy to strike missiles in their boost phase. See also **test bed.**

space control operations. Operations that provide freedom of action in space for friendly forces which, when directed, could deny it to an enemy; this includes the broad aspects of protection to U.S. and allied space systems and negation of enemy space systems. Space control operations encompass all elements of the space defense mission.

space defense. The defensive aspect of space control operations which includes all active and passive measures planned or taken to defeat attacks against friendly space systems or enemy attacks from space. See also **space control operations.**

Standard Missile. The U.S. Navy's premier surface-to-air defense weapon is a shipboard missile that is an integral part of *Aegis*. Its primary mission is fleet area air defense and ship self defense. However, it is currently being modified to intercept ballistic missiles from an *Aegis*-capable ship. See also ***Aegis*.**

submarine-launched ballistic missile (SLBM). A ballistic missile launched from a submarine with a range of 3,000 to 6,000 miles. See also **intercontinental ballistic missile (ICBM).**

tactical ballistic missile. A ballistic missile designed for short-range battlefield use, typically with a range of less than 300 kilometers. Tactical ballistic missile are normally mobile to ensure survivability and quick deployment, and can carry conventional and WMD warheads to target enemy facilities, assembly areas, artillery, and other targets behind the front lines

terminal defense segment (TDS). The portion of the Ballistic Missile Defense System that defeats ballistic missiles in the period of flight between atmospheric reentry and impact. See also **terminal phase.**

terminal phase. The final portion of a ballistic missile's trajectory after the midcourse phase and before trajectory termination. See also **terminal defense segment**.

test bed. A simulated environment where ballistic missile defense systems are tested and evaluated. The test bed uses currently available hardware and software products, in combination with surrogate technologies, to simulate realistic missile defense operations. Its purpose is to demonstrate technologies as they are developed, and to assess their ability to operate in concert with other assets and components of a layered missile defense architecture. Test bed demonstration results will lead to future technology insertions as additional components are developed.

theater ballistic missile defense. Ballistic missile defense forces that, in total, provide defense against ballistic missile attacks within an overseas military theater of operations. Such defenses may be deployed to protect U.S. military forces, allied forces, or civilian populations.

throw weight. The total weight of the reentry vehicles(s), warhead(s), guidance systems, and other payloads of a missile, not including the weight of the rocket.

tiered defenses. The use of ballistic missile defensive systems at different phases of the missile trajectory. See also **layered defense.**

trajectory. The path or curve described by an object moving through space. Every ballistic missile, regardless of its range, has a flight trajectory that includes three phases: boost, midcourse, and terminal.

warhead. Destructive payloads carried by missiles. Warheads may contain nuclear, biological, chemical, or conventional munitions. Some ballistic missiles also may carry dummy warheads, or decoys, to confuse interceptors.

weapons of mass destruction (WMD). A term that refers to weapons such as nuclear, biological, or chemical munitions capable of destroying life and property on a massive scale. Ballistic missiles can be tipped with WMD warheads. See also **ballistic missile**.

appendix a

State Missile Defense Resolutions

State of Alaska

SPONSOR SUBSTITUTE FOR SENATE JOINT RESOLUTION NO. 30 IN THE LEGISLATURE OF THE STATE OF ALASKA

TWENTIETH LEGISLATURE - FIRST SESSION
BY THE SENATE JUDICIARY COMMITTEE BY REQUEST
Introduced: May 2, 1997

Referred: Judiciary

A RESOLUTION

Relating to the defense of Alaska from offensive nuclear attack.

BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA: WHEREAS Alaska is the 49th state to enter the federal union of the United States of America and is entitled to all of the rights, privileges, and obligations that the union affords and requires; and

WHEREAS Alaska possesses natural resources, including energy, mineral, and human resources, vital to the prosperity and national security of the United States; and

WHEREAS the people of Alaska are conscious of the state's remote northern location and proximity to Northeast Asia and the Eurasian land mass, and of how that unique location places the state in a more vulnerable position than other states with regard to missiles that could be launched in Asia and Europe; and

WHEREAS the people of Alaska recognize the changing nature of the International political structure and the evolution and proliferation of missile delivery systems and weapons of mass destruction as foreign states seek the military means to deter the power of the United States in international affairs; and

WHEREAS there is a growing threat to Alaska by potential aggressors in these nations and in rogue nations that are seeking nuclear weapons capability and that have sponsored international terrorism; and

WHEREAS a National Intelligence Estimate to assess missile threats to the United States left Alaska and Hawaii out of the assessment and estimate; and

WHEREAS one of the primary reasons for joining the union of the United States of America was to gain security for the people of Alaska and for the common regulation of foreign affairs on the basis of an equitable membership in the United States federation; and

WHEREAS the United States plans to field a national missile defense, perhaps as early as 2003; this national missile defense plan will provide only a fragile defense for Alaska, the state most likely to be threatened by new missile powers that are emerging in Northeast Asia;

BE IT RESOLVED that the Alaska State Legislature respectfully requests the President of the United States to take all actions necessary, within the considerable limits of the resources of the United States, to protect on an equal basis all peoples and resources of this great Union from threat of missile attack regardless of the physical location of the member state; and be it

FURTHER RESOLVED that the Alaska State Legislature respectfully requests that Alaska be included in every National Intelligence Estimate conducted by the United States joint intelligence agencies; and be it

FURTHER RESOLVED that the Alaska State Legislature respectfully requests the President of the United States to include Alaska and Hawaii, not just the contiguous 48 states, in every National Intelligence Estimate of missile threat to the United States; and be it

FURTHER RESOLVED that the Alaska State Legislature urges the United States government to take necessary measures to ensure that Alaska is protected against foreseeable threats, nuclear and otherwise, posed by foreign aggressors, including deployment of a ballistic missile defense system to protect Alaska; and be it

FURTHER RESOLVED that the Alaska State Legislature conveys to the President of the United States expectation that Alaska's safety and security take priority over any international treaty of obligation and that the President take whatever action is necessary to ensure that Alaska can be defended against limited missile attacks with the same degree of assurance as that provided to all other states; and be it

FURTHER RESOLVED that the Alaska State Legislature respectfully requests that the appropriate Congressional committees hold hearings in Alaska that include defense experts and administration officials to help Alaskans understand their risks, their level of security, and Alaska's vulnerability.

COPIES of this resolution shall be sent to the Honorable Bill Clinton, President of the United States; the Honorable Al Gore, Jr., Vice-President of the United States and President of the U.S. Senate; the Honorable Newt Gingrich, Speaker of the U.S. House of Representatives; the Honorable Ted Stevens, Chair of the U.S. Senate Committee on Appropriations; the Honorable Bob Livingston, Chair of the U.S. House of Representatives Committee on Appropriations; the Honorable Strom Thurmond, Chair of the U.S. Senate Committee on Armed Services; the Honorable Floyd Spence, Chair of the U.S. House of Representatives Committee on National Security; and to the Honorable Frank Murkowski, U.S. Senator, and the Honorable Don Young, U.S. Representative, members of the Alaska delegation in Congress.

The Alaska Legislature Resolution SJR 30 was passed by the Alaska Senate 18-0 on May 6, 1997, and by the Alaska House 30-4 on May 11, 1997.

State of Arizona

A CONCURRENT RESOLUTION
DECLARING SUPPORT FOR A MISSILE DEFENSE SYSTEM.

Whereas, the people of the State of Arizona view with growing concern the proliferation of nuclear, chemical and biological weapons of mass 2 destruction and the missile delivery capabilities of these weapons in the hands of unstable foreign regimes; and

Whereas, the tragedy of September 11, 2001 shows that America is vulnerable to attack by foreign enemies; and

Whereas, the people of the State of Arizona wish to affirm their support of the United States government in taking all actions necessary to protect the people of America and future generations from attacks by missiles capable of causing mass destruction and loss of American lives.

Therefore

Be it resolved by the House of Representatives of the State of Arizona, the Senate concurring:

1. That the Members of the Legislature support the President of the United States in directing the considerable scientific and technological capabilities of this nation and in taking all actions necessary to protect the states and their citizens, our allies and our armed forces abroad from the threat of missile attack.

2. That the Members of the Legislature convey to the President and Congress of the United States that a coast-to-coast, effective missile defense system will require the deployment of a robust, multi-layered architecture consisting of integrated land-based, sea-based and space-based capabilities to deter evolving future threats from missiles as weapons of mass destruction and to meet and destroy them when necessary.

3. That the Members of the Legislature appeal to the President and Congress of the United States to plan and fund a missile defense system beyond 2005 that would consolidate technological advancement and expansion from current limited applications.

4. That the Secretary of State of the State of Arizona transmit copies of this Resolution to the President of the United States, the President of the United States Senate, the Speaker of the United States House of Representatives and each member of Congress from the State of Arizona.

The Arizona House Concurrent Resolution HCR 2027 was first read on January 30, 2003 After the third reading the bill passed on March 5, 2003, 42-15 (3 not voting). [42-15-3-0] *

State of California

BILL NUMBER: HR 51
AMENDED IN ASSEMBLY FEBRUARY 19, 1998

House Resolution No. 51--Relative to the crisis in Iraq.

WHEREAS, Iraq under Saddam Hussein has continued the production of weapons of mass destruction and missile delivery systems for these weapons; and

WHEREAS, Saddam Hussein has been defiant in the face of the international consensus that those actions should cease; and

WHEREAS, These weapons pose a threat to all people as well as to our American forces in the Middle East; and

WHEREAS, The people of California believe it is better to prevent an attack from weapons of mass destruction rather than to retaliate against them; and

WHEREAS, Many of the weapons of mass destruction that were possessed by the former Soviet Union are as yet unaccounted for; and

WHEREAS, United States President Bill Clinton has previously declared a national state of emergency stating that the proliferation of weapons of mass destruction continues to pose an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States; now, therefore, be it

Resolved by the Assembly of the State of California,

That it fully supports the President and the Congress of the United States in compelling Iraq's compliance with all conditions of the cease fire, including the United Nations inspection of Iraq's chemical and biological arsenal, and in eliminating the threat of Saddam Hussein's regime to Iraq's people and their neighbors; and be it further

Resolved, That the Assembly conveys to the President of the United States its support for his efforts and those of Congress to assure California's safety and security, and its support for ensuring that California can be defended against missile attacks; and be it further

Resolved, That the Chief Clerk of the Assembly shall transmit copies of this resolution to the Honorable Bill Clinton, President of the United States; the Honorable Al Gore, Jr., Vice President of the United States; the Honorable Newt Gingrich, Speaker of the House of Representatives; the Honorable Strom Thurmond, Chair of the United States Senate Committee on Armed Services; the Honorable Floyd Spence, Chair of the House of Representatives Committee on National Security; and to each Senator and Representative from California in the Congress of the United States.

California House Resolution HR 51 was introduced February 12, 1998; amended February 19, 1998; and passed 62-2.

State of New Hampshire

Be It Resolved By The Legislature of the State of New Hampshire:

WHEREAS, New Hampshire is located in the New England region of the Northeastern United States and is populated by over 1,000,000 persons, and maintains distinguished centers of higher learning, and is the site of advanced information and defense technology, and is noted for outstanding natural endowments of forests, mountains, lakes, and derives partial energy from nuclear power; and

WHEREAS, the People of New Hampshire are conscious of the state's current assets and favorable future development for their children in other generations; and

WHEREAS, New Hampshire responded to the call at Bunker Hill with volunteers in the struggle for American independence and has contributed to national defense through its citizenry ever since; and

WHEREAS, the People of New Hampshire are aware of the proliferation of weapons of mass destruction and their threat to New Hampshire, New England, and the United States; and

WHEREAS, the United States does not possess a means of defense against ballistic missiles, bearing warheads of mass destruction, launched by those who oppose American interests throughout the world; and

WHEREAS, New Hampshire is imperiled by the existing incapability of national self-defense against ballistic missile attack from hostile or accidental sources along with other States of the Union; in consequence, New Hampshire asserts it leadership as one of fifty;

BE IT RESOLVED that the Legislature of New Hampshire respectfully requests the President of the United States to take all actions necessary, within the considerable limits of technological resources of this great Union, to protect New Hampshire, New England, and all the people of the United States from the threat of missile attack; and be it

FURTHER RESOLVED that the Legislature of New Hampshire respectfully requests that the President of the United States act to allow the United States freedom to defend itself from missile attack, Treaties to the contrary not withstanding; and be it

FURTHER RESOLVED that the Legislature of New Hampshire conveys to the President and the Congress of the United States that national missile defense requires the deployment of the most robust system consisting of a land-based, sea-based, and space-based multi-layered architecture so that future threats will be adequately met or deterred.

The New Hampshire State Legislature HR 21 passed on February 14, 2002, 186-135.

State of New York

LEGISLATIVE RESOLUTION urging the President of the United States and the Congress of the United States to provide for an adequate missile defense system

WHEREAS, New York, the Empire State, located among the Middle Atlantic states and bordered by Canada and populated by an estimated 19,000,000 persons, is the center of world finance and commerce, and maintains universally recognized centers of learning and research in science, technology and human health, and is endowed with the highest mountains in the Northeast Adirondack uplands; and

WHEREAS, New York City was attacked by terrorists on September 11, 2001, with intensive destruction and death, a national tragedy which opened the 21st century with the American-led war against terrorism; and

WHEREAS, The people of New York are conscious and steadfast in defense of these assets of the Empire State and desire a secure and favorable future for their children and future generations; and

WHEREAS, The people of New York are aware of the global proliferation of short-range, medium-range and long-range ballistic missiles as weapons of mass destruction and their threat to New York, the United States and its armed forces abroad; and

WHEREAS, The United States does not possess a defense against such missiles launched by terrorist organizations, hostile states, or from ships anywhere on the world's oceans and seas, including waters adjacent to the coastal cities of America; and

WHEREAS, There is no defense against a SCUD-B missile, with a 15 kiloton nuclear warhead, fired at New York City from a container ship 300 kilometers off-shore which, from an air-blast over downtown Manhattan, would cause an estimated 2,800,000 fatalities and 3,6000,000 injuries; and

WHEREAS, A comprehensive defense against missile attack, including from short-range off-shore container ship threats, calls for a multi-layered system of defensive interceptors from ground, air, sea and space-based systems; and

WHEREAS, The United States Navy has demonstrated its capability to deploy ships to intercept hostile short-range and medium-range missiles while they are rising from their launchers; now, therefore, be it

RESOLVED, That this Legislative Body pause in its deliberations to hereby convey to the President of the United States and to the Congress that an effective missile defense system will require the deployment of a robust, multilayered architecture consisting of integrated land-based, air-based, sea-based and space-based capabilities to deter evolving future threats and to meet them and destroy them when necessary; and be it further

RESOLVED, That this Legislative Body pause further, acting to prevent a second disaster within its borders, to urge the President of the United States and the Congress to approve, plan and redirect funding for a Navy East Coast Test-bed program, similar to that underway on the West Coast involving Alaska and California, leading initially, within one-year, to an East Coast sea-based defense with which to defend New York from short-range missile attacks originating from container ships off its coast and later, with advance defenses against missiles launched from anywhere; and be it further

RESOLVED, That copies of this Resolution, suitably engrossed, be transmitted to the President of the United States, the Speaker of the United States House of Representatives, the President of the United States Senate, the Chairman of the Joint Chiefs of Staff, and the members of the New York Congressional Delegation.

Approved by the New York State Assembly Veterans Affairs Committee, March 2004.
Approved by the New York State Armed Forces Legislative Caucus, May 25, 2004.
Resolution submitted to the Assembly with 65 bipartisan cosponsors.

Commonwealth of Pennsylvania

THE GENERAL ASSEMBLY OF PENNSYLVANIA

Referred To Committee On Intergovernmental Affairs, June 11, 2001

Memorializing the President of the United States and Congress to fund and deploy a national missile defense system.

WHEREAS, The ballistic missile threat to the United States has been declared by the President, the Secretary of Defense, the Congress of the United States, the bipartisan Commission to Assess the Ballistic Missile Threat to the United States (known as the Rumsfeld Commission) and the United States intelligence community to be a clear, present and growing danger to the United States; and

WHEREAS, The United States currently cannot stop even one missile launched with malice or by accident by any number of foreign states or terrorist organizations; and

WHEREAS, It is immoral to intentionally leave the American people, our troops and overseas allies and the nation's children vulnerable to attack by nuclear, chemical or biological weapons delivered by ballistic missiles; and

WHEREAS, The citizens of the Commonwealth of Pennsylvania and the United States remain exposed to missile attack; therefore be it

RESOLVED, That the House of Representatives of the Commonwealth of Pennsylvania memorialize the Congress to fully fund and deploy as soon as technologically possible an effective, affordable global missile defense system, including a sea-based system to intercept theater and long-range missiles, space-based sensors and ground-based interceptors and radar, to protect all Americans, United States troops stationed abroad and our nation's allies from ballistic missile attack; and be it further

RESOLVED, That copies of this resolution be transmitted to the President of the United States, to the presiding officers of each house of Congress and to each member of Congress from Pennsylvania.

The Pennsylvania General Assembly referred House Resolution No. 238 to Committee on Intergovernmental Affairs, [A Resolution Memorializing the President of the United States and Congress to fund and deploy a national missile defense system] June 11, 2001, and passed by voice vote.

Commonwealth of Virginia

House of Delegates

Whereas Virginia, the Old Dominion, is located in the upper South region of the United States and is populated by over 7,000,000 persons, and is noted for its contribution to the founding of the United States through leadership and political thought, and maintains distinguished centers of higher education and research, and is the site of advanced information and defense technology, and is the center of national naval force concentration, and is the foremost shipbuilder on its coast while possessing natural endowments of mountains and forests on its western limits and agriculture on its southern tier; and

Whereas, the people of Virginia are conscious of these assets of the Old Dominion and a favorable future for their children and future generations; and

Whereas, Virginia provided leadership in the Revolutionary War and was the location of the surrender of Great Britain that ended it, and has contributed notably to national defense through its citizenry both in the military and industry ever since; and

Whereas, the people of Virginia are aware of the global proliferation of short-range, medium-range and long-range ballistic missiles as weapons of mass destruction and their threat to our nation, our allies, and our armed forces abroad; and

Whereas, the United States does not possess an effective defense against such missiles launched by hostile states or by terrorist organizations within the borders of such states or from ships anywhere on the world's seas and oceans, including near to the coastal cities of America; and

Whereas, the President of the United States has withdrawn from the treaty with the now extinct Soviet Union that prohibited American effective self-defense against ballistic missile attack, and has announced the deployment of a ground-based and sea-based limited missile defense system by the year 2005 as a beginning towards a robust system that will be multi-layered, meaning land, sea, air, and space interception components; and

Whereas, short-range and medium-range ballistic missiles launched from ships off the East Coast of the United States will be outside the protective reach of the Pacific Ocean-Alaska-based system, and the population of Virginia's tidewater as well as the preponderant national naval presence located therein are now vulnerable and will be still vulnerable to such a missile attack with warheads of mass destruction after planned fielding in 2005 of missile defenses in Alaska and California; and

Whereas, missile defense interceptors based in Alaska and California may not be able to protect the population of Virginia's tidewater and other East Coast areas from long-range ballistic missiles launched from threatening states in the Middle East and North Africa; and

Whereas, the United States Navy has demonstrated its capability to use ships that can be based in Virginia's Tidewater area to intercept short-range and medium-range ballistic missiles while they are rising from their launchers, which could be on nearby ships, and this capability can be improved to intercept long-range ballistic missiles; now, therefore, be it

Resolved by the House of Delegates:

That the Virginia House of Delegates hereby supports the President of the United States to continue to take all actions necessary, directing the considerable scientific and technological capability of this great Union, to protect all 50 states and their people, our allies, and our armed forces abroad from the threat of missile attack; and

That the Virginia House of Delegates hereby conveys to the President of the United States and the Congress that a ocean-to-ocean, effective missile defense system will require the deployment of a robust, multi-layered architecture consisting of integrated land-based, sea-based, air-based, and space-based capabilities to deter evolving future threats and to meet and destroy them when necessary; and

That the Virginia House of Delegates urges the President of the United States and Congress to plan and provide funding for a Tidewater Virginia and East Coast Testbed activity, similar to the West Coast test activities in Alaska, California, and the Pacific Ocean, leading by 2005 to an East Coast sea-based defense – initially against ship-based short- and medium-range ballistic missiles and, with improvements, against ballistic missiles of all ranges launched from anywhere; and

That copies of this resolution shall be sent by the House Clerk to the Virginia Congressional delegation, the Speaker of the House of Representatives, the President of the Senate of the United States, the Chairman of the Joint Chiefs of Staff, and the President of the United States.

The Virginia House of Delegates Resolution HR40 passed on February 1, 2003, 76-12 (3 abstained, 9 not voting).

State of Vermont

House of Representatives
Montpelier, Vermont
House Resolution

Whereas, Vermont is located in the New England region of the northeastern United States, and is populated by over 600,000 persons and maintains distinguished centers of higher learning, is the site of advanced information and defense technology, is noted for outstanding natural endowments of forests, mountains, and lakes, and derives partial energy requirements from nuclear power, and

Whereas, Vermonters are conscious of the state's assets and favorable future development for their children and other generations, and

Whereas, Vermont's citizenry has always contributed volunteers to our nation's defense, and

Whereas, Vermonters are aware of the proliferation of weapons of mass destruction and their threat to Vermont, New England, and the United States, and

Whereas, the United States does not possess a means of defense against ballistic missiles bearing warheads of mass destruction, launched by anyone who opposes American interests throughout the world, and

Whereas, Vermont is imperiled by the existing incapability of national

self-defense against ballistic missile attack from hostile or accidental sources, along with the other states of the union; in consequence, Vermont asserts its leadership as one of the 50 states, now therefore be it

Resolved by the House of Representatives:

That this legislative body urges the President of the United States to take all actions necessary, within the considerable limits of technological resources of this great union, to protect Vermont, New England and all the people of the United States from the threat of missile attack, and be it further

Resolved: That the President of the United States be allowed the freedom to defend the country from missile attack, treaties to the contrary notwithstanding, and be it further

Resolved: That this House conveys to the President of the United States and to Congress that national missile defense requires the deployment of the most robust system, consisting of land-based, sea-based, and space-based multilayered architecture, so that future threats will be adequately met or deterred, and be it further

Resolved: That the Clerk of the House be directed to send copies of this resolution to the members of the Vermont Congressional Delegation, the Speaker of the United States House of Representatives, the President of the United States Senate, the Chairman of the Joint Chiefs of Staff, and the President of the United States.

House Resolution HR32 introduced in January, 2002.

appendix b

Surrey and Space Technology Proliferation

Memorandum prepared by Ambassador Henry F. Cooper for the Independent Working Group in November 2003.

The Surrey Satellite Technology Ltd (SSTL) webpage[1] claims with some justification that SSTL is the world's leading pioneer of small satellite applications and technology. Over the past two decades, SSTL and its University of Surrey partner have produced reliable high-quality small satellites at significantly lower costs by adapting advanced, commercial-off-the-shelf (COTS) technologies for the harsher conditions of space, precisely the approach followed in the late 1980s by Lawrence Livermore National Laboratory's *Brilliant Pebbles* program. But, while the United States abandoned *Brilliant Pebbles*, Surrey excelled in developing and refining this innovative approach to innovative manufacturing and operations of small satellites.

SSTL and its staff of under 100 professionals and technicians, introduced modular microsatellite design in 1990, delivered its first usable remote sensing imagery from a 50 kg satellite in 1991; first demonstrated in 1993 on-board orbit determination using GPS along with a star camera and an advanced earth imaging system; and during the past twenty-three years has launched twenty-three small satellites into orbit for international customers as diverse as the United States Air Force and the Chinese Tsinghua University. Roughly half of SSTL's customers purchase know-how along with their satellites, and the other half opt for turnkey services.

1 See http://www.sstl.co.uk — especially on the company background. During the past 23 years, SSTL, in conjunction with the University of Surrey, has launched 23 small satellites, many of which are still operational and monitored, maintained or controlled from SSTL's mission and operations control center. About 100 professionals accomplish these missions, a small staff compared to the usual aerospace companies that build and operate spacecraft.

Currently, Surrey is under contract to deliver nine satellites for international customers: the first Galileo satellite for ESA; two high resolution Earth Observation satellites for the UK MOD and China MoST; five microsatellites for the first Earth Observation constellation (*RapidEye*); and a microsatellite for the Los Alamos National Laboratory.

SSTL recently won the prestigious World Technology Network Award for Space 2004 – beating such high profile teams as Jet Propulsion Laboratories' Cassini-Huygens team, NASA's International Space Station and Mars Rover teams, NASA's Institute of Advanced Concepts, and Bert Rutan's Scaled Composites team (recent winners of the Ansari X-Prize). On January 12, 2005, SSTL announced they had sold 10-percent ownership to a California-based commercial rocket company, SpaceX.

Surrey has built very small satellites with significant capabilities – tiny (less than 10 kg) "nanosatellites." They can be constructed in very short periods of time (one - two years) and at extremely low cost ($2-3 million each) opening up new possibilities for space exploration – including for numerous states and even individuals or groups. Numerous available rockets can be modified and used to launch these very light satellites into orbit. And two years ago, SSTL expected shortly to field "picosatellites," no bigger than a pencil, to maneuver through space via butane power sources,[2] and the greater flexibility in launching these relatively inexpensive, potentially potent spacecraft provides additional proliferation incentives.

The SSTL webpage also claims considerable experience with highly successful microsatellite technology transfer and training programs – e.g., involving Korea, Portugal, Pakistan, Chile, South Africa, Thailand, Singapore, Malaysia, China, Algeria, Nigeria, Thailand, Turkey, and Vietnam.. These intensive

2 See Fiona Harvey, "Surrey Brings the Space race Down In Size," *The Financial Times,* October 23, 2001.

and in-depth programs have enabled emerging space nations to take their first steps into space with relatively low cost and risk by capitalizing on the unique combination of academic and commercial activities available at Surrey. During 2002-2004, SSTL teamed with Russia's Rosoboronexport to launch from Plesetsk Cosmodrome eight microsatellites on three COSMOS rockets built by Polyot of Omsk.

A Case Study: The China Connection

In October 1998, Surrey announced it had "broken into China's tightly controlled internal satellite business with formation of a collaborative venture company in Beijing to develop microsatellites[3]." This announcement occurred barely three months after the 1998 Rumsfeld Commission delivered its unanimous bipartisan report to Congress, elaborating upon the growing ballistic missile threat and the pervasive proliferation of key technology important to space and defense systems.[4] Subsequently in January 2001, a second Rumsfeld Commission warned against a "space Pearl Harbor," reacting in part to activities in China, including "an advanced anti-satellite weapon called a 'parasitic satellite,' which will be deployed on an experimental basis and enter the stage of space testing in the near future."[5] China's official news agency (Xinhua) has also reported on parasitic satellites, which could attach themselves to U.S. satellites and destroy them upon subsequent radio command.[6]

This military mission is a straight-forward extension of the capabilities demonstrated by SSTL in conjunction with various international partners, notably including China. The reported cooperation between Surrey and China on missions related to such a parasitic anti-satellite capability led to reports of unhappiness between the Bush administration and the United Kingdom, particularly during early interactions with Prime Minister Tony Blair. British Shadow Defense Secretary Iain Duncan Smith reflected this concern, saying,

"There is no doubt about this: Surrey has put China into the space weapons business. I am very alarmed. I am particularly concerned because China seems to be right in the middle of nuclear proliferation, passing technology to North Korea, which helps other rogue states such as Iraq and Libya. This may seem like something far away from home. But it directly affects our own national security. This is all happening under the government that promised us ethical foreign policy. What we have got is no foreign policy." [7]

Smith was referring to the 1998 deal to develop a new microsatellite, between SSTL, "a company 95-percent owned by Surrey University," and Beijing's Tsinghua University. Mr. Blair himself officiated in the signing of this contract with China's Hangtain Company[8] – and within two years, China launched its 50 kg *Tsinghua*-1 micro-satellite – and launches of even smaller (~10 kg) satellites were planned. Some of these smaller Surrey satellites provided for the potential flow of U.S. technology to China through Surrey, as well. [9]

In response to the heightened concern about Surrey's role in proliferating such cutting edge technology, Audrey Nice, speaking for SSTL, said, "We have a joint venture company which is set up to build small satellites with China over the next 25 years. But this is not in terms of defence matters. They are Earth observation and communications satellites."[10] This statement attempted to obscure the reality that SSTL's technology and training programs can be – and probably are being – exploited for military purposes, as is clear from a previous statement by SSTL's founder and Managing Director, Professor Martin Sweeting: "Any satellite with on-board propulsion and navigation capability is potentially an anti-satellite weapon, and that means a number of satellites from several countries in orbit today."[11] Notably, in 2002 Professor Sweeting was knighthed by the Queen upon recommendation of the Prime Minister for his "services to microsatellite engineering."

3 See the discussion of SSTL in *Jane's Space Directory 2002-2003*, 25 January 2002, including its business dealings with numerous other nations. Notably, it also lists Clementine among the missions which employed SSTL technology – and Clementine space qualified the first generation Brilliant Pebbles technology – the best missile defense product from the Reagan-Bush I SDI years.

4 Rumsfeld I reference.

5 Rumsfeld II reference. On February 8, 2001, Former Air Force Chief of Staff and member of the 2001 Rumsfeld Space Commission, Ron Fogleman, observed on CNN that a Chinese newspaper was "openly talking about the Chinese developing a thing called a 'parasitic satellite' that would go up and attach itself to our major satellites and just sit there as a kind of sleeper agent, if you will, but ready to be activated."

6 The DoD's September 30, 2001, Quadrennial Defense Review Report provided an oblique reference to such parasats in stating "In addition to exploiting space for their own purposes, future adversaries will also likely seek to deny U.S. forces unimpeded access to space. Space surveillance, ground-based lasers and space jamming capabilities, and proximity micro satellites are becoming increasingly available. A key objective for transformation, therefore, is not only to ensure the U.S. ability to exploit space for military purposes, but also as required to deny an adversary's ability to do so."

7 Quoted in Jonathan Oliver, "US Anger At Blair Over Star Wars Deal With Chinese," *Mail On Sunday,* February 11, 2001.

8 See Richard D. Fisher, "Risky British Arms Sales to China," *The Washington Times,* February 7, 2001.

9 The January 12, 2001, Defense Daily quoted Director of the Pentagon's Program Analysis and Evaluation Steve Cambone and Defense Secretary Don Rumsfeld as referring to a "company in the United States, in conjunction with Surrey University, now developing and successfully testing micro-satellites that could be very problematic in the wrong hands."

10 Oliver, "US Anger At Blair."

11 Quoted by Emma Kelly in "U.S. Attacks SSTL Technology Sale," *Flight International*, January 23, 2001.

Tsinghua-1/SNAP-1: A Notable Case History

According to its June 29, 2000 press release, SSTL successfully launched the day before from Plesetsk on a single Russian COSMOS rocket two of its satellites: *Tsinghua*-1, a 50kg sophisticated microsatellite built at Surrey as a collaborative project with Tsinghua University, China; and Surrey's first nanosatellite – SNAP-1, a 6.5 kg spacecraft built under contract to the U.S. Air Force Academy. The two Surrey-built satellites rode piggyback on the Russian Nadezhda COSPAS-SARSAT satellite and all three operated in a 650 km sun-synchronous orbit.

Following the launch, Professor Sir Martin Sweeting said: "This is a very demanding research and development project, SNAP-1 will evaluate the use of commercial micro-miniature technologies and its four CMOS video cameras to demonstrate the inspection of other spacecraft in orbit – in this case *Tsinghua*-1. The two satellites will demonstrate, for the first time, orbital formation flying when SNAP-1 and *Tsinghua*-1 plan to rendezvous in orbit via an inter-satellite communications link some weeks into the mission."[12]

In Beijing, SSTL and Tsinghua engineers activated the *Tsinghua*-1 microsatellite immediately as it came in range of the Tsinghua Groundstation on its first pass over China at 18:30 BST, 28 June. Later at approximately 02:40 BST, 29 June, the SNAP-1 team at the Surrey Mission Control Centre in Guildford, UK, transmitted commands to its nanosatellite on its first pass over Surrey. For both spacecraft, these commands immediately activated the satellites' downlink and telemetry systems. Telemetry was received and indicated that all systems on-board both satellites were working as expected. It was the 18th successful SSTL launch since 1981.

SNAP-1 was shipped for launch within nine months of contract signing, and its design life on orbit was a year – but experience has indicated that a decade of useful life might be expected. SNAP-1 employed advanced, UK-developed, GPS navigation, computing, propulsion, and attitude control technologies – and, most notably, its primary payload is a machine vision system capable of inspecting other spacecraft. SNAP-1 was employed to image a Russian satellite and then rendezvous and fly in formation with the Chinese microsatellite, *Tsinghua*-1. These activities are described in more detail by SSTL's webpage and the January 4, 2001 SSTL press release.[13]

Two very important conclusions follow from this case history and the above discussion:

1) The state of the art in building and flying very small, sophisticated satellites has markedly advanced since the SDI pioneered these matters in the late 1980s and early 1990s – it is several technological generations advanced beyond that flown on the 1994 *Clementine* mission which space qualified the first generation *Brilliant Pebbles* technology (vintage 1990); and
2) This technology is readily available and affordable for others to apply, it is demonstrably a subject for university research experimentation in the international arena and its advance is no longer in the province of U.S. technologists or the U.S. government to control.

The Space-Race Horse Is Out Of The Barn

The fact that the "space-race horse is out of the barn" was made clear from an October 23, 2001 *Financial Times* review article describing Surrey's role in the widespread distribution of critical technology. Entitled "Surrey Brings the Space Race Down In Size," this excellent article by Fiona Harvey makes clear that rogue states and terrorists could use Surrey's miniaturization technology, among other things, to communicate undetected in planning and executing their threatening campaigns. And it makes clear the practical impossibility of ever returning the horse to the barn:

> *Only one ground station is needed to monitor and control [these small satellites], and a network of five satellites would be enough to ensure that one of the network was always in sight of the ground station. Launching such satellites has become easier since the end of the cold war. Across Russia lie stockpiles of missiles still guarded by the army but now largely useless to the government. A unarmed ballistic missile ("with the software altered to make it go up instead of coming back down," as Professor Sweeting notes) can carry half a dozen microsatellites into space – enough to set up a network that would be continuously monitored from a single ground station. A suitable missile and launcher can be bought for about 5-million pounds.*
>
> *. . . [Microsatellites designed to monitor environmental conditions] also pose a threat. David Baker of Jane's Space Directory points out that they can also assist in the planning and execution of military campaigns by rogue states. Terrorist units can communicate with each other without risk of those communications being intercepted, as they might be if they were using conventional media. Their price puts them within the reach of any well funded organization or individual. "[These Satellites] are a tremendous threat. These are the Kalishnikovs of the new century – they provide the means to prosecute aggression and from the enabling tools for old fashioned weaponry," says Baker.*
>
> *. . . [T]he U.S. government is taking the threat very seriously. In the Quadrennial Defence Review of September 30 this year, the Department of Defence noted that "microsatellites are becoming increasingly available to*

12 SSTL Press Release, 29 Jume 2000, Guildford, UK.

13 SNAP-1 also demonstrated the feasibility of a standardized modular nanosatellite bus; provided a test-bed for novel micro-electronic technologies - in particular a new GPS navigation system, cold-gas propulsion system, APD (CMOS) camera technologies and 32-bit RISC processors; provided experimental and imaging data to the radio-amateur/amateur-scientific communities; and provided a vehicle for the education and training of students in spacecraft engineering at undergraduate and postgraduate level.

