CHAPTER 14

MISSILE DEFENSE AND ARMS CONTROL

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> Many countries view ballistic and cruise missile systems as cost-effective weapons and symbols of national power. In addition, they present an asymmetric threat to U.S. airpower. Many ballistic and cruise missiles are armed with weapons of mass destruction.[1]
>
> National Air and Space
> Intelligence Center, 2009

The National Air and Space Intelligence Center's matter-of-fact statement encapsulates the strategic challenges posed by ballistic missile proliferation and, at the same time, establishes the rationale for investments in missile defenses across the globe. Simply put, states are investing in missiles, and the underlying skills and technologies to improve them, because missiles are effective and efficient weapons capable of filling a range of national security missions. Over 25 nations have ballistic missile capabilities today. Even though the aggregate number of missiles may be down relative to the Cold War, that statistic reflects reductions by the superpowers and masks the growth observed elsewhere in the world. The expansion of missile arsenals and the diverse uses contemplated for these arsenals explains the growing interest in missile defense. Missile defenses are becoming commonplace and, with the notable exception of U.S.-Russian arms control, noncontroversial. Stripped of the hangover of Cold War strategic thinking and seen from the views of nations other than the United States and Russia, the choice to erect defenses against ballistic missile threats is a logical and rational one.

Nowhere is this transformation better seen than in Asia. As ballistic missile arsenals grow in size and increase in sophistication, nations throughout Asia are investing in the development of defenses to counter those threats. Ballistic missile defense (BMD) programs run from Japan and South Korea in the north through Taiwan, south to Australia, then west to India into the Gulf States, including Israel; and ending in Turkey. Also included are Russia and China.

These developments are not speculative. They involve investment in real systems and deployment of real operational capability. As these systems are purchased or indigenously developed and subsequently deployed, they have challenged, and will continue to challenge, prevailing conceptions of the contributions of missile defense regional and international security. Cold War thinking concluded that missile defenses would destabilize the strategic nuclear balance. Such concerns seem less prevalent today. The United States and Russia still consider these issues in their bilateral discussions, but they do not appear as relevant in other contexts. The diversification of missions contemplated for ballistic missiles and their spread appears to have changed the logic for defense.

Perhaps the most intriguing question posed by these developments is why. Are these nations truly concerned about the threats posed by ballistic missiles? Are they being “encouraged” to purchase these capabilities by the United States? Does the United States see the extension of defensive capabilities as supporting its own interests? How will the extension of missile defenses affect and, in turn, effect changes in, the nuclear weapons landscape?

The available evidence suggests that all of these factors play a role in the growing investment in BMDs. Interest in defense is driven fundamentally by concerns about the dramatic increase in the size of regional missile arsenals and the proliferation of ballistic missile technology. States throughout Asia and around the world face neighbors, rivals, and adversaries with ever growing and ever more sophisticated missile arsenals. That trend shows no signs of abating. Further, the proliferation of missile technology is decoupling from the proliferation of weapons of mass destruction (WMDs). Traditionally, ballistic missiles were the preferred delivery systems for nuclear, chemical, or biological warheads and, consequently, nations pursuing WMDs would also pursue more advanced missile systems. This remains true, but the availability of increasingly powerful conventional munitions and more accurate missiles allows missile arsenals to serve the more traditional airpower roles of long-range, precision strikes. Shorter-range missiles with conventional munitions also play important battlefield roles in certain areas of the world.

The United States has clear interests in the expansion of missile defenses into Asia (and elsewhere). As the principal supplier of missile defense systems and components, it has apparent economic advantages from such expansion. More deeply, the expansion of U.S.-built defenses enables integration of those systems with U.S. capabilities, thereby expanding the coverage and capability of the U.S. sensor and interceptor network. Finally, beyond that practical consideration, missile defenses offer vehicles for strengthening bilateral or alliance ties and may be the foundation for new defensive security guarantees by the United States.

This chapter explores how BMDs bolster defensive security guarantees and advance U.S. regional and global security interests. At the same time, the motives, as well as plans, for investment in missile defense by leading nations will be discussed. A brief review of the ballistic missile threat precedes that discussion.

EVOLUTION OF BALLISTIC MISSILE ARSENALS

Missile arsenals are expanding in size, in the number of countries possessing them, and technical sophistication. The Barack Obama administration's 2010 *Ballistic Missile Defense Review* (BMDR) adds authority to these observations, noting that:

> The ballistic missile threat is increasing both quantitatively and qualitatively, and is likely to continue to do so over the next decade. Current global trends indicate that ballistic missile systems are becoming more flexible, mobile, reliable, survivable, and accurate, while also increasing in range.[2]

Accentuated by the spread of technology, further maturation of indigenous capabilities, and the deepening of experiential knowledge that comes with the design, construction, and testing of ballistic missile systems, the ballistic missile is a fixture of modern arsenals and will remain so for years to come.

Driving this trend is the simple utility of the missile. Defense analysts have occasionally described ballistic missiles as the "poor man's air force."[3] This description implies that those unable or unwilling to invest the large and sustained amounts of funding necessary to field modern conventional forces can still attain military might with ballistic missiles at much less relative cost. A ballistic missile arsenal (particularly one composed of sophisticated missiles of varied range capabilities) offers the potential to coerce, threaten, or blackmail adversaries.[4] Of course, many states also acquire ballistic missiles for deterrence and dissuasion purposes. The National Air and Space Intelligence Center aptly describes the many uses of ballistic missiles today:

> Missiles are attractive to many nations because they can be used effectively with a formidable air defense system, where an attack with manned aircraft would be impractical or too costly. In addition, missiles can be used as a deterrent or an instrument of coercion. Missiles also have the advantage of fewer maintenance, training, and logistic requirements than manned aircraft. Even limited use of these weapons could be devastating, because missiles can be armed with chemical, biological or nuclear warheads.[5]

China offers an illustration of a highly diversified missile program. China invests in all classes of missiles. Its intercontinental ballistic missile (ICBM) program can reach targets in Asia, Europe, and parts of North America. China's medium-range and anti-ship missile programs serve modest nuclear and robust conventional missiles. China is known to be testing its ballistic missiles against "airfield targets" at the 2nd Artillery missile range in the Gobi Desert. Concrete pads, aircraft, and hangers seen from Google Earth show the impacts of being hit with conventionally armed submunitions. Estimates suggest an intermediate-range ballistic missile (IRBM) can be packed with 990 1-pound (lb) submunitions. Coordinated, multi-missile attacks could hold U.S. airbases in Asia at risk and could inflict massive damage on them and their resident aircraft if an actual missile strike were to occur.

States with active development programs have conducted "several hundred launches of ballistic missiles over the past decade."[6] The BMDR notes that some states are increasingly acquiring and testing "advanced liquid-propellant systems and even solid-propellant systems," while also improving range and accuracy and incorporating "more aggressive denial and deception practices"[7] to ensure survivability against pre-launch attack. Modern ballistic missiles, like China's CSS-5, are accurate to 50 meters of the target and travel more than 1,100 nautical miles. North Korea's IRBM may have a range of more than 2,000 miles. Intercontinental threats are not as apparent today and reside mainly in Russia and China, but North Korea's Taepodong-2 may have a range in excess of 3,000 miles once deployed.

