
# Unmanned Systems Sentinel

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## NAVY/USMC:

### Unmanned Systems: A New Era for the U.S. Navy

The U.S. Navy's Unmanned Systems Directorate, or N99, was formally stood up this past September with the focused mission of quickly assessing emerging technologies and applying them to unmanned platforms. The Director of Unmanned Warfare Systems is Rear Adm. Robert Girrier, who was recently interviewed by Scout Warrior, and outlined a new, evolving Navy Drone Strategy.

The idea is to capitalize upon the accelerating speed of computer processing and rapid improvements in the development of autonomy-increasing algorithms; this will allow unmanned systems to quickly operate with an improved level of autonomy, function together as part of an integrated network, and more quickly perform a wider range of functions without needing every individual task controlled by humans. "We aim to harness these technologies. In the next five years or so we are going to try to move from human operated systems to ones that are less dependent on people. Technology is going to enable increased autonomy," Admiral Girrier told Scout Warrior.

Forward, into Autonomy

Although aerial drones have taken off a lot faster than their maritime and ground-based equivalent, there are some signs that the use of naval drones - especially underwater - is about to take a leap forward. As recently as February this year, U.S. Defense Secretary Ash Carter announced that the Pentagon plans to spend $600 million over the next five years on the development of unmanned underwater systems. DARPA (the Defense Advanced Research Projects Agency) recently announced that the Navy's newest risk taker is an "unmanned ship that can cross the Pacific."

Called the Sea Hunter, the vessel is a demonstrator version of an unmanned ship that will run autonomously for 60 - 80 days at a time. Known officially as the Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV), the program started in 2010, when the defense innovations lab decided to look at what could be done with a large unmanned surface vessel and came up with submarine tracking and trailing. "It is really a mixture of manned-unmanned fleet," said program manager Scott Littlefield. The big challenge was not related to programming the ship for missions. Rather, it was more basic - making an automated vessel at sea capable of driving safely. DARPA had to be certain the ship would not only avoid a collision on the open seas, but obey protocol for doing so.

As further evidence of the Navy's progress toward computer-driven drones, the Navy and General Dynamics Electric Boat are testing a prototype of a system called the Universal Launch and Recovery Module that would allow the launch and recovery of unmanned underwater vehicles from the missile tube of a submarine. The Navy is also working with platforms designed to collect oceanographic and hydrographic information and is operating a small, hand-launched drone called "Puma" to provide over-the-horizon surveillance for surface platforms.

Both DARPA and the Office of Naval Research also continue to create more sophisticated Unmanned Aircraft Systems. DARPA recently awarded Phase 2 system integration contracts for its CODE (Collaborative Operations in Denied Environment) program to help the U.S. military's unmanned aircraft systems (UAS) conduct dynamic, long-distance engagements against highly mobile ground and maritime targets in denied or contested electromagnetic airspace, all while reducing required communication bandwidth and cognitive burden on human supervisors.

CODE's main objective is to develop and demonstrate the value of collective autonomy, in which UAS could perform sophisticated tasks, both individually and in teams under the supervision of a single human mission commander. The ONR LOCUST Program allows UAVs (Unmanned Aerial Vehicles) to stay in formation with little human control. At a recent demonstration, a single human controller was able to operate up to 32 UAVs.

The Networked Machine.

The principle by which individual UAVs are able to stay in formation with little human control is based on a concept called "swarm intelligence," which refers to the collective behavior of decentralized, self-organized systems, as introduced by Norbert Wiener in his book, Cybernetics. Building on behavioral models of animal cultures such as the synchronous flocking of birds, he postulated that "self-organization" is a process by which machines - and, by analogy, humans - learn by adapting to their environment.

Self-organization refers to the emergence of higher-level properties and behaviors of a system that originate from the collective dynamics of that system's components but are not found in nor are directly deducible from the lower-level properties of the system. Emergent properties are properties of the whole that are not possessed by any of the individual parts making up that whole. The parts act locally on local information and global order emerges without any need for external control. In short, the whole is truly greater than the sum of its parts.

There is also a relatively new concept called "artificial swarm intelligence," in which there have been attempts to develop human swarms using the internet to achieve a collective, synchronous wisdom that outperforms individual members of the swarm. Still in its infancy, the concept offers another approach to the increasing vulnerability of centralized command and control systems.

Perhaps more importantly, the concept may also allay increasing concerns about the potential dangers of artificial intelligence without a human in the loop. A team of Naval Postgraduate researchers are currently exploring a concept of "network optional warfare" and proposing technologies to create a "mesh network" for independent SAG tactical operations with designated command and control.

Adm. Girrier was quick to point out that the strategy - aimed primarily at enabling submarines, surface ships, and some land-based operations to take advantage of fast-emerging computer technologies - was by no means intended to replace humans. Rather, it aims to leverage human perception and cognitive ability to operate multiple drones while functioning in a command and control capacity. In the opinion of this author, a major issue to be resolved in optimizing humans and machines working together is the obstacle of "information overload" for the human.

Captain Wayne P. Hughes Jr, U.S. Navy (Ret.), a professor in the Department of Operations Research at the Naval Postgraduate School, has already noted the important trend in "scouting" (or ISR) effectiveness. In his opinion, processing information has become a greater challenge than collecting it. Thus, the emphasis must be shifted from the gathering and delivery of information to the fusion and interpretation of information. According to CAPT Hughes, "the current trend is a shift of emphasis from the means of scouting.to the fusion and interpretation of massive amounts of information into an essence on which commanders may decide and act."

Leaders of the Surface Navy continue to lay the intellectual groundwork for Distributed Lethality - defined as a tactical shift to re-organize and re-equip the surface fleet by grouping ships into small Surface Action Groups (SAGs) and increasing their complement of anti-ship weapons. This may be an opportune time to introduce the concept of swarm intelligence for decentralized command and control. Technologies could still be developed to centralize the control of multiple SAGs designed to counter adversaries in an A2/AD environment. But swarm intelligence technologies could also be used in which small surface combatants would each act locally on local information, with systemic order "emerging" from their collective dynamics.

Conclusion

Yes, technology is going to enable increased autonomy, as noted by Adm. Girrier in his interview with Scout Warrior. But as he said, it will be critical to keep the human in the loop and to focus on optimizing how humans and machines can better work together. While noting that decisions about the use of lethal force with unmanned systems will, according to Pentagon doctrine, be made by human beings in a command and control capacity, we must be assured that global order will continue to emerge with humans in control.

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**http://cimsec.org/unmanned-systems-new-era-u-s-navy/26256**

**http://www.maritime-executive.com/editorials/new-us-navy-directorate-aims-for-unmanned-warfare**

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### ONR Plans Unmanned Vehicle Swarm Demonstrations

ARLINGTON, Va. — The U.S. Navy will conduct two technology demonstrations of swarming unmanned vehicles over the next nine weeks, the chief of naval research said. The demonstrations in July and September will feature unmanned aerial vehicles (UAVs) and unmanned surface vehicles (USVs), respectively.

The demonstration during the last week of July will feature the LOCUST (Low-Cost UAV Swarming Technology) that was demonstrated in 2014, said Rear Adm. Mathias W. Winter, chief of naval research and director, Innovation Technology Requirements, and Test & Evaluation for the Office of the Chief of Naval Operations.

The LOCUST includes a tube launcher that can launch multiple UAVs in rapid succession. An information-sharing data link between the UAVs enables autonomous collaboration among the UAVs. The swarm of UAVs can be used for offensive or defensive missions to overwhelm the capabilities of enemy platforms.

“Next week, down in the Gulf of Mexico, we will be launching 30 UAVs within two minutes and they will be forming up, flying, engaged,” Winter said. “That demonstration has been stair-stepped five, 10, 10, 10, 30 [UAVs]. We put that together not haphazardly.

“We’re able to bring in UAVs in flocks of 30, and then have four break off and go do something and come back,” he said.

Winter said the science behind swarming — “the intelligent algorithms and the ability to communicate, sense and avoid, re-group and separate”— is domain-agnostic.

“We take that learning and bring it into the surface domain. We’re going to be doing a surface swarming demonstration in September,” he said.

Winter said the Office of Naval Research is building up toward demonstration of domain-agnostic combinations in swarming vehicles.

“In the next demonstration, I want a UUV [unmanned underwater vehicle], USV and UAV swarming together,” he said. “We want to understand: is that technically feasible? The answer to that is yes.”

**http://www.seapowermagazine.org/stories/20160722-swarm.html**

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### Navy’s Future Submarines May Go to Sea with Robot Remoras

When Rear Adm. Michael Jabaley imagines the attack submarines of the future and how they’ll team with underwater drones, he pictures sharks — and the remora fish attached to them.

The remora, which uses its suction-cup head to catch rides with large marine animals, suggests there’s a new and better way for subs and unmanned undersea vehicles to work together, said Jabaley, the U.S. Navy’s program executive officer for submarines

“Everything we have done to date has been through repurposing of an existing interface between the submarine and the ocean,” he said at a recent talk at the Center for Strategic and International Studies. “We’ve used torpedo tubes, we’ve used signal ejectors, we’ve used the dry-deck shelter, we’ve even used the trash ejector as a way to get the payload out of the submarine and deploy it.”

The admiral is looking ahead to the class of attack submarines that will follow the Virginias, which were designed in the 1990s and whose first ship launched in 2003. The next class of SSNs would be redesigned “from the ground up [and] would seamlessly integrate UUVs,” possibly in a biomimetic fashion.

“The dream, actually, would be if you’ve ever seen a remora,” Jabaley said. “Those are the little fish that suck onto the big fish and go along, and seem to not affect the big fish at all, ride in the stream, and then when it’s time for them to go off and do something, they do, and then they come back. That’s forward-thinking. It’s different from anything we’ve done.”

The Navy’s current, jury-rigged way of using of UUVs is part of a broader trend within the military, as services circumvent the oft-protracted acquisition process by finding creative new uses for systems they already have. But it’s also a specific function of the United States' asymmetric advantage at sea, according to Peter Singer, an author and strategist at the New America Foundation.

“We’re just now scratching the surface in terms of what kind of robotics we can use, how many we might have, and how we can use them — in all the different domains, but particularly in undersea weapons,” Singer said. “One of the forcing mechanisms that leads to change is actual battlefield use. You can see that in the Middle East: Unfortunately, the challenge of IEDs is what had a forcing mechanism for ground robotics.”

The Navy, thus far, has been fortunate not to face that “forcing function of battle,” he said.

There’s also another decade and half of Virginia-class SSNs still to be built, not to mention the nuclear missile-launching Ohio-class replacements scheduled to start procurement in fiscal year 2021. When the

Navy does start thinking seriously about designing and generating the requirements for the next class of attack submarines, UUV integration will be just one of a myriad technological innovations, biomimetic or otherwise.

“If you look in nature, there are no fish designed around being long tubes with propellers behind them,” Singer said. “But you can also do things that you don’t even see in nature. You could litter the sea floor with batteries … and robotics would be able to go and charge on them.”

**http://www.nextgov.com/defense/2016/07/navys-future-submarines-may-go-sea-robot-remoras/129984/?oref=nextgov_today_nl**

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### Navy taking domain-agnostic approach to unmanned systems

The Navy is taking a domain-agnostic approach on unmanned systems and is even creating an undersecretary position for unmanned systems and an unmanned warfare systems directorate (N99) within the Navy Headquarters staff. The chief of naval research expressed similar sentiments recently to the effect that naval forces could develop simultaneous cross-domain swarms.

“I want an [unmanned undersea vehicle], [unmanned surface vehicle] and [an unmanned aerial vehicle] swarming together,” said Rear Admiral Mat Winter, Chief of Naval Research, at the Center for Strategic and International Studies on July 22. “We want to understand is that technically feasible? The answer to that is yes.”

To get there, Winter described a series of demonstrations — both upcoming and in the recent past — that have tested swarming technologies. Swarming technology — the act of overwhelming a target with a mass of vehicles, in any domain — aims to help solve the anti-access area denial environments developed by adversaries.

One such demonstrator program the Navy is testing is the Low Cost Unmanned Swarming Technology, or LOCUST. “My LOCUST program is truly maturing ... the algorithms to be able to maneuver individual vehicles in a complete concert, single organism type of domain and be able to break off and send and go do something, engage, sense, what have you, come back,” Winter told reporters following his remarks. “While meanwhile the communications, not only between, but then out because this is a capability, it’s a sensor, it’s a battlespace capability that we want to be able to utilize for overwhelming adversaries RF spectrum but also be able to provide communication and information back to our commanders.”

These algorithms that are developed can be applied across all the Navy’s operational domains of warfare, he said. “The UAV, which is just a USB stick, that’s not the science. The science is the intelligent algorithms and the ability to communicate, sense and avoid, regroup and separate. And that is domain-agnostic,” he added. “It’s for an application, but we have to continue to look how we can go across all domains.”

"We need to get out of this paradigm of domain that only aviators can talk about unmanned aviation systems. And that only submariners can talk about things that dwell underneath the water," Frank Kelley, deputy assistant secretary of the Navy for unmanned systems, said at the Sea-Air-Space conference on May 17. The Navy's director of unmanned warfare systems, OPNAV N-99, Rear Adm. Robert Girrier, said the service is looking to a systems of systems approach that doesn't just focus on one domain but rather a "general connectedness" approach. This connectedness, "accessing one domain and using it to help unlock another," can help the service start thinking in the larger framework of unlocking contested areas, he said at Sea-Air-Space.