. . . [adversaries] exploiting space for their own purposes" and seeking to sabotage U.S. exploitation of space. Therefore, the report said: "A key objective is . . . as required to deny an adversary's ability to do so."

The U.K. government enforces strict controls on the export of this technology. "Satellites, whether mini or otherwise are controlled in dual use regulations," says the Department of Trade and Industry. "All applications for a licence to export dual-use items are considered on a case-by-case basis against the consolidated European Union and national arms control licensing criteria, where there are grounds for believing a user would be the armed forces or internal security forces of the recipient country." Applications from countries or organizations deemed 'undesirable' would be refused. . . .

Yet such control is hard to pull off. One problem . . . is that the definition of undesirable turns out to be all too fluid. Western governments have an appalling record of supporting groups we prefer to think of as freedom fighters until they become terrorists. Another [problem] is the continuing growth of technological expertise. Currently, SSTL can continuously monitor its microsatellites when they are in orbit. Sitting in the Surrey Space Centre, operators can interrupt microsatellites if they are being put to uses different than those for which they were intended. However, one of the aims of SSTL is not just to sell finished products to developing countries, but also to teach those countries how to make satellites for themselves and develop their own space programmes. South Korea has already launched two satellites, Thailand has launched one and China is preparing its own. Each takes between 18 months and two years to build. That time will shorten as the teams of experts grow more expert.

Satellites that were constructed and launched by countries or organizations without the direct involvement of SSTL would not be susceptible to monitoring from its space center. "Eavesdropping on satellites is very difficult," explains Prof. Sweeting. Moreover, future satellites could be even smaller and cheaper than microsatellites. The company has recently built and successfully operated nanosatellites, which weigh as little as 6.5 kg. These would be more difficult to spot.

A space power such as the U.S. could remove micro- and nanosatellites from orbit by force if it so chose. More difficult would be the new generation of satellites under development in SSTL's laboratories. Prototypes of picosatellites have been built that are not much bigger than a pencil in length, with a butane power source that would make then able to navigate through space. And even smaller satellites are possible: credit-card-sized machines, with cameras and radio communications built in.

These tiny objects would float in space in little clouds, each communicating with one another and the ground and beaming around messages and images. Many individual satellites could be deployed without affecting the behavior of the group. These devices would be very inexpensive and could be launched in clouds from missile launchers in the back of rockets as micro- and nano-satellites are today. Professor Sir Martin Sweeting believes he will have the technology for picosatellites in place within seven years.

The Arms Control Search For Nirvana

In spite of the obvious futility of seeking to limit the proliferation of technology that makes such potent miniature space systems possible, the arms control community continues to press for agreements to do so. And this long-standing demonstration of "the triumph of hope over experience" is exploited by many who seek to impede U.S. space programs while advancing their own.

For example, China leads in the international call to "prevent an arms race in space" – or to prevent the "militarization of space." No doubt, these calls are just the diplomatic arm of China's strategy to develop a serious military space capability while seeking to impede similar U.S. developments[14] – and they resonate in the international scene with concerns expressed by a number of nations including among long-standing U.S. allies.

These international pressures are exacerbated by some in the U.S. Congress who seek to restrain the application of U.S.

14 The writings of numerous Chinese military planners make clear that China well understands the important role space can play in supporting terrestrial military forces with reconnaissance, communications, navigational aids, etc. Furthermore, such writings also demonstrate China understands the potential of space weapons. See, for example, *Chinese Views of Future Warfare*, edited by Michael Pillsbury, National Defense University Press, U.S. Government Printing Office, 1997; and Michael Pillsbury, *China Debates the Future Security Environment*, National Defense University Press, U.S. Government Printing Office, 2000. Furthermore, "The Cox Report" – the 1999 unanimous, bipartisan report of the House Select Committee on U.S. National Security and Military Commercial Concerns with the Peoples Republic of China, published by Regnery Publishing – concluded on page 196 that "the PRC is believed to be developing space-based and ground-based anti-satellite laser weapons" – which would be of "exceptional value for the control of space and information." The Cox Committee also concluded: "The PRC has the technical capability to develop direct ascent anti-satellite weapons." More recently, China became the third nation to execute successfully a manned space mission, an important step in its long-term deliberate strategy to become a space power – with aspirations for lunar and deep space exploration, according to Luan Enjie, director of the China National Space Administration. With a GNP and federal budget five times that of Russia's, China can easily outspend America's former chief rival in a new space race. And China's space program already is beginning to eclipse that of the European Space Agency, as observed by James Oberg in his September 15, 2003 *Scientific American* article, "China's Great Leap Forward."

technology to develop effective military space systems. For example, Congressman Dennis Kucinich (D-OH) has repeatedly sought such restraints, e.g., HR3616, titled The Space Preservation Act of 2002, called for President Bush to work for a worldwide ban on weapons in space – "to preserve the cooperative, peaceful uses of space for the benefit of all humankind by prohibiting the basing of weapons in space and the use of weapons to destroy or damage objects in space that are in orbit, and for other purposes." While such attempts have so far failed, they will undoubtedly be repeated in the months and years to come.

Of particular note is the summary report of Working Group 2 on Missile Defenses and the Uses of Space at the 52nd Pugwash Conference on Science and World Affairs, held in San Diego, CA on 12-14 August 2002. This product of some twenty-two working group members from eleven countries composes an early manifesto of arguments that will undoubtedly be further honed by those seeking to influence U.S. domestic and foreign policy out of a "fear that the vision of a small group of space warriors could lead to a condition of U.S. supremacy in space." The final paragraph of their report reads:

> *Having discussed space policies and the possible future danger of an arms race in space the group came to the conclusion that in this very critical moment urgent action is needed. Pugwash can and should contribute to this by informing the public and parliaments about the danger of space weaponization. Again, the group thinks that no state has the right to put arms into space. Space belongs to all mankind and should only be used for peaceful and scientific purposes, international cooperation and prevention of conflicts. A costly arms race in space can be avoided if decisive steps by the international community are started now.*[15]

Bottom Lines

It is hard to improve on the 2000 Commission to Assess United States National Security Space Management and Organization, chaired by now Defense Secretary Donald Rumsfeld:[16]

> *"That U.S. space systems might be threatened or attacked in such contingencies may seem improbable, even reckless. However, as political economist Thomas Schelling has pointed out, 'There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously.' Surprise is most often not a lack of warning, but the result of a tendency to dismiss as reckless what we consider improbable.*
>
> *"History is replete with instances in which warning signs were ignored and change resisted until an external, 'improbable' event forced resistant bureaucracies to take action. The question is whether the U.S. will be wise enough to act responsibly and soon enough to reduce U.S. space vulnerability. Or whether, as in the past, a disabling attack against the country and its people -- a 'Space Pearl Harbor' -- will be the only event able to galvanize the nation and cause the U.S. Government to act.*
>
> *"We are on notice, but we have not noticed."*

15 *Report of Working Group 2 – Missile Defenses and Uses of Space*, 52nd Pugwash Conference on Science and World Affairs, 10-14 August 2002, UC, San Diego, La Jolla, CA; Catherine Kelleher and Jasjit Singh, Co-Covenors: Gstz Neuneck, Rapportuer.

16 Report available on the web at http://www.space.gov/docs/fullreport.pdf

appendix C

Letter from Ambassador Henry F. Cooper to Senator John Warner

July 31, 2000

Dear Mr. Chairman:

I'm writing to correct the record, relative to recent testimony before the Senate Armed Services Committee by Defense Secretary William S. Cohen that the technical basis for emphasizing ground-based missile defenses was based on choices made in 1991 by the Bush Administration. According to a report in the July 26, 2000, *Washington Post*, he told your Committee that the Bush Administration selected ground-based missile defenses in 1991 as more technically mature and capable of more rapid development than space-based and sea-based alternatives. This is entirely untrue – it is contrary to history with which I am most familiar and indeed helped write.

I was Director of the Strategic Defense Initiative Organization (SDIO) from mid-1990 until January 1993; thus, I had immediate cognizance of all ballistic missile defense matters in the era referenced by Secretary Cohen. Before then, as you know, I closely followed SDI developments from my U.S. Negotiator post at the Geneva Defense and Space Talks from 1985 through 1989. In early 1990, I conducted an independent review of the SDI program for then Defense Secretary Dick Cheney under a mandate from then President Bush and, in my March 1990 report to him, I recommended its redirection to the GPALS (Global Protection Against Limited Strikes) architecture. President Bush formally adopted this plan in January 1991—and I had by then been working vigorously to redirect the SDI program for over six months. GPALS included a National Missile Defense (NMD) segment consisting of 5-6 sites of ground-based interceptors, a Global Missile Defense (GMD) segment consisting of 1000 space-based interceptors, and a Theater Missile Defense (TMD) segment consisting of several systems with sea-, air-, and mobile ground-based interceptors. A global command-and-control system was envisioned to integrate these segments and robustly protect Americans at home as well as our overseas troops, friends and allies from up to 200 ballistic missile warheads launched by any nation.

In my 1990 independent review, I was briefed that the technology for space-based interceptors —*Brilliant Pebbles*—was technically mature and ready for formal development. This SDIO assessment was supported by independent reviews of the Defense Science Board, the JASONs and other technical groups. Furthermore, because of the global coverage of such space systems, it was clear that *Brilliant Pebbles* would be the lowest cost and the most militarily effective means of defending both the United States and our overseas troops, friends and allies. It could provide intercept opportunities against attacking ballistic missiles beginning as early as in their boost-phase, throughout their exo-atmospheric mid-course phase, and even into their high-altitude endo-atmospheric reentry phase. [An architecture consisting only of ground-based defenses would clearly be a prohibitively expensive way to attempt to provide such global defensive coverage.] In any case, I recommended that GPALS consist of layered defenses, including space-, air-, sea-, and ground-based segments. *Brilliant Pebbles* was the most cost-effective GPALS component, by far.

Focused R&D on the *Brilliant Pebbles* space-based interceptor system was begun by LtGen Jim Abrahamson, the first SDIO Director, in 1987. It was formally designated the "first to deploy" component of American strategic defenses by my immediate predecessor as SDIO Director, LtGen George Monahan, and so announced in a Pentagon press conference which he convened in March 1990—roughly simultaneously with my independent report to Secretary Cheney. Ground-based defenses were assigned to a follower role. Moreover, their programmatic success was expected to be dependent on widespread adoption of the cutting-edge technology being exploited by *Brilliant Pebbles*—an expectation which, regrettably, has never been realized.

LtGen Monahan established a *Brilliant Pebbles* Task Force within the SDIO to manage the weapons system acquisition and, on my watch beginning in about May 1990, a competition narrowed the contractor teams to two: ones led by TRW/Hughes and by Martin Marietta. In addition to my supervision as the Acquisition Executive for all missile defense programs, this acquisition process was under Defense Acquisition Board (DAB) oversight. With the approval of the Defense Acquisition Executive, *Brilliant Pebbles* became SDIO's first approved Major Defense Acquisition Program (MDAP) in 1991. Had this program been allowed to continue, the life cycle cost of the resulting constellation of 1000 *Brilliant Pebbles* was then expected to be about $11 billion (in 1991 dollars), which included replacing each satellite once and the costs of full system operations for 20 years. These cost estimates underwent the usual scrutiny of the formal DAB process. If we had been provided the needed enabling policy (freedom from Article V of the ABM Treaty) and the necessary funding, I anticipated that first generation *Brilliant Pebbles* could have achieved initial defensive capability as early as in 1996.

The ground-based defense segment was not firmed up to anything like an equivalent status until well over a year later, and our progress was interlaced with the heated debate on Capitol Hill which led to the Missile Defense Act of 1991. I'm sure that you recall this period—since you were the primary author and a major proponent of that most welcome initiative after the Gulf War. Under intense Congressional pressure, memorably articulated to me personally by then SASC Chairman Senator Sam Nunn, I very reluctantly agreed to remove *Brilliant Pebbles* from its eminently deserved acquisition program status in 1992, in return for a Congressional commitment to begin deployment of a ground-based system "by 1996 or as soon as technologically possible" and, within the same statute, a formal promise that *Brilliant Pebbles* would receive "robust funding" as a technology demonstration program. Removing *Brilliant Pebbles* from its leading role most definitely was not a free will decision by the Bush Administration, contrary to Secretary Cohen's recent suggestion.

[I hoped to return *Brilliant Pebbles* to a formal acquisition status as soon as I could persuade the Congressional powers-that-be of the unique maturity, effectiveness and cost efficiency of the technology. The statutory promise—formalized in the Missile Defense Act of 1991—of "robust" funding for this most promising space-based defensive layer was dishonored in 1992, as the legislative record unequivocally reads. Nevertheless, because of its technological maturity, *Brilliant Pebbles* could have been revived and built faster than the first ground-based NMD site. However, this point was rendered moot by Defense Secretary Aspin's direction to completely terminate the program in early 1993—as he said, "taking the stars out of Star Wars."]

Of course, I am recapitulating political, not technical or scientific, issues that limited development of *Brilliant Pebbles*. The undeniable scientific fact is that the *Brilliant Pebbles* technology was mature in 1991—as the *Clementine* deep-space mission so clearly demonstrated in 1994. This very successful technology demonstration program was formulated in my office immediately after the Senate floor debate on the 1992 Defense Authorization and Appropriation Bills made abundantly clear that Senator Nunn and his like-minded colleagues were committed to destroying the *Brilliant Pebbles* program. Barely two years later and at a cost of about $75 million, the Clementine deep-space probe space-qualified the first generation *Brilliant Pebbles* hardware (scavenged from the then-defunct *Brilliant Pebbles* program) and software in the first return to the Moon in 25 years —gathering over a million frames of high-resolution imagery in 15 spectral bands and discovering water in the polar regions of the Moon. The small *Clementine* team, which pioneered the "faster, cheaper, better" approach of which NASA Administrator Dan Golden is so fond, was given awards by NASA and the National Academy of Sciences for this most impressive achievement.

But to prove once again that no good deed goes unpunished, President Clinton used his short-lived line item veto authority in October 1997 to kill the proposed *Clementine* follow-on science program, a program roundly supported by the scientific community. In the associated press conference, National Security Council senior staffer Bob Bell made explicitly clear that the President's veto was because the *Clementine* follow-on program was continuing to demonstrate ever more mature and capable technology that also could be applied to space-based defenses.

Meanwhile, the acquisition program for the ground-based defensive segment has also had a tortuous history. Because of the Congressional mandate in 1991, I worked throughout the Spring of 1992 with the DAB process to gain approval for the National Missile Defense segment of GPALS. As I testified in 1992, we were not able to frame a program to deploy at the first site by 1996; but with the needed funding, we believed we could begin operations with prototypical hardware at a Grand Forks, North Dakota site as early as in late 1997. Fully developed hardware could have been operational as early as in 2002. This program plan was fully coordinated through all of the DoD acquisition offices and submitted to the Congress on July 2, 1992, along with then Defense Secretary Cheney's indication that he had directed it be implemented as a top national priority.

Congress did not provide the funds needed to reach this objective, but did appropriate $1.8 billion for FY1993. Notably, Congress dropped a specific date objective (1996 in the 1991 Act) and called for deployment "by the earliest date allowed by the availability of appropriate technology and completion of adequate integrated testing of all system components." This funding shortfall and redirection from Congress led to a programmatic restructuring and an 18-month slip in the event-driven program strategy demanded by the DAB. The Defense Authorization Conferees did endorse the DAB's event-driven strategy as an appropriate low-to-moderate concurrency and risk program, observing that this plan could lead to deployment in about 2002. While noting that the Conferees did not yet endorse a decision to fabricate field prototypical elements at the initial site, the Conferees indicated they had no objection to planning for such a contingency as early as 1997 at the initial site. Of course, the Bush Administration's 1992 plans to reach these 1997 and 2002 dates were contingent on Congress providing the necessary funds—which Congress did not do.

Before the end of my watch, I had re-framed the NMD program to be consistent with the FY1993 appropriations and the Missile Defense Act of 1992. As indicated in my January 20, 1993, End of Tour Report, the DAB had approved a program that, if fully funded, could have begun defensive system operations in North Dakota with fully developed hardware as early as in 2004 (an 18-month slip because Congress did not provide the FY1993 funds necessary to keep the schedule proposed in the July 2, 1992, Report to Congress)—and with prototypical hardware as early as in 2000. The total investment to begin operations at the first site was expected to be around $22-24 billion in FY1991 dollars. Brilliant Eyes, the associated space-based sensor system, was expected to cost $4-5 billion. And the full multi-site NMD system was expected to cost an additional $16-18 billion —again, in FY1991 dollars. This program plan was fully staffed through the Pentagon's DAB with costing by independent OSD, Army, and Air Force—as well as SDIO—cost estimators. [Note that the first ground-based site was expected to cost about twice as much as the estimated life cycle cost of the *Brilliant Pebbles* segment of GPALS, which could have protected the entire world against limited attack. Simulations in 1991, using actual DSP data from the Gulf War, demonstrated that every SCUD launched by Iraq could have been intercepted by the *Brilliant Pebbles* constellation.]

In any case, the NMD program was fully funded in the out-year Pentagon budget: the Ground-Based Radar and space-based sensor (Brilliant Eyes) programs already were proceeding under fully funded, DAB-approved MDAPs, and Requests for Proposal had been issued to develop Ground-Based Interceptors—formal proposals from the GBI contractors were to arrive in Huntsville, Alabama within 30 days as I departed from SDIO on January 20, 1993. So, the Clinton Administration inherited a fully-approved NMD program—reviewed by the Pentagon's DAB and consistent with the law embodied in the FY1993 Defense Authorization Act—to build the first site to begin defending the territory of the United States as early as in 2000.

But the Clinton Administration—oblivious to the FY1993 Authorization and Appropriation directives—cut the $1.8 billion appropriated to develop the ground-based NMD system to $0.4 billion and returned unopened to the proposing GBI contractors their system development bids. The previously fully funded outyear NMD programs were cut by 80-percent. Ground-Based Radar development for NMD was discontinued—although related development continued because the THAAD GBR is part of the same radar family. Programs for space-based systems were sharply curtailed (as in the case of Brilliant Eyes) or eliminated completely (as in the case of *Brilliant Pebbles*). Even the Clinton's administration avowed top priority Theater Missile Defense programs were cut by 25 percent—scuttling the Navy's missile defense programs and boost-phase intercept technology demonstrations. Other technology programs to cope with the development of likely offensive countermeasures were also sharply cut—leaving current programs open to substantial criticism. Of great importance, the vision was lost for integrating the command-and-control system for forward-based TMD systems with a homeland NMD system.

In essence, these actions effectively destroyed the Nation's space-based missile defense options for the following decade. They also severely handicapped technical prospects for sea- and ground-based defenses, which could have benefited greatly from exploitation of the more mature key technologies that had been developed for space-based defenses in the 1980s and early 1990s.

It is simply incorrect to assert that technology for ground-based systems was more mature in 1991—the opposite was the case then and is, in fact, still the case. Indeed, ground-based systems could greatly benefit even today from exploiting the space technologies developed under the SDI program—which have continued to mature without support from the Pentagon's missile defense programs. It is shameful that the Clinton Administration has blocked the transfer of such technologies—presumably because their "Star Wars" origins make them politically incorrect.

Incidentally, review of the tortured history (since my 1990 independent review for Secretary Cheney) of the development of sea-based defenses would demonstrate that they, too, can be built sooner, cheaper, and better than ground-based defenses. While being much more cost-effective than ground-based systems from a technical perspective, both sea- and space-based defenses suffer from the same political problem—Article V of the ABM Treaty blocks their development, testing, and deployment, if they have NMD capability. So the fact that they are less expensive, more militarily effective, and can be built faster from a technical perspective will be of no defensive significance to the United States so long as the ABM Treaty continues to bind the hands of America's engineers. Furthermore, the fact that sea-based systems can easily be given NMD capability has led to a "dumbing-down" of TMD systems we are building to protect our overseas troops, friends and allies—all to avoid their having any NMD capability.

While I would have preferred an agreement with Russia along the lines the Bush Administration was discussing with Russia after President Yeltsin's January 1992 proposal to work together to build a joint global defense, I believe further negotiations about the ABM Treaty are no longer wise because of the imminent threat, as made clear by the Rumsfeld Commission. The Clinton Administration broke off those talks in 1993 and instead declared its allegiance to a restrictive interpretation of the ABM Treaty, which it has sought to "strengthen"—adding further restrictions that make more difficult even building effective theater defenses. We need now to build as soon as possible the most effective defenses we can for Americans at home as well as our overseas troops, friends, and allies. I believe this means moving away from the ABM Treaty immediately and building the most effective sea- and space-based defenses we can as soon as possible. If Russia wants to work with us to help build effective defenses for the world community—perhaps along the lines of boost-phase defenses as recently suggested by President Putin—that would be a welcome development. We should be willing to work together with all our friends and allies to build effective defenses for us all. But we need our enslavement to the ABM Treaty to end forthwith.

In summary, SDIO's history offers no support for the revisionist account of the relative maturity of ground- and space-based missile defense technologies in the early '90s recently offered to your Committee by Secretary Cohen (though I have no doubt as to his personal good faith in proffering such an account). Indeed, the historical truth is precisely the opposite of the impression his remarks conveyed. I urge the Committee to take into account this history in its future deliberations.

I appreciate the opportunity to correct the record on this potentially significant point. I would be pleased to discuss these issues further with you.

Sincerely yours,

Henry F. Cooper, Ph.D.

appendix d

The Rise and Fall of *Brilliant Pebbles*

The Missile Defense Agency's historian, Donald R. Baucom, fist published "The Rise and Fall of Brilliant Pebbles," in *International Flight Symposium*, October 23, 2001. This piece was subsequently published in the *Journal of Social, Political and Economic Studies*, Volume 29, Number 2, September 2004, 145-190. It is used with permission.

Introduction

In simple terms, missile defense systems consist of three basic components: sensors that detect and track missiles and missile warheads, weapons that intercept and destroy missiles and warheads, and battle management systems that integrate sensors and weapons into a coherent system. Regarding interceptors, there are two basic types: those that destroy their targets by means of an explosive warhead and those that physically collide with their targets. Interceptors of the latter type are known as hit-to-kill (HTK) interceptors or kinetic kill vehicles (KKV).

The principles behind kinetic kill vehicles were articulated in as early as 1960 in Project Defender, an inventory of missile defense technologies completed by the Department of Defense's Advanced Research Projects Agency. Given the state of technology when Defender started, the accepted wisdom was that destroying an ICBM warhead required the use of a nuclear-tipped interceptor. However, as Defender proceeded, faith in the accepted wisdom eroded. A July 1960 Defender paper put the matter as follows:

> *Intuitively, one feels, that in trying to intercept anything traveling at ICBM velocities, the resultant miss distance would be large. Until recently, systems considerations have been based on the premise that miss distances would be of the order of one or two hundred feet. This dictated the use of nuclear warhead with its attendant high cost and weight, and other disadvantages. During our space based interceptor studies, consideration of a light weight, 300 lb., interceptor using an IR seeker led to the conclusion that miss distances of 10 to 30 feet could be achieved. At these distances, fragment type warheads exploiting hypervelocity impact for kill appeared reasonable against tankage, motors, and other parts of the ICBM in boost. Further study indicated that a cheap effective warhead could be built weighing as little as 2 lbs.*[1]

Not only did it begin to appear that lightweight interceptors armed with conventional explosives were feasible, but even hit-to-kill interceptors. In the words of the Defender paper:

> *Computer simulation runs on several types of interceptors weighing about 50 lbs., and using IR homing have resulted in miss distances of one or two feet. This certainly indicates hypervelocity impact kill could be employed. Incidentally, a nose cone traveling at ICBM velocities in collision with one pound of material releases the energy equivalent of 6 pounds of TNT. In a word, the kinetic energy at that velocity exceeds the chemical energy available at that mass.*[2]

Another point to emerge from Project Defender was the advantages that accrue to the defense from using space-based interceptors to attack and destroy ICBMs while they are still in their boost phase. As the 1960 Defender paper put the matter:

> *A ballistic missile is more vulnerable in its propulsion or boost phase then in any subsequent part of its trajectory. At the same time, its identity is most difficult to conceal. These circumstances immediately suggest an early intercept system as an ideal solution to the defense problem. Unfortunately, enemy missiles are relatively inaccessible during this phase. So Far, the only promising defense system concept has been a space based or satellite borne interceptor. Such a system requires many thousands of interceptors in space, but at a given instant only a small fraction will be*

1 Harold N. Beveridge, "Defender Introduction," in Ballistic Missile Defense Program of the Advanced Research Projects Agency, *A Review of Project Defender for the Director of Defense Research and Engineering, 25-29 July 1960*, Volume I, p. 17 (hereafter *Project Defender, 1960*, Vol. I).

2 Beveridge, "Defender Introduction," pp. 17-19.

in a position to attack. The economic feasibility of such systems is heavily dependent upon equipment reliability and upon enemy countermeasures.[3]

The remarks about economic feasibility should be borne in mind, as they will surface prominently later in this history of *Brilliant Pebbles* (BP), a space-based, kinetic kill interceptor that was part of President Ronald Reagan's Strategic Defense Initiative (SDI) program. During its brief life span, Brilliant Pebbles became the central element of the SDI program. From their orbits around the earth, BP interceptors were to be capable of destroying Soviet ICBMs during their boost phase, eliminating their multiple warheads and decoys before these could be dispersed. In this way, a single Brilliant Pebbles interceptor could destroy as many as ten Soviet warheads. This pivotal role makes the BP story crucial to the broader history of the SDI program.

The Origins of Brilliant Pebbles[4]

By the early eighties, a number of strategic analysts had begun to worry that the Soviets were about to achieve a first strike capability that would allow them to cripple U.S. strategic retaliatory forces and still retain enough nuclear weapons to destroy America's cities. This situation led the Joint Chiefs of Staff in February 1983 to recommend to President Ronald Reagan that the U.S. begin to place greater emphasis in its strategic plans on developing missile defenses.

Having come to office favorably disposed toward strategic defenses, President Reagan was highly receptive to this message. In a nationally televised speech on 23 March 1983, the president announced his decision to launch an expanded research and development program to see if strategic defenses were feasible. In April 1984, following a year of technical and strategic studies to determine how best to pursue the president's goal, the Strategic Defense Initiative (SDI) Organization was chartered under the leadership of its first director, Lt. Gen. James A. Abrahamson of the U.S. Air Force. This organization was to carry out the SDI program of research and development to resolve the feasibility issue.[5]

For several years before the SDI program was started, there had been considerable interest in developing directed energy weapons (DEW) as a counter to ballistic missiles. However, it was becoming apparent when SDIO was established that DEW technology was immature and that it would require far too much money to develop effective DEW weapon systems for a near-term missile defense system. As a result, the focus shifted toward the development of HTK systems as demonstrated in the June 1984 Homing Overlay Experiment (HOE) conducted by the U.S. Army and the September 1986 Delta 180 experiment carried out by SDIO.

By the winter of 1986, Secretary of Defense Caspar Weinberger and General Abrahamson had concluded that the SDI program had advanced to the point where it was time to enter a strategic defense system into the defense acquisition process. On 17 December 1986, Weinberger briefed President Reagan on an architectural concept that included a constellation of orbiting interceptors that would be able to destroy Soviet ICBMs during their boost phase, thereby destroying all the warheads and decoys aboard the missiles before they could be dispensed in space. President Reagan approved the concept; and in the summer of 1987, SDIO presented the architecture for review by the Defense Acquisition Board (DAB), which then recommended approval of the concept by the Secretary of Defense. Weinberger accepted the recommendation in September 1987.[6]

Known formally as the Strategic Defense System (SDS) Phase I Architecture, the system concept approved by Weinberger included six major acquisition programs. These were the boost surveillance and tracking system (BSTS), the space-based interceptor (SBI), the battle management/ command and control and communications system, the space-based surveillance and tracking system (SSTS), the ground-based surveillance and tracking system (GSTS), and the exoatmospheric reentry vehicle interceptor system (ground-based interceptor). When combined in accordance with the architectural concept, these elements would form a multi-tiered defense that could attack Soviet missiles and warheads throughout their flight. The operational effectiveness goal for this system was spelled out by the Joint Chiefs of Staff in a 23 June 1987 memorandum.

The space-base elements of SDS Phase I, especially the space-based interceptor (SBI), presented several problems. In addition to being inherently distasteful to elements of America's political leadership that opposed weapons in space,[7] SBI would be

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3 Beveridge, "Defender Introduction," pp. 8-9.

4 For the general background in this section, see Donald R. Baucom, *The Origins of SDI: 1944-1983* (Lawrence, KA: University Press of Kansas, 1992) and "Developing a Management Structure for the Strategic Defense Initiative," Chapter 8, pp. 187-215, in Roger D. Launius, Ed., *Organizing for the Use of Space: Historical Perspectives on a Persistent Issue*, Vol. 18 in *AAS History Series* (San Diego, CA: Published for the American Astronautical Society by Univelt, Incorporated, 1995).

5 Baucom, *Origins of SDI*, pp. 129-134, 192-196.

6 Caspar W. Weinberger, *Fighting for Peace: Seven Critical Years in the Pentagon* (New York, N.Y.: Warner Books, 1990), pp. 323-24; Jack [John] Donegan to General [James A.] Abrahamson, Memorandum, 2 January 1987, with attachments. Weinberger claimed that the meeting with Reagan occurred on 19 December; a draft memorandum for Weinberger's signature attached to Donegan's memorandum indicates that the meeting occurred on 17 December. I have taken the date from the Donegan memorandum, as it is a contemporary document and Weinberger's memoir was prepared some years after the event.

7 Fred Barnes, "White House Watch: Brilliant Pebbles," *The New Republic*, 1 April 1991, p. 11. Barnes's article deals with BP in the context of GPALS and had this to say about congressional opposition to space-based systems: "The land (and sea) parts aren't controversial. Sam Nunn, the chairman of the Senate Armed

expensive and drive the cost of the architecture up.[8] Moreover, all space-based systems in the architecture would be vulnerable to attack by anti-satellite systems (ASAT) that the Soviets might develop.

In the case of SBI, the vulnerability problem was compounded by the system's design. It was to be a large garage satellite that would berth multiple interceptors until they had to be fired at attacking missiles. This meant that a single Soviet ASAT could destroy the garage and its suite of interceptors. The solution to these difficulties emerged from the work of Dr. Lowell Wood, a physicist from Lawrence Livermore National Laboratory.

After discussing the SBI problems with other missile defense experts, Wood concluded that small, autonomous interceptors might offer a solution to the vulnerability and cost problems associated with a space-based interceptor system. He then conducted a personal inventory of applicable technologies and concluded that autonomous interceptors could be produced using

> *technology that could be bought off-the-shelf, much of it only a little advanced over mass-produced consumer and technical professional electronics: video camcorders, scientific work stations and the like. Though this result was striking enough, it was even more astonishing to total up the likely costs: it seemed likely that a simple, small kinetic kill vehicle seeker package composed of such elements could be mass-produced for a few tens of thousands of dollars, moreover in the here-and-now.*[9]

Thus, this new interceptor was to "be small, cheap and smart. Most important, it would have none of the vulnerabilities that came with big tracking satellites or groups of interceptors housed in orbiting garages."[10]

As his work continued, Wood gained entree to General Abrahamson and began briefing the General on the new interceptor concept. By the fall of 1987, Abrahamson was sufficiently impressed with the concept to visit Lawrence Livermore National Laboratory where he watched a computer simulation of Brilliant Pebbles in operation, inspected hardware Wood had assembled, and talked with laboratory personnel. Based on this trip, Abrahamson ordered a substantial increase in funding for Brilliant Pebbles.[11]

A few months later, Wood introduced the public to the new interceptor concept and coined its name. Speaking at a conference in Washington, D.C., he described a miniaturization process that would lead to the emergence of "brilliant pebbles" from existing "smart rocks" like the Army's HOE vehicle and SDIO's Delta 180 test vehicle. The new interceptor, he argued, would be

> *designed to be brilliant, not merely smart, and to have far better than human vision, not just crude imaging systems, so that the defensive system architecture is simply the constellation of brilliant pebbles, and nothing else. Each pebble carries so much prior knowledge and detailed battle strategy-and-tactics, computes so swiftly and sees so well that it can perform its purely defensive mission adequately, with no external supervision or coaching. Complexity, durability, reliability and testability issues in such architec-*

Services Committee, and other Democrats look favorably on them. It's the space part--not only Brilliant Pebbles but also sensors known as Brilliant Eyes, which guide ground-based missile defenses--that draws criticism. Why? Because if deployed, the space-based elements would violate the Anti-Ballistic Missile (ABM) Treaty of 1972."

8 By April 1988, the costs of the Phase I system had increased from $40 to $60 billion to $75 to $100 billion. This increase had led the Strategic Forces Subcommittee of the Senate Armed Services Committee to question General Abrahamson about the causes of the cost increase when he appeared before the subcommittee on 18 April 1988. ("Abrahamson Pressed on SDI Cost," *Aerospace Daily*, 19 April 1988, p. 102, as reprinted in Office of Assistant Secretary of Defense for Public Affairs, *Current News*, 21 April 1988, p. 9.) A *Washington Times* article on 19 April claimed that the cost for the first phase of SDI could go as high as $150 billion. (Paul Bedard, "U.S. Must Decide on ABM by 1993, SDI Chief Warns," *Washington Times*, 19 April 1988, pp. A1, A4, as reprinted in Office of Assistant Secretary of Defense for Public Affairs, *Current News*, 21 April 1988, p. 6.) The *SDI Monitor* said that the cost of orbiting several hundred SBI garages, each housing ten interceptors, would be "ruinous." Faced with cost estimates of a $115 billion for an initial strategic defense system, SDIO last year decided to shift most sensor and SBI fire control work to space surveillance and tracking satellites (SSTS). The new design cut costs by $40 billion.

Under the revamped design, battle management computers would fly on SSTS satellites. The computers would use information from SSTS sensors and six boost surveillance and tracking satellites (BSTS) to control the space-based interceptors flying 1,000-1,500 kilometers below them.

But Monahan is uneasy with the decision to place heavy reliance on a constellation of only 18 SSTS satellites. "They become fat, juicy targets," he told reporters. "We've got a dependency [on SSTS] that I'm not wild about." ("SDIO Takes a Hard Look at Brilliant Pebbles," *SDI Monitor*, 29 May 1988, p. 139.)

9 For information on the origins of the Brilliant Pebbles concept, see Lowell Wood and Walter Scott, "Brilliant Pebbles," Research Completed under the auspices of the Department of Energy, Contract W-74505-eng-48, n.d. [internal evidence indicates that this paper was published after the end of January 1989 when James Abrahamson had retired from the Air Force], p. 4 (hereafter referred to as Wood and Scott, "Brilliant Pebbles"); William J. Broad, *Teller's War: The Top-Secret Story Behind the Star Wars Deception* (New York: Simon &Schuster, 1992), pp. 251-52. For the quoted material, see Wood and Scott, "Brilliant Pebbles," p. 4.

