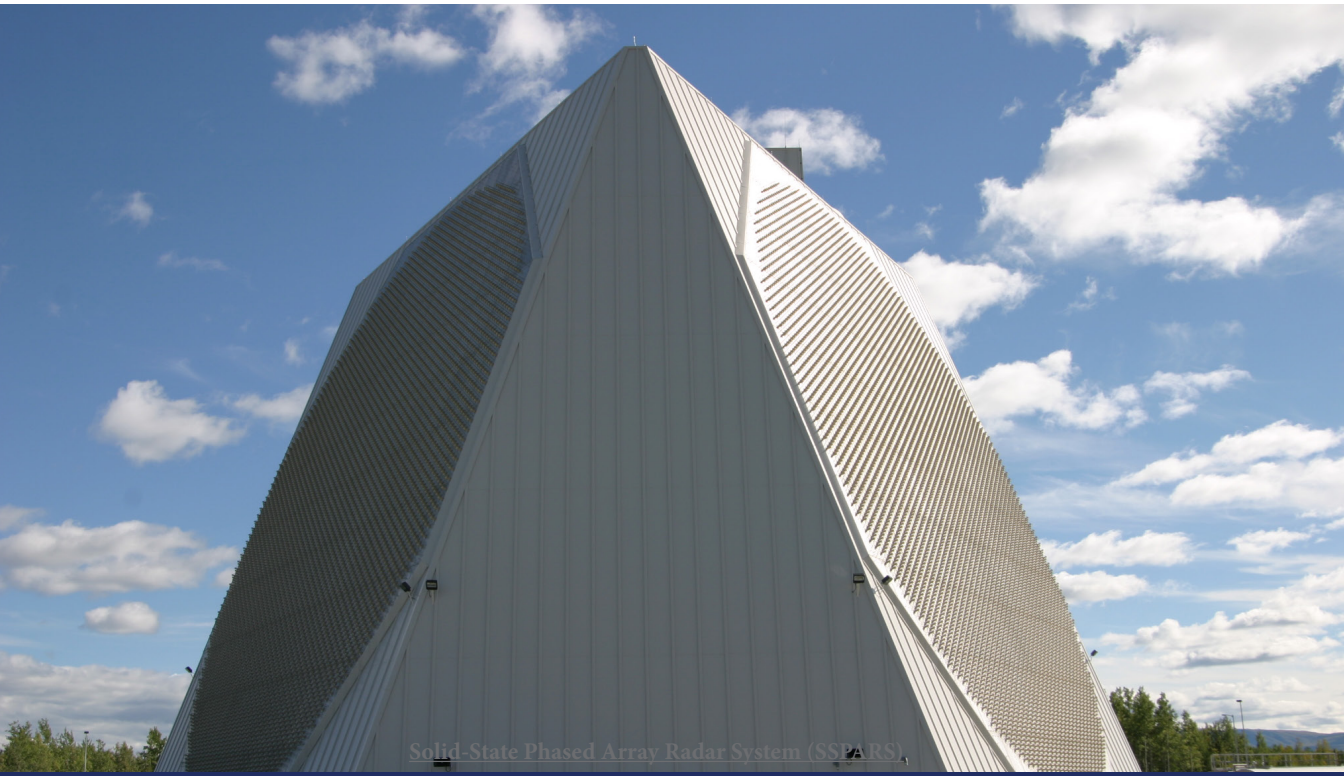
2015 STRATEGIC PRIMER: MISSILE DEFENSE

Volume 1



Solid-State Phased Array Radar System (SSPARS)

Current capabilities, and emerging threats

American Foreign Policy Council

Missile Defense and American Security

The American Foreign Policy Council (AFPC) has tracked offensive missile threats and advocated for a strong missile defense for well over a decade. The organization holds an annual Missile Defense conference on Capitol Hill and disseminates a monthly publication, the *Missile Defense Briefing Report* (MDBR), which monitors domestic and international missile defense developments. The purpose of this brochure is to provide an informative and concise overview of the threat posed by ballistic missiles, detail the current missile defense architecture and limitations, and provide policy recommendations to ensure the U.S. and its allies maintain an adequate defense against ballistic missile attacks.

Project Team

Director:	Rich Harrison
Editor:	Ilan Berman
Research & Content:	Ozzie Chung
	Ben Ridder

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SM-2 Launch | (http://www.mda.mil/global/images/system/aegis/2012_Aegis_2.jpg)

"The protection of the United States from the threat of ballistic missile attack is a critical national security priority."

- U.S. Department of Defense, *Ballistic Missile Defense Review*, February 2010

What is a ballistic missile?

