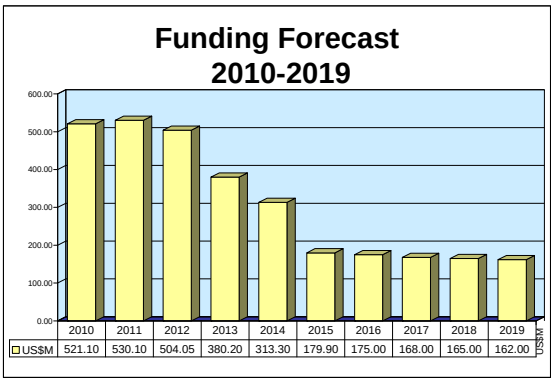
SBIRS High

Outlook

- Technical difficulties delaying progress of first launch by one year, now scheduled for 2011
- So much time and money invested that it will be cheaper to fund program to completion rather than cut and run
- This report will be transferred to Forecast International's *Space Systems Forecast – Satellites & Spacecraft* service in 2011



Orientation

Description. The Space-Based Infrared System (SBIRS) High is a satellite system being developed to replace the satellites of the Defense Support Program (DSP). It is designed to detect ballistic missile launches.

Sponsor

U.S. Air Force
Space & Missile Systems Center (SMSC)
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Status. The SBIRS High program is in development and production with a first launch expected in 2011.

Application. SBIRS is part of an overall early warning system to detect, identify, and track intercontinental ballistic missiles, sea-launched ballistic missiles, and tactical surface-to-surface missiles during their initial stages of flight.

Contractors

Prime

Lockheed Martin Space Systems - Sunnyvale	http://www.lockheedmartin.com/ssc, 1111 Lockheed Martin Way, Sunnyvale, CA 94088-3504 United States, Tel: + 1 (408) 742-4321, Prime

SBIRS High

Subcontractor

Northrop Grumman Space and ISR Systems	http://www.es.northropgrumman.com, 1100 W Hollyvale St, Azusa, CA 91702 United States, Tel: + 1 (818) 812-1000, Fax: + 1 (818) 969-9010, Email: ES_Communications@ngc.com (Developing SBIRS High Primary Infrared Sensor Payload)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features. The primary mission of the Space-Based Infrared System (SBIRS) is to provide initial warning of a ballistic missile attack on the U.S., its deployed forces, and its allies. SBIRS designers are incorporating new technologies to enhance detection and improve reporting of intercontinental ballistic missiles, submarine-launched ballistic missiles, and tactical ballistic missile launches. It supports battlespace characterization and technical intelligence missions by providing reliable, accurate, and timely data to unified combatant commanders, Joint Task Force commanders, the intelligence community, and other users.

SBIRS is to provide detection and tracking performance in order to meet requirements in the U.S. Space Command's Capstone Requirements Document and Air Force Space Command's Operational Requirements Document. It compliments the Defense Support Program, which has provided early warning of missile launches for over 30 years.

SBIRS will consist of two highly elliptical orbit payloads; four Geosynchronous Earth Orbit satellites plus one spare; two Relay Ground Stations (RGS); and the Mission Control Station (MCS).

Mission Control Station (MCS). The SBIRS MCS at Buckley Air Force Base in Aurora, Colorado, centralizes global command, control, and communications for strategic and tactical warning into a single modern facility. Currently, the MCS operates the Defense Support Program (DSP) and will have the capability to operate the new SBIRS payloads and spacecraft from the consolidated location in the future.

The MCS brought together multiple data processing facilities and units at various locations worldwide into a modern facility capable of handling current and future C4ISR requirements. The three legacy DSP ground stations were phased out of service in 2002 followed by the deactivation of the ALERT tactical center late that year. This provided the Air Force with a cost avoidance of more than $50 million in operations and maintenance costs and reduced the number of staff required to operate the worldwide system by more than 900 people.