These advantages offer clear incentives for the acquisition of missiles and the investment in the infrastructure to manufacture them indigenously. Proliferation presents more than concerns about the number of countries acquiring weapons. The weapons being acquired are increasing in quality, sophistication, and range. Those qualitative features compound the deterrence and defensive challenge. The BMDR elaborates:

> Globally, the intelligence community continues to see a progression in development from short-to-medium- and in some cases intermediate-range missiles. Development programs reflect increasing ambition in improving payload, range, precision, and operational performance.[8]

No strategy for addressing the threats posed by ballistic missiles is complete if it does not anticipate the evolutionary improvement of missile arsenals in the years to come.

The states most actively pursuing ballistic missile systems also rank as the most likely proliferators of the technology and knowledge needed to develop and mature indigenous missile capabilities elsewhere. The Missile Defense Agency (MDA) cites China's sale of solid-propellant technologies to Pakistan as a critical enabler of Pakistan's Shaheen II medium-range and Abdali short-range missiles.[9] Iran and North Korea are known to regularly exchange technologies and personnel to further advance each others' missile, and perhaps WMD, programs.

Complicating efforts to control the spread of critical technologies is their dual-use nature.[10] Not only do some technologies have nondefense industrial uses; others also contribute to legitimate space exploration aspirations. Consequently, specialty metals or sophisticated manufacturing tools may be exported for perfectly reasonable ends, only to be repurposed or reverse-engineered for resale.

Expanding proliferation networks further heighten the attractiveness of such weapons. Leveraging these relationships allows states and nonstate actors to forgo the considerable expense of indigenous development and production—which once constituted a severe handicap for poor and technologically primitive countries—and acquire sophisticated capabilities quickly. Now, even WMDs and their associated technology increasingly are available for purchase.[11] As the AQ Khan network demonstrated, nonstate actors are engaging in illicit transfers. While transfers of WMD and missile capabilities to terrorist organizations do not appear to have happened yet, the Department of Defense (DoD) believes there is "potential for a substantial increase in the transfer of advanced capabilities" from states with mature missile and WMD programs to less capable entities. [12] Australia's Ministry of Defense echoes DoD's pessimism, arguing:

> The number of states with a "break out" capability to rapidly produce WMD will also probably increase [over the next 20 to 30 years] with the proliferation of dual use infrastructure.[13]

The spread of more advanced missiles does not threaten only the United States. Other nations are becoming more sensitive to the security challenges presented by missile programs. Japanese defense officials are speaking out about the risks posed by North Korea's pursuit of nuclear weapons and the missiles to deliver them. In the wake of a North Korean nuclear test in the spring of 2009, Japanese officials pressed the international community to adopt a more aggressive stand against North Korea. The nuclear test "constitutes a grave threat to the security not only of Northeast Asia but of the entire international community when taken together with the enhancement of its ballistic missile capability," the Japanese Defense Minister said.[14] Japan's representative to the United Nations (UN) called North Korea's actions "a grave threat to the national security of Japan. . . ."[15] Editorializing about a reported North Korean missile test, the *Daily Yomiuri* called for Japan's Self-Defense Forces "to try to intercept the missile to minimize possible damage," should it errantly come toward Japan.[16]

The ballistic missile threat extends beyond North Korea. States throughout the Middle East are acquiring short-range, SCUD or SCUD-derived missiles. Iran's aspirations run higher, and are reflected in their fielded capabilities and in their stated intentions for the continued development of those capabilities. In South Asia, missile proliferation is the latest installment of the Indian-Pakistan rivalry. In North Pacific Asia, North Korea's increasingly sophisticated missile programs, coupled with its role as profligate exporter of technology and know-how, make it both a source of regional instability and a breeder of instability elsewhere. The Australian Ministry of Defence notes that:

> Threats posed by ballistic missiles and their proliferation, particularly by states of concern such as North Korea, constitute a potential strategic challenge to Australia . . . and other threats to regional security and stability.[17]

Absent from Figure 14-1, used by the MDA to show the current state of foreign ballistic missile programs, are the arsenals of Russia and China, which remain among the world's largest and most sophisticated. Both figure prominently in regional security calculations.

Figure 14-1. Foreign Ballistic Missile Programs, 2009.

A brief summation of leading missile arsenals follows. Several themes become clear in this abbreviated review. The upward trend in the investment of time and resources is obvious. The exchange of materials and knowledge among nations is evident. The pursuit of more capable and sophisticated missiles is a priority. The use of missiles to deliver nuclear or other WMD payloads and conventional missions provides new rationales for defenses.

China.

China has the most active ballistic missile development system in the world.[18] The MDA says China is "qualitatively and quantitatively improving its strategic forces."[19] In terms of ICBMs and strategic submarine-launched ballistic missiles (SLBMs), the DoD's 2009 *Military Power of China* report notes that since 2000, "China has shifted from a largely vulnerable, strategic deterrent based on liquid-fueled ICBMs fired from fixed locations to a more flexible strategic force."[20] This change is manifested by two new classes of ICBMs—the DF-31 and DF-31A—both solid-fueled, road mobile, and deployed in 2006 and 2007, respectively.[21] With the eventual addition of the long-range JL-2 SLBM, China's ICBM potential "could more than double in the next 15 years especially if [multiple independently targetable reentry vehicles or MIRVs] are employed."[22] Of particular regional concern must be Beijing's development of medium-range ballistic missile (MRBM) capabilities, especially anti-ship ballistic missiles (ASBMs), which could possibly sink aircraft carriers or deny other warships access to desired areas during a conflict.[23] These ASBMs would significantly complicate U.S. freedom of action on the seas in regions where they are deployed.[24] China's CSS-5 MRBM can strike "targets in the Pacific Theater and most of Asia,"[25] while a CSS-5 variant comprises the nascent ASBM capability. The U.S.-China Economic and Security Review Commission supports that conclusion, noting that Chinese air and missile capabilities will give it the capability to strike U.S. bases in Japan and elsewhere in East Asia.

Finally, China is also consistently expanding its short-range ballistic missile (SRBM) arsenal of CSS-7 and CSS-6s opposite Taiwan. Estimates have this arsenal growing by around 100 missiles per year, adding further tensions in the Straits and East Asia region.[26]

North Korea.

North Korea maintains an extensive indigenous missile program and is the quintessential example of a "secondary proliferator." It has received extensive foreign support from China, Russia, and Pakistan on many of its programs, notably the Nodong MRBM and Taepodong-1 (TD-1) IRBM. The North Koreans now act as "the Third World's greatest supplier of missiles, missile components and related technologies."[27] North Korea has aided many countries, including Iran and Pakistan, with missile development—not to mention helping Syria construct a nuclear reactor, first exposed in 2007.[28] North Korea is an emerging nuclear power. It has withdrawn from the Nuclear Nonproliferation Treaty (NPT) and restarted its once shuttered nuclear facilities. North Korea followed that test with a 3-4 kiloton underground nuclear explosion in May 2009.[29]

The Taepodong-2 (TD-2) represents North Korea's hope for an ICBM capability. Based partly on the TD-1 IRBM design, the first test in July 2006 ended in failure, breaking apart only about 40 seconds into flight.[30] Pyongyang, however, demonstrated a much improved TD-2 during an April 2009 test.[31] If fully developed, a three-stage TD-2 could "deliver a several-hundred kilogram payload up to 15,000 km, which is sufficient to strike all of North America."[32] The TD-1 was first tested in August 1998, a move that caused much consternation in East Asian capitals, particularly Tokyo. The TD-1 is a liquid-fueled, road-mobile missile able to fly at least 2,500 km.