Ballistic missiles are rockets which are propelled toward targets across long distances (of varying lengths) and capable of causing significant devastation. Intercepting a ballistic missile is a difficult technological challenge because they can reach speeds of 15,000 MPH (Mach 20) requiring radar to target them, very fast interceptors, and complex system integration. A missile's lethality and destructive ability is dependent on its payload; some missiles are capable of carrying weapons of mass destructions (WMD).

Excluding those in the possession of the U.S., there are over 6,000 ballistic missiles around the world. Most are possessed by U.S. adversaries, and their quantity has continued to increase at an alarming rate. These devastating weapons are deployed in various basing modes, and can be launched from silos, submarines, or via road-mobile launchers. Ballistic missiles are an efficient weapon because they do not require a human operator and serve as a major deterrent when paired with a nuclear weapon.

Who are the threat actors?

Russia and China both have vast arsenals of ballistic missiles, and have demonstrated advanced capabilities (including multiple warhead delivery) that are designed to defeat American missile defenses. Rogue states such as North Korea and Iran are likewise aggressively developing their ballistic missile programs, even as they focus on their respective nuclear capabilities.

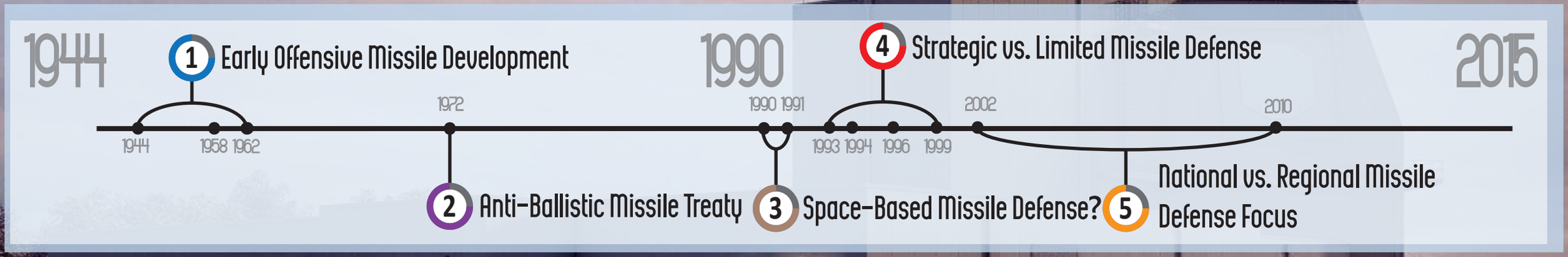
Addressing the threat

It is imperative that the U.S. continue to develop and field missile defense systems capable of countering the threat posed by ballistic missiles to the U.S. homeland, as well as to America's deployed troops and international partners.

National Missile Defense Act

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) with funding subject to the annual authorization of appropriations and the annual appropriation of funds for National Missile Defense.

— National Missile Defense Act of 1999
(Public Law 106-38 signed by President Clinton)



Missile Defense Timeline

"What if free people could live secure in the knowledge that their security did not rest upon the threat of instant U.S. retaliation to deter a Soviet attack, that we could intercept and destroy strategic ballistic missiles before they reached our own soil or that of our allies?"
– President Ronald Reagan, March 23, 1983

Early Offensive Missile Development
1944: Germany launches the V-2 Rocket against England as part of World War II hostilities. The missile has a 200 mile range, and at the time the Allies possessed no way to defend against it.
1958: U.S. Secretary of Defense Neil H. McElroy makes the U.S. Army responsible for developing missile defenses to counteract the Soviet Union's burgeoning ballistic missile arsenal.
1962: The *Nike Zeus* missile achieves the first successful intercept of a dummy intercontinental ballistic missile (ICBM) warhead.

Anti-Ballistic Missile Treaty
1972: The Treaty, concluded with the USSR during the administration of President Richard Nixon, limits the U.S. and Soviet Union to two missile defense sites (< 100 interceptors) and restricts the deployment of any space-based, sea-based, or mobile ABM systems capable of intercepting "strategic missiles." The restricted ABM interceptors were not permitted to travel faster than 4 kilometers per second.

Notably, the agreement did not halt the growth of U.S. and Soviet stockpiles; two decades after its signing, U.S. and Russian nuclear stockpiles had doubled and tripled, respectively.

Mutually Assured Destruction (MAD)
- During the Cold War, the U.S. and Soviet Union relied on a "balance of terror" created by their respective arsenals to maintain peace (without missile defense). This doctrine was known as Mutually Assured Destruction.

Strategic Defense Initiative (SDI) "Star Wars"
- In 1983, President Ronald Reagan proposed the creation of a system of space and ground-based interceptors to destroy enemy ballistic missiles and keep the peace. The Strategic Defense Initiative Organization (SDIO) is formed the following year.

