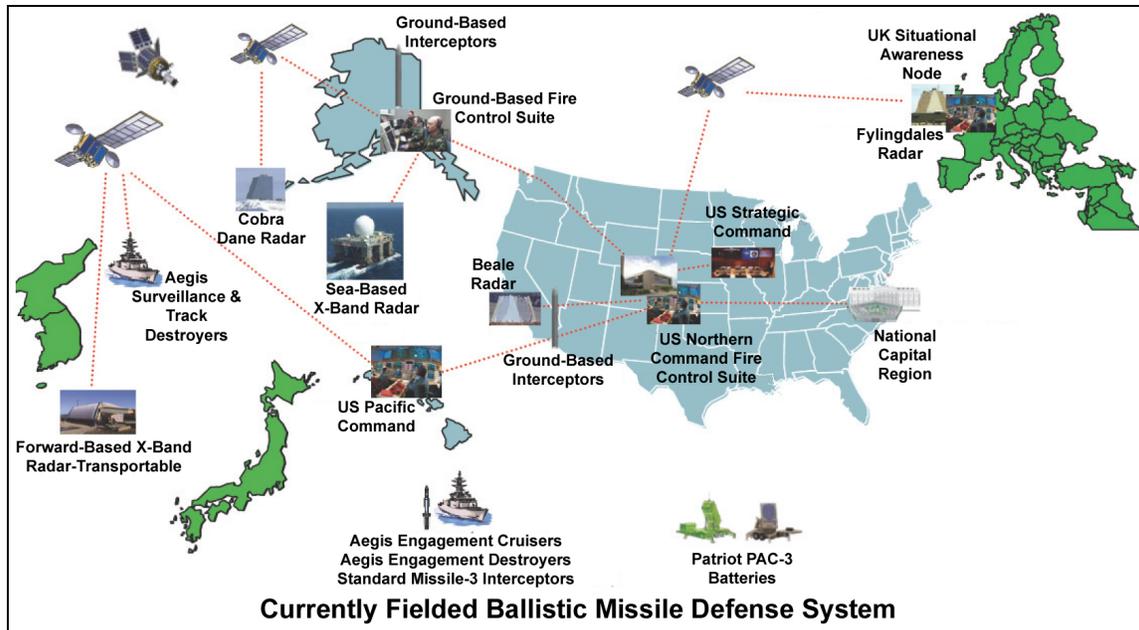


Ballistic Missile Defense System (BMDS)



Executive Summary

- The Missile Defense Agency (MDA) testing emphasis continues to move from testing the elements to testing the Ballistic Missile Defense System (BMDS).
- Due to test hardware problems associated with the Exoatmospheric Kill Vehicle (EKV), the MDA was unable to attempt any Ground-based Midcourse Defense (GMD) intercept tests during FY08. Instead, the MDA performed the Flight Test Other-03 (FTX-03) sensors-only flight test event.
- Terminal High-Altitude Area Defense (THAAD) and Aegis Ballistic Missile Defense (BMD) – theater elements of the BMDS – completed a combined total of five successful intercept flight tests in the past year.
- Command, Control, Battle Management, and Communications (C2BMC) continues to add and update functionality; battle management capability is still in early development.
- Sensor correlation and fusion that results in the generation of a weapon task plan remains untested during end-to-end live intercept flight tests. Multiple sensors were tested and a weapon task plan was generated during the sensors-only FTX-03 flight test; however, the MDA did not plan an intercept during the test.
- Target availability, reliability, performance, and cost remain major issues in BMDS flight testing.

System

- The current BMDS architecture integrates ballistic missile defense capabilities against all ranges of threats.
- BMDS is a distributed system currently composed of four elements and six sensor systems.

