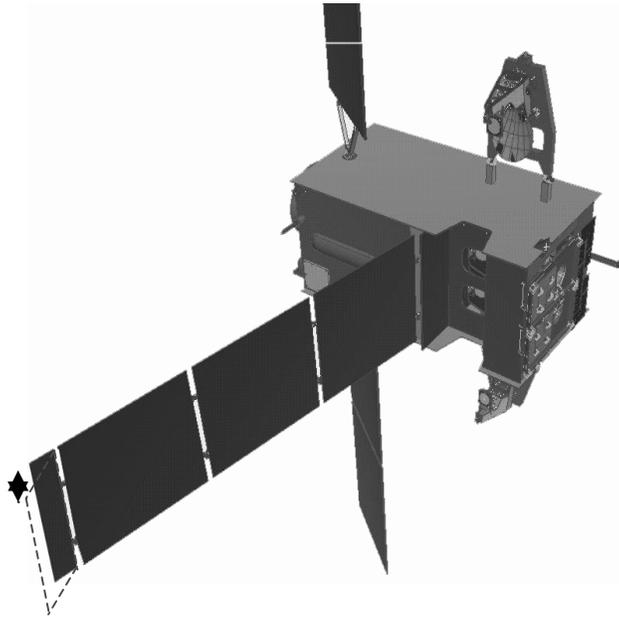


## SPACED-BASED INFRARED SYSTEM (SBIRS)



### DoD ACAT ID Program

Total Number of Systems: 4 GEO;  
2 HEO Payloads;  
Approx 30 LEO Satellites

Total Program Cost (TY\$): \$7,613M (excludes low component)

Average Unit Cost (TY\$): Varies by component

First Satellites: FY02 (HEO delivery)

FY04 (GEO launch)

FY06 (LEO launch)

### Prime Contractor

Lockheed Martin (High);  
TRW/Raytheon and  
Spectrum Astro/Northrop  
Grumman (Low)

### SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Spaced-Based Infrared System (SBIRS) replaces the current Defense Support Program (DSP). SBIRS improves support to theater CINCs, U.S. deployed forces and allies by providing better data quality and timeliness in four mission areas: Missile Warning, Missile Defense, Technical Intelligence, and Battlespace Characterization. By increasing the quality and timeliness of missile warning data over that provided by the Defense Support Program, SBIRS enhances *information superiority* and supports the operational concepts of *full-dimensional protection* and *precision engagement*, providing data directly to theater commanders in a timely and survivable manner, thus enabling U.S. forces to immediately react to a threat.

The SBIRS space segment includes a High and a Low component. The High component comprises six satellites: four in geosynchronous (GEO) earth orbit, with first launch in FY04, and two hosted payloads in Highly Elliptical Orbit (HEO), the first of which will be available in FY02. A fifth GEO satellite will be procured as a replenishment/spare. The Low component includes approximately 24

Low Earth Orbit (LEO) satellites, and several spares, with first launch in FY06. SBIRS High satellites will primarily improve current DSP operational requirements for missile warning, technical intelligence, and battlespace characterization. SBIRS Low satellites will provide a mid-course tracking capability and discrimination data critical for effective ballistic missile defense.

The SBIRS ground segment is being acquired in three increments. Increment 1, whose IOT&E is scheduled to begin in FY01, consolidates DSP and Attack and Launch Early Reporting to Theater (ALERT) ground stations into a single CONUS ground station, and will operate with DSP satellite data. Increment 2 upgrades Increment 1 software and hardware with the functions necessary to incorporate HEO sensor payloads and operate the new GEO SBIRS satellites. Increment 3 will provide the functionality necessary to operate SBIRS Low satellites.

## **BACKGROUND INFORMATION**

The SBIRS High component entered the EMD phase following a Milestone II DAB review in October 1996. SBIRS Low entered the Program Definition and Risk Reduction (PDRR) phase with Milestone I approval in August 1999, and two competing PDRR contracts were awarded.

Based on a restructured FY00 budget, the Air Force made substantive programmatic changes to both the SBIRS High and SBIRS Low systems during FY99. For the SBIRS High system, the Air Force delayed launch of the first GEO satellites from FY02-FY04, and re-scheduled incremental deliveries of the ground segment to align with the delayed satellite schedule. For the SBIRS Low satellites, the Air Force delayed first launch from FY04-FY06, and cancelled two proof-of-concept demonstration satellites, the Flight Demonstration System and the Low Altitude Demonstration System.

To mitigate the increased risk due to cancellation of the flight demonstrations, DOT&E influenced the Department to direct the Air Force to develop an acquisition strategy with significant design flexibility in the first six satellites, and a one year launch hiatus following those first six. The launch hiatus would allow sufficient testing to support a return-to-flight decision on the remaining satellites.

## **TEST & EVALUATION ACTIVITY**

The SBIRS test concept is built around a combination of operational assessments, combined developmental/operational testing, and dedicated IOT&E. These operational test and evaluation events progress in a building-block manner beginning with analyses, modeling and validated simulation, and ending with Hardware-in-the-Loop test beds and field tests on ground systems and on-orbit satellites.