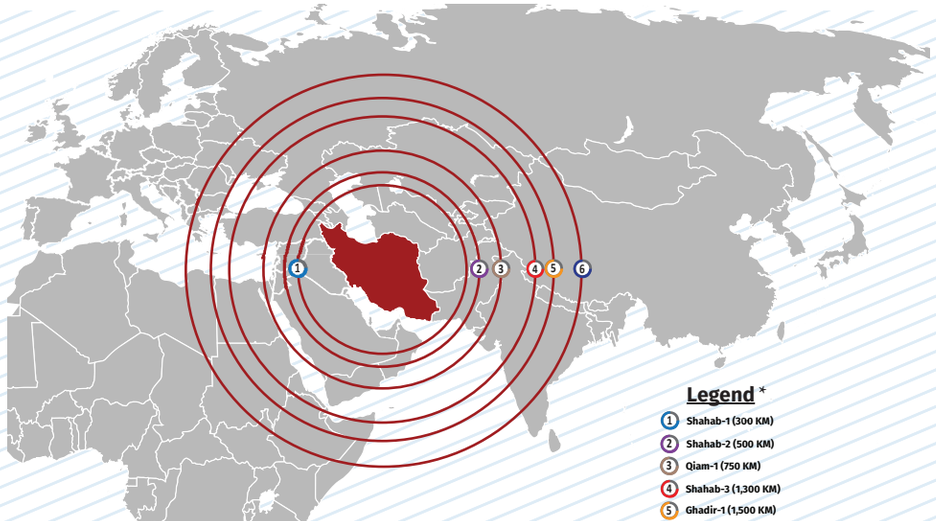
Space-Based Missile Defense?
1990: President George H.W. Bush green-lights the Brilliant Pebbles constellation concept of small satellites with hit-to-kill interceptors.
1991: SDIO is reoriented to focus on defending the U.S. homeland against limited missile attack.

Strategic vs. Limited Missile Defense
1993: Following the collapse of the USSR, President Bill Clinton emphasizes continued compliance with the ABM Treaty and scraps the Brilliant Pebbles program.
1994: The SDIO is renamed the Ballistic Missile Defense Organization (BMDO).
1996: New intelligence estimates reignite the national debate over the need for strategic missile defense.
1999: Congress passes the National Missile Defense Act of 1999, mandating protection of U.S. homeland from limited strikes.

National vs. Regional Missile Defense Focus
2002: President George W. Bush formally withdraws the U.S. from the ABM Treaty, and commits to developing both national and regional missile defenses.
2002: The BMDO is renamed the Missile Defense Agency (MDA).
2004: The U.S. national missile defense system begins to come online, expanding defense of the homeland from long-range missile threats.
2010: Under the administration of President Barack Obama, the U.S. significantly reduces defense spending, including investments in both regional and national missile defense.

Iran

"We judge that Tehran would choose ballistic missiles as its preferred method of delivering nuclear weapons, if it builds them. Iran's ballistic missiles are inherently capable of delivering WMD, and Tehran already has the largest inventory of ballistic missiles in the Middle East. Iran's progress on space launch vehicles—along with its desire to deter the United States and its allies—provides Tehran with the means and motivation to develop longer-range missiles, including intercontinental ballistic missiles (ICBMs)."
- James R. Clapper, Director of National Intelligence, Testimony before the Senate Select Committee on Intelligence, March 25, 2015