10 Broad, *Teller's War*, pp. 252-53.

11 Lowell H. Wood, "Operational Strategic Defense in the '80s: Very Near-Term Launch Capability for a Nitze-Satisfying SBKKV System," Presentation to Lt. Gen. James A. Abrahamson, in the Pentagon (Room 2E252), 24 February 1987; Ralph Kinney Bennett, "Brilliant Pebbles: Amazing New Missile Killer," *Reader's Digest*, September 1988, pp. 131-132.

tures thereby either simplify to readily manageable levels, or else vanish entirely.

Furthermore, Wood believed that BP interceptors might eventually be made so small (under a single gram in mass) that they would possess too little kinetic energy to assure destruction of an armored ICBM. In short, the lower limit on the size of a Brilliant Pebbles interceptor was the mass it required to be lethal when it struck its target. Certainly, Wood concluded, it was possible at that time to develop an effective Pebble that would weigh between 1.5 and 2.5 kilograms, which was about 100 times the mass needed to assure destruction of an armored missile.[12]

To provide effective missile defenses under conditions of the worst-case attack scenario could require as many as 100,000 Pebbles in orbit. However, Woods believed a more reasonable estimate of the size of the BP constellation was about 7,000. Even taking the worst case scenario would not make Brilliant Pebbles prohibitively expensive, since Wood expected the cost of a single BP to be driven down as low as $100,000 through mass production techniques and the use of what was essentially off-shelf, commercial technology. This meant that a constellation of 100,000 interceptors would cost about $10 billion.[13] Moreover, given their small mass, it should be fairly inexpensive to orbit the entire constellation.

In its mature form, the BP concept called for the interceptors to be housed in protective cocoons or "life-jackets." These devices would provide housekeeping support (communications, power, etc.) to the Pebbles until such time as a missile attack was detected. At this time the Pebbles would be armed for combat and shed their life jackets.[14]

As Wood was developing a more definitive version of the Brilliant Pebbles concept, SDIO was conducting its own search for answers to the cost and vulnerability problems associated with the Phase I architecture. Part of this effort was the Space-Based Element Study (SBES) that began in May 1988 under the leadership of Dr. Charles Infosino. General Abrahamson had initiated the study to help SDIO redesign the SBI, and he directed the SBES team to consider Brilliant Pebbles in its review of SBI candidates. The result was the first systematic evaluation of Brilliant Pebbles by an independent body and an endorsement of the BP concept. Based on the results of this review, Abrahamson concluded that SDIO should forge ahead with Brilliant Pebbles and perhaps even accelerate the program.[15]

While the SBES team was at work, the U.S. Air Force Space Division was conducting another review of the SBI element. The results of the Space Division review, along with information about other SBI developments, were reported to the Secretary of Defense in the fall of 1988. The Space Division report stated that work with sensors and signature data, along with trade-off studies, indicated that individual interceptors could directly engage re-entry vehicles using their own sensors, thereby eliminating the requirement for sensors on carrier vehicle satellites. Also, new data suggested that interceptor fly-out time could be doubled, while fly-out velocity could be increased twenty-five percent, resulting in greatly increased range for the SBI interceptors. The improved performance of interceptors, coupled with improvements in the ERIS ground-based interceptor, meant that the number of carrier vehicles in the SBI constellation could be reduced by over fifty percent from the original number of several hundred. These changes translated into lower projected costs for research, development, and acquisition. As a result, the cost of the SBI constellation dropped to $18 billion (FY1988 constant dollars), a reduction of sixty-six percent from earlier projected costs. The

12 Lowell Wood, "Concerning Advanced Architectures for Strategic Defense," Paper Prepared for Presentation at the Conference on the Strategic Defense Initiative: The First Five Years, Washington, D.C., 13-15 March 1988, pp. 4-7. One clear advantage of small-sized interceptors was a reduction in the cost of orbiting a constellation that would have to include several thousand pebbles. Indeed, consideration was given to orbiting BP interceptors using rail guns.

13 Wood, "Concerning Advanced Architectures for Strategic Defense," pp. 7-8. Regarding a worst-case scenario, Wood gave as an example "an instantaneous silo-dumping attack with maximum clustering of mobile launchers--the worst case imaginable." (p.8) In Wood and Scott, "Brilliant Pebbles," p. 8, the authors give 7,000 BPs as "a reasonable median number which fully satisfies the JCS tasking for Phase I strategic defense all by itself."

14 Strategic Defense Initiative Organization, *1993 Report to the Congress on the Strategic Defense Initiative*, January 1993, p. A22, states: "Each life jacket provides on-orbit power, low-rate attitude control, surveillance, communication, thermal control, navigation, and survivability."

15 Charles Infosino, Discussion with Donald R. Baucom, 14 July 1993, p. 1; Strategic Defense Initiative Organization, *Final Technical and Scientific Report: 16 May 1988-30 September 1988*, 14 October 1988, Executive Summary, pp. 1-2. The comment about the SBES study constituting the first systematic review of Brilliant Pebbles was made by Dr. Charles Infosino during a discussion with Ballistic Missile Defense Organization (BMDO) Historian Donald R. Baucom on 21 April 1993. Information on the origins and purposes of the study can be found inside the title page of the report on the "Report Documentation Page." This study was completed under contract SDIO84-88-C-0019. In addition to Infosino, the following were government employees who served as members of the SBES: Dean Judd (SDIO), Fred Hellrich (Navy/NRL), Ed Wilkinson (Army/SDC), Alan Weston (Air Force/AFAL), Dwight Duston (SDIO), and David Finkleman (USSPACECOM). Employees of FCRC/National Laboratories who provided technical support were: Bob Erilane (POET/Aerospace), Troy Crites (POET/Aerospace), T. J. Trapp (LANL), Chris Cunningham (LLNL), John Dassoulas (JHU/APL), Steve Weiner (MIT/LL), and Howard Wishner (Aerospace). A team of thirteen analysts provided by four companies also supported the effort. Members of the SBES team are listed on p. 53 of their report.

Space Division report noted that the analytical work associated with both the SBES and the development of the Brilliant Pebbles concept contributed to simplifications and improvements in the SBI element.[16]

As 1988 was ending, then, SDIO's analytical and redesign work was pushing the SBI concept toward the completely autonomous mode of operation that was a hallmark of the Brilliant Pebbles concept. One could now begin to think in terms of either defending the carrier vehicle against ASATs or simply dispersing the interceptors. If one chose the latter course of action, the interceptors would remain capable of destroying ICBMs and warheads while they themselves became relatively invulnerable to ASAT attack. The progress made with the SBI concept in the year following the first DAB review was summed up by an SDIO report stating that the SBI element of October 1988 departs from the initial SBI element concept in several respects. The initial element focused on autonomous SBI CV [carrier vehicle] satellites for communications, battle management, fire control sensing, and SBI survivability. With this approach, significant complexity and cost accrue to the CV satellite and in turn limit the performance for the space-based interceptor. The current SBI element concept changes the emphasis to increasing the performance of the interceptor, with a corresponding simplification of the CV satellite.[17]

In short, SBI was rapidly evolving toward a concept very similar to Brilliant Pebbles. [18]

Verifying the *Brilliant Pebbles* Concept: A Season of Studies

As 1989 began, General Abrahamson's tenure as SDIO Director was ending.[19] Yet, the design for SBI, the principal weapon system in the Phase I architecture, was still far from settled. This meant that Abrahamson's replacement, Lt. Gen. George L. Monahan, Jr., USAF, would immediately face a major architectural decision: what should be the structure of the space-based portion of the SDS Phase I system?

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 for ever decreasing incremental costs."[20]

This last point was important, for it said that Brilliant Pebbles could meet one of the critical requirements for deployment that were delineated in the Nitze criteria that had been adopted under the Reagan administration to determine whether or not a missile defense system, once developed, should be fielded. According to these criteria, any missile defense system deployed must be survivable and cost effective at the margin. The latter criterion meant essentially that it had to cost more to develop offensive countermeasures than to devise defensive responses.[21]

16 Strategic Initiative Defense Organization, *Program Overview*, December 1988, p. 34; Strategic Defense Initiative Organization, "Space-Based Interceptor Status Report: A Special Report to the Secretary of Defense," 26 September 1988 (updated 5 October 1988), pp. i, 5-7, 12.

17 SDIO, "Space-Based Interceptor Status Report," 26 September 1988 (updated 5 October 1988), p. 6.

18 For evidence of this evolution, see *Space-Based Interceptor Status Report*, pp. ii, 5, 20-22. Page ii states: "The Livermore National Laboratory's 'Brilliant Pebbles' concept of a proliferated 'singlet' constellation has not only provided the promise of a revolutionary capability but is also acting as a catalyst for innovative improvements in other SBI programs." See also Strategic Defense Initiation Organization, "Brilliant Pebbles," Information Paper, 9 March 1989. This paper states: "At the end of FY'88, all of the Brilliant Pebbles technologies, developed under SDIO funding to Lawrence Livermore National Laboratory (LLNL) with extensive industrial-sector participation, have been demonstrated." This same information paper stated: "The Brilliant Pebble navigation system is based on a novel, already-demonstrated real-time stellar navigation module and standard miniature angular rate-sensing and linear accelerometers, backed by a high precision clock."

19 On 26 July 1988, General Abrahamson informed Secretary of Defense Carlucci of his intent to retire effective 31 January 1989. Abrahamson stated that "a new Administration will undoubtedly have different ideas or approaches to SDI. Therefore, I reluctantly have concluded that the program will best be served by allowing new leadership to represent new policy and direction." Abrahamson selected the end of January 1989 as the effective date of his retirement to be sure there would be sufficient time to assure a smooth transition to the new Bush administration. James A. Abrahamson, Memorandum for Secretary of Defense, Subject: "Retirement for Active Duty--Action Memorandum," 26 July 1988.

20 James A. Abrahamson, Memorandum for Deputy Secretary of Defense, Subject: "'End of Tour Report,'--Information Memorandum," 9 February 1989, Attachment 1, "Lt General Abrahamson's Recommendations: *SDI Breakthrough Architectures*," pp. 1-1 through 1-3.

21 Nitze presented the criteria that bear his name in a speech at Philadelphia in 1985. See Paul H. Nitze, "On the Road to a More Stable Peace: Speech to the Philadelphia World Affairs Council," 20 February 1985. For a discussion of the origins of the criteria, see Paul H. Nitze with Anna M. Smith and Steven

About three weeks before Abrahamson submitted his EOT report, President George Herbert Walker Bush had taken office. With clear signs on the horizon that the Cold War was ending, the new Bush administration immediately launched a major review of American security requirements. Included here was an examination of the structure and objectives of the SDI program with this review encompassing possible future roles for missile defense. In the emergent security environment envisioned by Bush's instructions, these roles might vary from serving as the strategically dominant weapons system to protecting against Third World missile attacks or "the accidental launch of Soviet systems."[22]

In June 1989, President Bush issued National Security Directive 14 pertaining to the SDI program. Based on the findings of his administration's reassessment of national security requirements, the President had concluded that the goals of the SDI program remained "sound" and that "research and development of advanced technologies necessary for strategic defenses" should continue to be a major U.S. response to the "Soviet challenge." In this R&D effort, "particular emphasis" was to be placed on "promising concepts for effective boost-phase defenses, for example, 'Brilliant Pebbles.'" Bush also directed Secretary of Defense Richard Cheney to commission an independent review of the SDI program to see that the goals laid down in NSD-14 were carried out. This independent study was to be completed by 15 September 1989.[23] As we shall see, when this review was submitted on 15 March 1990, it contained a strong endorsement of the Brilliant Pebbles concept, which the report's author, Ambassador Henry Cooper, considered essential to the success of the SDI program.

As these presidential instructions were being formulated, General Monahan was developing his own plans to evaluate Brilliant Pebbles. By May 1989, these plans included two technical feasibility studies by outside advisers, a Red/Blue evaluation to judge how well BP would deal with Soviet countermeasures, and a "bottom up" cost estimate.[24]

Monahan had also developed a plan for getting his acquisition strategy approved by the DAB. Central to this plan was

L. Rearden, *From Hiroshima to Glasnost: At the Center of Decision* (New York: Grove Weidenfeld, 1989), pp. 406-407. For other discussions of the Nitze criteria as they related to Brilliant Pebbles, see Lowell H. Wood, "Operational Strategic Defense in the '80s: Very Near-Term Launch Capability for a Nitze-Satisfying SB-KKV System," Presentation to Lt. Gen. James A. Abrahamson, in the Pentagon (Room 2E252), 24 February 1987, and George Monahan and Lowell Wood, "Brilliant Pebbles," Transcript of Press Briefing, Pentagon, 9 February 1990, pp. 10-11. Indeed, the basic idea of mass-producing cheap BP interceptors would seem to offer the ability to counter any effort on the part of the Soviet Union to overcome strategic defenses by adding more ICBMs. Wood seems to have been concerned about the Nitze criteria as early as August of 1986 when he presented a "an invited talk" at a seminar in Austria. See Lowell Wood, "The Strategic Defense Initiative and the Prospects for International Cooperation in Space," Paper Prepared as Documentation of an Invited Talk to Be Given at the 29th Seminar for Diplomats, Klessheim, Austria, 5-8 August 1986, pp.5-6.

22 George Bush, Memorandum for the Vice President, et. al., National Security Review 12, Subject: "Review of National Defense Strategy," 3 March 1989, pp. 2, 6-8.

23 George Bush, Memorandum for the Vice President, et. al., National Security Directive 14, Subject: "ICBM Modernization and Strategic Defense Initiative," 14 June 1989, pp. 1, 3-4.

24 Lt. Gen. George L. Monahan, Jr., to the Honorable John J. Welch, Jr., Assistant Secretary of Defense for Acquisition, Letter, 5 May 1989. See also "SDIO Takes a Hard Look at Brilliant Pebbles," *SDI Monitor*, 29 May 1989, pp. 139-140. Not included in the studies described above is a general assessment of the SDI technology program completed in March 1989 by the American Institute of Aeronautics and Astronautics. Although Brilliant Pebbles is mentioned only briefly in the report's section that deals with kinetic kill technologies, this reference to BP comes in the context of a report that endorsed the SDI technology program. "No issues were identified" in the program that could not be resolved through the actions recommended in the report. Furthermore, the report said "no fundamental obstacles were found that a well-planned technology program could not surmount." American Institute of Aeronautics and Astronautics, *AIAA Assessment of Strategic Defense Initiative Technologies*, 15 March 1989, p. 30. For a brief description of the AIAA report, see [Strategic Defense Initiative Organization], "Strategic Defense System Space-Based Architecture Fact Paper," 9 February 1990. Wood and Scott, "Brilliant Pebbles," p.7, stated that in warming up for the 1989 cost estimating exercise, SDI was "gathering up a half-dozen cost estimates for Brilliant Pebbles." They also stated that they knew of eight additional studies that were underway. For another tally of the studies anticipated, see Theresa M. Foley, "Sharp Rise in Brilliant Pebbles Interceptor Funding Accompanied by New Questions about Technical Feasibility," *Aviation Week*, 22 May 1989, p. 21. Foley noted that in addition to studies by JASON and the DSB, three other studies were being conducted by Martin Marietta and Rockwell as part of their SBI contracts with the Air Force's Space Division. One of these was a reworking of the SBI architecture to reflect the results of moving the fire control responsibility from the SBI garage to the space-based sensor constellation, a move expected to reduce the cost of command and control while increasing the vulnerability of the space-based architecture. A study known as Scorpion involved the SBI contractors in an examination of the costs of the singlet configuration of the interceptor constellation. Under Scorpion, Rockwell examined a constellation of singlet interceptors compared to housing ten interceptors in a garage. Martin Marietta was to compare an alternative constellation in which two or three interceptors would be clustered together with the constellation that clustered ten together. Finally, there was to be an overarching cost evaluation with which the SBI contractors would assist the Space Division. At this time, estimates of the cost of BP interceptors varied from $250,000 to $1 million per pebble.

integrating the work being done on Brilliant Pebbles with "the on-going and planned activities of other SDI elements, especially SSTS and SBI." This would be accomplished through a fifth evaluation of the space-based component of the SDI architecture that would get under way in September 1989. By this time, the other evaluations of BP were to be completed; and their results would be assimilated into the September study. Then, in the late fall, SDIO would present the results of the September evaluation for approval by the DAB. Once the DAB accepted SDIO's plans, the Air Force would execute the approved space-based program in conjunction with Lawrence Livermore National Laboratory. Monahan had hoped to win approval for this approach during an 8 May 1989 DAB review,[25] which never occurred. Nevertheless, Monahan forged ahead with his plans.

One of the technical feasibility studies was conducted by JASON, a group of America's top scientists, who worked under the aegis of MITRE Corporation and advised government agencies on defense and other technical issues. This study was conducted during June and July of 1989 and focused on the technical feasibility of BP's component technology and of the battle management command, control and communications (BMC^3) system that was to be used with BP. In the process, the JASONs examined other interceptor concepts for comparison purposes.[26]

In the Pentagon, it is common for the leader of a major study or his surrogate to brief the sponsoring agency on the findings of that study. On 23 August 1989, Dr. John M. Cornwall, a physicist from Cornell University and leader of the JASON BP review, briefed General Monahan and key members of missile defense community. He reviewed the strong points of the BP concept, which included the proliferation of the interceptors and their autonomous operation. He also noted that the concept was based on conservative technologies that had already been developed in large measure through the work of the military services, SDIO, and Lawrence Livermore National Laboratory. The bottom line in the JASONs findings was that there were no technological "show-stoppers" or fatal flaws in the BP concept. Moreover, he continued, the Brilliant Pebbles interceptor could probably be produced using current technology, although a better BP interceptor could be produced with technologies that were just a couple of years downstream.[27]

The general points Cornwall made in his briefing were detailed in the written report filed by the JASONs on 3 October 1989. This report stated that

> *research on lightweight proliferated, autonomous kinetic-kill interceptors using near-term and maturing technology deserves continuing support. It will be essential to avoid either excessive conservatism or excessive optimism in choosing which technologies to support; near-term but not off-the-shelf technologies may be mission-critical. Although there does not appear to be any obvious technological show-stopper, there are several problems which must be addressed: performance of readily-available technology; lack of hardness of commercial technology against a nuclear environment; and serious countermeasures threats.* [28]

These unanswered questions notwithstanding, BP's general concept of autonomous interceptor operation offered important advantages. As the report put this matter:

> *[I]t makes sense to attempt an autonomous system, at least with no SSTS and possibly without BSTS. The extra constellation size needed (because of inefficiencies in selecting targets autonomously compared to central battle management) is likely to be less costly than the central battle manager, and, of course, avoids reliance on a small number of high-value or essential components which are hard to defend.*[29]

Regarding countermeasures, the JASONs noted the difficulty of developing effective devices and suggested how SDIO should deal with this issue. In the words of the report:

> *Anyone can invent countermeasures, but answering the question of which ones really work must (in most cases) await detailed stud-*

25 Lt. Gen. George L. Monahan, Jr., to the Honorable John J. Welch, Jr., Assistant Secretary of Defense for Acquisition, Letter, 5 May 1989.

26 JASON (The MITRE Corporation), *JASON Review of Brilliant Pebbles*, Vol. I, *Executive Summary*, September 1989 (JSR-89-900), pp. 2-3; [Strategic Defense Initiative Organization], "Strategic Defense System Space-Based Architecture Fact Paper," 9 February 1990. Dr. O'Dean Judd, BMDO's chief scientist, played a key role in setting up the JASON review. He had carefully analyzed the BP concept and was certain that it was sound. Having a prestigious body such as the JASONs reach the same findings would provide important validation for the BP concept. According to Judd, there was opposition in some quarters to having the JASONs complete the findings, since some believed that the JASONs would be biased against BP. (O'Dean Judd, "RE: Jason Statement," Email, 19 March 2001.

27 Donald R. Baucom, "Report of the JASONS," Meeting Notes, 23 August 1989.

28 JASON (The MITRE Corporation), *JASON Review of Brilliant Pebbles*, Vol. I, *Executive Summary*, September 1989 (JSR-89-900), pp. 2-3; [Strategic Defense Initiative Organization], "Strategic Defense System Space-Based Architecture Fact Paper," 9 February 1990. Although the date on the front of the JASON report says September 1989, the Report Documentation Page that is part of the front matter of the report gives its dates as 3 October 1989. Since the JASONs had found no major flaws in the Brilliant Pebbles concept, it was important that they state this finding in the strongest possible terms. Otherwise, detractors of the SDI program would use the report to flog the program, even though the report itself was a highly favorable endorsement of BP. The expression "no-show stoppers" was meant to be a categorical endorsement of Brilliant Pebbles that could not be misconstrued by the press. (O'Dean Judd to Donald Baucom, Subject: "Several," Email, 19 March 2001, 10:45 a.m.; O'Dean Judd to Donald Baucom, Subject: "Jason Statement," Email, 19 March 2001, 6:45 p.m.)

29 JASON, *Review of Brilliant Pebbles*, p. 4.

ies and engineering development; those which are effective may be too costly; and there may be effective counter-countermeasures. Only a full red/blue team study with the best available people on both sides can really address these crucial issues, . . .

The JASONs then listed six types of countermeasures (four classified and two unclassified) that merited further study.[30]

Overlapping the JASON study was the second technical feasibility study, which was completed by the Defense Science Board (DSB), a federal advisory committee established to advise the secretary of defense on technical issues. In June 1989, the DSB was directed to establish a Brilliant Pebbles Task Force to review the BP concept. The task force met six times between June and September with the various other groups, including the JASONs, that were examining the BP concept and completed its report at the end of December 1989. Like the JASONs, the DSB concluded that BP faced some technical problems that would have to be overcome, but found no fundamental flaws with the concept. The DSB report noted that the design of BP had thus far has been examined by a number of competent and independent groups. While these examinations had pointed to several areas for possible improvement, no fundamental flaws had been uncovered.[31]

The third evaluation of Brilliant Pebbles was a Red-Blue interactive countermeasures exercise completed in two formal phases, the first in July and August of 1989 and the second in September and October of 1989. The general conclusion of this study was that Brilliant Pebbles would be subject to the same countermeasures faced by all space-based elements in the SDI architecture, but faced no special problems in this area. The study's major recommendation was that survivability features should be built into the BP system.[32]

The fourth study was a joint cost review that SDIO and the Air Force conducted between May and December 1989. Among other things, this review compared the costs of architectures based on the older SBI concept and the new Brilliant Pebbles concept. It concluded that the cost of the Phase I SDS architecture with Brilliant Pebbles would be $55 billion, as compared with the $69 billion cost for the Phase I system with SBI.[33]

As each of these four reviews was completed, its results were assimilated into the Space Based Architectural Study (SBAS), the fifth study called for in General Monaham's May 1989 strategy. Based on its own findings and input from the other four reports, the SBAS would "evaluate the space-based elements of the Phase I Strategic Defense (SDS) architecture and determine whether the Brilliant Pebbles concept should become a part of the architecture." SBAS findings would then become the basis for Monahan's recommendations to the DAB regarding the structure of the space-based component of the SDS architecture. Monahan expected a final DAB decision by Thanksgiving 1989.[34]

The SBAS team proceeded by comparing Brilliant Pebbles with two other interceptor concepts. The team found that all three concepts were comparable when analyzed against the expected missile threat; however, based on the advantage to the

30 JASON, *Review of Brilliant Pebbles*, pp. 10-12.

31 Defense Science Board, *Report of the Defense Science Board on SDIO Brilliant Pebbles Space Based Interceptor Concept*, December 1989, pp. 1-2; [Strategic Defense Initiative Organization], "Strategic Defense System Space-Based Architecture Fact Paper," 9 February 1990. [p. 3]. Task force chairman, Robert R. Everett, submitted this report to the Secretary of Defense and the Deputy Secretary of Defense on 29 December 1989. (Robert R. Everett, Memorandum for Secretary of Defense and Deputy Secretary of Defense, Subject: "Final Report of the Defense Science Board on Brilliant Pebbles," 29 December 1989.) The report was marked for official use only and carried a notice inside its front cover that distribution of the report was restricted to U.S. government agencies by direction of the Secretary of Defense. This notice carried the date of 3 March 1990. Terms of reference for this DSB study had called for the BP Task Force to review and evaluate four items relative to BP and report its findings in briefing format by September 1989. The four items were: the advantages of BP compared to SBI, the soundness of the required technology, the risks and costs in developing the BP demonstration-validation design, and the validity of the demonstration-validation flight experiment program. See Donald J. Atwood, Memorandum for the Chairman, Defense Science Board, Subject: "Terms of Reference--Defense Science Board Task Force on Brilliant Pebbles," 28 August 1989.

32 BDM Corporation, *Architecture Blue Team Analysis*, Volume II, *Brilliant Pebbles*, Scientific and Technical Report (CDRL Item #A318) for Task Order No. 48 SDS, Prepared for the Strategic Defense Initiative Organization, 20 November 1989, pp. iii, I-1, I-3; System Planning Corporation, *Red/Blue Analysis of Post-Boost Vehicle Operations Countermeasure against Brilliant Pebbles*, Volume I, *Analysis*, SPC Final Report 1335, November 1990, p.1; [Strategic Defense Initiative Organization], "Strategic Defense System Space-Based Architecture Fact Paper," 9 February 1990. The System Planning Corporation report indicates that in addition to the two formal parts of this Red-Blue exercise, a "quick look at BP occurred in May 1989." This exercise showed that countermeasures could be effective and needed to be addressed in more detail. For this reason, the exercise team had recommended another round of exercises. (BDM Corporation, *Architecture Blue Team Analysis*, pp. I-13 - I-14.) Both the documents cited here are held by the BMDO Information Resource Center.

33 [Strategic Defense Initiative Organization], "Strategic Defense System Space-Based Architecture Fact Paper," 9 February 1990.

34 Strategic Defense Initiative Organization, "Strategic Defense System Space Based Architecture Study Report," Executive Summary, [25 October 1989], p. 1. The report is undated. However, Appendix A, Final Study Briefing, is dated 25 October 1989; Patricia A. Gilmartin, "Defense Dept. Postpones Decision on Brilliant Pebbles until November," *Aviation Week*, 14 August 1989, p. 23.

defense of proliferating its space-based interceptors, the team concluded that developmental work should be continued on only two of the three systems: Brilliant Pebbles and the "Gunrack" version of the original SBI.[35]

In addition to comparing interceptor concepts, the SBAS team decided to review SDS Phase I sensing requirements taking into consideration the increased sensing capabilities of new interceptors. Based on this review, the team concluded that the interceptors could engage warheads and post-boost vehicles without support from the Space-based Surveillance and Tracking System, but that some SSTS satellites would be required for surveillance purposes. As a result, the number of SSTS satellites required in an architecture that included proliferated space-based interceptors was only one-third the number approved by the DAB in October 1988. Where the Boost Surveillance and Tracking System was concerned, the study recommended that it remain a part of the Phase I architecture. While autonomous interceptors would ease the requirements levied on BSTS, neither the sensors of Brilliant Pebbles nor those associated with the Gunrack system could provide all the data made available by the BSTS. Finally, the SBAS determined that the number of Ground-based Surveillance and Tracking Systems in the architecture would have to increase by six to offset the loss of other capabilities.[36]

In addition to its analyses of the space-based components, the SBAS also compared the costs of four possible architectures: that reviewed by the DAB in October 1988 and one based on each of the three interceptors considered in the study. These cost estimates indicated that an architecture using either the Gunrack or Brilliant Pebbles would reduce the $69.1 billion cost of the October 1988 architecture by $7 to $13 billion. The architecture recommended by the SBAS had the following characteristics (all statements about increases or decreases in numbers of a component are relative to the October 1988 architecture):

- BSTS remained unchanged.
- SSTS reduced by two-thirds.
- Replace the earlier SBI with either the Gunrack or Brilliant Pebbles. (Development of both systems should be continued for at least awhile.)
- Several additional GSTSs would be required.
- The Ground-Based Radar and Ground-Based Interceptor would not be changed.
- The ground communications system for the command center element would have to be enhanced.[37]

35 SDIO, "Space Based Architecture Study," Executive Summary, pp. 1-10.

36 IBID, pp. 10-20.

37 IBID, pp. 21-25.

In the fall of 1989, with the results of the various studies of Brilliant Pebbles becoming known, it was apparent to Monahan that he would soon have to secure DAB approval for significant changes to the established SDS architecture. On 20 September 1989, as the Space-Based Architecture Study was nearing completion, General Monahan advised John Betti, under secretary of defense for acquisition, that he would be prepared to present the study's recommendation on the architecture to the Defense Acquisition Board during a review that was scheduled for 12 December 1989.[38]

About two weeks later, Betti agreed to this review, but set the date for 11 December. At the same time, he advised Monahan to be prepared for another DAB review in the spring of 1990, at which time SDIO would be expected to present "the Baseline for the Phase I Strategic Defense System."[39] This meant that SDIO would have only a few months to work out the details of a new architecture that would include Brilliant Pebbles.

DOD canceled the December DAB review, leaving Monahan in a difficult position. The new Brilliant Pebbles program had reached the point where it was necessary to initiate contract arrangements to start the development process. Yet, without some form of approval from DOD, Monahan could not proceed. This crisis was resolved when Dr. George Schneiter, head of the Strategic Systems Committee in Betti's office, authorized Monahan to proceed with the "next steps" in the BP acquisition strategy.[40] Over the next few months, Monahan would be largely on his

38 George L. Monahan, Memorandum for Under Secretary of Defense (Acquisition), Thru: Chairman, Strategic Systems Committee, Subject: "Review of the Space Segment of the Phase I Strategic Defense System (SDS)," 20 September 1989.

39 John Betti, Memorandum for Director, Strategic Defense Initiative Organization, Subject: "Defense Acquisition Board (DAB) Review of the Strategic Defense Initiative (SDI) Program," 3 October 1989. The DAB that was to be held in the spring of 1990 was originally scheduled for the fall of 1989.

40 George R. Schneiter, Memorandum for the Under Secretary of Defense for Acquisition, Subject: "Strategic Defense Initiative (SDI) Program Review," 16 January 1990; George R. Schneiter, Memorandum for the Under Secretary of Defense for Acquisition, Subject: "Strategic Defense Initiative (SDI) DAB Review," 6 February 1990. In this second memo, Schneiter wrote: "In a previous memorandum, I discussed some outstanding SDI acquisition issues. Following your direction to deal with what I could at my level, I informed the SDI Organization they should take the next steps in their recommended Brilliant Pebbles acquisition approach." Additionally, on 16 January 1990, General Monahan discussed the SDI program with Secretary of Defense Richard Cheney, who had advised Monahan that he expected the General to proceed with the program. Monahan interpreted these instructions as meaning that a DAB was not required for approval of his acquisition strategy for Brilliant Pebbles. Furthermore, the General laid out his plan for releasing the BP concept study RFP in the *Commerce Daily Bulletin*.

own to manage the acquisition of Brilliant Pebbles. During this period, the BP concept was gaining momentum.

On 7 February 1990, General Monahan accompanied President George Bush to Lawrence Livermore National Laboratory (LLNL) where Lowell Wood briefed the President. It was also during this visit that Bush himself gave LLNL and the BP program a boost, lauding America's national laboratories for "developing technologies to strengthen deterrence through strategic defenses." Among the most promising of these new technologies, said the President said, was Brilliant Pebbles.[41]

About a month after Bush's trip to Livermore, Henry Cooper's independent review of 15 March 1990 provided another endorsement of Brilliant Pebbles. Cooper said that the new concept promised to provide an affordable, cost-effective, and survivable space-based interceptor. Moreover, "no technological roadblocks to the Brilliant Pebbles system concept have been identified."[42]

Brilliant Pebbles and the Advent of GPALS

In addition to its affirmation of Brilliant Pebbles, the Cooper report laid out a new vision for missile defenses in the post-Cold War era. This vision flowed from Cooper's assessment of the strategic order that was emerging from a growing restiveness in the Soviet Union and from the proliferation of ballistic missile technology. There were two major implications of the new strategic realities. First, there would be an increased likelihood of accidental and limited missile attacks against the United States. Second, theater missile attacks against U.S. interests around the globe, including deployed U.S. forces, would be far more likely. Therefore, the U.S. missile defense program should begin to focus on providing protection against limited missile strikes (PALS), including those that might be made against deployed U.S. forces.[43]

To meet the requirements of the new strategic order, Cooper envisioned an architecture with three main components. The first element, a space-based system, would be central to any effective PALS system, since it would provide an overarching defense layer that would contribute to both theater defense and defense of the U.S. homeland. [44]

The space-based element of PALS was to be underpinned and complemented by the two other components in Cooper's PALS architecture. In the United States a ground-based interceptor system composed of several sites would combine with the space-based (global) element to provide a layered national

41 George L. Monahan, Jr., Interview with Donald R. Baucom, the Pentagon, Washington, D.C., 29 March 1990, p. 17; President George H. W. Bush, "Remarks by the President to National Employees of Lawrence Livermore Laboratory," Lawrence Livermore Laboratory, San Francisco, California, 7 February 1990. Bush presented a general rationale for the pursuit of missile defenses, telling his Livermore audience:

> *Together with strategic modernization and arms control, programs like SDI--the Strategic Defense Initiative--and one of its most promising concepts, Brilliant Pebbles, complement our ability to preserve the peace into the 1990s and beyond.*
>
> *If the technology I've seen today proves feasible--and I'm told it looks very promising--no war planner could be confident of the consequences of a ballistic missile attack. The technologies you are now researching, developing and testing will strengthen deterrence.*
>
> *Even as we work to reduce arsenals and reduce tensions, we understand the continuing, crucial role of strategic defenses. Beyond their contributions to deterrence, they underlie effective arms control by diminishing the advantages of cheating. They can also defend us against accidental launches--or attacks from the many other countries that, regrettably, are acquiring ballistic missile capabilities. In the 1990s, strategic defense makes much more sense that ever before, in my view.*
>
> *So a vigorous research, development and testing program at our national labs will be as crucial as ever, as we adapt both the size and shape of our nuclear deterrent. We're working on a significant reductions in arms--I think that's what the world wants. I believe in it strongly. But to protect the American people, we will settle for nothing less than the highest confidence in survivability, effectiveness and safety of our remaining forces.*

Bush's praise of BP was reported in the *Dallas Morning News* (Carl P. Leubsdorf, "Bush Declares Strong Support for 'Star Wars' Program," *Dallas Morning News*, 8 February 1990, p. 6A, reprinted Office of Assistant Secretary of Defense for Public Affairs, *Current News: Special Edition*, "Strategic Defense Initiative," p. 20. An editorial in the *Washington Times* also commented on the President's Livermore speech although it mentioned only SDI and not BP. This editorial referred to Livermore as the "brainstem of the Strategic Defense Initiative." ("The President at Livermore," *Washington Times*, 8 February 1990, p. F2.)