Elements

- Aegis Ballistic Missile Defense (BMD)
- Command, Control, Battle Management, and Communications (C2BMC)
- Ground-based Midcourse Defense (GMD)
- Patriot Advanced Capability 3 (PAC-3)

Sensors

- Aegis BMD AN/SPY-1 Radar
- Cobra Dane Radar
- Upgraded Early Warning Radars (UEWRs) – Beale and Fylingdales
- AN/TPY-2 (FBM) (Forward-Based Mission) radar (formerly Forward-Based X-band Transportable radar, or FBX-T)
- Space-Based Infrared System (SBIRS) / Defense Support Program (DSP)
- BMDS is employed as part of the nation's integrated strategic response plans.
- Projected near-term additions to the BMDS include the Sea-based X-Band (SBX) Radar, UEWR-Thule, and THAAD.
- Far-term additions to the BMDS may include:
 - Airborne Laser (ABL)
 - Kinetic Energy Interceptor (KEI)
 - Multiple Kill Vehicle (MKV)
 - Space Tracking and Surveillance System (STSS)

BALLISTIC MISSILE DEFENSE SYSTEMS

Mission

- The U.S. Strategic Command is responsible for synchronizing and integrating ballistic missile defenses employing U.S. Northern Command, U.S. Pacific Command, U.S. Central Command, U.S. European Command, and the BMDS to defend U.S. territory, deployed forces, friends, and allies against ballistic missile threats of all ranges, in all phases of flight. Initial capability will permit defending U.S. territory against simple ballistic missile threats and defending deployed forces, friends, and allies from theater-level ballistic missile threats.
- U.S. Strategic Command and U.S. Pacific Command will maintain situational awareness across the full mission engagement space using the C2BMC system.
- The Army employs Patriot to provide theater defense for the deployed forces against short- and medium-range threats. The MDA transferred Patriot to the Army; it is reported as an Army program.

Prime Contractor

- Boeing

Activity

- The MDA continued its emphasis on planning and conducting combined developmental and operational testing to the maximum extent possible during both flight and ground tests. Although not classic operational testing, the MDA incorporated as much operational realism as possible into its tests without compromising developmental test objectives.
- Due to test instrumentation problems, the MDA restructured the GMD flight test program. They conducted a non-intercept test, FTX-03, in July 2008 in place of FTG-04, and committed to adjusting their FY09 and beyond test program to ensure they collect the intercept data lost when FTG-04 was not accomplished. AN/TPY-2 (FBM), Aegis AN/SPY-1, SBX, and UEWR-Beale, C2BMC, and GMD Fire Control (GFC) elements participated in FTX-03.
- The MDA conducted two system-level ground tests, Ground Test Distributed-02 (GTD-02) in November 2007 and Ground Test Integrated-03 (GTI-03) in June 2008. One developmental ground test, Ground Test Other-3a (GTX-03a), occurred in February 2008. GTX-03b (scheduled for April 2008) was cancelled due to the test content being either deferred to a future test or re-allocated to GTX-03a.
- The MDA conducted a fully-digital simulation event of the BMDS in Performance Assessment 07 (PA07), which occurred in September/October 2007. This digital simulation included representations of GMD, Aegis BMD, AN/TPY-2 (FBM), C2BMC, and SBIRS/DSP. During FY08, the MDA cancelled the PA08 digital simulation event due to unavailability of Aegis BMD and AN/TPY-2 simulations of sufficient fidelity and validity, and to concentrate resources on preparations for PA09.
- THAAD conducted two intercept flight tests, Flight Test THAAD-08 (FTT-08) and FTT-09 between October 2007 and June 2008. Both events resulted in successful intercepts. THAAD also participated in GTX-03a, in preparation for GTI-03.
- Aegis BMD conducted three intercept flight tests, Flight Test Standard Missile-13 (FTM-13), Japanese FTM-1 (JFTM-1), and FTM-14, between November 2007 and June 2008. All three flight tests resulted in successful intercepts, and one of them demonstrated Aegis BMD ability to engage multiple, simultaneous threats. Aegis BMD conducted one sensor tracking exercise, Glory Trip-197, and participated in the GTX-03a ground test. In addition, Aegis BMD, using modified software in the current radar, fire control, and SM-3 Block 1A missile, participated in the successful shoot-down of a failed U.S. satellite.
- Patriot conducted the first successful flight test of the Missile Segment Enhancement (MSE) PAC-3 missile (Flight Test 7-1A) in May 2008 by firing an MSE control test missile at a simulated target.
- The U.S. Strategic Command Joint Functional Component Command for Integrated Missile Defense (JFCC-IMD) sponsored the Terminal Fury 08 wargame in November 2007, and the Assured Response 08a BMDS Exercise in June 2008.
- C2BMC participated in a variety of ground-tests, flight-tests, and wargames, including FTT-09, FTT-10, JFTM-01, FTM-14, FTX-03, GTD-02, GTX-03a, GTX-03d, GTI-03, Fast Shield, Terminal Fury, Assured Response 08a, Vigilant Shield 08, and JDIE-08.
- The MDA supported the Anti-Tactical Missile (ATM)-50 Patriot test in March 2008. This test was a Tactical Ballistic Missile (TBM) test using Patriot-as-a-Target (PAAT) with engagements by Patriot interceptors. ATM-50 also involved intercepting an Air Breathing Threat (ABT) in the debris cloud created by the PAAT engagements. Patriot also participated in FTT-10, and had four other successful flight test missions.
- The MDA used several single and multi-sensor satellite calibration exercises to gather data for modeling and simulation validation purposes.
 - Used Post Flight Reconstruction of the FTX-02 principal objects to anchor AN/TPY-2 model
 - Used a field data-driven approach to partner acceptability criteria with the BMDS Operational Test Agency Team

