SpaceViews
A publication of the Boston chapter of the NSS

The Promise of MIDAS

by Andrew J. LePage
February 21, 2000

Introduction

Today in the United States we almost take for granted the military's ability to detect missile launches anywhere on the planet and quickly determine whether it poses a threat to us, our allies, or our interests around the globe. This capability helped to maintain the nation's security for much of the Cold War and today provides an early warning against missile attacks by potential adversaries. This early warning capability is provided by a constellation of high flying DSP (Defense Support Program) satellites which use state of the art infrared detector arrays to constantly scan the Earth's surface.

But this reliable early warning capability is a product of years of effort by scientists and engineers across the country. At the dawn of the Space Age such a system was just a dream. Back then the country's first line of defense against missile attack was a string of radar installations across the North American Arctic frontier supplemented by radar equipped aircraft. While a formidable line of defense, this system at best provided only 15 minutes of warning before a nuclear warhead would strike. With the memory of Pearl Harbor still fresh in the minds of the public and the military establishment, a better solution giving even more warning time was needed.

The Beginning

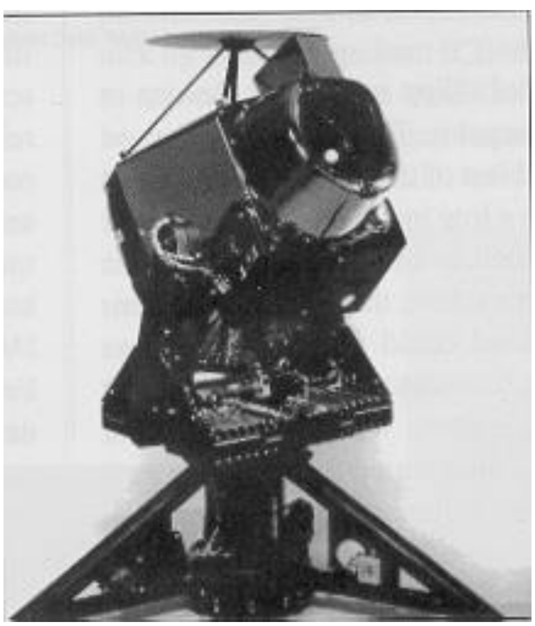
The beginning of the United States' early warning system can be traced back to studies performed during the early 1950s by Joseph J. Knopow. Working for the Operations Analysis Office in the Directorate of Operations at the USAF Headquarters, Knopow studied the ability of the then new generation of infrared (IR) sensors to detect turbojet powered bombers and transports as well as long range missiles. While this was found to be possible in principle, the detection of the bright plume generated by an ascending missile (potentially the most dangerous of these weapons) proved to be easiest with the technology available.

In June of 1955 Knopow joined Lockheed's new Missile and Space Division that was setting up shop in Palo Alto, California. Among its early programs was the development of WS-117L (Weapon System 117L) and the Agena upper stage that it would use. At this time, WS-117L was a catch all for the varied USAF satellite proposals with direct military applications. On the top of the list was a reconnaissance satellite capable of returning detailed pictures from behind the Iron Curtain (see **Spy in the Sky** in the March 1, 1999 issue of *SpaceViews*). Also included under the WS-117L umbrella was an elint (electronic intelligence) capability designed to detect Soviet Bloc radars and intercept their communications. Knopow was able to convince his superiors about IR sensor's ability to detect missile launches from orbit and in March of 1956 it was incorporated into the firm's WS-117L proposal to the USAF as Subsystem G.

While Subsystem G was included in the WS-117L contract when the USAF selected Lockheed as the prime contractor in June of 1956, there were still a host of skeptics that needed convincing. Many believed that while in theory a missile plume could be detected by IR sensors, the complex natural background structure of the warm Earth and its atmosphere would overwhelm the system's ability to differentiate a true threat from a false alarm. A system that generated an inordinate number of false alarms was almost as useless as no system at all. Over the years that followed, Knopow (now appointed the subsystem manager and later would become the program manager) and others went out to convert most of the skeptics generating almost unbounded enthusiasm among some in the USAF in the process.

But while broader support for the program was being sought, design work for the actual satellite moved forward. Like the reconnaissance satellite in WS-117L, this early warning payload would be integrated with the Agena upper stage being developed at Lockheed. At its forward end was mounted the Series I IR detector payload subcontracted to Aerojet-General Corporation. IR scanners to test the concept and gather data on natural backgrounds from aircraft and balloons would be built by Baird-Atomic, Inc.