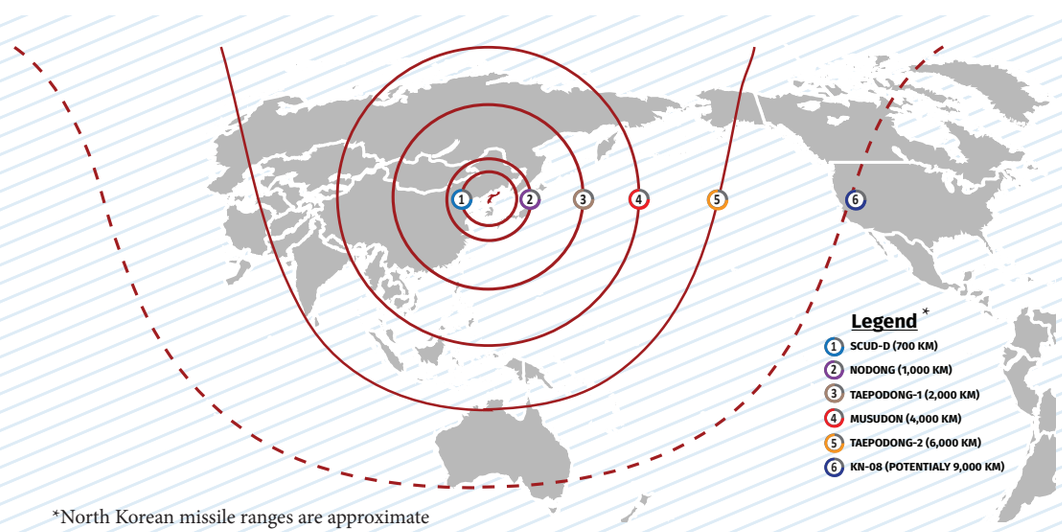


*Iranian missile ranges are approximate

Iran, the world's leading state sponsor of terrorism, also possesses the largest ballistic missile arsenal in the Middle East. Iran currently has the capability to strike U.S. allies and deployed forces in the Middle East and parts of Europe, and is developing an intercontinental ballistic missile capability that would enable it to strike the U.S. homeland. Iran has exhibited a history of both ballistic missile and nuclear cooperation with fellow rogue state North Korea - a partnership that has benefited the strategic capabilities of both countries. Notably, the recent nuclear negotiations between Iran and the "P5+1" powers have not imposed restrictions on Iran's burgeoning ballistic missile program.

North Korea

"Pyongyang is committed to developing a long-range, nuclear-armed missile that is capable of posing a direct threat to the United States and has publicly displayed its KN08 road-mobile ICBM twice. We assess that North Korea has already taken initial steps toward fielding this system, although the system has not been flight-tested. Because of deficiencies in their conventional military forces, North Korean leaders are focused on developing missile and WMD capabilities, particularly building nuclear weapons."
- James R. Clapper, Director of National Intelligence, Testimony before the Senate Select Committee on Intelligence, March 25, 2015



*North Korean missile ranges are approximate

North Korea is a major weapons proliferator with a robust ballistic missile arsenal of various ranges, from short-range rockets (for use against neighboring South Korea) to intercontinental ballistic missiles that could potentially be used against the United States. The North Korean regime is now developing the capability to launch those missiles from road-mobile and submarine based platforms. These missile developments, as well as three separate nuclear tests in recent years and associated developments, have increased the urgency of the North Korean threat.

looking ahead china & russia

RUSSIA
Russia possesses the largest arsenal of nuclear-tipped missiles of any potential U.S. adversary. The Russian government continues to modernize the country's nuclear triad, developing new submarines and road-mobile ICBMs with multiple independently-targetable reentry vehicles (MIRVs) capable of bypassing sophisticated missile defenses. The $750 billion modernization program is scheduled for completion in 2021. Russia's recent assertiveness in Ukraine, coupled with a December 2014 revamped nuclear warfare doctrine that lowers the threshold for the use of nuclear weapons in a conflict scenario, are serious sources of concern for American policymakers.

CHINA
China continues to modernize its already robust ballistic missile arsenal. According to the U.S. National Air and Space Intelligence Center (NASIC), "China has the most active and diverse ballistic missile development program in the world." Particularly concerning is the development of a class of nuclear powered submarines and continued measures to bolster its anti-access/area denial (A2/AD) capabilities with the creation of "carrier killer" missiles. The Chinese have also revised their Cold War posture of "minimum deterrence" with new land and sea-based missiles. Additionally, China recently began deployment of a MIRV capability on its missiles, further enhancing the ballistic missile threat to the United States.

Understanding Missile Interception
A robust missile defense system integrates several components. These include 1) sensors to identify and target the missile and warhead; 2) interceptors to destroy the missile and warhead; and 3) a command and control architecture to guide the interception process. Historically, there have been two approaches to intercepting and destroying a ballistic missile. The first method is fragmentation, when an interceptor's warhead explodes near the ballistic missile. The current strategy is dubbed "hit-to-kill," and entails a direct impact with the missile in a process that is often referred to as "hitting a bullet with a bullet." A third approach, directed energy technology, is now being incorporated into missile defense systems.

Range (KM)	Ballistic Missile
<150	BSRBM - Battlefield Short-range
150 - 1,000	SRBM - Short-range
1,000 - 3,000	MRBM - Medium-range
3,000 - 5,500	IRBM - Intermediate-range
>5,500	ICBM - Intercontinental
Launched from sea	SLBM - Submarine-launched

Missile Flight Path

Missile Interception requires: 1) identifying and tracking the missile or warhead; 2) discriminating the missile or warhead from other decoys; 3) determining where exactly to target; and 4) aiming and deploying the missile interceptor (or directed energy) to destroy the missile or warhead.

Boost
Easiest time to detect and monitor is at missile launch.

Ascent
Rocket motor is burned out and down-range sea-based systems can be effective to intercept.

Midcourse
Longest phase of flight, most opportunities for interception. Decoys are deployed.

Terminal
Final opportunity for missile intercept.

