Standard Missile 3 launched from Aegis combat system–equipped USS *Decatur* during Missile Defense Agency ballistic missile flight test intercepting separated ballistic missile threat target (U.S. Navy)

Understanding the Indications and Warning Efforts of U.S. Ballistic Missile Defense

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It is true today as it was ten years ago that this effort holds the promise of changing the course of human history, by freeing the world from the ominous threat of ballistic missile attack. Given the choice, shouldn't we seek to save lives rather than avenge them?

—President Ronald Reagan on the 10th Anniversary of the Announcement of the Strategic Defense Initiative

The critical mission of defending the U.S. homeland—homeland defense—requires a fully integrated capability to identify, categorize, and fuse strategic and tactical indications and warnings (I&W) by U.S. Strategic Command (USSTRATCOM), North American Aerospace Defense Command (NORAD), U.S. Northern Command (USNORTHCOM), and U.S. Pacific Command (USPACOM). Today's fiscally constrained environment may encourage decisionmakers to eliminate perceived I&W "redundancies" and create an I&W stovepipe for weapons release authorities (WRAs). In a mission area where time is of the essence and failure would result in grave damage to national security, such an arrangement would create an unacceptable risk to homeland defense.

Overview

According to the U.S. Missile Defense Agency, "countries invest in ballistic missiles because they are a means to project power in regional and strategic contexts" and provide "a capability to launch an attack from a distance."[1] This has led to an increase in ballistic missiles over the past 5 years. The total number of these systems outside the United States, the North Atlantic Treaty Organization, Russia, and China has risen to over 5,900.[2] Hundreds of launchers and missiles are currently located within range of deployed U.S. forces.[3]

According to the U.S. Intelligence Community, current trends indicate that ballistic missile systems using advanced liquid- or solid-propellant propulsion technologies are becoming increasingly mobile, reliable, survivable, and accurate, and have the ability to strike targets over longer distances. Moreover, the "proliferation of ballistic missiles is increasing the number of anti-access weapons available to potential regional adversaries. These weapons could be used to reduce military options for combatant commanders and decrease the survivability of regional military assets."[4]

These threats from state actors will likely become more dangerous due to increases in the numbers, capabilities, and lethality of delivery systems and payloads in development. North America currently has a modest BMD system specifically developed to counter intercontinental ballistic missile (ICBM) threats from rogue nations. BMD is a system of systems employing a layered defense architecture.[5] It architecture integrates BMD capabilities and intelligence systems for I&W to defeat ballistic missile threats.[6] Despite the vast array of terrestrial and space-based collection assets designed to provide I&W, however, the Intelligence Community faces challenges with providing strategic I&W. In particular, prioritization of geographic combatant commanders' priority intelligence requirements (PIRs) could potentially create gaps in coverage, affecting timely intelligence that supports WRAs for effective BMD employment. This is important because of the limited engagement timeframe for incoming ballistic missiles from launch to impact. The decision by a WRA to engage must occur within minutes of a launch to enable defeat of the incoming weapon.

Rogue State ICBM Threats to North America

Originally intended to counter the Soviet nuclear threat during the Cold War, BMD technology in the 21st century has shifted focus to defending the U.S. homeland against regional actors such as Iran and North Korea.[7] North Korea's advancements in its existing ICBM inventory and nuclear capabilities are a concern. While Iran does not currently possess an ICBM, Tehran is making tremendous strides in pursuit of ICBM technologies, also creating concerns for the United States.

