



Unmanned Systems Sentinel

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Thanks to Robin Alexander for providing several of the below articles. 20 APR 2016

Please keep in mind that in most instances the below summaries are excerpts from the original article. The full articles can be viewed at the accompanying hyper-links. The inclusion of these links does not represent an endorsement of the organization, service, or product. Immediately below are this edition's highlights with links to the respective articles:

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NAVY/USMC:

Wallops Island Ideal Location for Navy MQ-4C Triton Unmanned Aircraft

WASHINGTON, April 12, 2016 -- Congressman J. Randy Forbes (VA-04) visited Wallops Island on Tuesday, April 12th, 2016 to tour space facilities and meet with the Wallops Island Regional Alliance. His visit coincided with the Navy's consideration of Wallops Island as the East Coast base for the MQ-4C Triton unmanned maritime surveillance aircraft, which would require the stationing of up to 400 personnel plus family members at Wallops.

"Wallops Island does important work, with tremendous potential to play an even more significant role for NASA, our national defense, the commercial space industry, and the economy of the region," Congressman Forbes said. "As a member of the House Armed Services Committee and Chairman of the Seapower subcommittee, I am particularly interested in opportunities to bring new military missions to Wallops. With its prime location, room to grow, and experience operating unmanned systems, Wallops is an ideal place to base the Navy's new Triton aircraft, and I look forward to discussing that option with the Pentagon."

The Navy is currently considering Wallops as one of three East Coast options for permanently basing the MQ-4C Triton unmanned maritime patrol aircraft. The Triton provides real-time intelligence, surveillance, and reconnaissance (ISR) capabilities in maritime and coastal regions. Should the Navy select Wallops as the permanent East Coast location, it would serve as both a launch and recovery site, as well as an operational-level maintenance hub, supporting rotational deployments of personnel and aircraft outside the United States, in addition to the up to 400 permanent personnel plus families stationed there.

Wallops' central location in the Mid-Atlantic Region; its proximity to Patuxent River, Maryland where the Triton is developed; the presence of NASA's own RQ-4 Global Hawks (a similar aircraft) at Wallops; and the facility's relatively uncrowded airspace make it an ideal permanent location for this platform. Currently, the Navy is conducting an environmental assessment, with a decision on the permanent basing of the Triton expected later this year.

The facility at Wallops Island, Virginia is home to some of the most innovative work in the commercial space industry, and supports the needs of both NASA and the Department of Defense. Whether it is providing field carrier landing practice to Navy pilots, supporting rocket launches as part of Missile Defense Agency exercises, or serving as one of two U.S. sites launching vital cargo to support the International Space Station, Wallops is an integral part of U.S. space efforts.

<http://www.standardnewswire.com/news/4289811225.html>

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Navy underwater drones that act like submarines

NEWPORT, R.I., 15 April 2016. U.S. Navy anti-submarine warfare (ASW) experts needed target underwater drones that mimic the acoustic and non-acoustic signatures of advanced nuclear- and diesel-powered submarines. They found their solution from Lockheed Martin Sippican Inc. in Marion, Mass.

Officials of the Naval Undersea Warfare Center (NUWC) in Newport, R.I., announced a \$49.5 million contract to Lockheed Martin Sippican on Thursday to build 39 unmanned underwater vehicles (UUVs) able to emulate the behavior and sensor signatures of enemy submarines to help Navy ASW experts practice their skills from surface warships, submarines, helicopters, and fixed-wing aircraft.

These Sippican UUVs that can disguise themselves as potentially hostile submarines are called the MK 39 Mod 2 expendable mobile antisubmarine warfare (ASW) training targets (EMATT).

These next-generation ASW training targets are designed to help Navy submarine-, surface ship-, and aircraft-based ASW forces train to detect, hunt, and destroy quiet enemy submarines.

Navy aircraft and surface warship crews will use the second-generation EMATT to train in open-ocean, unrestricted, and on-range ASW training missions. The Navy can launch EMATT out of sonobuoy launchers on ASW helicopters and fixed-wing aircraft, and from moving surface warships.

The EMATT is 3 feet long, 5 inches in diameter, and weighs 22 pounds, so it is small enough to be dropped into the ocean by hand from ships or helicopters.

The submarine-emulating UUV has sensors that emulate acoustic and non-acoustic signatures of advanced nuclear- and diesel-powered submarines, and can operate for as long as eight hours on one battery charge. Sippican also offers a version of EMATT that can be launched from submarines called the Submarine Mobile Acoustic Training Target (SUBMATT).

Control software for the Sippican EMATT runs on a Windows PC or laptop computer, and can program the target's course, depth, speed, time, and passive tonal changes. The software also can program the EMATT to maneuver automatically in response to active sonar pings.

Lockheed Martin engineers are designing the latest version of EMATT to be more affordable than previous generations of ASW training targets. The latest version has programmable acoustics, better representation of hostile submarines than previous versions, and acoustic communications links that Navy forces can use in daytime, at night, and in rough seas, company officials say.

Lockheed Martin Sippican will do the work on Thursday's contract in Marion, Mass., and should be finished by March 2021. For more information contact Lockheed Martin Sippican online at www.sippican.com, or the Naval Undersea Warfare Center-Newport at www.navsea.navy.mil/Home/WarfareCenters/NUWCNewport.

<http://www.militaryaerospace.com/articles/2016/04/underwater-drones-submarines.html>

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Navy Unveils New Underwater Drone

SAN DIEGO - The Navy Wednesday unveiled what could be the future of unmanned vehicles.

When other kids were playing with toys, Wayne Liu was making them better and faster.

"When the Navy came along and said, 'I'll tell you what, we'll let you test out submarines and planes and aircraft carriers,' that was a like an offer too good to be true," Liu explained.

He has served for 25 years, and he is thrilled about the latest project he is taking part.

Unmanned vehicles can run out of juice after nine hours or 90. Recharging them can be dicey.

"You haul it out of the water in front of everybody onto a ship," Liu said.

That puts eyes on our underwater eyes. That is where the Undersea Power and Data Station (uPODS) comes in.

U.S. Third Fleet unveiled it at Naval Base Point Loma on Wednesday. It could be the next line of new and improved unmanned vehicles.

"The uPod is basically a self-serve gas station for unmanned vehicles," Liu explained.

It does it with energy. It wirelessly charges docked unmanned vehicles, and it soaks up the sun and even pumps power into itself.

If it is in the middle of the ocean with no service, it has what is basically a WiFi hotspot, so you can control it and collect data.

"The reason why it's cost effective for the taxpayers is that the Navy doesn't have to do everything by themselves," Liu added.

U.S. Third Fleet worked with Maritime Tactical Systems, Inc. (MARTAC) and Booz Allen Hamilton, which built a 360-degree hi-def DVR with infrared capabilities. It can also tow items for capture.

It does dangerous work so servicemembers do not have to, and it is a project Liu is proud of.

"That's pretty exciting," Liu said.

It is just one of 41 experiments in a program called Trident Warrior, which the Navy will test this summer.

<http://www.10news.com/news/military/navy-unveils-new-underwater-drone-041316>

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U.S. To Sail Submarine Drones in South China Sea

WASHINGTON – As it watches China build up its presence in the South China Sea, one reclaimed island at a time, the U.S. military is betting on a new technology to help retain its edge – submarine drones.

During the past six months, the Pentagon has started to talk publicly about a once-secret program to develop unmanned undersea vehicles, the term given to the drone subs that are becoming part of its plan to deter China from trying to dominate the region.

Ashton Carter, U.S. defense secretary, made special mention of drone subs in a speech about military strategy in Asia and hinted at their potential use in the South China Sea, which has large areas of shallower water.