North Korea conducts missile tests on important U.S. holidays such as Independence Day and Memorial Day. It tested six mobile theater missiles on July 4-5, 2006, before once again grabbing the world's attention with a spate of testing beginning on May 25, 2009. North Korea tested seven SRBMs on July 3-4, 2009.

Currently, North Korea deploys at least 200 road-mobile, liquid-fueled Nodong MRBMs and may be developing two new MRBM and IRBMs based on the old Soviet R-27 SLBM.[33] The Nodong has served as the model for Pakistan's Ghuari and Iran's Shahab-III MRBMs. In February 2009, South Korea reported that the Democratic People's Republic of Korea (DPRK) completed its new IRBM with a 3,200-km range potential.[34] The Nodong's potential 1,300-km range can strike most of East Asia, including Guam.[35] From an SRBM standpoint, North Korea deploys hundreds of road-mobile, liquid-fueled SCUD variants to threaten South Korea. It produces an extended-range version of the Russian SCUD B among its SRBM arsenal.[36]

Russia.

Russia not only possesses an extensive arsenal of missiles but contributes to the proliferation problem by selling missiles, technology, and expertise, both openly and secretly. According to the National Air and Space Intelligence Center, Russia retains the largest strategic missile force in the world—comprising ICBMs and SLBMs—despite mandated arms control reductions and attrition due to aging.[37] Russia's prioritization on modernizing its long-range strategic missiles predated the New START negotiations and does not appear to be impeded by it. New START will impose top-end limits on the size of the Russian and U.S. ICBM and SLBM arsenals, setting a cap of 800 ICBMs, SLBMs, and bombers. Russia's current ICBM arsenal includes a road-mobile version of its standard SS-27 Topol-M silo-based ICBM deployed in 2006, with a MIRVed Topol-M currently under development.[38] From an SLBM standpoint, Russia deploys the Sineva, but views the solid-fueled Bulava SLBM as its advanced replacement, due to its potential to carry 10 individually targeted nuclear warheads and travel 5,000 km.[39] The Bulava failed during a December 2009 test, but Moscow reiterated its commitment to the program, despite its poor record.[40] Finally, Russia still has a large SRBM arsenal of variants on the SCUD design, accounting for a significant portion of its proliferation activities, including to North Korea. The Russian SCUD-B "has been exported to more countries than any other type of guided ballistic missile."[41]

India.

India is actively developing its missile capabilities, consistently seeking longer ranges to deal bolster deterrence against its two chief peer competitors, Pakistan and China. India's most ambitious project is the three-staged, solid-fueled, road-mobile Agni-V IRBM, with an expected maximum range just shy of ICBM status at 5,000 km.[42] India is developing its predecessor IRBM, the Agni-III. The rail-mobile, nuclear-capable Agni-III has been successfully tested and will probably serve as the nuclear deterrent *vis-à-vis* China until the Agni-V is deployed.[43,44] The Agni-III will allow India to strike as far away as Beijing; the deployed Agni-II MRBM already allows New Delhi to strike all of Pakistan and most of China.[45] While planning to field updated or new SRBMs, India already deploys a variety of SRBMs, including the ship-launched Dhanush and air-launched Prithvi-II.[46]

Pakistan.

Always trying to match India in military capabilities, Pakistan maintains an active missile development program and deploys a number of systems. Also like India, it will probably consider arming its MRBM/IRBM missiles with nonconventional warheads. Pakistan has tested the solid-fuel Shaheen-II MRBM six times since 2004, and the U.S. intelligence community expects its deployment soon.[47] The Shaheen-II represents an improvement over the Ghauri-II MRBM, which is liquid-fueled and can fly only two-thirds as far.[48] Pakistan also currently deploys around 50 sophisticated, solid-fueled, road-mobile SRBMs, including the Hatf-1, Shaheen-I, and Ghaznavi launchers.[49]

Iran.

Many believe that along with North Korea, Iran might combine nuclear warheads with long-range ballistic missiles in the coming years. Already possessing the largest ballistic missile inventory in the Middle East, Iran, many believe, would "choose missile delivery as its preferred method of delivering a nuclear weapon" because it is "inherently capable of carrying a nuclear payload."[50] Iran is another case demonstrating the perils of proliferation, as it has received past assistance and technology from North Korea, Russia, and China.[51]

Additionally, Iran's pursuit of space launch capabilities offers legitimate cover for its pursuit of long-range missiles. The linkages between the Safir-II Satellite Launch Vehicle (SLV) and ICBM development are widely acknowledged.[52] The Safir-II first delivered a satellite into orbit in February 2009 and did so again in February 2010. Recent intelligence estimates suggest that a committed Iran, with access to foreign technology, could begin ICBM testing by as early as 2015.[53] In addition to its SLV program, Iran possesses other missiles, all under active development. One of its most advanced missiles, the Shahab-III MRBM, is based on the North Korean No Dong MRBM. The Shahab-III has a range up to 2,000 km, placing parts of southeastern Europe in danger, and Iran might have the ability to mass produce such missiles.[54] The two-stage, solid-fueled Sajjil-2 represents an even more advanced MRBM, with a potential 2,500-km range when fully developed. Iran is also developing its SRBM capabilities, with varying degrees of past or current cooperation with China, North Korea, and Russia. The arsenal includes road-mobile, liquid-fueled SCUD variants and the road-mobile, solid-fueled Fateh-110.[55]

Consideration of Iran's missile program also should take note of its advancing nuclear ambitions. The UN Security Council sanctioned Iran three times for its nuclear program, with the United States managing to push through a fourth set of sanctions in 2010 in response to continued Iranian intransigence. The U.S. Intelligence Community judges that Iran is "technically capable of producing enough highly enriched uranium (HEU) for a weapon in the next few years."[56]

MISSILE DEFENSE CHARACTERISTICS

Two basic concepts underscore contemporary approaches to ballistic missile defense—hit-to-kill and layering. Hit-to-kill is a reference to the physical destruction of an attacking ballistic missile. Layering is both a physical and strategic construct in which the defense is organized to exploit the weaknesses of a missile as it travels through its flight phases and provides the defender with multiple opportunities to detect and destroy the attacking missile.

Hit-to-Kill.

All currently operational ballistic missile defense systems are based on surface-launched interceptor missiles.[57] These interceptors use “hit-to-kill” capabilities to destroy their targets—attacking ballistic missiles. Hit-to-kill is descriptive—the interceptor literally “hits” the attacking missile to “kill” it. By aiming for and directly colliding with the attacking ballistic missile at extremely fast closing speeds, the interceptor uses kinetic energy to destroy the target.

The use of directed energy, or lasers, to apply heat to the missile is another way to destroy missiles. The laser destroys the boosting missile by burning through its metal skin until the skin cracks. Directed energy programs have had varying levels of support through the years. Most recently, the Airborne Laser (ABL) represented efforts to use directed energy for missile defense. Space-based lasers were briefly considered during the 1980s. The MDA’s support for directed energy shifted from a push for an operational program, and instead relegating the ABL to a research test bed before it was moved to long-term storage in early 2012.

Layering a BMD.

A ballistic missile’s flight is comprised of three segments, or phases. The first phase is the initial, rocket-propelled boost segment, in which the missile expends its fuel in order to leave the Earth's surface and exit the atmosphere into space. The second phase is the unpowered, ballistic, midcourse phase, during which time the missile's payload travels outside the atmosphere in a ballistic flight in the direction of its target. The third and final, or terminal, phase is the one in which the missile's warheads re-enter the Earth's atmosphere and deliver their destructive payloads on their targets. (See Figure 14-2.)

