

Technology Programs

Executive Summary

- The Missile Defense Agency (MDA) is pursuing a number of technology programs, including the Airborne Laser Test Bed (ALTB), the Precision Tracking Space System (PTSS), and the Airborne Infrared (ABIR) system.
- During FY10, the MDA transferred the Airborne Laser (ABL) to a national test platform (ALTB) for maturing advanced directed energy technologies for missile defense under the oversight of the Director, Defense Research and Engineering. During the past year, the ALTB conducted two flight tests involving boosting, liquid-fueled Foreign Material Acquisition (FMA) targets. These tests were unsuccessful due to unrelated hardware and software problems. The DoD continues to assess the future of the ALTB.
- The PTSS program is pursuing a pre-launch technology development program, incorporating state-of-practice infrared focal plane arrays, optical telescope designs, cooling systems, and on- and off-board data processing. In addition, PTSS is using the Space Tracking and Surveillance System (STSS) and the Near-Field Infrared Experiment (NFIRE) satellites to collect background and target flight test data to inform the PTSS design. STSS participated in five flight tests and collected track data in all five tests.
- For the ABIR technology program, the MDA used existing unmanned aerial vehicle platforms and sensors to collect data during two flight tests in FY10. The MDA is currently working to identify a set of ABIR knowledge points, with tentative completion dates through 1QFY13. ABIR participated in five flight tests and collected data in four tests.

Systems

ALTB

The ALTB is a national test bed operated by the MDA. It consists of:

- A modified Boeing 747 400F commercial aircraft.
- A megawatt-class chemical oxygen-iodine laser.
- A laser turret on the aircraft nose and two illuminator lasers on a bench in the fuselage.
- Optical benches with highly sensitive cameras, sensors, and mirrors.
- Hardware and software for battle management, command, control, communications, computers, and intelligence.
- Ground support equipment for storing, mixing, transporting, and loading laser chemicals.

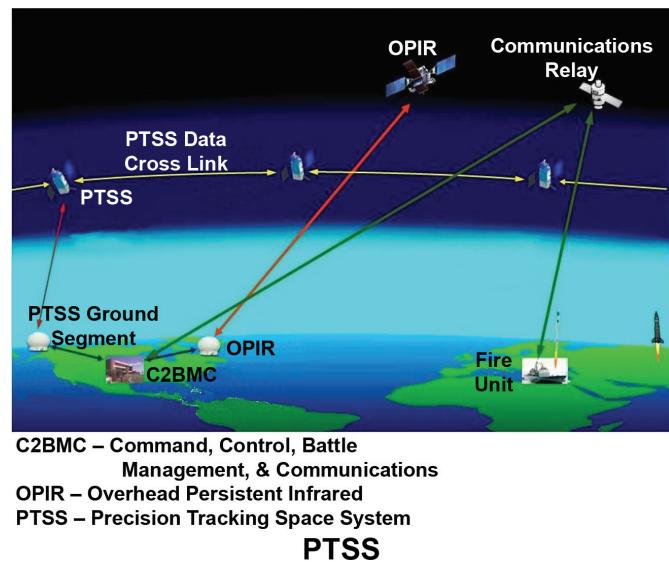


ALTB

PTSS

The PTSS is a program soon to enter technology development that will consist of a:

- Low-earth-orbit satellite constellation (space segment) capable of the optical detection, tracking, and characterization of ballistic missile target complexes from post-boost through the re-entry stages of flight.
- Ground segment capable of forwarding cues and tasking to the space segment, receiving and processing sensor image data, and relaying detection information to command and control nodes.



PTSS

ABIR

The ABIR is an advanced technology program that will consist of:

- Existing unmanned aerial vehicles (UAVs) modified to carry sensors, which can detect ballistic missiles in early stages of flight.
- Ground control stations for forwarding taskings to UAVs and relaying detection and tracking messages to command and control nodes.



ABIR

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Missions

ALTB

As a test bed, the ALTB does not have an operational mission and is not equipped to be an operational asset. The future function and direction of the test bed, including amount and type of testing, is still being assessed. Currently, the ALTB has the capability to:

- Autonomously acquire and track threat ballistic missiles using its passive infrared sensors.
- Establish precise track on the missile nose and an aimpoint on the propellant tank using its illuminator lasers.
- Potentially destroy a missile by placing laser thermal energy on the tank or motor case to weaken the casing, allowing internal pressure to rupture the tank.

PTSS

Combatant commanders intend to use the PTSS, a space-based sensor element of the Ballistic Missile Defense System (BMDS), to:

- Track medium-range, intermediate-range, and intercontinental ballistic missiles from post-boost through re-entry based on boosting tracks provided to PTSS by other space-based assets.

- Provide individual sensor track data to Command, Control, Battle Management, and Communications (C2BMC) for the generation of engagement quality tracks. Initially, PTSS will support Standard Missile-3 engagements while the support for engagements using other interceptors will be developed later.

