Duck Hunt

U.S. military plans defenses against growing UAV threat

Eric Tegler Washington

The increasing number and sophistication of unmanned aircraft operators has forced into the open a discussion that was until recently behind the blinds: How can the U.S. counter adversaries' UAVs?

Worldwide inventory stood at approximately 10,000 unmanned aircraft and more than 200 system types in 2010, according to the U.S. Army's Fires Center of Excellence (see related stories on pages 40-50). Along with the proliferation of large and small UAVs, officials predict they will increasingly be used in attack roles.

"This is a self-sustaining discussion now," says Raymond Buettner, director of the Naval Postgraduate School's Consortium for Robotics and Unmanned Systems Education and Research. "Every service has recognized that [unmanned air systems] can potentially be a threat to them. Because this is new, our thinking is appropriately broad."

Though no central counter-UAV organizing force exists in the U.S. military, discussion is centering on how to detect UAVs, whether to kill them and how to defeat them without breaking the bank.

On April 30 and May 1, the Army held a technical exchange on counter-unmanned air systems (CUAS) technologies. The classified meeting drew 68 packets for review, 26 of which were presented in person.

Detection, decision and defeat mechanisms at all echelons were discussed. Potential solutions ranged from kinetic and non-kinetic to electronic and cyberwarfare, according to the organizer of the exchange, Steve Bramlett, of the Army's Aviation and Missile Research, Development and Engineering Center.

Directed energy (lasers/high-power microwave) and cybernegation alternatives were of considerable interest. The most frequently offered systems, though, were ground-based and kinetic, he says. The relatively low cost of such systems and the speed with which they can be developed, acquired and deployed are likely factors in their popularity. However, all at the meeting agreed that a combined-arms approach will be essential.

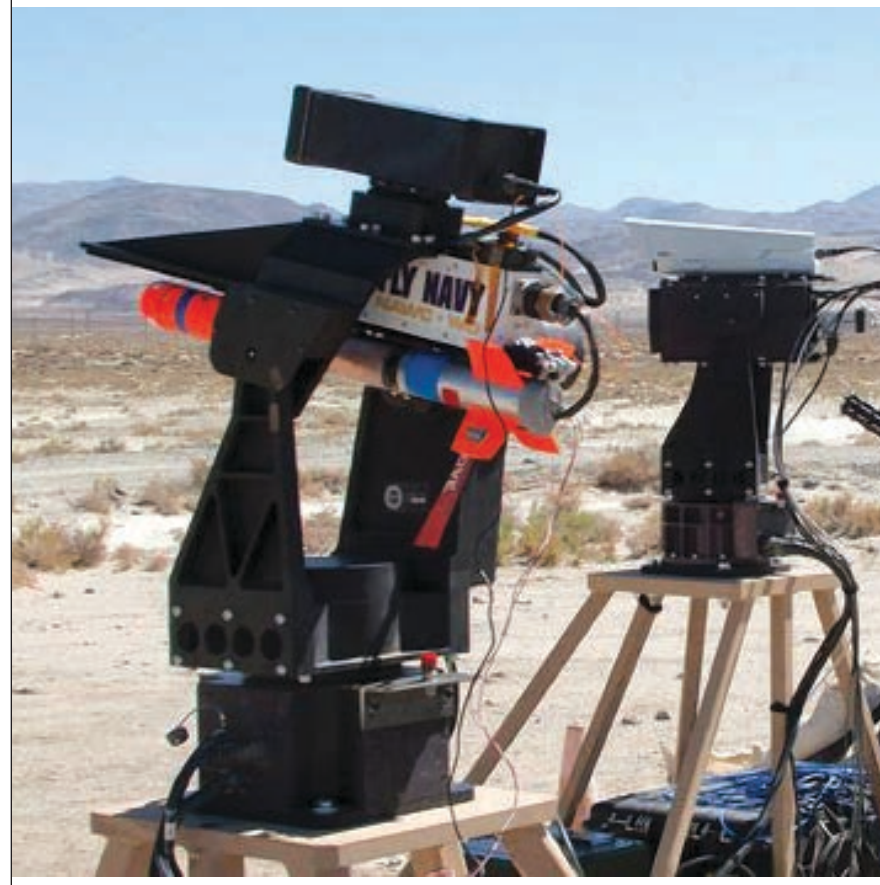
"All of our traditional kinetic air defense assets are big, expensive and set back at the brigade level," Bramlett notes. "A small, inexpensive threat—commercially based, possibly a swarm—fielded by an enemy can run through our sophisticated, expensive kinetic assets quickly. That's why we all realize we need combined arms and a cheaper kinetic solution at the tactical edge, battalion and below."

