VIEW

The Case for Missile Defense and an Efficient Defense of the US Homeland

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In May 2019, the Pentagon first announced a pause on the years-long troubled efforts to redesign the Exoatmospheric Kill Vehicle (EKV) of the Ground-based Midcourse Defense (GMD) system's interceptors.[1] Since 2004, the GMD system's mission is to defend the United States from ballistic missile threats. The EKV is a sensor-propulsion package that uses the kinetic energy from a direct collision with an enemy's missile warhead to destroy its target.[2] By August 2019, the Pentagon made the surprise decision to completely cancel the so-called Redesigned Kill Vehicle program of the GMD system.[3] For many, the decision represented an inflection point for homeland missile defense in its entirety.[4]

Since its inception, the GMD system had been under scrutiny for being too expensive and, according to its critics, ineffective.[5] More recently, with the emergence of hypersonic glide vehicles, continuing investment into the GMD system, which according to pundits could now become obsolete, was questioned.[6] Alternative missile defense systems like Aegis Ashore or Terminal High Altitude Area Defense (THAAD) were contemplated and presented with the goal to fill the role of GMD or at least complement its capability.[7] In addition, some believed to have identified a current gap in the homeland defense abilities of the GMD system; supposedly, the US East Coast could not be adequately defended with the current US missile defense capabilities.[8]

With this background, it must be the more surprising to those who believe that GMD is not sufficiently equipped to offer an efficient defense of the entire US homeland, that the Pentagon tasked the Missile Defense Agency in April 2020 to release a request for proposal to build America's next GMD interceptor, confirming the continued relevance of GMD.[9] This Next-Generation Interceptor will become the core of GMD and America's continued cornerstone of homeland missile defense going forward.

Over the last several months, multiple publications have described the evolving Iranian missile threat and attempted to highlight gaps in US defenses, particularly along the eastern seaboard.[10] Most certainly, the Iranian missile program is an important topic, and Americans should be concerned. The Iranian Islamic Revolutionary Guard Corps recently launched its first satellite into space. The launch dramatically revealed Iran's secret military space program and emphasized their

continued ballistic missile development, underscoring the potential threat for the United States.

(US Air Force photo by SrA Clayton Wear)

Figure 1. Ground-based Midcourse Defense. A test of the nation's Ground-based Midcourse Defense system was conducted from Vandenberg AFB, California, 25 March 2019 by 30th Space Wing officials, the US Missile Defense Agency, and US Northern Command.

Ground-based Midcourse Defense

Nevertheless, in the interest of providing clarity on a critically important defense concern, there are a few aspects that must be considered in greater detail. First, recent articles in US media paint a rather grim picture of the capabilities of the GMD system, especially for the protection of the American East Coast.[11] It is true that GMD is mainly focused on the missile threat emerging out of Asia.

Such missile threats fly on a trajectory over the Pacific Ocean toward the United States. However, this does not mean that the American East Coast is undefended or severely under defended by GMD, as it is implied.[12] When the GMD system was anticipated, it was done so mainly with the upcoming missile capabilities of North Korea in mind. GMD was designed as a defense against a limited intercontinental ballistic missile (ICBM) threat that could potentially emanate from rogue states.

For North Korea, it was evident that the ultimate missile development goal was the capability to eventually reach the United States with nuclear warheads. Still, in 2004, when GMD became operational, many contested the decision to field the missile defense system, reasoning that North Korea did not have ICBMs at the time nor would it be able to have such a capability anytime soon. Today, the North Korean threat is real, and Pyongyang can potentially reach the American mainland with ICBMs and nuclear warheads.

Knowing today's reality, the establishment of GMD over 15 years ago proved to be farsighted. It must also be argued that, despite widespread criticism about the reliability and excessive cost of this missile defense system (the only defense system in the world designed to counter ICBMs), GMD has already proven its tremendous security value. Without such a system in place, the US defense establishment would likely have viewed a preemptive military strike on North Korea as a necessity had Pyongyang obtained a nuclear ICBM capability. It is hardly conceivable that an undefended United States would have tolerated a nuclear armed, ICBM-capable North Korea. This preemptive strike may have resulted in a war on the Korean peninsula, with clear global implications.

