Missile Defense, the Space Relationship, and the 21st Century

The Independent Working Group
INDEPENDENT WORKING GROUP ON
Missile Defense,
the Space Relationship,
& the Twenty-First Century

2007 PRESENTATION
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Institute for Foreign Policy Analysis
Institute of the North
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Independent Working Group Co-Chairmen

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Shelby Cullom Davis Professor of International Security Studies
The Fletcher School, Tufts University and President
Institute for Foreign Policy Analysis

Dr. William R. Van Cleave
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Members (continued)

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George C. Marshall Institute

Mr. R. Daniel McMichael  
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Secretary, The Sarah Scaife Foundation

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Research Fellow  
Hoover Institution on War, Revolution and Peace  
Stanford University

Mr. H. Baker Spring  
F.M. Kirby Research Fellow in National Security Policy  
The Heritage Foundation

Mr. Mead Treadwell  
Senior Fellow  
Institute of the North

Professor Robert F. Turner  
Co-Founder and Associate Director  
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University of Virginia Law School

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former Deputy Chief of Naval Operations for Naval Warfare and Commander, U.S. Sixth Fleet

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Physicist  
Lawrence Livermore National Laboratory  
Visiting Fellow  
Hoover Institution on War, Revolution and Peace  
Stanford University  
Commissioner  
Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack
Project Advisors

Dr. Gregory Canavan
Senior Fellow and Scientific Advisor
Physics Division
Los Alamos National Laboratory

Mr. John Darrah
Chief Scientist Emeritus
U.S. Space Command and
Air Force Space Command

Dr. William R. Graham
former Chairman and CEO
National Security Research, Inc.
former Science Advisor to the President
Chairman, Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack

Dr. Jack Hammond
Senior Scientist
Lockheed Martin Corporation
former Director of Kinetic Energy and Directed Energy Programs
Strategic Defense Initiative Organization

Dr. Charles M. Kupperman
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former Executive Director of the General Advisory Committee on Arms Control

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and Professor and Department Head
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Missouri State University in Washington, D.C.

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President, Assured Space Access Technologies
former Director, Special Projects
Strategic Defense Initiative Organization

General Bennie Schriever, USAF (Ret.)†
former Commander
U.S. Air Force Systems Command

† deceased

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Goals of the IWG

Examine evolving threats to the United States, its overseas forces, allies, and coalition partners from the proliferation of ballistic missiles and weapons of mass destruction (WMD)

Identify missile defense requirements for the twenty-first-century security setting

Assess current missile defense programs in light of opportunities afforded by U.S. withdrawal from the ABM Treaty

Harvest technological opportunities that build on systems/technologies developed during the Strategic Defense Initiative (SDI) together with advances in science and technology made since then

Set forth recommendations for a robust, layered missile defense system
The ABM Treaty, a relic of the Cold War, is gone

Past prohibitions have been replaced with a commitment to defend the United States against ballistic missile attack

Existing and growing threat environment does not fit the Cold War model of deterrence through mutual vulnerability
  - Proliferation/availability of ballistic missiles and WMD systems/technologies
  - Rogue states and terrorist groups
  - Strategic competitors (China and Russia)
  - Asymmetric threats
    - WMD terrorism
    - Short-range ballistic missiles fired from off-shore vessels
    - Information warfare
    - Electromagnetic pulse (EMP)
    - Attacks on U.S. space assets
The New Strategic Setting

Missile Defense, the Space Relationship, and the 21st Century
An unprecedented number of international actors have acquired, or seek to acquire, ballistic missiles and WMD. Such actors do not attempt to match American capabilities but to inflict maximum damage to U.S. civilian population and infrastructure.
Warning time available before such states/groups develop these capabilities is dwindling because of increasing availability of missile and WMD technologies/systems and expertise

- Surreptitious development of weapons in guise of civilian nuclear power programs (Iran/North Korea)
- Transfer of ballistic missiles/components and know-how, e.g., from North Korea, Iran, Pakistan, China
- Reverse-engineering prototype missiles acquired on international market
- Development of “civilian” space programs (satellites, manned spaceflight) with direct military applications (China/Iran/North Korea)
North Korea has deployed close to 800 *Scud*-type ballistic missiles and approximately 200 *No Dong* medium range missiles.