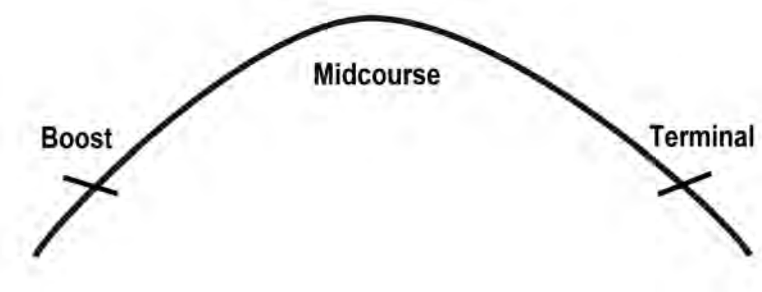

Figure 14-2. Diagram of the Three Phases of a Ballistic Missile's Flight.

In the missile's launch, or boost, phase, the missile is initially moving slowly, fighting inertia and atmospheric drag—all the while lofting all its fuel, as well as its payload—into the sky. Running only on internal fuel, the missile must escape the atmosphere and buildup speed to fly for most of its unpowered flight through space. It must do all of this within the few minutes that its fuel supply lasts.

While its motors are firing, a boosting missile burns immense quantities of highly flammable fuel, which generates immense amounts of thrust, and with it, immense amounts of heat. Infrared sensors can detect a boosting ballistic missile's heat plume from a great distance, especially from a space-based vantage point.

Another important aspect of a boosting ballistic missile is that in order to accelerate the missile's payload to the necessary velocity and loft it out of the atmosphere, all of the missile's contents must be retained inside the missile until the boosting is done. This is true regardless of the number of warheads inside the missile. This means that the boosting missile is a very "rich" target, in that all of a missile's destructive cargo—its warheads and decoys—can be destroyed simultaneously. Stopping the boosting missile requires shooting down only one target.

As a consequence, a missile is most conspicuous and most vulnerable in the boost phase. However, the actual interception of a boosting ballistic missile is also the toughest phase in which to actually reach it. A missile's boost phase lasts only some 300 seconds or less for ICBMs. Newer-generation solid-fuel rockets can take as little as 180 seconds to complete boosting, which offers precious little time in which to effect an interception. Any boost-phase missile-defense system must sense, decide, launch, and fly out to intercept a boosting ICBM, all the while constrained by the target's 180 to 300-second time frame, severely curtailing the effective range of a boost-phase defense weapon.

During the 1980s and early 1990s, kinetic or directed energy interceptions from space-based platforms were the preferred option for boost-phase defense. The Strategic Defense Initiative (SDI) invested in both techniques, and the U.S. Government was ready to begin procurement of a space-based kinetic energy system more commonly known as Brilliant Pebbles when the program was cancelled by the Bill Clinton administration.

There are no boost programs currently under development by the United States. In recent years, the ABL and ground-based Kinetic Energy Interceptor

(KEI) were designated boost-phase programs. The KEI was terminated altogether after a few years, and the ABL has moved to a pure research and development (R&D) platform before being mothballed in February 2012.

Midcourse Phase.

By the midcourse phase of a ballistic missile's flight, the weapon has left the atmosphere, and all of its propellant has been expended. In the airlessness of space, any and all payloads are released from the confines of the missile's nose and are set adrift to follow ballistic trajectories. There are now multiple targets for the defenses to sort out. Worse, countermeasures, chaff, decoys, spent booster stages (especially if they are deliberately fragmented), and housing shrouds are deployed as clutter with which to deceive defending sensor systems and conceal the real weapons.

Once the fuel is spent, the weapons also have little or no capability to maneuver and are set on their trajectories until they re-enter the atmosphere. Ballistic missiles spend the majority of their time in this midcourse phase, which lasts for as long as 20 minutes in the case of ICBM payloads. This phase affords the longest time during which to engage these targets. That and their relative inability to maneuver or change direction beyond their ballistic trajectory affords some advantages to the defense.

But there are significant challenges to successful midcourse interception. The defenses must correctly discriminate between warheads and decoys, and see through countermeasures, over distances of thousands of miles. Because of the distances that need to be traveled from the interceptor launch site to the target in space, the number of available shot opportunities is limited. This conundrum is of particular concern—because a likely response by the offense is to launch several missiles at once, complicating the defender's tracking, discrimination, and interception options. While the midcourse phase is paradoxically the longest time window in which to attempt an interception, it is also the most complex.

Terminal Phase.

The terminal phase is the third and final phase of a ballistic missile's flight. During this time, the warheads and decoys enter the atmosphere at extremely high speed. The warheads are designed to survive atmosphere re-entry heating in order to reach their ground targets and will continue on to their targets at speed, though decelerating due to atmospheric drag. Chaff and decoys will either lag behind the warheads or burn up altogether in the upper atmosphere. The terminal phase is thus inherently "self-discriminating," with only the warheads surviving re-entry to reach the lower atmosphere.

There are three very difficult challenges to be met in attempting interceptions during this phase. First and foremost, warheads entering the lower stratosphere take only 30 to 60 seconds to complete their transit and strike their ground targets. Second, defenses must successfully stop all of the warheads delivered by the missile—a challenging task, as well. Third, more technologically advanced states such as Russia possess Maneuvering Reentry Vehicles (MARVs), which can glide in the atmosphere (at very high speeds) in order to effect evasive maneuvers, making them much more difficult to intercept. In fact, Russia boasts that its MARV capabilities render missile defenses obsolete.[58]

In short, the terminal phase is the shortest time period in which to attempt to intercept a ballistic missile's warheads, requiring very-high-performance weapons to perform successfully in the short response time. Interception ranges and thus coverage zones are even more restricted for terminal-phase defenses.

Missile Defense Today and Tomorrow.

The U.S. missile defense program today consists of four classes of interceptors, numerous sensors and radars, battle management and command and control functions, and a globally integrated communications network. The defense is oriented to defeat missiles in the midcourse and terminal phases of flight. There are no active development programs focused on boost defense. Figure 14-3 summarizes the current and planned architecture as of fiscal year 2011.

Figure 14-3. Current U.S. Missile Defense Systems.

In fiscal year 2011, the MDA transitioned its funding for boost-phase developments to a program focused on Directed Energy. The agency intends to use the ABL Test Bed to push various high-power laser programs, while sustaining critical industrial capabilities. Critics of the ABL felt the chemical laser employed by the system was inefficient and costly, and pointed toward a rising class of laser technologies that appear to offer significant efficiency improvements. As yet, those laser systems are not capable of producing the amount of power needed to destroy a missile. Nevertheless, directed energy systems have great potential for missile defense missions as well as other defense needs. The MDA Directed Energy Program is structured to coordinate and cooperate with other DoD R&D efforts in this area to ensure that results and innovations are shared across the defense science and technology enterprise.

The Aegis and Ground-based Midcourse Defense (GMD) systems comprise the lion's share of the U.S. missile defense effort. The Aegis system has assumed the central focus of the Obama administration's plans. By 2015, the administration plans to have 32 naval vessels outfitted to perform missile defense missions, up from 21 in 2011. Those ships will carry more than 430 Standard Missile-3 interceptors and 100 Standard Missile-2 (SM-2) Terminal interceptors, up from 60 and 40 in 2011, respectively. The Obama administration has embraced the potential of the system and is investing ever larger sums in new variants of the interceptor.