Winter noted surface demonstrations that are testing these concepts in September. In fact, the Navy conducted a demonstration in 2014 on the James River that saw several surface vessels swarm a potentially threatening maritime asset. Winter said future concepts following these demonstrations will include multiple swarming boats to establish a perimeter, some breaking off to engage an adversary, then coming back to the formation — all with a human in the loop.

The Anti-Submarine Warfare Continuous Trail Unmanned Vessel, or ACTUV, recently redubbed Sea Hunter, was christened this spring. Winter told reporters following his remarks that ACTUV is still shared between the Defense Advanced Research Projects Agency and ONR, though DARPA will be looking to transfer it to the service soon.

One of the next steps is to apply these algorithms, technologies and concepts to the undersea domain with UUVs, which is more difficult than on the surface or in the air. "We understand the topography well enough but we're demonstrating, [and it's] still [in] experimentation," Winter said.

**http://www.c4isrnet.com/story/military-tech/uas/2016/07/26/navy-domain-agnostic-approach-unmanned-systems/87527600/?utm_source=Sailthru&utm_medium=email&utm_campaign=DB%200727&utm_term=Editorial%20-%20Daily%20Brief**

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## ARMY:

### 25th Combat Aviation Brigade Unmanned Aircraft Systems Forum

Assignment to Hawaii offers many special training opportunities that can only be found in these uniqueislands. The training area also presents significant challenges. This is especially true with respect to unmanned aircraft system (UAS) operations. Although most UAS units share difficulties with accessing training airspace, Hawaii is very confined from both the ground and airspace perspective. As more UAS units are assigned on the island of Oahu, additional stress will be added to the already claustrophobic conditions. In an attempt to understand and find solutions that would benefit all stakeholders, the Commander, 25th Combat Aviation Brigade (CAB) directed the brigade to host a UAS forum in December 2015. The forum hosted representatives from the RQ-7B Shadow UAS Program Manager, U.S. Army Garrison Hawaii master planning, brigade combat team (BCT) UAS leaders, Training and Doctrine

Command Capabilities Manager-UAS (TCM-UAS), Federal Aviation Administration (FAA), U.S. Army Pacific Aviation Resource Management Survey (ARMS), and U.S. Marine UAS units from Marine Corps Air Base, Kaneohe. Classes and topics of discussion centered on core aviation issues to include airspace, safety, standardization, maintenance, facilities, and Aviation Resource Management Surveys. The overall purpose of the forum was to facilitate the synchronization and optimization of both the ground and airspace required to maximize UAS operations in Hawaii for all joint partners while hosting discussions on topics relevant to leaders of UAS units. Just as importantly, the forum provided a foundation and a starting point from which all stakeholders can begin to prioritize and address both internal and external operational challenges.

Airspace

In order for UAS units and operators to train, they must have airspace in which to fly. This challenge is not unique to UAS units across the national airspace. Available airspace for flight training is extremely scarce and approval for UAS operations is a tedious process. To complicate matters in Hawaii, the main joint range complex is located on the island of Hawaii, over 200 miles away from Oahu. This proves to be an expensive option for flight training and can only be scheduled certain times of the year. On the island of Oahu, the challenge is not only a lack of available airspace for training but also the juxtaposition of the Honolulu Class B airspace. Couple these with an extremely cramped airfield that is home to 25th CAB assets and a Hawaii Army National Guard general support aviation battalion and the ability to operate UAS diminishes further. While restricted airspace exists next to Wheeler Army Airfield (WAAF), only two UAS can fly at a time and only when air traffic control services are available. The challenge is getting UAS operators the flying time they need to meet aircrew training program requirements.

With two 25th Infantry Division (ID) BCT UAS platoons, a Marine UAS unit, and an incoming 25th CAB Shadow UAS companyassigned to the cavalry squadron, airspace availability for the individual operator is at a premium. The long term solution to this dilemma is to try and expand the usable airspace for UAS operations. Coordination has already begun with the Department of the Army Representative to the FAA – Western Service Area to begin negotiations with the FAA to create an altitude based restricted area with an attached corridor from WAAF. It is well understood that this will take a significant amount of time, patience, persistence, savvy, and likely a good deal of compromise to achieve success. In the short term, all aviation units utilizing WAAF and the adjacent restricted airspace will need to synchronize schedules and times. Equally important, the air traffic control facilities will need to be flexible in their operating times when inclement weather trends prevent UAS operations.

Safety and Standardization

The most significant role that the 25th CAB offers is assistance with safety and standardization programs within the 25th ID BCT Shadow platoons - this initiative conducted in accordance with the Forces Command, Command Training Guidance for Fiscal Year 2016. Historically, BCT UAS platoons have struggled with these programs simply because they do not have oversight from a knowledgeable aviation headquarters. As with most CABs across the Army, the 25th CAB is partnering with the platoons

to assist. The 25th CAB is helping them with the core aviation programs as well as providing insights into their most difficult problems.

With regard to safety programs, the BCT platoons have to train Soldiers as safety officers. This is an additional duty for the BCT Soldier who still has military occupational skill requirements in his assigned job within the unit. The safety officer skillset becomes more of an issue as the Soldier moves on to increased responsibilities within the unit or changes duty stations. One solution we have suggested, is for the 25th ID BCT platoons to adopt the 25th CAB Safety and Standardization Standing Operating Procedures and our Mission Risk Assessment Worksheet. This would ameliorate issues with continuity, standardize programs, and standardize risk management across both BCTs and the CAB. Additionally, we have invited UAS platoon leadership in both BCTs to participate in the 25th CAB Command Safety Council where their safety and standardization issues can be addressed.

The 25th ID BCT Shadow platoons have demonstrated difficulty in properly managing flight records. The 25th CAB and BCTs have coordinated for the installation of the Centralized Aviation Flight Records System (CAFRS) onto the BCT UAS platoon's computers. Additionally, they will be integrated into the 25th CAB's CAFRS server to provide the ability for back-up services and synchronization with the CAFRS national server at Redstone Arsenal. Integrating the BCTs into CAFRS also allows the brigade standardization section to monitor, inspect records, and assist with flight records management on any computer with CAFRS installed.

Maintenance

Maintenance was a topic of significant discussion during the safety, ARMS, and maintenance presentations. Accident research through the risk management information system conducted by the 25th CAB Aviation Safety Officer revealed telling problems with component failure. Over a five year period from 2011 through 2015, known component failures accounted for over 70% of the Class D through B UAS accidents. As required by Department of the Army Pamphlet 738-751, Functional User's Manual for the Army Maintenance Management System - Aviation, component failures require a Product Quality Deficiency Report be sent to the Aviation and Missile Command (AMCOM), Communications-Electronics Command (CECOM), and Tank Automotive Command (TACOM) to recommend corrections and improvements to aircraft, UAS subsystems, and aviation mission equipment. This report additionally serves to alert AMCOM/CECOM/TACOM to problems encountered by units due to the receipt of defective equipment. The 25th BCTs did not know about these reporting requirements. It can be assumed that this is systemic across the Army Aviation UAS community. The cost of unmanned aircraft is rising significantly and the acceptance of component failure can no longer be tolerated as normal. The 25th CAB and BCTs must monitor known component failures and ensure proper maintenance reports are completed.

The Unmanned Aircraft System – Interactive system for maintenance tracking and documenting UAS repair parts is vastly different from the Unit Level Logistics System-Aviation (ULLS-A) used in Army Aviation. Although tracking differences can be overcome, the primary issue is the ordering of parts. An estimated 90% of Shadow parts must be ordered through the Field Service Representative (FSR) because

the parts are not in the Federal Logistics Data (FEDLOG) system. This system functions until a UAS unit deploys. Since there is only one FSR in Hawaii, it is unlikely he will travel with the deploying unit. Also, since there is no technical supply system for the BCT Shadow platoons to assist in tracking and receiving parts, the remaining 10% of parts must be ordered from unit supply which is an extremely slow method of procurement. Understanding the hurdles involved, we are recommending that UAS maintenance be brought under the ULLS-A and that UAS repair parts be registered in the FEDLOG system.

To summarize, many of the issues mentioned in the previous paragraphs associated with safety, standardization, and maintenance are a result of the observations stemming from two 25th ID BCT UAS platoon ARMS. The 25th CAB fully embraces its oversight role as a trusted sponsor and takes responsibility to help improve the 25th BCT UAS programs through a permanent partnership. This forum was received with enthusiasm and fulfilled the expectations of all the participants. We now have a unique opportunity to shape and influence UAS operations, management, and leadership. We also have the distinct responsibility as a branch to leverage our knowledge and experience to coach, teach, and mentor UAS junior officers, warrant officers, and non-commissioned officers who will eventually be the future leaders in the Aviation Branch. That means we have to be inclusive, innovative, and most importantly, unafraid of change so that the support we provide and the trust we have earned from the Soldier on the ground may remain unbroken.

CW5 Matt V. Fitter is the 25th Combat Aviation Brigade Aviation Safety Officer, Wheeler Army Airfield, Hawaii. CW5 Fitter's previous assignments include troop aviation safety officer; squadron aviation safety officer; Cavalry/Attack and Assault Observer/Coach/Trainer at the Joint Multinational Readiness Center, Hohenfels, Germany; and brigade aviation safety officer. He has completed two deployments to Iraq and one to Afghanistan. CW5 Fitter has served in the Army for 24 years with 23 years in Army Aviation. He is qualified in the UH-1H, the OH-58 A/C/D, and the UH-60M.

**http://www.rucker.army.mil/aviationdigest/articles/article8_artcl_v11.pdf**

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### U.S. Army Evaluates One of a New Breed of Tethered Drones

The U.S. Army will evaluate a tethered six-rotor drone capable of streaming high-definition video from up to 400 feet above ground level for days at a time. The CyPhy Works' Persistent Aerial Reconnaissance and Communications (PARC) System is one of a new breed of small drones designed to provide "persistent" overhead security and surveillance capabilities.

CyPhy Works, based in Danvers, Mass., announced on July 18 that it has received an order for the PARC system from the Army's Rapid Equipping Force (REF). Established in 2002 as a quick-reaction capability, the REF works with Army units to "identify urgent capability gaps and provide non-standard equipment solutions." The organization reports to the Army's Training and Doctrine Command; it maintains a forward presence in Iraq, Afghanistan and Kuwait.

The PARC system consists of a ground control station and a hex-rotor fitted with a gyro-stabilized electro-optical/infrared camera payload. The air vehicle is powered from the ground using CyPhy Works' patented micro-filament tether, which also supports "unbroken" high-definition video delivery and aircraft command and control.

The system was designed to meet military force protection and intelligence, surveillance and reconnaissance (ISR) requirements in the field. It also has commercial applications for facility and event security, communications and overhead inspection.

"The REF procured a system to help assess possible solutions to a validated requirement we received from a deployed unit," Lt. Col. Scott Schumacher stated in the announcement. "The intent is to assess and understand new technology in the realm of persistent, elevated ISR."

Also in July, Drone Aviation Corp., of Jacksonville, Fla., unveiled its new "Bolt" tethered drone at the Warrior Expo East event in Virginia Beach, Va. A small coaxial-rotor helicopter, Bolt operates at altitudes of up to 800 feet and has a centerline universal payload bay that supports radio, signals intelligence and ISR packages up to 15 pounds and requiring as much as 1 kilowatt of power.

At the Special Operations Forces Industry Conference in Tampa, Fla., in May, small unmanned aircraft systems manufacturer AeroVironment announced that the U.S. Combating Terrorism Technical Support Office (CTTSO) was evaluating its "Tether Eye" system. Tether Eye is a quad-copter that deploys automatically from a self-contained base station and ascends up to 150 feet above its launch point to provide day and night imagery and full-motion video to a ground station.

"Having the ability to deploy a 'virtual observation tower' at a moment's notice above buildings and vehicles represents a game-changing capability for ISR and security operations that has the potential to save lives," stated Amanda Toman, CTTSO program manager. "We look forward to continuing our evaluation of Tether Eye's capabilities with AeroVironment as a possible deployable capability across government facilities."

**https://www.ainonline.com/aviation-news/defense/2016-07-25/us-army-evaluates-one-new-breed-tethered-drones**

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### New Army secretary makes fire, watches robots on first Pacific tour

SCHOFIELD BARRCKS, Hawaii — From robots to rubbing two sticks together for fire, Secretary of the Army Eric K. Fanning kicked off his first tour of the Pacific on Tuesday with demonstrations of the service's high-tech and basic jungle know-how.

Fanning, who took over the position in May, visited the 25th Infantry Division's Lightning Academy jungle training, where he tried his hand at starting a fire with a 9-volt battery and steel wool, hoisting a heavy litter up a hillside and scrambling across a rope line.

He also visited demonstrations of a half-dozen robot prototypes from the Army's Pacific Manned-Unmanned Initiative, or PACMAN-I.

Several of the robots looked like miniaturized tanks and could be used for gear transportation, surveillance or remote-controlled weapons. Others were small flying drones.

