# Fact Sheet: An Introduction to Ballistic Missile Defense

The U.S. has developed and deployed a number of systems in an attempt to defend the U.S. homeland, troops and facilities abroad, and allies against ballistic missile attacks.

The Ground-based Midcourse Defense (GMD) System, originally referred to as "National Missile Defense", is intended for defense of the U.S. homeland against limited intercontinental ballistic missile (ICBM) attacks from a rogue state with a small number of nuclear weapons, such as North Korea. This system currently includes 33 interceptors deployed in Fort Greely, Alaska and 4 at Vandenberg Air Force Base, California. It is scheduled to have 44 interceptors by the end of 2017.

Theater defense systems, such as Patriot, Terminal High Altitude Area Defense (THAAD) and Aegis, are intended to defend against short-, medium- and intermediate-range missiles. They have been deployed in the Middle East, Europe, and East Asia to protect U.S. troops and allies in regional conflicts.

**How Does It Work?**

Ballistic missile defense systems seek to defend against an attack by launching interceptors that would hit incoming missiles and destroy them on impact. Intercepting ballistic missiles involves four steps:

1. Detection of the incoming missile (using radar and/or satellites)
2. Discrimination (distinguishing the missile or warhead from accompanying debris, decoys and other countermeasures)
3. Fire control (predicting the target location and guiding the interceptor)
4. Killing (hitting the missile or warhead with the interceptor)

The GMD system seeks to intercept incoming ICBMs during their midcourse phase. ICBMs can remain in the midcourse phase of their trajectory for around 20 minutes, giving defense systems more time to intercept the target. However, targeting is difficult, because nations that have perfected ICBM technology are also capable of adding decoys or countermeasures to their missiles that detach during the midcourse phase and travel at the same speed as the missile until atmospheric re-entry. That means GMD interceptors have to correctly identify a warhead amongst debris and decoys.

Other BMD systems, such as Patriot and THAAD, attempt to intercept incoming missiles during the terminal phase. The terminal phase is very short, and although the warheads are slowed down by air resistance, they still travel extremely fast. Atmospheric re-entry strips debris and decoys deployed in space from the warhead, but adversaries can use other countermeasures, such as chaff, to confuse defense systems.

Finally, the Aegis system is intended to intercept incoming missiles in the midcourse or terminal phase.

**What Are the Challenges?**

In theory, limited missile defense systems might improve a country's security. However, U.S. missile defense systems have encountered a number of challenges that throw their effectiveness into question. Countries can use countermeasures, such as decoys, to overwhelm ballistic missile defense systems. In flight test, the Missile Defense Agency (MDA) has not yet satisfactorily demonstrated the ability to distinguish between warheads and decoys. Furthermore, ballistic missile defense testing to date has been highly scripted for success and has not accurately reflected the operational environment.

In particular, the GMD system has long been plagued with technical challenges. The program was launched in the 1980s, but remained in the research and development phase until the early 2000s. In 2002, President George W. Bush ordered the withdrawal from the Anti-Ballistic Missile Treaty and announced that the United States should have an operational ballistic missile defense system by 2004. In order to accommodate this tight timeline, GMD was developed using a "spiral" approach. Instead of designing a new system to meet the project's goals, developers used technology that already existed or that could be quickly acquired with the intention of improving it in the future. Furthermore, GMD was exempt from the "fly-before-you-buy" policy, meaning that the system was deployed without a demonstration of effectiveness. Over a decade later, the GMD system continues to be developed and deployed concurrently. In a 2016 report, the Government Accountability Office (GAO) noted that concurrency is "a high-risk strategy that often results in performance shortfalls, unexpected cost increases, schedule delays, and test problems," and may have contributed to GMD's $40 billion and counting price tag.

The GMD system has performed poorly in flight tests despite their scripted nature. The interceptor has fully succeeded in only eight out of seventeen tests since 1999 (one test hit the target, but did not destroy it). The record has not improved over time. Since its deployment in 2004, the system has only succeeded in three out of nine tests, and since early 2010, only once in four attempts. Despite GMD's high cost and poor test record, the U.S. government has taken steps to expand the program. In 2016, Congress voted to remove the word "limited" from legislation defining the role of U.S. national missile defense, opening the door for the development of a system that would defend not only against limited attacks by rogue states, but also against attacks from countries with larger arsenals, like China and Russia. This type of defense would be far beyond the scope of limited missile defense and would require 100s or even 1000s more interceptors with much better capabilities than have thus far been demonstrated. Even if such a system were achievable from a technical standpoint, it would also be extremely expensive.

Beyond the technical challenges, there are questions about how adversaries could amend their own strategies to account for ballistic missile defenses. Ballistic missile defenses are not designed to defend against cruise missiles, which in turn could make cruise missile development seem more attractive. In addition, it is much cheaper to develop offensive missiles than defensive systems. Countries can simply decide to build more offensive missiles to counter an increase in defensive systems. That could lead to an arms race, which would threaten the very security that ballistic missiles were designed to protect.

Finally, countries could also decide to prioritize delivery methods other than ballistic missiles. For example, a nuclear weapon could be placed inside a shipping container and detonated in a port.

**What Should We Do About Ballistic Missile Defense?**

In an era of budget limitations, decisions about defense present tradeoffs. With every new GMD silo, there is less money for other defense programs and priorities.

Many experts recommend terminating the program, which costs too much for the little potential protection it could give us. Experts also argue that, because of the program's unreliability, it is unlikely that we – or our adversaries – would make strategic decisions based on its effectiveness. Others believe it should not be deployed until or unless testing in realistic environments under realistic operational conditions proves reliability and effectiveness. Until then, only research and testing should be funded. Going forward, at the very least, Congress should be more aggressive in exercising oversight over missile defense programs, demanding adherence to transparency and accountability standards observed by other weapons programs. Members of Congress should also press Administration officials on how and why GMD expansion could lead to a new arms race, and encourage the debate on the program's efficacy.

*Sources: Union of Concerned Scientists, U.S. Government Accountability Office, Missile Defense Agency, U.S. Department of State.*