Making Space Responsive

By Peter Grier

Space systems bring tremendous combat advantages, but they take too long to field. DOD is counting on its ORS office to speed things up.

Space systems have changed the way the US fights its wars. The intelligence they provide helps US forces outmaneuver their adversaries, and the communications they carry enable those forces to attack with precision.

Space-based capabilities have helped revolutionize logistics, reducing the size of forward deployed units and cutting the number of weapons needed. But the manner in which those systems reach space has changed little since the era of Apollo moon shots. The development of many national security satellites remains a lengthy and expensive process. For the most part, those satellites are designed with strategic, not tactical, uses in mind.

The Operationally Responsive Space office's mission is to fix this disconnect. This three-year-old office is a Department of Defense joint organization, housed at Kirtland AFB, N.M. It aims to boost and coordinate US efforts to make some space assets cheaper, faster, and more attuned to the needs of commanders on the ground.

The ORS office does not intend to replace the traditional model of space development, but to add additional capabilities and program resiliency, says director Peter M. Wegner. "We want this office to really be the focal point for exploring new ways of doing business in space ... and to be the focal point for having the ability to respond rapidly in a crisis," said Wegner.

As a model for its role, the ORS office looks to the development of the computer industry, according to Wegner. The rise of personal computers did not eliminate the market for big mainframe data crunchers, and in the same way, a quick-response space capability would supplement existing super space systems.

Right now, though, ORS is barely out of its infancy.

USAF photo by SrA. Andrew Lee

A Minotaur IV is launched into the night from a space launch complex at Vandenberg AFB, Calif.

help to US forces. The Army established a Tactical Exploitation of National Capabilities (TENCAP) program in 1973, for example. But DOD finally moved to create a focused departmentwide ORS office in part due to increased concerns about the vulnerability of the nation's space network. In short, it may not be as safe up there as it used to be.

Greater Risk

In this context, China's 2007 test of a direct-ascent anti-satellite weapon against one of its own satellites was a turning point. The successful test took the US and the rest of the world by surprise, created a giant cloud of space debris, and served notice that regional powers might be able to create havoc in the heavens, if they so choose.

At the same time, defense budgets appear to face a period of constraint. Huge national deficits loom in coming decades, and no aspect of government, even defense, is safe from reductions. Increasing redundancy in US space capabilities by throwing money at expensive development programs is not an option. Space, like other military activities, will be asked to do more with less.

Fortunately, advances in small satellite technology are making the vision of faster-paced and less-expensive system development more realistic. The goal of ORS is to harness this change to produce satellites that are, in the office's own phrase, "good enough" to satisfy the needs of troops across the spectrum of conflict, from peace to war.

This may require a degree of bureaucratic reinvention, and an acceptance of greater risk in the enterprise. "New approaches to methods, development, and acquisition are necessary to attain ORS capabilities and ... broader space operations efficiency," reads the office's founding document, a 2007 "Plan for Operationally Responsive Space" report to congressional defense committees produced by the deputy secretary of

USAF photo

A Minotaur I lofts the TacSat-3 into orbit from Wallops Flight Facility, Va. The TacSat-3 satellite was transferred to Air Force Space Command last summer.

Officially organized in 2007, it did not have significant numbers of personnel until 2008. In 2011, it will move from what its chief calls the "crawl phase," in which the office figures out how it fits in the larger US space community, and begin to walk by making its own technological investments. By 2015 or so, ORS should be in the full-speed "run phase," defined as providing multiple responsive space capabilities to combat forces.

The need for a more flexible and faster US approach to space assets is not driven just by current operational needs. Pentagon planners for years have dreamed of small satellites able to provide real-time

Lockheed Martin photo

The SBIRS GEO-1 satellite undergoes work at the Lockheed Martin facility in Sunnyvale, Calif. SBIRS typifies the large-effort, large-reward model of traditional space programs.

defense, then Gordon England; the DOD executive agent for space, at that time Air Force Undersecretary Ronald M. Sega; and Marine Corps Gen. James E. Cartwright, then head of US Strategic Command. This report defines operationally responsive space as "assured space power focused on the timely satisfaction of joint force commanders' needs." The US Strategic Command concept of operations for ORS sets a goal of producing space assets that can be employed in minutes to days by those who need them; deployed in days to weeks if more assets are needed; and developed in months to begin with.