The Series I payload consisted of a turntable rotating at two RPM with a Bouwers-concentric telescope attached. The tilt of this telescope relative to the turntable could be changed on command and was equipped with 27 lead sulfide IR detectors using filters to scan different parts of the spectrum. With the satellite in a nose down attitude, the detectors would sweep out a large donut shaped region from just above the horizon downwards to the limits of the sensors' field of view. Today's DSP early warning satellites use a similar scanning technique although now the whole spacecraft rotates, not just the sensor payload. Attitude control and orbital maintenance were provided by the Agena. Attached to its aft compartment were a pair of solar panels to provide power to the satellite and its payload.



The Series I IR payload carried by the first pair of MIDAS satellite designed to test the early warning concept. (USAF)

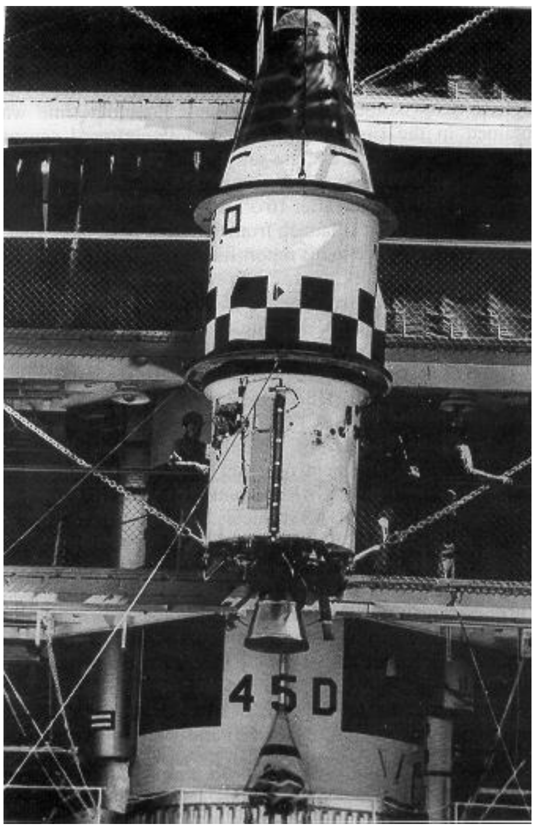
While plans for an operational system based on this design were constantly in flux because of changing USAF requirements, generally it was planned to consist of around a dozen satellites in polar orbits at an altitude of 2,000 nautical miles (3,700 kilometers or 2,300 statute miles). Such a system could monitor virtually all of the Earth's surface and provide up to 30 minutes warning of a missile launch - twice as much as the existing radar system. While a Thor IRBM was briefly considered as a launch vehicle, only the Atlas was powerful enough to loft the 1,600 kilogram (3,500 pound) payload into the proper orbit. The mission also required the in-orbit engine restart capability of the Agena B which was still under development. But for the initial pair of test flights, use of the smaller Atlas-Agena A to boost the payload into a low inclination, low altitude orbit from Cape Canaveral would suffice.

After the creation of ARPA (Advanced Research Projects Agency) in February of 1958, management of all military satellite programs including WS-117L were transferred to the new agency. Once again a new group of doubters had to be convinced of the feasibility of this early warning system. By mid-1958 this had been largely accomplished and work proceeded to build the test satellites. By November 15, 1958 ARPA officials split up WS-117L into separate programs. The interim reconnaissance satellite was spun off as the highly secret Project Corona which would be launched under the cover of the Discoverer program. The development of a more advanced reconnaissance capability continued independently as Samos. Finally, Subsystem G gained its independence to become the Missile Defense Alarm System or MIDAS. At this point work on the program was accelerated with the goal of launching the first test payload in late 1959. By February of 1959, USAF plans called for an operational capability no later than 1962.

Because of problems with ARPA's control of military satellite programs and widespread support for MIDAS, management of MIDAS along with some other projects was transferred back to the USAF on September 18, 1959. The new deployment plan called for four development flights (including the pair of Series I flights already in the works) for Phase I. Phase II included a half dozen research and development flights with an operational system coming as part of Phase III in the early 1960s. But this optimistic plan began to fall apart since the first two MIDAS test satellites were not even ready until the beginning of 1960.

A Rocky Road

The first MIDAS launch finally came on February 26, 1960 (40 years ago this week). Unfortunately, MIDAS 1 failed to reach orbit because of the improper separation of the Atlas and Agena which destroyed the rocket. Three months later on May 24 the second and last Series I MIDAS was successfully launched into a 484 by 511 kilometer (301 by 318 mile) orbit inclined 33 degrees. But once again, failure struck. The Agena's attitude control system failed sending MIDAS 2 into a tumble. A total of 30 minutes of data from the IR payload were recorded during the first two orbits resulting in some information on natural backgrounds and the detection of the star Betelgeuse. But the telemetry system finally failed after 16 orbits. As a result of the failures, the planned observations of large flares on the ground and the launch of a Titan II ICBM never occurred.