RQ-4 Global Hawk

Currently there is no capability to target ballistic missiles during the initial, or "boost" phase. However, the Missile Defense Agency is investing in Unmanned Aerial Vehicles (UAVs) to enable interception during this period of a missile's flight. The ability to rapidly detect a launch and react to it would significantly increase the opportunities for interception and provide an additional window for interception if an initial shot was unsuccessful.

BOOST & ASCENT

SENSORS

MIDCOURSE

TERMINAL

Land-, sea-, and space-based sensors, including satellites and radar, provide the Ballistic Missile Defense System (BMDS) with the ability to detect, track, and discriminate incoming ballistic missiles. The Army/Navy Transportable Radar Surveillance (AN/TPY-2) and the Sea-Based X-Band Radar (SBX) provide early detection and track all classes of ballistic missiles. Other sensors, including the Upgraded Early Warning Radars (UEWR), also aid in identifying and discriminating between targets. The BMDS relies on the interoperability of its sensors to provide its weapons systems the greatest chance of interception.

Sea-based X-band Radar

Current Systems

OBV Rocket - Ground-based Interceptor

Ground-based Midcourse Defense (GMD) is designed to protect the U.S. homeland from limited intermediate- and long-range ballistic missiles. GMD relies on the Ground Based Interceptor (GBI), which is designed to engage and destroy targets using the kinetic energy of the exoatmospheric kill vehicle (EKV). According to the Missile Defense Agency (MDA), GMD has successfully intercepted 9 of 17 targets since 1999. There are currently 30 deployed GBIs – 36 at Fort Greely, Alaska, and 4 at Vandenberg Air Base in California. 14 more GBIs will be installed at Fort Greely in the near future, and the MDA is researching possible East Coast locations for supplemental defense installations.

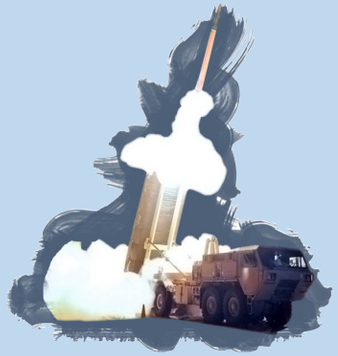
Aegis, the Navy's premier missile defense system, is currently deployed on 33 destroyers and cruisers —16 in the Pacific and 17 in the Atlantic. Aegis utilizes the Standard Missile-3 (SM-3) to intercept short- to intermediate-range ballistic missiles in midcourse phase. The land-based adaptation, Aegis Ashore, features prominently in the European Phase Adaptive Approach (EPAA). This includes installations in Romania and Poland.

USS Hopper launching a standard missile (SM-3)

Patriot Surface-to-Air Missile in Germany

Current Systems

Terminal High Altitude Defense (THAAD) is the warfighter's Upper Tier missile defense system. THAAD is capable of destroying ballistic missiles in the terminal phase, both in and out of the atmosphere. Transported by land, air and sea, THAAD is rapidly deployable. The MDA reports that THAAD has been successfully tested 13 times, 11 of which were intercepts.



THAAD Missile Interceptor

The PATRIOT Weapon System, armed with PATRIOT Advanced Capability-3 (PAC-3) missiles, provides the warfighter with Lower Tier missile defense. PATRIOT works in tandem with THAAD to provide a tiered missile defense structure. PAC-3 missiles employ hit-to-kill technology in order to intercept ballistic missile in the terminal phase. PATRIOT is also fitted with GEM missiles that utilize fragmentation to engage targets.

United States

Protection of the U.S. Homeland

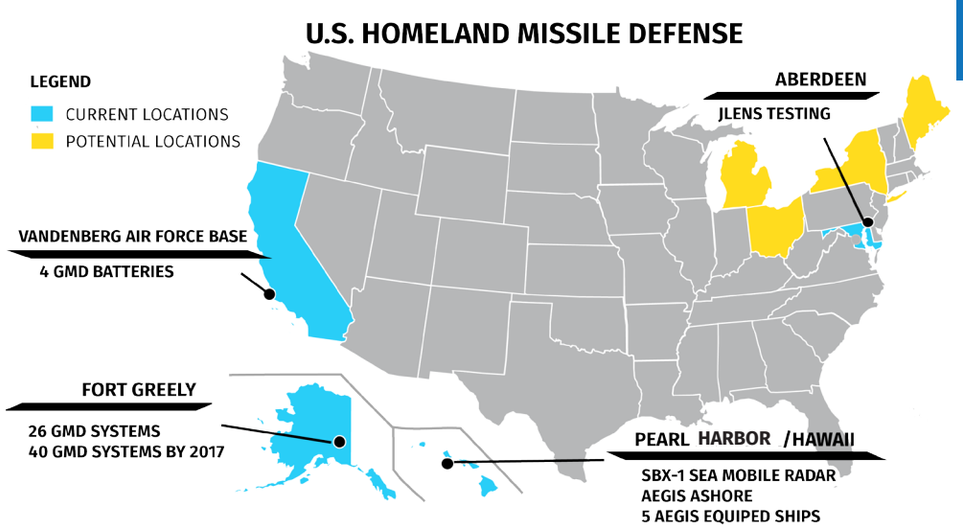
- On March 15, 2013, U.S. Secretary of Defense Chuck Hagel announced that North Korean advancements in long-range missiles and nuclear testing warrant further protection of the U.S. homeland from ICBM attack.
- The U.S. government therefore authorized the deployment of 14 additional Ground-Based Interceptors (GBIs) at Ft. Greely, Alaska, raising their number from 30 to 44 by 2017.