As a consequence of the FY99 programmatic changes, the House Appropriations Committee (HAC) asked DOT&E, in the Fiscal Year 2000 DoD Appropriations Bill, to submit an assessment of whether the SBIRS High acquisition strategy allowed for adequate testing to support a production decision. In December 1999, DOT&E reported to the HAC that SBIRS High testing would be adequate to support evaluation of operational effectiveness and suitability if the test program included a number of test events and resources. Required test events included sensor payload performance, functional and environmental tests; space vehicle functional and environmental tests; intersegment tests between the space vehicle and the ground segment; and system-level tests of the combined ground/space segment. Required test resources included a calibrated cryo-vacuum chamber with scene and target projection

capabilities, allowing infrared projection of realistic earth background clutter and missile flight intensities and kinematics onto the sensor's focal plane.

Increment 1 breached its initial operational capability baseline on February 29, 2000, and the developer and contractor have been working since then to stabilize software and hardware development and performance before beginning operational tests. The major problems that led to the breach involved ground software development and integration. Deficiencies included mission software instability, insufficient operational dependability, and Tracking, Telemetry, and Control errors. At present, the program expects Increment 1 to be ready for dedicated IOT&E in 3QFY01.

Increment 2 ground facilities, originally scheduled to be operationally available in FY03 (ahead of the GEO satellites), have been delayed to FY05, coinciding with operational turnover of the first GEO satellite. The ground and space segments will be simultaneously turned over to the user in FY05 as a turnkey system. This reduces overlap between the delayed Increment 1 deliveries and the previous Increment 2 delivery schedule, but increases concurrency risk between the SBIRS High ground and space segment deliveries.

SBIRS High satellite T&E activity during FY00 included HEO component-level qualification testing, development of a new Advanced Sensor Test and Integration Facility (ASTIF) to support sensor payload qualification and acceptance testing, and re-design of the GEO satellite from a plane flyer to a solar flyer. Component-level HEO testing at factory plants included qualification tests of the Focal Plane Assembly, the Analog Pre-Processor, and the Optical Telescope Assembly. HEO payload qualification tests at the ASTIF, located at the Aerojet facilities in Azusa, CA, will begin in spring 2001, and GEO qualification tests will begin in 4QFY02.

SBIRS Low T&E activity during FY00 included development of contractor models, simulations, and facilities to conduct PDRR-level ground demonstrations of Critical System Performance Characteristics in preparation for Milestone II and entry into the EMD phase in FY02.

## **TEST & EVALUATION ASSESSMENT**

Progress on Increment 1 software development has improved greatly. The current process improves configuration management and provides better government and contractor management visibility and measures to monitor progress. Continuing delays, however, remain a concern, and further Increment 1 schedule breaches would have serious impacts on Increment 2 deliveries and on the supportability of existing DSP and ALERT ground systems.

The revised Increment 2 strategy delays fielding of an operational, certified, Increment 2 ground segment until FY05, coincident with operational turnover of the first GEO satellite. Although this does not significantly delay the SBIRS High operational capability delivery to the user, it increases the risk of having to operate an on-orbit asset without a certified operational ground segment should Increment 2 ground software encounter similar delays to what has been experienced with Increment 1. To mitigate this risk, the Program Office is relying on an Interim Mission Control Station Backup (IMCSB) to develop Increment 2 software, to test and process data from the first HEO payload, and to test and control the first GEO satellite while a permanent Mission Control Station Backup (MCSB) is constructed. Once the MCSB is finished, it would be tested and certified for Increment 2 operations, and the MCS could then be upgraded from Increment 1 to Increment 2. While this provides significant risk mitigation, further steps should be taken to include plans for operational certification of the IMCSB should MCSB construction be delayed, or should MCSB software development and integration encounter similar

problems to those found in Increment 1. Furthermore, the need dates for the GEO satellites should be reviewed in FY03 and FY04, based on DSP health and Ballistic Missile Defense needs, to ensure that on-orbit assets are not deployed too far ahead of a certified ground segment.

For SBIRS High satellite testing, DOT&E's December 1999 recommendations to the HAC are all being implemented, with the exception of adequate scene and target projection capabilities at the ASTIF. Instead, the developer plans to rely on data from previous tests on an Engineering Test Model (ETM) of the flight sensor from which to validate modeling and simulation for performance assessments. In September 2000, DOT&E advised the Program Office that this approach was not adequate due to differences between the ETM and the flight design, and due to calibration problems and other anomalies from ETM tests.

For Increment 3, the developer has adopted an evolutionary software development plan that phases in ground software between CY06 and CY10, in pace with the population of the SBIRS Low constellation. Full constellation capability will not be delivered until approximately half of the constellation is on-orbit, at which point the IOT&E will be conducted. To ensure that full functionality will be available when needed, DOT&E will require a demonstration of stable, supportable, functional ground and space software prior to first flight to support the first six satellites, and that full software functionality be available and tested within the one-year launch hiatus.

## **RECOMMENDATIONS**

- Incorporate scene and target projection into SBIRS High payload performance tests.
- Develop risk mitigation plans should the MCSB construction or Increment 2 software be delayed.
- For SBIRS Low satellites, provide for full software functionality to be available and tested within the one-year launch hiatus.