Sensors

Executive Summary

- The AN/TPY-2 Forward-Based Mode (FBM) radar participated in Flight Test Ground-based Interceptor-06a (FTG-06a) in December 2010 and Flight Test Standard Missile-15 (FTM-15) in April 2011. In FTG-06a, the Missile Defense Agency (MDA) demonstrated AN/TPY-2 (FBM) radar capability to provide track data that supported the engagement planning and launch of a Ground-based Midcourse Defense (GMD) interceptor against an intermediate-range ballistic missile target and, for the first time, the MDA launched a GMD interceptor based on AN/TPY-2 (FBM) radar track data. In FTM-15, the MDA demonstrated AN/TPY-2 (FBM) radar capability to provide up-range track data that supported engagement of an intermediate-range ballistic missile target by a missile from an Aegis Ballistic Missile Defense (BMD) destroyer.
- The Sea-Based X-band (SBX) radar participated in FTG-06a. In this test, the MDA verified the effectiveness of software changes that it made to the SBX radar in response to the radar's undesirable performance in FTG-06. SBX demonstrated a capability to provide track data that supported GMD engagement planning against an intermediate-range ballistic missile target. The MDA, however, employed the SBX radar in a manner that departed from full operational realism.
- The MDA has gained significant operational experience with each of the Ballistic Missile Defense System (BMDS) sensors since the completion of sensor upgrade and development programs. The MDA and the BMDS Operational Test Agency Team, however, have not fully accredited models and simulations of the BMDS sensors for performance assessment.

System

The BMDS sensors are systems that provide real-time ballistic missile threat data to the BMDS. The data are used to counter ballistic missile attacks. These sensor systems are operated by the Army, Navy, Air Force, and BMDS, and include a satellite-based, infrared sensor system and seven phased array radar systems. The sensor systems are:

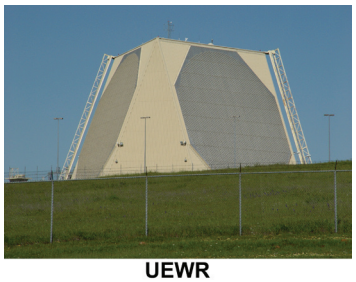
- Space-Based Infrared System/Defense Support Program (SBIRS/DSP), a satellite constellation of infrared sensors operated by the Air Force with an external interface to the BMDS located at Buckley AFB, Colorado

SBIRS/DSP

- Fixed site, fixed orientation, phased array radars
  - Cobra Dane Upgrade (CDU) Radar, an L-band radar (one radar face that provides 120-degree azimuth field of view) operated by the Air Force and located at Eareckson Air Station (Shemya Island), Alaska

Cobra Dane

  - Upgraded Early Warning Radars (UEWRs), ultra high frequency radars operated by the Air Force and located at Beale AFB, California (two radar faces that provide 240-degree azimuth field of view); Fylingdales, United Kingdom (three radar faces that provide 360-degree azimuth field of view); and Thule, Greenland (two radar faces that provide 240-degree azimuth field of view



UEWR

  - AN/TPY-2 (FBM) Radars, X-band radars (one radar face that provides 120-degree azimuth field of view) operated by the Army and located at Shariki Air Base, Japan and a site in Israel

AN/TPY-2

- Mobile platform, variable orientation, phased array radars
  - Aegis Ballistic Missile Defense (Aegis BMD) AN/SPY-1 Radars, S-band radars (four radar faces that provide 360-degree azimuth field of view) operated by the Navy and located aboard Aegis BMD-capable cruisers and destroyers

Aegis BMD

- Sea-Based X-Band (SBX) Radar, an X-band radar operated by BMDS and located aboard a twin hulled, semi-submersible, self-propelled, ocean-going platform (primarily a test asset that can be operationally deployed as needed)


SBX

Mission

Military operators for the U.S. Strategic Command, U.S. Northern Command, U.S. European Command, U.S. Pacific Command, and U.S. Central Command will use the BMDS sensors to:

- Detect, track, and classify ballistic missile threats that target the United States, U.S. allies, and U.S friends
- Provide data for situational awareness and battle management to the BMDS Command, Control, Battle Management, and Communications (C2BMC) element
- Provide data that support engagement of ballistic missile threats by the Aegis BMD and GMD systems

Major Contractors

- Aegis AN/SPY-1: Lockheed Martin – Moorestown, New Jersey
- AN/TPY-2: Raytheon Integrated Defense Systems – Tewksbury, Massachusetts
- CDU: The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama
- SBIRS: Lockheed Martin Space Systems Company – Sunnyvale, California
- SBX: The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama
- UEWRs:
  - Beale AFB and Fylingdales – The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama;
  - Thule – Raytheon Missile Defense Center – Woburn, Massachusetts

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Activity

Aegis BMD Radar

- The Aegis BMD radar, in its long-range surveillance and track capacity, participated in FTG-06a in December 2010 as an associated operation and acquired track data on the intermediate-range ballistic missile target. It also participated in multiple live tracking exercises during FY11 in the long-range surveillance and track capacity.
- Digital, or hardware-in-the-loop, representations of the Aegis BMD radar participated in the BMDS-level Ground Test Distributed 04b (GTD-04b) in February and March 2011 and Technical Assessment 04 (TA-04) in 4QFY11.

AN/TPY-2 (FBM) Radar

- The AN/TPY-2 (FBM) radar participated in FTG-06a from a location on Wake Island and, in that test, provided real-time track data to the GMD system.
- The AN/TPY-2 (FBM) radar also participated in FTM-15 in April 2011; in that test, the AN/TPY-2 (FBM) radar provided up-range track data to C2BMC for processing, down-select, and forwarding of tracks to an Aegis BMD 3.6.1 destroyer that was set up with remote engagements authorized.
- Digital representations of the AN/TPY-2 radar participated in the BMDS-level GTD-04b and TA-04.