BALLISTIC MISSILE DEFENSE SYSTEMS

- Provided verification of model and simulation software, environments, threat performances and signature, radar atmospheric propagation, radar antenna and front-end processing data to accredit ground test digital simulations for use in performance assessments
- Continued investments in ground test infrastructure including digital signal injection systems that will exercise tactical signal and data processors, a capability that also enables future Concurrent Training Testing and Operations
- The MDA accomplished a number of important BMDS information assurance activities.
 - Throughout 2008, conducted Controls Validation Tests on BMDS sensors including the Beale and Thule UEWRs, Cobra Dane, and the SBX
 - Conducted a penetration test on SBX in June 2008
 - In September 2008, using the Air Force's 92nd Information Operations Squadron, conducted a comprehensive network penetration test on the C2BMC
 - Fielded Network Intrusion Detection Systems and monitoring capability on secure GMD communication networks
 - Continued to harden its fire control loop and deployed external interface boundary protection devices between GMD and the BMDS elements, sensors, and test enclaves

Assessment

- The elements that comprise the present and future BMDS are at differing levels of demonstrated capability.
 - Patriot provides the most mature and best understood capabilities against its assigned theater-level missile threats. This assessment is based on the number and complexity of test and evaluation events in which Patriot has participated (both flight and ground testing) as well as combat operations during Operation Iraqi Freedom.
 - Aegis BMD made progress towards demonstrating a robust theater-level missile defense capability against its assigned threats. This assessment is based on considerably less flight and ground testing than PAC-3, and includes few real-world operations, with one notable exception. In February 2008, a modified Aegis BMD shot down a failed U.S. government satellite.
 - THAAD testing indicates that it will provide a significant increase in capability against short- to intermediate-range threats when the MDA incorporates it into the BMDS in FY10.
 - GMD was unable to perform any intercept flight testing in FY08 due to problems with the test equipment onboard the EKV. As the most technologically complex element of the fielded BMDS, GMD provides the least mature missile defense capability. While GMD has demonstrated a capability against a simple foreign threat, GMD flight testing to date will not support a high level of confidence in its limited capabilities. Ground testing continues to demonstrate increasing GMD integration, but additional test data collected under realistic flight test conditions is necessary to validate models and simulations and to increase confidence in the ability of these models and simulations to accurately predict system capability.
- The inherent BMDS defensive capability against theater threats increased during the last fiscal year and DOT&E expects this trend to continue. The inherent BMDS defensive capability against strategic threats, however, is limited to simple, ballistic missile threats launched from North Korea toward the United States. The delays in intercept flight testing this fiscal year and the continuing lack of accredited BMDS level models and simulations at the strategic level impacts the ability of DOT&E to determine whether any increases in strategic defensive capability have occurred this fiscal year.
- C2BMC continues to add new functionality and update existing functionality. Communications and situational awareness have improved, but challenges remain. To date, C2BMC is not sufficiently mature to provide support for an integrated, layered defensive capability against any range of threat missile.
- The ground test program has advanced faster than the flight test program can provide validation data for the models and simulations upon which ground testing relies (especially for defense against strategic threats). The misalignment between the ground and flight test programs is partially responsible for the lack of data to verify and validate PA07 as well as forcing the cancellation of PA08. The lack of sufficient data for validation and accreditation of models and simulations negatively impacted BMDS performance assessments as the results from ground testing could not be used for these assessments with any real confidence. The decision to forego PA08 and focus on the validation of models to support PA09 was a sound one.