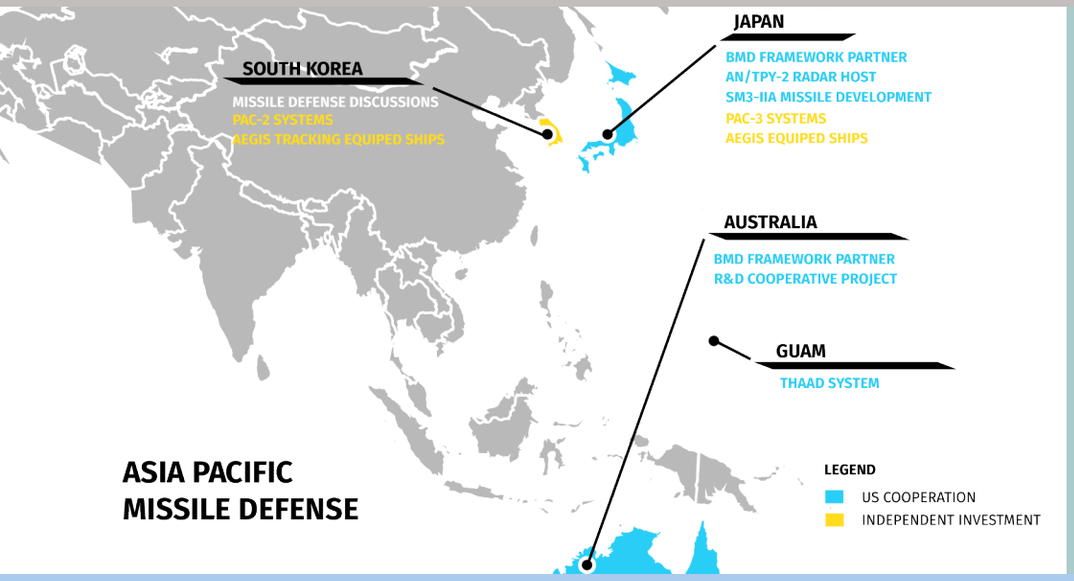
Debate about East Coast Missile Site

- An East Coast site would provide ability to shoot-assess-shoot for missiles originating from Iran.
- Directed by Congress, the Defense Department (DoD) is conducting Environmental Impact Studies for a potential additional GBI site in the U.S. DoD believes money is better spent instead on improving sensor systems.

Addressing short range sea-based threats

- While the U.S. has traditionally focused solely on ballistic missile threats, adversaries can also launch attacks using cruise missiles, which are faster moving and fly closer to the ground.
- To protect the Nation's capital against this new and evolving threat, the military has deployed the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS).
- Hovering at 10,000 feet, JLENS blimps provide 24/7 early warning coverage against cruise missile attacks.





Asia

Commitment to the Asia-Pacific Region

- The U.S. is obligated through its treaty commitments to extend its "nuclear umbrella" (interpreted to include missile defense) to several countries in the region, including South Korea, Japan and Australia.
- Regional missile defenses are in place principally to counter threats from North Korea, which possesses several hundred medium range missiles capable of reaching forward deployed U.S. troops in Guam, Japan, and South Korea, as well as a growing arsenal of intercontinental-range ballistic missiles. However, China has expressed its opposition to regional missile defense deployments, terming them "destabilizing" to Asian security.
- China's increasingly sophisticated intercontinental ballistic missiles pose a significant threat to deployed U.S. forces, American allies and the U.S. homeland itself. At the same time, China's expanding asymmetric capabilities (including cruise missiles, EMP, and laser weapons) likewise represent a growing danger to American forces in the event of a conflict in the region.

Missile Defense in the Middle East

- The U.S. does not yet have a formal missile defense network in the Middle East, but the six members of the Gulf Cooperation Council are working with the U.S. to deploy a comprehensive missile defense architecture.
- For the past three decades, the U.S. has allocated hundreds of millions of dollars to bolster Israel's defensive capabilities against both state threats (Iran) and terrorist actors (Hezbollah and Hamas).