North Korea continues to advance its existing ICBM arsenal. In December 2012, the North Koreans demonstrated their technological advancements in potentially launching an ICBM by successfully placing a satellite in orbit using an Unha-3 rocket. A variation of the Taepo Dong-2 ICBM, the Unha-3 is a three-stage rocket.[8] North Korea currently possesses two potential ICBM vehicles: the Taepo Dong-2 and KN-08.[9] In March 2013, Joint Chiefs of Staff Vice Chairman Admiral James Winnefeld commented, "We believe the KN-08 probably does have the range to reach the United States."[10] In addition, North Korea has taken steps to develop road-mobile KN-08 launchers, complicating timely I&W prior to launch and thereby creating exceptionally tight timelines for ICBM discrimination and ground-based interceptor (GBI) targeting post-launch.[11]

Currently, the North Koreans do not possess the means to place a nuclear warhead on either of these platforms. However, coupling their ICBM progress with the detonation of a third nuclear device in February 2013, North Korea is either intentionally or unintentionally signaling a desire to develop a capability to threaten North America.[12] As a result, in March 2013, Secretary of Defense Chuck Hagel announced that "the United States would be bolstering its missile defenses."[13]

For the past 60 years, North Korea, with its isolated, authoritarian regime led by a succession of unstable leaders, has been a seemingly intractable and exceptionally dangerous security and stability problem. There are numerous specific examples where Pyongyang's erratic and irrational behavior nearly reignited conflict on the Korean Peninsula. A nuclear-armed North Korea significantly changes the security calculus and the ability of the United States to negotiate with or influence Pyongyang. In April 2012, North Korea changed its constitution, describing the country as a "nuclear-armed nation."[14] In February 2013, Pyongyang threatened South Korea and the United States with a preemptive nuclear strike, further complicating the situation.[15] Whether North

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Korea would actually use nuclear weapons is hotly debated. However, an irrational North Korea equipped with nuclear-armed ICBMs *perceiving* a threat to its regime could result in a serious and dangerous miscalculation that would threaten North America.

Iran does not currently possess an ICBM capability; however, Tehran continues to prioritize and advance its ballistic missile programs. Since the 1980s, Iran has relied on its North Korean and Syrian partners to export and then assist in the development of short- and medium-range ballistic missile systems. Despite its original reliance on third parties, Iran's missile program has evolved over time, demonstrating the engineering and technical expertise necessary to develop missile technologies on its own.[16] In particular, Iran has continued to work on its satellite launch vehicles (SLVs). In February 2009, Iran successfully launched a satellite into orbit using its Safir-2 SLV platform. Since then, it has been working on upgrades for delivering heavier payloads into higher orbits.[17] According to Director of National Intelligence James Clapper, "Iran continues to expand the scale, reach and sophistication of its ballistic missile forces—many of which are inherently capable of carrying a nuclear payload."[18]

The Defense Intelligence Agency assesses that Iran's development of large space launch vehicles demonstrates an intent to develop ICBM technologies. In January 2012, Secretary of Defense Leon Panetta noted that "Iran might be able to develop a nuclear-armed missile about a year or two after developing a nuclear explosive device."[19] The rapid progress of Iranian missile technology and development is changing the minds of many senior leaders who had been skeptical about the future of Iranian ICBM capabilities and ability to threaten North America.[20]

Similar to North Korea, concerns exist regarding an ICBM-equipped Iran armed with nuclear devices. Iran possesses an extensive inventory of short- and medium-range ballistic missiles. Tehran incorporates these missiles in its overall strategy to "deter—and if need be retaliate—against forces in the region, including U.S. forces."[21] An Iran equipped with nuclear-tipped ICBMs would likely extend that strategy to include North America, thereby seriously affecting the U.S. position and leverage against Iran in regional security issues by holding major U.S population areas hostage. Again, any *perceived* threat to the Iranian regime could result in a serious miscalculation.

I&W Capabilities for BMD

To effectively use ground-based interceptors to counter threats, WRAs must have substantial intelligence resources to detect and monitor perceived indicators via analysts and tools that may offer adequate warning. Whether a single source of information or a fusion of multiple sources, I&W intelligence provides time-sensitive information to military commanders or other senior leaders who may authorize a response to an adversarial action or intention. BMD warning is enabled by a layered multisensor architecture that consists of fixed and mobile land-, sea-, and space-based assets located around the world. Future I&W capabilities for BMD will most likely include greater numbers of systems as described, in addition to more technologically robust systems in development. Nevertheless, the U.S. Government has signaled it will also incorporate joint and multinational efforts beyond those that already exist.[22]