The Pentagon's investment in subs "includes new undersea drones in multiple sizes and diverse payloads that can, importantly, operate in shallow water, where manned submarines cannot," said Mr. Carter, who visited a U.S. warship in the South China Sea on Friday.

By lifting the veil on new technologies such as drone subs, some of which it hopes will be operational by the end of the decade, the Pentagon is trying to deter potential rivals such as China and Russia by pointing to its continuing military superiority. The drones are part of a push by the U.S. military into robotics as it tries to keep one step ahead.

"The idea is that if we were ever to get into a bust-up in the South China Sea, the Chinese would not know for sure what sort of capabilities the U.S. might have," says Shawn Brimley, a former White House and Pentagon official now at the Center for a New American Security. "This might have some deterrent impact on the potential for provocative behaviour."

As military competition intensifies in the western Pacific between the U.S. and China, submarines have become one of the key areas. China's heavy investment in missiles has put at risk U.S. land-based forces

in the region and some of its surface vessels. As a result the U.S. is investing \$8bn next year in submarines to “ensure ours is the most lethal and most advanced undersea and anti-submarine force in the world,” as Mr. Carter put it last week.

Small, remotely operated subs have been used for some time in search and rescue and the Navy has been using Remus drones to search for mines. The new investments are in more autonomous vessels that might eventually carry weapons.

Last autumn, the U.S. Navy unveiled a 10-foot, semi-autonomous sub drone known as the large displacement unmanned underwater vehicle , which is due to conduct its first test voyage in open seas in the summer. Officials hope that a squadron will be operating by 2020 if tests go well. As well as being able to operate for 30 days at a time, other distinguishing features of the submarine include being yellow.

The initial function of sub drones is expected to be surveillance, however naval planners believe there are endless potential uses. One model is what one official calls a Russian doll approach – with a mother sub or surface vessel that can then release a series of much smaller drones that could be mines or used to track subs or even launch their own missiles.

Small sub drones would be much harder to monitor using sonar systems that are designed to find large objects in deep waters. It might be possible, for instance, for a vessel to enter an enemy harbor unobserved.

The Pentagon’s Defense Advanced Research Projects Agency has been testing a program it calls upward falling payloads – robot pods that would hide on the ocean floor for years and release sub drones or small surveillance aircraft once activated. Another reconnaissance drone under development is shaped and swims like a small fish.

“The use of undersea drones opens up a whole new area of capabilities,” said Mr. Brimley.

The principal obstacles at the moment are providing enough power for the drones so that they can stay underwater for long periods and communicating with them.

Officials are also debating how much autonomy they will want to give sub drones – an issue that will become more difficult if and when they start to carry weapons.

As well as investing in undersea drones, the U.S. is developing unmanned surface vessels. Last week the Pentagon unveiled what it calls the Sea Hunter, the prototype of a sub hunter. Robert Work, deputy secretary of defence, said the vessels could be used in the western Pacific in the next five years.

<http://www.ft.com/intl/cms/s/0/e5dd3d5a-0314-11e6-af1d-c47326021344.html>

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ARMY:

USAF:

USAF to integrate Litening pod onto Reaper UAV

The US Air Force (USAF) is to integrate the Northrop Grumman AN/AAQ-28(V) Litening targeting and designation pod onto the General Atomics Aeronautical Systems Inc (GA-ASI) MQ-9 Reaper unmanned aircraft system (UAS) to demonstrate the capability, it was disclosed on 12 April.

A pre-solicitation notice posted on the Federal Business Opportunities website outlines the Air Force Life Cycle Management Center (AFLCMC) Medium Altitude UAS Division's intention to award a sole-source contract to GA-ASI to carry out the integration work. No further details related to the purpose of the work or project timelines was revealed.

As noted in IHS Jane's C4ISR & Mission Systems: Air , the AN/AAQ-28(V) Litening is a family of airborne laser target designator pods developed by Israeli-company Rafael Advanced Defense Systems and Northrop Grumman. They offer precision strike and non-traditional intelligence, surveillance, and reconnaissance (ISR) capabilities in day/night/under the weather conditions for fighter and tactical strike aircraft via a staring forward looking infrared (FLIR); charge-coupled device (CCD) TV cameras; a laser designator; laser marker; laser spot tracker; and an Inertial Navigation Sensor (INS) on the stabilized gimbal.

In USAF service, the externally-mounted AN/AAQ-28(V)4 Litening Advanced Targeting (AT) pod is already integrated aboard a number of manned aircraft types, such as the Fairchild-Republic A-10 Thunderbolt II; Boeing B-52H Stratofortress; Boeing F-15E Strike Eagle; and Lockheed Martin F-16 Fighting Falcon.

<http://www.janes.com/article/59513/usaf-to-integrate-litening-pod-onto-reaper-uav>

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USAF bomber command shopping for drone dogfighters

The US Air Force unit charged with guarding a nuclear arsenal is searching for mini-drones designed to electronically dogfight other mini-drones.

A request for proposals released on 11 April by the Global Strike Command's security forces directorate seeks a supplier for a small fleet of interceptor drones weighing less than 2.72kg (6lb) each.

This counter-unmanned air system (UAS) force would be launched against small commercial drones sold in the USA, according to solicitation document.

The USAF envisions defeating small drones by disabling their communications equipment. The USAF drone would first detect signals commonly associated with commercial drones and wait for the all-clear from a ground operator. It would then attempt to broadcast a jamming signal over a narrow 60-degree arc up to a half-mile away.

The jammer should be able to disrupt at least four major communications frequencies – namely, 433MHz, 915MHz, 2.4GHz and 5.8GHz. The USAF also would attempt to jam the drone’s navigation signal, targeting both GPS L1 and GLONASS L1 both separately and concurrently, the solicitation documents say.

Up to 38 anti-drone systems will be distributed across eight Global Strike Command bases, including Barksdale, Dyess, Ellsworth, FE Warren, Kirtland, Malmstrom, Minot and Whiteman, housing the USAF’s strategic bomber fleet and managing intercontinental ballistic missiles.

The USAF expect the supplier to deliver all 38 systems within 90 days of contract award.

<https://www.flightglobal.com/news/articles/usaf-bomber-command-shopping-for-drone-dogfighters-424121/>

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Air Force Mulls Adding More Bases for MQ-9 Reaper Drones

The service is considering creating a new Reaper wing with units at two locations, according to a statement released Tuesday from the service. The move comes in response to surveys of officers and enlisted personnel who said they want more opportunities for such assignments.

The Air Force said it plans to review sites in the continental U.S., Alaska and Hawaii that don’t already host MQ-9s and will decide on the locations using several criteria, including runway length, capacity, environmental requirements and cost.

The first location under consideration “must also have an active-duty flying wing or group that performs at least one core RPA mission and/or is co-located with an active-duty distributed group system,” the release states, using the acronym for remotely piloted aircraft. “Crews will fly the MQ-9 from these locations but no aircraft will be associated with these units.”

The second location would require an 8,000-foot-long runway to host a full wing of 24 Reapers and be capable of performing launch and recovery and mission control, the release states.

The Reaper, nicknamed the “hunter-killer” for its ability to conduct both strike and surveillance missions, is the bigger brother to the MQ-1 Predator medium-altitude unmanned aerial vehicle, or UAV. Both systems are made by General Atomics Aeronautical Systems Inc. of San Diego.

The Air Force as of Sept. 30 had a total of 165 MQ-9As in inventory, in addition to 130 MQ-1Bs, according to information previously released by the service. Taken together, the drones account for more than half of the service’s intelligence, surveillance and reconnaissance fleet.