By congressional direction, the ORS office is supposed to come up with satellite payloads and buses of modular open-system design which cost $40 million for each satellite-bus combination. The target for space launches is a low $20 million per shot.

The task is admittedly daunting. The analogy ORS officials use is they are building a U-2 reconnaissance aircraft wing for space—while the aircraft are already being flown and missions are constantly changing. "We don't know what the threats will be, or where they'll come from, so these need to be adaptive systems," said Wegner.

The ORS chief acknowledges some in the US space community see his office itself as a threat to their resources. With money in short supply, the faster-cheaper approach inevitably will siphon cash away from larger space investments, others in the space community contend. Given the unpleasant truth that the services themselves compete for funding, as do programs within services, this attitude toward ORS is likely to persist. But in many cases people look to ORS as "complementary" to legacy systems, said Wegner. "We've developed some good collaborations," he said.

The Tiers

The ORS approach to its mission is organized in three tiers of ascending difficulty. These roughly match up with Wegner's description of ORS first crawling, then learning to walk, then running at full speed. Tier One is the rapid exploitation of current on-orbit assets. As outlined in the 2007 "Plan for Operationally Responsive Space," the timeline for Tier One response is hours to days. In other words, once commanders want something, they get it—fast. By necessity, Tier One likely would not involve construction of any new equipment.

Given it does not involve much money, Tier One is something on which ORS has already made progress. "Today I've got a team in my office that focuses on Tier One," said Wegner. "They're developing a database of space capabilities on orbit and systematically working through that to figure out how to get access to those in a crisis and then get data down."

Tier Two is intended to involve the stockpiling of ORS assets in a kind of space ready reserve. If troop needs can't be met with Tier One, then ORS runs out to its stockroom and sees what kind of modular capabilities it has lying around that can be combined into a low-cost satellite and launched within days or weeks. "That means you've really got to anticipate ahead of time what might be needed," said Wegner.

Tier Three would involve unanticipated requirements. If ORS can't fulfill a request with off-the-shelf parts, it should be able to develop and deploy an entirely new capability within months to a year, according to the 2007 DOD plan. "Achieving such a timeline will be very challenging and cannot be accomplished unless the amount of new development involved is very limited," notes an ORS fact sheet.

To lay the groundwork for eventually responding to Tier Three emergencies, ORS officials are trying to cultivate contacts with the scientific and technical communities, so they can figure out how to get such an innovative development process in place.

"How do you plan to solve an unanticipated need? You have to develop a very adaptive architecture," said ORS chief

Wegner. This architecture will have to be a modular, open system. ORS is looking at ways of building a modular and adaptable satellite bus, he added.

"What if I get a need, and I need to add two times as much propellant to the system?" said Wegner. "We're working that on the bus side right now."

If this is the case, why doesn't the ORS office use its money to build a stockpile of different kinds of satellites it could warehouse to guard against any eventuality? Simply put, it would be too expensive and it probably would not work. After five years of sitting around, this costly equipment might be obsolete.

One of the roles of the ORS office is to act as the coordinator of Pentagon-wide responsive space efforts, and one of the main programs ORS coordinates may be the Tactical Satellite series of experimental spacecraft. Back in 2007, the DOD responsive space plan described TacSat as "the principal test bed for proving out the technologies required to develop and field future ORS space capabilities."