The SBIRS ground segment replaced legacy software with an open architecture software solution that will accommodate SBIRS satellites as they are fielded.

Operational Characteristics. The sensor payloads include a scanning short-wavelength infrared acquisition sensor and a staring multispectral infrared tracking sensor. The acquisition sensors will provide high-resolution, horizon-to-horizon coverage, as well as coverage a few degrees above the horizon to search for, detect, and track missiles in the boost phase.

The track sensor is to receive a handoff from the acquisition sensor and continue to track the missile with greater precision through midcourse and reentry. An onboard signal and data processor will detect and acquire each target and measure its intensity and angular velocity. The resulting data are to be assembled into tracks and released as object-sighting messages to the ground segment of the missile warning system.

SBIRS-High

Source: Lockheed Martin

Program Review

DSP Satellites Relied On for 40 Years

Since 1970, the U.S. Air Force has relied on the Defense Support Program (DSP) satellites to detect ballistic missile launches. The satellites were designed to counter threats of nuclear attack from the Soviet Union. The satellites were also effective in detecting launches of Scud missiles during both the Iran-Iraq War and the Persian Gulf War.

Beginning in 1979 with the Advanced Warning System (AWS) program, the Pentagon began looking for replacements for the DSP satellites. The effort was accelerated in 1984, when the program was incorporated into the Strategic Defense Initiative (SDI) as the Boost Surveillance and Tracking System (BSTS). With the cancellation of the SDI, BSTS was once again called the AWS program. However, costs forced the AWS to be canceled as well in 1993.

In November 1994, the U.S. Air Force finally began the Space-Based Infrared System (SBIRS) program. According to the Air Force, SBIRS is better designed to handle current threats than DSP, and will require less labor to operate. In 1995, two contracts were awarded to Lockheed Martin/Loral/Aerojet and Hughes/TRW for the pre-SDD phase. In 1996, an SDD contract was awarded to Lockheed Martin.

Ground Stations Consolidated

SBIRS Increment 1 consolidated existing DSP ground stations into a single Continental U.S. ground station, scheduled for the first quarter of FY01. This schedule reflected a year's delay to the Acquisition Program Baseline. An additional $21 million in O&M funds would be required to continue legacy DSP systems and was requested in the FY01 President's Budget.

The first payload was delivered in August 2004; delivery of the second was planned for February 2005, to be piggybacked on the launch of classified SIGINT satellites. Rewiring some of the payload delayed finalizing the system for delivery.

In November 2004, the System Signal Processing Assembly software was completed. In an April 2004 statement, the Air Force said that the program would probably run $1 billion over budget through FY13.

Sensor delivery was pushed back at least four months, slipping first satellite launch to 2005.

Congress appropriated an additional $91 million over the president's budget request in FY05 to address development program shortfalls. Additional funding could be added from FY06 to FY10 to address cost growth due to program delay.

In its February 2006 Project Justification documents, the Pentagon stated that the USD (AT&L) certified the SBIRS EMD program to Congress on December 12, 2005, as required by the Nunn-McCurdy Act. Additional funding was added in FY07-FY10 to match the OSD Cost Analysis Improvement Group (CAIG) restructured program cost estimate.

GAO SBIRS Assessment

A GAO analysis found that as of June 2004, research and development costs were $7.497 billion, an increase of 99 percent. With a procurement cost of $1.517 billion, the overall program cost was estimated to have become $1.973.3 billion, an increase of 149.9 percent over the original plan.

The SBIRS High program's critical technologies, including the infrared sensor, thermal management, and onboard processor, have demonstrated acceptable levels of maturity after many years of difficult development. The design is now mature since approximately 98 percent of the expected design drawings have been released. Production maturity could not be determined because the contractor does not collect statistical control data. In August 2004, the contractor delivered the first payload (the HEO-1 sensor) after a delay of 18 months. This created additional delays and cost increases. As a result, the program is again being re-planned.

