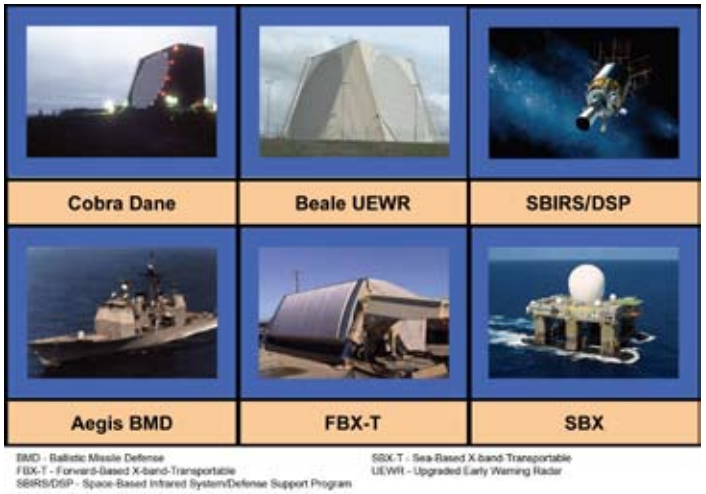
Sensors

Executive Summary

- The Ballistic Missile Defense System (BMDS) sensors provide target detection, track, and discrimination data to both the Ground-Based Midcourse Defense (GMD) Fire Control (GFC) and the BMDS Command, Control, Battle Management, and Communications (C2BMC) system.
- GFC uses data from these sensors to generate GMD weapon task plans and for situational awareness. BMDS C2BMC uses sensor data for situational awareness, but, as it matures, will use sensor data for battle management.
- For the Ground-Based Interceptor (GBI) Flight Test 02 (FTG-02) intercept flight test in September 2006, the Missile Defense Agency (MDA) used an operational sensor, the Beale Upgraded Early Warning Radar (UEWR), for the first time to provide the GFC with radar data to generate a weapon task plan.
- Cobra Dane observed "targets of opportunity" as part of its legacy mission. It has not yet been used to transmit track data to the GFC as part of an intercept flight test. It has passed simulated target data.
- No BMDS sensors have high-fidelity performance models and simulations validated and accredited for use by the Joint Operational Test Agency to assess operational capability.



System

The BMDS sensors are:

- Cobra Dane - an L-band single-face (120 degree azimuth field of view), phased array radar located at Shemya, Alaska
- Sea-Based X-band (SBX) Radar: an X-band single-face, phased array radar on a movable mount, positioned on a fifth generation twin-hulled, semi-submersible, self-propelled ocean-going platform, home-ported at Adak, Alaska
- Upgraded Early Warning Radars: Ultra High Frequency (UHF) fixed site, fixed orientation, phased array radars located at Beale Air Force Base, California (2 faces, 240 degree azimuth field of view), and Fylingdales, England (3 faces, 360 degree azimuth field of view)
- Forward-Based X-band-Transportable (FBX-T) Radar: a Terminal High-Altitude Area Defense (THAAD) high resolution, X-band, phased array radar with modified software to provide post-boost acquisition and tracking of long-range ballistic missiles. The operationally deployed radar at Shariki, Japan, is designated AN/TPY-2 (FB).
- Aegis Ballistic Missile Defense (BMD) Radars: Aegis AN/SPY radars modified to provide surveillance and tracking of long-range ballistic missiles
- Space-Based Infrared System (SBIRS)/Defense Support Program (DSP): an infrared satellite constellation and ground station that provides the BMDS with the initial notification of a ballistic missile launch and defended area determination

Mission

U.S. Strategic Command warfighters will use the BMDS sensors to:

- Detect, track, and classify ballistic missile threats targeting the United States, its allies, and its friends
- Provide situational awareness data to the BMDS C2BMC element
- Generate weapon task plans for ballistic missile defensive systems such as Aegis BMD and GMD

Activity

- Cobra Dane: Due to its location and field-of-view, Cobra Dane cannot participate in BMDS intercept flight test events. During the past year, it participated in seven ground tests and acquired and tracked targets of opportunity.
- SBX: SBX spent most of 2006 in transit to the Pacific and undergoing early checkout and calibration of its radar. During this development and early testing, SBX only tracked satellites. On September 1, 2006, MDA used SBX to track both the target and interceptor during the FTG-02 intercept flight test. SBX collected endgame radar data; it did not support GMD weapon task plan generation or send data to C2BMC and the BMDS.
- UEWRs: The BMDS will use several UEWRs for radar detection, tracking, and classification. On February 23, 2006,

during Flight Test 04-1 (FT04-1), the Beale UEWR tracked a flight test target for the first time as part of a risk reduction test for FTG-02. Then, on September 1, 2006, MDA used the Beale UEWR radar data to generate a weapon task plan for the interceptor during FTG-02, a first for an operational sensor. The Beale UEWR also participated in numerous ground tests during 2006. MDA used most of 2006 to upgrade and test the Fylingdales UEWR.