Developing *Taepo Dong 2* long-range missile capable of hitting targets in Alaska and Western United States.

May possess as many as eleven nuclear weapons.

Can now arm ballistic missiles with nuclear warheads.
The Rogue State Threat
North Korea
Is a key proliferation source with sales of missiles and other WMD technologies, components, and expertise.

The “July 4th” North Korean launch of seven ballistic missiles (a mix of 6 Scuds and No Dongs and one Taepo Dong 2) into the Sea of Japan demonstrates a capability for multiple launches.

Unclear if current U.S. ground-based missile defense (GMD) system would have been sufficiently “operational” for successful engagement of the July 4th Taepo Dong 2; it would have provided no protection to U.S. forces and/or allies in the region.

- Underscores the need to develop rapidly sea- and space-based capabilities for both regional and CONUS-based missile defense as well as to collaborate with international allies and partners.
Iran has deployed 2,000-kilometer-range *Shahab* 3 ballistic missile capable of hitting Israel, Turkey, targets in Southeastern Europe, and U.S. forces in the Persian Gulf.

- Also testing *Shahab* 3 in manner suggesting a nuclear detonation in space (EMP attack) which would severely hamper U.S. power projection in region.

Reported to be working on the 4,000-kilometer-range *Shahab* 5 and a follow-on intercontinental ballistic missile (ICBM)

- Iran will probably develop an ICBM before 2015.
### The Rogue State Threat

**Iran**

<table>
<thead>
<tr>
<th>Rocket</th>
<th>Range (km)</th>
<th>Payload (kg)</th>
<th>Height (kg)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shahab 1</td>
<td>330</td>
<td>985</td>
<td>11.2</td>
<td>Operational</td>
</tr>
<tr>
<td>Shahab 2</td>
<td>700</td>
<td>700</td>
<td>12.3</td>
<td>Operational</td>
</tr>
<tr>
<td>Shahab 3</td>
<td>1200+</td>
<td>1200</td>
<td>16.6</td>
<td>Operational</td>
</tr>
<tr>
<td>Shahab 4</td>
<td>2,000+</td>
<td>1000</td>
<td>25</td>
<td>Development</td>
</tr>
<tr>
<td>Shahab 5</td>
<td>4,000+</td>
<td>1000</td>
<td>32</td>
<td>Development</td>
</tr>
</tbody>
</table>

**Missile Defense, the Space Relationship, and the 21st Century**

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Pursuing a clandestine weapons program under guise of its civilian nuclear activities

International efforts to halt/redirect Iran’s nuclear program have been unsuccessful
  o Iran has resumed uranium enrichment

Iran will be able to produce nuclear weapons before the next decade

Mounting threat to the region, Southeastern Europe, and forward-deployed U.S. forces by current/projected Iranian ballistic missiles and its WMD program highlights the requirement for sea- and space-based capabilities and need for international missile defense cooperation
  o Present U.S. GMD has no regional capability nor able to defend against EMP attack
Additional nations currently possess ballistic missiles and/or are seeking to acquire such capabilities together with WMD

- Syria (FROGs, SS-21s, Scuds including mobile Scuds and a longer-range Scud-D)
- Egypt (clandestine effort to acquire WMD and ballistic missile technologies)
- Saudi Arabia (potential transactions between Pakistan’s A.Q. Kahn nuclear proliferation network and Saudi Arabia under investigation; reportedly seeking follow-on ballistic missiles from China)

Threat reinforces necessity for sea- and space-based defense assets and international cooperation to protect allies and U.S. forces in this volatile region
China has an active and robust ballistic missile program

- ~ Thirty Dong-feng 5 and Dong-feng 31 ICBMs, ~ 110 intermediate range Dong-feng 4, Dong-feng 3, and Dong-feng 21 missiles

Upgrading existing arsenal with Dong-feng 31 solid-fueled ICBM

- Incorporates Multiple independently-targetable re-entry vehicle (MIRV) technology designed to defeat primitive anti-missile systems
- Rail-mobile variants under development

Successfully flight-tested submarine-launched version of the Dong-feng 31, the Julang 2, with 9,600 kilometer range
Approximately 700 SRBMs deployed opposite Taiwan
  - One hundred SRBMs added each year
  - Chinese generals have threatened ballistic missile attack on the United States in context of Taiwan