Design stability has been an issue for SBIRS High. The first HEO sensor was delivered in August 2004 after an 18-month delay due to excessive electromagnetic interference (radio waves emitted by the sensor's electronics that interfered with the host satellite). The program office reports that it applied the knowledge gained from the design problems on this sensor to the second HEO sensor, which was delivered in February 2005 – a 13-month delay from the restructured schedule. Initial testing of the second sensor revealed one electromagnetic interference issue.

HEO Satellite Launched

In June 2006, the first high Earth orbit (HEO) satellite was launched. It passed on-orbit calibration tests for the infrared sensors and line-of-sight testing in November of that year. It also detected the launch of a Defense Meteorological Satellite with its infrared sensors. Lockheed Martin and the U.S. Missile Defense Agency expect the satellite to be certified as fully operational in mid-2008.

In August 2006, Lockheed Martin completed testing of the first geosynchronous orbit satellite. The program tested the equipment in ambient conditions to verify correct operations of electrical power, command and data handling, thermal management, guidance navigation, and control, communications, and propulsion systems.

The SBIRS High program continues to run into trouble. High costs have made the program a target for a Congress intent on lowering defense spending, while technical issues have caused a number of further cost and schedule overruns. In a report written in September 2007, the Government Accountability Office (GAO) reported that further increases in the SBIRS program are possible. As if to emphasize the point, U.S. Air Force Secretary Michael Wynne notified the Pentagon in October of that year of an additional cost overrun. A system that controls basic functions of the satellite once in orbit was not working properly; some reports said it could cost up to $1 billion to fix.

Despite these issues, the program continues to make progress. In July 2007, Lockheed Martin completed thermal vacuum testing of the payload for the first SBIRS satellite. The program also continues to conduct and complete a number of other tests, including tests designed to determine how the satellite will perform in extreme environments.

A U.S. Air Force/Lockheed Martin team completed an on-orbit checkout of the HEO-2 payload in June 2008. In August of that year, Lockheed Martin handed over the HEO-1 payload and ground system to the USAF. The HEO-1 payload and ground system were accepted for operation by the Air Force in November and formally certified by the U.S. Strategic Command a month later.

In February 2009, the U.S. Air Force vacuum tested the GEO-2 payload. Lockheed Martin also submitted a proposal for a follow-on production phase in April 2009. Under the follow-on production phase of the SBIRS program, the Air Force will purchase the third and fourth HEO satellites and a third GEO satellite. There will be an option for a fourth GEO satellite.

Second SBIRS HEO System Achieves USSTRATCOM Certification

In August 2009, the second SBIRS Highly Elliptical Orbit (HEO-2) payload and associated ground systems had been certified for missile warning operations by the U.S. Strategic Command. The formal certification by USSTRATCOM completed the system development, operational activation, and certification process,

demonstrating the capability of the SBIRS HEO sensor and associated ground systems to provide timely, accurate, and unambiguous warning data in support of USSTRATCOM missions.

The SBIRS team then progressed through key integration and test activities on the first geosynchronous orbit (GEO) spacecraft, completing flight software subsystem development. The new flight software subsystem will enable the operation, control, and monitoring of the satellite's health, status, and safety while performing important functions such as telemetry, thermal control, power management, and fault detection and recovery activities.

The team next geared up for thermal vacuum testing, which consisted of testing the GEO-1 satellite in a flight-like environment where the heating, cooling and vacuum conditions of space are simulated while the spacecraft is operated as it will be on orbit.

First SBIRS GEO Spacecraft Progressing in Thermal Vacuum Test Phase

By October 2009, the first SBIRS spacecraft (GEO-1) was progressing through thermal vacuum testing, where it already completed the first of several hot and cold temperature cycles as part of a comprehensive test-like-you-fly process. The extensive test was the last environmental test phase prior to final checkout and shipment to the launch site in late 2010.