The service is desperate to attract more drone pilots. Many airmen in the field have been leaving due to stress and burnout, creating a shortage that has forced commanders to scale back missions.

It recently offered a new \$15,000 annual bonus to experienced RPA operators. The so-called critical skills retention bonus took effect Oct. 1 and carries a total value of between \$75,000 to \$135,000 — half of which can be paid up front — to airmen in the 18X specialty code with at least six years of experience.

The private sector is also responding to the workforce shortage. General Atomics recently opened a training academy in Grand Forks, North Dakota, for drone pilots from the U.S. and allied countries.

<http://www.dodbuzz.com/2016/04/12/air-force-mulls-adding-more-bases-for-mq-9-reaper-drones/>

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USAF introduces new measures to improve UAV community

The US Air Force (USAF) has instigated new measures to help improve the morale of its unmanned aerial vehicle (UAV) operators/pilots, in an effort to address a growing shortfall in numbers.

The two new initiatives announced by the air force on 11 April were recommended by the Air Combat Command's Culture and Process Improvement Program, which seeks to address a number of issues affecting the morale and welfare of personnel involved in UAV operations.

Firstly, eight reconnaissance squadrons will be re-designated as attack squadrons, secondly the US Air Force Chief of Staff General Mark A. Welsh III has authorized operators/pilots to log combat time when flying an aircraft within designated hostile airspace, regardless of their physical location.

In terms of re-designating reconnaissance squadrons as attack squadrons, this is in line with the USAF's wider goal of transitioning all of its General Atomics Aeronautical Systems Inc (GA-ASI) RQ-1 Predator platforms (reconnaissance) over to the GA-ASI MQ-9 Reaper (attack) by 2020. As noted by the USAF, the re-designation will affect the names, but not the core missions of UAV squadrons at Holloman (Air Force Base) in New Mexico, Whiteman AFB in Missouri, and at Creech AFB in Nevada.

The initiatives follow concerns that the USAF is losing UAV operators/pilots to low morale and stress at a time when they are needed more than ever. Operations of the Predator and Reaper-series UAVs have been surged repeatedly over the last decade. The service had been executing 65 combat air patrols in early 2015 (up from the steady-state capacity of 55), though this has now been reduced to 60 to try and alleviate some of the overload on operators/pilots.

In an effort to counter to wider malaise in the USAF's UAV community, the service is instigating its 'Remotely Piloted Aircraft (RPA) Get-Well Plan', which includes temporarily retaining a portion of pilots who are on loan from other airframes; increasing the use of Air National Guard and Air Force Reserve personnel; and seeking recently qualified MQ-1/9 pilot and operator volunteers to deploy for 179 days to 'stressed' UAV units.

<http://www.janes.com/article/59436/usaf-introduces-new-measures-to-improve-uav-community>

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USAF re-designates eight MQ-1 Predator units as attack squadrons

The US Air Force will re-designate eight General Atomics Aeronautical Systems MQ-1 Predator reconnaissance squadrons as "attack" units.

The name change has been approved by US Air Force leadership in recognition of the ongoing transition to an "all-MQ-9" force.

Even though the Predator has carried weapons since 2002, it's mostly used for intelligence, surveillance and reconnaissance missions.

It has two hard points to carry dual Lockheed Martin AGM-114 Hellfire missiles, whereas the huskier MQ-9 has six hard-points and a payload capacity of 1,360kg (3,000lbs), or four Hellfire missiles and two 227kg (500lbs) laser-guided bombs.

USAF began operating the 'RQ-1' in 1996

"The re-designation anticipates the air force's ongoing transition to an all MQ-9 fleet and acknowledges the capability of these units to support military operations that can include strikes against targets," the service announced on 11 April.

"The air force has also authorized [remotely piloted aircraft] aircrews to log combat time when flying an aircraft within designated hostile airspace, regardless of the aircrew's physical location."

The changes, approved by USAF chief of staff Gen Mark Welsh, came about as part of US Air Combat Command's culture and process improvement programme, the service notes.

The eight re-designated MQ-1 squadrons reside at Holloman AFB in New Mexico; Whiteman AFB in Missouri; and Creech AFB, Nevada.

The air force has long sought to transition to the MQ-9 and phase out the MQ-1, but war commitments and budget constraints conspired against that original schedule.

The air force revealed last August that it will shift its remaining 130 or so MQ-1s to the boneyard in 2018, except the ground control stations will remain for MQ-9 control.

<https://www.flightglobal.com/news/articles/usaf-re-designates-eight-mq-1-predator-units-as-attack-424122/>

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NATIONAL AIR SPACE:

AOPA joins industry letter supporting uniform UAS regulation

AOPA and nine other aviation groups signed a letter opposing a proposed amendment to the U.S. Senate's FAA Re-authorization Act that would do away with federal preemption in the integration of unmanned aircraft systems (UAS) into the National Airspace System.

Section 2152 of the FAA Re-authorization Act calls for federal preemption in UAS regulation, but an amendment proposed by Sen. Dianne Feinstein (D-Calif.) would eliminate that preemption and allow states and local governments to propose their own rules and regulations.

AOPA Senior Vice President of Government Affairs Jim Coon said, "AOPA's primary concern is the safety of pilots and passengers of manned aircraft, and the best way to ensure the safe integration of UAS's into the airspace is to have clear and uniformed rules across the country."

According to the letter, "Proposals by state and local governments in these areas have the potential to create a complicated patchwork of laws that may erode, rather than enhance, air safety."

The letter went on to say that non-uniformed regulation could have "a profound effect on the operations of the manned aviation community."

The Association for Unmanned Vehicle Systems International, Aerospace Industries Association, Cherokee Nation Technologies, Consumer Technology Association, DJI, Drone Manufacturers Alliance, General Aviation Manufacturers Association, National Business Aviation Association, and Small UAV Coalition also signed the letter.

<http://www.aopa.org/News-and-Video/All-News/2016/April/12/AOPA-joins-industry-letter-supporting-uniform-UAS-regulation>

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Senate Approves Amendment to FAA Bill Extending UAS Test Sites Authorization for 5 Years

Amendment to Strengthen UAS Research and Development, Support Work at UND Also Included

WASHINGTON – Senator John Hoeven today announced that the FAA Re-authorization bill now under consideration in the Senate includes an amendment he authored and introduced that will extend for five years congressional authorization for the nation's six unmanned aerial systems (UAS) test sites tasked with integrating UAS into the National Airspace. Under current law, the test sites' authorization expires next year, on September 30, 2017. The Senate approved Hoeven's amendment Monday evening.

The senator spoke on the Senate floor this week to urge support for his bipartisan legislation, which he said would enable the six UAS tests sites, including the Northern Plains UAS Test Site in Grand Forks, to continue to advance their work.

"The test sites have already made remarkable gains, such as nighttime operations, flying multiple aircraft in the same airspace and researching and testing aircraft up to 1,200 feet," Hoeven said. "Nevertheless, there's much left to do, and that will require investment and support from industry

partners. Those partners will be much more likely to use the FAA test sites if they can be sure those sites will be operational beyond the end of Fiscal Year 2017.”

The FAA Re-authorization bill passed by Congress in February 2012 included an amendment introduced by Hoeven that directed the agency to establish six test sites tasked with integrating UAS into the National Airspace. The six sites were established beginning in December 2013 following a competitive process, and Grand Forks Air Force Base was named as one of the sites. The 2012 bill authorized the test sites for five years, and the current Hoeven amendment would extend their authorization by an additional five years, through September 30, 2022.