42 Henry F. Cooper, *SDI Independent Review*, 15 March 1990 (hereafter Cooper, *Independent Review*), Executive Summary, p. 2. Cooper would later claim that Edward Teller introduced him to the BP concept in 1988. "My subsequent all-day visit to Lawrence Livermore National Laboratory," Cooper wrote, "persuaded me of the potential of the hardware under development." See Henry F. Cooper, "Why Not Space-Based Missile Defense?" *Wall Street Journal*, 7 May 2001. Cooper claimed that 1000 BPs were expected to cost $11 billion in 1991 dollars. "This included all the costs of building and launching the Pebbles, operating them for 20 years, and replacing each Pebble once over the two decades. If fully funded, and without the constraining ABM Treaty, I believe the first-generation Pebbles could have begun operating as early as 1996." For details on the charter for Cooper's study, see Dick Cheney, Memorandum for Secretaries of the Military Departments, et. al., Subject: "Independent Review of the Strategic Defense Initiative Program," 22 December 1989; Larry Burger, Memorandum for the Under Secretary of Defense (Acquisition), Subject: "Terms of Reference (TOR) for the Process Action Team on SDI," 10 July 1990. Burger was an official in DDR&D[S&TNF].

43 Henry F. Cooper, *SDI Independent Review*, 15 March 1990, pp. 4, 25-29. For Cooper's views on trends toward the increasing threat of limited missile attacks see pp. 1, 55-79.

44 Cooper, *SDI Independent Review*, p.26-29.

missile defense system with a high kill probability against a limited attack. Overseas, "local, regional, or terminal defenses would be required" to complement the global element and to ensure protection against shorter-range missiles.[45]

Cooper made several specific recommendations relative to Brilliant Pebbles. In addition to endorsing the existing baseline program, which called for BP to operate only during the boost and post-boost phases, Cooper believed that the Pentagon should consider expanding the BP mission to include operations against re-entry vehicles during the mid-course phase of their flight and in the high endoatmospheric portion of the terminal phase of their flight. Such an expansion would substantially increase the effectiveness of missile defenses, provide a hedge against countermeasures, and enhance the value of BP to a PALS system. On the other hand, the mid-course intercept mission would bring with it the nettlesome challenge of mid-course discrimination, the resolution of which might require the deployment of additional sensors such as Brilliant Eyes, an improved infrared sensor system composed of several hundred small, low-altitude satellites.[46]

In support of his proposal to expand the BP mission to include mid-course interception, Cooper called for the completion of the studies necessary to support an informed decision on his proposal. Top Pentagon leaders, including General Monahan, concurred with the study requirement. As a result, General Monahan chartered the Mid and Terminal Tiers Review (MATTR) in the Spring of 1990. [47]

However, before this study was completed, a number of major developments occurred in the SDI program. For one thing, General Monahan retired at the end of June and was succeeded in July 1990 by Ambassador Cooper. About a month after Cooper assumed his duties, SDIO conducted the first BP flight test.

In this test, which occurred on 25 August, a payload consisting of a suite of sensors, a processor, and an attitude control system was be lofted to an altitude of 124 miles by a rail-guided, three-stage Black Brant X (BBX) launched from Wallops Island, Virginia. Once outside the atmosphere on the way up, the payload package was to separate from the booster. Then, the BP sensor would acquire and track the thrusting Nihka motor of the BBX third stage, demonstrating its ability to accomplish these tasks against an operational missile. Additionally, the star tracker was to take various images that the computer would use to generate commands for the attitude control system, which would control the flight of the instrument package.[48]

In the event, one of the explosive separation bolts that held the test vehicle's fairing in place fired prematurely, leaving the

45 Cooper, SDI Independent Review, pp. 26-29.

46 Cooper, Independent Review, pp. 16, 20-23, 50-51, 92-95. See also pp. 26-28 where Cooper discusses the fact that BP was not designed to find cool targets in dark space. Cooper stated that "the critical problem of midcourse discrimination must be addressed by any midcourse system--and this is a very difficult problem." He discussed the challenges of mid-course discrimination on pp. 20-23. Dr. Charles Infosino advised the BMDO Historian that Dr. Lowell Wood had carefully restricted the operations of his BP system to the early phases of an ICBM's flight where the BP could easily find its target and avoid the problem of mid-course discrimination. Apparently, in response to this expansion of the BP mission, Livermore developed a concept called Genius Sand, in which BP interceptors would themselves be fitted with tiny interceptors that could be used against RVs and decoys in the midcourse battle. A recent document from LLNL described the concept as follows:

> T*he Advanced Interceptor Technology (AIT) Program at LLNL has been pursuing research and development of advanced lightweight, miniature kinetic kill vehicles for more than a decade. During the Brilliant Pebbles (BP) program, LLNL developed a concept for a $\leq$ 1 kg mini-KV that we named Genius Sand (GS) to indicate the high levels of miniaturization that these vehicles required. This concept was proposed in order to extend the effectiveness of the Boost Phase Brilliant Pebble system in the decoy-rich, multi-warhead environment of the midcourse battle space. This concept called for the Brilliant Pebbles space based interceptor to carry approximately a dozen Genius Sand vehicles that could be deployed in midcourse engagements against RVs and other countermeasures.*

Advanced Interceptor Technology Program, Lawrence Livermore National Laboratory, National Nuclear Security Administration, "Genius Sand: A Miniature Kinetic Vehicle Technology Demonstration for Midcourse Counter-Countermeasures and Submunition Kills," Prepared for the Ballistic Missile Defense Organization and the U.S. Army Space and missile Defense Command Space and Missile Defense Technical Center, 5 November 2001, p. 5.

47 [Secretary of Defense], Memorandum for the Secretaries of the Military Departments, et. al., Subject: "Implementation of the Results of the Independent Review of the SDI Program," n.d., with attachment. This unsigned, undated memorandum is bound inside the front cover of Cooper, *Independent Review*. Volume II of the MATTR report states that the MATTR study was initiated by General Monahan in the spring of 1990 in response to the Cooper report. William Z. Lemnios, Ostap S. Kosovych, and Maile E. Smith, *Strategic Defense Initiative Mid and Terminal Tiers Review (MATTR): Final Report*, Vol. II, *MATTR Overview*, 1 March 1991, p. 1-1.

48 [Strategic Defense Initiative Organization], Memorandum for Correspondence, "SDIO Brilliant Pebbles Experimental Flight," 27 August 1990. Details on the Black Brant X launch vehicle may be found in Patrick E. Fitzgerald, *Special Projects Flight Experiment, Flights 1 and 2: Program Introduction/Requirements Document*, April 1990, pp. 5-6. Fitzgerald was an employee of Ball Aerospace; he prepared the introduction/requirements document for SDIO. The 27 August memorandum details the rockets involved in the Black Brant booster stack. These were the MK-70 Terrier built by Hercules, the Black Brant V built by Bristol Aerospace, and the Nihka also built by Bristol.

fairing attached to the rocket by a single bolt. As a result, the fairing was bent and separated improperly, pulling out the telemetry package and causing a loss of test telemetry only eighty-one seconds into the flight. Because of the loss of telemetry, only tangential benefits were realized from the test. Among these was the first successful observation of a rocket by SDIO's ultraviolet plume instrument (UVPI) that was carried aboard SDIO's Low-Power Atmospheric Compensation Experiment (LACE) spacecraft orbiting overhead. The UVPI automatically acquired and tracked the burning of the Nihka motor. At the end of the flight, the components of the experiment splashed down in the Atlantic Ocean as planned.[49]

While no telemetry was received during the first test, it was apparent that the cause of the failure was outside the BP test package. Therefore, SDIO did not need to modify the BP test package. This knowledge, combined with the fact that the objectives of the second test were similar to those of the first, meant that there was no need to repeat the first experiment, since "'the objectives of experiment one could be achieved on a successful flight test two.'" The second test would have to be delayed somewhat to allow time to correct the faulty mechanism that had caused the BBX to shed its protective shroud improperly.[50]

A little over three weeks before the BP test, Iraq had invaded Kuwait, setting in motion a sequence of events that would have important implications for the SDI program. The Iraqi aggression prompted President Bush to mobilize a coalition to drive Saddam Hussein out of Kuwait. Over the next five and a half months, the United States deployed a major force to the Middle East under operation Desert Shield.

As the United States was deploying its forces to the Middle East, Henry Cooper was garnering support for his PALS concept. A key date in this process was 3 January 1991, two weeks before the Gulf War began, when President Bush received his first full-blown briefing on the new SDI program, now known as GPALS for Global Protection Against Limited Strikes. The presentation took place in the Situation Room in the basement of the White House and was attended by key officials in the Bush government.[51]

Bush decided to adopt the GPALS concept, but his decision was problematical. SDI had never been popular with the Democratically-controlled Congress, which had cut SDI deeply the two previous years and, in FY 1991, placed "sharp restrictions" on space-based elements, which threatened to violate the ABM Treaty. Yet, if GPALS were to have a truly global capability, it would have to include the space-based Brilliant Pebbles. In the words of a "Pentagon official":

> *"To have global protection, you've got to have space-based weapons, . . . They're always in position. If Saddam had a 4,500-kilometer weapon, he couldn't reach the U.S., but he could hit most of Western Europe. Where would you put your ground-based interceptors? You'd have to have them everywhere. The beauty of space-based interceptors is they protect many targets at once. The equivalent protection cannot be done from the ground. Besides, you're better off environmentally and politically have the stuff in space. In space, nobody sees the things."*[52]

Circumstances would soon change, offering President Bush a window of opportunity for advancing the new SDI architecture.

Tensions in the Middle East had been growing since the beginning of the massive U.S. buildup. The Iraqis were known to possess a considerable number of Scud variant missiles and had used these missiles lavishly in their earlier war with Iran. As a result, there was considerable concern that forces of the American-led coalition would come under missile attack during the Desert Shield build-up. The tension of Desert Shield gave way to the violence of Desert Storm in the pre-dawn darkness of 17 January 1991 when the coalition's air forces were unleashed on Iraqi targets. The six weeks of warfare that followed produced a major military milestone: the first operational engagement between defensive and offensive missiles. The clash between Patriots and Scuds prompted a reporter for the *Los Angeles Times* to declare that the "age of 'Star Wars'" had begun.[53]

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49 "Bad Bolt Deemed Pebble Problem," *Space News*, 19-25 November 1990; "SDIO Brilliant Pebbles Experimental Flight," 27 August 1990; Colonel Rowland "Rhip" Worrell, "SDI 'Brilliant Pebbles' Test Flight," Defense Department Briefing, 18 April 1991. Worrell stated that the flight duration at the time of telemetry loss was seventy-one seconds.

50 "SDI Testing: Brilliant Pebbles Will Push on to Second Test," *SDI Monitor*, 26 October 1990, p. 242.

51 Fred Barnes, "White House Watch: Brilliant Pebbles," *The New Republic*, 1 April 1991, p. 10.

52 Quoted in Fred Barnes, "White House Watch," p. 11. Barnes presented several reasons why GPALS was unlikely to be accepted in early January 1991. Among these were the departure of President Reagan, SDI's leading advocate; the refusal of Congress to grant Reagan's request that Abrahamson be promoted to four-star general and Abrahamson's being "forced to retire;" Monahan's leadership of the program--he managed the program without championing it; and the distraction of Cheney by his advocacy of the B-2 bomber and of Bush with Soviet relations and German re-unification. (Barnes, p. 10)

53 For information on the start of Desert Storm, see Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey: Summary Report* (Washington, D.C.: U.S. Government Printing Office, 1993), pp. 11-12. For the quotation on the beginning of the Star Wars era, see Melissa Healy, "High-Tech Missile Hits Bull's-Eye," *Los Angeles Times*, 22 January 1991, p. 1. Healy made this comment in response to what was considered at the time to be the first Scud-Patriot battle of the war on 18 January. The actual effectiveness of the Patriot was a much debated topic after the war, and there was some question as to whether the Patriots fired on 18 January were really reacting to a Scud attack or merely a false radar indication. Nevertheless, the Patriot seems to have played a crucial strategic role in keeping the fragile Gulf War coalition viable. This point was made by William Safire, in his Op-Ed piece: "The Great Scud-Patriot Mystery," *New York*

As the war progressed, Americans were confronted nightly with television images of civilians and soldiers running for cover as Scuds streaked toward their targets and Patriot missiles rose from their launchers to meet them. Two leading senators, Sam Nunn (D-GA) and John Warner (R-VA), actually experienced a Scud raid while visiting Israel. It was not surprising, then, that the combined houses of Congress applauded President Bush on 29 January 1991 when he announced in his State of the Union Address that the focus of SDI was shifting to the GPALS architecture. "I have," the President said, "directed that the SDI program be refocused on providing protection from limited ballistic missile strikes--whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas, and to our friends and allies."[54]

A few weeks after Bush's State of the Union Address, the MATTR team completed the study that Monahan had initiated in the Spring of 1990. This study addressed "the ability of the Phase I Strategic Defense System to engage reentry vehicles in their midcourse and terminal phases of flight, with a view toward simplification, cost reduction, and increased effectiveness." It evaluated three versions of the BP concept: the baseline system that operated only during the boost and post-boost phases of an ICBM's flight, Brilliant Pebbles-Midcourse, and Brilliant Pebbles-Terminal. Based on this evaluation, the study recommended including "Brilliant Pebbles (augmented with midcourse intercept capabilities)" in the SDI architecture, which should also include Brilliant Eyes, the Exo/Endo Interceptor (E^2I), a terminal radar to support E^2I, and the Command Center Element to tie the elements together. The study also recommended including GSTS and GBI in the architecture to increase its robustness, but noted that these had a lower priority than the other elements. This architecture, the report concluded, provided for interception in the boost/post-boost, midcourse, and terminal phases of a missile's flight and would force

> *the offensive force planner into complex decisions for off-loading RVs in favor of penetration aids. The presence of a midcourse and terminal phase of defense will force the Soviets into a situation where either there will be fewer midcourse decoys than before, or one in which there will be no terminal decoys if the Soviets elect to concentrate on the midcourse phase. In any event, the two layers of defense should result in a more robust ground-based defense.*[55]

As fully articulated in SDIO's May 1991 report to Congress, the new GPALS architecture would include four major components: a ground-based national missile defense system to protect the United States, a ground- and sea-based system to defend deployed U.S. forces and the forces and peoples of American allies, a space-based system (Brilliant Pebbles) that could protect any point on the globe against a limited missile attack, and a battle management/command and control system that integrated the other three components into a coherent, synergistic system. Of the three defensive components, Brilliant Pebbles was the most important, since it "would provide global detection of an attack" and was to be capable of destroying both strategic and theater ballistic missiles, provided the latter traveled a distance that exceeded six hundred kilometers. A later fact sheet would put the case for BP as follows:

> *The role of Brilliant Pebbles is vital to the GPALS mission. BP will provide global protection against ballistic missiles. While on orbit, a BP will be able to detect a hostile missile launch, decide whether or not to engage the target, and destroy the target by colliding with it. Once given intercept authority from man-in-the-loop, BP will do all of this autonomously and will communicate with other BPs to coordinate which Pebble will engage which target.*
>
> *The Brilliant Pebbles program represents more than an alternate design for a space-based interceptor. First, BP is a different architectural concept for the space-based segment and incorporates distributed operations, autonomy, and reduced dependence on other system operations.*[56]

This was the state of the GPALS architecture as members of Congress began their deliberations on the authorization and appropriation bills for fiscal year 1992. As they did, images of Gulf War missile attacks were still fresh in their minds. Their efforts produced the Missile Defense Act (MDA) of 1991 that became law in November 1991.

Times, 7 March 1991, p. 25, reprinted in Office of Assistant Secretary of Defense for Public Affairs, *Current News: Early Bird*, p. 3. Safire noted that in the case of the Patriot missile: "Psychology triumphed over technology. Why did the Scud, a terror weapon that delivered many of its warheads, fail to terrorize? The ironic reason: The Patriot, even if investigators find it failed in its military mission to kill warheads, averted Saudi panic and Israeli need for reprisal by providing a false sense of security."

54 George H. W. Bush, "State of the Union Address," 29 January 1991.

55 David R. Israel, William Z. Lemnios, Maile E. Smith, and Ostap S. Kosovych,, *Strategic Defense Initiative Mid and Terminal Tiers Review (MATTR): Final Report*, Vol. I, *Executive Summary*, 1 March 1991, pp. 1-1, 2-1, 3-1. See also Philip Finnegan, "SDIO Shifts Focus, Prepares for Cuts," *Space News*, 8-14 October 1990, pp. 1, 20.

56 Strategic Defense Initiative Organization, *1991 Report to the Congress on the Strategic Defense Initiative*, May 1991, pp. 2-2 - 2-9. See p. 2-5 for the quotation on Brilliant Pebbles. Figure 2-5 on p. 2-9 presents diagrammatically the central role of BP in the GPALS architecture. The fact sheets are Strategic Defense Initiative Organization, "Brilliant Pebbles and GPALD" and "The Brilliant Pebbles Program," Fact Sheet, [18 April 1991]. The titles given here represent two different fact sheets printed front and back on a single sheet of paper.

Congressional Strictures and the Demise of Brilliant Pebbles

Although widely acclaimed by missile defense advocates for setting specific deployment goals for both theater and national missile defense, the MDA of 1991 was in fact a compromise document that also included strong language requiring missile defense deployments to be compliant with the ABM Treaty. This agreement allowed the United States to deploy a single ABM system at Grand Forks, North Dakota, and restricted the number of interceptors at this one site to one hundred. But even here, the MDA introduces a degree of ambivalence for it opens with a statement in Section 232 that implies an expectation that the ABM Treaty would be altered to permit deployment of a fully effective missile defense system that would include multiple sites. Thus, we read:

> *It is the goal of the United States to . . . deploy an anti-ballistic missile defense system, including one or an adequate additional number of anti-ballistic missile sites and space-based sensors, that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles.*

However, in the following section, which specifies implementation measures, the MDA qualifies this goal by charging the secretary of defense with deploying

> *by the earliest date allowed by the availability of appropriate technology or by fiscal year 1996 a cost effective, operationally-effective, and ABM Treaty-compliant [italics added] anti-ballistic missile system at a single site as the initial step toward deployment of an anti-ballistic missile system . . . designed to protect the United States against limited ballistic missile threats, including accidental or unauthorized launches or Third World Attacks.*[57]

Further ambivalence is to be found in the law's specific instructions regarding Brilliant Pebbles. On the one hand, the act seemed to recognize that the BP interceptor was critical "to providing a highly effective" missile defenses, since Section 234 (a) called for "robust funding for research and development for promising follow-on anti-ballistic missile technologies, including Brilliant Pebbles." Yet, it expressly forbade the inclusion of BP in the initial plans for a limited national missile defense. In the words of the MDA: "EXCLUSION FROM INITIAL PLAN: Deployment of Brilliant Pebbles is not included in the initial plan for the limited defense system architecture described in section 232 (a)." Moreover, when Congress needed a hostage to ensure the Pentagon would submit a required report on "conceptual and burden sharing issues associated with the option of deploying space-based interceptors (including Brilliant Pebbles)," the hostage taken was Brilliant Pebbles. No more than fifty percent of MDA funding for BP could be spent until forty-five days after DOD submitted the report to Congress.[58]

Some degree of clarity comes in the MDA's specifications for the initial national missile defense architecture, for these were clearly drawn from the ABM Treaty. The architecture was to include only one hundred ground-based interceptors in accordance with treaty provisions. It was to have only "fixed, ground-based, anti-ballistic missile battle management radars." Finally, the architecture was to make optimum "utilization of space-based sensors, including sensors capable of cuing ground-based anti-ballistic missile interceptors and providing initial targeting vectors, and other sensor systems *that are also not prohibited by the ABM Treaty* [italics added], such as a ground-based sub-orbital surveillance and tracking system."[59]

Faced with this ambivalence, a fainthearted SDI program manager might have severely restricted the Brilliant Pebbles program. Henry Cooper was anything but fainthearted. And under his tutelage, SDIO continued to push BP because of its primal role in GPALS, thereby setting himself and his agency on a collision course with congressional Democrats, many of whom were committed to arms control and staunch opponents of SDI.[60] The critical collision came on 9 April 1992 when Ambassador Cooper testified before the Subcommittee on Strategic Forces of the Senate Armed Services Committee.

By this time, Sam Nunn, chairman of the Armed Serves Committee, was suspicious of the Brilliant Pebbles program. This suspicion manifested itself in a request from Nunn to the General Accounting Office for a review of the analysis that SDIO had done regarding the possible effectiveness of Brilliant Pebbles.[61]

The GAO started its report by describing the BP architecture that was to consist of several staggered rings of interceptors orbiting at an altitude of about 400 kilometers. The report then noted that SDIO's estimates of the capabilities of the Brilliant Pebbles concept were based on com-

57 U.S. Congress, House of Representatives, 102d Congress, 1st Session, *National Defense Authorization Act for Fiscal Years 1992 and 1993: Conference Report to Accompany H.R. 2100*, Report 102-311, 13 November 1991, p. 34. It was Part C of this act that carried the title: "Missile Defense Act of 1991." Hereafter, this document will be referred to as MDA of 1991.

58 MDA of 1991, p. 35.

59 MDA of 1991, pp. 34-35.

60 As a space-based weapon, BP was sure to run afoul of ABM Treaty supporters, since that treaty forbade mobile ABM systems, whether ground-, sea-, air-, or space-based. Additionally, there was the issue of weapons in space. Regarding this latter point, at the end of May 1993, General Charles Horner, Commander-in-Chief, U.S. Space Command, stated that "you have a problem with philosophical people who say they are against weapons in space. They are missing the boat, because the weapon in space is not the space-based interceptor. It's the warhead on the intercontinental ballistic missile." (Ben Iannotta, Interview with General Horner, *Space News*, 31 May-6 June 1993, p. 22.)

61 United States Government Accounting Office, *Strategic Defense Initiative: Estimates of Brilliant Pebbles' Effectiveness Are Based on Many Unproven Assumptions*, GAO Report NSIAD-92-91, March 1992, p. 2 (Hereafter, GAO/NSIAD-92-91).

puter simulations of forty different attack scenarios and that such simulations offered the only method of analysis available "at this early stage" in the program. The results of this analytical process were to be used to refine a BP design that would then be put through a five-year testing program to secure data that would then replace the assumptions and theories of the simulations.[62]

GAO granted that computer simulations were useful tools and that such simulations were the only means of investigating matters such as the performance of a future system. Still, developers must be careful to avoid the pitfall of mistaking data from simulations for information that was necessarily representative of reality.[63]

Included as an appendix to the GAO report was a letter from Henry Cooper in which he generally concurred with the GAO's findings. However, at the same time, Cooper noted that SDIO's use of simulations was within the bounds of sound engineering practice. In his words:

> *Brilliant Pebbles simulation activities are consistent with a program in the demonstration and validation phase. The "maturity" of Brilliant Pebbles simulations will change and be enhanced with improvements in the design of primary system hardware prototypes. It is crucial that the simulation efforts provide sufficiency to allow the program to proceed to the next milestone.*
>
> *The report indicates that simulations may rely on data that are incomplete and assumptions that may be inaccurate. That does not limit the simulation usefulness. [sic] The Strategic Defense Initiative Organization has relied on an arduous engineering assessment tempered by real-world experience to arrive at a working hypothesis. Assumptions are based upon a combination of the understanding of the system operation, operating characteristics, and engineering analysis. As more data becomes available, assumptions are modified as necessary. Additionally, the Strategic Defense Initiative Organization has relied upon the best available threat information, as found in the most current intelligence scenarios.*
>
> *It also should be noted that some of the assumptions reflect validated operational requirements. The acquisition process requires an evaluation of system capability to meet those requirements. The Strategic Defense Initiative Organization does not randomly choose parameters. Operational requirements are matched, to the greatest extend possible, to system performance assumptions. Furthermore, it should be recognized that system effectiveness also is a function of selected tactics and that the user, U.S. Space Command, is deeply involved in the development of operational employment, strategy, and tactics.*[64]

Nunn received this report within two weeks[65] of the 9 April hearings, and it may have contributed to the hostility toward Brilliant Pebbles that he exhibited during the hearings. Since his presence was required on the floor of the Senate where an important budget resolution was being considered, Nunn missed the opening of the hearings. When he entered the hearing room about 4:30 p.m., Nunn effectively took control of the proceedings, directing a staff aide to put up a series of large poster-board briefing charts as he proceeded to take Cooper step-by-step through the points he wanted to make.[66]

First, Nunn noted that the Missile Defense Act established for SDI the goal of fielding a treaty-compliant ABM system by 1996 while allowing for a delay if this goal proved technically unfeasible. Nunn indicated that he was willing to be flexible with regard to the date, but was upset by an assertion by SDIO to the effect that Congress had failed to provide the funding needed to meet the 1996 deadline. Nunn then accused SDIO of creating the shortfalls through its own funding allocations. Included in the SDIO allocations that Nunn challenged was excessive spending on space-based elements, including Brilliant Pebbles, that could not be ready in time for the specified deployment date of 1996.[67]

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62 GAO/NSIAD-92-91, pp. 3-4. Regarding the specific assumptions in the SDIO simulations, GAO included "assumptions about many key operational characteristics" such as the ability of the constellation to maintain continuous surveillance of the earth's surface, the length of time required for the BP interceptors to receive the enabling command that would allow them to attack approaching missiles, and the handling of target assignment to individual BP interceptors.

63 GAO/NSIAD-92-91, p. 11.

64 Henry F. Cooper, SDIO Director, to Frank C. Conahan, Assistant Comptroller General, Letter, 26 February 1992. For a more detailed critique of the GAO report, see R. H. Worrell, III, Memorandum for GAO, Subject: "Draft GAO Report on BP Effectiveness," 4 February 1992.

65 GAO Report NAISD-92-91 was dispatched to Nunn by Nancy R. Kingsbury to Sam Nunn, Letter, 27 March 1992, which is included in the front of the report itself.

66 Hearings of the Strategic Forces Subcommittee of the Senate Armed Services Committee, Subject: "FY 93 SDIO Budget Request," 9 April 1992, transcript prepared by contractor for SDIO, p. 28. The SDIO Historian, Dr. Donald R. Baucom, attended these hearings. The account of the hearings presented here reflects the influence of his recollections as captured in notes taken during the hearings.

67 Transcript of 9 April 1992 Hearings, pp. 28-31. There was an exchange at this point between Cooper and Nunn as to what treaty-compliant meant. From his perspective, Cooper said, treaty-compliant meant that the LDS could only be deployed at Grand Forks. Only if the ABM Treaty were amended could the system be deployed at other sites. Nunn said that legally, this provision meant the conditions specified by the ABM Treaty at the time the MDA of 1991 was passed. Cooper responded that what he meant was that if the ABM Treaty were amended to allow deployment at other sites, it might be better to deploy at three sites, one of which might not be Grand Forks. If that turned out to be the case, deploying at Grand Forks would waste about $2 billion. Under these circumstances, DOD would come back to Congress and ask for permission to change the deployment plans. Nunn then dropped the issue and moved on to

After Cooper defended his programmatic and funding decisions, Nunn accused him of continuing to push the GPALS architecture in the face of the MDA's requirement for the deployment of a limited national missile defense system at Grand Forks. Instead of pushing systems like the Ground-based Surveillance and Tracking System that would add to the effectiveness of the Grand Forks deployment, Cooper had chosen to allocate "$390 million for Brilliant Pebbles, even though Congress specifically excluded it from the Limited Defense System [LDS] architecture." Nunn ended this line of argument by essentially charging that Cooper had purposefully undermined the LDS deployment.

> *So, it is my assertion, Mr. Ambassador--which you can rebut--that what you've done by a combination of funding, and the reduction in GSTS, is, you made sure that Grand Forks would not be effective if we did it during this decade. Therefore, you made it almost impossible for it to happen during this decade. I don't know the motive for that, but that's what it looks like to me.* [68]

Cooper defended his program decisions by pointing out the problems associated with the GSTS program, which would add about $1 billion to the program if pushed at the level advocated by Nunn. He also stated a second time that in choosing the funding level for space-based and follow-on research and development that he had taken as his guide the funding levels voted by Congress when it passed the MDA: 11% of program funding for space-based interceptors and 14% for other follow-on technologies. Nunn then responded that regardless of Cooper's points, the prospect of a 1996 deployment date for the limited defense system was not supported by the current SDIO program. To this, Cooper replied that the 1996 date had never really been possible.[69]

All of this notwithstanding, Nunn continued to hammer home his basic point: SDIO was planning to spend $2.6 billion on Brilliant Pebbles, a development that could not possibly contribute to an LDS deployment for 1996, the priority established by the MDA. "It's clear Mr. Ambassador, just by the numbers, it's absolutely clear, that your priority is not--maybe it's the right priority but it's not the priority of Congress--your priority is not to meet an early deployment date on an ABM [Treaty]-compliant system." The fact that SDIO was in the process of spending $2.6 billion on the BP program made it was clear that Cooper's priority was "still Brilliant Pebbles." Therefore, Nunn continued, "it's very clear" that Congress will have to make "a more definitive statement" of its goals for the SDI program in this year's authorization law.[70]

The contention between Nunn and Cooper in the April exchange was caused by the ambivalence of the MDA of 1991, a compromise document cobbled together to mollify the differences between the proponents of missile defense and the advocates of arms control. The former favored an all out effort to field a missile defense with the most capable technology in the shortest possible time. The latter were determined to protect the ABM Treaty. The goal of fielding a system by 1996 played to advocates of missile; requiring the limited national defense system to be treaty-compliant satisfied arms control supporters.

In his exchange with Nunn, SDI program manager Cooper was trying to explain how he had taken congressional instructions and chosen from among the available technological options a mix of systems that would provide a limited defense capability at the earliest time. The program Cooper designed also provided for the incorporation over time of new and improved components that would enhance overall system performance. Not having wrestled with the performance trade decisions that Cooper had been forced to take, Nunn could not fully appreciate the difficulties posed by the 1996 deployment deadline. Part of Cooper's concern was, no doubt, to maintain the integrity of the BMC^3 system, the embodiment of the system architecture, which had to be designed from the outset to integrate not only near term systems, but follow-on systems as well. Without this kind of architectural planning, any system fielded was a technological cul-de-sac that would quickly lose its effectiveness in the face of offensive threats that would surely continue to evolve and improve.

Realizing the seriousness of the situation, Cooper moved immediately to cut $2 billion from the funding profile of the overall space-based interceptor program. These cuts included reductions that forced a slippage of thirty months in the Brilliant Pebbles program.[71]

At the same time, Nunn was moving ahead with plans to codify the views he had expressed in the 9 April 1992 Senate hearings. In doing so, he would be sounding the death knell for Brilliant Pebbles and the entire GPALS concept, for GPALS was radically dependent for its effectiveness upon Brilliant Pebbles, which provided an overarching, 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.

The themes that Nunn had expressed in his 9 April exchange with Cooper surfaced again in August during the Senate debate of the FY 1993 authorization act and suggest that Senate Democrats were intent on fixing what they saw as flaws in the Missile Defense Act of 1991. On 7 August 1992, Senator

his next point. (pp. 29-30)

68 Transcript of 9 April 1992 Hearings, pp. 32-35.

69 Transcript of 9 April 1992 Hearings, pp. 35-37.

70 Transcript of 9 April 1992 Hearings, pp. 38-39, 42.

71 "SDIO Scales Back Brilliant Pebbles, Brilliant Eyes in Near Term," *Defense Daily*, 7 May 1992, p. 216, reprinted in Office of Assistant Secretary of Defense for Public Affairs, *Current News: Special Edition*, 7 May 1992, pp. 11-12.

Nunn again expressed his reservations about the direction of the SDI program. SDIO had "continued to spend excessive amounts" on Brilliant Pebbles, said Nunn,

> *despite Congress' clear direction last year excluding it from the architecture for the multiple-site limited defense system. Since that eventual multi-site system will not likely be completed until the second half of the next decade--in other words, sometime after 2005--there is no need to develop Brilliant Pebbles for possible deployment any sooner.*
>
> *This action [being contemplated by the Senate] puts the Brilliant Pebbles funding profile on a downward slope, a course the committee believes is fully justified given the uncertainty over how and where this option might fit into the picture.*[72]

During the same debate, Senator Carl Levin (D-MI) asserted that the threat to the U.S. form a ballistic missile attack was not as serious as previously believed and faulted Congress for providing too much money for Brilliant Pebbles. In his words:

> *The Committee discovered this year that its intent had been disregarded. More money was being put into research of Brilliant Pebbles and taken away from limited defense systems even though early deployment of Brilliant Pebbles had been specifically excluded. After that experience, we should have learned that if we don't want Brilliant Pebbles to be a priority for deployment, we should stop allocating such high sums for research on Brilliant Pebbles.*
>
> *Space-based sensors are something we should be continuing research on but space-based interceptors like Brilliant Pebbles should be explored for a follow-up system, not funded as the crash course program.*[73]

In response to the comments of Nunn and Levin and other signals coming from Congress relative to the SDI program, Secretary of Defense Richard Cheney warned Nunn that congressional restrictions on SDI might prompt President Bush's top advisors to recommend a veto of the authorization bill. Cheney said that restrictions in both the House and Senate versions of the FY1993 Defense Authorization Bill would undermine the top national priority accorded missile defense in the Missile Defense Act of 1991. Indeed, the funding levels in these bills would

> *likely postpone until the next century our effort to protect the American people from a ballistic missile attack, severely curtail Brilliant Pebbles--contrary to the "robust funding" called for in the Missile Defense Act, and jeopardize our efforts to join Russia and our Allies in realizing a joint global protection system as agreed by President Bush and President Yeltsin. Unless the final bill sustains our ability to pursue global missile defense consistent with the Missile Defense Act, the President's senior advisors would recommend a veto.*[74]

Cheney's defense of Brilliant Pebbles was not helped by the failure of its third flight test on 22 October 1992. This was to be a non-intercept flight test during which a booster would carry into space both a target and a kill vehicle built by Lawrence Livermore National Laboratory. Once in space the two test vehicles were to separate, and the four-foot long target was to ignite its engine. After watching the engine ignite, the thirty kilogram BP vehicle would then accelerate to a speed of two kilometers per second and close to within ten meters of the target.[75]

Seventeen seconds after liftoff from Wallops Island, personnel on the ground noticed pieces falling off the booster. Fifty-five seconds into the flight, when it became obvious that the booster had experienced a major failure, range safety destroyed the rocket. Later analysis pointed toward a failed nozzle in the first stage of the ARIES I booster as the cause of the booster's failure.[76]

In the meantime, the views expressed by Nunn and Levin in their August floor speeches were being incorporated into the National Defense Authorization Act for FY 1993. Here, Congress modified the 1991 Missile Defense Act by making it clear that preserving the ABM Treaty was of paramount concern to Congress. In the 1991 version of the law, Section 232, paragraph (a) (1), stated:

> *(a) Missile Defense Goal.--It is a goal of the United States to--*
>
> *(1) deploy an anti-ballistic missile system, including one or an adequate number of anti-ballistic missile sites and space-based sensors, that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles.*[77]

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72 Senator Sam Nunn, Speaking in Debate on the FY 1993 DOD Authorization Act, *Congressional Record*, 7 August 1992, p. S11831.