SBIRS Ground Segment Reaches Milestones

The U.S. Air Force/Lockheed Martin team developing the SBIR) achieved two key milestones in January 2010. First, testing demonstrated that the ground system was on track to support launch of the first SBIRS geosynchronous (GEO-1) satellite in the constellation. Second, the successful completion of a readiness review allows the ground system to be moved into the next level of integration. The testing, known as the Combined Day-In-The-Life Test (CDITL), validated the functionality, performance, and operability of the SBIRS GEO ground system for its planned operational use. The campaign included testing of over 1.5 million source lines of code and 133 ground segment requirements. The new SBIRS ground system includes software and hardware necessary to perform activation, checkout, and initial operations of the GEO-1 satellite after launch. SBIRS uses "Day-In-The-Life" test events to validate the integrated ground system, following successful verification at the segment level.

The CDITL test integrated several geographically separated sites used for command and control, factory engineering support, and direct interface to mission data users. The 17-day test included the use of high-fidelity spacecraft simulators to complete the launch and early orbit test processes and products that will be used for GEO-1 launch. Lockheed reported each site contributed significantly to the observed stability, robustness, and operability of the SBIRS.

Completion of the ground segments verification process and the CDITL led to the readiness review, known as the System Integration Readiness Review. The completion of this event on January 12 meant that the ground segment could be officially moved into the next level of integration. The Sunnyvale-based System Engineering, Integration and Test group formally accepted the ground segment's delivery for system-level integration, to include multiple end-to-end test and rehearsal events with space vehicle simulators and the GEO-1 vehicle itself. This series of events will lead to system and operations readiness to launch and operate the GEO-1 space vehicle.

Second SBIRS Achieves Test Milestone

Lockheed Martin achieved a key integrated test milestone on the second SBIRS geosynchronous orbit (GEO-2) spacecraft at its facilities in Sunnyvale, California. Lockheed Martin made the announcement on February 16, 2010. The GEO-2 satellite, designed to provide new missile detection and surveillance capabilities for the nation, has completed its first phase of BIST-1, an extensive functional test that characterizes the overall performance of the satellite and establishes a performance baseline for the remainder of the test program.

With the completion of BIST-1, the team will proceed with final factory work on the satellite and prepare for the final, comprehensive BIST milestone prior to entering environmental testing. The spacecraft is planned for launch aboard an Atlas V launch vehicle in 2012.

SBIRS High

Funding

U.S. FUNDING

	FY09 QTY	FY09 AMT	FY10 QTY	FY10 AMT	FY11 QTY	FY11 AMT	FY12 QTY	FY12 AMT
RDT&E (U.S. Air Force)								
PE#0604441F								
3616 SBIRS High EMD	-	542.4	-	521.1	-	530.0	-	504.4
	FY13 QTY	FY13 AMT	FY14 QTY	FY14 AMT	FY15 QTY	FY15 AMT	FY16 QTY	FY16 AMT
PE#0604441F								
3616 SBIRS High EMD	-	389.2	-	313.3	-	179.8	-	N/A

All $ are in millions.

N/A = Not Available.