Current U.S. defense system has extremely limited capability against the growing PRC ballistic missile inventory; none against SRBM threat to Taiwan
  - Robust layered defense with sea- and space-based interdiction elements would address such threats
PRC has an increasingly sophisticated space program

Beijing developing advanced military capabilities to challenge U.S. supremacy in space
- Lasers and missiles capable of destroying satellites
- Nano-satellite technologies
  - *Ziyuan* 1 and *Ziyuan* 2 remote-sensing satellites

Two successful manned flights of the *Shenzhou* spacecraft
- Space station planned for 2020
- Manned-flight to moon purported long-term goal

*Underscores PRC’s rapidly growing ability to access and utilize space for military missions*
Russia retains formidable offensive strategic arsenal based on the SS-18 Satan ICBM

In 2003, Russia implemented new military doctrine further emphasizing its extensive reliance on nuclear weapons

- Viewed as hedge against Western encroachment and a means to blunt U.S. missile defense system

Moscow’s principal ballistic missile development project is the Topol ICBM, now in advanced testing

A highly maneuverable variant, the Topol M, can carry MIRV warheads

Deployment of the first Topol M missiles with mobile launchers slated for 2007
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Strategic Competitors
Russia

Topol Missiles

<table>
<thead>
<tr>
<th></th>
<th>Topol</th>
<th>Topol M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range (km)</td>
<td>10,500</td>
<td>10,500</td>
</tr>
<tr>
<td>Payload (kg)</td>
<td>1,000</td>
<td>1,200</td>
</tr>
<tr>
<td>Height (kg)</td>
<td>20.5</td>
<td>21.9</td>
</tr>
<tr>
<td>Status</td>
<td>Operational</td>
<td>Operational</td>
</tr>
</tbody>
</table>
Russian Navy is flight testing *Bulava* sea-launched missile system with range of ~ 8,000 km which carry ten or more MIRV warheads.

The U.S. missile defense system *does not* address the current/projected threat posed by Russia.

- Robust layered defense with sea- and space-based interdiction elements would address such threats.
Dangers to American interests are greatly compounded by such asymmetric threats as:

- WMD terrorism;
- electromagnetic pulse (EMP) attacks; and,
- ship-borne Scud attacks.
Several terrorist groups seeking WMD and ballistic missile capabilities:

- In 1994, Iran’s Islamic Jihad Organization attempted to purchase a nuclear bomb or fissile material from Russia.
- Al Qaeda wants to conduct chemical, biological, radiological, or nuclear attacks.
- As current situation in Lebanon confirms, Hezbollah possesses extensive missile capabilities (*Katyushas* and short-range rockets) acquired from Iran and Syria.
The United States faces an EMP threat that could have catastrophic consequences.

EMP, caused by a nuclear detonation above the earth’s surface, could cripple U.S. electronic systems and critical infrastructure such as telecommunications, banking and finance, fuel/energy, transportation, food and water supply, emergency services, government activities, and space systems.

One high-altitude nuclear detonation could produce devastating damage spanning the United States.
Asymmetric Threats
Electromagnetic Pulse (EMP)

EMP Coverage

- height of burst (km)
- intensity also depends upon:
  - weapon design
  - location of burst

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National Infrastructure Vulnerability

Water

Power

Fuel

Communication

Transportation

Government services

Emergency services

Financial services

EMP attacks disrupt electronics, communications, and transportation, effectively isolating resources and services.
Several potential enemies, including terrorists, possess, or could soon acquire, the capability to launch an EMP strike:

- North Korean sale of nuclear weapons and Scud missiles is likely avenue to achieve such a capability.
- Iran testing Shahab 3 in mode indicative of an EMP attack.

Scud missiles fired from ships off the U.S. coast could conduct EMP attacks:

- Tehran has reportedly test launched a ship-borne Scud.

The current U.S. missile defense system has marginal capability against the EMP threat; none against a regional EMP strike.
United States faces a growing threat from short-range ship-launched ballistic missiles

Secretary of Defense Donald Rumsfeld stated that a “Middle East country” (probably Iran) tested a ballistic missile (likely a Scud) from a cargo vessel in the late-1990s.