Support for UAS Research and Development at UND

The Senate also approved a second amendment offered by Hoeven and Senator Thad Cochran to strengthen existing UAS research programs, including the FAA’s Center of Excellence on UAS (COE) which is led by the University of North Dakota (UND) and the University of Mississippi. The amendment instructs the FAA Administrator to leverage to the maximum extent possible the capabilities of the UAS COE and the test sites when establishing standards for UAS safety and certification of UAS aircraft. The COE, established in May 2015, is responsible for researching and developing technologies and policies for the use of UAS in the United States.

<https://www.hoeven.senate.gov/news/news-releases/senate-approves-hoeven-amendment-to-faa-bill-extending-uas-test-sites-authorization-for-five-years->

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DARPA Flight Tests Demonstrate Optical Sense-and-Avoid Capability

A research effort associated with DARPA’s Aircrew Labor In-Cockpit Automation System (ALIAS) program recently conducted the first successful flight tests of a shoebox-sized, plug-and-play system designed to enable manned and unmanned aircraft to automatically detect nearby aircraft and avoid potential mid-air collisions. An unmanned air vehicle (UAV) repeatedly used the technology demonstration system to detect and track in real time a Cessna 172G aircraft approaching from various vertical and horizontal distances.

The integrated sense-and-avoid (SAA) system includes a single optical camera that provides imagery for detection and tracking. The system also incorporates passive ranging features that assess the likelihood of an incoming aircraft intersecting the flight path of its host aircraft, and collision-avoidance capabilities to determine the best way to steer the host aircraft out of harm’s way. The work is part of a DARPA effort to create a low-cost, easily installed system to detect oncoming or crossing aircraft and determine the best avoidance strategy compliant with standard rules that set minimum vertical and lateral distances between aircraft during flight.

“This successful flight test is a step toward adding external perception to ALIAS’ toolkit for advancing in-flight automation,” Dan Patt, “What pilot wouldn’t want to set a box on their dashboard that would

provide an additional pair of eyes to alert of potential collisions? This SAA system has the potential to enable a wide range of manned and unmanned systems to safely integrate into an increasingly populated and complex airspace.”

DARPA has been developing this capability over the past two years and put the technology demonstration system through extensive preliminary testing before the recent flight tests, which evaluated only detection and tracking. Based on the success of those flights, DARPA is planning another phase of the effort, which includes joint funding from the U.S. Air Force Research Laboratory (AFRL).

This follow-on research would shrink the system size; further test the ranging and collision-avoidance features; mature additional capabilities of the system such as detecting aircraft below the horizon and in poor light conditions; and improve calculations for optimal aircraft trajectories to avert impending collision.

The system could ultimately serve as a line of defense in future layered air-traffic management systems that could include Automatic Dependent Surveillance-Broadcast (ADS-B) transponders and ground-based radar systems that are part of the federal NextGen effort. There is particular potential applicability for unmanned air systems or aircraft with reduced crew sizes.

The ALIAS program envisions a tailorable, drop-in, removable kit that would enable high levels of automation in existing aircraft and facilitate reduced need for onboard crew. The program intends to leverage the considerable advances that have been made in aircraft automation systems over the past 50 years, as well as the advances that have been made in remotely piloted aircraft technologies, to help shift and refocus pilot workloads, augment mission performance and improve aircraft safety.

http://www.uasvision.com/2016/04/07/darpa-flight-tests-demonstrate-optical-sense-and-avoid-capability/?utm_source=Newsletter&utm_campaign=e9cffe834b-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-e9cffe834b-297560805#comments

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FAA Reviews and Publishes Micro UAS Report

The Federal Aviation Administration (FAA) is currently reviewing the report and recommendations of the Micro Unmanned Aircraft Systems (UAS) Aviation Rulemaking Committee. The agency had tasked the group to develop recommendations for performance-based regulations that would let certain unmanned aircraft operate over people not directly involved in the flight of the aircraft. The rulemaking committee, which began meeting March 8, worked under a tight deadline of April 1 to deliver its report. The task force included a diverse set of aviation stakeholders, including UAS manufacturers, UAS operators, consensus standards organizations, researchers and academics. “We commend the committee members for their sincere dedication and for producing a comprehensive report in such a short time,” said FAA Administrator Michael Huerta. “This type of collaborative government and industry partnership is exactly what is needed to keep pace with this rapidly changing industry and will

serve as a model for future rulemaking advisory tasks.” The ARC’s consensus report recommends establishing four small UAS categories, defined primarily by risk of injury to people below the flight path. For each category, the group recommends assigning a potential risk linked to either weight or impact energy. The report also addresses operational restrictions and standards to minimize the risks associated with each category. The FAA will use the information in the report to develop a flexible, performance-based proposed rule. The public will have an opportunity to comment on the proposal based on the ARC’s recommendations. You can download a copy of the report here.

<http://www.faa.gov/uas/publications/media/Micro-UAS-ARC-FINAL-Report.pdf>

http://www.uasvision.com/2016/04/07/faa-reviews-and-publishes-micro-uas-report/?utm_source=Newsletter&utm_campaign=e9cffe834b-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-e9cffe834b-297560805

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AUVSI Study of FAA Exemptions Published

The Association for Unmanned Vehicle Systems International (AUVSI) has released an interactive analysis that finds 38 types of business operations have been approved by the Federal Aviation Administration (FAA) to fly unmanned aircraft systems commercially in the National Airspace System (NAS). According to the report that analyzed more than 3,000 FAA exemptions, aerial photography received the most, followed by real estate and aerial inspection. The report also finds that exemptions have been approved in all 50 states and Puerto Rico.

“The UAS industry is poised to be one of the fastest growing sectors in the U.S. and these numbers demonstrate that a wide variety of industries are eager to take advantage of this technology,” said Brian Wynne, president and CEO of AUVSI. “From inspecting our nation’s infrastructure to providing farmers with aerial views of their crops, the applications of UAS are virtually limitless. It’s no wonder businesses – small and large – are clamoring to use this technology.”

The report has interactive features that enable users to view the FAA exemption data in easy-to-read graphs and gain unique insight into the current landscape of the UAS industry. Using AUVSI’s web tools, users can isolate state-specific data on the most popular applications for UAS, the most prevalent manufacturers for each type of use, and economic overviews on the companies gaining FAA exemptions.

In Sept. 2014, the FAA started granting exemptions for certain low-risk commercial UAS applications under Section 333 of the FAA Modernization and Reform Act of 2012. Since then, the agency has received more than 15,000 and approved more than 4,600 petitions.

AUVSI analyzed the first 3,136 exemptions approved by the FAA. Specifically, the report finds:

The approved exemptions cover 38 different types of business operations, with aerial photography receiving the most approvals with 2,557. Real estate followed with 1,969 exemptions and aerial inspection with 1,671 exemptions.

Exemptions were approved for operators from all 50 states and Puerto Rico. California received the most with 360, followed by Florida with 328 and Texas with 268.

The number of exemptions granted each month grew sharply from March 2015 to May 2015, reaching a peak in October of that year, at 419. Over 360 exemptions were granted in January 2016 alone.

Most commercial UAS operators are small businesses. About 90 percent of the nearly 3,000 companies receiving exemptions make less than \$1 million in annual revenue and have fewer than 10 employees.

About 65 percent of all platforms mentioned in the exemptions are manufactured by DJI Global. Rotary-wing platforms are used about six times more than fixed wing platforms.

While the Section 333 process continues to unlock the potential of UAS technology, AUVSI emphasized that regulating by exemption is no substitute for finalized rules.