MIDAS 2 and the attached Agena A stage being lifted atop its Atlas booster. (USAF)

Efforts now turned towards building the Series II MIDAS. This new version carried an improved IR payload built by Baird-Atomic featuring 175 detectors capable of spotting an ICBM launch at a slant range of 7,800 kilometers (4,800 miles). The turntable also had an increased spin rate of six RPM allowing the sensors to sweep across the horizon every ten seconds. Instead of the Agena A, the Series II MIDAS would use the larger Agena B to place the satellite in the 2,000 nautical mile (3,700 kilometers or 2,300 statute miles) polar orbit intended for the operational system.

The launch of MIDAS 2 on May 24, 1960. (USAF)

But as work progressed on the new Series II satellite, other satellites would contribute data on natural backgrounds vital for the MIDAS program. On December 20, 1960 Discoverer 19 was launched on a Thor-Agena B. Instead of a high resolution camera and return vehicle like those carried by earlier Discoverer satellites as part of the Corona program, this satellite was equipped with a radiometry payload designated RM-1. While an attitude control gas leak on the Agena B made it difficult to control the satellite, it did return valuable data that were described as "90% usable".

A repeat of this mission using radiometry payload RM-2 was launched as Discoverer 21 on February 18, 1961. In addition to the IR radiometry mission, Discoverer 21 also performed an important engineering test. During its first orbit, the engine of the Agena B was restarted for 1.05 seconds adding about 110 meter per second (240 MPH) to the satellite's orbital velocity. This first test of the in-orbit restart capability was not only important to the MIDAS program but also to other programs as well including NASA's new lunar program, Ranger, that would also use the Agena B (see **Heading Towards the Lunar Surface** in the January 17, 2000 issue of *SpaceViews*). But once again failure struck when the power system failed on the ninth orbit bringing the mission to a premature end. Over the next five years, a half dozen Corona reconnaissance satellites would carry smaller IR radiometry instruments as supplemental payloads to gather yet more data for MIDAS.

Finally on July 12, 1961 the first Series II payload was ready for launch this time from the Point Arguello Launch Complex on the coast of California. But as soon as MIDAS 3 achieved polar orbit, failure struck the program once again. One of the two solar panels failed to deploy properly and MIDAS 3 died after returning only a limited amount of data. As an investigation into the failure started, the feasibility of the whole early warning concept was again called into question resulting in a lengthy series of reviews. Many felt that this system could not detect the launch of solid rocket propelled missiles which were now seen as the new and upcoming threat.

While scientists and engineers redoubled their efforts to convince government officials of the continued feasibility of their concept, MIDAS 4 was launched on October 21, 1961. But failure struck once again when the ascending Atlas lost roll control injecting the satellite into the wrong parking orbit. This malfunction was compounded by the Agena's excessive use of attitude control gas during its pair of burns in an attempt to compensate for the trajectory errors. By the time MIDAS 4 completed its first orbit, its attitude control gas was depleted rendering the satellite uncontrollable. Then during the fourth orbit, one of the solar panels attached to the Agena failed. During the brief time it had left, the IR payload on MIDAS 4 did detect the launch of a Titan ICBM 90 seconds after liftoff from Cape Canaveral on October 26. MIDAS 4 was finally shut down after a week in orbit as it power reserves were finally depleted.

The final Series II spacecraft, MIDAS 5, was launched on April 9, 1962. But during the sixth orbit, a massive power failure struck the satellite prematurely ending yet another mission. While theory and the limited orbital data indicated that the concept of an early warning satellite seemed sound basically, the MIDAS program was proving to be an abysmal failure. The development and deployment of an operational early warning satellite constellation seemed further away than ever.

Bibliography

R. Cargill Hall, "Missile Defense Alarm: The Genesis of the Space-based Infrared Early Warning", *Quest*, Vol. 7, No. 1, pp. 5-17, Spring 1999

Curtis Peebles, *The Corona Project: America's First Spy Satellites*, Naval Institute Press, 1997

N.W. Watkins, "The MIDAS Project: Part I Strategic and Technical Origins and Political Evolution 1955-1963", *Journal of the British Interplanetary Society*, Vol. 50, No. 6, pp. 215-224, June 1997

Author

Drew LePage is a physicist and freelance writer specializing in astronomy and the history of spaceflight. He can be reached at lepage@visidyne.com