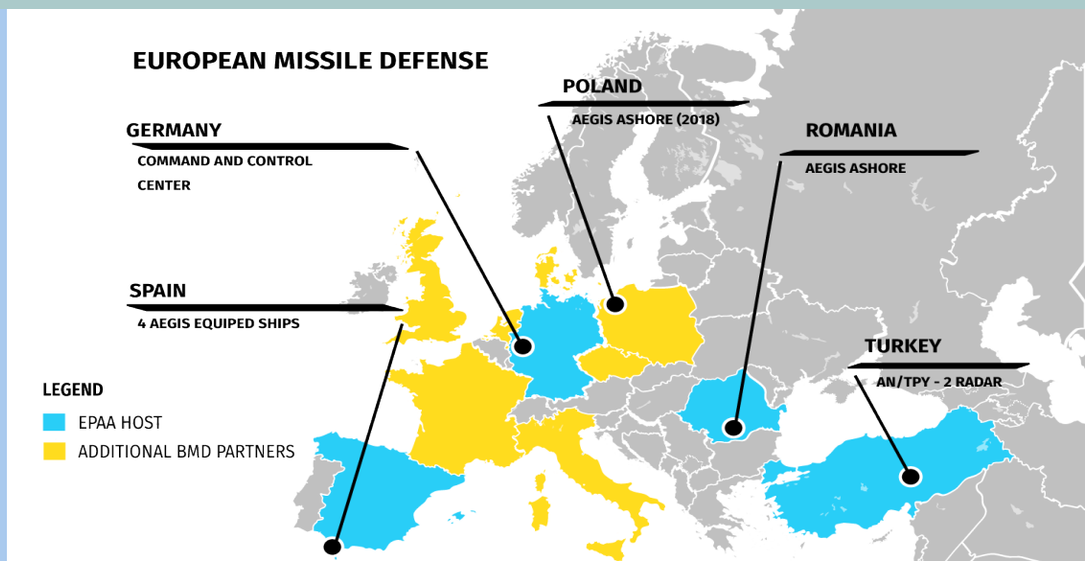
Europe

Regional Missile Defense in Europe

- In 2007, the Bush administration proposed a planned "third site" of missile defenses in Europe to offer Europe protection against medium- and extended-range missile threats from the Middle East.
- Poland and the Czech Republic subsequently joined the planned site as partners, agreeing to host Ground-based interceptors (GBIs) and early warning radars for the project, respectively.

European PhaseAdaptive Approach (EPAA)

- In 2009, the Obama administration abandoned plans for the "third site" in favor of a defense architecture focused on protecting regional allies in lieu of defense of the U.S. homeland.
- Despite technical evidence that the new EPAA cannot intercept Russian missiles or invalidate the Kremlin's strategic deterrent, Moscow continues to seek to limit or terminate the initiative - including through a binding agreement with the U.S. that interceptors will not target Russian missiles. Russian officials argue that the signing of the nuclear deal with Iran in July 2015 (Joint Comprehensive Plan of Action), obviates the need for missile defenses in Europe altogether.
- The EPAA's complete architecture is anticipated to reach completion in 2018, and will be capable of defending the countries of Europe against IRBMs.



CHALLENGES

VALUE OF MISSILE DEFENSE

The importance of missile defense to U.S. national security cannot be overstated. Pursuit of a robust missile defense signals American strength and resolve in the face of growing strategic capabilities among competitors and adversaries. It deters nuclear proliferation by denying hostile nations the ability to threaten a conventional or nuclear missile strike. By doing so, it empowers the U.S. in its diplomatic relations and the pursuit of its foreign policy goals.

However, missile defense is not a panacea. U.S. national missile defense systems are not meant to absorb large scale ballistic missile attacks. In accordance with the 1999 National Missile defense Act, the U.S. will continue to deploy a limited defense geared toward defending against rogue nations states and accidental launches. Therefore, the U.S. must use other means of deterrence to counter the large-scale and sophisticated capabilities of countries like China and Russia. For the U.S. to counter threats from China and Russia, it will require a significant funding increase.

BUDGET CHALLENGES

A common critique of missile defense is that it is unduly expensive and costly, drawing money away from other defense priorities. The reality is that missile defense is a necessity - and a comparatively cheap one.

The missile defense budget only makes up a small fraction of the DoD budget—around 1.7%, or $7.6 billion in FY2014. The money spent on missile defense, meanwhile, provides for the direct protection of the U.S. Additionally, it is necessary to understand that the cost of missile defense is significantly lower than the costs associated with damage and recovery from an attack on U.S. forces abroad or the homeland.

It is of critical importance to invest in the future of missile defense. Today, the cost of an offensive missile is still much lower than the cost of an interceptor. More funding must be committed to ensure technical improvements, greater cost-efficiency, and that U.S. defenses remain ahead of the global threat.