- Challenges associated with targets engaged by both strategic and tactical missile defense systems remained throughout FY08.
 - The MDA suffered another target failure in FTX-03 in July 2008 when the target fell short of its intended impact point and failed to properly execute a subsystem package. Critical test data were not collected.
 - The THAAD program encountered another target failure when the foreign military acquisition target expended for THAAD Flight Test 10 in September 2008 failed to sustain propulsion long enough to execute the flight test profile.
 - The MDA is continuing to develop the Flexible Target Family (FTF), which it hopes will not only reduce cost through production efficiency and modular flexibility, but also improve reliability and timeliness. Currently, the FTF's first planned target launch is planned for April 2009. However, the recently completed General Accountability Office audit of the MDA target program highlighted the challenges MDA still faces.
 - Currently, the FTF is not ready. As a result, the MDA continues to use less reliable targets that sometimes do not meet program requirements to fully demonstrate their systems' capabilities. The MDA is still several years away from a fully implemented FTF. It is questionable

whether the anticipated cost-saving will be realized. In the meantime, the MDA will continue to suffer schedule delays, retests, and partially met test objectives as the result of unreliable and inadequate older targets and target designs.

- Efforts to improve information assurance are showing progress. For example, the comprehensive penetration test against the C2BMC demonstrated its resistance to external threat efforts. MDA's use of independent evaluators such as the 92nd Information Operations Squadron this past year and the National Security Agency's Information Assurance Directorate in early 2009 is an important step in demonstrating information assurance for the BMDS.
- The BMDS program relies heavily on modeling and simulation such as the Parametric Endo-Exoatmospheric Lethality Simulation (PEELS), Kinetic Warhead Evaluation (KWEVAL), and GMDPEELS models to estimate lethality against its spectrum of threat targets. The credibility of those models is closely tied to the empirical data used to develop and validate them. While MDA conducted subscale lethality testing on strategic targets and continued to execute the THAAD LFT&E program in 2008, lethality testing has not kept up with the need to assess BMDS lethality for an expanding set of targets and engagement conditions that are part of the expanding BMDS mission. Because the current version of GMDPEELS incorporates only one accredited target model, lethality against other targets in ground tests associated with GBI endgame analysis cannot be assessed. While PEELS and KWEVAL contain many targets, models for newer

untested targets need to be added and some of the existing target models could require additional test data for validation. The lack of sufficient test data for lethality model development and validation has limited past BMDS lethality assessments and, without additional lethality test and evaluation activities, will become a more significant limitation as the threat evolves.

Recommendations

- Status of Previous Recommendations. The MDA addressed seven of the previous nine recommendations. The MDA continues to improve the collection of reliability, availability, and maintainability data, and is reviewing the target program.
- FY08 Recommendations.
 1. In conjunction with the expanding BMDS mission, the MDA should review its test and analysis data requirements to support lethality simulation development and validation and formulate a long-term plan to address those requirements.
 2. The MDA should coordinate for an official designation of a BMDS Computer Network Defense Service Provider organization within the DoD to provide a comprehensive system approach for information assurance and standardize computer network defenses and responses.
 3. The MDA should conduct a flight test with Aegis BMD, the AN/TPY-2 (FBM), the Beale UEWR, and the SBX all participating to demonstrate target correlation and fusion that generates a weapon task plan and results in a successful intercept of a threat-representative target.