This threat is increasing as the July 4, 2006 Scud launches by North Korea underscores.

- Sale by Pyongyang of Scuds (and nuclear weapon materials and components) to rogue states and/or terrorists is a distinct possibility.
An attack on New York City by a nuclear-tipped *Scud* fired 300 kilometers offshore could result in 2.8 million fatalities.

- Numerous U.S. cities near our coasts face a similar threat.

*Scuds* launched from ships could also conduct EMP strikes.

The current U.S. missile defense system has no capability to deter or intercept a ship-borne *Scud* attack.
The ground-based missile defense (GMD) system now in deployment is a single, midcourse system based on technologies developed before U.S. withdrawal from the ABM Treaty.

GMD provides extremely “modest” coverage, and no global capability.

Explicitly intended as a limited defense against a small, rogue state threat scenario:
- Nine interceptors in Alaska, two in California
- GMD test record: five intercepts out of ten attempts under highly scripted circumstances

Uncertain if GMD would have been sufficiently “operational” to intercept the Taepo Dong 2 launched by North Korea on July 4th.
GMD is not adequate to meet the range of threats facing the United States

- Asymmetric threats
  - WMD terrorism
  - Short-range ballistic missiles fired from off-shore vessels
  - EMP attacks
- Evolving missile arsenals of strategic competitors China and Russia
- Protection of forward deployed U.S. forces and U.S. allies against states with arsenals of medium and short-range ballistic missiles
A global layered defense capability is necessary to counter these unaddressed threats

- Interdiction assets based in space provide the highest leverage, most effective capabilities and, along with sea-based components, must be a fundamental element of a multi-tiered global U.S defense architecture
- This option would complement the GMD system but afford superior coverage at less cost than expanding GMD sites
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Intercept Opportunities

<table>
<thead>
<tr>
<th>Shot Opportunities</th>
<th>Ground-based Interceptor</th>
<th>Space-based Interceptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-range missile (9000km+)</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Mid-range missile (2500km)</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Short-range missile (6000km)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Given the diverse and growing threats, the United States must develop and deploy a defense that:

- Deters hostile states from developing or acquiring missile capabilities
- Dissuades actors from both attempting to challenge the United States and to acquire ballistic missiles
- Can defeat any ballistic missile that could be launched against the United States, its forces, and/or allies

The United States must develop/deploy a missile defense with global reach, capable of coping with threats against its population and infrastructure, and our forces and allies from any direction and at all times, irrespective of their geographic origin.

A comprehensive layered defense with space-based interdiction assets, capable of intercepting and destroying ballistic missiles in each of the three flight phases, has this global capability and permanence.
A U.S. missile defense should be (1) capable of interdicting a missile soon after launch and (2) provide multiple intercept opportunities.

Each phase of a layered defense has advantages and limitations.

**Boost Phase:**
- Rising missile especially vulnerable because it is accelerating slowly and easy to detect.
- Missile destruction occurs before dispersal of payload.
- Debris from missile, including warheads, may fall on the launching country producing deterrent effect.
- Always “on station” and unconstrained by sovereignty issues and operations on another nation’s territory.

Boost phase short in duration (two to five minutes) limiting interception opportunities.
Midcourse Phase:
Longer flight duration (~ twenty minutes) offers multiple intercept opportunities

Discrimination between warheads and decoys is a problem

Terminal Phase:
Warheads reentering the atmosphere create tell-tale infrared signatures while atmospheric effects shred away decoys and false targets providing greater targeting confidence

Speed of warhead and short duration of terminal phase are challenges

A maneuvering warhead would compound difficulties
A layered defense approach affords multiple opportunities to destroy missiles and payloads reducing burden on any one layer.

Layered defenses also complicate the design of ballistic missiles:
- To minimize interception a missile shell is hardened making it heavier, slower, with less range, and able to carry fewer warheads or decoys.

Layered defenses allow sharing of technologies between systems in different phases providing logistical, interoperability, and cost-saving benefits.

Failures in any layer of a multi-tiered system compensated for in other layers whereas a single-tier defense must be near 100-percent effective.