“While some businesses are flying, this current system of case-by-case approvals isn’t a long-term solution. For the full potential of the UAS commercial market to be realized in the U.S., the FAA needs to finalize its small UAS rule, without further delays.” Wynne said. “Once this happens, we will have an established framework for UAS that will reduce the barriers to commercial operations. The positive effects of the regulation will be felt by companies across the nation.”

An economic impact study released by AUVSI found the UAS industry will create more than 100,000 new jobs and more than \$82 billion in economic impact within the first ten years following UAS integration.

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The complete analysis is available here.

<http://www.auvsi.org/auvsiresources/exemptions>

http://www.uasvision.com/2016/04/15/auvsi-study-of-faa-exemptions-published/?utm_source=Newsletter&utm_campaign=d03ea96528-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-d03ea96528-297560805

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Senate Debates Legislation That Aims To Prevent State UAV Laws

WASHINGTON – The Senate is debating contentious legislation aimed at preventing states and cities from adopting drone laws amid an ongoing battle pitting the federal government and drone industry against local lawmakers.

The bill provoked a fight because dozens of states adopted laws on subjects such as banning weapons on remote-controlled aircraft or requiring police to issue a warrant to use drones for surveillance. The Federal Aviation Administration, however, contends it alone governs national airspace.

The U.S. Code states the federal government has complete sovereignty over airspace. To reinforce that position, pending Senate legislation governing the FAA initially said that no state could enact a law about the “design, manufacture, testing, licensing, registration, certification, operation, or maintenance of an unmanned aircraft system, including airspace, altitude, flight paths, equipment or technology requirements, purpose of operations, and pilot, operator, and observer qualifications, training, and certification.”

But Sen. Dianne Feinstein, D-Calif., has proposed to drop that language. Her state has been a leader in developing local drone laws after complaints dealing with privacy and safety, such as high-flying drones grounding planes that fight wildfires.

“Reckless drone use varies significantly in different states and even within a state, which is why we need to maintain the ability for states to set their own standards of drone operation,” Feinstein told USA TODAY.

“One in five incidents of reckless drone use nationwide has occurred in California, and densely-populated areas with critical infrastructure like Los Angeles and San Francisco need flexibility to enact rules that address their unique challenges.”

State drone laws could clash with federal drone policy

A Senate vote on the FAA legislation could come as early as Thursday. The House version of legislation governing the FAA didn’t include that drone language.

The drone industry had sought to reinforce the federal government as the ultimate arbiter for rules of the remote-controlled aircraft because of the confusion that could result from a patchwork of state laws.

“In the absence of FAA action, we may soon be facing a legal quagmire,” Brian Wynne, CEO of the industry group Association of Unmanned Vehicle Systems International, told a House panel in September. “Challenges to questionable state laws will tie up the courts and at significant expense to taxpayers. If the FAA feels it needs clarification of its authority, I would urge Congress to provide such clarity and legislatively settle this issue.”

The Aircraft Owners and Pilots Association, which represents general aviation, also urged uniform regulations covering drones.

"AOPA's primary concern is the safety of pilots and passengers of manned aircraft and the best way to ensure the safe integration of (drones) into the airspace is to have clear and uniform rules across the country," said Jim Coon, the group's senior vice president for government affairs. "Proposals by state and local governments in these areas have the potential to create a complicated patchwork of laws that may erode, rather than enhance, air safety."

As the FAA works to complete its first drone regulations for aircraft weighing up to 55 pounds, states have been debating and approving laws for years dealing with drones. Last year, 45 states considered 168 drone bills, according to the National Conference of State Legislatures. And 20 states approved 26 bills, according to the group.

At least 41 states have debated drone bills already this year, with six states adopting nine laws. For example, Idaho, Indiana and Wisconsin prohibited using drones for hunting, and Oregon prohibited putting weapons on drones. Utah banned flying drones near wildfires.

The National Governors Association, National Conference of State Legislatures, the National League of Cities, the U.S. Conference of Mayors and the National Association of State Aviation Officials each opposed the Senate provision that sought to pre-empt local laws.

"It goes too far, and infringes on traditional state and local powers – such as the protection of basic rights of citizens, the operation of state and local agencies, and the protection of areas like public schools and state and city parks," the groups said in a joint statement supporting the Feinstein amendment.

<http://www.usatoday.com/story/news/2016/04/13/senate-drops-provision-against-state-drone-laws/82990972/>

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PUBLIC SAFETY:

NSF grant supports design of attack-resilient micro aerial vehicles

Drones are seeing increased use in a wide array of applications, including delivery and inspection services, aerial photography, mapping and surveying, and search and rescue missions.

Integrating these unmanned aircraft systems, known more technically as micro aerial vehicles (MAVs), is expected to have a significant economic impact, with a predicted investment of \$91 billion over the next decade.

“Each of these vehicles, however, could be hijacked or deliberately controlled for malicious purposes, exposing us to unprecedented vulnerabilities.”

The \$166,000 award will enable Huang, whose expertise lies in robotics, to develop consistent state estimation algorithms that will allow drones to detect abnormalities in their sensing and react to them to compensate for malicious attacks.

Disrupted drone navigation has both economic and security implications.

“The Department of Homeland Security is particularly interested in this issue because drones are so ubiquitous,” Huang says.

He emphasizes that his work focuses on protecting the sensing systems that drive navigation — not on the communication systems embedded in MAVs. While other researchers are addressing communication vulnerabilities, he says, little to no attention has focused on securing MAV navigation.

“As MAVs become integral to our economy and national security, we face ever more frequent and threatening attacks,” Huang says. “By enabling secure MAV navigation in the presence of malicious attacks, this research will add one more layer of protection to our society.”

In addition, the research will foster novel MAV-based applications, such as providing aerial transportation during humanitarian aid and delivering supplies in hard-to-reach areas during and after disasters.

The project will also create research opportunities for both graduate and undergraduate students from UD, and an integrated outreach program will provide innovative hands-on teaching and learning of robotics programming for K-12 students.

Huang’s research will contribute to the theory of stochastic estimation and control and the theory of sparse and convex optimization while also fostering further study on secure and consistent state estimation in robotics.

<http://www.udel.edu/udaily/2016/apr/micro-aerial-vehicles-041516.html>

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UAV Solutions demonstrates two SUAS - project is being run by the US Department of Homeland Security's Science and Technology Directorate

Two of UAV Solutions’ small unmanned aircraft systems (SUAS) have taken part in flight demonstrations for the Robotic Aircraft for Public Safety (RAPS) Phase II project, the company announced on 12 April.

The project is being run by the US Department of Homeland Security's Science and Technology Directorate (DHS S&T) to assess the application of SUAS to enhance situational awareness in support of border security and law enforcement operations.

UAV Solutions' Phoenix 30 quad rotor VTOL UAS and Talon 120LE fixed-wing UAS were assessed during the event. DHS S&T developed a test plan for participants to follow with scenarios including emergency response, beacon response, injured operator/search and rescue and border surveillance.

Bill Davidson, chief executive officer and chief engineer, UAV Solutions, said: 'We are developing low cost solutions that meet the needs of border security operators and law enforcement for scenarios where persistent surveillance is required. All our aircraft platforms can be quickly deployed for instant situational awareness.'

Weighing 20lbs, the hand-launched Talon 120LE is a man-portable UAS with a flight endurance of over two hours. The UAS' payload section can house a UAVS Dragon View combined electro-optical/infrared (EO/IR) camera sensor or payloads up to 2.5lbs.

The Phoenix 30 UAS weighs approximately 10lbs and carries a maximum two-pound payload. The UAS requires no assembly and takes only a few minutes to deploy. Endurance is 25 to 30 minutes depending on mission profile.