Cobra Dane Radar

- In FY11, the Cobra Dane radar observed targets of opportunity. The Cobra Dane radar also tracked orbital debris and active satellites as a contributory sensor to the U.S. Space Command Space Surveillance Network.
- Digital representations of the Cobra Dane radar participated in the BMDS-level GTD-04b.

SBIRS/DSP System

- During FY11, the SBIRS/DSP system observed domestic and foreign launch events, provided launch event data to the operational BMDS, and participated in FTG-06a and FTM-15.
- Digital representations of the SBIRS/DSP system participated in the BMDS-level GTD-04b, TA-04, and multiple other BMDS-level ground tests.

SBX Radar

- The SBX radar participated in FTG-06a from a location in the Pacific Ocean, and in that test, provided real-time track data to the GMD system.
- Digital representations of the SBX radar participated in the BMDS-level GTD-04b.
- The SBX mobile platform (with SBX radar onboard) transited to Vigor Shipyard Seattle (formerly Todd Pacific Shipyards) in Seattle, Washington, in May 2011 and underwent scheduled maintenance and upgrades in May through August.

UEWR

- The UEWR at Beale AFB viewed the GMD interceptor flyout in FTG-06a, but due to its location, it played no role in target engagement.
- Digital representations of the UEWRs at Beale, Fylingdales, and Thule participated in the BMDS-level GTD-04b.
- The MDA issued a pre-solicitation notice in June 2011 of intent to upgrade Air Force Early Warning Radars at Clear

Air Force Station, Alaska, and Cape Cod, Massachusetts, to become part of the MDA's sensor network.

Assessment

- The MDA has gained significant operational experience with each of the BMDS sensors since the completion of sensor upgrade and development programs.
- The MDA and the BMDS Operational Test Agency Team, however, have not fully accredited models and simulations of the BMDS sensors for performance assessment. Representations of the AN/TPY-2 (FBM) radar, the SBX radar, and the UEWR have been accredited for limited uses. Representations of the Aegis BMD radar, the Cobra Dane radar, and the SBIRS/DSP system have not been accredited.

  Aegis BMD Radar
  - The MDA continues to evaluate the capability of the Aegis BMD radar in its long-range surveillance and track mode to support GMD engagement of intermediate-range and intercontinental ballistic missile threats.
  - The Aegis BMD radar has participated in FTGs as an associated operation and as an operational sensor asset that has supported intercepts as part of an ensemble of sensors that included the AN/TPY-2 (FBM) radar, the SBX radar, and the UEWR at Beale AFB.
  - The MDA has not conducted a BMDS intercept flight test that uses the Aegis BMD radar data in real-time as the primary data source for GMD engagement planning.

  AN/TPY-2 (FBM) Radar
  - In FTG-06a, the MDA demonstrated AN/TPY-2 (FBM) radar capability to provide track data that supported the engagement planning and launch of a GMD interceptor against an intermediate-range ballistic missile target and, for the first time, the MDA launched a GMD interceptor based on AN/TPY-2 (FBM) radar track data.
  - In FTM-15, the MDA demonstrated Aegis BMD capability to use up-range track data from an AN/TPY-2 (FBM) radar to support engagement of an intermediate-range separating target. In that test, an Aegis BMD 3.6.1 destroyer, set up with remote engagements authorized, intercepted an intermediate-range separating target with a Standard Missile-3 (SM-3) Block IA missile using up-range AN/TPY-2 (FBM) radar track data.

  Cobra Dane Radar
  - Due to its location and field-of-view, the Cobra Dane radar has not participated in BMDS intercept flight tests.
  - Data from targets of opportunity and ground tests support performance estimates for the current configuration of the Cobra Dane radar. These estimates rely on models and simulations that are not yet validated and accredited for use in performance assessment. The MDA plans to conduct a target flight test through the Cobra Dane radar field-of-view in 3QFY15 to support model and simulation accreditation.

  SBIRS/DSP System
  - SBIRS/DSP system performance will be reviewed in the classified annex of DOT&E's "2011 Assessment of the Ballistic Missile Defense System (BMDS)" report to Congress.

  SBX Radar
  - In FTG-06a, the MDA verified the effectiveness of software changes that were made to the SBX radar in response to its undesirable performances in FTG-06 and demonstrated a capability of the SBX radar to provide track data that supported the engagement planning against an intermediate-range ballistic missile target.
  - The MDA, however, employed the SBX radar as an acquisition radar (rather than in its normal role as just a tracking radar) in order to achieve specific developmental test objectives and to reduce risk to the achievement of primary test objectives.

  UEWR
  - Due to their locations and fields-of-view, the UEWRs have not participated in BMDS intercept flight tests in an operationally realistic manner.
  - Data from targets of opportunity and ground tests support performance estimates for the current configuration of the UEWRs. These estimates rely on models and simulations that have not been fully accredited for use in performance assessment.

Recommendations

- Status of Previous Recommendations. Although the MDA and combatant commanders have made progress on developing concepts of operations for the sensors to be used as part of the phased adaptive approach to providing missile defense in Europe, the FY09 recommendation remains open pending completion of those concepts and implementation in operational testing.
- FY11 Recommendation.
  1. The MDA should conduct a BMDS intercept flight test that uses the Aegis BMD radar data in real-time as the primary data source for GMD engagement planning.