**Bottom Line:**
*A layered architecture, with a space intercept component, ensures a more robust performance with reinforcing advantages and synergies.*
Access to and utilization of space is critical to the geopolitical, military, and economic status of the United States.

- Also essential for deployment of a layered missile defense and to protect existing space-based assets and infrastructure.

U.S. space systems face numerous threats: strikes against ground stations, launch systems, or orbiting satellites including EMP attacks.

Numerous other states are becoming space powers capable of challenging the United States.

- Over thirty-five countries have space programs.

America’s growing dependence on space-based assets and supporting infrastructure increases the probability of attacks by adversaries seeking to harm the U.S. economy and eliminate the advantages our space infrastructure provide U.S. forces.
To maintain space primacy, the United States must be able to detect and deter attacks on its space infrastructure, identify the source of the attack, and quickly recover and reconstitute vital assets.

- It must also deny the hostile use of space by adversaries.

Without a concerted effort continued U.S. preeminence in space is not assured.

The United States is not putting sufficient resources into military space programs.

- Numerous U.S. national security satellites are approaching obsolescence.
To continue as the dominant space power the United States must:

- Reduce cost of building and launching space systems and develop new sensors capable of detecting and tracking smaller, moving, and concealed targets.
- Develop advanced surveillance and defensive and offensive technologies for space control, situational awareness (a capability that does not exist in most U.S. space assets), and information operations.
- Remain at least one generation ahead of its international competitors.
We should reject legal regimes and arrangements that would restrict utilization of space including Russian, Chinese, and other proposals to prohibit the use of space for missile defense.

The experience of the ABM Treaty exposes the folly of efforts to impose international legal prohibitions against space-based missile defense.

- Currently proposed legal regimes are more likely to place restrictions on the use of space by the United States rather than on adversaries unlikely to be bound by international agreements against the weaponization of space.
The 2001 Space Commission Report called for the development/deployment in space of the means to deter and defend against hostile acts on U.S. space assets and U.S. interests.

Space is central to the development, testing, and deployment of a missile defense system capable of protecting the United States, its overseas forces, and its allies.

- Interdiction assets based in space provide the highest leverage, most effective capabilities and must be a central element of a global, layered U.S. missile defense architecture.
- Unlike sea- and ground-based systems, space-based elements are unfettered by deployment times to regions or by constraints imposed by host countries.
- The United States must build on the cutting-edge technologies developed in the 1980s and early 1990s.
Resurrecting and building on *Brilliant Pebbles* (BP) technologies is crucial for an effective defense architecture:

- Constellation of small, completely autonomous, advanced kinetic-kill vehicles based in space
- Inexpensive, efficient and means of destroying enemy ballistic missiles especially in boost and midcourse flight
- Also provides early warning and missile trajectory data to other BP elements, and to sea- and ground-based defense systems
- BP systems, coupled with subsequent technological advances, have applications for sea-and ground-based defenses
- In early 1990s, BP was cancelled because of the ABM Treaty
A layered missile defense architecture incorporating 21st-century BP interdiction elements would render an adversary’s ability to influence U.S. decisions by threatening to launch nuclear weapons against the United States, its deployed forces, or its allies extremely difficult.

- A strategically significant defensive deterrent would dramatically reduce the value of offensive missile technologies to would-be aggressors.
The nature of the political opposition to missile defense over the past five decades has been unique

- What has been most technologically effective has been least politically acceptable

Normally, technical rather than political reasons will drive whether or not to develop and deploy a particular weapon system.

In the case of missile defense the reverse is true:

- What has been politically acceptable has been least technologically effective
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.

Spaced-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.
The problem transcends administrations and political parties reflecting political opposition to effective missile defenses over the past five decades.

- Political considerations shaped technical behavior that too often was designed to achieve certain predetermined political ends.

The ABM Treaty and the doctrine of mutual assured destruction (MAD) made virtually impossible the deployment of the most technically sound and cost-effective missile defense systems.
The Logic Pyramid 1993-Present

**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 midcourse-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 it is most politically acceptable.
U.S. withdrawal from the ABM Treaty cleared the way for a more logical/efficient use of technology, and forced missile defense opponents to set forth other reasons why the United States should not defend itself.

- To date, however, the United States has stopped far short of fully implementing this lesson learned.