Land-based components of the BMD warning system include fixed sites and mobile phased-array radar sensors. Upgraded early warning radars located in Alaska, California, Greenland, and the United Kingdom provide all-weather, long-range tactical warning of ballistic missile launches, including estimated launch and impact points, to the command authority.[23] The Cobra Dane Upgrade is a midcourse radar in Alaska that detects missiles out to 2,000 miles and operates in the L-band radio frequency.[24] The Army Navy/Transportable Radar Surveillance and Control (AN/TPY-2) consists in part of a high-resolution X-band radar primarily deployed in support of U.S. allies in Asia, Europe, and the Middle East; however, it can also provide acquisition and tracking data for the integrated BMD system.[25]

Sea-based components of the BMD warning system include the ship-based Aegis and semi-submersible platform-based radars, which can each detect and provide acquisition and tracking information for the BMD system. The mobile nature of naval platforms allows them to be repositioned around the globe with efficiency to improve BMD detection coverage during heightened tensions within a given region. There are currently 31 cruisers and destroyers based in the Atlantic and Pacific fleets that are fitted with the Aegis BMD system, with an additional two undergoing installation. Aegis Ashore Installations will be located in Romania and Poland as part of the European Phased Adaptive Approach, with an Aegis Ashore test facility in Hawaii.[26] The Aegis system works in conjunction with the Army Navy/Shipboard Phased-Array Radar (AN/SPY-1) S-Band radar and can detect, cross-cue, and track ballistic missiles to provide warning to other regional and national assets.[27] Aside from U.S.-operated systems, Japan purchased Aegis for its four *Kongo*-class guided missile destroyers,[28] and smaller, less capable Aegis versions are carried by Australia, Norway, South Korea, and Spain.[29] Furthermore, the Sea-Based X-Band (SBX) radar is mounted on a twin-hulled, self-propelled drilling platform that is jointly operated by the Missile Defense Agency and Military Sealift Command.[30] Primarily used for BMD testing purposes in the Pacific, the SBX radar can also be deployed in support of homeland defense. The land-, sea-, and space-based sensor systems can provide target track information to the command, control, battle management, and communications (C2BMC) system, which then provides tracking information to other radar systems and track and discrimination information to the shooter systems for organic or remote engagement.

Space-based systems have provided the United States a strategic and tactical I&W capability for more than five

Patriot Advanced Capability–2 missile launcher during crew drill (U.S. Air Force/Nathanael Callon)

decades. The once-classified, second-generation satellite constellation known as the Defense Support Program (DSP) was first launched into orbit in 1970.[31] DSP satellites use short- and mid-wave infrared sensors in a geosynchronous Earth orbit (GEO), allowing constant or near-constant vigilance in support of the overhead persistent infrared mission.[32] The third-generation satellite constellation known as Space-Based Infrared Systems uses a mix of GEO and highly elliptical orbit satellites, which allows for scanning and staring[33] of selectively targeted areas with increased sensitivity as compared to the older DSP satellites.[34]

Future sensors are in development to improve and enhance current BMD warning capabilities. In addition, multinational efforts in the Asian, European, and Middle Eastern regions will become more robust and include nontraditional partners such as China and Russia,[35] suggesting that the United States and its allies perceive North Korea and Iran as the primary antagonists of the ballistic missile threat. These future platforms will enable earlier I&W, which will increase the engagement windows for the BMD systems and provide additional decision timeframes for the WRAs.

Combatant Commander Responsibilities for I&W

Although USSTRATCOM provides subject matter expertise on global I&W for ICBM threats as well as planning and operational issues related to BMD, each geographic combatant commander is responsible for protecting the homeland in the command's respective area of responsibility (AOR). USNORTHCOM and USPACOM have specific roles and tasks within this construct.[36] The USNORTHCOM commander has the overarching responsibility of protecting North America as the supported command, with assistance from USPACOM and NORAD as supporting commands.[37]

The USSTRATCOM commander is responsible for synchronizing global BMD plans and operations, in addition to providing missile warning to