<https://www.shephardmedia.com/news/uv-online/uav-solutions-demonstrates-two-suas/>

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Mississippi State UAS Map Wildfire Damage

Researchers at Mississippi State are using innovative unmanned aircraft technology to help state and federal officials assess extensive wildfire damage to a unique natural habitat on the Coast. Biologists and geographic information system specialists from the Grand Bay National Estuarine Research Reserve, along with the U.S. Forestry Service, are assessing the land and habitat that recently burned as a result of a large wildfire that spread across southeast Jackson County into Alabama.

These experts are working with Mississippi State's Geosystems Research Institute to survey the after-burn of more than 4,200 acres.

In a few hours, GRI's unmanned aerial systems (UAS) are able to capture imagery of the remote, wild, woodlands and marsh of GBNERR, the Grand Bay National Wildlife Refuge and other adjacent lands.

"The MicaSense RedEdge is multispectral sensor. It can sense energy at five different wavelengths with two of those wavelengths beyond our own vision in the near infrared (NIR) region of the electromagnetic spectrum," NGI Director Robert Moorhead said.

The university's Altavian Nova Block III UAS scanned the area at 1,000 feet and used the sensor device to capture the biodiversity of vegetation health and in precise detail the areas of upland and marsh that burned.

"Researchers no longer have to guess about the status of biodiversity restoration. The multispectral sensor provides precise data that gives researchers the status of vegetation extent and the areas under stress in the coastal ecosystem," Wasson explained.

Lindsay Spurrier, a geographic information specialist with GBNERR, said before they used unmanned aerial vehicles to help them learn more about the importance of fire to restore habitats, their studies were limited by imperfect evidence.

“A crew of field biologists would spend weeks trying to hike to remote spots within the upland pines and across the marsh to gather enough data to get a good sample of vegetation post burn,” Spurrier said.

“The imagery taken from the unmanned aerial vehicles gives us in almost real time the changes in the trees and vegetation, along with showing the density and regrowth,” she said.

UAS is becoming a popular tool for land managers and researchers because it gives them easy access to all the land they are tasked with managing. “It is important because it can show us where there are dense, thick stands of trees that compete with new plants for water and nutrients,” Spurrier said. “These mosaicked images help us determine where to conduct prescription burning to create an opening to let more light filter in and spur new vegetation growth,” she explained. Grand Bay NERR is a state-federal partnership with the Mississippi Department of Marine Resources and the National Oceanographic and Atmospheric Administration’s Office for Coastal Management. GBNERR is one of 28 NERRs nationwide.

http://www.uasvision.com/2016/04/05/mississippi-state-uas-map-wildfire-damage/?utm_source=Newsletter&utm_campaign=0c72612095-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-0c72612095-297560805

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New Study Details Commercial Uses of UAVs

The most popular commercial uses for drones involve photography, real estate and inspections, according to an industry review released Wednesday of more than 3,000 permits granted by the Federal Aviation Administration.

Permits have been granted in all 50 states. California has the most at 360, Florida 328 and Texas 268, according to the study by the Association for Unmanned Vehicle Systems International.

The variety of business operations has grown with the number of permits. There are 38 functions, including accident investigation and news gathering, according to the study.

And rotor-copters are six times more popular than fixed-wing aircraft.

“The (drone) industry is poised to be one of the fastest-growing sectors in the U.S. and these numbers demonstrate that a wide variety of industries are eager to take advantage of this technology,” said Brian Wynne, the industry group’s CEO.

His group has estimated the industry will create 100,000 jobs and generate \$82 billion in economic activity during the first decade after FAA approves rules for their use.

The FAA began granting exemptions for commercial drones in September 2014 while developing comprehensive rules. The rules for drones weighing up to 55 pounds are expected to be completed by June.

The FAA granted 4,680 commercial permits through Monday. The industry group analyzed the first 3,136 exemptions and posted the information on an interactive website www.auvsi.org/exemptions

While a company could use drones for several purposes, the most popular were 2,557 for photography, 1,969 for real estate and 1,671 for inspections.

The businesses are small. About 90% of the companies have less than \$1 million in annual revenue and fewer than 10 workers.

"While some businesses are flying, this current system of case-by-case approvals isn't a long-term solution," Wynne said. "The positive effects of the regulation will be felt by companies across the nation."

Commercial Drone Licenses by State [\(Graph available at below link\)](#)

A drone license is a Section 333 exemption given out by the FAA that allows someone to commercially operate an unmanned aircraft system (UAS).

<http://www.usatoday.com/story/news/2016/04/13/drone-uses-permits-faa/82940820/>

<http://fortune.com/2016/04/13/heres-where-commercial-drones-are-most-likely-buzzing-overhead/>

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SENSORS/APPLICATIONS:

Nuclear engineer creates paper-like battery suitable for UAS

Built from the byproducts of the silicone industry, a new paper-like battery developed by a Kansas State University mechanical and nuclear engineering professor could improve unmanned aircraft system operations.

Gurpreet Singh, associate professor at KSU, and his team have found a new material combination for a batteries electrode design. The electrode portion of a battery is responsible for conducting electrical current through contact with a nonmetallic part of a circuit. The new electrode design utilizes a glassy ceramic called silicon oxycarbide that is sandwiched between large platelets of chemically modified graphene. The design is lighter and just as productive as other battery materials. The material can be used in lithium ion batteries as well. It is also suitable for applications in below zero temperatures, a feature that the researchers say make it suitable for aerial applications.

"The paper-like design is markedly different from the electrodes used in present day batteries because it eliminates the metal foil support and polymeric glue—both of which do not contribute toward capacity of the battery," Singh said.

In addition to the temperature threshold, the battery material is rechargeable. "This suggests that rechargeable batteries from silicon-glass and graphene electrodes may also be suitable for unmanned aerial vehicles flying at high altitudes," Singh said, "or maybe even space applications."

Singh said his team wants to explore the production of lithium-ion battery fuel-cells and how the paper-like batteries will hold up when shaped or manufactured through 3D printing applications.

<http://uasmagazine.com/articles/1464/nuclear-engineer-creates-paperlike-battery-suitable-for-uas>

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Drone-Mounted NIR to Find out Where the Bodies Are

Near infrared (NIR) is an analytical technique used in a variety of applications, from drug tablet manufacturing to detecting counterfeit products. It can also tell you where the bodies are buried.

Recently, researchers have been experimenting with NIR on the forensic science side of things, as a means to uncover hidden graves, such as those of homicide victims or even the mass graves of victims of attempted genocide. Studies have shown that NIR allows crime scene investigators to distinguish graves from their surroundings.

Currently, Marilyn Isaacks, a recent graduate of Texas State University's anthropology program, has been looking into how drones and other remotely controlled aircraft can be combined with NIR to track down hidden remains on the surface.

As a body decomposes, it introduces nutrients to the soil, creating a concentrated area, or "island," of fertility known as a cadaver decomposition island (CDI). Isaacks is researching how such CDIs show up in the NIR spectrum and how time effects how well they show up on that spectrum. Her current study is exploring how long NIR cameras mounted on unmanned aerial systems last and their usefulness in locating human remains.

Based on the studies so far, remote sensing with NIR has proven to be much safer and quicker than sending personnel into the field to comb forests and other terrain for hidden remains.

http://www.uasvision.com/2016/04/08/drone-mounted-nir-to-find-out-where-the-bodies-are/?utm_source=Newsletter&utm_campaign=bb823dd9d8-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-bb823dd9d8-297560805

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COUNTER UAS:

FAA's Highly Redacted Contract for Airport Drone Detectors

The Federal Aviation Administration is working on new technology that can detect and identify drones and drone pilots who fly near airports, according to a contract obtained by Motherboard using the Freedom of Information Act.