Ground-based Interceptors

Arguably, the Iranian missile program is very similar to that of North Korea. It must be expected that there are Iranian plans to follow in North Korea's ICBM footsteps. Although *optimized* for a limited threat out of North Korea, GMD planners also took a future Iranian threat to the East Coast into consideration when GMD was established. To further improve East Coast missile engagements, a data terminal at Fort Drum, New York, is an operational part of the In-Flight Interceptor Communications System (IFICS). The IFICS consists of a set of data terminals and antennas that are placed in specific geographic locations to support communications with an in-flight GMD interceptor.[13]

GMD's Ground-based Interceptors (GBI) in Alaska are capable of intercepting incoming ICBM threats from Iran. Fort Greely, Alaska, proves to be a formidable location for the GMD interceptors, because it enables GBIs to defend against limited threats aimed at both the East and West coasts. Unquestionably,

an additional interceptor site for GMD on the East Coast would provide redundancy and give additional advantage in a potential Iranian ICBM attack scenario. GBIs travel with a speed of over 7 kilometers per second, exceeding 27,500 km/h, toward their target and release the EKV, which destroys the warhead through kinetic energy in the midcourse phase of the threat missile's flight in space.[14] These intercepts ideally take place as far away as possible from US territory. The key for this to happen, which is often overlooked in the discussion, is the data about the missile threat provided by multiple sensors. The sooner and the more accurate that information is collected from sensors on incoming threats, the higher the probability of the defense's success. Early warning and data collection provide more time to engage the threat and require fewer interceptors that need to be used. It is primarily this critical sensor and radar architecture arena that must be analyzed when understanding the threat that a missile attack from Iran on the East Coast presents.

Sensor Architecture

Developing a more efficient sensor architecture is far more important and effective for the defense of the East Coast than building additional categories of shooter capability. There are two types of missile defense radars: classification radars and discrimination radars. Discrimination is more precise and is needed to identify the actual warhead of the missile, which is difficult to detect among decoys and several other parts that break off the missile. Currently, in contrast to the Pacific Ocean, there is no discrimination radar that could adequately detect an incoming warhead in midcourse over the Atlantic Ocean after the warhead has separated. As a result, more interceptors would have to be fired at more potential missile pieces and decoys because of the uncertainty as to which object was the actual warhead. Adding an additional category of interceptors to the arsenal when the actual defense weakness is based on sensor architecture would be like providing a near-sighted sniper a second rifle when he actually needs glasses.

Aegis Ashore in Fort Drum

Recently, it has been argued that our homeland defense architecture should incorporate the Aegis Ashore weapon system to provide ICBM defense of the East Coast.[15] An Aegis Ashore system at Fort Drum, in upstate New York, is contemplated and supported in the media. But such a system located at Fort Drum would most likely not achieve what the proponents of that idea project. It could neither provide coverage for the entire East Coast nor would it offer a better defense capability against ICBMs than the existing GBIs. Aegis Ashore is a

theater defense system that was originally conceptualized to counter regional medium- and intermediate-range missile threats with its SM-3 interceptor missiles. Admittedly, the enhanced version of the SM-3, the SM-3 Block IIA, shows very promising capabilities that may also make it possible to engage ICBMs in a limited role. However, it should be emphasized that the system is designed to defend against a different class of missile entirely.

Although nearly all US missile defense systems were originally designed for other threats and eventually grew into their other roles, the new SM-3 Block IIA has not yet been tested to determine if it can engage an ICBM-class threat. The only interceptor in the US arsenal that has successfully intercepted an ICBM class threat is the GMD system's GBI. GMD is the only US missile defense system that was specifically designed to counter long-range ballistic missiles threatening the US homeland. GBIs use a three-stage booster, giving GMD the necessary ability and power to perform intercepts over great distances. This range gives GMD, by far, the greatest coverage area of any US missile defense system. GMD is a strategic defense system, whereas other missile defense systems, including Aegis and THAAD are generally classified as "regional" systems. They are mainly geared toward short- to intermediate-range ballistic missile threats. While they may have homeland defense applications in certain circumstances and may be equipped with enhanced interceptors in the future, they still have much smaller coverage areas as compared to GMD and, subsequently, much less capability against ICBMs.