MISSILE DEFENSE PRIORITIES

Protection of the U.S. homeland is and must remain our top priority. The first step to securing the nation is by ensuring the 44 GBIs that will be deployed in 2017 and beyond are properly functioning.

The MDA is planning a Redesigned Kill Vehicle (RKV) for deployment in 2020, and this effort should be supported. To acquire a next generation kill vehicle, the U.S. should also pursue the development of a Multiple Object Kill Vehicle (MOKV), which is capable of destroying missiles with multiple warheads or those with countermeasures.

Funding should also be prioritized for upgrading sensor systems to ensure incoming missiles can be accurately tracked and targeted. It is equally important to commit funding to ensure proper integration between various sensors and interceptor systems.

Finally, the establishment of a third site in the U.S. should remain a priority, pending additional funding not already committed to missile defense programs.

FUTURE OF MISSILE DEFENSE

There are several new technologies that are beginning to play an integral role in missile defense - most notably, directed energy weapons and electromagnetic railguns.

Directed energy weapons (i.e., lasers) travel at light speed and hit a target over long distances with high accuracy. These "deep magazine" technologies will be used to counter increasingly large arsenals of adversary missiles. The now defunct airborne laser project successfully shot down an ICBM (the laser was housed on a Boeing 747 commissioned by the Missile Defense Agency) and demonstrated proof of the concept. A next generation Unmanned Aerial Vehicle program is now experimenting with lasers for sensing, acquiring, and potentially destroying targets.

Electromagnetic rail guns are a potentially viable interceptor alternative, offering lower cost per shot due to inexpensive projectiles.

Prior to an offensive missile leaving the adversary's launcher there are several options to attack it, referred to as "Left of Launch." Cyber operations can be conducted, as can electronic warfare via manipulation of sensor systems. The U.S. must also ensure U.S. missile defenses are resilient and secure from cyber attack.

Space Surveillance Telescope. DARPA | (http://www.darpa.mil/uploadedImages/Content/Our_Work/TTO/Programs/SST/17312%20Document%)

RECOMMENDATIONS

As it stands today, the missile defense capabilities outlined in this primer are in danger of failing to keep pace with the threat posed by Iran and North Korea's burgeoning strategic capabilities. In order to better protect the U.S. and its allies, the United States will need to accelerate, adapt and strengthen its missile defense efforts on several concrete fronts. These include:

Bolstering the Budget

- Focus on exporting U.S. missile defense systems to allies to more broadly share the burden against threats.
- Recommit funding to missile defense initiatives to at least the level of FY 2009 (>$9 Billion).

Protection of the Homeland

- Fund the RKV to ensure enhanced capability for GBIs.
- Invest in the MOKV to reduce the need for the launch of multiple interceptors.
- Continue investments in technologies designed to combat hypersonic and cruise missile threats.

Sensors, UAVs, Space, and Integration

- Support space based initiatives, including the establishment of a "test bed" for development and testing.
- Invest in the development of sensor technology, which can more accurately discriminate targets, and do so both in space and on UAVs.
- Prioritize funding for command and control systems allowing for interoperable missile defense interceptors and sensors.

New Technologies

- Funding for directed energy systems, particularly lasers, and electromagnetic rail guns should be a major priority.
- Commit funding for both offensive and defensive cyber operations.

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About AFPC

For over three decades, the American Foreign Policy Council (AFPC) has played an essential role in the U.S. foreign policy debate. Founded in 1982, AFPC is a 501(c)(3) non-profit organization dedicated to bringing information to those who make or influence the foreign policy of the United States and to assisting world leaders with building democracies and market economies. AFPC is widely recognized as a source of timely, insightful analysis on issues of foreign policy, and works closely with members of Congress, the Executive Branch and the policymaking community. It is staffed by noted specialists in foreign and defense policy, and serves as a valuable resource to officials in the highest levels of government.

About The Defense Technology Program A revolution is taking place in the nature of warfare. The proliferation of ballistic missiles and weapons of mass destruction has given rogue states and terrorist groups unprecedented access to potentially devastating capabilities, while space and cyberspace have emerged as distinct new arenas of strategic competition. The American Foreign Policy Council's work in these areas is aimed at helping U.S. officials understand and respond to this new, and increasingly complex, threat environment.

For more information about the program, please contact Richard Harrison, Director of Operations and Defense Technology Programs at Harrison@afpc.org.

Ground-based Midcourse Defense Interceptor Launch | (http://www.mda.mil/global/images/system/gmd/ftg05c.jpg)

509 C Street NE
Washington, D.C. 20002
Telephone: 202.543.1006
Fax: 202.543.1007
www.afpc.org