

THE DRO

It's a small world after all.

UNTIL recently, conducting surveillance and delivering munitions from the air was the sole province of nation-state air forces. Now, anyone with a drone can do the same.

Over the last decade, drones—or unmanned aircraft systems—have become cheaper, more capable, easier to fly, and ubiquitous. Even hobby machines can pose a military threat. Combined Joint Task Force–Operation Inherent Resolve Commander Army Lt. Gen. Stephen J. Townsend said ISIS has made extensive use of drones to observe bases and deliver explosives.

“It’s not episodic or sporadic,” he said during a press briefing in October. “It’s relatively constant and creative.”

On one occasion, ISIS packed a drone with explosives and then detonated it after it was retrieved by coalition forces, killing four.

Speaking at the Unmanned Systems Defense forum in October, Air Force Brig. Gen. Brian M. Killough, the director of strategy, concepts, and assessments, said even though drones haven’t yet posed a major military threat, they can still degrade mission performance. He compared their effectiveness to Germany’s use of V-1 and V-2 rockets during World War II. Though “highly ineffective militarily,” the rockets were nevertheless “incredibly effective psychologically.” He likened drone assaults to mortar attacks on a forward operating base.

The Army had a more sobering assessment in a counter-unmanned aircraft system strategy extract that was released in October.

“Analysis of the future operational environment and recent military operations around the globe clearly illustrates the seriousness of the UAS threat,” the report states. “As technology has progressed, both reconnaissance and attack capabilities have matured to the point where UAS represent a significant threat to Army operations from both state and nonstate actors.”

Russia, for instance, has been honing its UAS capabilities and techniques since it saw Georgian forces effectively use drones for intelligence, surveillance, and reconnaissance during the 2008 war.

THE NEW WARS

By Will Skowronski, Senior Editor

To catch up, they implemented a massive development program that has paid off in the ongoing conflict in eastern Ukraine. There, Russian-backed separatists have used the latest UAS models—including Russia’s Orlan-10, Granat-1, and Takhion and others from Israel, France, and China—to spot and monitor artillery targets, the report notes. One analyst considered UAS-guided artillery to be “the most significant difference-maker in a conflict between otherwise equal forces.”

In short, ISIS isn’t the only threat. Deployed troops and platforms also aren’t the only vulnerabilities.

At AFA’s Air, Space & Cyber Conference in September, Air Force Global

Strike Command chief Gen. Robin Rand said UASs had flown in the US “over some of the areas that we don’t particularly like them being over.”

The threat will only grow. The Army report says that while between 80,000 and a half-million drones were operating in US airspace in 2016, some 700,000 new drones were expected to be sold by the end of that year.

Meanwhile, technology will make UASs smaller, cheaper, and more capable, Dan Stamm, Battelle’s manager for counter-UAS programs and coinventor of a drone jammer, told *Air Force Magazine*.

“This is one of the very rare cases that I can think of where our adversar-

TSgt. Benjamin Hawkingson hand-launches an RQ-11B Raven unmanned aircraft system at Vandenberg AFB, Calif. Raven is equipped with a video camera that streams live footage to an operator on the ground.

ies are able to directly leverage the development that is in the best interests of industry and commerce,” he said.

“In other words, everything that the drone manufacturers are doing to make their drones more appealing to commerce, to the market, is directly applicable to advancing the capability of the adversary: greater ranges, more robust communications, greater payloads, longer flight durations, just name it across the board—lighter, faster, better.”

The Army strategy extract states that small UASs are particularly difficult to defeat and “less effectively countered by existing integrated air and missile defense capabilities” due to their proliferation and low/slow profile. They typically have smaller radar cross sections, infrared signatures, and electromagnetic footprints.

Though the military has used small UASs and the larger remotely piloted aircraft (RPA) for decades, the Defense Department is playing catch-up on countering the new threat posed by small drones.

The Pentagon’s Joint Improvised-Threat Defeat Organization (JIDO)—the same group that developed counterimprovised explosive device capabilities—began following the drone threat in late 2013, but just began testing counter-drone technologies along with the Army Rapid Equipping Force last summer, a DOD spokeswoman

said by email. JIDO is planning a Hard Kill Challenge to assess counter-UAS threats this spring.