Source: FY2011 U.S. Budget Documents

Contracts/Orders & Options

Contractor	Award ($ millions)	Date/Description
Lockheed Martin	2,152.4	Sep 2002 – CPAF contract mod to support restructuring of SBIRS High component engineering, manufacturing, and development. The contract re-baselined the program, provided the incentive structure and extended the period of performance to Jun 30, 2010. (F04701-95-C-0017)
Lockheed Martin	8.5	Sep 2004 – CPAF/IF contract mod for the enhanced technical intelligence exploitation of SBIRS sensor data. ETISS added additional hardware and software to the Interim Mission Control Station Backup until Jun 2010. (F04701-95-C-0017, P00276)
Lockheed Martin	12.1	Mar 2005 – CPAF contract mod to SBIRS (High) EMD contract. Provided for operational and maintenance support for the Increment 1 system. Also provided two modifications to the operational system, an engineering study evaluating the supportability of Increment 1 and software/hardware support. Completed Jun 2010. (F04701-95-C-0017, P00309)
Lockheed Martin	6.3	Jun 2005 – Contract mod to the existing SBIRS High component EMD contract. This contract action primarily provided technical support to 2nd Space Warning Squadron Combined Task Force and Mission Assurance in the areas of SBIRS hardware/software/communications testing, and exercises support and verification of operational stability. Completed by Jun 2010. (F04701-95-C-0017, P00320)
Lockheed Martin	48.6	Aug 2005 – CPAF contract mod extended engineering and technical support to conduct planning and execution for launch and on-orbit checkout of the SBIRS Geosynchronous Earth Orbit (GEO) satellites while continually operating the highly elliptical orbit payload. The period of performance was extended through 2010. This contract action supported the SBIRS Combined Task Force, located at Boulder, CO. Completed Jun 2010. (F04701-95-C-0017, P00313)
Lockheed Martin	11.6	Aug 2005 – CPAF contract mod for a development and qualification engineering effort that developed and qualified alternative drop-in single board computers for the SBIRS program. Completed in Jun 2008. (F04701-95-C-0017, P00316)

Contractor	Award ($ millions)	Date/Description
Lockheed Martin	12.7	Oct 2005 – CPAF/CPFF contract mod to existing SBIRS High component EMD contract. This contract action primarily supported a development and engineering effort that produced rapid prototypes and provided for their sustainment prior to their incorporation into the baseline. Completed Jun 2010. (F04701-95-C-0017/P00300)
Lockheed Martin	58.3	Sep 2006 – CPAF contract mod to existing EMD contract. Completed Sep 2007.
Lockheed Martin	13.0	May 2007 – CPAF/CPFF contract mod to existing EMD contract. Provided support to the MDA ballistic missile defense system test and modeling and simulation program team. Work to be completed Sep 2010. (F4701-95-C-0017/P00433)
Lockheed Martin	40.1	Apr 2007 – CPAF/CPFF contract mod to existing SBIRS High component EMD contract. This contract will conduct conceptualization, planning, and execution for launch and on-orbit checkout of the SBIRS GEO satellites while continually operating the highly elliptical orbit payload to be performed at the Interim Mission Control Station Backup Facility and Interim Test Center. Work will be completed between 2010 and 2012. (F04701-95-C-0017, P00418)
Lockheed Martin	78.6	Sep 2007 – Mod to existing EMD contract for the SBIRS High component. This contract exercised the option that provided for FY08 continued sustainment of the contractor logistics support and legacy sustainment effort. Lockheed Martin provided personnel and infrastructure for maintenance activities. (F04701-95-C-0017, P00459)
Lockheed Martin	97.0	Aug 2008 – Mod to existing SBIRS High component EMD contract exercised two options that provided for FY09 continued sustainment of the contractor logistics support and legacy sustainment effort. Lockheed Martin provided personnel and infrastructure for maintenance activities. (F04701-95-C-0017)
Lockheed Martin	1,387.4	May 2009 – CPFF contract for an amount not-to-exceed $1,487,400,000 for production of the third SBIRS GEO satellite 3, the production of Highly Elliptical Earth Orbit payload 3 and modification of the SBIRS Ground systems to accommodate operations of three payloads simultaneously. At this time, $1,115,550,000 has been obligated. SMC/ISSW, El Segundo, CA, is the contracting activity. (FA8810-08-C-0002, P00002)
Lockheed Martin	262.5	Jul 2009 – Contract for the long lead parts and material procurement for the fourth SBIRS GEO satellite and the fourth Highly Elliptical Orbit payload. At this time, $137,125,000 has been obligated. Space SBIRS Wing, Los Angeles Air Force Base, CA, is the contracting activity. (FA8810-08-C-0002)
Scitor Corp	15.0	Dec 2009 – A $15,000,000 contract to extend advisory and assistance services to the Space SBIRS Wing for a six-month period starting Jan 1, 2010. At this time, $4,605,965 has been obligated. ISSW/PK, El Segundo, CA, is the contracting activity. (FA8810-09-C-0002)

