The Floating Eye

Aerostats have become an invaluable force protection asset and communications multiplier.

By Peter A. Buxbaum, TISR Correspondent

An NCO stationed at an installation near Sadr City in Baghdad was the first to come up with the idea of using aerostats to facilitate extended line-of-sight radio communications. She wanted to improve her radio communications by placing the antenna on the aerostat while keeping her radios securely on the ground.

The result of her curiosity was that Syntonics received an order from the Army to develop and deliver such a capability. Syntonics delivered its FORAX-HARC (fiber optic remote amplifier extension, high antenna for radio communications) system, a radio frequency-over-fiber communications technology that enables the tethered PTDS aerostat to serve as a radio tower. The system extended the range of radios and penetrated the urban canyons of Baghdad to provide line-of-sight communications.

This story is illustrative of the innovations being applied to a technology that is anything but new. Some of the companies providing aerostats and their payloads to the U.S. military have been doing so for many decades. But conditions of current U.S. military operations—the skies are uncontested—combined with innovations to the aerostats themselves and the payloads they carry, have allowed aerostats to provide very useful and cost-effective capabilities to today's warfighters.

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The same attributes that made aerostats popular at sporting events make them equally useful for military operations. Aerostats are able to provide persistent surveillance more efficiently and cost-effectively than manned or unmanned aircraft. Newly-developed payloads, such as the FORAX-HARC system, allow aerostats to function as a communications hub. There are a number of aerostat systems used by the U.S. military. PTDS was first put into service as part of the effort to defeat improvised explosive devices (IEDs) deployed to Iraq in September 2004, and has since been deployed to Afghanistan as well. Today, 37 PTDS systems are deployed and another 29 are in production.

TCOM has been at the forefront of innovative developments in tethered aerostat systems for over 40 years. It is considered by many as the industry pioneer that introduced most of the revolutionary advancements in tethered aerostat systems. For the ISR community, TCOM's experience has been successfully applied to deployment in theatre in support of the military and intelligence communities globally. Foreseeing the need for defense and homeland security needs, TCOM was the first to convert aerostats to militarized systems which covered all three levels of war: tactical, operational and strategic.

TCOM has designed, built and deployed the largest off-the-shelf selection of aerostat systems, with more than seven models currently available in varying sizes for maximum efficiency and they have been deployed around the globe. When hostilities broke out in Iraq, the U.S. Army deployed their aerostat there. At that time, the company grew the 15-meter to a 17-meter to allow additional payloads on the aerostat. In total, the U.S. Army deployed 28 TCOM tactical systems to Iraq.

As tactical requirements grew for the Army and Navy in Afghanistan, TCOM designed 22- and 28-meter systems—both of which are part of PGSS. When asked what factors differentiate TCOM, company President Dave Barlow replied, "TCOM's unmatched team of more than 60 full-time engineers dedicated to the development and support of aerostats enables us to react quickly to design, produce, and field sophisticated new systems to meet our customer's rapidly changing mission landscape. Our customers report that TCOM's systems are unmatched with respect to their reliability and durability."

Raven Aerostar and TCOM provide aerostats to the Persistent Ground Surveillance System (PGSS), a Department of Defense rapid fielding initiative. The program will be providing 60 25,000 cubic foot aerostats to forward operating bases in Afghanistan. Thirty of the units have already been delivered over the last two years.

The basic proposition for the use of aerostats revolves around their cost-effectiveness and flexibility. "Aerostats cost as little as $200 an hour to put up," said Lon Stroschein, vice president and division general manager at Raven Aerostar. "This compares to tens of thousands of dollars per hour for an unmanned aerial vehicle. And with a UAV, you still have a crew and an aircraft to maintain."

"All aircraft have some capability to provide airborne ISR and communications support," said Ron Browning, business development manager, Mission Systems and Sensors Division of Lockheed Martin. "Consequently, when looking at the long endurance mission, the challenge lies with the concept of operations and the resulting allocation of resources."

To maintain persistent coverage over a given area in Afghanistan for a month at a time would require an orbit of several conventional aircraft or UAVs to provide the same capabilities as PTDS, according to Browning. "With each aircraft orbit comes the respective resource allocation for fuel, personnel and bandwidth to execute the mission," he said. "And even then, there may be gaps in coverage due to weather conditions. The resulting cost would be significantly higher, and overall mission performance would be significantly lower" than to perform the same mission with the PTDS.

Aerostats can also stay aloft much longer than aircraft. "A Predator or Global Hawk can provide 48 hours of service at a time," said Stroschein.

"Aerostats can provide hundreds of hours of service before topping off the helium. A high-end camera can look out and provide surveillance for miles."

A tethered aerostat by definition is not mobile and therefore not suitable for every mission for which a UAV is capable. But it turns out that they are quite robust when it comes to withstanding enemy fire," noted Bruce Montgomery, president of Syntonics LLC.

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Stroschein categorizes aerostats by volume. The size of the vehicle will dictate the weight of the payloads it can carry, the altitude at which it hovers, and the kinds of missions it can perform. Small aerostats of 6,000 cubic feet or less require two individuals to quickly launch and recover and are used for tactical missions.

"They can carry a carry a small camera, radar, listening device," said Stroschein. "The quick launch and recovery within minutes makes them suitable for tactical missions."