This emphasis is seen most clearly in the Obama administration's regional defense initiatives. The Phased Adaptive Approach (PAA) centered on Europe is focused on "addressing missile defense interoperability with NATO and our allies and partners as the threat from the Middle East is anticipated to increase over the next decade."[59] Designed to intercept short-, medium-, and intermediate-range missiles coming from Iran, the PAA replaced the Bush administration's proposed European "Third Site" GMD-based architecture with an Aegis-based system. The PAA will deploy ship-based Aegis SM-3 IA interceptors to the Mediterranean along with AN/TPY-2 and SPY-1 radars and a command, control, battle management, and a communications (C2BMC) system by the end of 2011.

The four-phase plan calls for additional ship-based assets, an improved interceptor (the SM-3 IB), and an Aegis Ashore battery in Romania to be deployed by 2015. In Phase 3, the SM-3 IIA interceptor that presently is under development in cooperation with Japan is scheduled for use at a site in Poland and at sea. Additional sensors and tracking capabilities also should be brought online by 2018. Finally, by 2020, Phase 4 calls for deployment of the SM-3 IIB interceptor to "provide an early intercept (pre-apogee) capability against MRBMs and IRBMs and provide an additional layer for a more enhanced homeland defense against ICBMs from today's regional threats."[60] With the exception of its radars and target discrimination capabilities, the GMD system is not expected to support the PAA.

Further development of the SM-3 family of interceptors is a work-in-progress. The SM-3 IB, which is planned for use in 2015, continues to encounter divert and attitude control issues and a slipping flight test schedule. The others, which are even more advanced, likely will encounter the delays expected of new and advanced technical systems. "Any new program is going to have issues to deal with," Lieutenant General Henry Obering (Ret.), former director of the Missile

Defense Agency, said in a discussion of the current state of the missile defense program: "What's a little disturbing to me is there was a lot of painting the SM-3 Block 1B program as proven and reliable and just another flight test of the current version, and it's not."[61]

Current plans call for emplacement of 30 ground-based interceptors (GBIs), based principally in Alaska, with four more stationed in California. Review of a recent flight test failure has yet to reveal the cause, and the MDA believes more ground and non-intercept flight tests of the new kill vehicle are required before another intercept test is planned. Work on a two-stage GBI continues "as a potential hedge to allow for a longer intercept window of time if ICBMs were launched against the United States from Northeast Asia or the Middle East."[62] Limited financial resources, manpower, targets, and range availability will force a further delay in the 2-stage GBI test schedule, since the investigation of the 3-stage GBI failure takes precedence. The MDA does not envision a 2-stage flight test until FY 2014.

Both the Aegis and GMD systems are intended to intercept and destroy ballistic missiles during the midcourse phase of their flights. As previously noted, this puts enormous pressure on the radars and sensors to track and discriminate the warhead from countermeasures that may be used. Critics of the GMD system in particular question whether it has the capability to do that against even the most rudimentary of targets. They also contend that tests of the GMD, and to a lesser extent, the Aegis system, lack operational realism. The target discrimination capacities of the U.S. missile defense are closely guarded for precisely these reasons. Little public information is available about these efforts. Tests of both systems in their operational configurations have occurred over the last half-decade. As of fiscal year 2011, Aegis performed successfully in 10 of 12 such tests[63] and the GMD in three of five, with the two failures being the most recent tests. Certainly, more testing is needed, but the tests require targets, which are very expensive and prone to their own failures. They also require range time, which is in demand for other military purposes, and are very expensive.

The final interceptor components of the U.S. missile defense are terminal interceptors—the Terminal High Altitude Area Defense (THAAD), the Sea-based Terminal, and the Patriot Advanced Capability 3 (PAC 3). By 2015, 9 THAAD fire units and more than 430 interceptors are scheduled for deployment. Sixty PAC 3 fire units and nearly 800 interceptors will be in place, along with 100 sea-based terminal SM-2 missiles. Each of these systems represents the last line of defense and is capable of defending a very defined, limited area. Originally contemplated as point defenses, the terminal systems also are quite attractive internationally. PAC 3 is a relatively mature system and cheap compared with purchasing an *Aegis* vessel or GBI field. THAAD is relatively new, but has a proven record of test success—seven for seven in its present configuration—and is being pushed for export by the United States.

Declining budgets and political pressure to deploy capability and demonstrate test success places a large strain on the missile defense budget and detracts from its ability to invest in future concepts. R&D investment in the present program is oriented toward evolving the SM-3 toward longer ranges and will remain the focus of effort through 2020, according to current plans. Associated with that effort is the expansion of related sensor, radar, and command, control, and battle management capabilities. MDA envisions creation of a precision tracking and surveillance satellite constellation and is examining use of the Predator Unmanned Aerial Vehicle (UAV) as an airborne sensor to complement existing terrestrial assets.

In short, under current plans and budgets, the U.S. missile defense of the 2020s will look much like the missile defense of today. The absence of clear and sustained investment in advanced concepts means any radical change of course will require some time before it would be ready for testing, and even longer before deployment.

For those nations that rely on U.S.-developed technologies, their future missile defenses will look much the same. Sales of the PAC 3, THAAD, and eventually the Aegis system will populate the defensive arsenals of U.S. friends and allies with capabilities that are easily integrated with the U.S. command and control network. Indeed, because of the expense of the sensor, radar, and battle management systems, some nations may opt to integrate as a matter of priority.

Japanese interest in the missile defense mission predates the emergence of North Korea's missile capabilities. Japan was one of the first countries to express willingness to work with the United States following the announcement of the SDI in the 1980s. North Korean activities are largely credited with catalyzing Japanese public awareness of the heightened threat posed by ballistic missiles in the region. Following a Nodong test in 1993, Japan and the United States began jointly studying threats and approaches in a formal fashion. A joint technology study was launched in response to the 1998 North Korean test, which produced a joint research agenda and helped fashion the groundwork for the more formal partnership that has evolved.

By 2003, the Japanese government had announced its intention to purchase and deploy missile defense assets, including the PAC-3 and Aegis ballistic missile defense systems. Shortly thereafter, the United States and Japan signed a formal memorandum outlining joint research projects and a cooperative testing agenda designed to benefit both parties, with a particular emphasis on improvements to the SM-3 interceptor used by the Aegis BMD.

Japan signed a license to produce the PAC-3 system in 2005.[64] Today, PAC-3s are stationed at several bases in Japan.[65] In 2006, the U.S. Army activated an X-band radar in northern Japan to track regional ballistic missiles.[66] The two nations began working on the radar in 1998. The powerful radar can identify objects from thousands of miles away and is designed to differentiate between decoys and real missile warheads.

The signature element of the Japanese missile defense architecture is its investment in the Aegis and SM-3 systems. The cooperative research program produced a lightweight nosecone for the SM-3 that was flight tested in 2006.[67] According to the MDA, the new nosecone eliminated the need for additional maneuvering, allowing for faster interception opportunities. Japan's significant investment of resources and technical know-how in the SM-3 IIA distinguishes its contributions from those of nearly every other U.S. missile defense partner. No other country has invested so many of its own resources into developing a new missile defense system, with the notable exception of Israel.

