Ballistic Missile Defense System Elements

The Ballistic Missile Defense System (BMDS) is a complex system of elements and supporting efforts. The integration of these many elements will enable a robust, layered defense to defend against a hostile missile in all phases of flight.

Learn more about the BMDS with the following fact sheets: Ballistic Missile Defense System and BMDS Test Record.

Ballistic missile trajectories are commonly divided into four phases of flight: boost, ascent, midcourse, and terminal. Each element will play an important role in a robust system intended to defend against hostile missiles in any phase of flight.

Phases of flight.

Boost Phase

The 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. 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.

Ascent Phase

The ascent phase begins right after the missile’s powered flight and ends just prior to apogee. The MDA is preparing to leverage emerging Ascent Phase Intercept (API) technologies to hedge against threat growth and realize the greatest potential for reducing cost and increasing operational effectiveness of missile defense. This rationale is based in part on a Defense Science Board 2002 Summer Study, which emphasized the benefits of ascent phase intercepts. API would allow us to intercept early in the battle space and optimize our ability to execute a shoot-look-shoot tactic to defeat a threat before countermeasures are deployed, minimize the potential impact of debris, and reduce the number of interceptors required to defeat a raid of threat missiles. Additionally, by destroying missiles early, the remainder of the BMDS architecture is not required to track and kill a threat reentry vehicle (warhead) and associated objects, nor do we have to incur the costs of maintaining a significant number of expensive interceptors to destroy advanced countermeasures in a later phase of a threat missile’s flight.

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 countries like North Korea and Iran. This system can only defend against intermediate and long-range ballistic missiles. The Aegis sea-based missile defense element utilizes existing Aegis cruisers and destroyers armed with interceptor missiles designed to defend against short- to medium-range ballistic missiles, and has been successfully tested against an intermediate range missile. 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 with 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 actual missiles 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 a 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 near-term Sea-Based Terminal Defense capability using the SM-2 Block IV missile, 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.