For example, the payloads on the 600-pound MUTT — Multi-Utility Tactical Transport — could be swapped out depending upon mission. During the demonstration, it sported a remote-controlled M2 .50-caliber gun.

"As we focus on trying to make sure we're prepared for increasingly creative adversaries and emergent threats, we need to make sure we're fielding new technology as quickly as we can," Fanning told reporters after the demonstrations.

There are two important elements to dealing with emerging threats, he said, starting with building and procuring the right technology.

"But the second is actually getting it into the field; getting it into the hands of soldiers," he said. "What's great about PACMAN today is, we did that. We took these new things and we gave them to soldiers and we had them exercise with them and give us their feedback on what they think is best, how they'd improve it, how they'd use it. There was clearly a lot of excitement out there."

The idea of PACMAN-I originated with former U.S. Army Pacific commander Gen. Vincent Brooks, said Drew Downing, a technology adviser with USARPAC.

"His theme was that we'd spent that past 15 years developing great equipment for the soldiers, but primarily for Afghanistan and Iraq," he said. "Then in 2013 we had the pivot to the Pacific, and he was concerned that a lot of the initiatives for concepts and capabilities were more focused on that region rather than the Pacific."

Among those PACMAN-I robots is a GPS-guided helicopter about the size of a wren called the Black Hornet 2. Built with several high-definition cameras inside, the device was being tested at the squad and platoon level for pinpoint surveillance.

"In the air, about 20 meters over your head, it looks like nothing more than a hummingbird," Staff Sgt. Brock Roe said. "And there's no sound disruption. This is so quiet that we can hover about 10 feet over your head and you'd never even know it's there."

"We are focused in the Army getting back to full-spectrum training, training for all sorts of different fights," he said. "That was clearly evident by the jungle training today."

The Army is a "critical part" of the Pacific region's missile defense, Fanning said.

His next stop is Guam, where he will tour the Terminal High-Altitude Area Defense, or THAAD, installation, which is intended to defend against North Korean missiles. He said it will be the first time

he's seen the advanced missile defense system, a version of which will be deployed to South Korea by the end of next year.

"We can only get at an increasingly creative adversary — a number of different adversaries — if we think more jointly and more creatively," he said, noting that the ongoing Rim of the Pacific exercise in Hawaii demonstrated that Army helicopters could be used in new ways, including shooting air-to-ship missiles.

**http://www.stripes.com/news/new-army-secretary-makes-fire-watches-robots-on-first-pacific-tour-1.421109?utm_source=Sailthru&utm_medium=email&utm_campaign=Defense%20EBB%2007-27-16&utm_term=Editorial%20-%20Early%20Bird%20Brief**

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## USAF:

### Engineering professor developing mind-controlled drones for Air Force

**Future of robotic warfare could be nigh.**

An engineering professor at Arizona State University is developing technology that would allow an Air Force pilot to control an entire fleet of drones using his mind.

Panagiotis Artemiadis runs the university's Human-Oriented Robotics and Control Lab, where researchers seek to understand and improve interactions between humans and robots. The lab was awarded grants totaling $860,000 from the Defense Advanced Research Projects Agency and U.S. Air Force in 2014 to build out the mind-control technology.

"Ten or 20 years from now, instead of having big expensive aircraft or drones, you can have hundreds or thousands of inexpensive ones you deploy in an area," Artemiadis said. "Even if you lose half of them, you can still achieve your goals."

And those drones can be controlled, at least in part, with the human mind, he said. The pilot wears what looks like a high-tech swimmer's cap, equipped with 128 electrodes that detect brainwaves. The electrodes identify where thoughts originate in the brain and determine the pilot's intended commands, and then those commands are communicated to the robots via Bluetooth.

A pilot can instruct a cluster of flying drones or terrestrial vehicles to move in a certain direction, spread out over a larger area, or circle around a specific target. To date, one subject has been able to control as many as four drones inside of the lab, Artemiadis said. The project will soon move to a 5,000-square-foot facility where researchers hope to increase that number to 20 and eventually into the hundreds.

"It's a matter of getting good signals with cheap and portable electrodes. Once you have this, you can definitely do this outdoors if you want," Artemiadis said.

Before you picture X-Men-style warfare, Artemiadis said he does not expect mind control to completely replace pilots' joysticks and computers -- at least for the time being. Controlling robots completely with one's mind requires a high degree of concentration that may be difficult to conjure on the battlefield.

But Artemiadis added there ultimately may be applications beyond defense, such as humanitarian aid distribution, package delivery, or search and rescue operations.

"We are adding more degrees of freedom and more capabilities," he said.

**http://www.stripes.com/news/air-force/engineering-professor-developing-mind-controlled-drones-for-air-force-1.419043?utm_source=Sailthru&utm_medium=email&utm_campaign=DFN%20EBB%207.15.16&utm_term=Editorial%20-%20Early%20Bird%20Brief**

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## NATIONAL AIR SPACE:

### Report claims small UAV ruling places USA ahead of Europe

A new report has placed the USA ahead of its European counterparts in the introduction of regulations covering the civil use of unmanned air vehicles – a feat for a nation that has long been criticized for holding back the booming industry.

In June, the US Federal Aviation Administration finalized the long-awaited small UAV ruling, allowing systems weighing less than 25kg (55lb) access to national airspace under 400ft – or 100ft below airspace reserved for manned aviation – as of August, which is being considered a progressive move by the authority.

“The introduction of the small UAS rule in the United States is putting pressure on Europe to come up with its own set of regulations,” Teal Group says in its World Civil UAS Market Profile & Forecast.

“Until the introduction of the small UAS rule by the FAA, many individual European countries were well ahead of the United States. Generally, regulations for UAVs less than 150kg are being handled by individual European Union nations. Regulations for larger ones are expected to be handled by the European Commission.”

While the report notes that Europe is allowing flights on a national scale, work continues on a drive to harmonize these.

“As yet, Europe does not have harmonized regulations for UAS smaller than 150kg,” it says. “The lack of final UAS rules presents problems for companies seeking to invest and develop business cases to address the commercial market.

“Manufacturers need to be able to understand what systems will be allowed to operate in European nations. European service providers need to be able to ensure that they are able to operate across national boundaries.”

It adds that 18 nations have established their own regulations to allow for some operations, but that these are generally restricted to line of sight. France, the UK, Spain and Denmark are at the forefront of UAV integration within Europe, it adds.

Figures on European operations are difficult to compile because of the scale of the continent and the limited amount of published information, the paper adds. However, based on what is known, the commercial UAV market has tripled in size in the past year.

“That would suggest more than 10,000 commercial UAV operators now authorized to work in Europe,” it says. “These are generally very small companies working to establish the commercial viability of using UAS for different applications. Almost all of them are using systems with 15kg or less weight.”

The Teal Group report adds that liberalized rules for UAV access to national airspace internationally will be critical, as rules around the world vary greatly.

“They range from a total lack of restrictions in lightly regulated areas to a complete ban in others,” it says. “The FAA has made a big step with the introduction of small UAS rules that will normalize their commercial use in national airspace.”

**https://www.flightglobal.com/news/articles/report-claims-small-uav-ruling-places-usa-ahead-of-e-427574/**

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### Wisconsin Unmanned Aerial Systems Advisory Board formed

A new advisory board has been formed in Wisconsin to focus on unmanned aerial systems (UAS), also known as drones. The Board is composed of a broad spectrum of UAS users in the state from both the private sector and public agencies. The President of the Board is Chris Johnsom, founder and CEO of PilotTrainingSystem.com and Director of the UW-Madison Flight Lab. Board members include representatives from the private UAS sector, non-profits, the FAA, legal firms, first responders, hobbyists, and the Wisconsin Departments of Justice, Natural Resources, Administration, and Transportation.

More information about the WUAB is available on their website. Meetings, scheduled to be held quarterly, will be open to the public. According to Dr. Johnson, WUAB is so new that they do not have a calendar on their interim website yet, but the next meeting will be in early October.

The mission of the new Board is to offer a source for technical expertise and discussion of safety and privacy issues related to civilian UAS use. The Board intends to develop policy recommendations for state, local, and institutional bodies through its quarterly meetings. Readers who have been following

the Mapping Bulletin's updates on UAS regulations in the state and through the FAA will be aware that the FAA's new "Part 107" rules have opened the door for commercial UAS applications in the national airspace.

Also of note is an upcoming UAS conference at UW-Madison on October 3-4, 2016. Additional details can be found here. This conference is being offered through UW-Madison's Department of Engineering Professional Development. More details will be available closer in time to the event.

**http://www.sco.wisc.edu/wisconsin-geospatial-news/wisconsin-unmanned-aerial-systems-advisory-board-formed.html**

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### UAS Detection, Mitigation Part of Short-Term FAA Bill

The short-term bill extending FAA funding to the end of September 2017 directs the agency to continue opening airspace to unmanned aircraft systems (UAS), but also to quantify and mitigate the potential hazards they pose in airspace around airports. Measures called for include developing means of remotely identifying UAS and their operators, mitigating the airspace hazard at airports, testing to determine the collision risk to manned aircraft and piloting the UAS traffic management (UTM) ...

**http://aviationweek.com/commercial-aviation/uas-detection-mitigation-part-short-term-faa-bill**

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### Sorry, you can’t attach guns and flamethrowers to your drone

If you were thinking that the FAA doesn’t really have a say in what you do with drones, you can kiss that thought goodbye. At the U.S. district court in Connecticut, a federal judge ruled against drone pilot Austin Haughwot and his father Bret in this matter. The Haughwots’ attorney argued that the Federal Aviation Authority has no authority to regulate drones, according to Ars Technica. The ruling now can be used as precedent, just in case others were wondering about the FAA’s reach.

It turns out this drone pilot attracted attention from the YouTube videos he posted depicting a drone he rigged with a handgun. The original video was posted last July, and in early November the FAA sent the Haughwots administrative subpoenas looking for a number of records, including accounting of any money they might have earned from the YouTube video. The elder Haughwot refused to provide the supoenaed documents, claiming that because he and his son hadn’t been accused of a crime or violation, they didn’t need to comply.

Related: Even if you’re bothered by that drone over your house, you can’t shoot it down

Soon afterwards, Haughwot posted a second video, this time showing a drone equipped with a flamethrower "roasting" a turkey suspended between trees. Again, the FAA requested they comply with the first subpoenas and again the Haughwots refused.

In February, the FAA took the Haughwots to federal court, seeking enforcement of the subpoena. Mario Cermae, the Haughwots' attorney, argued that the FAA "can't possibly rule over all things in the sky."

"The statute did not contemplate their existence," Cerame wrote in his brief. "Rather, the statute was directed at airplanes, helicopters, and blimps, and the resources on the ground to support them."

Judge Jeffrey A. Meyer disagreed. He wrote, in part, "Even if a good faith argument might be made that the devices at issue here could fall outside the definitional scope of the term 'aircraft,' the FAA has a legitimate purpose at the least to acquire more information by means of investigation in order to assess in the first instance whether the devices are within the scope of its authority to regulate."

So the Haughwots lost and must produce a lot of paperwork. Unless, of course, they appeal, which they must do within 30 days of the ruling.

**http://www.digitaltrends.com/cool-tech/drone-handgun-flamethrower-faa-can-investigate/**

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### FAA UAS Section 333 Petitions on Hold

The FAA has stopped processing Section 333 Exemption applications. With thousands of petitions in the queue, the FAA will make applicants that would qualify to operate under Part 107 wait until the new rule is effective in August to operate. Meanwhile, those petitioners that will not fall under Part 107, the FAA will continue to process the Section 333 Exemption petitions.

On June 22, the FAA issued a blanket letter to nearly 7,500 Section 333 Exemption petitioners that the fate of their requests will largely depend upon whether the petitioner's desired operation falls into one of three "Tiers." The Tiers, the FAA's planned actions, and the consequences for petitioners are as follow:

Tier 1

Initial Assessment: The petition's requested operation may be conducted entirely under Part 107 after August 29th without a waiver or exemption.

FAA Action: The FAA will close the petition's docket and will not continue processing the petition.

Consequences: Petitioner will have to wait until August 29th to operate under Part 107.

Tier 2

Initial Assessment — The petition's requested operation must be conducted with a waiver under Part 107.

FAA Action — The FAA will close the petition's docket and treat the petition as a waiver request under Part 107.

Consequences — Petitioner will have to wait until August 29th to operate under Part 107, and thereafter wait for the FAA's approval of the waiver to conduct those certain operations.

Tier 3

Initial Assessment: The petition's requested operation may not be conducted under Part 107 or waiver without further regulatory relief.

FAA Action: The FAA will continue processing the petition.

Consequences: Petitioner will have to wait until approval of the Section 333 Exemption to operate.If pending applicants believe that their requests fall into Tiers 2 or 3, the FAA encourages the applicant to contact the FAA, if the FAA has not contacted them within 60 day.

Although the notice was released on June 22, some Tier 1 Section 333 exemption shave been granted. The criteria under which the FAA will make limited exceptions and continue processing Tier 1 petitions remains unclear.

Apart from preparing to comply with Part 107 operations, petitioners should examine which Tier their petition falls into, as well as contacting the FAA regarding the processing of their petition. Petitioners should also consider whether the waivers under Part 107 may be desirable to seek, particularly for beyond line of sight, night time, or over-crowd operations.