In December 2007, the Japanese Aegis system performed its first successful interception. A second test in December of 2008 failed to intercept the target.[68]

Tests since that time have proven successful, including the one in October 2010.[69]

South Korea's commitment to the construction and deployment of the Korean air and missile defense (KAMD) network by 2012 has been in place for several years.[70] The KAMD consists of PAC-2 interceptors, Aegis destroyers equipped with surface-to-air missiles with some application to ballistic missile defense, and the installation of an early warning radar. South Korea is spending $1 billion to purchase 48 PAC-2 systems, including launchers, missiles, and radars, from Germany in response to the North Korean missile threat.[71] The PAC-2s reached initial operational deployment in 2010. The PAC-2, which was used by the United States during the first Gulf War against Iraqi SCUDs, uses blast fragmentation to destroy the attacking missile, rather than the more sophisticated hit-to-kill of the PAC-3. Independently, the U.S. Army maintains more than 60 PAC-3s in South Korea.

The other element of this defense is the outfitting of its Aegis destroyers, with sea-to-air missiles purchased from the United States. The announced plan calls for Standard Missile 6s (SM-6s) to be placed aboard the South Korean vessel, *Sejong the Great*, with future commitments to arm two additional Aegis vessels once they are constructed.[72] The SM-6 was developed by the U.S. Navy to address primarily cruise missile threats, but from the onset, the new missile was seen to have applications to the short-range or theater ballistic missile challenge. That characteristic fits well with the expressed intent of South Korea regarding its missile defense plans. South Korea has avoided integration with the long-range U.S. missile defense architecture and instead has focused on acquiring capabilities applicable to the North Korean threat.

This is not without pressure from the United States. In the spring of 2008 and several times since, U.S. Lieutenant General Walter Sharp, Commander of U.S. forces in South Korea, publicly encouraged the South Korean government to build a layered missile defense system, including airborne lasers and the PAC-3.[73] Instead, South Korea continues to improve the theater defense it is assembling. In June 2008, the country's Defense Ministry announced the purchase of a new radar system to aid the detection of North Korean launches.[74]

South Korea reiterated its policy of independence, but then partnership again in 2010. In a restatement of the country's policies, the South Korean defense ministry said discussions about the sharing of information and use of resources would continue, but was careful to note that "this does not mean (South) Korea will participate in the U.S. regional defense system."[75]

Taiwan's security environment presents a different context for evaluating Asian missile defense trends. Facing a substantially larger and increasingly more sophisticated Chinese missile threat, Taiwan has sought U.S. assistance to bolster its defenses, but those requests quickly become enmeshed in the larger U.S.-Taiwan-China relationship. Nevertheless, the United States did approve sales of the Patriot PAC-3 system to Taiwan in 2008 as part of a much larger sale of arms to the island nation.

In October 2008, the Bush administration agreed to sell Taiwan 330 PAC-3 missiles to address the growing SRBM arsenal of China, believed to number more than 1,400.[76] Earlier that year, the U.S. Army provided Raytheon Corp. with a $79-million foreign military sales award to upgrade Patriot system radars and provide engineering and training services for Taiwan.[77] The upgrades will allow three existing Patriot launchers to be armed with newer PAC-3 missiles, enabling Taiwan's existing missile defenses to launch either PAC-2 or PAC-3 interceptors.[78] Prior to the sales, Taiwan possessed approximately 200 PAC-2 interceptors. A total of six PAC-3 batteries are planned to be online in 2011.[79]

Unsurprisingly, expanding Taiwan's defensive capabilities arouses Chinese criticism. Surprisingly, the capabilities also sparked debate over their defensive value to Taiwan. An article in the *Naval War College Review,* for instance, claims the defenses would still allow nearly 1,000 Chinese SRBMs to hit their targets, and the Patriot radars are attractive targets for a first strike.[80] Even proponents of growing Taiwanese missile defense acknowledge that more interceptors are needed before the defense can credibly deter China, but they see advantages for the United States and Taiwan from the forward progress.[81] U.S. access to a new Taiwanese early warning radar bolsters the international, Internetted sensor capabilities underpinning the long-range U.S. defensive shield, for example.

In 2004, the United States and Australia entered into a 25-year agreement that provides the framework for cooperative actions on missile defense.[82] The framework agreement, similar to that between the United States and Japan, loosely defines activities and technical areas in which the two countries might work together. Specifically mentioned are the development and testing of advanced radar technology and provision of missile defense capabilities on Australian naval vessels.

Australia is in the midst of constructing three new Aegis destroyers under its Air Warfare Destroyer program. Citing the North Korean long-range missile threat, the Australian government initiated planning for ballistic missile defense capabilities to become part of these vessels.[83]

The United States and Australia have studied the integration of Australia's radar networks into the missile defense architecture, notably the Jindalee over-the-horizon (OTH) radar. Long before the signing of the cooperative agreement in 2004, the United States and Australia jointly conducted Project DUNDEE (Down Under Early Warning Experiment) to test whether the Jindalee radar could detect theater ballistic missiles. The 1997 experiment saw the radar successfully detect and track representative theater ballistic missiles.[84] Australia's Pine Gap radar is an established element of the international early warning system and may have contributions to missile defense.[85]

Singapore's Aster-15 missile and *Formidable*-class frigates have the ability to network with other vessels in a manner analogous to the U.S. Aegis system.

To varying degrees, Japan, South Korea, Taiwan, and Australia have each pursued missile defense options in response to the proliferation of ballistic missiles in their region. So long as North Korea and China continue to invest in the acquisition and improvement of their short- and long-range missile capabilities, these nations will likely continue their investment in defenses.

Israeli missile defense systems generally are interoperable with their U.S. counterparts. Israeli-U.S. technical cooperation is long established, and the United States has provided Israel with significant financial resources to support its missile defense program. In Fiscal Year (FY) 2012, for example, the MDA is requesting more than $100 million for Israeli Cooperative Programs, which include the Arrow system and a program known as David's Sling.

Elsewhere in the Middle East, interest in missiles abounds. Saudi Arabia, Kuwait, Bahrain, Qatar, and the United Arab Emirates (UAE) all are involved in missile defense discussions with the United States in one form or another. While one suspects Iran is the primary threat motivating this interest, the spread of SCUDs and other short-range missiles throughout the region makes the picture more complex. In terms of systems, the U.S. military has stationed its own assets in the region, namely, a mix of Aegis, PAC-3, and THAAD batteries. None of the Arab states have acquired advanced capabilities, but that will change. The UAE are the long-rumored home for the THAAD system. Once sales like that are allowed to proceed, others will be sure to follow.

Turkey presents a complicated case. As both a Middle Eastern and European power, with ties to the Muslim world as well as NATO, Turkey has security positions that generally reflect careful balancing. As NATO's embrace of missile defense became firmer and eventually formal policy, Turkey's awkward position has become ever more acute. During negotiations within NATO and even during the Bush administration's push for a European missile defense site, the Turks were critical of defensive efforts.[86] The planned defense did not defend all of NATO, they argued; in particular, large parts of southern Europe and Turkey were left "undefended" by the then-notional system. Turkey also wanted to avoid naming Iran as the chief missile threat to NATO.[87] When the Obama administration unveiled its initiative for Europe, Turkey was suggested as a possible location for a radar system. Reports suggest the Turks were initially supportive of the idea and then cooled on it, at least publicly. Leaked diplomatic cables reveal the complexity of Turkey's position. On the one hand, Turkey's dependence on Iran for energy is well known and was judged a major factor in Turkey's public positions on the relationship of Iran to NATO's efforts. On the other hand, Turkish defense officials secretly agreed with U.S. assessments of the implications of a nuclear Iran for regional stability and agreed with the need to construct a missile defense suitable to protect Turkey and the rest of Europe.[88]

In the weeks before the Lisbon agreements in late 2010, when NATO nations agreed to the goal of constructing a European missile defense, Turkish leaders pressed for numerous concessions to secure their approval, but most were dropped or pushed off for further discussion.[89]

China and Russia both have or are developing missile defenses of their own. Chinese missile defenses mimic the U.S. hit-to-kill approach. In a highly public test in 2010, official Chinese reports touted the successful test of a ground-based midcourse defensive capability.[90] In 2007, China tested an anti-satellite system using much the same capability. Details remain murky, but if China is pursuing a midcourse interception capability, it will encounter the same difficulties confronting similar U.S. systems—namely target discrimination and tracking.