The need for such systems also implies detection and decision-making at lower levels, down to the platoon level. Defeating small UAS will not only require cost-effective negation systems but new chain-of-command mechanisms.

"It's a complicated, expensive problem," Bramlett acknowledges. "The U.S. must negate the threat without fratricide, coalition or civilian casualty risks. The enemy doesn't regard those problems. They'll have cheap plentiful items and will not be concerned with positive I.D. CUAS is an asymmetric technical and financial battle."

The search for inexpensive countermeasures comes from the top. Army Gen. Martin Dempsey, chairman of the Joint Chiefs of Staff, advised the services in a recent air and missile defense document to "find ways to avoid scenarios where adversaries launch large numbers of relatively cheap rockets, ballistic and cruise missiles, or unmanned air systems, and our only response is to intercept them with highly complex and expensive weapons."

Dempsey's challenge has been the focus of the Joint Integrated Air and Missile Defense Organization's (Jiamdo)



U.S. NAVY

The U.S. Navy's Air Warfare Center Weapons Division has seen the Spike missile system as a way to counter fast inshore attack craft, but the Army may consider it as a way to counter UAVs.

Black Dart exercises. Black Dart is the Pentagon's only live-fly, live-fire joint CUAS capability demonstration, held annually to assess existing and emerging CUAS concepts, systems and architecture. In 2013, it encompassed approximately 1,000 people, 40 sensor and negation systems, 13 UAS variants and 10 types of tactical aircraft.

Among the systems evaluated during the two-week exercise was one jointly demonstrated by the Army and Navy. Since 2004, the Navy has been developing a 25-in., 5.5-lb. missile called Spike. Funded with support from the Pentagon, Spike began as a developmental program to train entry-level engineers.

Meanwhile, over the last two years the Army has been evaluating integration of its Palletized Protection System fire-control radar with a variety of different UAS interceptors. According to Greg Wheelock, technical lead at the Navy's Air Warfare Center Weapons Division (Nawcwd), Spike had been considered casually as a CUAS tool, but a 2012 meeting with Army Research, Development and Engineering Center (Ardec) engineers gave rise to the idea of pairing Spike with the Palletized Protection System. The combination successfully intercepted targets during experiments at the Navy's China Lake range in 2013. Nawcwd sees potential for Spike as a gap-filler against fast inshore attack craft; the Army sees it as one of many possible CUAS solutions.

"As we work through different defeat mechanisms, we see if we can pair them up with other types of detection/tracking," says Ardec's Hannibal People. "We try to [create] a sort of plug-and-play architecture."

The approach is being taken across the services. The Air Force Research Laboratory declined to comment on its classified activities, but like others, it is looking at both kinetic and non-kinetic CUAS strategies.

Spike-type systems may miss the low-cost target, however. Fabricating some two-dozen Spike missiles has cost $50,000 per unit, Nawcwd says, though a 1,000-missile production run could lower the prototype price per unit by about one-third.

Lasers are a better alternative, Buettner says, pointing to both Navy and Army directed-energy experiments that address multivector threats rapidly, potentially for cents on the dollar rather than tens of thousands per kill.

CUAS need not be a vehicle-destroy proposition. The Fires Center, Jiamdo, the Joint Staff and other CUAS stakeholders agree that rendering the mission of a UAS ineffective is sufficient. Traditional electronic warfare will play a role as will kinetic alternatives such as proximity fragmented explosive devices carried by systems like Spike or Socom's Switchblade micro-missile. The unhardened nature of smaller UAVs makes the use of electromagnetic pulse tactics possible as well.