**http://www.jdsupra.com/legalnews/section-333-petitions-on-hold-65963/**

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## PUBLIC SAFETY:

### Mississippians Are Helping Lead Way on Commercial Use of Drones

Mississippi State University extension associate Louis Wasson says, a few years ago, there was a lot of excitement in the agricultural world about using unmanned and remotely controlled aircraft, sometimes called drones. But, he says, the farmers and retailers didn't really know how to use them.

"They would go and buy them, and then you can talk to them and they say, yeah, it's sitting on my shelf. So here at Mississippi State, working with the researchers, we're determining how best to use the technology. It offers a huge amount of information. But how to get that information out of the data is the key. "

Wasson says photos taken from drones can, for example, help farmers see how their crops and irrigation systems are doing.

Robert Moorhead is director of the Geosystems Research Institute at Mississippi State. He says drones can be used to help with monitoring environmental changes, mapping, and even to help during natural disasters. During Hurricane Katrina, he recalls, the civil air patrol flew out of Jackson.

"They would spend time getting down to the coast, to be a surrogate communication link, a satellite so to speak, for communication purposes, spend an hour in the air, and then head back to Jackson. With a UAS we could have put something up to be up for 10 hours, or 24 hours at a time."

Mississippi State is also part of a group called the Alliance for System Safety of UAS through Research Excellence, or ASSURE, that is advising the Federal Aviation Administration on rules and policies for unmanned systems.

And, just last week, the FAA expanded the restricted air space over Stennis Space Center, which will allow for even more private and public research and development of unmanned aerial vehicles.

**http://www.mpbonline.org/blogs/news/2016/07/19/mississippians-are-helping-lead-way-on-commercial-use-of-drones/**

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### Project Lifesaver in Dallas Co. First to Get High Tech Drone

A special program in Dallas County designed to track people with Alzheimer's if they wander off and get lost — just got a high tech upgrade.

Authorities say the new heavy-duty state-of-the-art drone will make the search more efficient.

They say the drone is equipped with video and thermal imaging technology.

The drone was donated by Alzheimer's and Autism Outreach Group. Oscar Calloway is the Executive Director.

"We can now actually search for people at night time with thermal imaging," said Calloway.

"As long as a person is alive, as long as a person has body heat that thermal imaging is going to show that person up. They'll find them.

Calloway says the group plans to provide drones to sheriff's departments around the state.

**http://www.alabamanews.net/2016/07/18/project-lifesaver-in-dallas-co-first-to-get-high-tech-drones/**

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## AgriLife research remote sensing technology aims to solve critical crop diseases

Sensor technology could possibly solve many challenges of crop production, and Texas A&M AgriLife Research faculty are aggressively attempting to find new solutions.

Dr. Alex Thomasson, an AgriLife Research biological and agricultural engineer, and Dr. Seth Murray, AgriLife Research corn breeder, both in College Station, and others are working jointly on several projects.

One project, an unmanned ground phenotyping system, provides data that can be used to aid decisions in breeding and production agriculture through techniques like conceptual modeling and spatial prediction, according to the scientists.

“The current ground phenotyping vehicle we are working on allows us to drive the vehicle through a field of corn and collect real-time data,” Thomasson said. “We are also developing an autonomous phenotyping vehicle that will navigate itself through the field based on GPS. The purpose of these vehicles is to be able to drive through the field even over mature corn so we can collect data all the way through its growth cycle. This allows us to measure the height of the plant, evaluate the temperature of the plant and also get light reflectance in various wavelengths to determine the health of the plant.

“We can also look at other characteristics like the drought tolerance of the plant. The data these machines collect will ultimately enable the breeder to make selections from the best varieties and to do so much quicker.”

Thomasson and other AgriLife and U.S. Department of Agriculture scientists are developing the ability to use remote sensing to detect and treat cotton root rot. Cotton Incorporated has been a strong supporter of this research, some of which is occurring at the Stiles Farm at Thrall.

“The cotton root rot project involves a lot of remote-sensing work to detect the locations of infection within individual fields,” he said. “It’s expensive for cotton farmers, not only the yield losses from the disease but the treatment to prevent it. It’s costing them about $50 an acre to treat the fields, but this research can save them a lot of money by enabling them to treat only the infected areas of a field. Some are trying to use satellite data to identify infected areas, but the image resolution is low. We’ve begun using UAVs (unmanned aerial vehicles), which give us images with extremely high resolution. We have the potential to see where each infected plant is so we can know exactly where to place fungicide in subsequent seasons.”

The remote-sensing research is related to a broader scope of research projects implemented by AgriLife Research. The Texas A&M Coordinated Agricultural Unmanned Aerial Systems project and Ground Vehicle Validation is a collaboration of more than 40 faculty members within the Texas A&M University System.

Led by AgriLife Research, the project also involves the Texas A&M Engineering Experiment Station, the Center for Autonomous Vehicles and Sensor Systems, and the Center for Geospatial Applications and Technologies, as well as businesses and farmers. The research centers on 1,400 acres of AgriLife

Research fields near College Station where corn, cotton, sorghum and wheat, as well as peaches and perennial grasses are grown.

**http://www.agprofessional.com/news/agrilife-research-remote-sensing-technology-aims-solve-critical-crop-diseases**

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### 1st US system to keep drones away from wildfires kicks off

BOISE, Idaho — The first national system intended to prevent hobby drones from interfering with planes and helicopters fighting wildfires has launched, federal authorities say.

The U.S. Interior Department announced the kickoff of the pilot project Monday that uses a smartphone app and real-time wildfire information to create virtual boundaries, or geofences, that drones can't cross.

Officials say drones colliding with firefighting aircraft could be catastrophic. Planes and helicopters have been grounded numerous times this year because of drones, most recently on Sunday in Southern California where 10,000 homes are threatened by fire. Earlier this month authorities arrested a man they say flew a drone over a Northern California wildfire and grounded firefighting aircraft.

"We believe this program, which uses the global positioning system to create a virtual barrier, will move us one step closer to eliminating this problem for wildfire managers," Mark Bathrick, director of the Interior Department's Office of Aviation Services, said in a statement.

The Interior Department developed the system with DJI, the world's largest civilian drone-maker, and two other companies that specialize in offering navigational information to drone fliers, AirMap and Skyward.

Specifically, the Interior Department allows AirMap and Skyward to get the latest wildfire information directly from the federal agency's Integrated Reporting Wildland-Fire Information program.

That information is then immediately pushed to drone pilots through apps on their smartphones, with the smartphones themselves typically used to navigate in combination with the drone's GPS.

DJI has its own app called DJI GO. AirMap pushes the Interior Department's wildfire flight restriction information to DJI. DJI uses it as a safety feature that prevents its drones from flying in temporary flight restrictions at wildfires. It even prevents DJI drones from taking off in wildfire restricted areas. The system can be overridden by those authorized to fly over a wildfire.

"This enhancement ... will help prevent DJI drones from inadvertently taking off within, or flying into, a wildfire location without authorization," Brendan Schulman, DJI Vice President of Policy and Legal Affairs, said in a statement.

Ben Marcus, CEO of AirMap, said DJI is the only drone maker so far to take that step but attributed it more to DJI's large size. He expected smaller companies that make drones to begin integrating the technology as well to set up the geofences around wildfires based on Interior Department information.

"Giving drone operators real-time information about wildfires we think will dramatically increase the safety for firefighters," Marcus said.

For drone pilots without a DJI drone, smartphone apps can still provide the Interior Department's location of wildfire flight restrictions, but it will be up to the operators to avoid flying over a wildfire rather than the drone technology automatically preventing an incursion.

Marcus estimated that more than 70 percent of drones now operating in the country will benefit from the real-time wildfire information.

**http://m.startribune.com/1st-us-system-to-keep-drones-away-from-wildfires-kicks-off/388165232/**

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## SENSORS/APPLICATIONS:

### Like Battlebots, Except These Robots Automatically Patch Cybersecurity Holes

Hacking teams and their algorithms will square off in a Las Vegas arena, in a contest sponsored by DARPA.

The Pentagon agency that brought you robotic cars will bring robotic hackers to a Vegas resort next month.

The $2 million Cyber Grand Challenge, sponsored by the Defense Advanced Research Projects Agency, will pit machines against insecure software to pierce the holes—and fix ‘em.

The entire event will be shown on screens in the Paris Las Vegas Hotel’s 5,000-person auditorium while sportscasters narrate the competition, according to DARPA organizers. The tournament will run in conjunction with an annual Vegas hacker conference called DEFCON.

The hope is that computers will be able to discover and patch bugs, like the Heartbleed vulnerability, in any commercial software, including the variety that goes into the F-35, organizers say.

The top seven teams from a 2-year-long contest will let their computers run wild at a daylong Capture the Flag-style tournament of code Aug. 4. Competitors range from Raytheon contractors to former University of California, Santa Barbara students now flung all over the world.

Today, it can take about 312 days to discover a vulnerability in software already out on the market, according to the Pentagon.

The aim of the competition is to “bring that entire discovery-comprehension-patch-response timeline down from a year to minutes or seconds,” said Mike Walker, DARPA program manager for the challenge.

Admittedly, the nature of automated cybersecurity does not lend itself to the visual spectacle of robocar “Stanley” navigating the Mojave Desert with no one behind the steering wheel during a 2005 DARPA self-driving car challenge.

“Autonomy in the domain of vehicles is easy to see and grasp,” Walker told reporters on Wednesday. “Bringing autonomy to the cyber domain is harder to see because it happens inside the logic and memory of networked computers, and it’s an adversarial pursuit.”

Killer Robot Hackers?

The results of the coding experiment might be more tangible, if one considers that more than an estimated 20 billion objects containing software will be hooked to the internet by 2020.

“When you buy something that is part of the internet of things on the shelf today, when you look on the back, what you don’t have is a sticker that tells you what machine investigated its security and what machine will guard its security in the future,” Walker said. “That’s something we could [have] as part of an open technology revolution in computer security automation.”

By an open technology revolution, in this case, he means every piece of software the rival machines write will be placed on a public server in perpetuity.

What are the odds that one of these robotic hackers could be repurposed for malicious use by a foreign intelligence agent or cybercrook?

“We believe that all computer security tools are dual use,” meaning the systems can be used for commercial or military purposes, Walker said. “They become defensive through openness.”

He continued, “If we have an open technology revolution, where the availability of the software is democratized, then we don’t believe that the nefarious misuse will be feasible because the bugs that could be found will already have been patched.”

It is unclear how many years it’ll be before robots can beat humans at breaking into networks.

“The answer is, ‘I don’t know,’” Walker said. “We are actually trying to prove autonomy before we can say it exists and start speculating about its future development path.”

Another test for the concept of robot hackers might come as early as the next day. DEFCON, which every year hosts a human capture the flag game among programmers, has invited the winning automaton to vie against fingers and brains Aug. 5. Walker said he does not expect any machine to win against humans at DEFCON.

“Stanley was a remarkable vehicle that earned its place in the Smithsonian, but it does not belong on an F1 Course,” he said.

http://www.defenseone.com/technology/2016/07/battlebots-except-these-robots-automatically-patch-cybersecurity-holes/129904/

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**This scientist can control a swarm of drones with his thoughts**

What's the only thing that could make a regular drone sound boring? A swarm of thought-controlled drones, of course.

As unbelievable as it sounds, this is exactly what researchers at Arizona State University have developed — with technology that allows one person to control multiple robotic drones simply by thinking about different tasks. To do this, the operator wears a skull cap which records electrical brain activity through 128 electrodes, and outputs instructions to a computer, which then relays information to the drones via Bluetooth.

"For the past year, we have been working on building a control interface between a human and a swarm of robots by using the brain recordings of the human-commander," Panagiotis Artemiadis, director of ASU's Human-Oriented Robotics and Control Lab, tells Digital Trends. "After analyzing the brain recordings, we found areas of the brain that can be used to control the formation and other collective behaviors of a swarm of drones. We record the electrical activity of those areas using non-invasive methods, and we decode this activity to control variables for the robotic swarm. The human commander can control the motion and formation of the robotic swarm in real-time by only thinking about their desired motion."

Artemiadis' lab has previously worked on the neural control of prostheses, and has demonstrated that it is possible to carry out highly dexterous control of a robotic arm using electromyographic signals. However, controlling a swarm of drones is another matter altogether.

"The brain is wired to control artifacts that resemble human limbs," Artemiadis says. "The complexity of a system that requires the brain to activate areas to control robotic artifacts that do not resemble natural limbs — in our cases a swarm of drones — is significant and so far unexplored. Until a few months ago, nobody knew that specific brain areas can be activated when the human observes collective behaviors of swarms. The fact that the brain can adapt to output control actions for a swarm of multiple robots is fascinating and quite useful for human-robots interaction."

And it's pretty freaking cool, to boot!

https://ca.news.yahoo.com/scientist-control-swarm-drones-thoughts-173843512.html

http://www.dailymail.co.uk/sciencetech/article-3697421/Is-MIND-CONTROL-future-warfare-Swarms-drones-developed-army-guided-brain-waves.html

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## The killer 'legobots' are coming: US Military to build modular robot parts they can plug together for different missions

It sounds rather like a children's toy - modular 'chiplets' that can be put together to form a robot.