73 Senator Carl Levin, Speaking in Debate on the FY 1993 DOD Authorization Act, *Congressional Record*, 7 August 1992, p. S11889. Ambassador Cooper would later claim that this debate "made abundantly clear congressional leaders were bent on destroying the Pebbles program, and not allowing its testing in Earth orbit." See Henry F. Cooper, "Why Not Space-Based Missile Defense?," *Wall Street Journal*, 7 May 2001, p. A22.

74 Dick Cheney to Sam Nunn, Letter, 9 September 1992.

75 "Nozzle at Fault in Failed Brilliant Pebbles Test," *Aerospace Daily*, 6 November 1992, pp. 206-207.

76 Strategic Defense Initiative Organization, Office of External Affairs, Memorandum for Correspondents, No. 298-M, 23 October 1992; "Brilliant Pebbles Flight Test Fails," *Aerospace Daily*, 26 October 1992, pp. 133-134; "SDIO Experiment Launch Vehicle Problems," Internal SDIO Document, [Approximate Date 1 November 1992]. The results of the Brilliant Pebbles test program are summarized in "Brilliant Pebbles Restructured to Demo Program," *SDI Monitor*, 15 January 1993, p. 21. According this article, the final two BP tests using LLNL hardware had been canceled by 15 January 1993. Apparently, these cancellations were part of what Colonel Rhip Worrell, BP program manager, meant when he said that LLNL's role in the program had been "throttled back significantly" when BP was latter transferred to the Air Force. Also involved in the cutback to the BP program was a slippage of twelve-to-eighteen months in the contractor test program and the possibility that "one or two of the planned intercept tests might be canceled."

77 U.S. Congress, House of Representatives, *National Defense*

The 1992 Authorization Act replaced this paragraph with the following:

> *(a) Missile Defense Goal.--It is a goal of the United States to--*
>
> *(1) comply with the ABM Treaty, including any protocol or amendment thereto, and not develop, test, or deploy any ballistic missile defense system, or component thereof, in violation of the treaty, as modified by any protocol or amendment thereto, while deploying an anti-ballistic missile system that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles.*[78]

The 1992 Act also significantly cut funding for space-based interceptor research and development, including funding for Brilliant Pebbles. The 1991 act had established the space-based interceptor element and defined it as follows:

> *The Space-Based Interceptors program element shall include programs, projects, and activities (and supporting programs, projects, and activities) that have as a primary objective the conduct of research on space-based kinetic-kill interceptors and associated sensors that could provide an overlay to ground-based anti-ballistic missile interceptors.*

For this program element, the 1991 Act provided $465 million and specified that not more than $300 million of this money could be spend on Brilliant Pebbles. The 1992 version of the act cut total funding for the space-based interceptor element to $300 million.[79]

Where the architecture was concerned, the limited defense system specified in the MDA of 1991 was retained in the 1992 bill. However, wording as to a sense of urgency with regard to deployment, specifically, the requirement to deploy by 1996 or as soon as was technically feasible, was removed. Additionally, the ground-based surveillance and tracking system was specifically mentioned as a sensor candidate in the limited national missile defense system. Moreover, in accordance with a point Nunn stressed in his April exchange with Cooper, the FY 1993 act directed SDIO "to plan the architecture for the initial, Treaty-compliant ABM site on the basis of the Treaty as now constituted and not as it may be revised." Furthermore, only after DOD determined that the use of upgraded early warning radars in an ABM system was treaty compliant could these radars be included in planning for the treaty-compliant site of the limited defense system.[80]

The 1992 authorization act also required SDIO to divest itself of "far-term follow-on technologies" that "could distract management and result in funding shortfalls" as SDIO came increasingly to focus on a "near-term deployment architecture." Far-term technology referred to "a technology that is not likely to be incorporated into a weapon system within 10 to 15 years after the date of enactment of this Act."[81] This requirement, combined with Nunn's view that Brilliant Pebbles would not be needed until after 2005, constitute another major step in the decline of BP, since these two points could form the basis of a rationale for transferring the program to another agency.[82]

By the beginning of 1993, Brilliant Pebbles had begun its death rattle. First, SDIO announced in early November 1992 that it would be forced to remove the funds-strapped BP program from the acquisition process. Then, SDIO transferred the program to the Air Force with an effective date of 18 December 1992 and let new contracts in January 1993 to convert the Brilliant Pebbles program into an "advanced technology demonstration."[83]

Brilliant Pebbles continued its decline under the new administration of President William J. Clinton. On 2 February 1993, Secretary of Defense Les Aspin issued his budget guidance for the SDI program; it reduced Brilliant Pebbles to a technology base program. Aspin's guidance was codified in Program Budget Decision (PBD) 756 of 3 March 1993, which detailed the changes that the Clinton administration was imposing on the Brilliant Pebbles program. The Secretary's final decision for FY 1994 reduced BP's $100 million total obligation authority to $75 million and moved BP into the follow-on tech-

Authorization Act for Fiscal Years 1992 and 1993: Conference Report to Accompany H.R. 2100, Report102-311, 13 November 1991, p. 34 (hereafter House Report 102-311).

78 U.S. Congress, House of Representatives, *National Defense Authorization Act for Fiscal Year 1993: Conference Report to Accompany H.R. 5006*, Report102-966, 1 October 1992, p. 44 (hereafter House Report 102-966).

79 House Report 102-311, p. 37; House Report 102-966, p. 43.

80 House Report 102-966, pp. 44-45; 643-644.

81 House Report 102-966, p. 45.

82 Henry F. Cooper, "A Summary of SDI Programs and Plans for Theater and National Ballistic Missile Defense," 4 January 1993, p. 12, noted that the Space-Based Interceptor program, which he noted was Brilliant Pebbles, "could, within 15 years, provide significant added performance capabilities." Cooper also stated in a footnote on this page that the "pace at which systems concepts can be fully developed and fielded" in the case of BP "is set by the available funding--not the state of technology. Present schedules could be considerably shortened, perhaps up to half, if technology limited development programs were funded."

83 "SDIO to Renegotiate Brilliant Pebbles Contract, Slow Program," *Aerospace Daily*, 5 November 1992, pp. 196-197; Rhip Worrell, "Brilliant Pebbles: A Technology Demonstration Program," Set of Briefing Slides, 3 December 1992, Slides 3, 7; Thomas A. Fitzgerald, Memorandum for Brilliant Pebbles Interface POCs, Subject: "Brilliant Pebbles Task Force Relocation," 16 December 1992. In his "Strategic Defense Initiative: General Manager's Report," January 1993, Briefing, Dr. James Carlson stated that the Air Force and SDIO had signed the transfer memorandum of agreement on 15 December 1992. Slide 3 of the Worrell briefing states that Cooper directed the restructuring of the BP program in November 1992. Slide 7 states that Cooper had directed that the BP program was to be realigned to comply with congressional intent, including the transfer of "far term follow-on technologies to services."

nology category.[84] With this shift in status and funding, the Brilliant Pebbles program was renamed the Advanced Interceptor Technology (AIT) Program in March 1993.[85]

The AIT program limped along until 1 December 1993 when Dr. James D. Carlson, acting deputy director for the Ballistic Missile Defense Organization (BMDO),[86] issued a stop work order ending the program. Carlson explained the reasons for the decision as follows:

> *Reductions in the Ballistic Missile Defense Organization (BMDO) Research and Support Activities program mandate radically reduced funding in FY1994 for the Advanced Intercept [sic] Technology program. Furthermore, our implementation of Bottom Up Review decisions and fiscal constraints for the Ballistic Missile Defense FY1995-99 program can provide for only a single exoatmospheric kinetic kill vehicle integrated technology program and cannot support a separate space-based interceptor effort.*
>
> *Therefore, you are directed to immediately stop all work on the Advanced Intercept [sic] Technology program funded under PMA F1214. All further technical effort must immediately cease. The Air Force must absolutely minimize termination costs in bringing these efforts to a close.*

Carlson found it regrettable that the program had to be terminated "given past investments and program progress." However, under the circumstances, termination was unavoidable.[87]

Epilogue: *Clementine* and the Ghost of *Brilliant Pebbles*

> *But Clementine's very triumph worked against it in ways that shed light on the politics underlying the space program. The spacecraft's supporters in the Pentagon believe that the Clinton administration dislikes Clementine because it represents the ghost of Star Wars, which was President Reagan's pet program, and therefore prefers a program to rival it.[88]*

By the end of 1991, the budget cuts that were strangling the Brilliant Pebbles program had aroused concern that the capabilities of space-based technologies developed in the SDI program would never be demonstrated. As a result, in January 1992, Lieutenant Colonel Pedro L. Rustan and a number of his SDIO colleagues gathered in the office of SDIO Director Henry Cooper and formulated the concept for a space probe mission based on the technologies being developed for Brilliant Pebbles.[89] This was the genesis of Clementine,[90] a joint under-

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84 Les Aspin, Memorandum for Director, Strategic Defense Initiative Organization, Subject: "FY 1994 Budget Adjustments," 2 February 1993; Program Budget Decision Number 756, Subject: "SDI Programs," 3 March 1993.

85 Department of Defense, Office of the Inspector General, "Brilliant Pebbles Program," Audit Report Number 94-084, 14 April 1994, p.1; Keith Englander, "Strategic Defense Initiative: Advanced Interceptor Technology Program," Briefing, 31 March 1993.

86 On 13 May 1993, Secretary of Defense Les Aspin announced that DOD was changing the name of the SDI Organization to Ballistic Missile Defense Organization.

87 James D. Carlson, Memorandum for Air Force Program Executive Officer for Space, Subject: "Advanced Intercept Technology (AIT) Program Stop Work Order," 1 December 1993. Project 1214 is listed in Ballistic Missile Defense Organization, *1994 Report to the Congress on Ballistic Missile Defense*, July 1994, p. A7, as the "Advanced Interceptor Technology (AIT) Program." The entry under this project number states: "This effort encompassed demonstrating key space interceptor and satellite technologies, based on system requirements and designs, and performing risk reduction. The Brilliant Pebbles (BP) program developed the primary technology in the AIT program. This project is to be discontinued after FY 1994." The funding profile for this project included only $15,000 in FY 1994, presumably for contract termination costs.

88 William E. Burrows, "The New Millennium," *Air and Space Magazine*, August-September 1996.

89 This account of the origins of the Clementine program merges accounts given by Ambassador Cooper and Pete Rustan. Henry F. Cooper, "Why Not Space-Based Missile Defense?," Wall Street Journal, 7 May 2001, p. A22, states that Clementine was formulated in his office "immediately after a Senate floor debate in 1992 made abundantly clear congressional leaders were bent on destroying the Pebbles program, and not allowing its testing in Earth orbit." Colonel Pedro L. Rustan, who as a lieutenant colonel ran the Clementine program, gives two versions of the origins of Clementine. In one, he fixes the origins in a September 1990 letter from the NASA administrator to the under secretary of defense for acquisition (Atwood) asking about the use of DOD technologies in NASA's space exploration program. This spawned a six-month study that suggested a candidate mission that would entail a fly-by of the near-earth asteroid Geographos. Rustan then noted that "the mission interested SDIO because it would use natural celestial bodies instead of man-made targets to flight-qualify advanced lightweight technologies." The target asteroid would be "a cold body against a deep space background." Moreover, the "approach is at a realistic closing velocity of about 11 km/sec." Rustan went on to say that in early 1992 this mission, with a two month lunar mapping component added, was approved by the SDIO director as part of the agency's sensor integration program. (Rustan, "Clementine: Mining New Uses for SDI Technology," p. 38.) In a later account (Pedro L. Rustan, "Editorial: Clementine Mission," Journal of Spacecraft and Rockets, November-December 1995), Rustan said that by 1991, the development of most of SDIO's space programs had been stopped. Rustan considered it detrimental to the U.S. space program that "no spacecraft were going to be built and flown that would take advantage of the many advanced lightweight components that had been developed for small space-based interceptors and surveillance systems. Therefore, some of us decided that a low-cost space mission should be built, demonstrating the usefulness of the newly developed technology. Thus the Clementine Program was born."

90 Pedro L. Rustan, "Clementine: Mining New Uses for SDI Technology," *Aerospace America*, January 1994, p. 38, provides the following explanation for the name "Clementine."

> *In early 1992, with the addition of a two-month lunar mapping segment to demonstrate sensor performance, the [fly-by] mission [to Geographos] was approved as part of the [SDIO] sensor*

taking sponsored by the Ballistic Missile Defense Organization and NASA.

The Clementine probe would first be launched into a low earth orbit where it would remain for a week while its systems were checked out and stabilized. Then, its interstage motor would boost it into a lunar orbit where it would remain for about two months, taking "pictures" of the Moon in various bands of the electromagnetic spectrum. To assure full coverage of the moon's surface, after a month in one orbit, Clementine would shift to a second one. After the second month in lunar orbit, the probe would maneuver into "a two-revolution phasing loop with the Earth and obtain a gravity-assist lunar swingby." This would be followed by a three month flight that would culminate in a rendezvous with the near-earth asteroid Geographos. Closing at 10.8 kilometers per second, Clementine and the asteroid would pass within about a hundred kilometers of each other. Then, the probe would continue out into deep space.[91]

Launched aboard a Titan II rocket on 25 January 1994, Clementine was spectacularly successful in the lunar portion of its mission. In seventy-three days, it completed about 350 lunar orbits and took almost 1.8 million multi-spectral images of the moon. These images provided the "first high fidelity photometric survey of an extraterrestrial body."[92] Furthermore, Clementine's data indicated the existence of water at the lunar poles.[93] Unfortunately, while Clementine was performing the maneuver that would fling the probe toward Geographos, a computer malfunction caused the spacecraft's attitude control system to carry out an eleven minute burn that depleted the probe's fuel and left it rotating at eighty revolutions per minute, making it impossible for Clementine to complete the asteroid flyby.[94]

In addition to the very valuable lunar data collected, Clementine served as a highly successful test-bed for twenty-three lightweight SDI technologies, all of which performed properly. A number of these technologies were directly related to the Brilliant Pebbles program. Specifically, Clementine's cameras and sensors had been developed for BP. Clementine also verified the autonomous operational mode that was to have been employed with Brilliant Pebbles. This verification came during orbit number 303, when Clementine operated in a completely autonomous mode throughout the full orbit. Given these achievements, Ambassador Cooper was not wide of the mark when he wrote in May 2001 that "the Clementine deep-space probe successfully space-qualified nearly the entire suite of first-generation Brilliant Pebbles hardware . . . and software."[95]

Beyond these accomplishments, Clementine lent support to the philosophy that had initially guided the Brilliant Pebbles development and acquisition process – the maximum use

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integration program. Since the mission would help determine the mineral content of the Moon and the asteroid, the project was named Clementine, after the old ballad. And Clementine will indeed be "lost and gone forever" after the flyby.

91 Rustan, "Clementine: Mining New Uses for SDI Technology," pp. 38-39; Paul DeLaHunt, Steve Gates, and Marv Levenson, "Clementine Attitude Determination and Control System," *Journal of Spacecraft and Rockets*, November-December 1995, p. 1054-1055.

92 "Clementine Launched," *Aviation Week*, 31 January 1994, p. 28; Trevor C. Sorensen, et. al., "Spacecraft Autonomous Operations Experiment Performed during the Clementine Lunar Mission," *Journal of Spacecraft and Rockets*, November-December 1995, pp. 1049, 1053; Henry Garrett, Pete Rustan, and Dwight Duston, "Clementine: Future Space Technology—Today," *Military and Aerospace Electronics*, 28 September 1995. The copy of this article in the BMDO historical files does not include pagination. The quotation given here is from the first page of the article. For a detailed analysis of the Clementine mission, see Committee on Planetary and Lunar Exploration, Space Studies Board Commission on Physical Sciences, Mathematics, and Applications, National Research Council, *Lessons Learned from the Clementine Mission* (Washington, D.C.: National Academy of Sciences, 2001).

93 Leonard David, "Clementine Data Suggest Moon Harbors Ice," *Space News*, 16-22 October 1995, p. 3; "Ice on Moon Confirmed; Exploitation Seen Possible," *Aerospace Daily*, 4 December 1996, pp. 331-332. The title of the *Aerospace Daily* article is deceiving, for the article itself states: "Wesley Huntress, associate NASA administrator for space science, said yesterday the up-coming Lunar Prospector mission, scheduled for launch in September 1997, 'will permit scientists to infer the presence or absence of ice with greater precision than possible via the innovative but indirect method used by the Clementine team.'" According to "Jury Still out on Lunar Water," *Astronomy*, September 1997, p. 20, a group of scientists led by Cornell astronomer Donald Campbell challenged the findings of ice on the Moon in an article appearing in the 6 June 1996 edition of *Science*. The date of the *Science* article was 6 June 1997 vice 1996. The Lunar Prospector probe did confirm the Clementine team findings of water on the Moon's surface. (Director of the Ballistic Missile Defense Organization, Memorandum for the Under Secretary of Defense for Acquisition and Technology and the Principal Deputy Under Secretary of Defense for Acquisition and Technology, Subject: "Ballistic Missile Defense Organization's Clementine Missile to the Moon--INFORMATION MEMORANDUM," 17 March 1998. This memorandum was drafted by Dr. Dwight Duston, BMDO's Assistant Deputy for Technical Operations.)

94 Paul DeLaHunt, Steve Gates, and Marv Levenson, "Clementine Attitude Determination and Control System," *Journal of Spacecraft and Rockets*, November-December 1995, p. 1054.

95 Katie Walter, "Adapting to a Changing Weapons Program," *Science and Technology Review*, January/February 2001, p. 19; Henry F. Cooper, "Why Not Space-Based Missile Defense?," *Wall Street Journal*, 7 May 2001, p. A22; Henry Garrett, Pete Rustan, and Dwight Duston, "Clementine: Future Space Technology—Today," *Military and Aerospace Electronics*, 28 September 1995. The copy of this article in the BMDO historical files does not include pagination. The quotation given here is from the first page of the article.

of commercial off-the-shelf components and a minimum reliance on hardware designed to military specifications. Those who developed Clementine referred to the probe as "a desktop computer hooked up to some camcorders and a mobile phone."[96]

The success of Clementine also points up one of the basic characteristics of development programs like Brilliant Pebbles. The knowledge and technical developments spawned by such programs do not simply evaporate when a program is terminated. Instead, they remain in the technology base that supports U.S. aerospace developments.[97]

Brilliant Pebbles was an integrating concept that started out by drawing upon America's broad technology base, military and commercial, for the components needed to make the interceptor a reality. During BP's short four-year life, it enhanced these components and related knowledge, and both the components and the knowledge remained in the U.S. technology base when Brilliant Pebbles was canceled. Indeed, in 2001, Lawrence Livermore National Laboratory responded to renewed interest in space-based interceptors under the administration of President

George W. Bush by resurrecting the Brilliant Pebbles technology and concept. This came in a proposal for a technology demonstration program aimed at developing "a new class of miniature kill vehicles."[98]

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96 Katie Walter, "Adapting to a Changing Weapons Program," *Science and Technology Review*, January/February 2001, p. 19; Henry F. Cooper, "Why Not Space-Based Missile Defense?," *Wall Street Journal*, 7 May 2001, p. A22; Henry Garrett, Pete Rustan, and Dwight Duston, "Clementine: Future Space Technology—Today," *Military and Aerospace Electronics*, 28 September 1995. The copy of this article in the BMDO historical files does not include pagination. The quotation given here is from the first page of the article.

97 Department of Defense, Office of the Inspector General, "Brilliant Pebbles Program," Audit Report Number 94-084, 14 April 1994, p. 2.

98 Advanced Interceptor Technology Program, Lawrence Livermore National Laboratory, National Nuclear Security Administration, "Genius Sand: A Miniature Kinetic Vehicle Technology Demonstration for Midcourse Counter-Countermeasures and Submunition Kills," Prepared for the Ballistic Missile Defense Organization and the U.S. Army Space and Missile Defense Command Space and Missile Defense Technical Center, 5 November 2001, pp. 4-5.

appendix e

International and National Security Law The Campaign to "De-weaponize" Space: Why America Needs to Defend Our Space Assets and Our Right to Deploy a Space-based ABM System

"International and National Security Law: The Campaign to 'De-Weaponize' Space: Why America Needs to Defend our Space Assets and our Right to Deploy a Space-Based ABM System," was written by Robert F. Turner and first appeared in *Engage*, Volume 5, Issue 1, April 2004. It is reprinted with permission of the Federalist Society.

On December 13, 2001, President Bush announced that the United States was withdrawing from the 1972 Anti-Ballistic Missile [ABM] Treaty, pursuant to the terms of Article XV of that bilateral accord.[1] The withdrawal became legally effective at the expiration of a six-month period of notice.

The termination of the ABM Treaty removed the only legal prohibition against the United States developing a space-based ABM system to protect itself and other countries against rogue states or terrorist groups who might either seek to slaughter large numbers of innocent people with Weapons of Mass Destruction (WMD) delivered via ballistic missile, or seek to use the potential of such an attack to blackmail the United States into abandoning an ally or making other concessions to tyranny or terror. Although a detailed discussion of the relative benefits of a space-based ABM system is beyond the scope of this article, it should be noted that many technical experts believe that such a system would be by far the most effective approach.

The issue being addressed here is broader than the ABM debate. The United States military in the twenty-first century is tremendously dependent upon space-based assets. We fight wars using precision munitions delivered to the war zone by aircraft guided by the Global Positioning System (GPS) and guided to within a few feet of their target by signals from multiple GPS satellites. Targeting instructions, weather, and numerous other data are provided to decision makers by other satellites. These satellites are undefended at present, and the technology already exists to destroy them.

Indeed, it is no secret that the People's Republic of China has been working on an advanced anti-satellite system of "parasitic satellites" designed to destroy key American military satellites during periods of crisis.[2] In June, 2000, the chairmen and ranking minority members of the House and Senate Armed Services Committee appointed eleven members to the Commission on the Organization of National Security Space, created pursuant to the National Defense Authorization Act for FY 2000.[3] Two other members were appointed by Secretary of Defense William S. Cohen in consultation with the Director of Central Intelligence. On January 11, 2001, the Commission – chaired by Donald Rumsfeld – issued its report, which concluded, *inter alia*:

> *Space systems are vulnerable to a range of attacks that could disrupt or destroy the ground stations, launch systems or satellites on orbit. The political, economic and military value of space systems makes them attractive targets for state and non-state actors hostile to the United States and its interests. . . .*
>
> *The U.S. is more dependent on space than any other nation. Yet, the threat to the U.S. and its allies in and from space does not command the attention it merits from the departments and agencies of the U.S. Government charged with national security responsibilities. . . . The reality is that there are many extant capabilities to deny, disrupt or physically destroy space systems and the ground facilities that use and control them. Examples include denial and deception, interference with satellite systems, jamming satellites on orbit, use of microsatellites for hostile action and detonation of a nuclear weapon in space. . . .*
>
> *As harmful as the loss of commercial satellites or damage to civil assets would be, an attack on intelligence and military satellites would be even more serious for the nation in time of crisis or conflict. As history has shown—whether at Pearl Harbor, the killing of 241 Marines in their barracks in Lebanon or the attack on the USS* Cole *in Yemen—if the U.S. offers an inviting target, it may well pay the price of attack. With the growing commercial and national security use of space, U.S. assets in space and on the ground offer just such targets. The U.S. is an attractive candidate for a "space Pearl Harbor."*[4]

We have been warned, but forces are currently at work that would deny America the ability to defend its space-based assets. A few argue that such measures are already unlawful, but most legal experts—even those deeply committed to arms control—recognize that U.S. options can only be curtailed by making new law. So, both within the United States and around the world, a campaign is underway to pressure the United States to negotiate and ratify a new multilateral treaty prohibiting the militarization or "weaponization" of space. Support for such an effort is widespread around the globe, with Russia, China, and Canada playing prominent roles. Domestically, at least one announced presidential candidate has introduced legislation endeavoring to compel the President to join in this effort.[5] On its face—without understanding the nature of the existing threat and our inability to verify compliance with such a treaty if we do leave our space resources vulnerable—the idea of "preventing a new arms race" in space will be attractive to a large number of Americans and their representatives.

It is therefore important for civic-minded members of the legal profession to be aware of these developments and to understand some of their ramifications. To that end, this article will briefly examine the existing legal regime governing military uses of outer space and the effort to bring into force new limitations—limitations motivated in large part by a perceived need to prevent the United States from building an effective anti-ballistic missile system now that the 1972 ABM Treaty has been terminated.

1. Legal Arguments Against Space-Based Ballistic-Missile Defense

Any effort to promote an effective ballistic-missile defense program, or other defensive systems involving the use of space, will undoubtedly face two related, but inconsistent, challenges. A few will contend that the corpus juris spatialis—the international law governing outer space – already prohibits the "militarization" or "weaponization" of space.[6] This contention is so devoid of legal merit that all but the most hard-core opponents of BMD will fall back to the argument that international law ought to ban such uses of space, and going forward with a U.S. space-based ABM program will forever preclude that possibility and thus undermine "world peace" for eternity. But, as will be shown, this argument, too, is unpersuasive.

In reality, the "militarization" of space began with the first Sputnik launch in 1957, and virtually every space platform has at least some potential military use. Indeed, precisely because they have been used for military purposes, the existence of space-based platforms has contributed tremendously to the maintenance of international peace and security, upholding the UN Charter, and the promotion of fundamental humanitarian values.

For example, when the UN Security Council in November 1990 authorized the use of armed force in response to Iraq's blatant aggression against neighboring Kuwait, the United States and its allies made regular use of satellites both to accomplish their military missions expeditiously and effectively and to reduce both "friendly fire" loses and "collateral damage" to innocent civilians to a minimum.

Most weapons systems are inanimate objects deriving any moral character from the purpose and manner in which they are used. A pistol in the hands of a policeman may prevent murder and uphold the rule of law. The same handgun could become an instrument of great evil in other hands. Large numbers of tanks, howitzers, and aircraft—backed up by the threat of nuclear retaliation by the United States—kept most of Europe free during the more than four decades of the Cold War. There is evidence that the threat of a nuclear response dissuaded Saddam Hussein from using weapons of mass destruction against United Nations coalition forces during Operation Desert Storm.[7]

The debate over whether the United States should enter into a treaty prohibiting it from protecting its people and military forces—and, to the extent possible, protecting innocent potential victims in other countries as well—from attack by totalitarian rogue states or international terrorists will not likely be a short one. At present, neither the President nor two-thirds of the United States Senate seem so inclined. But, in the meantime, it is important to understand that a space-based ballistic missile defense system would not even arguably be in violation of America's current obligations under international law, and moving to protect our people for growing catastrophic threats will not preclude a future decision to ratify a "non-weaponization" treaty any more than our initial investment in a rudimentary ABM system in the late 1960s prevented us from entering into the 1972 ABM Treaty with the Soviet Union.[8]

2. The Prohibition Against National Ballistic Missile Defense

Until June 13, 2002, the United States was bound by treaty obligation "not to deploy ABM systems for a defense of the territory of its country"[9] and "not to develop, test, or deploy ABM systems or components which are . . . space-based,"[10] but that obligation ceased to exist when the United States acted pursuant to Article XV and withdrew from the 1972 ABM Treaty. Since that date, there have been no domestic or international legal obligations prohibiting the United States from developing and deploying a space-based ABM system. The provisions of Article 2(4)[11] of the UN Charter would, of course, prohibit the aggressive use of such a system.

3. The 1967 Outer Space Treaty

By far the most important treaty governing the use of outer space is the Treaty on Principles Governing the Activities of

States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (more commonly known as the "Outer Space Treaty"), which entered into force in October 1967 and currently has nearly 100 parties. It has been characterized by legal scholars as the "Magna Carta of Outer Space Law,"[12] the "constitution of outer space,"[13] and "the foundation for international legal order in outer space."[14] And because some have alleged that it prohibits a space-based ABM system, it is important to look at least briefly at the Treaty.

The lengthy preamble recognizes "the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes," but preambles are not binding under international law. The key operative language commonly relied upon by those who contend the Outer Space Treaty prohibits military activities is contained in Article IV, which provides:

> *States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.*
>
> *The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited.*

As the text suggests, the first paragraph of Article IV prohibits the orbiting or installation of weapons of mass destruction—that is, nuclear, chemical, or biological weapons—in space. Since none of the ballistic-missile defense proposals being considered by the United States involve the use of WMD, our focus should be on paragraph two, which is limited to "[t]he Moon and other [natural] celestial bodies." Again, space-based BMD systems currently under discussion do not involve the "establishment of military bases, installations and fortifications," the "testing of any type of weapons" or "the conduct of military maneuvers on celestial bodies." So paragraph two of Article IV is also no impediment.

Many critics of ballistic missile defense would like to interpret the "peaceful purposes" language more broadly than its clear context permits. But the record of the treaty negotiations shows that several states pointed out that the "peaceful purposes" language applied only to activities on celestial bodies, and the text was not changed.[15] This was thus not an oversight.

It is also important to understand that the term "peaceful purposes" in the Outer Space Treaty was understood to mean "non-aggressive" rather than "non-military." This is clear both from the travaux preparatorie (preparatory works or negotiating history) of the Treaty and from its context, as it would have made no sense at all to place specific limits on bases, maneuvers, or weapons of mass destruction if all military uses of space were being outlawed. Further, Article IV makes specific reference to the permitted use of "military personnel" in space.

The point is sufficiently important that a bit of background may be useful. The term "exclusively for peaceful purposes" in connection with outer space first appeared in (nonbinding[16]) UN General Assembly Resolution 1348 (XII), which was introduced by the United States and approved by the General Assembly on November 14, 1957. When it was first introduced, the United States subjectively contemplated a regime in which all military uses of outer space would be prohibited, and this view was endorsed by several other states as well. But the American view changed sometime between late 1958 and 1959, and the United States has since 1959 consistently taken the view that "peaceful purposes" means "non-aggressive" rather than "non-military" purposes.[17] Indeed, in the early 1960s the United States Air Force began working on a Manned Orbiting Laboratory (MOL), and this program was ongoing when the Outer Space Treaty was negotiated.[18] As the late Senator Albert Gore (father of the former vice president by the same name) told the United Nations General Assembly more than four decades ago, the "test of any space activities must not be whether it is military or non-military, but whether or not it is consistent with the United Nations Charter and other obligations of law."[19] It is noteworthy that during more than four decades no country has formally objected to the American definition that "peaceful purposes" means "nonaggressive" rather than "non-military."[20]

The Soviet Union also had ongoing military programs involving space in the late 1950s and early 1960s, but they were highly secret and—for propaganda reasons, as well as to try to block American space programs—Moscow argued that "peaceful purposes" precluded any military uses of space. But as Soviet programs became more visible Moscow gradually acquiesced in the American position, which was clearly reflected in the text of the Outer Space Treaty[21]

Today, there is near universal agreement among states that the Outer Space Treaty does not ban non-aggressive military activities in outer space that do not involve weapons of mass destruction or take place on celestial bodies. This is evident in the behavior of even the strongest critics of any effort by the United States to deploy a space-based anti-ballistic missile defense system, because, rather than alleging such a program would be unlawful, they are calling for a new treaty that would either "demilitarize" or "de-weaponize" outer space.

4. "Peaceful Purposes," the Antarctica Treaty, and the UN Charter

The "peaceful purposes" language of Article IV(2) of the Outer Space Treaty follows a pattern established by the 1959 Antarctica Treaty, and it is clear from even a casual examination of their texts that the Outer Space Treaty was in many respects patterned after the Antarctica Treaty. But rather than proving (as some argue) that the Outer Space Treaty was intended to preclude all military uses of space, the 1959 treaty demonstrates that the world community knew how to "demilitarize" a region when it so wished, and the departure from the language employed in the treaty they were using as a model clearly reflects an intention to depart from its meaning. Thus, Article I of the Antarctic Treaty provides:

> *Antarctica shall be used for peaceful purposes only. There shall be prohibited, inter alia, any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military maneuvers, as well as the testing of any type of weapons*[22]

The negotiators of the 1967 Outer Space Treaty clearly elected to apply this demilitarization regime only to "celestial bodies" like the Moon, and not to outer space in general.

It is also noteworthy that the language in question refers to peaceful purposes, and not to capabilities or uses. Purposes clearly refers to the subjective intentions of the actor, and thus a dual-use technology can presumably be used even on a celestial body if the purpose for which it is placed there is non-aggressive (and it does not otherwise violate an expressed prohibition of the Outer Space Treaty). As Major Christopher Petras, at the time Chief of Operational Law at U.S. Space Command, observed in a recent law review article: "Like a truck, a telephone, or a pair of binoculars, orbiting space stations have no inherent characteristics that make them civil or military; rather, it is how the space station is utilized that is key to determining its civil or military potential."[23]

A far better analogy than the Antarctica Treaty in understanding the current *corpus juris spatialis* is the 1982 UN Convention on the Law of the Sea, which in Article 88 provides simply: "The high seas shall be reserved for peaceful purposes."[24] This does not prohibit warships from traveling the high seas at will, from launching aircraft or transporting combat forces. It doesn't prohibit parties to the Convention from using their warships to launch missiles at the territory of other states so long as the operation is non-aggressive in nature.

Does this mean that it is lawful under the Outer Space Treaty for the United States to carry out activities in space that are not "peaceful" so long as they do not take place on celestial bodies? Certainly not, in the sense that this term is used in the Treaty. Because Article 2(4) of a different treaty, the United Nations Charter, clearly prohibits all aggressive uses of military force by states. This point is (unnecessarily) affirmed by Article III of the Outer Space Treaty, which provides:

> *States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.*

The fallacy of the argument that any capability to use military force is contrary to international law and a threat to world peace is apparent from the very first article of the UN Charter, which declares the organization's primary purpose to be the maintenance of "international peace and security" by taking "effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace . . . ."[25] When the United States joined with other peace-loving nations in 1991 and used armed force to eject Iraqi forces from Kuwait, they were using military force to preserve international peace—clearly a "peaceful" purpose.

Among the oldest principles of international law is that states may use military force when necessary to defend themselves from aggression. This principle was not limited by the UN Charter, and indeed is expressly affirmed by Article 51.26 And measures taken by the United States to defend its territory, its people, its armed forces, or even its satellites in space from foreign attack are lawful both under the Outer Space Treaty and the UN Charter.

5. Opponents of American Ballistic-Defense Programs Admit Non-Nuclear Ballistic-Missile Defense is Not Contrary to International Law

After President Ronald Reagan announced in 1983 that the United States would seek to develop a national ballistic-missile defense system, Moscow announced an intention to seek a ban on space-based defenses through a new multilateral treaty.[27] More recently, in order to "demilitarize the space environment," Russia "has put a series of proposals before the United Nations that would have the effect of imposing a prohibition on the testing, deployment, and use of space weapons."[28]

More recently, at a May 2003 Pugwash Workshop in Spain, Andrey Vinnik of the Russian Ministry of Foreign Affairs lamented:

> *The military activities currently prohibited in outer space by the international law are as follows:*
>
> - *placement of nuclear and other WMD on orbit around the Earth, their installation on celestial bodies or stationing in outer space;*
> - *nuclear weapons testing;*
> - *establishment of military bases, installations and fortifications and conduct of military manoeuvres on celestial bodies (except for the Earth) or orbits around them;*
> - *hostile activities or use of force on celestial bodies or orbits around them;*

- *military or any other hostile use of environmental modification techniques in outer space;*

However insufficient perfection of the international legal regime, which carries out regulation of military space activity, nevertheless leaves an opportunity to place into outer space separate kinds of weapons;

The international law does not prohibit such kinds of military activity, for example, as placement in outer space of anti-satellite weapons; development and deployment in outer space of optical-electronic and radio-electronic jamming devices, etc.[29]

Similarly, on June 7, 2001, Ambassador Hu Xiaodi of the People's Republic of China submitted a working paper to the UN Conference on Disarmament entitled "Possible Elements of the Future International Legal Instrument on the Prevention of the Weaponization of Outer Space."[30] Obviously, if the Outer Space Treaty had prohibited the "weaponization of outer space" such a "future international legal instrument" would be unnecessary.