Even if, as it is often pointed out, the GMD system only has a 60-percent success rate, that is still a 60 percent better rate against ICBMs than any other system.[16] In this context however, it also has to be understood that the reported 60-percent success rate is a cumulative result of all live fire tests and the number of intercepts combined. Contrary to popular belief, however, not every GMD test was designed to hit its target. Some tests were conducted to study the rocket engines, behavior during near misses, and so forth. Therefore, the 60-percent value is misleading.

The new SM-3 Block IIA missile's range is classified, but it is a significantly enhanced range compared to the original SM-3. The new Block IIA version has a 21-inch diameter along its entire length, compared to the older SM-3 versions, which have a 21-inch-diameter booster stage at the bottom, but are only 13.5 inches in diameter along the remainder of their lengths. The increase in diameter to a uniform 21 inches with the new SM-3 Block IIA provides more room for rocket fuel, permitting the Block IIA version to have a burnout velocity (a maximum velocity reached at the time the propulsion stack burns out) that is greater than that of the older SM-3 versions.[17] However, the uniform 21-inch diameter

also represents the maximum possible diameter size expansion for the SM-3 interceptor missile, as it is constrained by the size of the launching platform. Regardless of range and fuel enhancements, with an incoming ICBM nuclear warhead flying 20 times the speed of sound, there would not be much time to achieve a successful engagement with a SM-3 out of Fort Drum, nor the chance to get multiple shots on the target (which is the standard procedure in missile defense to ensure the destruction of the threat).

An even further enhanced version of the SM-3 (SM-3 Block IIB) with a longer range is of course possible, but there are clearly design limitations for increased range. GBIs, on the other hand, are basically ICBMs without a warhead and have similar ranges as ICBMs. They are much bigger in size than the SM-3 and are launched out of refitted silos that were originally designed for the US Minuteman ICBMs. They use the same rocket stages that are used to launch satellites into space. A SM-3, however, could never carry enough fuel to have a similar range, due to its much smaller size, and could therefore never engage a threat in comparable distance as a GBI.

The current GMD architecture is sufficient, albeit not optimized, to defend the East Coast against a potential limited ICBM attack from Iran. Defense capabilities against an Iranian ICBM could be enhanced by establishing a *GBI site* (not an Aegis Ashore site) at Fort Drum and could even be made significantly more efficient by adding a discrimination radar midway en route between Iran and the East Coast. Possible locations for such a radar could be in Iceland or in Greenland for example, with both already having US military presence there. Further, the three AN/TPY-2 Forward-based Mode radars that are supporting regional missile defense in Europe and the Middle East should be integrated into the GMD architecture for the defense of the US homeland (currently they are not). Although these radars are capable of discrimination, in their present locations and orientations, they are geographically too close to Iran to apply this feature in the case of an Iranian ICBM launch and, therefore, could not detect a warhead that separates in the midcourse phase of the missile flight in outer space. A potential Iranian ICBM directed at North America would have left the field of view of those radars by the time of warhead separation. Nevertheless, the three forward-based AN/TPY-2 radars in the European and Middle Eastern theaters could play a similar role for Iranian missile threats as the two AN/TPY-2 Forward-based Mode radars in Japan for launches out of North Korea. The two American radars in Japan are integrated in the GMD architecture and provide early warning and sensor cueing for homeland defense for missile threats out of North Korea.

Aegis Ashore and Terminal High Altitude Area Defense in Hawaii

Similar assessments are being promulgated for an Aegis Ashore system in Hawaii, just as in Fort Drum. Although transforming the Aegis Ashore test site on Kauai into an operational asset is certainly cheaper than building the long-planned Homeland Defense Radar Hawaii, the defense value for Hawaii against ICBMs is greatly reduced without said radar. The Department of Defense recently dropped funding and plans to build the proposed missile defense radar in Hawaii.[18] However, construction of the highly capable Homeland Defense Radar Hawaii would considerably increase the time window and efficiency for GBI launches from Alaska or California. This additional time window and critical threat data would create more security for Hawaii from ICBMs than an Aegis Ashore system could, even under the most optimal circumstances.

