SOLVING SENSOR DILEMMAS
History-making Army satellite: 10 years later

By John London and Mark Ray

Unattended ground sensors have been used by the U.S. military in various forms for more than 50 years for remote detection of enemy activity. For example, ground sensors are placed to detect enemy motion or sounds, such as digging to place improvised explosive devices.

These sensors generally have to trade-off competing requirements. They typically need a line of sight to transmit their data to a friendly ground receiving station which can expose forward-deployed forces during sensor emplacement and operations, or they require higher power and larger antenna to reach a satellite which can expose the sensor to discovery and defeat.

Ten years ago in April 2008, Lt. Gen. Kevin Campbell, then-commanding general of the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) saw an opportunity to demonstrate a solution to this dilemma. Small satellites in Low Earth Orbit could retrieve the data directly from the sensors without exposing forward forces, maintain the covert nature of the sensors and reduce the power and size requirements levied on the sensor.

Campbell directed the development of eight flight-capable nanosatellites within 12 months. That feat was accomplished in April 2009 with the delivery of eight satellites by the Miltec Corp.

In Orbit After 50 Years

On Dec. 8, 2010, USASMDC/ARSTRAT orbited and successfully operated the Army's first satellite in more than 50 years, a 4-kilogram 3U nanosatellite about the size of a loaf of bread dubbed the Space and Missile Defense Command-Operational Nanosatellite Effect (SMDC-ONE). This nanosatellite demonstrated the viability of Army smallsats for communications relay and data exfiltration from unattended ground sensors and ended the long drought of Army satellite development efforts.

Limited demonstrations were conducted in orbit where data from an unattended ground sensor were collected, transmitted to the cube satellite through a NEXUS gateway and then relayed to a ground station.

Since the SMDC-ONE launch in 2010, 11 additional USASMDC/ARSTRAT smallsats have flown to Low Earth Orbit with varying designs for multiple missions, the majority focused on testing and demonstrating communications capabilities for the Army Warfighter.

After the first SMDC-ONE mission in 2010, USASMDC/ARSTRAT progressively developed and matured smallsat technologies, including three orbiting smallsats designated as the SMDC Nanosatellite Program-3 (SNaP-3). The SNaP-3 satellites were developed in partnership with the Office of the Secretary of Defense Joint Capability Technology Demonstration Program.

The most complex mission to date and the Army's largest satellite since COURIER 1B in 1960 is an imaging satellite called Kestrel Eye that was launched in August 2017. Kestrel Eye was deployed from the International Space Station by astronaut Mark Vande Hei, a retired Army colonel. This satellite has a mass of around 50 kilograms including an optical payload to provide digital imagery at about 1.5 meter ground sample distance.

Kestrel Eye's ambitious goal is providing imagery to the lowest tactical level at unprecedented speed. USASMDC/ARSTRAT also is developing technologies in advanced communications and other applications for the benefit of the ground tactical Warfighter.

Smallsat Paradigm

The U.S. Army has been heavily dependent on military and commercial space systems for communications, command and control, reconnaissance and weather information since the 1970s. In more recent years, the Department of Defense (DOD) uses satellite communications to support a variety of critical mission needs, from unmanned aerial vehicles and intelligence to voice and data for military personnel.

According to a Government Accountability Office report, "In fiscal year 2011, the most recent information available, the DOD spent over $1 billion leasing commercial SATCOM."[1] The report indicated ". . . DOD demand for SATCOM is growing, but expected capacity will remain flat, suggesting military capability will need to be significantly supplemented with commercial SATCOM in the future."[2]

Smallsats such as SMDC-ONE began as a university teaching tool in 1999. Universities, small companies and even countries without traditional space programs suddenly had the ability to build and launch science experiments and technology demonstrations on a budget.

What began very humbly has blossomed into a niche space market within the traditional space community. SpaceWorks Enterprises, Inc., estimates approximately 125 smallsats are scheduled for launch each year and nearly 2,400 will require launch through 2023.[3]

Small satellites like SMDC-ONE and SNaP-3 operating in Low Earth Orbit may be harbingers of a new paradigm where smallsats augment and supplement traditional SATCOM architectures and thereby reduce the burden and decrease the cost for the Department of Defense. Kestrel Eye likewise represents another option to provide tactical imagery to the Warfighter, to supplement existing commercial and government imagery systems.

USASMDC/ARSTRAT is working to a space technology roadmap which includes development of Earth-sensing and advanced communications small satellites. Consequently, current programmatic goals for USASMDC/ARSTRAT include developing global communications coverage for the warfighter, enabling near real-time low resolution imagery collection and dissemination, and finding new and innovative ways to implement space applications and technologies that offer enhanced or new capabilities to the warfighter.

In the ten short years since the announcement of the SMDC-ONE satellite initiative by Campbell, USASMDC/ARSTRAT has put in place an active program of satellite technology development that holds great promise for providing low-cost, responsive data from space to the Army of the future.

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[1] United States Government Accountability Office, *Defense Satellite Communications: DOD Needs Additional Information to Improve Procurements* (Washington: GAO-15-459, July 2015), under "Why GAO Did This Study," https://www.gao.gov/assets/680/671484.pdf

[2] Ibid., 12.

[3] SpaceWorks Enterprises, Inc., *2018 Nano/Microsatellite Market Forecast*, 8th ed. (Atlanta: 2018), 8, http://www.spaceworkscommercial.com/wp-content/uploads/2018/02/Nano-Microsatellite-Market-Forecast-8th-Edition-2018.pdf.