Opposition to missile defense persists particularly against the most technologically feasible global defense, a space-based interdiction component, because of concerns about the “weaponization of space.”

This spurious argument ignores history, and the current efforts of other states to weaponize space.
The result is a ground-based defense (GMD) that is politically the most acceptable but technologically the least effective defense architecture.

Other bogus indictments assert that missile defense is:
- Wasteful and ineffective
- Will give America too much unilateral power
- Provocative and destabilizing
- Morally wrong

Such outdated mindsets and misconceptions must be rectified and efforts made to solidify/augment the consensus of most Americans in favor of missile defense.
A failure of government model based on public choice theory developed by Dr. James M. Buchanan, 1986 Economic Sciences Nobel Prize recipient, helps explain why greater demand for missile defense has been unable to overcome lesser demand against it.

Compromise is a natural condition in democracies.

When differences among the electorate are narrow, the median normally produces a solution satisfactory to nearly all people.

When differences are great between the majority favoring missile defense and a minority opposing it, the median is watered down with a solution that falls far short of what would be required for the effective missile defense favored by a majority.

This has been the situation throughout the history of missile defense.
### The Politics against Missile Defense

**Government Failure on Missile Defense Versus Public Support**

<table>
<thead>
<tr>
<th>Willing to accept &quot;progress&quot; reports from government that show some kind of motion.</th>
<th>Unwilling to accept significant developments. Will protest positive actions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% for missile defense</td>
<td>20% against missile defense</td>
</tr>
<tr>
<td>10% undecided</td>
<td></td>
</tr>
</tbody>
</table>

**Political Dilemma: How to Satisfy Both.**

1. placate the majority who demand little.
2. satisfy the demand of the minority by doing little.

**Net result:** conduct a "circular" operation that involves some visible evidence "that something is being done" but do nothing substantive to alienate the minority.

**Trade-off outcomes:** a missile defense program with appropriate visibility to satisfy casual public observance but always with minimum results, which equals government failure.

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**The Independent Working Group**
This phenomenon continues today: the passive majority wants missile defense and expects government to develop and deploy it versus a proactive minority demanding no—or highly restricted and marginally effective—deployments.

- The government responds by supplying contradictory outcomes leaving missile defense in a “techno-political cul-de-sac” (i.e., the “modest,” limited GMD system).

Whether the majority of American voters will demand an effective missile defense before a catastrophic event or after the fact when a huge loss of life and extreme infrastructure damage has occurred remains to be determined.
To deal with the missile defense impass before the fact, the voter must:

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 that the nation’s elected officials and bureaucrats be transparent in their views about missile defense, and if opposed, explain why the defense of their constituents takes second place on their agendas
Foundation in place for international participation in a layered missile defense

Consensus emerging regarding threat posed by ballistic missiles and need for missile defenses

Numerous U.S. allies and NATO have active missile defense programs underway (e.g., *Patriot* and *Aegis* systems)

Basis for division of labor:

- U.S. emphasis on space-based components, with international partners and the United States, deploying sea-based and ground-based systems
- If they have relevant expertise, allies should also participate in the development of both sea- and space-based assets, given that they provide far greater missile defense capabilities than ground-based systems
International Dimensions of Missile Defense

Missile defense collaboration:
- Strengthens alliances/coalitions
- Reinforces extended deterrence/security guarantees
- Reduces incentives for hostile actions against U.S. interests
- Furnishes data for an interoperable layered defense system
- Facilitates access to allied advanced technologies
- Provides cost savings and reduced development times

Key issue to be addressed: sharing of information as well as technology transfer and the allocation of contracts

Allied contributions will reflect conditions facing individual nations and tradeoffs/competition between missile defense and other budgetary priorities
Innovative development of technology by the U.S. government requires visionary and sustained leadership, competent scientists and engineers, and requisite resources.