At close range over land, the potential collateral effects of such countermeasures must be considered, Buettner says, making non-kinetic alternatives more attractive. The Navy's robotics consortium embraces networkcentric warfare concepts, targeting drones before they reach the battlefield. The first counter-steps may be cyberbased. As mentioned, a handful of small UAV autopilot systems exist, and their operating systems are potentially vulnerable.

Detection and classification methods will be vital. Jiamdo asserts that the most challenging aspect of CUAS is "the ability of the Joint Force to acquire enough information for the warfighter to make a timely, accurate decision to negate a UAS threat."

The Naval Postgraduate School consortium apprises the secretary of the Navy of developments in UAV research and experimentation and evaluating concepts such as UAV swarms. "Swarms"—autonomously coordinated groups of small UAVs—exemplify the type of challenge traditional air defense systems are ill-suited to address: multiple, small targets potentially coming from points around the compass. They may appear on the ocean horizon, from over a ridge, behind a stand of trees or the opposite side of a wall. Relatively simple and inexpensive, they could potentially overwhelm, confuse and deceive military anti-air systems.

"Swarms offer robustness outside the capabilities of the single vehicle," Buettner points out. Destroying one or several may not thwart their mission, and their architecture is commercially available. Chinese autopilot systems are proliferating in the small vehicle market, he notes.

The consortium's swarm research supports a classified report known as Project Jason that is attempting to characterize the swarm threat from small attack UAVs such as Israel Aerospace Industries' Harpy.

The Army is pursuing a similar challenge with low-slow-small targets that may or may not swarm together. Low-slow-small UAS are hard to detect with radar, infrared or acoustic sensing. Although interception is highly feasible, it is complicated by the cost difference between high-end interceptors and low-cost UAVs.

Lockheed Martin presented multiple offerings during the Army's recent technical exchange. Lockheed spokesperson Melissa Hilliard would not offer specifics but says the company is offering concepts ranging from new technologies with emerging capabilities to new ways of employing existing products.

The Army's technical exchange also confirmed that a combined-arms approach will be vital for detecting as well as defeating CUAS. Radar detection is effective but it is not available at small unit levels nor widely dispersed. Other means of detection, such as passive ones like infrared or magnetic anomaly sensors, will be important. "It's a huge problem," Bramlett says, adding that micro UAS will be a challenge similar to improvised explosive devices.

Going Live

NATO's new command-and-control system is 15 years in the making, and Italy plans to be the initial user

Tony Osborne Poggio Renatico, Italy

Italy is working to become the first country to go operational with a new NATO computer system, which will streamline the alliance's command and control structure.

The Air Command & Control System, developed by Thales-Raytheon Systems, will not only provide a more advanced tool for operational planning but will also become the reference point for any future NATO theater-ballistic missile defense.

Fifteen years since contract award, Thales-Raytheon Systems is now in the final throes of testing the system at four sites in Belgium, France, Germany and Italy, as well as on two mobile systems, before replication in other NATO member countries. The Italian air force (AMI) believes it is ahead of the pack in introducing the Air Command & Control System (ACCS) into service, and commanders are optimistic about being able to provide an initial operating capability this December, with a full operational capability supporting the country's peacetime military air operations set to follow a year later.

The ACCS will replace the diverse command-and-control systems NATO members now use with a single architecture that can be replicated for all of the member states. The new systems has the benefit of reducing the training burden by potentially allowing for the cross-pollination of international personnel, who will be able to use the system in different countries without the need for extra training. NATO commanders are studying the possibility of establishing a training school to serve all the nations who opt for the ACCS. Other advantages include the ability of administrating one country's airspace from another country in the event of an emergency or natural disaster.

Italy has been eager to replace its current legacy Airborne Early-Warning Ground Environment Integrated Segment (Aegis) system, which integrates the country's various radar heads and air defense systems.