Nevertheless, the transformation of the Aegis Ashore test site in Hawaii into an operational asset provides more defense value than the aforementioned hypothetical Aegis Ashore system in Fort Drum. Hawaii's island geography and the relatively small area to cover could give the Aegis Ashore system, under certain conditions, a role as last intercept option in case of a missed GMD engagement.

An additional defense layer potentially provided by an enhanced THAAD interceptor in case Aegis Ashore also misses its target, as is suggested by some reports, is not realistic.[19] The time for THAAD to engage the incoming warhead, which at this point would probably be starting (or at least be very close to) reentry into the Earth's atmosphere at extremely high speeds, would be exceptionally short. The terminal phase of an ICBM lasts only one to two minutes.[20] In this phase, the warhead is also being armed.[21] A successful THAAD engagement at this stage with a potentially armed nuclear warhead could be tantamount to a nuclear air burst in the vicinity of Hawaii. This may be viewed as preferred to a potential nuclear ground burst in Hawaii but is in no way an outcome that justifies integrating THAAD resources into the US homeland defense architecture in Hawaii. Rather, the alternative is to fully optimize a potential GMD engagement through more capable GBIs and the most effective sensor architecture possible, in combination with an Aegis Ashore system (which is also enhanced through an optimized radar architecture) as last resort for failed GBI intercepts. THAAD is a highly valuable defense resource on the theater level for countering short-, medium-, and intermediate-range ballistic missiles, which THAAD would not face in Hawaii, due to its geographic location. Instead, THAAD would potentially only contribute to homeland defense in Hawaii with unresolved and potentially marginal effectiveness. There seems little value in creating a supposed additional defense layer that, even under the best circumstances, may be liable to fail when

two more capable and appropriate defense layers could be more profoundly optimized for the best possible defense solution.

Sea-Based X-Band Radar

As previously mentioned, discrimination of the actual warhead is of utmost importance to ensure a successful intercept. The Sea-based X-Band Radar (SBX) provides this discrimination capability for missile threats in midcourse over the Pacific Ocean for the GMD system. SBX is a highly capable discrimination radar that is mounted on a self-propelled former oil platform. Its ocean-spanning mobility allows it to be repositioned as needed to support homeland defense. However, this flexible support concept could also mean that SBX may end up being in an unfavorable location for the defense of Hawaii when needed. In addition, the system cannot achieve its full performance under heavy rain and other weather-related environments.[22] SBX can provide GMD with extremely valuable data; however, a complete reliance on this one sensor for discrimination seems problematic. The Homeland Defense Radar Hawaii, with its discrimination capability, would have been an extremely efficient and important addition to the present sensor architecture for Hawaii. Instead, GMD will rely on the Long-Range Discrimination Radar (LRDR) in Clear, Alaska, for homeland defense. LRDR is currently under construction, scheduled to be completed in the next two years, and will provide a permanent discrimination radar for the Pacific. The LRDR in Alaska will complement SBX and lessen the reliance on this one single asset. However, it is important to note that SBX is still moderately better equipped to produce relevant data, since it operates in the X-Band radar frequency and is therefore more precise in discriminating objects and a possible warhead than the LRDR, which operates in the S-Band frequency.

The Aegis Ashore test site in Kauai, Hawaii, is equipped with a SPY-1 radar. Its range will most likely not be sufficient to guarantee a distant enough ICBM engagement. Fortunately, the new SM-3 Block IIA interceptor has the capability to Launch on Remote (LoR) and Engage on Remote (EoR). This means that the interceptor could be launched based on data from a radar other than the organic SPY-1 radar and then guided into the target by the SPY-1 radar (LoR) or even be completely independent from its SPY-1 radar, relying totally on another radar, for the entire engagement (EoR). But unfortunately, there is currently no other radar that could provide discrimination data for Aegis Ashore if the Homeland Defense Radar Hawaii is not built. SBX is only supporting GMD. To use SBX data for remote SM-3 launches or engagements, its link architecture would have to be redone. When completed, LRDR's location in Alaska may not be ideal for the defense of Hawaii. An alternative will be to equip the Aegis Ashore site in Hawaii

with a different radar. The highly capable SPY-6 or the SPY-7 radar (a scaled-down version of the LRDR), which will complement the upcoming Japanese Aegis Ashore sites, will be needed in Hawaii as well.

