SATELLITE SYSTEMS - Infrared Early Warning Systems

The MIDAS program, the third offshoot of WS 117L, focused on developing a satellite with an infrared sensor to detect hostile ICBM launches. It began its life as a separate program when AFBMD placed the infrared portion of WS 117L (Subsystem under a separate contract with Lockheed effective 1 July 1959. The payload consisted of an infrared sensor array and telescope inside a rotating turret mounted in the nose of an Agena spacecraft. Plans which were never carried out called for an operational constellation of eight satellites in polar orbits to constantly monitor launches from the Soviet Union. Unfortunately, the program's first four test satellites launched in 1960 and 1961 ended in a launch failure and early on-orbit failures.

DOD kept the program in a research and development phase rather than approve an operational system in 1962. The MIDAS program was lengthened and renamed Program 461. The next two launches in 1962 also ended in an early on-orbit failure and a launch failure. Finally, a satellite launched on 9 May 1963 operated long enough to detect 9 missile launches. After another launch failure in 1963, the last Program 461 satellite, launched on 18 July 1963, operated long enough to detect a missile and some Soviet ground tests. Data collection and analysis continued until 1968 under Lockheed's contract for Program 461 to support the next early warning program. Additional launches in 1966, using improved spacecraft and sensors, demonstrated the system's increasing reliability and longevity. Although a launch on 9 June 1966 failed, launches on 19 August and 5 October 1966 placed their spacecraft into highly useful orbits, where their infrared sensors gathered data for a year, reporting on 139 American and Soviet launches. The MIDAS program and its successors were declassified in November 1998.

DOD initiated a new program late in 1963 to develop an improved infrared early warning system, which ultimately became the Defense Support Program. After an early phase known as Program 266, contracts for development of Program 949, the Defense Support Program (DSP), were awarded to TRW for the spacecraft on 6 March 1967 and to Aerojet for the infrared sensor on 1 March 1967. The new concept involved placing the satellites into orbits at geosynchronous altitude (22,237 miles), where only three or four would be necessary for global surveillance. Like MIDAS, the satellites would employ telescopes and IR detectors, but the necessary scanning motion would be accomplished by rotating the entire satellite around its axis in space several times per minute. An evolving network of two, and later three, large ground stations in Australia, Europe, and the continental U.S. controlled the spacecraft and data.

The first DSP satellite was launched on 6 November 1970, using a Titan IIIC launch vehicle. A long series of increasingly larger, more sophisticated, and more reliable satellites followed, all of them except two launched on Titan III or Titan IV vehicles. The 23rd and final DSP satellite was successfully launched on the first operational Delta IV Heavy EELV in November 2007.

DSP provided a level of early warning that soon became indispensable for both military and civil defense. The spacecraft also carried sensors that performed nuclear surveillance, a mission inherited from the Vela system (following in this chapter). Although designed for strategic uses, DSP proved to be more versatile. During the Persian Gulf War, it provided early warning against tactical missiles as well.

By 1997, SMC and Air Force Space Command had exploited that capability by adding central processing facilities and tactical ground stations to provide tactical data from DSP to battlefield commanders more rapidly and efficiently.

During the early 1990s, SMC began to pursue concepts and technologies for follow-on systems to replace DSP. By 1994, the concept for a system to succeed DSP was known as the Space-Based Infrared System (SBIRS) and was identified as a requirement by DoD in a "Space-Based Warning Summer Study" issued in September1994. SBIRS was to be an integrated system that would support several missions: missile warning, missile defense, battlespace characterization, and technical intelligence.

The SBIRS concept actually included two planned satellite systems, referred to as SBIRS High and SBIRS Low. Both were heirs of infrared technology developed for the Ballistic Missile Defense Program (earlier known as the Strategic Defense Initiative) during 1983-1995. SBIRS High was focused on the detection and tracking of missiles during the earlier phase of their flight, while their motors were generating heat and infrared signatures in short wave lengths. SBIRS Low would add the capability of tracking and reporting other data about missiles during the middle portions of their flight, when their infrared signatures were at longer wave lengths.

To prepare for the development of SBIRS Low, SMC awarded contracts for on-orbit demonstrations to TRW on 2 May 1995 and to Boeing on 2 September 1996. However, oversight of the SBIRS Low program was transferred back to the Missile Defense Agency (MDA) during 2001, where it was renamed the Space Tracking and Surveillance System (STSS). The MDA developed STSS demonstration satellites to test the feasibility of providing midcourse surveillance of ballistic missile launches, and it launched the first two demonstration satellites together on 25 September 2009 using a Delta II vehicle. By the end of 2013, the STSS demonstration satellites were participating in successful missile intercept tests by the MDA.

SMC awarded a ten-year development contract for SBIRS High to Lockheed Martin on 8 November 1996. The SBIRS High program had to be restructured during 2001 and again in 2005 to deal with potential cost and schedule overruns, but its technical progress continued. On 18 December 2001, a consolidated SBIRS Mission Control Station (MCS) at Buckley AFB, Colorado, was declared operational. The MCS provided a central capability for command and control of all operational DSP satellites and other infrared data sources. The completion of this first segment of the ground system upgrade allowed older DSP ground stations to be closed. Afterward, the ground system continued to evolve to support satellites of the SBIRS High system.

The space segment of SBIRS High consisted of two kinds of satellites occupying very different orbits. Payloads known as SBIRS HEO flew in highly elliptical orbits and were designed to detect ballistic missiles launched from submarines in the region of the Arctic Ocean as well as certain other targets. HEO payloads, which were equipped with scanning IR sensors, were carried on host satellites from other programs. Payloads known as SBIRS GEO flew on their own satellites in geosynchronous orbit and were designed to carry out strategic missile warning and detection with scanning IR sensors as well as tactical

missile warning and detection (and other technical intelligence) in focus areas using staring IR sensors. The satellite's sensors featured greatly improved sensitivity and revisit rates compared to DSP.

The restructured SBIRS program after 2005 called for delivery of two developmental GEO satellites, two HEO payloads, and associated ground systems. Based on the success of the developmental hardware in testing, SMC awarded a follow-on production contract for the third GEO satellite and the third HEO payload to Lockheed Martin in 2009. It exercised options for the fourth GEO satellite and HEO payload in 2011.

By the end of 2013, operational results after the initial launches of SBIRS HEO and GEO were proving the systems to be highly successful, and the new SBIRS constellations continued to grow. The first two orbiting HEO payloads were operationally certified by US Strategic Command on 5 December 2008 and 7 August 2009. SMC accepted delivery of the HEO-3 payload in July 2013 and approved its shipment for integration with the host spacecraft. The GEO-1 and GEO-2 satellites were launched on 7 May 2011 and 19 March 2013 using Atlas V vehicles. Air Force Space Command accepted both GEO satellites for operations during 2013.

SMC also began to examine alternatives and improvements for the SBIRS system. One possibility that led to orbital testing was called the Commercially Hosted Infrared Payload (CHIRP). It consisted of a wide-field-of-view staring infrared sensor built by Science Applications International Corporation. The payload was hosted on a commercial geosynchronous communications satellite called SES-2. It was launched on 21 September 2011 and carried out many demonstrations of possible tactical applications for commercially hosted infrared technology. After several extensions of the contract for additional demonstrations, the sensor was decommissioned on 6 December 2013.