Timetable

Month	Year	Major Development
	1993	FEWS program canceled
	1994	ALARM program canceled
	1995	SBIRS program initiated
1Q	FY97	SBIRS High Authority to proceed
4Q	FY97	Initial Systems Design Integration, COBRA BRASS Ground Station Build 1 Testing complete at Sandia, installed at ground site, SBIRS High HOSV/Spacecraft PDR

SBIRS High

Month	Year	Major Development
3Q	FY98	SBIRS High Orbiting Space Vehicle/Spacecraft PDR, Ground Increment 2 Interim Design Review, System PDR
2Q	FY00	SBIRS High Payload CDR
3Q, 4Q	FY01	SBIRS High Payload CDR
4Q	FY01	SBIRS High Ground Increment 2 CDR, GEO CDR
3Q	FY01	SBIRS High Ground Increment 2 CDR
1Q	FY02	SBIRS High Ground Increment 1 Consolidated DSP stations
1Q	FY02	SBIRS Nunn-McCurdy breach report to Congress
3Q, 4Q	FY02	PDR
1Q	FY03	Effectivity 1 – Interim Mission Control Station – Backup (IMCS-B) certification
4Q	FY03	Integrated Training System available
4Q	FY04	HEO Sensor #1 delivery
2Q	FY04	DSP capable M3P to Systems engineering, integration, and test team (SEIT)
3Q	FY05	Relay Ground Station hardware installation
4Q	FY05	HEO Sensor #2 Delivery
1Q	FY06	GEO payload thermal vacuum
Jun	2006	HEO-1 satellite launched
2Q	FY07	Delivery of MCSB-H to SEIT
3Q	FY07	GEO-1 payload delivered to LMSSC
4Q	FY07	Effectivity 3 HEO message certifications, Effectivity 11 HEO Backup Operations
Dec	2008	U.S. STRATCOM formally certified HEO-1 satellite for operations
	2011	GEO-1 Spacecraft launch
	2012	GEO-2 Spacecraft launch

Worldwide Distribution/Inventories

This is a **U.S. Department of Defense** effort under the management responsibility of the **U.S. Air Force**.

Forecast Rationale

The primary mission of the Space-Based Infrared System (SBIRS) is to provide initial warning of a ballistic missile attack on the United States, its deployed forces, and its allies. SBIRS is to replace the Defense Support Program (DSP), which has provided the U.S. with early missile warning information since the 1970s.

SBIRS was also initiated to meet all military infrared surveillance requirements through a single, integrated system and to provide better and timelier data to the Unified Combatant Commanders, U.S. deployed forces, and U.S. allies. SBIRS incorporates new technologies to enhance detection and improve reporting of intercontinental ballistic missile launches, submarine launched ballistic missiles, and tactical ballistic missile launches.

The program has seen its share of technical problems in both hardware and software, which have delayed the schedule by approximately one year. One can expected a go on production of four GEO spacecraft and two HEO payloads for SBIRS High during the 10-year forecast period. A contract for additional GEO spacecraft, GEO-5 and GEO-6, could take place as these spacecraft were recommended by the U.S. Congress in 2008. The SBIRS High HEO-1 payload was declared operational in November 2008, and the GEO-1 satellite is expected to launch in 2011.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR RDT&E FUNDING (in millions US$)												
Designation or Program		**High Confidence**				**Good Confidence**			**Speculative**			
	Thru 2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Lockheed Martin Space Systems - Sunnyvale (Prime)												
SBIRS High **<> United States <> Air Force**												
	8,647.50	521.10	530.10	504.05	380.20	313.30	179.90	175.00	168.00	165.00	162.00	3,098.65
Total	8,647.50	521.10	530.10	504.05	380.20	313.30	179.90	175.00	168.00	165.00	162.00	3,098.65