BRINGING DOWN ISIS DRONES

Combatants are receiving new capabilities. During an October briefing, Air Force Col. John L. Dorrian, spokesman for Combined Joint Task Force-Operation Inherent Resolve, said the DroneDefender—and other, unidentified advanced systems that can detect, identify, track, and defeat UAS threats—has supplemented the services’ in-theater capabilities.

Shortly after ISIS struck with its “Trojan Horse” drone, two Air Force remotely piloted vehicles brought down another ISIS drone that coalition forces spotted near Mosul, Iraq. Working together, the aircraft used electronic warfare capabilities to disable the drone in less than 15 minutes.

Air Force Secretary Deborah Lee James announced the successful downing during a Center for a New American Security event in October and called on the services’ rapid capabilities of-fice to come up with a solution to the “emerging danger.”

The answer is “not necessarily the development of a new thing to defeat it,” she said. “It could be taking what we’ve got already and packaging it in a different way to go after the threat. But we need to do that type of work rapidly.”

At about the same time, the Air Staff stood up a working group to come up with a comprehensive plan.

“The working group cuts across functional areas and commands to integrate the Air Force’s best experts who have been empowered to act rapidly so they can continue to outpace the evolution of the threat and quickly deliver capabilities to the warfighter,” service spokeswoman Erika Yepsen said in an email. “While our airmen downrange innovate and act to defeat threats as they evolve, this cross-functional working group will build a strategy to anticipate and defend against current and future small unmanned aircraft systems.”

In late October, the service released a request for proposal to acquire a portable drone defense system to protect AFGSC facilities. The RFP calls for a handheld device that must be able to disrupt or manage the radio frequency link between a commercial UAS and the pilot and be able to passively detect RF signatures to aid the user in detecting and locating UASs. The system should also be able to disrupt satellite navigation signals, the RFP said.

At the AFA conference, Rand said fielding any capability to protect US nuclear infrastructure will require extensive discussions between military commands, law enforcement agencies, and other federal agencies, including the Department of Energy. “These discussions are happening ... but, you



The Battelle DroneDefender jammer system disrupts UAS operations using remote control interference and GPS disruption.



USAF photo courtesy of Wight-Patterson AFB, Ohio

Airmen operate a Skate small unmanned aircraft system during field testing. The small aircraft offers real-time video streaming and infrared imagery. The Air Force is playing catch-up in this area, but is expected to put more emphasis on developing and fielding SUASs soon.

from either a proficiency or sufficiency standpoint, defeat the UAS threat.”

Stamm said he and Alex Morrow, co-inventor of the DroneDefender jammer, considered a number of ideas, including the use of kinetic solutions—lasers, nets, even trained falcons—before settling on the jamming used by Battelle for its ease of use and safety. Any hard kill option, he said, causes the drones to fall out of the sky, risking injury or damage on whoever or whatever is below it.

know, it’s not easy,” Rand said. “You have to be very judicious and prudent about how you apply changes.”

Neither the service or JIDO provided additional details on their counter-UAS efforts. In its report, the Army says more advanced sensors are needed so troops can reliably detect small UASs. The report suggests advanced identification technology should be used to enable forces to distinguish between friendly and adversary drones. To defeat the threat, the report calls for the integration of joint capabilities to destroy drones before and after they’re launched using both kinetic and nonkinetic means.

“There is no single, comprehensive materiel solution that will make the UAS problem disappear,” the Army report states, nor is there is an Army, joint, or multinational capability “that can,

M’raj Islamic News Agency



Kurdish Peshmerga forces with an ISIS drone shot down in March 2016 near Mosul, Iraq. The drone was used to observe and photograph Peshmerga troop positions.

DroneDefender resembles a rifle but with two antennas in place of a barrel. It allows the user to disable commercially available drones from up to about 400 yards away by severing the command and control link between the pilot and UAS, using complex disruption waveforms.