The Chinese strategic position explains its interest in defensive options. Facing what it perceives is an increasingly hostile United States and suspicious of U.S. encirclement via client-allied states, wary of Russian intentions, and guarded about India's aspirations, China has perceptions of its security environment that continue to reflect a longstanding sense of insecurity. At the same time, China recognizes its growing power and ability to influence regional and global affairs. The twin, seemingly exclusive, dynamics explain China's embrace of offensive missile development and proliferation of missile technologies and investment in its own defense.

The Chinese military announced in January that it has successfully intercepted a missile in mid-flight in a test that came in the midst of growing tensions with Taiwan. China called the system being tested "ground-based midcourse missile interception technology." Chinese missile defense systems are shrouded in secrecy, but U.S. military analysts believe China has augmented its air defenses with "homemade technologies adapted from Russian and other foreign weaponry."[91] A 2009 Pentagon report says the Chinese air force has received eight battalions of upgraded Russian SA-20 PMU-2 surface-to-air missiles since 2006, with another eight on order.[92] The Chinese defense budget for 2009 reached $71 billion, with no disclosed amount for missile defense.

While it remains difficult to assess the types of missile defense systems China employs and where it will employ them, the Hongqui-9 is one known missile defense system deployed in China. It is a long-range, high-altitude surface-to-air missile system and is designed to track and destroy aircraft, cruise missiles, air-to-surface missiles, and tactical ballistic missiles.[93] According to a 2008 DoD report, the Chinese have also deployed 32 S-300PMU systems (SA-10 Grumble), 64 S-300PMU1 systems (SA-20A Gargoyle), and 32 new S-300PMU2 systems (SA-20B Gargoyle). These systems are the Russian equivalents of the U.S. PAC-1 and PAC-2 systems.

Russia's involvement in missile defense debates is extensive. Not only is this involvement a complicating factor for U.S.-NATO efforts *vis-à-vis* Europe, but Russia's continued investment in its own missile technologies presents enormous technical challenges of missile defense systems that look to check sophisticated strategic threats. Additionally, Russian investment in defensive capabilities, drawing on its Cold War systems, continues to present targeting challenges on the strategic level. More worrisome is the prospect that those systems may be sold on the international market and proliferated globally. Russia's objections to the expansion of the U.S. missile defense into Europe is well known; it dominated headlines in the last years of the Bush administration and throughout the New START nuclear weapons reductions negotiations. U.S. assurances that the planned defenses would not be capable of intercepting Russian missiles were unpersuasive or ignored, leaving many Western analysts to conclude that Russian objections were rooted elsewhere. Indeed, the planned emplacement of U.S. military assets in Poland and the Czech Republic—two former client states of the Soviet Union—was known to irritate many in Russian leadership. The Obama administration's reversal of the Bush plan for Europe at first was interpreted as a capitulation to Russian objections. The administration's subsequent announcement of the PAA, which calls for interceptors and radars to be placed in Romania and Poland, did not initially produce the same level of reaction from Russia as the Bush plan did. With the start of the New START negotiations, Russian efforts to constrain missile defenses shifted to the treaty negotiation table. Ultimately, the United States rejected many of those limitations, although some analysts question the outcome.

An outcome of those discussions, however, is the expressed desire to find a more formal role for Russia to play in U.S. missile defense plans. Harkening back to President Ronald Reagan's promises to share SDI technology, the pursuit of U.S.-Russian/Soviet cooperation in regional or global missile defenses is not new. Current discussions are serious, with the Russians claiming they seek "red-button" control over whether to fire an interceptor.[94]

Russian investments in the country's own missile defenses are notable. The central systems are the S-300 and S-400 surface-to-air systems. Basically terminal defense systems akin to the U.S. PAC-3 or THAAD missile defenses, the S-300 and S-400 were originally designed as cruise missile or anti-aircraft defenses. They subsequently were modified for ballistic missile defense missions. Deployment is fairly limited. Public reports put 30 battalions of S-300s in the Russian arsenal. A gradual replacement of the S-300 with the more capable S-400 is planned. A limited number of S-400 battalions are known to exist.

Defensive Security Guarantees.

The internationalization of missile defense offers new opportunities for the United States and other nations to forge defensive alliances. The limits of the current technology virtually demand such arrangements, particularly if a large area is to be defended from attacks originating from many sources. For the United States, with its global interests and requirement to defend globally dispersed targets, a distributed sensor and interceptor architecture is a necessity. The United States has welcomed international partnerships and sales of completed systems, both of which are intended to link with U.S. capabilities. For nations developing their own missile defense systems, like India or China, bilateral or multilateral partnerships are less important, because the area to be defended is smaller, allowing their defenses to be more focused.

Beyond the practical considerations for the United States, its investments in missile defense offer the potential to give new life to old alliances and add value to newer relationships. In a manner similar to the offensive nuclear umbrella extended by the United States to its European and Asian allies throughout the Cold War, the rudimentary structure of a defensive security umbrella is now forming. Much of the debate during the Cold War concerning missile defense focused on whether the introduction of defenses would destabilize deterrence relationships between the United States and the Soviet Union.[95] As the bilateral superpower competition gave way to a multilateral environment with few enduring conflicts, the United States has begun to see missile defense as an important tool to strengthening its new and longstanding regional alliances. The 2010 BMDR speaks extensively to this new emphasis.

The BMDR establishes a strategy and policy framework that assigns international outreach and partnerships a role of high prominence. It states:

> . . . The United States will seek to lead expanded international efforts for missile defense. It will work more intensively with allies and partners to provide pragmatic and cost-effective capacity. The United States will also continue in its efforts to establish a cooperative [ballistic missile defense] relationship with Russia. The United States, with the support of allies and partners, seeks to create an environment in which the acquisition, deployment, and use of ballistic missiles by regional adversaries can be deterred, principally by eliminating their confidence in the effectiveness of such attacks, and thereby devaluing their ballistic missile arsenals. This will help undergird a broader stra-

> tegic objective: to strengthen deterrence in key regions through the integrated and innovative use of military and nonmilitary means that adapt regional deterrence architectures to 21st-century requirements.[96]

Current U.S. thinking sees several roles to be played by missile defenses. The first are the practical contributions already alluded to. The BMDR commits the United States to partnerships to "provide pragmatic and cost-effective capacity" and help maintain "military freedom of maneuver." Missile defense is a tool to broaden ties with Russia. But, most importantly, missile defense is a means to deter regional adversaries and "adapt regional deterrence architectures to 21st century requirements."[97] In this context, the term "regional deterrence architecture" is a euphemism for the function of alliances. The BMDR is even more explicit on the notion of the guarantee implied by the U.S. missile defense umbrella. It states:

> Ballistic missile defenses help support U.S. security commitments to allies and partners. They provide reassurance that the United States will stand by those commitments despite the growth in the military potential of regional adversaries.[98]

These defenses also are called "an essential element of the U.S. commitment" to regional alliances.