The contract, between the FAA and CACI International, notes that the tech will allow the FAA to “identify rogue unmanned aircraft systems” near airports and suggests that the agency believes some of its drone education outreach efforts are not working.

Specific details of the program were redacted from the contract without an official exemption listed by the FAA FOIA office. Motherboard has appealed this decision. The existence of the program, called “Pathfinder,” was announced by FAA Deputy Administrator during a hearing before the House Aviation Subcommittee in October.

In a press release, CACI CEO John Mengucci noted that the agreement “provides a proven way to passively detect, identify, and track UAS—or aerial drones—and their ground-based operators, in order to protect airspace from inadvertent or unlawful misuse of drones near U.S. airports. This CACI-built solution will help ensure a safe, shared airspace while supporting responsible UAS users’ right to operate their aircraft.”

The FAA redacted large portions of the contract without an explanation.

Since that announcement, few details of what the project is or how it works have been made public. The contract obtained by Motherboard, embedded below, titled “Cooperative Research and Development Agreement,” reveals more about the impetus behind the program—namely that the FAA believes its many drone education outreach efforts aren’t making the skies safe for manned aircraft.

“Data shows that current training, outreach, and educational campaigns are not sufficient deterrents to UAS interference at airports and other critical airspace,” the FAA wrote in the contract.

What to do about drones that fly near airports or at high altitudes has been quite the conundrum for the FAA, which recently mandated that all hobby drone pilots register themselves with the agency. As part of the registration process, you must promise to “not fly near aircraft, especially near airports.” The FAA has also started the “Know Before You Fly” drone education campaign to discourage people from flying unsafely.

The bulk of the contract is fairly standard and is a modified version of a basic contract of this type posted online by the FAA.

“The purpose of this Cooperative Research and Development Agreement is to serve as a mechanism to safely explore procedures and processes in and around the FAA’s airport environment to identify rogue

unmanned aircraft systems consisting of the unmanned aircraft and pilot in command," the contract says.

Under the terms of the two-year contract, which will last until October 6, 2017, the FAA will not pay CACI but will allow it to test its technology at airports and the FAA will provide technical details and support that might help the company.

"The FAA may provide engineers, scientists, or any other form of professional or clerical personnel; facilities and equipment (especially facilities that cannot be found in private industry and are necessary to the testing and development of aviation technology); intellectual property; or any other resources, with or without reimbursement. The FAA may provide anything but money to the collaborating partner," according to an FAA presentation about these types of contracts.

"CRDAs are sensitive to the needs of business organizations to protect commercially valuable information," the presentation continued. "Trade secrets or confidential information supplied by a partner shall not be disclosed. Trade secrets or privileged information that develops during the course of a CRDA can be protected from disclosure for up to five years."

In a cover letter sent to me with the request, the FAA noted that it withheld seven pages of the contract that contain "commercial or financial information that was voluntarily submitted to the government," an exempt class of information from FOIA requests. However, details on one page of the document were redacted (seemingly with a marker, which is unusual) without any exemption being cited. Motherboard has appealed this particular redaction and asked for more information about where the program will be deployed and how it will work—information that I requested in my original request but was not provided.

http://www.uasvision.com/2016/04/05/faas-highly-redacted-contract-for-airport-drone-detectors/?utm_source=Newsletter&utm_campaign=0c72612095-RSS_EMAIL_CAMPAIGN&utm_medium=email&utm_term=0_799756aeb7-0c72612095-297560805

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Rafael unveils Drone Dome counter-UAV system

The Israeli company Rafael Advanced Defense Systems unveiled on 11 April a new system that detects, tracks and disrupts unmanned aerial vehicles (UAVs).

Known as the Drone Dome, the system was unveiled at the LAAD security conference in Brazil. Rafael described it as an "end-to-end system designed to provide effective airspace defense against hostile drones (micro- and nano- UAVs) used by terrorists to perform aerial attacks, collect intelligence, and other intimidating activities."

The system uses a combination of a RADA RPS-42 tactical air-surveillance radar and electro-optical sensors to detect UAVs through 360 degrees. Once a target has been detected, it begins to track and classify it.

"The data is combined and correlated and alerts the operator of the hostile UAV. The system initiates either automatic interference operation, as per pre-defined rules in the C4I engine, or manual operation by the operator," Rafael said.

The system can disrupt UAVs by jamming global navigation satellite system (GNSS) and radio frequency (RF) signals.

"When the threat reaches the neutralization area, the hostile drone is neutralized by [the] activation of directional GNSS and [the] RF Inhibitor/Jammer system," the company added.

The Drone Dome is designed to cause "minimal collateral interruptions to the surrounding urban environment, with maximum safety to friendly aircraft," according to Rafael.

<http://www.janes.com/article/59577/rafael-unveils-drone-dome-counter-uav-system>

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INTERNATIONAL:

China Deploys Pollution-Monitoring UAVs

The Economic Times (IND) (4/13) reports that China has deployed three UAVs at its environment tracking station in the Hebei province to identify and reduce potential sources of pollution across the region. The article explains that three unmanned aerial vehicles, "two with fixed-wings and one with multi-rotors, will take aerial photographs of suspect factories and workshops to provide evidence of polluting activities." Cao Yaming, who is an engineer at the tracking station said, "Flying at up to 3,500 meters off the ground with a top speed of 140 kilometers per hour, the UAVs can effectively monitor mountainous areas even under poor weather conditions," adding, "They can make up for any shortfalls in human-led ground inspections and satellite remote sensing monitoring."

<http://economictimes.indiatimes.com/news/international/world-news/china-deploys-drones-to-monitor-sources-of-pollution/articleshow/51790470.cms>

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COMMENTARY:

In the Empty Arctic, How to Get the Job Done? With A Drone

It's hard to say what the 2,000-pound bull Steller sea lion hauled out on a rocky shore in the far western Aleutians thought about the strange object hovering 150 feet above him. An odd bird? The world's largest mosquito? Whatever it was, he paid it no mind—and that's just what the people who were piloting the small drone, an APH-22 hexacopter, had hoped for.

When the researchers survey sea lions the usual way, from a plane belonging to the National Oceanic and Atmospheric Administration (NOAA), the animals often get spooked. Sometimes an adult sea lion, rushing into the water, will crush a pup that happens to be in the way.

But the little drone, nicknamed "Stella," not only didn't scare the sea lions, it was able to fly in low clouds and fog that grounded the NOAA plane. During the 2014 summer season, it surveyed nearly 1,600 Steller sea lions, giving NOAA its most thorough survey of the endangered population since the 1970s.

"It was even able to detect body condition and branded animals," Erin Moreland of the NOAA Marine Mammal Lab explained to a crowded conference in Fairbanks last fall on unmanned aerial vehicles (UAVs), as engineers prefer to call drones. Using a much larger ScanEagle UAV equipped with thermal imaging cameras, Moreland's team also surveyed ice seals in the Bering Sea. The drone got resolution of less than an inch while flying at a thousand feet.

As climate change radically alters the Arctic environment, Moreland said, "so many animals are being proposed for listing [as endangered species], it's very hard to keep up with population surveys." Drones may be part of the answer.

Fighting Fires

The void that drones could fill in the Arctic—an extremely remote region with little infrastructure and some of the worst weather in the world—extends well beyond wildlife surveys. (Read more about the push to develop the Arctic.)

In Alaska, drones are being tested for use in fighting wildfires, in responding to oil spills, in search-and-rescue operations, and as temporary communication hubs along the Arctic coast, where even satellite phones have trouble picking up signals.