ABIR

Combatant commanders intend to use ABIR, together with other forward sensors, to:

- Acquire, track, and assess ballistic missile events during early stages of flight.
- Report tracking information to C2BMC for engaging ballistic missile threats.

Major Contractors

- ALTB: Boeing, Integrated Defense Systems – Chicago, Illinois
- PTSS: Johns Hopkins University Applied Physics Laboratory – Laurel, Maryland
- ABIR: To-be-determined following competitive bids and contractor selection

Test and Evaluation Activity and Knowledge Point Progress

For the technology programs, the MDA uses knowledge points to measure development progress by focusing on the set of critical activities that define each program's risk.

ALTB

- In February 2010, the system successfully conducted the first set of in-flight lethality demonstrations against both liquid- and solid-fueled missiles.
- In September and October 2010, the MDA conducted two subsequent tests against boosting, solid-fueled FMA targets, but problems during both tests prevented high-energy lasing from occurring.
 - During the September 2010 flight test, one of the beam-directing mirrors in the optical bench exceeded pointing limits while the high-energy laser was lazing the target. The built-in auto safety features immediately shut down the laser after about 1.1 seconds of laze. It appears there was an error in the beam-directing software.
 - During the October 2010 flight test, the high-energy laser incorrectly reported it was not ready to fire and aborted the engagement. The MDA traced the cause to a single micro-switch on an iodine valve that incorrectly reported a closed-valve condition. The MDA replaced the valves and implemented new software procedures to ensure a single fault of this type cannot cause a system abort in the future.

PTSS

- The STSS demonstration program and the NFIRE program are supporting the development and fielding of PTSS by acting as surrogate sensors.

- STSS participated in Japanese Flight Test Standard Missile-4 (JFTM-4) Event 1 in October 2010 and collected stereo tracking data on a simple separating short-range ballistic missile (SRBM) target. JFTM-4 Event 1 was the first stereo data collection on a ballistic missile.
- The MDA conducted Flight Test Other-16 (FTX-16) Event 1 in March 2011 to assess the capability of Aegis BMD to conduct a launch-on-remote engagement of a ballistic missile using the STSS track data. STSS tracked a simple unitary SRBM from boost through re-entry, but due to a problem in the External Sensors Laboratory (ESL), track data did not go to the Aegis BMD ship for a simulated Aegis BMD launch-on-remote engagement.
- Flight Test Standard Missile-16 (FTM-16) Event 1 in March 2011 was a simulated Aegis BMD engagement of a complex separating SRBM target. Satellite Vehicle 1 detected and tracked the target in the post-boost stage of flight.
- In July 2011, STSS participated in the return-to-flight demonstration of air-launched SRBM targets, Flight Test Other-17 (FTX-17). During the test, both STSS Satellite Vehicles detected and tracked the target in both boost and post-boost stages of flight to form a stereo track.
- During THAAD FTT-12 (IOT&E) in October 2011, STSS successfully tracked both targets and sent track data to the ESL. By test design, the ESL did not forward the data to THAAD.

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- In addition to flight testing, the MDA plans to use analysis and hardware-in-the-loop testing to develop PTSS. During the past year, MDA demonstrated the following:
 - Accurate, simultaneous tracking (stereo track) of the same target by two STSS satellites.
 - Launch-on-remote performance against live targets in FTM-15 using Aegis BMD hardware-in-the-loop.
 - Engage-on-remote performance multiple times using simulated data in hardware-in-the-loop testing.
 - STSS receiving systems cues during FTM-15, ABIR/STSS track data fusion in post-test experiments, and STSS providing precision cues during FTM-16 E2 in a simulation-over-live scenario.

ABIR

- ABIR sensors collected data during JFTM-4 Event 3.
- During FTX-16 Event 1 in March 2011, ABIR successfully acquired the target based on a boost-phase cue from STSS tracks.
- In March 2011, ABIR participated in FTM-16 Event 1. During the test, ABIR acquired and tracked the target based on a cue. ABIR also demonstrated multi-object tracking.
- ABIR participated in FTX-17 in July 2011. During the test, ABIR received a cue from the C2BMC prototype software

generated from data from the overhead sensors, but did not track the target.

- During the THAAD FTT-12 (IOT&E) in October 2011, ABIR successfully tracked both targets.
- Over the next few years, the MDA intends to evaluate the following ABIR capabilities during flight testing with the existing hardware:
 - The ability of ABIR to generate a two-dimensional track with sufficient accuracy and timeliness to support BMDS engagement.
 - The ability of ABIR to extract feature data with a two-color infrared sensor to support discrimination.
 - The raid size capacity of ABIR.
 - The ability of ABIR to generate a 3-dimensional track from a single platform.
 - The ability of advanced sensors to extract additional features from a threat.

Recommendations

- Status of Previous Recommendations. There were no previous recommendations.
- FY11 Recommendations. None.

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