Is GMD Obsolete?

The idea of the entire GMD system facing technological obsolescence as was put forward in some media publications is based upon incorrect assumptions.[23] GMD, like THAAD, Aegis, and every missile defense system in the US arsenal, is designed to engage an incoming missile according to a predictable trajectory and according to a calculation of where an enemy missile will be at a certain time. Often, Russian and Chinese development of hypersonic glide vehicles, which do not travel on a predictable trajectory, is cited as a reason to limit investment into GMD and abandon the program. This perspective misses some key points that must be considered for a reasonable discussion.

GMD was never intended to defend against Russian or Chinese missile attacks. The sheer number of their ballistic missile arsenals would easily overwhelm GMD without the need for hypersonic weapons. Even decades-old technologies used by Russia and China, such as Maneuverable Reentry Vehicles (MaRV), Multiple Independently Targetable Reentry Vehicles (MIRV), and Multiple Reentry Vehicles (MRV), pose significant issues for GMD. The introduction of hypersonic glide vehicles by Russia and China does not change the balance in strategic missile defense (its impact on a regional theater missile defense is another matter). GMD's purpose has always been the prevention of a limited ICBM threat to the United States posed by rogue states. It is currently not anticipated that North Korea or Iran will be able to develop hypersonic glide capabilities, nor do they possess MaRV, MIRV or MRV capability, even though these technologies have been around since the 1970s and 1980s.

The United States must certainly invest into research and development of countermeasures to the upcoming threat of hypersonic glide vehicles, but this should not come at the cost of existing defenses against real ICBM threats from rogue states, which are likely to persist and even grow. Conflating investment in GMD due to the threat from near-peer state actors such as Russia and China is a distracting mistake. GMD must continue to serve its role as an ICBM defense system from rogue states and must continuously be evaluated for areas of improvement in support of this mission.

THAAD and Aegis Ashore and the Defense of the US Homeland

Within the arena of air and missile defense, regional or theater missile defense systems such as THAAD and Aegis Ashore are increasingly being discussed as assets that should be deployed domestically in the role of homeland defense. These systems are currently only deployed outside of the United States—in Europe, Asia, and the Middle East. The media commonly proposes these assets as supplements or replacements to the existing GMD framework.[24] Although these discussions are likely beneficial in that they bring new ideas that may lead to an ultimate improvement in the robustness of homeland defense, it should be emphasized that these regional/theater-level missile defense assets are currently not proven capable to sufficiently engage ICBMs. If these systems are modified or enhanced to a degree in which they are capable of doing so in the future, they will never offer the same North American continental coverage as GMD. This shortcoming is based on their inherent design limitations.

Aegis Ashore and THAAD could still play a vital role in the defense of the US homeland by providing what they have proven to do exceptionally well and what they are currently doing in Asia, Europe, and the Middle East—providing protection from medium- and intermediate-range ballistic missile threats. The ICBM threat from rogue states is real, but it is not the only potential missile threat the United States faces. There is growing concern that the destabilizing northern area of South America is seeing increased involvement from Russia, China, and Iran. A hostile military presence in this region would not require an ICBM class of missile to threaten the country. It is only a matter of time before a ballistic or cruise missile threat emerges from this part of the world. It would be naïve to think that hostile actors would not seize upon the destabilized region as an opportunity to pressure the United States in furtherance of their objectives. Domestically deploying regional missile defense systems, such as THAAD and Aegis Ashore, in anticipation of these threats is certainly worth discussing. Similar to the initial planning sessions on the North Korean threat in the 1990s, defense concerns coming from the south may be met with skepticism or even mockery. This initial reaction should not dissuade thought leaders and military planners from objectively reviewing the growing threat from this region and America's vulnerability to it. Upon consideration of this threat, it is likely that planners will determine THAAD and Aegis Ashore could effectively serve as the country's defensive response.

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Notes

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