However, Darpa's latest project has one difference - its machine could kill.

The US Military research agency hopes to build a library of components to aid everything from smart drone building to instant language translation

Darpa hopes to shrink traditional military machines into single 'chiplets' to build a library of components to aid everything from smart drone building to instant language translation. Shown, an artist's impression of the components that could be shrunk onto a single chip.

Darpa hopes to shrink traditional military machines into single 'chiplets' to build a library of components to aid everything from smart drone building to instant language translation. Shown, an artist's impression of the components that could be shrunk onto a single chip.

HOW IT WOULD WORK

The system will create a library of custom and commercial 'chiplets'—small-scale chips that individually embody a particular function, such as data storage, computation, signal processing, and managing the form and flow of data.

By assembling and integrating dozens of chiplets, mosaic style, on a so-called interposer, which is like a small printed circuit boardl, all of those microsystems' functions could be performed in a much closer huddle and can perform more efficiently than if they were distributed in the usual way among a suite of chips attached to a conventional PCB.

It says it hopes to shrink traditional military machines into single 'chiplets'.

'By challenging the technology community to integrate the collective functions hosted by an entire PCB onto a device approaching the size of a single chip, Darpa'snewest program is making a bid to usher in a fresh dimension of technology miniaturization,' the agency says.

'We are trying to push the massive amount of integration you typically get on a printed circuit board down into an even more compact format,' said Dr. Daniel Green, manager of the new program.

Called  Chips, which stands for Common Heterogeneous Integration and Intellectual Property (IP) Reuse Strategies Program, the project could boost speeds in computers.

'It's not just a fun acronym,' Green said.

'The program is all about devising a physical library of component chips, or chiplets, that we can assemble in a modular fashion.'

'This is increasingly important for the data-intensive processing that we have to do as the data sets we are dealing with get bigger and bigger,' Green said.

Although the agency refuses to reveal what machines it hopes to build, it does say 'the new architectural strategy at the program's heart could open new routes to computational efficiencies required for such feats as identifying objects and actions in real-time video feeds, real-time language translation, and coordinating motion on-the-fly among swarms of fast-moving unmanned aerial vehicles (UAVs).'

The Darpa project aims to create a library of hi-tech 'chiplets' that could then be used to creates military drones, robots and other devices - much like slotting together the pieces of a children's toy.

The Darpa project aims to create a library of hi-tech 'chiplets' that could then be used to creates military drones, robots and other devices - much like slotting together the pieces of a children's toy.

DARPA has posted a Request for Information to harvest ideas at the front-end of the program from expert and industry players.

'Key to the success of CHIPS will be standards and interfaces, and this means we will be working with a community, not all by ourselves,' said Green.

A major aspect of the CHIPS vision is the eventual availability of a library of custom and commercial 'chiplets'—small-scale chips that individually embody a particular function, such as data storage, computation, signal processing, and managing the form and flow of data.

By assembling and integrating dozens of chiplets, mosaic style, on a so-called interposer, which is like a small printed circuit boardl, all of those microsystems' functions could be performed in a much closer huddle and can perform more efficiently than if they were distributed in the usual way among a suite of chips attached to a conventional PCB.

**http://www.dailymail.co.uk/sciencetech/article-3699914/The-killer-legobots-coming-Military-build-modular-robot-parts-plug-different-missions.html**

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### Park brings in drones to survey trees – Hawaii

It takes a serious threat to convince the National Park Service to allow drones in its airspace, and for Puuhonua O Honaunau that was the death of palm trees.

The park has lost about 65 palms during the last several years, said Adam Johnson, chief of integrated resources management and supervisory archaeologist for the park.

That led him to bring in the unmanned aerial devices to give him an idea of what was going on. The service workers think there are at least two, possibly three, fungi attacking the trees and potentially insects as well.

Thankfully, Johnson said, the trees are not suffering from the coconut rhinoceros beetle that savaged Oahu's palm trees.

Many of the trees in the park were planted more than 100 years ago, he said, so some deaths were expected.

But the number was excessive, and other trees are in poor shape — with weak new leaves and thinning crowns. At that point, the tree's already dying, Johnson said.

The plan is to help determine what is going on and give a baseline image of what's happening, said Ryan Perroy, assistant professor of the University of Hawaii at Hilo geography and environmental science department. He uses drone technology in much of his research.

Drones are less disruptive than other options, Perroy said, which would include surveying each tree from a bucket truck or a helicopter, he said.

A bucket truck could also lead to damage of the site, he said.

Following the NPS procedures to get the drones into the park took a lot of effort, Johnson said, but it was worth it for the efficiency in surveying the park's hundreds of trees.

Beyond convincing his boss, he said there were an additional eight months of work and five levels of approval to go through.

"This had to go up to the Washington offices," Johnson said.

The drone equipment on Monday took the form of three units, all using four rotors. One carried a high-quality camera for visible light, while another had a hyper-spectral system that allowed photos into near-infrared, Perroy said.

Monday's flights were under cloud cover, which Perroy said made it a lesser option for the hyper-spectral system. The clouds interfere with the various types of radiation, he said, making it less useful than a bright sunny day.

The drone flew a pattern "like a lawnmower," Perroy said, as it followed a series of even passes over the area of interest.

That route was programmed into the machine, which largely flew on its own, while someone holding the control panel watched it in case it should begin to act up.

The first area surveyed was the southern beach section of the park, an area excluded by the great wall on the site.

It landed, giving park workers time to offload the high-resolution images and recharge the batteries.

During that time, park staff moved to clear the royal area, the region enclosed by the great wall, dominated by heiau and featuring most of the park's historical sites.

The staff tried to minimize the trouble of clearing people out during the survey time by scheduling flights on days with lowest attendance, Johnson said.

When the drones went up, they sounded like a swarm of bees sweeping the site, with Sean Headrick of Aerotestra, Inc. holding the controls.

The park has begun to recover from the tree deaths in one way.

They replanted some of the lost palms, placing them inside the trunks of their predecessors. This will reduce the disturbance of the historic sites, Johnson said.

**http://hawaiitribune-herald.com/news/local-news/park-brings-drones-survey-trees**

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### Boeing lab seeks partnerships for autonomous technologies

The idea of unmanned aircraft systems (UAS) working autonomously in collaboration with other unmanned vehicles on the ground or underwater might seem like science fiction, but it's already being tested at Boeing's Collaborative Systems Laboratory (CASL).

Mike Abraham manager of Boeing's new lab at St. Charles, Missouri, said one recent experiment involved a disaster response scenario in which a UAS and an unmanned ground vehicle worked together. The UAS provided oversight and situational awareness, enabling a ground vehicle to find its way through a debris field and stop a simulated gas leak.

"A lot of the multi-vehicle stuff has traditionally been thought of multiple air vehicles operating together," Abraham explained. "But when you can start taking advantage of an air vehicle, a ground vehicle or subsurface marine environments and doing what each vehicle does well to get a common mission done, that's when you start talking about autonomy and collaborative behavior."

In other words, it's getting unmanned systems to work together in a manner similar to how people accomplish tasks.

"To have unmanned vehicles collaborate to get a common mission done is really one of the main visions of what we're trying to demonstrate and mature," Abraham said. "What's going to make these vehicles have utility is being able to do these kinds of missions. We have a dedicated place to do that type of experimentation in a controlled environment where we can instrument what's doing and see what's happening."

CASL is part of the Boeing Research and Technology-Missouri (BR&T-Missouri) research center. The lab is equipped with an 80,000-cubic-foot motion capture system that allows the facility to simultaneously operate multiple unmanned air vehicles (UAV) and unmanned ground vehicles.

It also has an indoor flying test range with a high-resolution blended projection system for the development and testing of vision-based technologies, such as image processing algorithms or detection

of moving objects in scenery. The system can work in concert with the motion capture system and high-fidelity simulations to support live-virtual testing in realistic simulated scenarios.

Nancy Pendleton, vice president with Boeing's research and technology division, leads system technology at the Missouri research center.

"We create that infrastructure and environment in the lab where you can test out your concept, prototype autonomous ideas, and then evaluate whether they can do the job intended," she said. "You can visualize it and evaluate it. In some cases, as you get further downstream from maturation of the technology, you can use this lab to validate your concept. Is it doing what it was expected to do and is intended to do? It readies you for a larger test that would potentially be done outside in a regular environment."

Abraham said that since the lab recently opened, he's fielded numerous inquiries from universities seeking to partner with Boeing, something the company encourages.

"Other groups within the company that have research or technology projects can come in with either their industry or academic partners and use the facility for doing experimentation," he said. "What we want to support going into the future is schools bringing in new and novel technologies to Boeing that we can benefit from."

Pendleton noted that in addition to working with partners throughout Boeing, the company is also working with external entities to adapt, apply and mature concepts in the realm of autonomous technologies in which Boeing is making investments.

**http://uasmagazine.com/articles/1517/boeing-lab-seeks-partnerships-for-autonomous-technologies**

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### AT&T's Drone Inspection Program

AT&T has reached another milestone by launching the trial phase of our national drone program. Led by Art Pregler, our national drone program is driving innovation, and focuses on how AT&T and our customers can benefit from drone-based solutions.

Art's team brings decades of military, flight control and tech experience to the job. This has allowed the team to hit the air flying, so to speak. We're already using drones to perform aerial inspections of our cell towers, and this week at our SHAPE Conference in San Francisco, we'll demonstrate that capability live.

Connecting drones to our nationwide LTE network lets us capture data and feed it directly to our systems. In turn, this can allow us to make changes to our network in real time.

By using drones to inspect a cell site, we're able to conduct inspections more quickly and safely – and even access parts of a tower that a human simply could not. We anticipate this will allow us to improve our customers' experience by enhancing our cell sites faster than ever before.

We expect our experiences will lay the foundation for new, exciting drone applications.

FlyingCOWPossible uses include Flying COWs (Cell on Wings) providing LTE coverage at large events or even rapid disaster response. A Flying COW may even be able to provide coverage when a vehicle is unable to drive to a designated area.

In addition to how we're using drones to enhance our network, AT&T's IoT team, led by Chris Penrose, is developing solutions for our customers. We're researching how in-flight drones can use our LTE network to send large amounts of data in real-time. This capability may benefit areas such as insurance, farming, facility and asset inspections, and even delivery service companies.

We're moving toward the future by pushing the envelope on what's technologically possible for drones. Look for more news from us at SHAPE, including a first-hand look at how drones are taking our network to new heights.

**http://www.uasvision.com/2016/07/20/atts-drone-inspection-program/?utm_source=Newsletter&utm_campaign=21524d6d6b-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-21524d6d6b-297560805**

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**Analysis of Kinematics of Flapping Wing UAV Using Opti-Track Systems**

**Abstract**

An analysis of the kinematics of a flapping membrane wing using experimental kinematic data is presented. This motion capture technique tracks the position of the retro-reflective marker(s) placed on the left wing of a 1.3-m-wingspan ornithopter. The time-varying three-dimensional data of the wing kinematics were recorded for a single frequency. The wing shape data was then plotted on a two-dimensional plane to understand the wing dynamic behaviour of an ornithopter. Specifically, the wing tip path, leading edge bending, wing membrane shape, local twist, stroke angle and wing velocity were analyzed. As the three characteristic angles can be expressed in the Fourier series as a function of time, the kinematics of the wing can be computationally generated for the aerodynamic study of flapping flight through the Fourier coefficients presented. Analysis of the ornithopter wing showed how the ornithopter closely mimics the flight motions of birds despite several physical limitations.

**http://www.mdpi.com/2226-4310/3/3/23**

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## COUNTER UAS:

## COMMENTARY:

### What's ahead for unmanned ground vehicles?

With much discussion, interest and doctrine now enshrined for unmanned systems in the air domain -- and, perhaps to a lesser extent, in the sea and undersea domains -- unmanned ground systems are much harder to perfect than their air and sea counterparts.

There are significantly more objects on the ground for unmanned systems to avoid than in the air or the sea, making operations inherently difficult. Despite these challenges, the military is pressing forward in developing concepts for unmanned ground vehicles.

"Our main work in ground vehicles is quite exciting," William Roper, director of the secretive Strategic Capabilities Office, said at CSIS July 13. The Strategic Capabilities Office, or SCO, works to protoype and test solutions to be adapted rapidly using existing systems or technologies.

Roper said that this year his office has sought to increase its work with the Army. Part of this work centers on channeling and utilizing existing advancements in commercial driverless vehicles. "We've taken a very hard look with the Army on what's the mission impact if we use commercial-style unmanned ground vehicles. Given that they're not going to go off road, but do we get a good enough solution to get moving...to me, [good enough] usually means it's good enough to get started because I see the improvement pipeline behind it."

However, according to others in the military space, unmanned ground vehicles could still be far off be given the complexities and obstacles that exist in this domain. While commercial driverless cars were developed on predictable, mapped, paved roads, in military use "not only will we stay on roads, but when the roads become more dangerous we'll go off road," Deputy Defense Secretary Robert Work said at a Washington Post-hosted event in March. "That type of navigation is extremely difficult."

For Roper, his hope is "that we will find a sweet spot for saying let's go out and start working with existing technology that when future technologies allow us to go off road mature, we'll already have experience in the pipeline."