- FBX-T: During development and checkout, FBX-T frequently tracked space objects and satellites as well as two ballistic missile targets of opportunity. MDA also used FBX-T in eight ground tests to demonstrate integration into the BMDS. The FBX-T is currently deployed to an operating location in Japan.
- Aegis BMD: Aegis participated in more than a dozen live tracking exercises, ground tests, and real-world operations during FY06. These events exercised the long-range surveillance and track capability of the Aegis BMD radar and demonstrated interoperability with the BMDS.
- SBIRS/DSP participated in seven ground tests culminating in the hardware-in-the-loop GTI-01 test event in September 2006 and in the distributed ground test GTD-01 in November 2006. These tests exercised SBIRS/DSP connectivity to both the GMD hardware-in-the-loop facility and the direct operational interface to C2BMC. This interface enables C2BMC to get early warning data directly from SBIRS/DSP instead of having to go through a GMD communications network. SBIRS/DSP also participated in seven BMDS system-level flight test events by providing early warning data.

Assessment

- Cobra Dane: Performance estimates for Cobra Dane are limited to the ground test results and missile targets of opportunity that fly through the radar search volume. These estimates rely on models and simulations that are not yet validated and accredited for use in operational evaluations. To validate and accredit these models and simulations and confirm software corrections from a previous flight test, MDA will need to fly another target through the Cobra Dane radar field of view.
- SBX: SBX successfully collected data on both the interceptor and the target during FTG-02. MDA is analyzing that data. SBX has not yet supported a live intercept as the primary sensor, nor has it operated from its planned home port in Adak, Alaska.
- UEWRs: As the primary sensor during FTG-02, the Beale UEWR provided the radar intercept data used by the GFC to generate the weapon task plan that resulted in a successful intercept. FTG-02 was the first time a BMDS operational sensor supported a GMD intercept test. MDA is still analyzing the data; however, early results show excellent performance by the radar. Fylingdales UEWR will not achieve operational capability for the missile defense mission until MDA upgrades it with the Beale modifications, tests it, and integrates it into the BMDS in FY07.
- FBX-T: MDA deployed the first FBX-T in early 2006. Prior to deployment, MDA conducted simulated intercepts using FBX-T data, but did not accomplish any live intercept testing with the FBX-T operating as the primary sensor. MDA will demonstrate FBX-T integration with the BMDS, including operational communication links from its deployed location in Japan in December 2006. FBX-T still needs to demonstrate its capability to support a GMD flight test.
- Aegis BMD: Aegis BMD continues to evaluate its interoperability and support BMDS testing and real-world activities. Aegis BMD collected valuable data during long-range surveillance and track exercises and real-world events for performance analysis relative to supporting the BMDS mission. Aegis BMD has yet to participate in a BMDS flight test that uses AN/SPY-1 radar data in real-time to develop a GMD weapon task plan.
- SBIRS/DSP: SBIRS/DSP has demonstrated the ability to provide limited support to the BMDS. MDA and the Air Force will improve capability when they install new software changes at the SBIRS/DSP ground station.

Recommendations

- Status of Previous Recommendations. MDA has taken actions on all of the FY05 DOT&E recommendations.
- FY06 Recommendations.
  1. MDA should fly another target through the Cobra Dane field of view to verify the software fixes that resulted from FT 04-5 and provide data for validating and accrediting Cobra Dane models and simulations. The target should use a variety of countermeasures and target dynamics to provide crucial performance data.
  2. Using a variety of countermeasures and target dynamics, MDA should fly a target through a UEWR field of view to gather crucial data on performance for validating and accrediting models and simulations.
  3. MDA should use both SBX and Aegis BMD as the primary engagement support sensor for generating the radar intercept data during flight tests that culminate in an actual target intercept using a GMD interceptor.
  4. Before deploying the second FBX-T, MDA should use it as the primary sensor generating the radar intercept data during a flight test that culminates in an actual target intercept using a GMD interceptor.
  5. MDA should conduct a system-level ground test using the actual communications links and planned personnel to demonstrate that the deployed FBX-T can support the BMDS mission.
  6. MDA should accelerate SBIRS/DSP ground station software upgrades to improve its support to testing, training, and operations.