6. Leading Arms Control Proponents Acknowledge Space-Based Defenses are Not Illegal

With a few notable exceptions, some of the strongest opponents of American ballistic-missile defense programs have acknowledged that current international law does not constrain the kinds of programs being discussed in this paper. For example, during a panel discussion on April 14, 1998, John Pike—Director of the Space Policy Project of the Federation of American Scientists—responded to a question by observing:

> *Under the Outer Space Treaty weapons of mass destruction, in practice nuclear weapons, are prohibited from being placed in orbit. There are currently no restrictions on ground-based anti-satellite systems. . . . Everything in between that, space lasers, a lot of the missile defense stuff, is more or less up for grabs. The presumption is that we are either currently permitted to or could rearrange the ABM restrictions to facilitate deployment of just about everything as long as it was not a nuclear weapon in space.*[31]

Writing about the Outer Space Treaty in the February 2001 issue of the Center for Defense Information's *Defense Monitor*, Dr. Nicholas Berry acknowledged:

> *What is noticeable is what the Treaty leaves out. The defensive use of ballistic missiles with nuclear warheads—assuming compliance with self-defense provisions of Article 51 of the UN Charter—are not illegal . . . . Ballistic missiles do not orbit and they were purposely excluded. Weapons other than nuclear or of mass destruction are also allowed and can be placed in orbit. Lasers, conventional explosives, and kinetic devices can be deployed in space as an SAT system or as a launching pad for space-to-ground or space-to-air attacks.*[32]

The self-described "progressive" British American Security Information Council (BASIC) has acknowledged that the U.S. withdrawal from the ABM Treaty "will leave the 1967 Outer Space Treaty (OST) as the only current legal bar on space weaponization. However, while the OST bans the placing of weapons of mass destruction in space, on the moon or other celestial bodies, it has no prohibitions on other weapons systems."[33]

At the above-mentioned May 2003 Pugwash conference, a paper prepared by experts from the United States, Norway, and the United Kingdom observed:

> *A decision to deploy space weapons would not face many constraints . . . .*
>
> *The legal framework governing space weapons is minimal. The only explicit rules regarding space weapons are those prohibiting conventional weapons on celestial bodies and weapons of mass destruction everywhere in space. Conventional space weapons are therefore legal as long as they are based on a satellite rather than the moon. The legal framework has been further weakened by the abolition of the Anti-Ballistic Missile Treaty. Law is therefore no obstacle to deployment.*[34]

In March 2003, a spokesperson for Project Ploughshares (an agency of the Canadian Council of Churches devoted to "peace and justice") gave a press briefing in which she asserted:

> *We are currently standing at a crossroads in the development of outer space. First called for by US President Eisenhower in 1958, the principle that space would be used for peaceful purposes has been accepted for nearly 50 years. Although the term "peaceful purposes" was never clearly defined, it was accepted that this included military, communications, commercial, and scientific uses. But there is strong movement within the U.S. military establishment to expand the military uses of space to include war-fighting capabilities, to go beyond the accepted parameters of "peaceful uses" and the norm against placing weapons in space. . .*
>
> *There is a broad international consensus opposing the weaponization of space and supporting the creation of a legal instrument banning the placement of weapons in outer space. Still, little progress has been made towards achieving this ban, while space has become increasingly militarized and the U.S. is taking steps to make space weapons a reality. . . .*
>
> *Space has been "militarized" since the earliest communications satellites were launched into orbit. Today, militaries worldwide rely heavily on satellites for command and control, communications, reconnaissance and monitoring, early warning, treaty verification, and navigation with the Global Positioning System (GPS). Research and development is frequently funded by defence contracts. States accept that "peaceful purposes" include military use, even that which is not particularly peaceful, and space is considered a sanctuary only in that no weapons are deployed there.*[35]

Indeed, the relatively few serious assertions that are made that the Outer Space Treaty bans either the "militarization" or "weaponization" of space tend to either come from exuberate neophytes (such as in notes by law students) or are so obviously strained by the writers' policy commitments as to be totally unpersuasive.

Professor Mark Markoff, of the University of Fribourg, Switzerland, has long asserted that Article I of the Outer Space Treaty precludes military use of outer space. Article I reads in full:

> *The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.*

The theory here apparently is that the "common interest" concept embodied in Article I is inherently inconsistent with any military use of space. But as the UN Charter makes clear, it is difficult to imagine any "common interest" of greater importance than maintaining international peace and deterring aggression. As already discussed, the contributions made by military uses of space during the 1991 effort by the world community to bring an end to Iraqi armed aggression against Kuwait belie any seriousness in such an argument.

Particularly unpersuasive is a letter to the editor of the June 2002 issue of *Arms Control Today*, in which two senior arms control lawyers argued that the Outer Space Treaty prohibited the "stationing of strike weapons of any sort in low-Earth orbit, including kinetic kill vehicles and lasers." Noting that a 1963 UN General Assembly declaration of legal principles stated that "the use of space shall be carried on for the benefit and in the interests of all mankind...," John Rhinelander and George Bunn reasoned:

> *The Outer Space Treaty was intended to implement this principle. Its first article says that the use of space "shall be carried out for the benefit and in the interests of all countries." The only weapons it explicitly bans from orbiting around Earth are nuclear and other weapons of mass destruction because they were the primary concern in 1967. . .*
>
> *In fact, the Outer Space Treaty contains one overall rule: space shall be preserved for peaceful purposes for all countries. It requires any state considering activities that "would cause potentially harmful interference" with other states' activities to undertake appropriate consultations. Similarly, other states may request consultations.*
>
> *Further provisions for consultation were included to give the parties realistic opportunities to achieve post-1967 agreements on what the general provisions should mean in the future. For instance, if a state decided to test and possibly orbit in space an anti-satellite weapon (ASAT) utilizing a laser or kinetic kill vehicle, other states parties to the space treaty could request consultations. They could conclude that the treaty prohibits the orbiting of the proposed ASAT. We believe that such an interpretation could be a permissible interpretation of the treaty. Indeed, space testing or deployment of other future strike weapons that are inconsistent with "the benefit and in the interests of all countries," within the meaning of the Outer Space Treaty, might produce a similar interpretation.*[38]

This proposal from two of the most highly-regarded champions of arms control is truly alarming. To suggest that a state may be legally bound by a treaty to new terms clearly not contained in the treaty text and clearly opposed by that state during the negotiation process simply because a majority of parties decades later elect to "interpret" the treaty to incorporate a fundamentally broader scope—particularly a treaty affecting the fundamental right of sovereign states to defend themselves— would be a prescription to end the process of treaty-making by any rational state. This is not the law, and it should not *become* the law. It is true that, if they so wish, the parties to the Outer Space Treaty may alter its meaning and prohibit either the weaponization or even the militarization of outer space, but this could only be done by an *amendment* that would not be binding upon the United States without its consent.

7. Customary International Law Does Not Prohibit ABM Programs

International legal rules result both from written treaties and from what is called "customary international law," as evidenced by a long-standing practice of states accompanied by a belief (*opinio juris*) that their conduct is legally required. The most authoritative behavior in determining the existence of such a rule are the practices of the states most affected by the alleged rule.

Obviously, the United States and the Soviet Union/ Russia are by far the two states with the most active programs in space. And if either of them felt that space-based ballistic-missile defense systems were already barred by either conventional or customary international law they would have found no need to enter into a new treaty in 1972 prohibiting such conduct. The ban they created through that treaty—binding only the United States and the Soviet Union—lasted for three decades, but ceased to exist with the expiration of the ABM Treaty in June 2002.

The use of military satellites by the United States, Russia, and many other states also clearly refutes any suggestion that—despite the clear terms of the Outer Space Treaty—there has somehow developed a rule of customary international law prohibiting any military or defensive uses of outer space beyond those spelled out in the 1967 treaty.

8. The Logical Consequences of Prohibiting the "Militarization" or "Weaponization" of Space

At first impression, the idea of preventing any military use of outer space may seem attractive. No one *likes* war, and virtually anyone familiar with the George Lucas *Star Wars* fantasies would favor a more peaceful future for the world. But more serious reflection reveals the hidden "costs" that would accompany any effective prohibition against military uses of outer space.

One might start by considering the GPS, a system of two-dozen satellites that became fully operational in March 1994 and was designed by the U.S. military to pinpoint locations around the globe within a matter of feet. The *primary purpose* of GPS was to facilitate navigation and combat operations by the American military. It is used to guide missiles, bombers, fighters, tanks, and even foot soldiers as they engage an armed enemy in combat.

In part because of the remarkable accuracy of this then-incomplete technology, in 1991 the international coalition authorized by the UN Security Council was able to end Iraqi aggression against Kuwait in six weeks with only a tiny fraction of the predicted casualties on both sides. The old TERCOM (terrain contour matching) guidance system of earlier generations of cruise missiles was largely ineffective over the shifting sands of vast deserts. GPS guidance put them right on target time and again. Using satellite guidance systems, American tanks were able to charge across the barren terrain of the Arabian Desert while their Iraqi counterparts were confined largely to main roads. Search-and-Rescue operations were facilitated and minefields cleared with the use of GPS satellites.[37]

Satellites handled eighty-five percent of the communications needs of coalition forces in 1991, including more than 700,000 telephone calls each day. Joint Chiefs of Staff Chairman General Colin Powell asserted that satellites were "the single most important factor" that enabled the Coalition forces to build the command, control, and communications networks for Operation Desert Shield.[38]

General Norman Schwarzkopf's brilliant "left hook" maneuver into Iraq in February 1991 was made possible in part because of satellite microwave imagery that analyzed the moisture content of the soil and found routes that could support the sixty-eight ton M-1 Abrams main battle tanks that led the attack.39 And when Saddam Hussein tried to counter by firing Scud missiles into other countries in the region, satellites detected the launches and helped coordinate the defensive responses40 —which, nevertheless, often failed because the United States had done little to prepare in advance to defend against ballistic-missile attacks.

None of this would have been possible had military uses of outer space been outlawed. And, obviously, if GPS satellites must be destroyed in the name of demilitarizing space, their beneficial contributions to human safety and convenience in scores of other ways—from helping commercial ships and aircraft plot their course and avoid collisions, to helping lost recreational boaters and hikers find their way to safety when they lose their way or the sun goes down—will also be terminated.

Such a rule would also ban any use of satellites for meteorology, communications, imagery, and virtually any other purpose that might also serve a military end. Those unfortunate enough to live too far from local broadcast towers would no longer be able to access news or entertainment by satellite television, and any foreign news they could access would likely be days late in arriving in the absence of satellite communications.

Speaking at a panel discussion on April 14, 1998, sponsored by the NGO Committee on Disarmament at the United Nations, Ron Cleminson, Senior Adviser for Verification in the Canadian Department of Foreign Affairs, observed:

> *We talk about 'weaponization of space' and 'the use of space for military purposes,' but it is also indispensable to the whole arms control process. Without the use of space-based imagery, and space-based monitoring, we would not have any significant arms control treaties. In the early days of the Cold War between the U.S. and the Soviet Union, the major arms control treaties, the SALT treaties, the ABM Treaty, were monitored and verified by the use of space-based equipment and space-based sensors only. . . . Without the use of military satellites there would not be an ABM Treaty, SALT or START treaties. So from an arms control perspective the military use of space can be beneficial.*[41]

Nor would many of the benefits of military space platforms be preserved if a new treaty prohibiting the "weaponization" of space were to enter into force. Because GPS satellites are an integral component of nu-merous weapons systems—every bit as important in getting ordinance to its target as the bombs themselves or the aircraft that deliver them. And drawing artificial distinctions between gun sights, magazines, and bullets, or bombers and the communications systems that tell them when to attack what targets and provide the necessary GPS coordinates, makes little practical sense.

> *In a 1793 letter to James Monroe, Thomas Jefferson wrote: I believe that through all America there has been but a single sentiment on the subject of peace & war, which was in favor of the former. The Executive here has cherished it with equal & unanimous desire. We have differed perhaps as to the tone of conduct exactly adapted to the securing it.*[42]

That sentiment is as valid today as it was 210 years ago, but it could be expanded to include not only "all America" but the entire world save for a small number of totalitarian tyrants. We should have learned on September 11, 2001, that—again to quote Jefferson—"[w]eakness provokes insult and injury, while a condition to punish, often prevents them."[43] Only the truly foolish, or those who for their own political agendas wish to see America weakened, would contend that to utilize our technological superiority to protect ourselves and other peace-loving peoples from attacks by terrorists and tyrants is a threat to international peace.

Those who recognize the legitimacy of an ABM system yet advocate outlawing such a program would do well to consider its demonstrated potential to defeat and deter aggression. Space-based platforms helped the U.S.led coalition in 1991 bring Iraqi aggression to an end, uphold the rule of law, and restore peace to Kuwait. Countless additional lives would likely have been placed in jeopardy in the absence of this technology. To step backwards from that proud record of accomplishment and intentionally blind and weaken those forces that exist for our defense—in the process greatly increasing the risks of unnecessary collateral damage and friendly-fire loses when peace must be preserved—would neither promote world peace nor sound U.S. national security policy.

In summary, it is clear the the *corpus juris spatialis* at present does not prohibit the United States from taking appropriate defensive measures to safeguard its space-based assets or to protect its population or that of its allies against weapons of mass destruction attacks using ballistic missiles, save for the prohibitions in the Outer Space Treaty prohibiting military activities on the moon or other natural celestial bodies and banning the orbiting of weapons of mass destruction. Nor is there currently in force a legal regime prohibiting the "militarization" or "weaponization" of space. On the contrary, the United States and many other countries have incorporated space-based assets into military activities and weapons systems for many decades.

As a policy matter, particularly in light of the tremendous dependence of U.S. military forces today on space-based systems, anyone arguing that the United States should agree to a new legal regime that would leave our defensive assets at the mercy of hostile actions by any of a number of known or unknown potential adversaries—while giving us little of obvious value in return— must bear the burden of explaining why this is in America's interest. Unfortunately, a campaign is now underway to pressure our government to acquiesce in just such a regime—driven at least in part by countries and groups that perceive "unchecked American military power" as the greatest threat to world peace in the foreseeable future.

It is important that members of the legal profession be aware of this campaign and advise policy makers and civic groups alike to look carefully at such proposals before jumping on any bandwagons in the name of peace or to "prevent Star Wars." Our long-term ability to protect our people and the ability of our military to accomplish their missions in the years ahead may well be at risk if this campaign to "demilitarize" or "deweaponize" outer space is successful.

Professor Turner holds both professional and academic doctorates from the University of Virginia School of Law, where in 1981 he co-founded the Center for National Security Law. A former three-term chairman of the ABA Standing Committee on Law and National Security, he has chaired the Federalist Society's National Security Law Subcommittee since its inception. After serving twice in Vietnam as an Army officer, he was a Public Affairs Fellow at Stanford's Hoover Institution on War, Revolution, and Peace and later served five years as national security adviser to Senator Robert P. Griffin on the Foreign Relations Committee, special assistant to the Under Secretary of Defense for Policy, Counsel to the President's Intelligence Oversight Board in the Reagan White House, and Principal Deputy Assistant Secretary of State, and as the first President of the congressionally-established U.S. Institute of Peace. A former Charles H. Stockton Professor of International Law at the U.S. Naval War College, Turner is the author or editor of more than a dozen books and has testified before more than a dozen committees of Congress.

Endnotes

1 Article XV of the ABM Treaty provided:
1. This Treaty shall be of unlimited duration.
2. Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Treaty if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests. It shall give notice of its decision to the other Party six months prior to withdrawal from the Treaty.

2 Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests. 2 See, e.g., Sing Tao Jih Pao [Hong Kong], Jan. 5, 2001, citing "wellinformed sources" as saying "To ensure winning in a future high-tech war, China's military has been quietly working hard to develop asymmetrical combat capability so that it will become capable of completely paralyzing the enemy's fighting system when necessary by 'attacking selected vital points' in the enemy's key areas. The development of the reliable anti-satellite 'parasitic satellite' is an important part of the efforts in this regard." http:// www.centerforsecuritypolicy.org/index.jsp?section=papers&code=01P_04.

3 PUB. L. 106-65 (2000).

4 REPORT OF THE COMMISSION ON THE ORGANIZATION OF NATIONAL SECURITY SPACE, Executive Summary, Jan. 11, 2001, at xii-xiii.

5 See, e.g., Space Preservation Act of 2002, HR 3616, 107th Cong., 2nd Sess., 2002 (introduced by Representative Dennis Kucinich).

6 The terms "militarization" and "weaponization" are distinct concepts, the first referring to preventing the use of space for "military purposes" and the second—a subcategory of the first—to preventing the basing in space of military weapons or major components of weapons systems.

7 See, e.g., Robert F. Turner, *Nuclear Weapons and the World Court*, in THE LAW OF MILITARY OPERATIONS 309, 340-42 (Michael N. Schmitt, ed. 1998).

8 Indeed, when the United States first proposed the idea of an arms control agreement limiting ABM systems the Soviet Union rejected the idea, noting that such systems were inherently "defensive" in character. It was only after Moscow realized that America was moving forward with developing such a system, and because of our superior technology were likely to surpass the Soviet system then being developed, that Moscow not only agreed to limit such weapons but insisted that it be done by formal treaty instead of the executive agreement format used for the SALT I agreement on offensive arms.

9 Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems, Signed at Moscow May 26, 1972, 944 U.N.T.S. 13, entered into force Oct. 3, 1972.

10 Id. Art. V.

11 U.N. CHARTER, Art. 2(4) ("All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in

any other manner inconsistent with the Purposes of the United Nations.").

12 See, e.g., Richard A. Morgan, *Military Use of Commercial Communication Satellites: A New Look*, 60 JOURNAL OF AIR LAW AND COMMERCE 237, Sept-Oct 1994 at 237; and Maj. Douglas S. Anderson, *A Military Look Into Space: The Ultimate High Ground,* ARMY LAWYER, Nov. 1995, text at n.51.

13 Christopher M. Petras, *The Use of Force in Response to Cyber-Attack on Commercial Space Systems*, 67 JOURNAL OF AIR LAW AND COMMERCE 1213 (2002) at 1249.

14 Christopher M. Petras, *"Space Force Alpha" Military Use of the International Space Station and the Concept of "Peaceful Purposes,"* 53 AIR FORCE LAW REVIEW 135 (2002) at 149

15 See, e.g., Richard A. Morgan, *Military Use of Commercial Communication Satellites: A New Look*, 60 JOURNAL OF AIR LAW AND COMMERCE 237, Sept-Oct 1994 at text accompanying note 335; and Maj. Robert A. Ramey, Armed Conflict on the Final Frontier, 48 AFLR 1 (2000) at 81.

16 UN General Assembly resolutions do not by themselves have the force of law, although they may be used to establish the existence of customary international law in certain circumstances.

17 Ramey, *Armed Conflict on the Final Frontier* 79.

18 Christopher M. Petras, *"Space Force Alpha" Military Use of the International Space Station and the Concept of "Peaceful Purposes,"* 53 AIR FORCE LAW REVIEW 135, 135 (2002). The MOL program was cancelled in June 1969 because of the high costs of the Vietnam war. Id. See also, Maj. Douglas S. Anderson, *A Military Look Into Space: The Ultimate High Ground,* ARMY LAWYER, Nov. 1995, note 62 and accompanying text.

19 Quoted in Anderson, *A Military Look Into Space,* note 78 and accompanying text.

20 Richard A. Morgan, *Military Use of Commercial Communication Satellites: A New Look*, JOURNAL OF AIR LAW AND COMMERCE, Sept.-Oct. 1994, at text accompanying notes 308 & 394; Petras, *Space Force Alpha" Military Use of the International Space Station and the Concept of "Peaceful Purposes,* at 171.

21 Military scientific research is expressly envisioned by Article IV of the Treaty.

22 Antarctic Treaty, 402 U.N.T.S. 71, signed at Washington, DC, on 1 December 1959, entered into force on 23 June 1961, Art. I.

23 Petras, "*Space Force Alpha*"at 180.

24 Article 88 of the UN Law of the Sea Convention provides "The high seas shall be reserved for peaceful purposes." United Nations Convention on the Law of the Sea, concluded at Montego Bay, Jamaica, on 10 December 1982, UN Doc A/CONF. 62/122 (1982); 21 ILM 1261.

25 UN CHARTER, Art. I(1).

26 "Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security. Measures taken by Members in the exercise of this right of self-defence shall be immediately reported to the Security Council and shall not in any way affect the authority and responsibility of the Security Council under the present Charter to take at any time such action as it deems necessary in order to maintain or restore international peace and security." U.N. CHARTER, Art. 51.

27 Pavel Podvig, *A History of the ABM Treaty in Russia* (Moscow Institute of Physics and Technology, Feb. 2000, PONARS POLICY MEMO 109, at 1.

28 David Tan, *Towards a New Regime for the Protection of Outer Space as the "Province of All Mankind,"* 25 YALE JOURNAL OF INT'L LAW 145, 167-68 (2000).

29 Andrey Vinnik, Russia's Approaches to Strengthening the International Legal Regime Prohibiting the Weaponization of Outer Space and Efforts for Building an International Coalition in This Sphere, Pugwash Meeting no. 283, Castell—n de la Plana, Spain, 22-24 May 2003, available on line at: http://www.pugwash.org/reports/nw/ space2003-vinnik.htm.

30 Available on line at: http://www.china-un.ch/eng/12869.html.

31 Available on line at http://disarm.igc.org/outersp.html. 32 Dr. Nicholas Berry, *Existing Legal Constraints on Space Weaponry*, DEFENSE MONITOR, Vol. XXX, No. 2, Feb. 2001, at 2.

33 David Grahame, A Question of Intent: Missile Defense and the Weaponization of Space, BASIC NOTES, 1 May 2002, at 1-2.

34 Available on line at http://www.pugwash.org/reports/nw/space-2003marshall-sy.htm.

35 Available on line at: http://www.ploughshares.ca/CONTENT/BRIEFINGS/brf033.html.

36 George Bunn & John B. Rhinelander, *Outer Space Treaty May Ban Strike Weapons*, ARMS CONTROL TODAY, June 2002, available on line at http://www.armscontrol.org/act/2002_06/letterjune02.asp. George Bunn was General Counsel to the Arms Control and Disarmament Agency at the time the Outer Space Treaty was negotiated, and John Rhinelander served as Legal Adviser to the U.S. delegation to the SALT I negotiations in Moscow.

37 Maj. Douglas S. Anderson, *A Military Look Into Space: The Ultimate High Ground,* ARMY LAWYER, Nov. 1995, text accompanying notes 15-20.

38 Quoted in id., note 23 and accompanying text.

39 Id. at note 26 and accompanying text.

40 Id. at note 27 and accompanying text. [[Maj. Douglas S. Anderson, *A Military Look Into Space: The Ultimate High Ground,* ARMY LAWYER, Nov. 1995,]]

41 Transcript available on line at: http://disarm.igc.org/outersp.html.

42 Jefferson to Monroe, June 28, 1793, 26 PAPERS OF THOMAS JEFFERSON 392 (John Catanzariti, ed. 1995).

43 Jefferson to Jay, Aug. 23, 1785, 8 *Papers of Thomas Jefferson* 426, 427 (1953).

appendix f

Greatest Space Events of the 20th Century: The 60s

By Andrew Chaikin
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27 December 1999
Used with permission.

For America, the 1960s begin on an anxious note. Many in the U.S. feared the nation was lagging dangerously behind the Soviet Union in development of intercontinental ballistic missiles (ICBMs). In reality, secret photos from American spy satellites were about to confirm what high-flying aircraft had already shown: the so-called missile gap was not real.

But the Eisenhower administration could not reveal this knowledge to the public, and in 1960 John Kennedy won the presidency over Eisenhower's vice president, Richard Nixon, partly on the strength of his stance on the missile gap.

When it came to space exploration, no one could be sure how much Kennedy would improve on his predecessor's lukewarm attitude. Within months after entering office, however, Kennedy had no choice but to focus on human spaceflight.

On April 12, 1961, the Soviets launched a 27-year-old fighter pilot named Yuri Gagarin on the world's first piloted space mission. In his spacecraft *Vostok* ("east"), launched atop a converted R 7 missile, Gagarin made a single orbit of the Earth, returning 108 minutes after liftoff.

The Soviets did not reveal that the Vostok had suffered a malfunction prior to reentry that almost killed Gagarin. When the cosmonaut returned unharmed and exhilarated by his flight, the Soviet Union had scored another key space victory.

Kennedy reacts

For the young American president, Gagarin's flight came as a serious blow.

In Kennedy's mind, competition with the Soviets in space had become vital to U.S. international prestige. On May 5, a former Navy test-pilot named Alan Shepard – judged by many to be the best pilot among the Original Seven astronauts – became the first American in space.

Inside his tiny *Mercury* spacecraft, which he named Freedom 7, Shepard rode a *Redstone* booster on a 15-minute suborbital flight. The nation reacted to Shepard's feat with wild enthusiasm, and Kennedy took notice.

Kennedy had already been thinking about how to pull ahead of the Soviets in space. He'd asked his advisors to come up with a project that would give the U.S. a clear victory.

Less than three weeks after Shepard's flight, speaking before a joint session of Congress, Kennedy made an announcement that would have seemed unthinkable just years before: "I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth."

Many who heard these words – including some at NASA – wondered if Kennedy's challenge was realistic. (A few even wondered if Kennedy had lost his senses.) But it didn't take long for the space agency to begin figuring out how to achieve it.

Meanwhile, the space race sped onward with ever more ambitious flights.

John Glenn – the astronaut who seemed to step most easily into the role of American hero – became the first American to orbit Earth on February 12, 1962. Inside his *Friendship* 7 spacecraft Glenn circled the globe three times, marveling at the beauty of orbital sunrises and sunsets before sweating through a fiery reentry into Earth's atmosphere.

Three more astronauts followed Glenn into orbit; in May 1963 the sixth and last piloted *Mercury* mission saw Gordon Cooper spending more than a day in space.

As important as these missions were for the U.S. program, they were overshadowed by the Soviet *Vostok* flights. Cosmonaut Gherman Titov made the first daylong flight in 1962. Andriyan Nikolayev in *Vostok* 3 and Pavel Popovich in *Vostok* 4 staged the first dual spaceflight in 1963. Also in 1963, a former cotton mill worker and parachute jumper named Valentina Tereskhkova became the first woman in space, logging almost three days in *Vostok* 6.

And the Soviet firsts didn't end there. Under pressure from Soviet premier Nikita Khrushchev, chief space designer Sergei Korolev staged another orbital "spectacular." The Americans were planning their two-man *Gemini* flights, but Korolev upstaged Gemini's planned debut by launching three cosmonauts in a "*new*" spacecraft called Voskhod ("sunrise").

In reality, *Voskhod* 1 was nothing more than a converted *Vostok*. Only by taking the dangerous step of denying the cosmonauts ejection seats and spacesuits was Korolev able to achieve the feat. Fortunately, *Voskhod* 1 flew without mishap.

But that wasn't true for the *Voskhod* 2 team of Pavel Belyayev and Alexei Leonov, who made their day-long mission in March, 1965.

Early in the flight, a spacesuited Leonov wriggled into a narrow, inflatable airlock attached to the *Voskhod's* cabin, leaving Belyayev to pilot the ship. Leonov then emerged into the void and spent several minutes floating free in history's first spacewalk.

Leonov almost didn't live to tell the tale: In the vacuum of space his suit ballooned dangerously, making it almost impossible for him to get back inside. Only by releasing some of his suit's air – an almost desperate measure, considering the risk of decompression sickness – was the exhausted cosmonaut able to reenter the cabin.

Once again, the world was not told of these difficulties, and Leonov's feat seemed to leave the U.S. program in the dust. But it would not be long before the Americans caught up.

A bridge to the moon

Even as the Soviets racked up one space first after another, NASA was getting closer to the first piloted Gemini missions. Launched by a converted *Titan* 2 missile, Gemini was the most sophisticated spacecraft yet created. Gemini astronauts would utilize an on-board computer. And they would be able to change their orbit – something no Soviet crew had yet accomplished.

For NASA, Gemini would serve as a bridge between the relatively simple *Mercury* flights and the awesome challenge of the *Apollo* moon program.

In just 20 short months, between March 1965 and November 1966, 10 *Gemini* crews pioneered the techniques necessary for a lunar mission.

They made spacewalks, some lasting more than two hours. They spent a record-breaking 14 days in space – the expected duration of a lunar-landing flight – in a cabin no bigger than the front seat of a Volkswagen. (One astronaut later called the two-week *Gemini* 7 flight "the most heroic mission of all time.")

They mastered the arcane complexities of orbital mechanics to achieve the first rendezvous between two spacecraft in orbit, and the first space docking. And they made the first controlled reentries into Earth's atmosphere.

To be sure, the *Gemini* missions had their harrowing moments, none more so than when *Gemini* 8 astronauts Neil Armstrong and Dave Scott barely escaped disaster when one of their maneuvering thrusters malfunctioned, causing their spacecraft to tumble wildly through space.

And several spacewalkers had their own difficulties – working in weightlessness was trickier than NASA expected, and more than one sortie had to be cut short when an astronaut became exhausted. Despite these problems, Gemini was considered a tremendous success. It gave the United States the lead in the space race, which was about to become a moon race.

Robotic Explorers

Meanwhile, the Americans and Soviets were extending humanity's reach beyond Earth orbit by means of ever more sophisticated robotic probes. The U.S. *Mariner* 2 became the first interplanetary spacecraft when it flew by Venus in 1962 and sent back data about this cloud-shrouded world. Another American craft, *Mariner* 4, took the first closeup pictures of Mars in 1965.

Closer to home, in 1966, the Soviet Union achieved the first soft landing of a spacecraft on another world when Luna 9 came to rest on the moon's Ocean of Storms and sent back images of its dusty surface.

Also in 1966, U.S. *Surveyor* landers began exploring the lunar surface, and a series of Lunar Orbiter spacecraft began a detailed photoreconnaissance of the moon from orbit. These missions not only advanced scientific understanding of Earth's nearest neighbor; they helped pave the way for the piloted missions that would follow.

Disaster and triumph

By 1967, both the United States and the Soviet Union were ready to test the spacecraft they would use to send humans to the moon. In the process, both countries suffered devastating failures.

On January 27, 1967 the crew of the first piloted *Apollo* mission – veterans Gus Grissom and Ed White, along with rookie Roger Chaffee – perished when a flash fire swept through the sealed cabin of their *Apollo* 1 command module. NASA's investigation of the tragedy revealed numerous technical flaws in the craft's design, including the need for a quick-opening hatch and fireproof materials in the cabin. The fire would ultimately delay the *Apollo* program for more than 20 months.

Disaster struck the Soviets in April 1967, when cosmonaut Vladimir Komarov piloted Soyuz 1 ("union"), an Earth-orbit precursor of a planned lunar-orbit vehicle. When Komarov's flight was plagued by malfunctions, controllers ordered him to come home early. But the craft's parachute did not deploy properly and Soyuz 1 slammed into the Earth's surface at tremendous speed, killing Komarov. The Soviets too had found that winning the moon race could exact a terrible price.

For the Americans, at least, 1967 ended on a triumphant note with the debut of the giant Saturn 5 moon rocket. Towering 363 feet (110 meters) above its launch pad, the Saturn's three stages contained as much chemical energy as an atomic bomb.

When it lifted off on November 9, powered by 7.5 million pounds of thrust, the Saturn's fire and thunder were truly awesome to behold. For NASA, the Saturn 5's flawless test flight marked a key milestone on the road to the moon.

Apollo rising

Americans returned to space on October 11, 1968, when the crew of *Apollo* 7 made an 11-day Earth-orbit test of the *Apollo* command and service modules, which had been redesigned in the wake of the fire.

The flight went so well – one mission controller dubbed it "101-percent successful" – that NASA decided to take a stunningly bold step with *Apollo* 8 – its crew would orbit the moon.

There was a note of urgency in the plan: Intelligence reports showed that the Soviets, who had recovered from the loss of Soyuz 1, were planning to send two cosmonauts on a circumlunar flight before the end of the year.

But after two pilotless circumlunar test flights experienced malfunctions in the fall of 1968, Soviet officials refused to give the go-ahead for a piloted mission.

The way was clear for the *Apollo* 8 crew – Frank Borman, Jim Lovell and Bill Anders – to make history.

On December 24, 1968, after a 66-hour journey across 230,000 miles (370,140 kilometers) of space, the three men fired their spacecraft's main engine to go into lunar orbit. They remained there for 20 hours, making navigation sightings, taking photographs and beaming live television pictures back to Earth, before returning home.

After a reentry at 25,000 m.p.h. (40,230 kilometers per hour) – faster than humans had ever traveled – Borman's crew splashed down safely in the waters of the Pacific.

Apollo 8 was more than a technical triumph, more even than a milestone in exploration: It was a mountaintop experience for the entire human species. A single photograph from *Apollo* 8, showing Earth rising beyond the moon's barren horizon, became one of the century's most famous and inspiring images.

For the Soviets, *Apollo* 8's success was a stinging defeat that seemed to take the wind out of their own moon effort, at least temporarily. For NASA, it had the opposite effect. Now the way was clear to attempt the lunar landing. If all went well on *Apollo*s 9 and 10, *Apollo* 11 would try for a landing the next summer. But that was a big "if;" each mission ranked as one of the most complex and difficult space missions ever attempted.

Amazingly, both flights – *Apollo* 9, an Earth-orbit test of the entire *Apollo* spacecraft and *Apollo* 10, a "dress rehearsal" for the landing in lunar orbit – were almost flawless.

When *Apollo* 10 splashed down on May 26, Neil Armstrong and his *Apollo* 11 crew had less than two months left to prepare for the ultimate test flight.

To land on the moon

July 16, 1969 dawned clear and hot for the spectators (estimated at a million people) who flocked to Cape Kennedy for the *Apollo* 11 launch.

They were not disappointed.

At 9:32 a.m. (13:32 GMT), the *Saturn* 5 came to life, its fire akin to a second sun, its roar shattering the morning stillness as it sent Armstrong and crew mates Buzz Aldrin and Mike Collins on history's third lunar voyage. Three days later the men arrived in lunar orbit, knowing that their real mission – the landing attempt – was about to begin.

On July 20, Armstrong and Aldrin, clad in their spacesuits, took their places in the tiny cabin of the lunar module, Eagle, leaving Collins to pilot the command ship, Columbia. The two ships separated, and with a blast from their lander's descent engine, Armstrong and Aldrin began their trip down to the moon's Sea of Tranquillity.