NORAD and other combatant commanders if the appropriate combatant command is unable to do so.[38] To this end, the USSTRATCOM commander established the Joint Functional Component Command for Integrated Missile Defense (JFCC-IMD) as the synchronizing body for the BMD system.[39] The Missile Defense Agency and JFCC for Intelligence, Surveillance, and Reconnaissance support JFCC-IMD in providing "shared situational awareness, integrated battle management C2 [command and control], adaptive planning, and accurate and responsive battle damage assessment."[40]

BMD System

The ballistic missile defense system is a complex, distributed system of five elements (four shooter elements and one C2 element), five sensor systems (four radar systems and one space-based system), and supporting efforts. The integration of these many elements and efforts enable a robust, layered defense against a hostile missile in all phases of flight.[41] The shooter elements include the Aegis BMD, Terminal High-Altitude Area Defense system, Patriot missile defense system, and Ground-Based Midcourse Defense (GMD) system. The sensor systems include the Aegis BMD AN/SPY-1 radar, Cobra Dane radar, upgraded early warning radars, AN/TPY-2 (forward-based mode) radar, and Space-Based Infrared Systems/DSP. In addition, the Sea-Based X-Band radar (primarily a test asset that can be operationally deployed as needed) will be used within the BMD system when available. The command and control element is the C2BMC, a vital operational system that enables the President, Secretary of Defense, and combatant commanders at strategic, regional, and operational levels to systematically plan BMD operations, collectively see the threat develop, and dynamically manage designated networked sensors and weapons systems to achieve global and regional mission objectives.[42] This group of automated systems enables each sensor and shooter to integrate by sharing targeting information and engagement control for a WRA.

The U.S. GMD missile system currently is the only demonstrated capability for defense against ICBM threats to the United States.[43] Planners bin ballistic missiles into one of five categories based on their maximum range capabilities: close range (62–186 miles), short range (under 620 miles), medium range (between 620 and 1,800 miles), intermediate range (between 1,800 and 3,400 miles), and intercontinental (greater than 3,400 miles).[44] For ICBM threats to the United States, the BMD system relies on GBIs launched from U.S. bases to intercept and kill the missile or warhead during the midcourse phase of its flight. (GBIs are the only system available to attack an ICBM during this phase.) The United States currently has GBI silos at Fort Greely, Alaska, and Vandenberg Air Force Base, California.[45]

Ground-based interceptors are three-stage, solid-fueled boosters with an exoatmospheric kill vehicle (EKV). Upon ICBM launch detection and recognition as a threat to the United States, a WRA can launch GBIs in self-defense. The decision to launch must be made with enough time available for the GBI to reach the ICBM during the midcourse phase. During the GBI flight, the EKV separates from its booster and uses onboard sensors for target detection, guidance, and discrimination, resulting in a collision with the targeted reentry vehicle while it is still in its midcourse phase.[46]

ICBMs have three stages of flight: boost, midcourse, and terminal. The boost phase begins with the launch of the missile/warhead and lasts until the rocket engine burns out, approximately 3 to 5 minutes.[47] The midcourse phase, which is the longest phase of flight, starts after rocket engine burnout and continues with the missile/warhead exiting Earth's atmosphere, reaching its apogee, and beginning its descent, and can last up to 20 minutes.[48] During the terminal phase of flight, the detached warhead reenters Earth's atmosphere and continues until detonation or impact. This generally lasts less than a minute.[49] In total, the three stages of ICBM flight last less than 30 minutes. During this time, a WRA must identify the ICBM launch, determine if the launch is a threat to the United States, decide to engage the ICBM with GBIs, and achieve a successful kill while the missile is still in its midcourse phase of flight. Currently, the BMD system relies on intelligence and sensors to indicate the construction or deployment of rogue nation systems to provide warning of an impending attack. This additional time allows for deployment of additional radar sensors toward the anticipated launch site in order to detect and track any incoming missile.

