



The Missile Defense System

One of the greatest threats facing the world today is the increasing proliferation of ballistic, hypersonic and cruise missiles, and weapons of mass destruction. Nonproliferation activities, including diplomacy and arms control agreements with Russia, have been successful in reducing this threat. However, despite reductions in the number of weapons deployed by the United States and the former Soviet Union, missile proliferation continues on a wide scale today and could increase as the technology is transferred. Countries make investments in missiles because they provide them with the means to project power both in a regional and strategic context and a capability to launch an attack from a distance. A country with no missiles today may acquire them quickly, and these missiles could become available to non-state terrorist groups.

Because it can defend critical nodes, military assets and seats of government, missile defense programs enhance nonproliferation activities. In other words, missile defense can provide a permanent presence in a region and discourage adversaries from believing they can use ballistic missiles to coerce or intimidate the U.S. or its allies. In times of crisis, we can surge mobile missile defense capabilities into a region to enhance deterrence and, if a missile is launched, improve protection of critical assets and limit damage over a wide area. The ultimate goal of missile defense is to convince countries that missiles are not militarily useful or a worthy investment and place doubt in the minds of potential aggressors that a missile attack against the United States or its allies can succeed.

The layered missile defense technology being developed, tested and deployed by the United States is designed to counter missiles in all phases of flight. Since missiles have different ranges, speeds, size and performance characteristics, the Missile Defense System is an integrated, layered architecture that provides multiple opportunities to destroy missiles and their warheads before they can reach their targets. The system's architecture includes:

- networked sensors (including space-based) and ground- and sea-based radars for target detection and tracking;
- ground- and sea-based interceptor missiles for destroying a ballistic missile using either the force of a direct collision, called "hit-to-kill" technology, or an explosive blast fragmentation warhead;
- and a command, control, battle management and communications network providing the operational commanders with the needed links between the sensors and interceptor missiles.

All of our missile defense elements are operated by uniformed U.S. military personnel. The United States also has missile defense cooperative programs with a number of allies, including United Kingdom, Japan, Australia, Israel, Denmark, Germany, Netherlands, the Czech Republic, Poland, Italy and many others. The Missile Defense Agency also actively participates in NATO activities to maximize opportunities to develop an integrated NATO ballistic missile defense capability.

Ballistic missiles follow a four-phased trajectory: boost, ascent, midcourse and terminal.

Boost Phase

Boost phase defenses can defeat ballistic missiles of all ranges, including Intercontinental Ballistic Missiles (ICBMs), but it is the most difficult phase in which to engage a missile. The intercept window is only from one to five minutes after launch. Although the missile is easiest to detect and track in the boost phase because its exhaust is bright and hot, missile defense interceptors and sensors must be in close proximity to the missile launch. Early detection in the boost phase allows for a rapid response and intercept early in its flight, possibly before any countermeasures can be deployed.



Midcourse Phase

The midcourse phase begins when the enemy missile's booster burns out and it begins coasting in space towards its target. This phase can last as long as 20 minutes, allowing several opportunities to destroy the incoming ballistic missile outside the earth's atmosphere. Any debris remaining after the intercept will burn up as it enters the atmosphere. The Ground-based Midcourse Defense element is now deployed in Alaska and California to defend the U.S. homeland against a limited attack from rogue nations. This system can only defend against intermediate and long-range ballistic missiles. The Aegis ballistic missile defense element utilizes existing Aegis cruisers, destroyers, and ashore sites armed with interceptor missiles designed to defend against short- to intermediate-range ballistic missiles. A network of advanced sensors, radars and command, control, battle management, and communication components provide target detection, tracking and discrimination of countermeasures to assist the interceptor missile in placing itself in the path of the hostile missile, destroying it with kinetic energy, also known as hit-to-kill technology. These sensors and radars include transportable X-band radars, as well as advanced radars aboard Aegis cruisers and destroyers capable of operating in the world's oceans. We have also built the largest X-band radar in the world, the Sea-Based X-band, which is mounted on a floating platform allowing it to traverse the world's oceans. This radar provides precise tracking of target missiles of all ranges and discriminates between warheads and countermeasures that could be deployed with a hostile missile.

Terminal Phase

The terminal phase is very short and begins once the missile reenters the atmosphere. It is the last opportunity to make an intercept before the warhead reaches its target. Intercepting an incoming warhead during this phase is difficult and the least desirable of the phases because there is little margin for error and the intercept will occur close to the intended target. Terminal phase interceptor elements include the Terminal High Altitude Area Defense (THAAD) now being delivered to the U.S. Army; the Aegis BMD Sea-Based Terminal Defense capability using SM-2 and SM-6 missiles; and the U.S. Army's PATRIOT Advanced Capability-3 (PAC-3), now deployed worldwide. These mobile systems defend against short- to medium-range missiles.

Hypersonic Glide Phase Intercept

The Aegis Sea-Based Terminal system has a limited capability to intercept maneuvering hypersonic warheads within the atmosphere. The Missile Defense Agency is developing an Aegis based Glide Phase Interceptor to extend this capability to the exo-atmosphere.

Cruise Missile Defense

Several of the missile defense systems that provide ballistic missile defense capability such as Sea Base Terminal interceptor and the Army Patriot interceptor also have capability against cruise missile and air-breathing threats.

Testing

Testing must account for the ever-changing ballistic missile threat and the latest technological developments. Ground and flight tests provide data needed for highly advanced modeling and simulation activities that allow us to measure and predict the performance of all missile defense technologies. Successful flight tests, in particular, give the warfighter greater confidence in the system's capabilities.