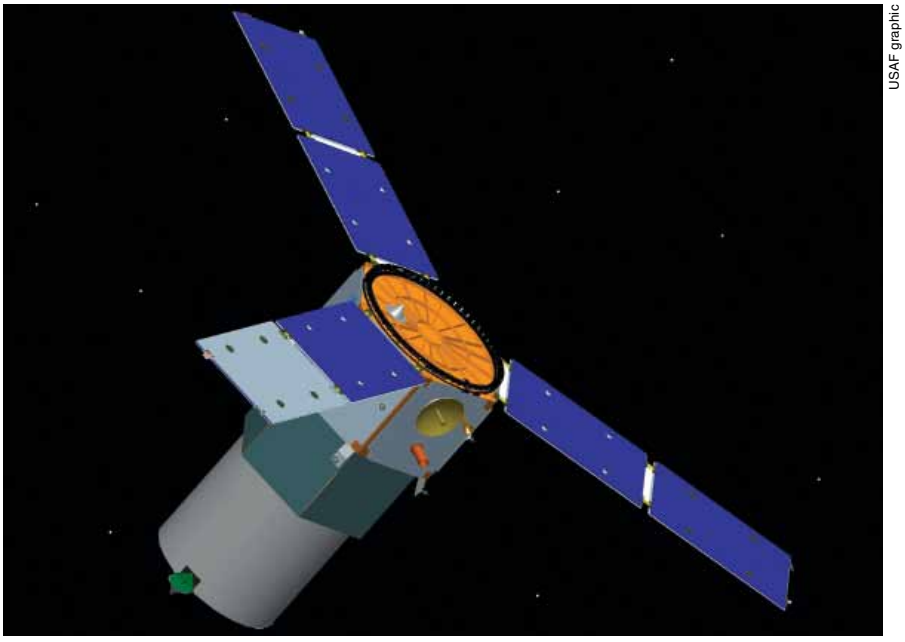
An Air Force Minotaur I rocket put TacSat-3 into low Earth orbit in May 2009. The satellite's primary payload is ARTEMIS, the Advanced Responsive Tactically Effective Military Imaging Spectrometer. This land-focused sensor captures light from a wide swatch of the electromagnetic spectrum, enabling it to detect specific substances, from damp dirt to the types of metal used in weapons. In minutes, it can theoretically deliver situational awareness to troops on the ground.

TacSat-3's experimental phase went so well, this past summer the $95 million satellite was turned over to Air Force Space Command. AFSPC will run the program under US Strategic Command oversight, with the Army the primary beneficiary of TacSat-3's intelligence. "Overall, the TacSat-3 mission is a stepping stone for delivering operationally relevant space capabilities to the joint force commander," said Wegner in June, when the turnover was first announced.

For the ORS office, TacSat-3 has indeed been a stepping stone. In many ways, the TacSat program has been a precursor to ORS-1, the Operationally Responsive Space office's first operational satellite.

The ORS-1 program is the result of a request from US Central Command for additional intelligence-surveillance-reconnaissance capability in Southwest Asia. The program timeline is ambitious, with a planned 24 months from its October 2008 initiation to launch.

The Space Development and Test Wing is executing the program for the ORS office, which in turn is coordinating with CENTCOM, STRATCOM, and other organizations involved in the effort. Goodrich Corp. is partnering with Alliant Techsystems to produce the operational satellite system.



USAF graphic

An artist's conception of Air Force Research Laboratory's TacSat-3 on orbit. TacSat-3 sensors can detect a wide range of substances, from damp dirt to metals used for weapons.

Budget Unpredictability

"In some senses, we've been able to—almost from a clean sheet of paper—look at the way we build space capabilities," said Wegner. "That's the great lesson learned out of ORS-1."

Schedule is important to ORS office officials.

Historically, the US launches space assets when planners are comfortable everything is ready. ORS, in contrast, is willing to accept a bit more risk in the name of capability acceleration. This could mean looking at integration and test schedules, for instance, to see where a little time can be shaved off. Or it could mean using lighter single-strength parts instead of parts bulked up to provide redundant strength. "Spacecraft are very nonlinear," said Wegner. "You add a pound to the solar array, and it ripples through the whole system. If you can take out a little bit, that effect gets magnified through the rest of the system. ... It's interesting to watch that effect."

The ORS-1 team successfully completed a system requirement review in December 2008; a preliminary design review in March 2009; and critical design review in June 2009. The satellite system now is ready for launch, which was originally scheduled for late 2010. But ORS-1 has run into a launch vehicle manifest problem. Essentially, there are five payloads now vying to ride Minotaur I rockets into space.

"There's uncertainty about what date we can actually launch," said Wegner.

The problem is not due to a lack of Minotaur boosters, which are solid-fuel rockets constructed from converted ICBMs. The problem is process constraints that are preventing satellites from being launched as soon as they could be, said the ORS head. "There are lots of boosters, but in essence only one team that can pull those out of storage, integrate them together, and go launch them," said Wegner.

The other main challenge the ORS office faces is one virtually all Pentagon programs can relate to: competing demands for scarce military resources and budget unpredictability. It is an uncertain time in the Defense Department. This can make setting priorities year after year difficult.

"For example, when we think what mission we should go off next and do, it's been somewhat difficult to get that nailed down," said Wegner. "From year to year, what's important to senior leaders sort of changes. ... It's a challenging part of the job." ■

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