Mid-sized aerostats of 6,000 to 50,000 cubic feet and large aerostats of over 50,000 cubic feet are normally moved atop trailers and are handled by crews of five or more. They can take several hours to deploy.

"These aerostats stay on site for weeks at a time," said Stroschein. "The large aerostats fly high enough to be out of reach of small arms fire. They are less mobile but they can carry more payload." The mid-sized and large aerostats are often used for personnel protection at installations such as embassies and forward operating bases.

The U.S. Army's Persistent Threat Detection System is a tethered aerostat-based force protection, communication, intelligence, surveillance and reconnaissance system. Lockheed Martin's 74K Aerostat System was selected by Army for PTDS. The 74K aerostat hosts multi-mission payloads and is functionally integrated with the overall command information architecture.

"PTDS provides near-constant communication relay and video dissemination to response teams with day and night, 360-degree detection, surveillance and target marking capability in hostile weather and operating environments," said Browning. "PTDS has the ability to maintain persistent surveillance in an area of coverage extending more than 23,500 square miles for periods exceeding 25 consecutive days. It operates at altitudes up to 5,000 feet above ground level."

PTDS provides several advantages over potential alternatives, according to Browning. "PTDS provides round-the-clock surveillance for weeks at a time," he said. "PTDS has more than 400,000 hours of in-theater mission time and flies when other aircraft are grounded due to weather. PTDS hosts concurrent multi-mission payloads that are easily upgradeable as new sensors become available."

The PGSS aerostats can monitor many miles around a base. "They are able to watch roadways leading up the base and to monitor convoys as they approach," said Stroschein. Thanks to the surveillance

provided by the aerostat payloads, there have been several instances in which insurgent activity in the vicinity of forward operating bases has been thwarted, according to Stroschein.

The persistent surveillance provided by the aerostats is enabled by wide area motion imagery sensors, essentially a low-rate video that snaps pictures at the rate of two per second. Wide area capabilities allow users to look at a much broader expanse of real estate and multiple users can find different targets in the field of view of the sensor.

Logos Technologies provides those kinds of cameras to both PTDS and PGSS. Most aerostats can't carry payloads of much over 100 pounds, noted John Marion, director of the company's persistent surveillance division. This required the miniaturization of the cameras Logos Tech provides to other platforms such as Constant Hawk. "The payloads are identical for the two programs," said Marion. "They provide 360 degree overwatch to look at an area 100 square kilometers around a forward operating base. The wide area cameras also service to cue other sensors on board the aerostat." The quality resolution of the resulting imagery is intermediate. "It's not as good as a fully zoomed-in spotter," said Marion, "but we cover 100 square kilometers and they are covering 100 square meters." Logos Technologies began shipping the wide-area cameras to Afghanistan last summer.

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Scot Wesolaski

Syntonics' FORAX-HARC system "can extend radio coverage for as far as the antenna can see," said Montgomery. "Data throughput for networked radios is also increased because you are avoiding an extra relay hop." The system capitalizes on the existing FORAX technology to fly the antennas for as many as four SINCGARS radios and two Enhanced Position Location Reporting System (EPLRS) radios on aerostats. FORAX-HARC uses a single optical fiber in the aerostat's tether to connect ground radios to antennas on the aerostat.

"High antennas improve line-of-sight radio coverage over long distances as well as into congested urban areas and over mountainous terrain," said Montgomery. "This auxiliary payload allows commanders to communicate over 50 to 70 miles instead of five to seven miles, and over hills and down in urban clutter."

Aerostats can carry high antennas inexpensively. "We are piggybacking our payload on an existing asset," said Montgomery. Syntonics expects to complete delivery of 30 units in early 2012.

GE Intelligent Platforms provides subsystems for payloads carried on aerostats and other aerial vehicles. "Military programs are increasingly calling for more processing on board the sensor," said Scot Wesolaski, the company's industry manager for ISR. "Our products provide those capabilities and functionalities to airship payloads."

Two key-related capabilities that enable both persistent surveillance and onboard processing are secure data storage and video compression. "They want to download data to the platform as opposed to the ground," said Wesolaski. "They want actionable intelligence to be delivered to the guys on the ground."

Compression allows massive imagery files to be reduced to levels that can be handled by the processing power of onboard payload sensors. The GE video compression card "allows the delivery of information quicker, faster and better," said Wesolaski. "We also provide graphics processing units that provide much better image quality and the capability to do parallel processing on the platform itself."

Aerostats may not be new, but nor is the technology standing still. "Since first introduced, PTDS has continued to evolve in response to increasing mission requirements," said Browning. "As a result, enhancements in almost all areas of the system have been introduced to respond to these requirements. We see this trend continuing as new technologies and capabilities become available for inclusion in PTDS."

Raven Aerostar is currently in the process of manufacturing its first aerostat out of a new fabric called high strength laminated aerostat material (HSLAM). "HSLAM cuts the weight of the material anywhere from 35 percent to 45 percent," said Stroschein. "It is also much stronger than the fabric we have been using for last 50 years."

Stroschein anticipates that PGSS aerostats will be able to upgrade to HSLAM simply by replacing the standard envelope. "That way," said Stroschein, "the aerostat will be able to carry 35 percent more payload, and more sensors will provide more surveillance for the exact same platform." ✯

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