Integrated Threat Analysis: Current Situation

A number of factors degrade effective strategic I&W, creating a particularly dangerous situation with respect to the North Korean ICBM threat and timely WRA response for BMD employment. First, North Korea is an isolated, closed state that denies robust, comprehensive intelligence collection operations. As a result, the Intelligence Community relies on nonpersistent, space-based imagery collection for North Korea.[50]

Second, these nonpersistent, space-based assets are in high demand, especially by coalition commanders focused on the Korean Peninsula. The capabilities needed for BMD I&W are shared with other PIRs, such as North Korean long-range artillery; short-, medium-, and intermediate-range ballistic missiles; and ground, air, and air defense forces.

Third, even when these space-based assets are used to collect information on North Korean ICBMs, the road-mobile threats, combined with North Korean camouflage, concealment, and deception efforts, make them extremely difficult to find and track. Thus, it is conceivable that the first indication of a North Korean ICBM launch against North America would come from tactical I&W from overhead persistent infrared assets, starting the clock for a WRA to make a GBI engagement decision.

According to Joint Publication 3-27, *Homeland Defense*, and the Unified Command Plan, it is incumbent upon

Oscar-01 launch control facility missile trailer at Whiteman Air Force Base, MO (U.S. Air Force)

USPACOM, USNORTHCOM, and USSTRATCOM to use the I&W resources in their toolkits to warn against ballistic missile threats.[51] Regional assets, such as Aegis cruisers and destroyers, fixed early warning radar sites, and mobile radar systems, provide information to the combatant commanders for I&W. The President has delegated weapons release authority to USNORTHCOM, precluding USSTRATCOM from WRA for engaging targets.[52] These combatant commander responsibilities reinforce the necessity of I&W and BMD system capabilities within the combatant command to ensure timely response and engagement of all BMD threats to the United States.

Conclusion and Recommendations

Ballistic missile defense is a no-fail mission that requires an interdependent and complementary effort to generate and track strategic and tactical indications and warning intelligence. It is imperative that leaders understand the importance of the BMD system and component systems to ensure continued funding for these systems and I&W platforms. This will reduce the chances of creating stovepipe systems that cannot (or are slow to) communicate with other systems. In a mission area where time is of the essence and failure would result in grave damage to national security, failure to support the BMD system would create an unacceptable risk to homeland defense. It is also imperative that we continue to improve and grow I&W capabilities for BMD throughout the combatant commands.

Although USSTRATCOM is responsible for synchronizing global I&W for ballistic missile threats, USNORTHCOM, along with USPACOM, requires its own organic I&W capability for BMD for four primary reasons. First, a USNORTHCOM ballistic missile defense I&W element, specifically focused on ICBM threats to the homeland, can collaborate with USPACOM, USSTRATCOM, and the Intelligence Community to leverage the imagery collection resources for strategic I&W of the Pacific region, primarily North Korea. Without this focused attention and emphasis, other commands may weight collection efforts more toward peninsula-focused PIRs, especially during times of increased tensions, and thereby create gaps in collection coverage.

Second, a USNORTHCOM BMD I&W element, in close collaboration with USSTRATCOM and USPACOM and focused on tracking strategic I&W developed by monitoring ICBM activity on the Korean Peninsula, would exponentially increase overall situational awareness of North Korean preparations and intentions for launching an ICBM. Strategic I&W is critical in order to position other mobile platforms as well as to prepare the BMD system, should indications show a North Korean desire and readiness to launch.

Third, should North Korea launch an ICBM against North America, a USNORTHCOM BMD I&W element could ensure that the intelligence-to-shooter is properly communicated in a

timely manner to the USNORTHCOM commander. Upon notification of a launch, the commander has only a few minutes from launch identification to determine if it is a threat to North America and to successfully engage the threat.

Finally, due to limited time and resources, actions and reactions to a missile launch must be flawless, especially among geographic combatant command areas of responsibility. The entire system must work as one unit despite its geographically distributed parts. To aid in the effective handoff of BMD responsibilities between AORs, shared, pristine situational awareness is paramount. North Korean intent is evident. Ballistic missile defense of the homeland is a no-fail mission that starts with collaborative and timely strategic and tactical I&W provided by USNORTHCOM, USPACOM, and USSTRATCOM. **JFQ**

Notes

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