Once the link is broken, commercial drones will revert to a lost-link protocol. Generally, there are three: hover in place, land in place, or return



Pieces of a Hezbollah drone shot down by the Israeli air force in 2006.

Israeli Air Defense Forces photo

to the point of origin. A secondary DroneDefender capability can disrupt GPS signals, preventing the UAS from flying a waypoint mission or returning to its point of origin.

Stamm said interest in the DroneDefender has spiked alongside the recognized threat level.

“We have seen that shift just in the last few years, from kind of what is perceived as possibly harmless—or less harmful for sure—to, ‘Holy cow, this is now a really cheap guided weapon,’” he said.

Since booking the first sale in early 2016, Battelle has sold 105 units to the Defense Department, Department of Homeland Security, and foreign militaries. Stamm said Battelle is developing expanded, larger, more capable jamming systems and is looking into other spaces along the counter-UAS response spectrum: detection, identification, tracking, and defeat.

The Russian-backed rebels in eastern Ukraine have proved adept at bringing down drones through a variety of means. The Army Counter-UAS strategy extract says the Russians have used electronic warfare systems to “effectively neutralize Ukrainian UAS.” They’ve also grounded long-range surveillance aircraft controlled by the Organization for Security and Cooperation in Europe, the group tasked with monitoring the often-ignored cease-fire there. The OSCE report suggests several long-range drones have been disabled through a mix of surface-to-air missiles and signal jamming.

As potential adversaries pursue counter-UAS technologies, the US military

will need to develop means for its RPAs to defend themselves.

The Air Force employs a mix of larger RPAs—the MQ-1 Predator, MQ-9 Reaper, RQ-4 Global Hawk, and stealthy RQ-170 Sentinel—and small UASs, including the RQ-11B Raven, RQ-20A Puma AE, Wasp III, and RQ-12A Wasp AE.

Until recently, USAF has used small UASs for limited tactical objectives, but the service’s “Small Unmanned Aircraft Systems (SUAS) Flight Plan: 2016-2036,” released last May, suggested the small drones can play a much larger role.

FOCUS ON THE FAMILY

“This intersection of unmanned technology maturation with widespread industry innovation” will drive the rapid advancement of a cheap, effective “family” of small UASs “focused on traditional Air Force roles and missions,” the report states. In spite of this, “the Air Force finds itself behind the power curve, having forgone the opportunity to embrace and operationalize these developments through a dedicated acquisition program, let alone an independent line of funding. We have reached the point where SUAS applications are greatly outpacing strategy and policy.”

The flight plan says small UASs will soon be capable of functions such as counter-UAS operations, security for large or strategic complexes, and even enhancement of anti-access, area-denial environments.

At the Unmanned Systems Defense forum in October, USAF Col. Brandon

E. Baker, director of remotely piloted aircraft capabilities, said the development of technologies—including the areas of command and control, antenna and sensor miniaturization, processing power, and power capacity—will allow the service to employ small UASs globally.

“We anticipate we’re going to be able to miniaturize more and more so that one day, we can—no kidding—darken the skies and apply mass against an enemy,” he said. “That overwhelming mass has made us successful as a military as long as we’ve existed.”

Baker said deploying large numbers of SUASs at one time is a protection in itself, but the service is also working to ensure communication links and reduce latency to allow its SUASs to operate in highly contested environments. Baker said such measures could include the use of new waveforms, aerial layer networking, and cognitive autonomy. The service’s SUAS flight plan calls for requirements to ensure sufficient data encryption and anti-jamming technology.

UASs need to be able to operate untethered to a network in case those are disabled, Baker said.

“I don’t want it to be a Hollywood movie, where if you can defeat the network, everything just drops out of the sky. That’s not going to make a lot of sense for us,” Baker asserted. “The platforms have to have a certain level of cognition: ... the ability to sense the environment, learn from the environment, and then make decisions.” ✪

A contractor recovers a Scan Eagle small unmanned aircraft system after a mission for Operation Inherent Resolve in Iraq. Advancing technology is making the UASs smaller, cheaper, more capable—and more dangerous in enemy hands.



USAF photo by SrA. Jordan Castelan