There are myriad uses for unmanned ground vehicles, said Paul Scharre, senior fellow and director of the 20YY Future of Warfare Initiative at the Center for a New American Security, such as driverless vehicles for convoys (which have already been used), vehicles that can accompany dismounted soldiers or even unmanned vehicles that can serve as scouts to look for enemy positions, allowing for greater risk than a commander might take with a manned element.

Armed and driverless: Unmanned ground vehicles

With these systems, however, it's all about the level of autonomy, Scharre told C4ISRNET. This distinction exists between remotely controlled vehicles and those that are fully autonomous, which are

not binary but rather are somewhere in the middle. For example, a vehicle could follow along in a convoy operating under existing levels of robotics, such as cruise control or autopilot, with an operator in the cabin to take control if need be. This would free up the soldier to pay greater attention to what's ahead such as threats or improvised explosive devices, as well as reduce accidents.

Additionally, fully autonomous systems, Scharre noted, won't be plausible because if a system gets stuck or runs into a situation where it needs help and calls back, a user must be allowed to remotely operate it.

The scout capabilities are probably more near-term than systems that will operate alongside soldiers given all the complexities involved in systems being able to understand where humans are in relation to the vehicle, he added.

Taking advantage of technologies that already exist in the commercial space regarding driverless cars can help accelerate integration and understanding for the Army and Marines to ensure they have personnel that are "trained to use it and know how to analyze the impact, they've thought through what missions they can do," Roper said.

Going forward, Scharre said he sees a lot of potential, especially surrounding advancements in object recognition and deep neural networks in which researchers have been able to build neural networks to exceed some human abilities. They networks aren't functional in all environments such as rain or snow, but the advancements are impressive.

Scharre conceded that Russia is building a large volume of unmanned ground systems that include golf cart-sized vehicles and tanks. Moreover, Russia is arming many of its systems, something he said the U.S. has been hesitant to do. Russia is more aggressive in operational concepts and building prototypes, especially of the weaponized variety, he added.

Roper stated that he will be reporting back to Army leadership as to what his office found in unmanned ground systems.

**http://www.c4isrnet.com/story/military-tech/uas/2016/07/14/whats-ahead-unmanned-ground-vehicles/87042796/?utm_source=Sailthru&utm_medium=email&utm_campaign=DFN%20EBB%207.15.16&utm_term=Editorial%20-%20Early%20Bird%20Brief**

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### Military Must Prepare for Unmanned Aircraft Threat

Low-cost unmanned aerial vehicles are equipped with cameras, laser designators, radio frequency collection devices or weapons. The size and composite materials used in UAV production make them difficult to defeat with traditional force protection measures and short-range air defense systems commonly employed by maneuver forces.

In Ukraine, both Ukrainians and Russian-backed separatists are operating UAVs in relatively large numbers. They are reportedly operating more than a dozen variants including fixed- and rotary-wing configurations, each functioning at different altitudes with various sensor packages.

For nearly three decades, U.S. and allied forces have had the luxury of conducting ground and air operations in a virtually uncontested airspace environment. Development and fielding of air-defense systems has declined and passive air defense skills have atrophied across the force. Leaders at all levels cannot be lulled into a false sense of security because of the small size of these UAVs. They are as effective, if not more effective, than traditional manned aircraft (or even stealth aircraft) in reconnaissance, surveillance, and target acquisition precision attack and indirect fire support.

UAVs can create serious problems for maneuvering or static forces. Conventional air-defense systems often “filter” out tracks to avoid confusion with clutter, large birds and aerostats. Systems optimized for this threat often forfeit effectiveness against other target sets (manned aircraft, cruise missiles, rockets and mortars, and ballistic missiles).

A reduction of dedicated air-defense units to maneuver brigades creates potential gaps in air defense coverage. And soldiers are “numb” to UAVs. Recent combat experience in Iraq and Afghanistan indicates troops may be highly accustomed to friendly UAVs and, therefore, less likely to be concerned about them flying overhead and less inclined to actively search for UAVs operating in their battle space.

Many soldiers lack UAV recognition training. This issue is compounded by the ever-increasing proliferation of new UAV designs and off-the-shelf systems sold to multiple countries. U.S. Army and joint doctrine have not kept pace with the threat.

UAVs provide the enemy critical intelligence such as a unit’s precise location, composition and activity. They may also provide laser designation for indirect fires or direct attacks using missiles; rockets; small “kamikaze” munitions; or chemical, biological, radiological and nuclear weapons. Some payload configurations can contain radar and communications jamming or other cyber attack technology.

UAVs are the air threat of the next fight. Technology development and employment around the world demonstrates a relevant and viable air threat. Air defense artillery liaison officers cannot be lulled into a false sense of security because of the relatively small size of these platforms.

Air defense artillery liaison officers — when working with or within an integrated air defense system — should take an active role to address threats to the maneuver force, suggest UAV-specific rules of engagement when there is a reliable ability to distinguish unmanned platforms, ensure criteria for “hostile act” and “hostile intent” specifically address UAVs and are written in terms any soldier can understand. They also must ensure all joint data link contributors utilize a common set of track amplification data — air type, air platform and air activity — to categorize the UAV target.

Critical assets within the continental U.S. have already been “attacked” by nefarious UAVs. It is only a matter of time before these systems are directly or indirectly responsible for loss of life or interference

with critical infrastructure. In some circumstances, Title 10 military personnel and equipment may be required to operate subordinate to civil-military organizations.

Per Department of Defense Directive (DODD) 3025.18, DoD resources may be used in an immediate response to prevent loss of life, mitigate damage to infrastructure, or in support of mutual aid agreements (Title 42 USC).

It is unlikely that most organic communications systems will be compatible with the civil organizations being supported, thereby increasing reliance on knowledgeable liaison officers. Missions may include air defense coverage for the National Capital Region, key power/communications infrastructure, national borders, sporting arenas, political conventions and presidential inaugurations.

Technology used to counter UAV threats within our own borders must be in compliance with Federal Aviation Administration and Federal Communications Commission regulations. Military planners cannot assume they are exempt from fines or prosecution for violating civil airspace or spectrum management policies in the interest of thwarting a potential hazard.

It must be assumed targets of vital interest are being watched and targeted. UAS operations are not limited to the battlefield; they have already been used to disrupt our daily routines at home and violate traditional security measures surrounding our borders, prisons, nuclear facilities and sporting venues.

Leaders across the board must take an active role in educating themselves and training their units to defeat this threat.

Jeffrey Lamport and Anthony Scotto are unmanned aircraft experts at the joint deployable analysis team, part of the Joint Staff J6, located at Eglin Air Force Base, Florida.

**http://www.nationaldefensemagazine.org/archive/2016/august/Pages/MilitaryMustPrepareForUnmannedAircraftThreat.aspx?utm_source=Sailthru&utm_medium=email&utm_campaign=Defense%20EBB%2007-21-16&utm_term=Editorial%20-%20Early%20Bird%20Brief**

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### Opinion: Drones Threaten US Airspace.

The Wall Street Journal (7/18, Cooke, Harrison & Rignanti, Subscription Publication) published an opinion piece by three members of the Air Force Scientific Advisory Board urging the Federal Aviation Administration to adopt regulations properly regulating drone flight safety. They urge the FAA to convene a forum setting international standards addressing safety of flight, such as requiring all non-military drones to be equipped with electronics allowing authorities to prevent their inappropriate operation in specified airspace. They argue that scientific literature can yield evidence to inform policy. Systematic simulation and modeling can answer questions and test operational concepts. Science and policy decisions, they argue, must account for the complexity of the national airspace to prevent unintended consequences. They urge FAA support of a consensus study on drones conducted by the Board on Human Systems Integration of the National Academies of Sciences, Engineering and Medicine.

http://www.wsj.com/articles/national-airspace-is-threatened-by-drones-1468873671

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**Strategic Capabilities Office Is 'Buying Time' For Offset: William Roper**

WASHINGTON: William Roper's Strategic Capabilities Office is exploring some of the most innovative concepts in the US military. Imagine a militarized version of Pokémon Go, helping Army soldiers locate real-life threats instead of cartoon monsters. Imagine robot brains in a box — an "autonomy kit" — that Navy sailors can install on a patrol boat so it can operate without a crew. Imagine Marines using modified "big data" marketing software to track anti-American sentiment and predict dangerous developments instead of what people buy.

"The big data tools… are in beta testing today and I think will be ready for prime time within a year," Roper told me in a rare interview. The autonomy kits are works in progress, he said, while augmented reality for combat troops (a la Pokémon Go) is more nascent.

Roper doesn't see himself as a revolutionary, however. He's more like MacGyver, frantically jury-rigging gadgets from whatever's at hand to stop the bad guys. In a world where America's adversaries are exploiting rapidly advancing, widely available technology to erode our military advantages, Roper is buying time.

Buying Time for the Offset Strategy

DARPA and Defense Department labs are developing breakthrough technology as part of the Pentagon's Third Offset Strategy. A central theme is autonomous artificial intelligence — operating both in real-world robots and in cyberspace — but there is also promising work in hypersonic missiles, 3-D printing, and other areas. There's just one problem: time.

"I'm really impressed with a lot of the technologies that those groups are working on, but it does take time to get them out to the field," Roper told me. So, with potential adversaries striving mightily to catch up, he said, "SCO is working on the front end in a buying-time role for the Department."

The premise of the Third Offset Strategy is that modern American military supremacy rests on inventions made in the 1970s — stealth, smart bombs, wireless digital networks — and it's past time to start working on the next generation of revolutionary technologies. The premise of the Strategic Capabilities Office is that, in the meantime, there's plenty of room for improvement in the current generation.

"We have over a trillion dollars' worth of sunk costs in the systems we have bought and operated, (and) there's a lot of potential under the hood to modify these systems," Roper said. "Our job, instead of looking forward to the future technologies that are coming out of the research shops, is to look backwards to the systems that we currently have."

“These two things dovetail,” Roper went on. “Let’s say we buy the Department 10 years or 15 years of time (in which) the current systems will still have sufficient surprise and unexpected capabilities to be able to win future conflicts. That’s 15 years for the technology shops (to work on) programs that they can fast-track and move to field, so by the time that we’ve exhausted all of our ideas, there’s a new set of ideas.”

Roper’s favored analogy is World War II. The breakthrough inventions of that war — chiefly airplanes, tanks, submarines, and radios — had first been used in battle twenty years before, in World War I. (Radar is a partial exception, since it was an offshoot of radio). Germany overran Europe not because it had better technologies but because it combined them better. Once the Russians, for example, figured out what the Germans had done, they had the technology to emulate it and blitz the Germans back.

All the major powers had the same basic technology, Roper argued, and that baseline stayed “static” until the US exploited revolutionary physics to develop the atomic bomb. Yet between 1939 and 1945, there were tremendous advances in combat power as hard-won combat experience and engineering trial-and-error found the best ways to use the same underlying technology.

“In World War II, almost every idea was wrung out. It had to be in order to keep advantage,”: said Roper. Since 1945, however, US military technology has never been put so thoroughly through the wringer. That problem is a byproduct of success — we managed to deter the Soviets instead of fighting them, and no foe since has threatened us with extinction — but it’s still a problem.

“That natural wringing-out function that was performed in World War II has not been performed with the last generation of systems,” Roper said. SCO will help the services with “wringing out all the dregs of the things that we have, before we come in and say we need a new thing.”

How SCO Works

When speed is the priority, the trick is to combine existing technologies in new ways, especially by bringing rapidly advancing commercial technology into the slower-moving military world.

Of the 23 projects (many classified) that SCO has worked on so far, said Roper, the typical time from initiation to completion is three years. That’s a lightning pace for a Pentagon that measures major development programs in decades.

“Most of the capabilities that we work tend to be one to four years. Five years is not too long for us,” Roper told me. “If a fantastic idea were to come in that took six years to do” — and nobody else in the Defense Department were doing it — “I would not exclude taking it on, but I’d have a higher burden of proof.”

SCO doesn’t have and doesn’t want a hard-and-fast rule for what kind of projects it can take on, Roper emphasized. It doesn’t even issue formal requirements, which usually serve as holy writ for Pentagon acquisitions.

“I was asked … I’m going to have to say at least 500 times during the first year, ‘what’s your requirement?’” Roper said at the Center for Strategic & International Studies last week. “The best thing about running my office is that I have no requirements. I have a mission, kind of like the guys in World War II.

Requirements all too often become a sacred straitjacket, preventing intelligent trade-offs.

“Where we often trip ourselves up is we write down numbers that we wish were true…but then once they take on the word ‘requirement,’ it means that they have to be,” Roper said at CSIS. The current system tends to lock specs down too early — range, speed, accuracy, etc. — without room for tradeoff.

Roper doesn’t even have a normal budget. SCO gets a flat $16 million a year for its analysis and testing overhead, but every specific project has to earn its own way into the Pentagon budget, he said at CSIS: “If I’m not putting new concepts in, eventually we evaporate and go away.”

So what kinds of new concepts is Roper pushing? We’ll delve into those details — robot boats, big data, and augmented reality — tomorrow in Part II. [Click here to read the second part of the story.]