At 50,000 feet (15,240 meters) they ignited *Eagle's* engine once more, beginning the landing's final phase, called the powered descent. Everyone knew there could be problems, and there were: On the way down, an overloaded computer threatened to abort the mission; only quick thinking by experts in Mission Control allowed Armstrong and Aldrin to continue.

A thousand feet (305 meters) above the lunar surface, Armstrong saw that the craft was heading for a crater the size of

Timetable of Robotic Space Missions: 1960s

Achievement	Country	Spacecraft	Launch Date
First closeup photos of moon	United States	*Ranger* 7	July 28, 1964
First interplanetary flyby	United States	*Mariner* 2	August 27, 1962
First closeup photos of Mars	United States	*Mariner* 4	November 28, 1964
First photos from moon's surface	Soviet Union	*Luna* 9	January 31, 1966
First lunar satellite	Soviet Union	*Luna* 10	March 31, 1966
First automatic space docking	Soviet Union	*Cosmos* 186-188	October 27 / October 30, 1967

a football field that was rimmed with boulders as big as automobiles.

Taking control, he steered Eagle to a clear spot and brought the craft into a vertical descent, while Aldrin called out the diminishing altitude. With his fuel supply running low, Armstrong struggled to see his landing spot through a storm of moon dust kicked up by the descent engine.

Finally, a blue light on the instrument panel signaled that three metal probes on *Eagle's* footpads had touched the moon.

"Contact light," announced Aldrin. Eagle settled gently onto the dusty lunar ground and Armstrong shut down the engine. The two men turned to each other and shook hands in a brief moment of celebration.

Then Armstrong radioed to a waiting Earth, "Houston, Tranquillity Base here. The *Eagle* has landed."

Almost seven hours later, Armstrong emerged from *Eagle*. After descending the ladder on the craft's front landing leg, he planted his left foot on the ancient dust of the Sea of Tranquillity and declared: "That's one small step for [a] man, one giant leap for mankind."

Minutes later, Aldrin joined him on the surface, and for a bit less than two hours, the two men collected rocks, planted the American flag and took pictures.

They also experienced the delights of moving in the moon's one-sixth gravity and marveled at the beauty of the utterly pristine, utterly ancient lunar landscape. Then it was time for history's first moonwalk to end, as the astronauts climbed back into their lander for a fitful rest.

On July 21, the moment of truth for Armstrong and Aldrin was at hand: the firing of *Eagle's* ascent rocket to return them to lunar orbit, and a reunion with Collins. Everyone, on Earth and in space, knew that the engine had to work, or Armstrong and Aldrin would face a lonely death on the moon.

When the prescribed moment came, Aldrin pushed a button on the on-board computer and, after a brief moment, the engine ignited with an invisible flame. Amid a spray of insulation, *Eagle* ascended like a superfast, silent elevator, heading for a rendezvous with *Columbia*. *Apollo* 11's safe return on July 24 marked the beginning of a new age, one in which human beings could truly be called a spacefaring species.

For NASA, the age of lunar exploration was only beginning: More landings were ahead, including *Apollo* 12's pinpoint lunar touchdown in November.

The United States had won the moon race. But the 1970s would bring a change of fortunes for the space agency, while the Soviet Union blazed a new trail, as pioneers of long-duration space missions.

Timetable of Piloted Space Missions: 1960s

Achievement	Country	Crew	Spacecraft	Launch Date
First human in space	Soviet Union	Gagarin	*Vostok* 1	April 12, 1961
First American in space	United States	Shepard	*Freedom* 7	May 5, 1961
First daylong spaceflight	Soviet Union	Titov	*Vostok* 2	August 6, 1961
First woman in space	Soviet Union	Tereshkova	*Vostok* 6	June 16, 1963
First multi-person spaceflight	Soviet Union	Komarov, Yegorov, Feoktistov	*Voskhod* 1	October 12, 1964
First spacewalk	Soviet Union	Belyayev, Leonov	*Voskhod* 2	March 18, 1965
First 8-day space mission	United States	Cooper, Conrad	*Gemini* 5	August 21, 1965
First space rendezvous	United States	Schirra, Stafford	*Gemini* 6	December 15, 1965
First two-week space mission	United States	Borman, Lovell	*Gemini* 7	December 4, 1965
First space docking	United States	Armstrong, Scott	*Gemini* 8	March 16, 1966
First lunar-orbit flight	United States	Borman, Lovell, Anders	*Apollo* 8	December 21, 1968
First lunar landing	United States	Armstrong, Collins, Aldrin	*Apollo* 11	July 16, 1969

appendix g

Maldon Institute Memorandum on the World Peace Council

Memorandum to the Independent Working Group on Missile Defense
Submitted 18 August 2004

INTRODUCTION

The World Peace Council (WPC), a prime international conduit for communist propaganda and covert action, was conceived by the politburo of the Union of Soviet Socialist Republics (USSR) at an obscure Polish village 56 years ago.

Among those present at the Polish meeting were Mikhail Suslov, responsible for the USSR's ideological warfare campaigns; Irene and Frederic Joliot-Curie, French Nobel Prize winners; Pablo Picasso, the Spanish artist; Pablo Neruda, a Chilean poet; Pablo Casals, the Spanish cellist; and Paul Robeson, an American singer.

As World War II ended in Europe in 1945, the Cold War between the United States and the USSR was beginning. In that same year the Kremlin's leadership decided to institute the Information Bureau of the Communist and Workers Parties, known as the Cominform. Essentially, this was a Stalinist deception, eliminating, as a sop to the West, the Communist International (Comintern) and replacing it with the equally powerful Cominform.

Four years later, in 1949, Mikhail Suslov, the Soviet Union's Politburo member responsible for ideological warfare campaigns, addressed the third meeting of the Cominform and stated:

> *"Particular attention should be devoted to drawing into the peace movement trade unions, women's, youth, cooperative, sport, cultural, education, religious, and other organizations, and also scientists, writers, journalists, cultural workers, parliamentary, and other political and public leaders."*

With very minor alterations in wording, Suslov's statement was adopted by the participating Communist parties as a resolution which committed the Moscow-line parties to the "peace" effort. ["Resolution of the Meeting of the Communist Information Bureau, November 1949, One the Report of M. Suslov," *Workers Champion Unity for Peace*, New Century Publishers, February 1950.]

THE WORLD PEACE COUNCIL

The WPC emerged as an organization in 1950. Among the Communist-controlled organizations that evolved and were established by the Soviet Union during the succeeding years were the Afro-Asia People's Solidarity Organization (AAPSO); International Association of Democratic Lawyers (IADL); International Federation of Resistance Fighters (FIR); International Organization of Journalists (IOJ); International Union of Students (IUS); Women's International Democratic Federation (WIDF); World Federation of Democratic Youth (WFDY); World Federation of Scientific Workers (WFSW); World Federation of Trade Unions (WFTU); and the World Peace Council. Another front that grew in importance was the Christian Peace Conference (CPC), which was under Soviet control from 1968 and continues to operate in tandem with the WPC.

The WPC was housed at the same Moscow address – 36 Prospect Mira – as the Soviet Peace Fund (SPF), later the Russian Peace Fund, claiming 35-member states, was controlled by the International Department of the former Communist Party of the Soviet Union (CPSU). As the USSR began to disintegrate, the WPC moved its headquarters to Lonnrotinkatu 25, in Helsinki, Finland

Just prior to and after the abortive coup that attempted to restore the CPSU oligarchs to power in August 1991, Oleg Kharkhardin, a SPC representative, arrived in the Finnish capital as the new Soviet secretary to the WPC carrying a "one time financial gift" of at least $2 million to the WPC. Informed speculation is that this, and similar gifts to more than a dozen groups controlled by the International Department, were made before the demise of the USSR two months later.

The $2 million was placed in a fund to continue the operations of the WPC, managed by a small and secret group that included Kharkhardin and the then WPC Executive-Secretary, Ray Stewart, a New Zealander.

During the past decade, the WPC has experienced several moving experiences, first from Helsinki to Prague, thence to Paris and, for the past four years, to Othonos Street, 10557 in Athens, Greece.

THE STOCKHOLM PEACE APPEAL

Since 1950, when its first initiative was to launch the Stockholm Peace Appeal, the World Peace Council was the Soviet Union's single most important international front organization. The WPC's first Stockholm Peace Appeal sought an absolute ban on the atomic bomb at a time when the Soviet Union's nuclear capability lagged far behind the United States.

The 1950 Stockholm Appeal declared that "*the first government to use the atomic weapon against any country whatsoever would be committing a crime against humanity and should be dealt with as a war criminal*." This theme was promoted by leaders of every U.S. disarmament drive.

Meeting in Sofia, Bulgaria, in February 1974, the World Peace Council set up a new body, the "Conference of Representatives of National Peace Movement," to meet annually and coordinate building up local WPC affiliates, particularly in the non-Communist countries. The December 1974 meeting in Prague, Czechoslovakia, of this WPC body, chaired by Romesh Chandra, discussed implementation of the WPC's 1975 "*program of action*" that included "*special efforts… to draw new forces into their ranks*."

The Prague WPC meeting issued an appeal entitled "Make Détente Irreversible," which considered disarmament and U.S.-Soviet arms control agreements the key to "reducing tensions." But the WPC's Prague appeal also demonstrated that their goal was to reduce American and NATO military strength, which was "provoking tension," and that in its view *détente* would not be "irreversible" until the West got rid of its nuclear and conventional forces. The WPC appeal explained that *détente* was necessary because "*détente created more favorable conditions for the waging of the people's struggles. … The context of détente loosens the grip of imperialism on oppressed nations and on newly independent states dominated by multinational corporations*."

1975 NEW STOCKHOLM CAMPAIGN

Disarmament was the subject of four "commissions" of the May 30 to June 2, 1975 WPC Presidential Committee meeting in Stockholm. The topics were:

1 – Ending the arms race and international détente;
2 – Disarmament and development (social and economic consequences of the arms race);
3 – Dangers of development of new types of weapons (imperialist methods of warfare);
4 – Peace and nuclear weapon-free zones as a contribution to ending the arms race."

In addition to representatives of the WPC's national affiliates, international organizations sending representatives to this WPC meeting included the Women's International League for Peace and Freedom (WILPF), the Stockholm International Peace Research Institute (SIPRI), UNESCO and the World Federation of United Nations Associations (WFUNA). According to the WPC, all participants in the Presidential Committee meeting signed the WPC's New Stockholm Appeal petition initiated at the meeting.

The WPC's dual emphasis on supporting revolutionary terrorist movements while promoting Western disarmament was shown in the decision of the WPC Presidential Committee at that meeting to award its Joliot-Curie Gold Medal simultaneously to the chief of the Palestine Liberation Organization (PLO), Yasir Arafat, and to Bram Fischer, a white Afrikaner member of the South African Communist Party who led the terrorist arm of the African National Congress (ANC) in a sabotage and terrorism campaign in the early 1960s. Fischer died of cancer while serving a life imprisonment term for his terrorist crimes.

The WPC's "New Stockholm Appeal" closed with a request for collaboration "*to all governments and parliaments, all peace and other movements, to political parties, trade unions, women's and youth organizations, to religious, social and cultural bodies which are engaged in endeavors for mankind's advance, to join hands in a great new worldwide offensive against the arms race*."

Of course it was tremendously convenient for the WPC that the Communist governments, the Soviet Union's Third World client states, national peace committees, Communist parties, and a network of WPC-allied international Communist front organizations were already in place through which outreach to trade union, women's and youth, religious, social and cultural groups could be made.

As the new disarmament campaign escalated during the next decade, the Communist Party, U.S.A.- (CPUSA) controlled World Peace Council affiliates, then operating in the United States, moved to harness the organizational structures built during the anti-Vietnam agitation, and unrelated international and domestic social issues to the new disarmament campaign.

On reviewing the WPC's activities in the United States since its formation, it must be emphasized that although the WPC enjoyed a measure of "credibility," particularly in Africa and other Third World countries, an examination of the WPC's ostensible support for "peace" shows that its efforts coincided without deviation from support of Soviet international policies and goals, through backing revolutionary terrorist "national liberation movements" to supporting sweeping Soviet disarmament initiatives that provided neither for international controls nor inspections.

The philosophy of the WPC is well described in its own words: "U.S. imperialism has committed yet another blatant crime using its war machinery and tremendous military build-up thousand of miles away from the U.S.A. in an attempt to intimidate and force into submission those who defend their independence and sovereignty."

CONTROLLING THE WORLD PEACE COUNCIL

The WPC was, at least until 1994, a creature of the Kremlin. Operating under the direction of the CPUSA International Department headed by Boris Ponomarev, a secretary of the CPSU Central Committee and candidate member of the Politburo who worked under Suslov's direction for more than 30 years, the WPC increasingly took an expanding role in Soviet agitation and propaganda operations.

The WPC's stated goals in the 1970s, and to the end of the Cold War, were to mobilize public pressure to block U.S. plans to modernize NATO's Theater Nuclear Forces (TNF) with medium-range Pershing II and cruise missiles, and to upgrade NATO's anti-tank capability with enhanced radiation warheads (neutron bombs). Also targeted was U.S. plans to upgrade strategic nuclear forces with MX mobile missiles and the B-1 bomber, the shelving of the unratified SALT [Strategic Arms Limitation Talks] II treaty, and U.S. Rapid Deployment Force and naval forces in the Indian Ocean and Persian Gulf area.

Organizationally, the WPC was salted with members of the pro-Soviet Communist parties and with reliable pro-Soviet leftists. The WPC's president was for many years, Romesh Chandra, 85, who was in the 1960s a member of the Central Committee of the Communist Party of India. In 1978, the Central Intelligence Agency (CIA) prepared a non-classified study of Soviet propaganda operations which the House Intelligence Committee published as part of its hearing, *The CIA and the Media*. That report said in part:

> "*Yet the Kremlin does not rely on Chandra alone to carry out its policies in the WPC. A representative of the Soviet Communist Party has for years sat at Chandra's side, in a background role, but holding ultimate control. This position was held for a number of years by Aleksandr Berkov, but the job was taken over in early 1977 by Igor Belyayev. Berkov and later Belyayev were listed only as one of a number of secretaries in the Secretariat, but they were recognized within the organization as the final authority, including the power of veto. Berkov, for example, was known to have overruled Chandra on certain decisions involving meetings or other activities and relayed the party line concerning WPC causes and operations.*"

The study said that the International Department "*is responsible for major clandestine political activities abroad including the front organizations, foreign Communist parties and activities such as strikes and demonstrations designed to destabilize foreign governments.*"

In terms of power in Moscow, the report stated that the International Department "*stands firmly over the KGB for clandestine political activities*," and that in these matters, the KGB may act only on the direction of the International Department.

Most of the WPC leaders were active in the Communist parties of their own countries and also led the local WPC affiliate. These WPC "national peace committees" in turn are run as fronts of the local Moscow-line Communist parties which, like the WPC, were directed by the International Department of the CPSU. That provided two mechanisms for ensuring that the resolutions and statements of the local WPC affiliates did not deviate from the line set by the Soviet Communist Party.

THE REVISED WORLD PEACE COUNCIL

In May 2004, the World Peace Assembly, the governing body of the WPC, met in Greece and elected Orlando Fundora, 77, a Cuban, as its president. According to Fundora, from 1990 to 1994, attempts by delegates, led by the Russians, attempted to turn the WPC into a "*bland, odorless, colorless council – an organization that would not upset anyone.*" Fundora added, "*It was visible that the collapse of the socialist camp debilitated the Council very much at the time.*"

At a conference in Mexico ten years earlier, Japan, France, Portugal, Palestine and Cuba created a new secretariat (its predecessor had disappeared) and the "debilitating tendencies" from Scandinavia and other European states were challenged and defeated. Joining the six state delegations already noted, were Mexico, Costa Rica, Panama, Ecuador, Argentina, the Dominican Republic, Canada and the United States. The revivified WPC marked its success by a statement attacking "*NATO's genocidal action in the war against Yugoslavia.*"

In May 2004 at the Athens meeting there were 134 delegates from 62 organizations from 47 countries. (Orlando Fundora's figures were 150 delegates, 60 member-organizations and 50 countries.) There were numerous declarations that ranged from support for Slobodan Milosevic to attacks on the United States and its allies worldwide, through denunciations of NATO and its policies and the presence of U.S. troops in Iraq, Afghanistan, Korea, the Balkans and Haiti.

Fundora was named as president, Hong Ha, vice president of the Vietnam Peace Committee, vice president and Coordinator for Asia; Thanassis Parfilis, from Greece was elected General Secretary. Romesh Chandra together with Evangelos

Mahairas of Greece, both former communists and presidents of the WPC were named Presidents of Honor.

As the Marxists say, “The Struggle Continues!”

appendix h

Summary Statement on East Coast Missile Defense

Ronald C. Tocci

New York State Armed Forces Legislative Caucus

Tuesday, May 25, 2004

SUMMARY STATEMENT

We really are considering two matters here: one is whether the United States Government will provide the people of New York and the rest of the nation with a full and effective defense against a missile attack from anywhere in the world.

The other is whether or not our government can be persuaded to remove the political barriers in order to bring this about, so that, for instance, we can proceed with the development of regional East Coast defenses against short-range sea-borne Scud missiles, this as a building block leading – through *concurrent* efforts – toward a space-based system that can provide global protection.

And, for those who still doggedly maintain that missile defense is technologically impossible – even in the face of overwhelming evidence to the contrary – I draw your attention to *Spirit* and *Opportunity*. Any nation that can put a couple of robots on Mars to select and analyze tiny pieces of rock and move selectively through the Martian landscape is a nation that most assuredly is capable of taking out a missile that's been fired at its people. Or, if that's not a good enough example, how about a sea-launched cruise missile that can find somebody's mailbox 600 nautical miles away?[1]

No. The impediments we face today are political not technical. They come from a 30-year-old political decision by the U.S. Government to hold the American people deliberately hostage to the offensive weapons of another nation – in this case the entire nuclear arsenal of the Former Soviet Union.

This concept of consciously keeping our citizens vulnerable to someone else's weapons – thereby knowingly putting them in harm's way – became in the mid-1960s the centerpiece of a doctrine called Mutual Assured Destruction, or MAD (rather appropriately named by the way).

The idea was that both the Soviets and the Americans would hold their peoples hostage to each other's nuclear weapons to create a "Balance of Terror." Simply put: "You nuke our kids and we'll nuke yours!"

In other words, *the U.S. Government's way of defending its people against an attack was to wait until the nation first had been struck by one or more nuclear warheads – resulting in the likely deaths of millions before we would even think about striking back to kill even more millions, providing we had the stomach for it.*

In 1972, the ABM Treaty was put into place to enforce this MAD doctrine. And for 30 years we adhered strictly to its provisions, so that the American people were thus deprived of constructive efforts to deploy missile defense systems – a unique form of government denial of protection that has never before nor since been accorded to the people of this nation.[2]

Then, in 1989 the Berlin Wall came down and in 1991 the Soviet Union became extinct, to be replaced by Russia as the dominant force in the Commonwealth of Independent States. By that time, however, other nations were building their nuclear arsenals – China, North Korea, Iran, India, Pakistan, Libya, and so on, with Russia and other parts of the CIS still laying claim to thousands and thousands of nuclear warheads, which raised then and continues to raise now huge nuclear security and stability problems – such as an unauthorized or deliberate launch by either a sovereign state or terrorist group.

As a consequence to all of this, in June, 2002, President Bush withdrew the United States from the ABM Treaty, and since then, the government has been moving in a somewhat off-again-on-again fashion in dealing with this now 45-year-old idea of defending our people from missile strikes – the laid-back pace of which is becoming a real curiosity in this post-9/11-21st-Century era of unmitigated terror and violence.

Which is why we are here. We want to get something going on the East Coast quickly – before we lose something else – and we want to see more purposeful and forthright action in moving toward at least a limited global protection system, which requires inclusion of a space-based system.

But there is something amiss that's holding us back that is neither technical nor economic. It is the lingering ghost of MAD.

In spite of the ABM Treaty withdrawal, the doctrine of Mutual Assured Destruction still remains the driving intellectual force upon which much of the opposition constructs its several different public arguments as to why missile defense is "unworkable" or "dangerous" or "provocative" or "threatening" or "destabilizing" or "wasteful" or "imperialistic" or "unnecessary" or "selfish" or "immoral."

Right now MAD is being held in place by the cultures it has created, rather than by some legal instrument – this as a consequence of over 40 years of application in which its basic precept – that of holding the American population hostage to someone else's weapons – has been a constant in the calculus of both the political and the strategic cultures that have driven significant parts of U.S. foreign, security and defense policies for so many years.

Evidence of this abounds. Here are some recent examples.

Forty-nine retired generals and admirals wrote to the President on March 26, 2004 urging the postponement for technical reasons of ground-based strategic mid-course ballistic missile defense, which may or may not be valid. But what is more significant is a follow-on paragraph which basically denigrates the importance of this and presumably other systems, because:

> *U.S. technology, already deployed, (presumably our high-tech spy satellites, precision ordinance, and formidable arsenals of offensive nuclear weapons) can pinpoint the source of a ballistic missile launch. It is, therefore, highly unlikely that any state would dare to attack the U.S. 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.*[3]

Translation: It's not really necessary to defend our population, since if someone is foolish enough to strike at us, we will nuke them. We'll be safe, because they wouldn't dare.

This clearly is a continuation of the MAD doctrine, that is, we deliberately leave our people defenseless, essentially – it can be argued – as a dare to someone to try something.

Let's look at some of the implications of this advice to the President and to the American people.

Assuming that some sort of U.S. preemption would first be attempted, which is not made clear here but has been argued elsewhere, it would mean that the United States would need a global 24-hour-monitoring system that could first detect the *preparation* for a launch (very difficult to interpret) and then to move swiftly enough to kill a missile *before* it is launched, a feat even more technologically complicated than *anything* proposed for the kind of missile defenses that we have been discussing – so that these retired generals and admirals, if they do also have preemption in mind, are seemingly contradicting themselves, leaving the impression, rightly or wrongly, that while we may actually have the technology, it should not be used to defend the people of New York or of the rest of the nation.

Further, their adherence to MAD is evident in the very clear implication that should we fail to preempt such a strike – thereby perhaps resulting in the deaths of some two or three million Americans – we will then subject the aggressor to "annihilation." This is MAD Cold-War-style that suggests a long-standing political bias against missile defense.

Two other points bear mention. Some of our enemies actively seek their own deaths, not only in killing the Infidels but to achieve eternal paradise. It is unlikely that the threat to annihilate them will act as much of a deterrent. Indeed, annihilation could prove to be an incentive, as in: Go ahead, make my day!

Finally, with respect to the retired generals and admirals, this stark reality: Even if we had the most sophisticated global command system imaginable, it would be virtually impossible to detect and prevent a covert planned strike from either a land-based mobile missile launcher (and there are many of them hidden all over the Eurasian landmass) or from the camouflaged deck of a freighter or from a submarine – all of which can move largely undetected to strike at will. These mobile platforms are the 21st Century mass destruction weapons of choice.

They can be readied to fire too quickly for a preemptive response. You can only get them in flight before they hit you – which is what missile defense is all about.

Besides, how do you annihilate a population if you might not know for sure whose submarine it is or who exactly arranged for the freighter or how to pinpoint the state sponsor and/or terrorist group who fires the mobile missile and then vanishes into the porous reaches of Eurasia? What president will order up a multimillion-casualty strike under those conditions?

Wouldn't it be better to have missile defense, which harms no one, as the first line of defense, rather than incinerating someone else's society as our first line of defense?

Perhaps the most compelling evidence that purposeful population vulnerably continues as part of our security culture can be found in our current relationships with both Russia and China, who remain exempt from, and thus, out of the reach of any missile defense efforts the U.S. Government may be taking to defend its own people.

In other words, the offensive nuclear weapons of Russia and China are off limits to any defense efforts we ultimately build – deliberately keeping our population defenseless against them, as the following statements attest.

First, from late in the Clinton years, here is a rundown of some of the "Talking Points" used by a high administration official in his Moscow discussions, reportedly first leaked to the public by the *Bulletin of Atomic Scientists*, circa 1999:

> *. . . The U.S. NMD [national missile defense] system would not be directed against Russia and would not weaken Russia's strategic deterrent potential . . . Both [nations] now possess and, as before, will possess under the terms of any of the possible future arms reduction agreements, large, diversified, viable arsenals of strategic offensive weapons . . . These strategic offensive forces give each side the certain ability to carry out an annihilating counterattack on the other side regardless of the conditions under which the war began . . .*[4]

This is not "old hat." The policy still is in place a decade later, with the Bush Administration's reassurances even more publicly proclaimed to include not just the Russian Federation but China as well, this as reported in a major Australian newspaper, *The Australian*, on February 10, 2004:

> *. . . The frank insights into the US plans to develop a missile shield over the US came in a briefing with senior US officials who are visiting Canberra. US State Department Bureau of Arms Control senior advisor for missile defence Kerry Kartchner [after discussing U.S. restricted missile defense plans against only rogue states] . . . said China and Russia were the only powers that could trigger an "offensive-defensive" arms race. "(But) we have taken steps in both cases to assure China and Russia that the limited modest missile defence the US plans to deploy is not aimed at them . . ."*

Then on April 16, 2004, a major American newspaper gave editorial support to this pledge to keep Americans – and other friendly nations – defenseless against the weapons of China, but warned against the U.S. and non-Communist Asian nations from going too far with this notion of a limited defense against even rogue nations, and most particularly against developing any defenses that might protect Taiwan from Chinese missiles, stating:

> *By pushing ahead with its plans for (limited) missile defense in Asia, the Bush administration runs the risk of creating a larger threat than the one it means to counter. The danger . . . is that it would unnecessarily isolate and antagonize China . . . The greatest folly is to make Taiwan part of such a system. A missile defense would be destabilizing as well as unnecessary . . .*[5]

And how have the Russians responded of late? Some arms controllers have maintained for 40 years that a U.S. missile defense would lead to an arms race but there has been no credible evidence to support this assumption. Quite the contrary, the opposite appears to be true, as this March 24, 2004 report from *Russia Reform Monitor* suggests – which contrasts sharply with the tranquil assurances given by Kerry Kartchner on behalf of the United States Government six weeks earlier, as cited above:

> *Defense Minister Sergei Ivanov has said Russia may revise its defense posture if NATO retains its "offensive military doctrine," Interfax reports . . . Ivanov warned that because [Russia's interests could be threatened] it cannot be ruled out that Russia will turn nuclear weapons "back into a real military tool." He also wrote that Russia's interests and commitments to its allies might require the "preventive use of force."*[6]

There is further evidence that MAD is still with us. As has been discussed, a space-based system, with layered backup, would have a global reach that could "see" an enemy launch from anywhere in the world and respond instantly through "layered defenses" – to be reasonably certain of destroying the incoming warhead (actually, up to 200 warheads could be handled with an efficiently designed program).[7]

Such a system obviously would put an end to the current situation of holding our people hostage to certain parts of the world. It would end the doctrine of MAD and with it replace the culture of what we *can't* do to defend ourselves with a culture of what we *can* do to defend ourselves.Early in the Bush Administration, this prospect was at least discussed in favorable terms, though no really definitive actions were taken to restart our efforts regarding a space-based system.

The following statement as reported in the April 2, 2004 Missile Defense Briefing Report explains itself:

> *Space-based capabilities are not on the American agenda for the near future, according to the Pentagon's top missile defense official [speaking before a missile defense conference on March 22] . . . Missile Defense Agency (MDA) director Lieut-Gen. Ronald Kadish said that the contemporary ballistic missile threat does not currently warrant a space-based anti-missile capability . . . "From the standpoint of threats we face . . . we don't need to put weapons in space . . ."*[8]

So, what is to be done? It is pretty clear that our government continues a policy of selective hostage-holding. It is a policy of deliberate vulnerability that has neither been officially proclaimed nor even discussed in any meaningful way with the American people.

It is a policy that must be brought out into the full light of day to be examined openly and candidly by the people of the State of New York and of the rest of the nation. This can be done by asking ourselves, as citizens, and, most pointedly, also asking our political leaders – elected and pretenders alike – this one critical question:

Should it be the policy of the United States Government deliberately to hold its own citizens hostage or otherwise vulnerable to the offensive weapons of another nation or terrorist group?

The answer is vital to our future. If we choose to hold ourselves, our families, our friends, our neighbors deliberately defenseless to someone else's weapons, then it should be publicly recognized as a conscious American decision and then we should be prepared to accept the consequences.

If we choose not – then we will want a very good missile defense. But this will not become a reality until this very large question is answered with a resounding negative.

And for those who are against missile defense for New York and other states, there's a question for them: *Why do you not want to defend us from a missile attack? What is it that makes you so terribly hostile to the idea?*

However all of these questions may be answered – or even if they are never asked because people don't care all that much – whatever – *Americans will get their missile defense.*

The question here is when? Will it be before the fact – or after the fact, where some estimates calculate a huge loss of life and extreme infrastructural damage that could occur.[9]

Will there be, at some point, another sort of 9/11 inquiry? Let us hope not.

So it is that our Resolution not only calls for a responsible missile defense but it helps to set the stage with what surely should become a hugely important public discussion.

So that, whatever may be written or said in the future about whether or not the people of New York and elsewhere across America choose to defend themselves against ballistic missile attack – it will not be the that "The people were never told."

End Notes

1 The Tomahawk sea-launched cruise missile (sometimes referred to as the Tomahawk Land Attack Missile or TLAM) currently in the U.S. inventory has an accuracy level of 10 meters or less (~30 feet) with a range of 600 nautical miles for land attack missions. It can carry a 1000 pound conventional warhead or in some configurations, combined effects bomblets. ALSO: The Tactical Tomahawk would add the capability to reprogram the missile while in-flight to strike any of 15 preprogrammed alternate targets or redirect the missile to any Global Positioning System (GPS) target coordinates. It also would be able to loiter over a target area for some hours, and with its on-board TV camera, would allow the warfighting commanders to assess battle damage of the target, and, if necessary redirect the missile to any other target. Tactical Tomahawk would permit mission planning aboard cruisers, destroyers and attack submarines for quick reaction GPS missions. If approved by Congress, the next generation of long-range Tomahawk cruise missiles would cost less than $575,000 each. The cost savings and increased capability comes from eliminating many older internal systems and components built into the model currently in the Navy Fleet. In addition, streamlined production techniques and modular components would combine to lower the cost.

2 For details concerning the history of MAD and the ABM Treaty, see "Discussion Points on Missile Defense For The Homeland, Friends And Allies," prepared for the State Legislature of New Hampshire Hearings on Missile Defense, submitted 8 January 2002. FURTHER NOTE: Beginning in the mid-1950s, the U.S. was actively engaged in missile defense development that used small nuclear warheads to be exploded near an incoming enemy nuclear missile. Known as the NIKE, Sentinel and Safeguard systems, they were in varying stages of development through to the advent of the ABM Treaty "that would make the development of such defenses impossible . . . [Even if in that day] Sentinel had been deployed or Safeguard's operation continued, either would have provided adequate protection against the threats experienced up to the present, short of those [thousands of warheads] from the Soviet Union." FROM: Dr. Gregory H. Canavan, Senior Fellow and Science Advisor at Los Alamos National Laboratory Missile Defense For The 21st Century (Draft), Ballistic Missile Defense Technical Studies Series, The Heritage Foundation, 2003, 20.

3 See "49 Generals And Admirals Call For Missile Defense Postponement," full text of letter of March 26, 2004 to the President signed by Admiral William J. Crowe (USN, ret.), General Alfred G. Hansen (USAF, ret.), General Joseph P. Hoar (USMC, ret.), and 46 other retired officers, www.wagingpeace.org/articles/2004/03/26_generals_admirals_postponement.

4 From: "Documentation, ABM Treaty 'Talking Points,' NMD Protocol: Topics for Discussion," Comparative Strategy, An International Journal, Vol.19, No.4, 2000, 361, 364, 365. Verified as those of John D. Holum, who on August 7, 2000 became Under Secretary of State for Arms Control and International Security and Senior Adviser to the President and the Secretary of State for Arms Control, Nonproliferation and Disarmament. Beginning in 1993, he was Director for the Arms Control and Disarmament Agency. This statement, particularly as highlighted by the above italicized sentence, is regarded by several recognized experts as one of the most rare and candid admissions by any senior U.S. official that the ABM Treaty was about intentional U.S. societal vulnerability to nuclear attack, and thus, official recognition of the MAD doctrine to hold Americans hostage.

5 From: "Asia's Ill-Advised Umbrella," editorial, The New York Times, 16 April 2004, A20.

6 From: Russia Reform Monitor, The American Foreign Policy Council, Washington, D.C., No.1133, 24 March 2004.

7 Refer to Ambassador Henry F. Cooper's briefings, before members of the State of New York Legislature at various times in 2003 and 2004, as well as his presentation at conference "Defending the Northeast, the Nation, and America's Allies from Ballistic Missile Attack," Institute for Foreign Policy Analysis, Inc., Valley Forge, PA, 28-29 June 2001.

8 From: Missile Defense Briefing Report, The American Foreign Policy Council, No.139, 2 April 2004.

9 One involves the Al Qaeda, or similar group, outfitting five "tramp" freighters or possibly container ships with nuclear tipped (15-kiloton, Hiroshima size) SCUD-B missiles. The number five was selected because the pattern of mounting "the mother of all" attacks, at least on September 11, involved at minimum five commercial jets, three of which succeeded. Were such a cataclysmic event to be contemplated, it seems reasonable to assume that five vessels likely would be involved, with, say, three deployed off the East Coast (New York, Washington, Norfolk and the Atlantic fleet) and two off the West Coast (San Francisco, San Diego and the Pacific fleet). The combined death toll projected by reliable data could be as high as 3,729,000 not counting a like number of injuries, plus extreme damage to infrastructure. While not attempting here to assess the probability, it should be stressed that the capability is realistically available and, thus, deserves to be factored into homeland defense planning. Source: *Scenarios Involving Various U.S. Cities Attacked by Al Qaeda Terrorists with Sea-launched SCUD Nuclear Missiles*, The Institute for Foreign Policy Analysis, Inc., Cambridge, MA.

appendix

The Legacy of *Brilliant Pebbles*, *Clementine*, and *Iridium* for Future Space-Based Missile Defenses

Substantial contributions to this Appendix were made by Drs. Lowell Wood, Ed English, Lyn Pleasance and Arno Ledebuhr, principals in conducting the *Brilliant Pebbles* and *Clementine* programs – and also knowledgeable of Motorola's *Iridium* communication satellite system, which exploited Brilliant Pebbles' concepts.

Those who cannot remember the past are condemned to repeat it.
– George Santayana, *Life of Reason*

Since withdrawing from the Anti-Ballistic Missile (ABM) Treaty in 2002, the United States is no longer legally precluded from acquiring highly effective space-based interceptor defenses, moreover in a very short time-interval. The primary impediment to doing so arises from lack of political will, rather than difficult or costly technical challenges. The needed technology was developed during the Reagan and Bush-41 administrations (1984-1992), was abandoned by the Clinton administration in 1993, and has not yet been revived. At best, there have been hints that the current administration may initiate a plan to begin a "space-based testbed" in a future administration, sometime in the next decade.