"We wanted to increase the functionality of the airpower to have additional capabilities, commonality, interfaces and standardization with other nations," says Col. Arturo Cattel, commander of the air force's radar coordination center, known as CCGRAM.

The system has been installed inside a command-and-control bunker at the joint AMI and NATO radar base at Poggio Renatico, a station that previously held the Combined Air Operations Center 5, the site from which Operation Unified Protector over Libya was coordinated.

In parallel with the current Aegis setup, the AMI began testing the ACCS using live feeds from Italian air force air defense radars, civil air traffic control radars and other sensors to see the "ACCS operational at a tactical level," says Cattel.

"We started with live interfaces," Cattel says. He notes they opted not to use simulation so that they could place their operators in a real environment to fully vet the system. As part of the tests, the air force connected approximately 50 live interfaces from ground to airborne radars to air defenses as well as to flight plans and metrological feeds to give operators an impression of how the system could operate at a tactical level.

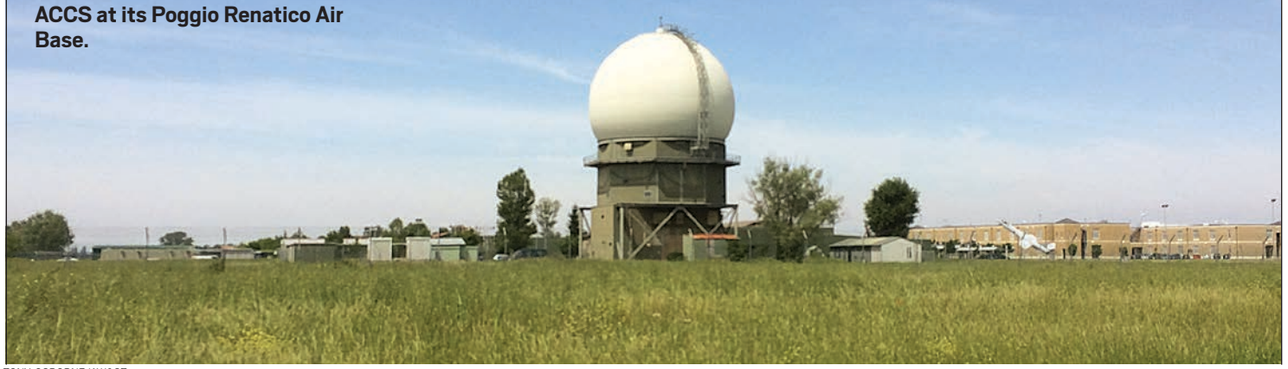
Germany is also planning to introduce the ACCS by the end of the year at its command-and-control site at Uedem, and work is underway on replicating the system at 10 more sites in some key NATO states—Norway, Poland, Spain and Turkey, among others. Newer NATO nations will follow later. Some countries will also necessitate the creation of backup sites, which for Italy will be Licola, near Naples.

When the backup sites are in place, the old command-and-control systems can be turned off.

ACCS will also serve as NATO's first building block toward the creation of a theater missile defense (TMD) system for the Alliance. An early build of the ACCS software known as InCa Spiral 1, which has a TMD element, was developed and installed for NATO at its facilities in Ramstein, Germany, in late 2012. It quickly proved itself useful when Turkey requested the deployment of Patriot batteries to its Syrian border over concerns about the use of ballistic missiles in the region.

"They had everything ready for when a real-life situation occurred," explained Ken Nesbitt, operational adviser on command-and-control and missile defense at Thales-RaytheonSystems. NATO is also in the process of modernizing deployable versions of the system. The Deployable Air Command and Control Center is essentially a mobile version of the ACCS, which is fitted into a series of internationally standardized containers that could be deployed anywhere in the world to support a major military operation or humanitarian mission.

Personnel are being trained on the equipment itself and on how to streamline the deployment processes, but NATO regards the requirement for a deployable command-and-control system as a top priority. Toward that end, commanders are hoping to achieve full operational capability by the end of this year with the ability to fully deploy within five days, should such an action be needed.



The Italian air force has installed ACCS at its Poggio Renatico Air Base.

TONY OSBORNE/AW&ST