Google Cars, Pokemon Go, & The Future Of War: Roper Interview Part II

William Roper is “buying time” for the rest of the Pentagon, he told us in a rare interview. His Strategic Capabilities Office finds near-term but game-changing upgrades for existing weapons systems, preserving American advantage over rapidly advancing adversaries while DARPA and Defense Department labs develop a new generation of breakthroughs. Yesterday, we wrote about Roper’s overall approach. Today, we get into specific technologies.

Robot Boats & Google Cars

Unmanned vehicles are a great example of how Roper’s near-term approach diverges from the longer-term Third Offset Strategy. DARPA, famed for long-range longshots, recently commissioned the world’s largest unmanned ship, the 130-foot Sea Hunter (aka ACTUV). Meanwhile, however, the Strategic Capabilities Office is working with the Navy on “autonomy kits” that can be installed aboard a conventional vessel to let it operate unmanned. After the unmanned mission, the kit can be taken back off, if desired, to let the boat operate with a human crew again.

SCO is working on various Navy small craft, one of the largest being the new Mark VI patrol boat. They’re not optimized for unmanned operations — they have a lot of hardware to support a human crew, for example — but, said Roper, “we start with the ships we have.”

While purpose-built unmanned designs like Sea Hunter are maturing, the Navy can add autonomy kits to a vast number of vessels already in service and use them in new ways. The retrofitted craft can do less than a purpose-built robo-boat will, but they can do it now. Ultimately, by the time the thoroughbred robots do enter service, the Navy will already have years of experience with autonomy kits, creating a cadre of skilled operators and tacticians who can make the most of unmanned vessels.

A similar logic governs Roper's examination of unmanned ground vehicles. DARPA and the Army have struggled for over a decade to build truly autonomous robots able to find their own way on the ground, a much more complex task than flying through empty air. Meanwhile Google, Tesla, and others have invested billions in self-driving cars.

Civilian vehicles designed to drive on the highway in peacetime aren't yet able to maneuver off-road and under fire. But commercial industry is investing so heavily, and the underlying information technology is advancing so rapidly, that the military should take advantage. "My hope," Roper said last week at the Center for Strategic and International Studies, "is that we will find a sweet spot (to) go out and start working with existing technologies, (so) when future technologies that allow us to go off-road mature, we'll already have experience."

Fortunately, SCO doesn't have to invent the technology involved, just tailor it. The commercial world already tracks people's spending and social media habits with at-times Orwellian thoroughness. (Roper promises SCO will anonymize its data to protect privacy). "The marketing world aggressively tries to understand, synthesize, find patterns, in this kind of information because it helps them make smarter real-time choices," Roper said. "We believe there'll be an analog for us."

"We think augmented reality can be game-changing," Roper said. "It's a technology that's going to be matured, pushed by the video game industry, that is focused on taking large amounts of complicated information and displaying it in an intuitive and actionable way. It would be really wise to follow that as opposed to trying to make up our own approach."

Augmented reality displays of big-data findings would be particularly useful in cities, where the sheer density of people, structures, and technology creates a social, physical, and electromagnetic environment far more complex — and potentially far more lethal — than anything in the natural world. "Urban conflict may be the most challenging we face," Roper said. "That's one of the reasons why we're working on big data so heavily."

**http://breakingdefense.com/2016/07/strategic-capabilities-office-is-buying-time-william-roper/?utm_source=Sailthru&utm_medium=email&utm_campaign=Defense%20EBB%2007-18-16&utm_term=Editorial%20-%20Early%20Bird%20Brief**

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### The Force Is Not With You: Government Rules Could Land 'Star Wars' Drone Pilots in Prison

What kid hasn't watched "Star Wars" and imagined skimming the Death Star trench in an X-Wing, tangling with TIE Fighters to save the Rebel cause?

For a long time, playing out these flights of fancy was restricted to video games. But thanks to drone technology—not quite anti-gravity, but close—the Force may be coming to a neighborhood near you. A company known as Propel is marketing "Star Wars Battle Quads"—faithful miniatures of some of the most iconic craft from that galaxy far, far away—that can dogfight one another above your backyard.

When the models are released, enthusiasts will be able to blast out of their backyard spaceport in the Millennium Falcon, tangle with Darth Vader's TIE Fighter, or dodge trees on Imperial speeders.

But, kids (and let's be honest, adults, too), before you get too excited, keep this in mind: While most people will see these as harmless toys, regulators at the Federal Aviation Administration claim these palm-sized drones are "aircraft" no different than a passenger-laden 747 jet. That means that drones are subject to a host of federal laws and regulations that were originally written for manned aircraft, and carry severe civil and criminal penalties that are disproportionate in this context.

Here are just a few of the absurd crimes the FAA could accuse you of committing:

Destroying an aircraft—According to 18 U.S.C. § 32, anybody who willfully "damages, destroys, disables, or wrecks any aircraft in the special aircraft jurisdiction of the United States" has committed a felony punishable by up to 20 years' imprisonment. Amazingly, the FAA has confirmed that this statute applies to drones, even though it is abundantly clear that Congress wrote the statute to criminalize takedowns of traditional, manned aircraft by terrorists and criminals. So, dogfight at your own risk—and don't even think about recreating the speeder bike chase on Endor.

Aiming a laser pointer at an aircraft—18 U.S.C § 39(A) criminalizes "knowingly aim[ing] the beam of a laser pointer at an aircraft" or "at the flight path of such an aircraft." Doing so can land you in prison for up to five years. Again, criminalizing this behavior only makes sense in the context of manned aviation, where a laser point can—and has—blinded pilots behind the controls of actual aircraft. What damage, however, is done by aiming a laser pointer at a drone? The jury is still out on that question, but violating this law is almost guaranteed given that these battle quads feature laser pointers intended to mimic Rebel blasters.

Failing to register as a drone owner—Last December, just days before Christmas, the FAA released a rule mandating that all drone owners register themselves with the FAA if the drone they are flying is used for hobby or recreational purposes, and weighs more than 0.55 pounds—the equivalent of two sticks of butter. Failure to register before your first flight constitutes a felony punishable by up to $277,500 in fines and three years' imprisonment, a penalty scheme that the FAA's own drone registry task force noted was utterly disproportionate in the drone context.

As if this is not bad enough, hapless drone operators flying purely for fun could find themselves fined for failing to comply with commercial drone regulations. For years, the FAA has divided drone activities into "recreational" and "commercial" categories along largely arbitrary and ill-defined lines. The result: Someone may think that he is flying purely for fun, but the FAA might think otherwise, and proceed to fine him for failing to comply with rules he did not know applied to him.

In fact, in one case, the FAA targeted a drone operator in Florida in precisely this fashion, determining that since he posted videos of his drone joyrides on YouTube, a site that had advertisements, his activity was, in fact, commercial. Another man, Mical Caterina, used a drone to photograph an event protesting the killing of Cecil the Lion. He did this as a favor to a friend, and for his troubles the FAA is now fining him $55,000 for failing to comply with commercial drone rules.

Thanks to draconian rules likes these, arbitrarily enforced by FAA bureaucrats without concern for the costs of unpredictable regulatory enforcement, yours may be the drones they're looking for. It's no wonder that some might yearn to become a Rebel and take out their frustrations on the Empire's finest.

But future X-Wing pilots should probably restrict themselves to bull's-eyeing womp rats instead of other drones, because if you actually take down Darth Vader's toy TIE, you could find yourself hauled before a judge on federal felony charges. And no, "restoring peace and justice to the Galaxy" is not likely to be a winning defense.

**http://dailysignal.com/2016/07/22/the-force-is-not-with-you-government-rules-could-land-star-wars-drone-pilots-in-prison/?utm_source=TDS_Email&utm_medium=email&utm_campaign=MorningBell&mkt_tok=eyJpIjoiTmpObE1EVXdOalUxWVRBMyIsInQiOiJJWkdUUWw5YTJXSmtaSkxJdGtlZ1pWaEd6TmdZYXFrZmRic3hKTjVZT2Y1NmNcL0JVcVBvcnZpY3pWYVZOOWxobFQ5alVZRkZrczZaU1ZxdnZhUXlORUhER1BUTFJrTHVzQVVzUGFKNEFMTEE9In0%3D**

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### UUVs hit their stride

New designs in autonomous submersibles for military applications are setting new standards for long-endurance power storage and stealthy propulsion for surveillance, mine warfare, and anti-submarine warfare operations.

Unmanned underwater vehicles (UUVs) have been compared to cats' whiskers as extended sensors, although they could more accurately be compared to catfish barbels, whisker-like feelers loaded with tiny taste buds and olfactory sensors to help the fish survive in dark, murky waters.

UUVs are the undersea cousins of unmanned aerial vehicles (UAVs), but are running two decades or more behind UAVs in development and military implementation - a situation U.S. Navy officials say is about to change.

"The key technologies for UUVs in general really can be categorized in autonomy and power, which have had the most focus in the last few years," says Dan Tubbs, deputy director of sea & land at Boeing Phantom Works in Huntington Beach, Calif. "Battery power is one of the keys, but other things are being looked at by ONR [Office of Naval Research] and other companies, such as fuel cells, aluminum power capability, air-independent power, etc.

"You see a lot of AUVs [autonomous undersea vessels] in oil and gas today, where a commercial surface ship will launch a UUV to traverse the sea floor and bring data back," Tubbs continues. "In the military world, work is going on with Knifefish [General Dynamics], which would use UUVs to do mine reconnaissance on the sea floor. That and other programs are really doing recon, but other work is being done to keep people out of dangerous locations, such as disabling [underwater] mines."

A key difference between military UAVs and UUVs is communications, Tubbs adds: "UAVs have evolved rapidly in direct communication with people on the ground while flying. For UUVs, there is no real high-bandwidth communications path for that kind of direct link. So while AUVs will follow, to a large degree, the path forged by UAVs, there still needs to be significant work on how to talk to those vehicles, especially in terms of weaponized UUVs. ISR [intelligence, surveillance, and reconnaissance], whether below water or on the surface, is absolutely viable for UUVs today, although they still have to overcome communications limitations."

The counter-UUV challenge

A small business innovation re- search solicitation last year gave a detailed Navy description of the requirements for advancing and deploying next-generation UUV technologies to counter emerging threats, including enemy UUVs:

"New or improved sensing concepts and technologies are needed to better recognize the presence of UUVs operating in ports and harbors, particularly in the proximity of U.S. Navy ships and submarines," the solicitation stated. "The maturity and proliferation of UUVs throughout the world is presenting an emerging challenge for force protection in harbor environments. It is important to counter sensor-laden units that do not present a direct threat, but an armed UUV presents a particularly compelling challenge. The mobility of UUVs limits the effectiveness of traditional mine countermeasures, like change detection."

Ships tied up in harbors are stationary and inviting targets for UUV sensors or weapons. "The stationary nature of the assets that are being protected in harbors allows for slow and deliberate approaches by enemy platforms," the solicitation states. "Current strategies for detecting and classifying UUVs employ systems that were originally designed to detect combat swimmers and scuba divers. A number of these systems have demonstrated some capability against UUV targets that were presented in a controlled research environment, but the typical warning ranges do not provide a completely satisfactory response window. It is envisioned that a multimodal layered approach has the potential to significantly increase the average response window available to counter UUV approaches to U.S. Navy assets."

Given the ubiquity of and nearly universal reliance on UAVs after 15 years of constant combat development, it may be hard to remember the scant military interest in unmanned aircraft decades ago. Military interest in UAVs did not start rising until scientists at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., noted Israeli efforts to remove human pilots from dangerous reconnaissance missions. As a result, DARPA began a series of small research programs.

It has been a similar challenge for UUVs and their proponents, especially given many years of predominantly land warfare and air-dominance operations. UUV interest revived, however, in the wake of a deadly small boat terrorist attack on the destroyer USS Cole in the Yemen harbor at Aden in 2000.

The GhostSwimmer UUV from Boston Engineering is designed to mimic the behavior and movement of a fish to preserve stealth for military missions like surveillance, mine countermeasures, port security, and similar defense and homeland security applications.

## Growing interest in UUVs

UUV interest later increased with feigned Iranian attacks on U.S. ships in the Persian Gulf, constant threats against naval and commercial shipping by North Korea, the growing U.S. face-off with China in the Western Pacific, pirates off the coast of Africa, and even the use of relatively primitive semisubmersibles by drug smugglers off U.S. coasts in the Atlantic, Pacific, Caribbean, and Gulf of Mexico.

"Unmanned capabilities have a high value in removing the risk to humans, but the success of these technologies in UAVs has made it a much more mainstream option for UUVs," notes Aaron Heisler, mechanical engineering manager at embedded computing specialist Extreme Engineering Solutions (X-ES) in Middleton, Wis. "Regardless of the mission - SIGINT, offensive, communications - once we have the capabilities to perform those without putting humans at risk, our regional influence will not be restricted by very expensive manned platforms.

"There has been a very significant interest in the latest processors for prepackaged small-form-factor solutions, the goal being to improve the prime's capability, cost- and schedule-wise," Heisler continues. "Expectations following creation of N99 [Unmanned Warfare Systems Directorate] to push these technologies in this application space is for significant advancement and more military and government interest in UUVs. I think we're approaching the threshold where UAV success and widespread acceptance are opening the door for UUVs. The creation of the new office should ensure those technologies will see significant investments in the future."