When viewed in context of the broader Obama administration strategic defense policies, the significance of these statements comes into clearer focus. At roughly the same time that the Obama Department of Defense (DoD) was issuing the BMDR, it also was negotiating the first major reductions to the U.S. nuclear weapons arsenal in many years and doing so in the context of the President's desire to seek a world with zero nuclear weapons. The prospect of nuclear disarmament raised worries in some quarters about the continued vitality of U.S. security guarantees to its allies, particularly NATO and Japan.[99] The nuclear guarantee was characterized as the foundation of these nations' own security policies. Consequently, the credibility of the U.S. nuclear program is a major security concern not only for the United States, but for many nations.

The expansion of missile defense may bolster the intangible aspects of the nuclear umbrella. At its core, the nuclear umbrella is a U.S. commitment to stand by and come to the aid of the allied nation and to do so in a meaningful and substantive way. The deterrent function of the nuclear arsenal is judged to have a positive dissuasive effect on an adversary. Missile defenses, if they are sufficiently robust, can have the same effect.

Like the nuclear deterrent, missile defenses must be credible. By reducing the probability that a ballistic missile strike will successfully hit its target, the presence of a defense may dissuade an aggressor from a strike. For the current threat environment, in which the number of missiles used in a conflict should be low, a defense can credibly manage a likely threat scenario. If the number of missiles involved in an exchange grows, the technical limitations of current missile defense architectures may be overwhelmed, at worst, or put in a position in which the offensive has greatly improved its probability of a successful strike. In such a circumstance, the credibility of the defense is weakened. Nations under the umbrella would be expected to explore offensive and defensive steps unless the United States moved to strengthen the defense and restore its credibility.

Critics of missile defenses insist they can never achieve the reliability needed. Like a nuclear second-strike capability, reliability is in the eye of the beholder. If the United States and its allies can create enough doubt about the probability of a successful missile strike, the defense may succeed in deterring attacks beyond what it can actually do. The defense is not the only option available in times of crisis, but it is an important complement to those capabilities. The United States and its allies will retain other offensive military and nuclear capabilities with which to respond in the event a defense is overwhelmed. The purpose of defense is not necessarily to repel 100 percent of the attacker's force. A defense also can sufficiently weaken the attacking force to make a counterattack more successful. Third, a defense forces the attacker into a large-scale attack to overwhelm it, which in turn, raises the probability that the United States would respond to such an attack. As Paul Bracken argued, "Missile defense links active protection of an allied nation's population to the likelihood of triggering the American security guarantee. The larger the attack, the more probable is a U.S. response."[100]

The use of the ballistic missile for offensive actions other than the delivery of nuclear weapons offers another opportunity for allied nations to work together. Collective defense of airfields, bases, and other militarily significant targets is noncontroversial. Investment in air defenses or port defenses is expected, and sharing of capabilities between allied nations commonplace. As the use of the ballistic missile shifts from a delivery device for weapons of mass destruction to a delivery device for conventional munitions in its role as the "poor man's air force," the role of defense shifts as well. Nations in regions where missiles are expected to play this role will invest in defenses to limit the impact of those strikes and to deter their adversaries from using them in the first—using the same logic that might drive the investment in a new air defense. The United States can apply the traditional methods of arms sales, training, and co-development to missile defenses. Such methods have served it well as alliance maintenance tools by providing allied or friendly nations with the systems, infrastructure, training, and knowledge needed to address their security needs. At the same time, such actions expand the global reach of weapons systems that are interoperable with those of the United States, increase opportunities for joint training exercises with those nations to improve the fighting effectiveness, and offer export markets for U.S. industry, which is increasingly important as pressures mount on the U.S. defense budget.

CONCLUSION

The strategic logic for missile defense has undoubtedly changed. The proliferation of technology and capability, coupled with what appears to be clearer intent to use missiles for offensive and deterrent purposes, is driving demand for defenses across the globe. During the Cold War, the United States and the Soviet Union wrestled with the concern that introducing defenses would upset their delicate balance of terror. In a world where many nations possess missiles, bilateral deterrent relationships resting exclusively on offensive retaliation appear to have less value. That is particularly the case when we consider that many nations plan to use their ballistic missile arsenal as delivery vehicles for conventional munitions and for battlefield applications. Just as a nation might respond to the introduction of a new class of aircraft with more sophisticated air defense systems, so today nations are responding to the introduction of missiles with missile defenses.

By moving to exploit this new interest, the United States will not only be able to improve the effectiveness of its own defense, but reap the ancillary benefits of strengthening its alliances and relationships. Current defensive architectures rely on an interconnected suite of sensors and radars to track attacking ballistic missiles. These systems, in turn, provide data to the interceptors that attempt to hit the attacking missile. Numerous limitations vex the defense. The sensor and tracking capabilities have to be refined enough to detect and follow small objects over thousands of missiles amidst clutter and debris designed to hide them. The interceptors face range limitations by virtue of how big they are and how fast they fly. As a consequence, the objective of the U.S. missile defense system is to obtain as many opportunities to destroy the attacking missile as possible across its path of flight. This requires different kinds of defensive systems. The spread of missile defenses that are compatible or interoperable with those of the United States offers significant leveraging opportunities that should improve the effectiveness of the defense.

More importantly, the spread of defenses offers opportunities to revitalize old alliances and build new ones. As the proliferation of ballistic missiles creates new security concerns for U.S. friends and allies, the operational nature of the current complement of defenses likely binds the nations together. More broadly, investing existing alliance relationships with the new mission gives them new purpose and currency. Defense also can come to complement the offense. As the

United States pursues nuclear arms reductions, it can use the expansion of missile defense to allay the concerns of those nations that sit under its nuclear umbrella who may have begun to question the credibility of the U.S. commitment to their security. Through the extension of a defense security guarantee, the United States reassures its allies of its commitment to employ its military forces in their defense, thereby helping to restore credibility to the guarantee formerly provided by offensive retaliation.

Missile defense is not a panacea, but it does offer new tools to address the new threats faced by the United States and many other nations. Continued technical improvements should result in improvements to the defense, but offenses also are expected to continue innovating to defeat the defense. A perfect defense is a fleeting goal. Instead, a more realistic assessment of the complementary role defense can play in addressing the tactical and strategic challenges posed by expanding missile arsenals would conclude that the defense decreases the probability of a successful attack, complicates offensive planning, and provides options other than preemption or retaliation in times of crisis.

ENDNOTES - CHAPTER 14

1. *Ballistic and Cruise Missile Threat*, NASIC-1031-0985-09, Wright-Patterson Air Force Base, OH, National Air and Space Intelligence Center, 2009, p. 3.

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3. Ballistic missiles are powered during their initial phase of flight (usually called "boost phase") before leaving the atmosphere and following an unpowered, inverted-U shape trajectory toward a predetermined target. Ballistic missile ranges can vary from 100 or so kilometers (km) to more than 10,000 km.

4. Ballistic missiles are classified by range as follows: Short-Range Ballistic Missiles (SRBMs) = 150 - 799 km. Medium-Range Ballistic Missiles (MRBMs) = 800 - 2,399 km. Intermediate-Range Ballistic Missiles (IRBMs) = 2,400 - 5,499 km. Intercontinental-Range Ballistic Missiles (ICBMs) = 5,500 km and greater.

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