Examples of such programs include:

- The Manhattan project
- Intercontinental ballistic missiles
- The Apollo lunar program
- Nuclear submarines
- Stealth
- The Polaris missile

Maintaining such excellence is difficult even with early successes

- The initial tide of innovation normally defaults to the risk-averse approach of bureaucracies
America’s defense-industrial and S&T base is eroding:
- DOD’s competence to manage S&T efforts has atrophied
- Pentagon increasingly outsourcing key decision-making and S&T management responsibilities
- In the next three to five years, nearly half the aerospace-defense workforce will be eligible for retirement
- U.S. engineering degrees are declining precipitously
- America’s “non-defense” high tech supply chain is rapidly moving offshore

Graduate enrollment in S&T fields by U.S. citizens is steadily eroding
- Advanced degrees earned in science and engineering by Americans declined from 75 percent in the mid 1960s to less than 60 percent today

These trends are more disturbing given the astonishing increases in advanced degrees being awarded in foreign countries
- Between 1991 and 2001, science and engineering Ph.D.s in China and South Korea rose by 535 percent
The decline in U.S. S&T personnel entering our national laboratories, in defense aerospace, and the commercial sector (now the breeding ground for technologies for defense applications) means that the scientists and engineers upon which military space programs and the development of enabling technology rely is aging and will atrophy without needed replacements.

The Pentagon’s ability to exploit innovative missile defense technology is at grave risk because of these trends and a lack of continuity and institutional memory given the political disruption to SDI developments in the 1990s.

A government and industry effort charged with rapidly reviving and deploying SDI technology is needed:

- A small, empowered, technically competent management and engineering team from government and industry should be fully supported with adequate funding.
**General Recommendations**

Make deployment of multi-layered defense an urgent national priority.

Develop public recognition of the threat posed by ballistic missiles and WMD including short-range ship-based launches, and EMP attacks.

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.

Create more effective organizational structures for missile defense.

Raise the national profile with direct involvement at the presidential level and greater bipartisan support in Congress.

Reaffirm and strengthen commitment to primacy in space.

Recreate and sustain the scientific and technology base.
Complete the GMD sites in Alaska and California but do not expand the number of ground-based sites. Instead direct additional funding to sea-based and space-based missile defense. Land-based systems are the least effective of the various basing modes.
Recommendation 2: Expand Sea-Based Defenses

Deploy sea-based missile based on the U.S. Navy Aegis Vertical Launch System and the Standard Missile (SM)

Accelerate current SM-3 Block 1 program for boost-phase and late-midcourse interdiction
- Anticipated cost: $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

Fund SM-2 Block IV to defend against a shipborne Scud launched off the U.S. coast
- Estimated cost: $50 - $100 million
Recommendation 2: Expand Sea-Based Defenses (Cont)

Revive *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

- Would produce velocities more advantageous for boost phase intercepts than achievable by other SM-3 variants
- Would 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

Integrate missile defense with homeland security plans to protect coastal cities and infrastructure

Equip additional U.S. vessels with the *Aegis* anti-missile system

Encourage U.S. allies equipped with *Aegis/SM* to do the same
Revive *Brilliant Pebbles* and develop space-based interceptors for boost-, midcourse, and terminal-phase interdiction

Within three years, test a space-based missile defense system

- Anticipated cost: $3-5 billion

Begin operating space testbed for interceptors, integrated into U.S. Strategic Command’s global architecture, within 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: $16.4 billion
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.
Encourage allied missile defense capabilities based on a suitable U.S.-allied division of labor, while strengthening allied participation.

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.
Recommendation 6: Develop New Organizational Structures

Create 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.

Establish 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, ensure formalized and frequent interactions/exchanges among the proposed organizational entities.
Recommendation 6: Develop New Organizational Structures

Identify and increase the number of senators and congressmen cognizant of the centrality of space to U.S. national security

Establish a Congressional Caucus on Space and Missile Defense to build support for U.S. space primacy, space control, and assured access

Reorganize National Science Foundation to revive student and faculty interest in space and defense technology

Reorganize military education system to increase scientists and engineers in the uniformed military and civilian DOD workforce
  o Heightened focus on physical sciences at military undergraduate schools
  o Incentives (pay and promotion) to military officers and civilian DOD officials to acquire advanced degrees in science and engineering
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

Support missile defense component of space security research via advisory and peer groups in 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
Recommendation 8: Educate the American Public

Inform 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

Make missile defense a homeland security priority at local, state levels

Strengthen state and local participation in space and missile defense education and security policy development with Department of Homeland Security partnerships