DARPA continues to lead military research of future technologies and missions for unmanned marine vehicles that operate on the surface or under the water. One of DARPA's high-profile research programs is the Anti-Submarine Warfare [ASW] Continuous Trail Unmanned Vessel (ACTUV) program to develop an unmanned surface vessel (USV) optimized to track quiet diesel-electric submarines persistent to limit the submarine's tactical capacity for surprise.

"We're looking for test-ready, multi-sensor approaches that push the boundaries of today's automated sensing systems for unmanned surface vessels," DARPA Program Manager Scott Littlefield says. "Enhancing the ability of these kinds of vessels to sense their environment in all weather and traffic conditions, day or night, would significantly advance our ability to conduct a range of military missions."

Next is the DARPA Blue Wolf to develop UUVs with inherent operational and tactical advantages like stealth and surprise. Blue Wolf also is an attempt to introduce fundamentally new UUV designs.

## Overcoming size and weight

Today UUV size, weight, and volume are constrained by their launch and recovery systems. UUV range, moreover, is limited by the amount of energy available for propulsion and the power necessary to maintain underwater speeds. Current state-of-the-art energy sources are limited by safety and certification requirements for host platforms.

In September 2015, the Naval Undersea Warfare Center (NUWC) in Keyport, Wash., awarded $2.5 million Blue Wolf contracts on behalf of DARPA to Boeing Defense, Space & Security in Huntington Beach, Calif., and to Lockheed Martin Mission Systems and Training in Riviera Beach, Fla. They joined the Charles Stark Draper Laboratory in Cambridge, Mass., which won a $3.7 million Blue Wolf contract, and Applied Physical Sciences (APS) Corp. in Groton, Conn., which won a $3.1 million Blue Wolf contract.

DARPA also is working on the Hydra Distributed Undersea Network to create a force multiplier that enables rapid, scalable, and cost-effective deployment of capabilities much faster and more cost-effectively. U.S. Navy assets must cover vast regions of interest around the globe even as force reductions and fiscal constraints continue to shrink fleet sizes. To maintain an advantage over adversaries, the Navy must project key capabilities in multiple locations at once, without the time and expense of building new vessels to deliver those capabilities.

"The climate of budget austerity runs up against an uncertain security environment that includes natural disasters, piracy, ungoverned states, and the proliferation of sophisticated defense technologies," DARPA's Littlefield says. "An unmanned technology infrastructure staged below the ocean's surface could relieve some of that resource strain and expand military capabilities in this increasingly challenging space."

Rear Adm. Mathias Winter, chief of the Office of Naval Research (ONR) in Arlington, Va., and Navy Secretary Ray Mabus also have touted development of a UUV that can operate underwater for long periods without refueling.

The program-of-record in that regard is the Large-Displacement UUV (LDUUV), a naval prototype that would use new energy technologies to enable months of operations in the littorals without returning to port or being directed from a mothership. According to ONR documents, "new energy sources for UUVs will increase the current energy density significantly, allow for quick recharge or refueling, operate at an acceptable cost level, and enable pier-to-pier operation with months of endurance."

The BIOSwimmer UUV from Boston Engineering, a biologically inspired UUV built to resemble a tuna fish, is designed for inspecting ships, securing ports, and marine maintenance.

UUV mothership

While Boeing has been one of the contractors bidding to be prime on the LDUUV, the company's Phantom Works in Huntington Beach, Calif., has moved ahead using company money to develop just such a vessel: the Echo Voyager, which rolled out on 10 March 2016 and is scheduled to begin sea trials off the California coast this summer.

"The Navy is changing its acquisition approach and we're waiting to see how that plays out," says Boeing's Tubbs about LDUUV, but adds Boeing is moving forward with its in-house-funded program. "Around 2010, we embarked on developing a concept for something that could change the paradigm on how UUVs operate in terms of increasing their legs so they could be out for weeks or months at a time

instead of only two or three days. And removing UUVs from the tyranny of the host platform, which limits UUV size as well as redundancies and fault tolerance onboard.

"With invested Boeing money to change the UUV paradigm, how UUVs are utilized in commercial, military, and science markets, to provide a change to the commercial off-the-shelf (COTS) curve on how to use UUVs for important missions," Tubbs says. "We believe we have taken a large step. We've also done work on how to support the UUV in the field; Echo Voyager is designed so it is supportable and maintainable by folks on the pier without being pulled from the water, much as you would a manned submarine, which makes it much more economical to utilize."

With its hybrid rechargeable power system and modular payload bay, the 51-foot Echo Voyager follows earlier Boeing UUV designs, such as the 32-foot Echo Seeker and 18-foot Echo Ranger, but is the company's first to offer fully autonomous, long-duration capability with sufficient payload space for a wide range of missions.

While it is too early for customer contracts on the Echo Voyager, Tubbs says if they received an order today, they could deliver the first vessel in 24 months or less and, without significant additions to the facility, produce at least two a year at Huntington Beach.

Master plan for UUVs

While the current version of "The Navy Unmanned Undersea Vehicle Master Plan" is classified, the publicly released 2004 version listed 11 mission categories for UUV operations: intelligence, surveillance, and reconnaissance; mine countermeasures; anti-submarine warfare; inspection/identification; oceanography; communications/navigation network node; payload delivery; information operations; time-critical strike; barrier patrol for homeland defense and force protection; and sea base support.

Accomplishing so wide a variety of missions will require the same kind of developmental work that has gone into UAVs since the terrorist attacks of 9/11, with many of those able to transfer directly or with only minor modifications to UUVs.

One potential use for the UUVs would be to act as an undersea warning and control system - a submersible version of the U.S. Air Force Airborne Warning and Control System (AWACS) surveillance and air traffic and control system jet. "A UUV with an AWACS capability for subs to surface ships is a possibility, as is expanding communications, where multiple services engaged simultaneously may not always work," says Joe Eicher, business development manager at embedded computing specialist Kontron in Poway, Calif.

Eicher also cites the Northrop Grumman Battlefield Airborne Communications Node (BACN) as a future candidate for UUVs. The BACN, he says, "can serve as a translator between communications technologies. You can see a UUV designed to bridge gaps in hardware and feature interoperability in a similar manner. Battery power will be a very important part of the future of UUVs. If the battery runs out before it gets home, it might sink and become a target for enemy recovery. So intelligent power management would have to be employed in a UUV, including knowing when to return to base."

One issue with UUVs continues to be size. "These vehicles have been around for some time on the commercial and research sides, but are a relatively recent endeavor on the military side to develop on a scale large enough to be of use to the Navy," Kontron's Eicher says.

"It seems like a natural evolution from all the work that has been done on UAVs, but developing underwater capability for military use is relatively new," Eicher adds. "There have been proof-of-concept efforts, such as Echo Ranger, but I think we're now moving beyond the point where we showed something to the Pentagon, only to see it mothballed, to actually moving forward with development and deployment."

Medium- to large-sized UUVs designed by Boeing are demonstrating enabling technologies for a future UUV mothership that could deploy smaller UUVs or even unmanned aircraft for wide-area surveillance.

Open-systems electronics

A new entrant into the UUV market is North Atlantic Industries (NAI) in Bohemia, N.Y. For the past year NAI engineers have been adapting their company's boxes, boards, and I/O for a classified mine-hunting UUV program. Their overall UUV efforts include onboard equipment to analyze sensor data, gauge strain, and measure water temperature, says Lino Massafra, NAI's vice president of sales and marketing. While most of that data is used on and by the UUV, NAI also can provide Ethernet communications back to a manned vessel.

"The entire architecture we're offering for the UUV market is the same as we offer for custom-on-standard-architecture [COSA] for all our customers," Massafra explains. "That fits in nicely with the integrated modular architecture some U.S. Department of Defense people have been resisting but now are beginning to understand the threats are changing, almost monthly, and if it takes five to 10 years to bring a new program out, we don't have that kind of time anymore."

NAI engineers capitalize on the company's expertise in modular electronics architectures to adapt components and subsystems to UAV applications. "A modular architecture helps us pick and choose how to configure a system and, with very little if any non-recurring engineering, we can turn things around and populate systems with specific I/O functions and processing to meet specific requirements as part of our accelerated time-to-market," Massafra says. "That's our COSA approach. Customers can do everything in-house, which is very expensive, or go full COTS, which makes you dependent on others. We bring together the best of both worlds, with a custom solution using COTS products under COSA."

Component companies such as NAI and Kontron must maintain a constant vigil on the emergence of new chips with higher efficiency, higher channel count, better resolution, and higher speed that can be used in future products.

"The key thing is there are only a limited number of configurations in a fixed-box design as opposed to our COSA approach," Massafra notes, adding a warning that the federal government may be making it easier for other nations to close the technology gap, including UUVs. "What's preventing the U.S. from moving forward is budget cuts and so many rules and regulations being put in place that limit the

innovative aspects of small businesses such as ours," he asks. "They may only want to buy five pieces from us off-the-shelf, but then when they want more they are asking us to justify earned value management and a lot of other paperwork."

The Boeing Echo Voyager is one of the largest UUVs ever developed and is expected to be a prototype for future generations of UUV motherships and long-range submersible surveillance craft.

Homeland security concerns

ONR and the U.S. Department of Homeland Security Science & Technology Directorate (DHS S&T) are supporting the advancement of two related products at the Boston Engineering Corp. Advanced Systems Group in Waltham, Mass.

The first is GhostSwimmer, a stealthy biomimetic UUV for military missions like surveillance, mine countermeasures, port security, and similar defense and homeland security initiatives. The other is BIOSwimmer, a biologically inspired UUV built to resemble a tuna fish. It has broad commercial and homeland security applications like inspecting ships, securing ports, and marine maintenance.

"Unmanned systems directly support our sailors, making their jobs easier, more efficient, and, ultimately, a more effective combat team," says Navy Rear Adm. Robert Girrier, director of the Navy's N99 office of unmanned weapon systems.

"As unmanned systems continue to come online and mature, we're changing how we think and how we operate, so we're not just reacting to the challenges we face today, but focusing creativity and initiative to ensure we prevail in the future," Girrier says. "I remain committed to developing and integrating unmanned systems into our broader warfare areas."

A wide range of companies are looking to get a piece of what is seen as a major growth market in the coming decade, not only vessel manufacturers, but sensor, power, communications, and other mission-support technologies and components. German-based Kontron AG, for example, offers control, guidance, sonar, and other components to UUV primes.

"The common thread of interest on anything unmanned is safety critical," says Kontron's Eicher. "If you have a zone where you don't want to risk collisions, you want the UUV to operate in a safety-critical mode. Anytime you have any kind of unmanned vehicle making decisions as it moves along, you want to be very, very sure it won't damage anything or risk lives. That has to be a mechanism that not only detects a problem, but has a fallback position, such as shutting down and floating to the surface.

"There also are questions about throughput - how many cores can we provide, what is our thermal efficiency - so it meets their envelope for environmental operability," Eicher continues. "Can it withstand the pressures in which it operates? What is the total load of the processor? How do we feed that out? The Navy also will want to maintain very tight-loop security on UUVs so the enemy cannot employ any countermeasures to usurp functionality or spoof us with erroneous data.

"UAVs have been around a long time now and more effort has been applied to making future generations stealthy," Eicher says. "That also seems a logical step for UUVs, applying sister technologies similar to UAVs."

Networking UUVs

Today's UUVs typically receive control via data link from a manned surface ship or submarine. Due to the relatively short range of underwater communications, finding a UUV could make it easier to backtrack it to that vessel, no matter how stealthy it might be.

That is one benefit of long-endurance autonomous undersea vessels (AUVs), such as the proposed LDUUV or Boeing's Echo Voyager, which operate independent of and far from their controllers.

At a 29 January 2016 event cohosted by the U.S. Naval Institute and the Center for Strategic and International Studies, Girrier described how his new office fits into the Navy's other staff centers - Amphibious Warfare Directorate (N95), focused on ship-to-objective maneuver; Surface Warfare Directorate (N96), implementing a distributed lethality concept; Undersea Warfare Directorate (N97), working to achieve undersea dominance; and Air Warfare Directorate (N98), which will build the airwing of the future.

The X-ES XChange3018 is a conduction- or air-cooled, 3U VPX, 10 Gigabit Ethernet switch module, which can support compliance with the VICTORY specification as an infrastructure switch and router in UUV applications.

"It is the future. It is not at the expense of, it is not in replacement of - it is a complement to [the other warfare directorates]," Girrier told the conference. "The domain is the enabler; the domain is where the vehicle [operates], where the 'what' plays out. It's increasingly about 'how' and 'how fast' for that larger end-state. So I think there's a greater realization of cross-boundaries.

"We are living in a world that is connected more than ever with the surge of technology and rapid information sharing. We are also living in an increasingly dangerous world with contested regions on the sea, in the air, under the sea, and in cyberspace. My job, drawing on fleet experience, is to see how unmanned systems and technology can help solve problems we face in contested regions around the world. How can unmanned systems help leverage the capabilities of our ships, submarines and aircraft?"

**http://www.militaryaerospace.com/articles/print/volume-27/issue-4/special-report/uuvs-hit-their-stride.html?cmpid=enl_MAE_Weekly_2016-07-27&eid=288641596&bid=1480016**

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