Such plans often reflect a false view that space-based interceptor systems are much more complex and costly – or less "technically ready" – than ground-based defenses, which are the primary focus of ongoing missile defense programs. But that premise does not square with history, which should be reviewed from time to time to make clear that the choice for not giving the American people the benefits of space-based defenses is purely a political decision – made quite deliberately by the past two administrations, indicating the bipartisan nature of the political aversion to building effective space-based defenses.

Current missile defense programs are often traced to the Strategic Defense Initiative (SDI), launched by President Ronald Reagan in his March 23, 1983 speech and the Strategic Defense Initiative Organization (SDIO) formed in April 1984. But, while many SDI programs indeed have descendants in ongoing missile defense programs, notably missing since 1993 is any serious effort to consider space-based defenses, which were previously crucially important – literally, primal – to the overall layered defense architecture.[1] In particular, as discussed below, space-based interceptors were easily the most innovative, most mature, cost-effective defense system to result from the $30 billion invested in the SDI during the Reagan and Bush-41 administrations.[2]

The following discussion briefly traces the evolution of space-based interceptors during the SDI era and relevant technology demonstrations through the mid-1990s, when all the needed technologies were demonstrated such that there can be little objective doubt of the SDI claims for space-based interceptor systems. Since then, technology outside of Department of Defense (DOD) missile defense programs has advanced several generations, so great confidence can be placed in building and deploying a highly-effective space-based defense within 5 years for $5-10 billion, as soon as it is politically correct to initiate such development.

Prelude – Smart Rocks. By 1986, the SDIO and its contractors had developed a kinetic energy Space-Based Interceptor (SBI) defensive system concept involving a few thousand more-or-less conventional guided missiles housed in several hundred large platforms deployed in low-earth orbit, supported by an

1 Considered were all basing modes and both directed energy (e.g., beams of electromagnetic radiation of various types and several different 'flavors' of particles beams) and kinetic energy defenses (e.g., explosively-fragmenting warheads carried by ground-to-air interceptor-rockets and "hit-to-kill" vehicles which acted by merely 'driving into' attacking missiles and warheads). President Reagan instructed the DOD not to use "volume" attack-negation means that might require use of nuclear warheads of any type, a basic point often obscured or denied outright in revisionist or poorly-informed histories.

2 See Appendix C for a definitive discussion of the history justifying the claim that, in 1993, SDI technology for space-based interceptors was more mature than that for ground-based interceptors.

extensive distributed command-and-control infrastructure, including a multiplicity of observation and communications systems based in part on constellations of earth-orbiting platforms.[3] Because this defensive architecture contemplated interdiction of the flight of a large ballistic missile by arranging an extremely high-speed collision between it and a much smaller interceptor-missile in which the destructive military objective is accomplished *only* by the kinetic energy of the arranged collision, this system was nicknamed "Smart Rocks," with the computer- and sensor-bearing (and thus "smart") 'rocks' being 'thrown' by the defense into the paths of the far larger missiles launched toward distant targets by the offense.

However, as the program evolved and the "Smart Rocks" design was elaborated and its projected performance analyzed, increasing concern arose as to the economic cost, the military effectiveness and the vulnerability of such a system – i.e., the degrees of its fundamental compliance with the "cost-effectiveness-at-the-margin" criteria first enunciated by Ambassador Paul Nitze, then mandated by President Reagan in Executive Order and finally codified in statute. The system, whose cost was estimated by DOD to be approximately $120 billion, seemed likely to offer only quite limited defensive efficacy – and was assessed by teams of DOD experts to be relatively "fragile" in terms of its ability to cope with likely countermeasures by the offense.

The Advent of Brilliant Pebbles. In September 1986, an alternative approach was demanded privately by the Missile Defense Caucus in the Congress, a demand endorsed the evening of the same day by a majority of the Committee on the Present Danger, presented to the president privately the following day, and immediately endorsed by him. One such alternative was offered in 1987 and its development commenced in cloistered circumstances at the Lawrence Livermore National Laboratory (LLNL); this alternative surfaced publicly in late 1988, following President Reagan's veto of the Defense Authorization Act (because it would suppress SDIO's spending on space-based interceptors) and after initiation of a series of DOD and presidential reviews.[4]

This new defensive architecture consisted of an earth-orbiting constellation of a few thousand individual interceptors, each housed in its own support spacecraft. Each interceptor-spacecraft combination would have the entirely-on-board capability to detect ballistic missile launches and thereafter to track the flight of the missile's booster-rocket and, if directed, swiftly change its orbital parameters to intercept the booster or its warhead at ultra-high speed, converting both into incandescent vapor high in space, due to their mutual kinetic energy alone.

Various intrinsic and optional features permitted this constellation to be entirely autonomous in its defensive operations, i.e., independent of all other U.S. capabilities.[5] Indeed, each spacecraft could be made autonomous upon command. These features – crucial to the robustness of the defensive system in plausible military circumstances (indeed, in specific ones whose plausibility had been asserted in private by representatives of the Soviet government) – necessitated far more capable computers, sensors, communications, and rocket-propulsion than had been expressed in the baseline designs of "Smart Rock" defenses.

Very importantly, the desired system cost and performance dictated that the individual elements of interceptors be of light weight, small size, and low price; i.e., they must be derived from the most modern technologies commercially supported, most of whose figures-of-merit had been advancing exponentially in time. Extended intervals of R&D to 'reach' for the technically-unavailable or reliance on proprietary technologies of likely-high price or questionable source-reliability were precluded by program "ground rules." In addition to its emphasis on the use of the highest-performance technologies reliably available from anywhere, the system was distinguished by its intensive "mass discipline" – its intolerance of inclusion of non-essential mass anywhere – and its frank appeal to the characteristic economies of mass production to achieve the cost goals of the underlying defensive architecture. The small size and high performance estimates of this system relative to those of its immediate "Smart Rocks" ancestor naturally elicited the nickname of *Brilliant Pebbles*.

Before DOD formally adopted *Brilliant Pebbles* (BP) into the Strategic Defense System (SDS) architecture as the Global Defense Segment thereof – and simultaneously designated it as the "most technologically mature" and "first to deploy" of all of the component Segments of the Strategic Defense System in March 1990, it "scrubbed" all aspects of the proposed system very intensively throughout most of 1989, responding in part to a classified *ad hoc* Presidential Decision Directive signed by President George H.W. Bush in June 1989. This highly multi-faceted scrubbing resulted in changes throughout the technical designs, architecture, and software of the previously-proposed *Brilliant Pebbles*, usually in the direction of adding new capabilities or augmenting existing ones.

Key 1989 Red Team Contributions. Arguably the single most significant of the nine major pebbles reviews during 1989 was

3 Space-based sensor systems, forerunners of today's SBIRS-High and SBIRS-Low/SSTS systems, were an integral part of this SBI system, composed a major percentage of the overall system cost, and posed significant systemic vulnerabilities to defense suppression attacks.

4 Appendix D gives an informative review of the rise and fall of the *Brilliant Pebbles* program from the perspective of the Missile Defense Agency's historian.

5 In particular, no other space-based or ground-based sensor system was required to support *Brilliant Pebbles*. Further, it could replace SBIRS-High and SBIRS-Low/SSTS in providing tactical warning and attack assessment data, as well as the surveillance and tracking information to terrestrially-based, components of a layered defense.

Brilliant Pebbles *Component and Subsystem Mass Design Goals*

BP KKV Dry Mass: 2.843 kg

Propellant Mass: 6.000 kg

BP KKV Wet Mass: 8.843 kg

ΔV> 2.5 km/s; Burnout Acceleration >9-g

	Quantity x Unit Mass† (g)	Element Mass (g)
Pumps	2 x 50	100
Valves	2 x 35	70
Gas Generator	1 x 30	30
Iso Valves	2 x 15	30
ACS Valves	6 x 18	108
Regulator	1 x 30	30
Thrusters	4 x 105	420
Thruster valves	4 x 20	80
Bridge Structure	1 x 100	100
Tanks	2 x 230	460
Miscellaneous	150	150
DACS Total		1578

†Based on hardware components and designs

KKY Payload:	**Mass (g)**	**Totals (g)**
Star Tracker		85
Lens	30	
FPA	5	
Elec.	10	
Struct.	40	
UV/Vis		152
Lens	67	
FPA	5	
F.W.	18	
Elec.	10	
Struct.	52	
IR Tracker		225
Lens	100	
FPA	45	
Elec.	10	
Struct.	70	
LIDAR Receiver		280
Laser Transmitter		130
IMU		85
Processor		160
Processor	100	
Shield	60	
Power System		130
Battery	80	
Elec.	50	
Miscellaneous		18
Payload Total		**1265**

the one performed by DOD's dedicated 'Red Team,' which critiqued the pebbles baseline design from the vantage-point of a "robust Soviet Union in 2010." Until this review, the basic pebbles concept was that of an exceedingly capable air-to-air interceptor missile, housed inside of an absolutely minimal "life jacket" which decoupled it from the space environment for an interval of 1-2 decades, maintaining it in condition to be called upon at any time to perform its military mission of defeating a ballistic missile in the early phases of its flight – and to employ its sensors to detect the launch of such missiles.[6]

The Red Team burdened this paradigm with a hypothetical year-2010 operational environment in which pebbles would face a variety of simultaneously-imposed, highly robust countermeasures for many hours before an all-out intercontinental ballistic missile (ICBM) attack – and then would be required to operate in the face of these countermeasures throughout every moment of their defensive operations. Substantial modifications of pebbles design – including some growth of mass and dollar budgets and additional (e.g., underground nuclear) testing – ensued; however, a manifestly highly robust design resulted. At the same time, all provisional pebbles capabilities not found to be required by the performance demands of the Red Team were deleted without exception, in the process of specifying the design and features of the "Government Brilliant Pebble" in later 1989.

Key 1990 **Brilliant Pebble** *Features.* The figure above lists the mass of the various components of the 1990-vintage LLNL version of a *Brilliant Pebble*, as incorporated into the Global Protection Against Limited Strikes (GPALS) architecture formally adopted by the Bush-41 administration. The objective of this space component of the GPALS architecture, which employed 1000 pebbles in low-earth orbit, was to provide high confidence[7] in destroying a major percentage (well over half) of 200 warheads that might be abruptly launched from anywhere in the world at the United States or its overseas troops and allies (the remainder of the 200 warheads was assigned to ground-based elements of the layered GPALS architecture). This *Brilliant Pebbles* constellation, then expected to comprise a quarter of the total GPALS defensive system cost, was to be given multiple intercept opportunities against ballistic mis-

6 Indeed, the concept of an air-to-air interceptor missile that was 'jacketed' to be able to fly in earth orbit for an indefinitely long interval was one empirically determined to be highly congenial to both officials and uniformed officers in DOD, as the favorable characteristics of such missiles – including their costs, performances and service-lives – were widely appreciated.

7 The most design-stressing requirement was that each warhead 'counted' as successfully defeated would have to be negated by two separated dispatched pebbles, each of which had a conservatively-evaluated probability-of-kill – P_k – of 0.9, so that the compounded P_k of the two pebbles defending-in-concert was conservatively rated as 0.99. The statistical 'leakage' of warheads assigned to the baseline pebbles defensive constellation in a worst-case (short range; no warning; salvo-launched) attack on the United States thus amounted to roughly one single warhead.

siles in all phases of flight – boost, midcourse and high-endoatmospheric – making it a layered defense against even medium and short-range ballistic missiles world-wide.[8]

After the GPALS architecture was adopted, SDIO invited industry to compete to manage the *Brilliant Pebbles* Demonstration-Validation (DemVal) program intended to design for deployment a 1000 pebble constellation (with logistics costed to support replacing each pebble once during a 20-year period). Two teams were selected – ones led by Martin Marietta and another by an *ad hoc* TRW-Hughes co-captaincy – and SDIO proceeded to begin a competitive formal acquisition program. The two specific designs differed in detail, but not in substance, with the baseline LLNL concept summarized here. Both teams were confident that they could build an operational system within an $11 billion (FY 1989 dollars) 20-year total life-cycle cost estimate, approved by the DOD Cost Analysis Improvement Group (CAIG) as a part of the Defense Acquisition Board Milestone I reviews. Indeed, they offered firm, fixed-price contract proposals to deliver as-specified pebbles in earth orbit to the government, which were accepted.

The *Brilliant Pebbles* Program conducted seven flight tests – three orbital and four sub-orbital ones – and developed an extensive capability for integrated system testing on the ground, including tethered flight-tests. Unfortunately, the last test of a highly optimized "pebble" that had passed all ground qualifications failed when the *Minuteman* launch vehicle had to be destroyed before releasing the pebble. The DOD decision to invest in the development programs of the two selected DemVal teams meant that the prototype hit-to-kill vehicle would not be fully "battle" tested.

Although these tests were not always completely successful, they provided an impressive data base to support the formal development process and provided many useful insights into key phenomena important to dealing with potential countermeasures and indeed to demonstrating latent unanticipated capabilities. For example, one intercept failure due to a faulty target warhead nevertheless demonstrated the pebbles' unanticipated capability to track and close on a reentering warhead in the earth's upper atmosphere. The program also participated in a major manner in three underground nuclear weaponry effects tests at the Nevada Test Site, validating the designed-in hardness against key nuclear weaponry effects of various pebbles components and technologies.[9] Concurrent testing of pebbles components against other types of threats to its effectiveness – e.g., laser and microwave beams, "engineered space debris," etc. – also took place at various specialized DOD test facilities.

There are many differences between this "Vintage 1990 Pebble" and the hit-to-kill interceptor vehicles of the present-day missile defense systems, none of which are space-based. In addition to being much smaller and of far lower mass (by roughly 5-fold) than present-day interceptor kill vehicles, pebble requirements led to many more capabilities – e.g., in the population and performance levels of its active and passive sensors, and in its computer control and propulsion sub-systems – to intercept with high reliability highly-capable ICBMs and their components, as well as to assure survivability and full functionality of the defense in the face of robust active and passive counter-countermeasures.[10]

The Decline of Brilliant Pebbles *and the Rise of* Clementine. This the most cost-effective and mature program of the major components of GPALS architecture was curtailed by Congress in 1992 and eliminated by the Clinton administration in 1993 – but not for technical or management reasons. As explicitly noted in an April 1994 report by the DOD Inspector General, this fully-approved, Major Defense Acquisition Program – the SDI's first – had been managed "efficiently and cost-effectively within funding constraints imposed by Congress" and the termination of key contracts "was not a reflection on the quality of program management."

Indeed, it was a purely political decision – anticipated by SDIO management in the last year of the Bush-41 administration. When the 1992 Defense Authorization Act directed the SDIO to reduce *Brilliant Pebbles*' status from a fully approved Major Defense Acquisition Program to a technology demonstration program, SDIO recognized the lethality of this political resistance to developing space-based defenses should there be a change of administrations in 1992, and sought a politically viable "hedge" program to prove key pebbles technologies.[11] These considerations led to a program to send a spacecraft using pebbles' technology so far away from the earth before its capabilities were exercised that there would be no concern that

8 However, for defensive effectiveness scoring purposes, only pebbles operations in boost-and-bussing phases were 'counted.' Pebbles effectiveness in midcourse and high-endoatmospheric defensive operations was formally regarded as "purely bonus" in nature.

9 These were the last U.S. missile defense components exposed to a nuclear weaponry effects testing environment.

10 Technology has advanced several generations beyond the levels employed in the 1990 pebble. Consequently, a pebble of comparable capability based on today's technology would weigh a fraction of its 1990 predecessor – or alternately a more capable pebble could be employed within the same "mass budget;" e.g., to achieve boost-phase intercept capability against even shorter-range ballistic missiles.

11 It is interesting to speculate as to whether President Reagan would, as he did in 1988, have repeated his veto of the 1990 Defense Authorization Act for this politically-motivated constraint on space-based defenses. But the Bush-41 administration did not have the same level of commitment to SDI, and the 1992 political campaign rhetoric made it clear that a change in administrations would lead to the demise of all efforts to build homeland missile defenses.

Clementine *Sensor was a Modified 3rd Generation* Brilliant Pebbles *Sensor*

Clementine represented a comprehensive test of *Brilliant Pebbles* Sensor Designs

Clementine Sensors:	mass (g)
Star Tracker A:	290
Star Tracker B:	290
UV/Visible Camera:	410
HIRes/LIDAR Receiver:	1120
Laser Transmitter Head:	635
Laser Power supply:	615
Near Infrared Camera:†	1920
Longwave Infrared Camera:†	2100
Total Sensor Mass as Flown:	7380
Sensor Inter. Processor (SIP):	1000
Sensor Pow. Dis. Sys. (SPDS):	3000

†Mass includes internal power conditioning in both IR cameras (significant mass reduction in these cameras possible if SPDS was used in place of internal power converter system)

key components and performance characteristics of a counter-ICBM system were somehow being exercised in space.

A specific proposal to conduct such a demonstration was approved by SDIO in April 1992, and its flight commenced twenty-one months later, in January 1994. This test-flight was to return to the moon and use the pebbles' sensor suite to map its surface during several lunar orbits, then to "slingshot" by the Earth into an orbit around the sun while passing close to a deep space asteroid – and thereafter be "lost and gone forever." Aptly, this spacecraft was nicknamed *Clementine*, and it was the means of the last in-space tests of *Brilliant Pebbles* technology and capabilities.[12]

Clementine's implementation and mission-execution expressed a basic division of labor between the Naval Research Laboratory (NRL) and LLNL, where the *Brilliant Pebbles* concept originated. NRL built the *Clementine* spacecraft, integrating into it then-state-of-the-art technologies useful or essential for high-performance space-based interceptors. LLNL provided a version of the *Brilliant Pebbles* sensors and control computer system adapted for long-term use in the deep space environment and modified to accommodate the science goals of the *Clementine* mission. The figure above indicates the *Clementine* sensor suite was somewhat heavier than the *Brilliant Pebbles* sensor suite to accommodate different and to some degree more demanding conditions of the extended *Clementine* space mission.[13] Though heavier than pebbles, the mass of the more extensive sensor suite still compares very favorably to the far lower-performance ones of the kill vehicles of current missile defense systems.

Remarkably severe budgetary stringencies and the unprecedentedly fast pace of the *Clementine* mission compelled creation of spacecraft-controlling software throughout virtually all of the mission, with required software often delivered to the spacecraft mere days before its mission-critical use – another *Clementine* 'first'. This unique "just in time" mode of software delivery worked spectacularly well for the first 7 months of the remarkably-complex mission, but resulted in a crucial failure after the main portion of the mission – the lunar mapping – had been completed, just before the asteroid 'near-miss' could be attempted.

The *Clementine* spacecraft is presently in circumsolar orbit, and was operational when contacted most recently by the National Aeronautics and Space Administration's (NASA) Deep Space Network, more than a year after mission-termination. In recognition of its many unique features and singular accomplishments, *Clementine's* flight back-up spacecraft is on permanent display in the Lunar Alcove of the National Air and Space Museum.[14]

Most notably, *Clementine* space-qualified all *Brilliant Pebbles* technology except for the light-weight miniature propul-

12 In May 1993, the Reagan-Bush I Strategic Defense program, including all associated component and system development for space-based interceptors, was personally cancelled by the Secretary of Defense of the incoming Clinton administration. *Clementine* alone was allowed to continue, apparently due to widespread misunderstandings as to the implications of its mission success and its perceived-minimal *a priori* likelihood of success.

13 The baseline pebbles sensors were designed for use over *multi-minute* intervals in the near-earth environment, during flyout from the pebbles "life jacket" to the ICBM being intercepted; in marked contrast, *Clementine*'s assigned main task was the high-resolution, spectrally-resolved mapping of the moon over a *multi-month* interval. Unsurprisingly, lunar features of greatest interest had different spectral characteristics than those of ballistic missile rockets-in-flight, so that cameras' spectral filters had to be changed, and thermal characteristics of some of the *Brilliant Pebbles* battle-cameras had to be adapted to the circum-lunar orbital environment.

14 The Committee on Planetary and Lunar Exploration of the Space Studies Board of the National Research Council published in 1997 a detailed discussion of this path-setting mission in it's *Lessons Learned from The Clementine Mission*. This review contained many references to novel *Clementine* data, much of which was published in a 1994 issue of the AAAS's prestigious journal, *Science*, Vol. 266, cover-dedicated to the *Clementine* mission.

Astrid *Demonstrated* Brilliant Pebbles *Pumped Propulsion System*

Component	Mass (g)
Nose Cone with Pilot Tube Sleeve	280
Avlonics, Cables, and Transducers	222
Forward Skirt Assembly	230
Aft Skirt (4 Sections)	830
Fins (4)	960
Internal Airframe Parts	400
Thermal Protection	590
Heavyweight Propulsion Parts	680
Miscellaneous	100
Tank (15.3) liter Volume)	730
Lightweight *Brilliant Pebbles* Propulsion Parts:	
Quad Piston Pump Assembly	365
Liquid Filter Manifold	62
Liquid Regulator	0.027
Gas Generator Feed Manifold	0.024
Gas Generators (2)	0.233
Warm Gas Regulator	0.016
Warm Gas Check Valve	0.010
Burst Disk (2)	0.012
Thruster (Four) Valve Assembly	0.152
Thrusters and Mounts (4)	0.332
Subtotal	1233
TOTAL Dry Mass:	8250

Astrid Flight Experiment	
Wet Mass:	209.4g
Dry Mass:	8250g
Prop. Mass:	12690g
ΔV> 2km/s	
Thrust > 450 N	

sion system – and that capability was demonstrated on an *Astrid* flight test in 1994.[15]

Astrid *Demonstrated Pebbles Miniature Propulsion.* The *Astrid* flight-test series employed a 21 kg fully fueled ground-launched rocket using 3rd generation *Brilliant Pebbles* propulsion hardware. A lightweight titanium propellant tank formed the vehicle structure and a re-configured BP propulsion system was constructed to support the simultaneous thrusting of four axial thrusters. Fast liquid valves using warm pilot gas were used to control the four thrusters. The lightweight hardware shown above is similar to other key *Brilliant Pebbles* component masses shown on page i:62. This experiment used a four cylinder "quad" pump assembly with twice the number of pump cylinders used in the *Brilliant Pebbles* design.

The final *Astrid* flight-test experiment successfully demonstrated all the key subsystems needed for a *Brilliant Pebbles* propulsion system. Warm gas thrusters and light-weight piston-tanks-as-structure had previously been tested separately,[16] so this experiment validated that a boot-strapping, on-demand propulsion system was flight-feasible and performed according to expectations. This effort complemented prior development work that was carried out in rocket vendor test cells and at LLNL and represented an end-to-end validation of the miniaturized reciprocating pump concept. This *Astrid* vehicle is believed to be a world record-holder in flight-demonstrated change in velocity (Δv) for this size and mass. This flight experiment demonstrated the validity of the *Brilliant Pebbles* Divert and Attitude Control System (DACS) mass budget.

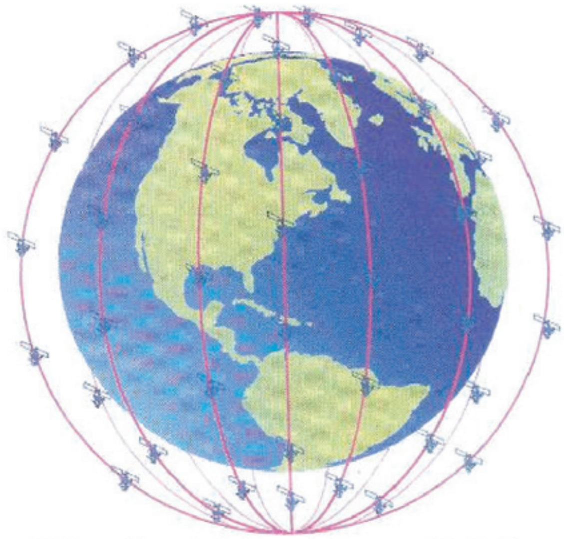
The Death of Clementine *– and of Innovative Space-Based Interceptor Technology.* With the award-winning publication of the scientific fruits of the *Clementine* mission early in 1994-5, it seemed reasonable to expect that DOD would permit follow-on work to proceed toward realization of a set of advanced technologies useful in a wide variety of DOD spacecraft. However, President Clinton employed his short-lived line-item veto to de-fund all *Clementine* follow-on work – Congressionally 'earmarked' funding had kept the program proceeding at a minimal level on a year-by-year basis up until that point – with the cognizant White House staffer proclaiming to a press conference that this represented the final termination of the *Brilliant Pebbles* program.[17]

15 See J.C. Whitehead, et al, "Design and Flight Testing of a Reciprocating Pump Fed Rocket," AIAA 94-3031, 30th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Indianapolis, IN, June 27-29, 1994

16 J.C. Whitehead, "A Lightweight Pumped Hydrazine Maneuvering Vehicle," 1992 JANNAF Propulsion Conference, Indianapolis, IN, Feb. 24-27, 1992 (UCRL-JC-109568)

17 The remarkably small but very talented *Clementine* team had won both individual and group awards for NASA and the National Academy of Science for their unique contributions – and the scientific community was very supportive of a follow-on mission intending to use even more advanced commercially-available technology to fly-by a deep-space asteroid, competing that portion of the original *Clementine* mission. In the White House press briefing, the president's aide indicated that the president's veto was because this mission would use "Star Wars" technology and might violate the ABM Treaty.

Motorola's Iridium *Global Communication System – An Example of a Distributed Constellation*



Iridium constellation: 6 rings x 11 platforms

Iridium cellphone RF footprints

When the line-item veto was overturned by a Supreme Court decision, the Clinton administration's Air Force officials proceeded to re-program the Congressionally-earmarked funds to other purposes, and *Clementine* died – and so ended the Pentagon's deliberate efforts to advance key technology that would support effective space-based defenses.

Iridium *Validated* Brilliant Pebbles *Operational Concepts.* *Clementine* and *Astrid* demonstrated the space-worthiness of all the 1990-vintage technology needed to build and operate the *Brilliant Pebbles* spacecraft – one at a time. But aspects of building, deploying, and operating a *Brilliant Pebbles* system of 1000 spacecraft remained controversial – and key to proving the viability of an effective space-based interceptor system.

For instance, DOD has never mass-produced spacecraft (remember the system concept called for 1000 essentially-autonomous pebbles to be operated by a very small officer-cadre), nor launched satellites in quantity or at high rates – nor had anyone else in the world with the exception of the Soviets. Furthermore, the U.S. practice had been to "body-wrap" each of its operational military spacecraft, enveloping each one with an average of not much less than 100 (military+civilian-contractor) operational personnel, and it was widely asserted that this was a prerequisite for spacecraft mission-performance up to DOD specifications. SDIO understood that a new way of building, deploying and operating spacecraft was required to achieve the *Brilliant Pebbles* system goal – and built the development of such innovative attributes into its DemVal program. These key aspirations and programmatic initiatives also died with the *Brilliant Pebbles* and *Clementine* programs.

Nevertheless, these concerns were also laid to rest in the 1990s by a Motorola-led consortium, with its manufacture, launch-integration, launch, orbital deployment and subsequent operation of the *Iridium* worldwide satellite cellular telephony-supporting constellation. *Iridium* built and launched a constellation of 95 mid-sized (800 kg each – over 10 times more mass than the 50 kg pebble) spacecraft between May 1997 and November 1998, at a peak build-rate of 4 spacecraft-per-week, employing 19 launchers from a wide variety of American and foreign space-launch service-suppliers.[18] Spacecraft quality has been operationally demonstrated to be exceptionally high – only 2 of the launched 95 failed in the first half-dozen years of operation, an in-service mortality rate unrivalled in mass-produced spacecraft of all types and origins. As illustrated on the previous page, the *Iridium* constellation provided world-wide coverage for communications via handheld cellphones and pagers.

The documented marginal unit cost of these spacecraft was less than $10 million, comparable to (though 50-percent higher than) the meticulously-prepared Bush-41 pebble cost-estimates on a "per-pound" basis (the actual per-pound marginal cost of an *Iridium* satellite in 1997 was <$12 K/kg, and the projected per-pound marginal cost of a pebble in 1990 was ~$8 K/kg).[19] Moreover, the peak build-rate of these much larger

18 Thus, the documented mass-weighted spacecraft build-rate *and* the total spacecraft mass-on-orbit for the *Iridium* constellation were substantially greater than that contemplated by the SDI program for the GPALS *Brilliant Pebbles* constellation.

19 The difference in per-pound cost of *Iridium* and pebbles vanishes entirely when account is taken of the fact that *Iridium*

spacecraft was spacecraft-mass-comparable to that planned for *Brilliant Pebbles* by the Bush-41 DOD. The total cost for developing and deploying the 66-satellite operational constellation within a half-decade interval was about $5 billion, all paid for by the private investment community.

Quite importantly, the entire *Iridium* constellation, in full commercial operation, is operated by a ground-crew of fewer than ten people, implicitly validating the pebbles estimate of a required ground crew of the same magnitude – versus the thousands of personnel postulated by traditional rules-of-thumb.

Just as *Clementine* demonstrated that a first-of-a-kind, very high-performance deep space mission can be controlled by a mission control center crew of typically two people (in marked contrast to the many dozens of staff characteristic of NASA missions of comparable complexity), *Iridium* established that complex operations of large constellations of sophisticated spacecraft can be controlled, year-after-year through the present day, by a literal handful of staff supported by highly automated expert system control software.

Iridium, though an economic disaster for its initial investors, has been an outstanding technological success, and its current commercial operation is cash-flow-positive. Quite importantly in the present context, the creation and operation of *Iridium* has provided complete, essentially quantitative validation of several of the key economic, logistics and operational postulates of the *Brilliant Pebbles* ballistic missile defense architecture.

When combined with the legacy of *Clementine* and *Astrid*, *Iridium* demonstrates that there cannot be any rational controversy regarding any of the major technical issues to be addressed in building a cost-effective effective space-based interceptor system.

Aftermath. When the United States exercised its Article XIV rights and withdrew from the ABM Treaty in June 2002, it ended the only legal impediment to unilateral deployment of space-based means from defending against ballistic missile attacks, e.g., with a modernized form of *Brilliant Pebbles*. Nevertheless, the "outside-the-Treaty" action taken by the Bush-43 administration have thus far been only to commence to build far less effective and more costly ground-based missile interceptors in Alaska (rather than in the Treaty-licensed location of Grand Forks, North Dakota) – supplemented with sea-based radar and forward-deployed interceptors on Navy ships.

For all intents and purposes, U.S. development of lightweight space technology ceased with the cancellation of the GPALS Program in 1993. Several component vendors attempted to develop commercial products based on the pebbles designs and offered them to the spacecraft industry. OCA, for example, built a version of the Pebbles Star Tracker, which was flown on Mars 98 and Stardust missions. But interest in lightweight systems and components waned, and OCA no longer exists. Until recently, lightweight propulsion systems were still under development at LLNL – but the Pentagon recently abandoned this last remnant of the *Brilliant Pebbles* effort.

With applications mostly outside of the United States, lightweight inertial measurement unit (IMU) development has continued, infrared sensors and coolers have improved significantly and most importantly, digital electronic systems have improved by more than 100-fold, as Moore's Law would indicate. The Danish company Terma offers a Wide Field of View Star Tracker. As discussed in Appendix B, the University of Surrey in Great Britain has been the leading proponent for lightweight space systems and has flown many lightweight systems using technology basically similar to and in some cases performance-comparable to the *Brilliant Pebbles* and *Clementine* technology-set. The People's Republic of China appears to have embraced the idea of lightweight, high performance space systems, with Surrey aid.

It is more than a little ironic that, at a time when the United States is growing increasingly concerned about proliferation of technology which could adversely affect our security and with nominally-growing interest in space-based systems, to find that capabilities pioneered by this country are now owned and exploited by foreign interests. It is clear, however, that given the capabilities of American industry, and a concerted effort similar to that invested in the BP program, American leadership and effective dominance over this area of technology can be re-established.

Future Prospects for Space-Based Interceptors. However, the Bush-43 administration hasn't chosen to revive 15-year-old designs to support building viable space-based defenses.[20] Those sensor-satellite programs that support the ground-based missile defense architecture inherited from the Clinton administration have, without exception, continued to fall ever more thoroughly behind schedule (by at least two-fold, in the best case) and to run ever more over-budget (typically, by three-fold). Space-based interceptor efforts, limited to paper-study projects, have likewise slipped their purely-paper schedules – after all, no real hardware efforts have been initiated – and recently have been deferred into the effectively-indefinite future, while space-based interceptors astoundingly have been evaluated as "technologically premature."

spacecraft carried relatively little propellant, whereas pebbles were 'rich' in low-cost propellant. Indeed, the 'dry mass' of pebbles in constant-value dollars was greater than that of *Iridium*.

20 Such lightweight technology would also significantly benefit other defense programs – such as the Navy's sea-based defenses. Lightweight kill vehicles would make feasible an interceptor that would fit into the existing Vertical Launch System (VLS) existing around the world on U.S. ships and those of our allies. This would avoid the costly development of a large interceptor – and a new VLS and supporting infrastructure for a dedicated subset of the fleet, with a substantial consequent impact on fleet operational flexibility.

All this is in striking contrast to the far more serious, Soviet-focused missile defense program of the Bush-41 administration, which planned to deploy the *Brilliant Pebbles* segment of its strategic defensive architecture – the Global Protection Against Limited Strikes system – starting deployment of a constellation of 1000 pebbles in 1996 and completing it in 1998. Moreover, this later-'90s deployment was to express the technology extant in 1989, and was to be highly effective against a far more formidable ICBM/submarine-launched ballistic missile threat to the American homeland – as well as to friends and allies all over the world – than that formally declared to currently exist. The total life-cycle DOD CAIG-validated cost-estimate of this Bush-41 defensive deployment, including all of its RDT&E expenses, all of its production and launch costs, all of its operational and testing costs for 20 years – plus complete replacement of the constellation (involving the orbiting of another 1000 pebbles) – was $11 billion (1990 dollars).[21]

In marked contrast to having an impressive global missile defense capability for 20 years, the 6-year RDT&E budget for the Bush-43 ballistic missile defense program (2001-2006) – including no deployment costs – is administration-stated to be roughly $50-billion as-spent dollars. A January 2006 Congressional Budget Office study estimated that the current missile defense program could cost another $247 billion between now and 2024.

A detached observer perhaps could be excused for some puzzlement as to the origin and nature of the differences in ballistic missile defense tastes, judgments, and directions of the Bush-41 and -43 administrations.

21 *Brilliant Pebbles* as specifically designed in 1990 couldn't be reproduced these days, as many of the key technologies have so modernized that their 1990 versions are found only in technology museums. As would be expected from considering consumer-familiar features of the ongoing Silicon Revolution, such key pebbles technologies have become somewhat smaller, lower mass, less power-consumptive and less expensive over the 14-year interval since the pebbles design was 'frozen' by the Bush-41 DOD – but they typically express more than a hundredfold improvement in performance. A modernized pebble thus would be somewhat smaller, lower-mass and less expensive than the 'Government Pebble' of a decade-and-a-half ago – and would offer far greater military performance in its sensing, data-processing, and communications sub-systems. The present-day total life-cycle cost of the Bush-41 pebbles GPALS missile defensive system, as then designed-and-operated, would be of the order of $16 billion (2006 dollars).