In 2014, when wildfires scorched an area in Alaska larger than the state of Massachusetts, University of Alaska Fairbanks researchers flew a drone into the 200,000-acre Funny River Fire on the Kenai Peninsula. Smoke from the blaze had grounded local flight crews. The drone flew the perimeter, mapping and photographing hot-spots, to which fire commanders then dispatched firefighters.

"The firefighters really liked it," says Marty Rogers, the director of UAF's Alaska Center for Unmanned Aircraft Systems Integration. "It was extremely accurate and they could actually see pictures of the terrain."

Thirty miles north of Fairbanks at UAF's Poker Flat Research Range, scientists tested another UAV last year on the ultimate Arctic environmental disaster—an oil spill in ice-covered waters. Researchers spilled oil into a man-made basin, 300 square feet by three feet deep and dotted with miniature icebergs. They sprayed the mini-spill with a small amount of herding chemical to thicken the oil, then ignited it—an appealing option for oil companies when conditions make it impossible to collect the oil.

When a crew of five in a helicopter ignited the spill, they got great results. But the small UAV stole the show. "With the UAV we ignited a marine flare, flew it over the spill and boom! In situ burn," says Jessica Garron of the University of Alaska. The appeal of the drone is safety, she says: "If you lose a UAV in the ocean, it's not good. But it's a lot better than losing five guys in the ice."

Where's Oscar?

That's the exact scenario the U.S. Coast Guard imagined last summer when it simulated a search and rescue operation 20 miles off Prudhoe Bay. The Coast Guard cutter Healy, one of the nation's two operational icebreakers, dropped a six-man life raft in the pack ice of the Beaufort Sea.

Strapped into the raft was a "thermal Oscar," a human-size dummy in a life jacket with a head wired to give off the same heat signal as a human. A team based at the old Defense Early Warning station at Oliktok Point then launched a ScanEagle drone to try to find the Oscar, along with a smaller, battery powered Puma launched from the ship.

Both drones found the Oscar—but only after operators on the Healy steered them to the target.

"They didn't do a particularly great job at finding one hot head in a sea of ice and shadows," says Rich Hansen of the Coast Guard. "What that told us was we need better sensors and search patterns." But Hansen still believes UAVs have a lot of potential for search and rescue in a region where communities are far apart, manned aircraft are often unavailable, and ship traffic is projected to rise.

Counting Bowheads

One evening last September, as the Arctic sun sank into the Beaufort Sea near Barrow, I watched as another ScanEagle came scudding over the ocean with a faint metallic buzz and was snagged by its two-story tether. Navy contractors hustled over to collect the plane. Robyn Angliss and Megan Ferguson, two whale researchers from the Marine Mammal Lab in Seattle, went along to remove two digital cameras.

Over the next year they'll pore over tens of thousands of photographs to see if the drone might help with the annual whale surveys off Barrow—in which human spotters in an airplane attempt to count gray bowheads in a gray sea the size of Minnesota. (Thermal imaging, which Moreland used to detect ice seals, would be useless with bowheads; they're so well insulated that their skin is the same temperature as the sea around them.)

Ferguson dreams of one day coupling an aerial drone with an underwater glider to get far better counts of Arctic whales. Marty Roberts of UAF has a longer drone wish list: flying along pipelines to "sniff" for spills, scouting ahead of ships for icebergs, surveying the ecology of remote coastlines to track the rapid changes that are now underway.

"This is the future, whether you believe it or not," he says. "It's like GPS used to be only for the military and now it's ubiquitous. Drones will be part of everyday life."

<http://news.nationalgeographic.com/2016/04/160414-Arctic-drones-wildlife-fire-oil-spill-environment/>

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Sea Hunter: How America Could Revolutionize Naval Warfare Forever

The prototype boat in DARPA's Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) program, the Sea Hunter, is beginning sea trials. Sailing last week from Portland to San Diego, she'll undergo two years of testing to determine whether an unmanned ship under "sparse human control" can trail Iranian, Russian, or Chinese diesel submarines exiting port. If she works, she'll relieve the Navy's very capable-but-expensive destroyers of that duty. She may also seriously change the way war at sea would be fought.

Andrew Davies of the Australian Strategic Policy Institute wrote in February that what navies today call frigates are often bigger than cruisers, or what they once called cruisers. Alastair Cooper of the Royal Australian Naval Reserve followed this month with an essay insisting that the ships' functions have remained the same, but the size required to achieve those functions has increased. Perhaps we should call that the iPhone 6S argument; inexorable growth isn't always better. What's clear is that the bigger ships—Australian, American, or otherwise—are expensive to buy and expensive to operate. According to the US Congressional Research Service, a new destroyer of the Arleigh Burke class costs about \$1.7 billion to procure. Operating and support costs are harder to discern, as the Navy Department doesn't published audited accounts. But just paying salaries and benefits (recently estimated by the Reserve Forces Policy Board as \$108,000 annually) to each crew of 323 costs about \$95,000 per day. Fuel and repairs add a lot more.

With those sorts of costs, the US Navy is quite reasonably complaining that it can't possibly police the planet with 300 ships. Whether policing the world is a good goal is another matter, but if that's the task, at least do it sensibly. Chasing Somali pirate skiffs with 9,000-ton destroyers was an egregious waste of resources when the Coast Guard's 1,800-ton cutters would have provided the same overmatch. And if building and operating are costly, losing a ship in a fight is costlier yet. Indeed, a salient argument against continuing to invest in Ford-class aircraft carriers, as noted by Jerry Hendrix of CNAS, is their extreme concentration of power and people. As heavily defended as they may be, they're still very lucrative targets. A few torpedoes will place any one hors de combat. Along those lines, as the Navy wraps up the conceptual design of its next amphibious ship in the next few months, the service is considering whether those ships should be more heavily armed, for a lot more money, if only because they carry so many people worth defending.

But is there a way to produce capability without all that concentration? Worth rereading is Greg Jaffe's article of fifteen years ago on Admiral Cebrowski's idea of the 'Streetfighter' —"Debate Surrounding Small Ship Poses Fundamental Questions for U.S. Navy" (Wall Street Journal, 11 July 2001). At the time, the big issues were dispersion of power and expendability of single units. Like a small airplane, a 1,000-ton vessel with a small crew could be lost without national trauma. The original concept thus called for a

ship of similar cost to a fighter jet—perhaps \$100 million. The eventual result, however, was the Freedom and Independence classes of littoral combat ship. At 3,000 tons, they were pretty much lightly-armed frigates to begin with.

Since that programmatic trauma, DARPA has been working on something yet smaller, and wholly unmanned. The 145-ton, unarmed Sea Hunter will be a far cheaper way of trailing or chasing submarines than sending a 3,000-ton frigate or a 9,000-ton destroyer. As National Defense magazine noted, at the start of the program, DARPA was aiming for a serial production cost of \$20 million per ship. Excluding design and software expenses, Leidos and Vigor Shipyard are delivering the prototype for under \$23 million. That's a bit more, but in serial production, bulk parts purchasing and the learning curve would produce much cheaper ships. All the better, DARPA's program manager Scott Littlefield expects operations to cost between \$15,000 and \$20,000 per day. That broadly compares to the flying costs of an MQ-9 Reaper.

Sea Hunter is one program in which the defense secretary needn't hector for More Innovation; that will happen naturally. As these ships go to sea, operators will find reasons to ask for additions. The crews of the early MQ-1 Predators were frustrated that they could only watch targets, then call for fire. So, the first and obvious choice for upgrading the ACTUV will be the addition of few anti-submarine torpedoes. Some chaff and flares would be a lightweight and inexpensive way of discouraging an easy kill by an anti-ship missile (though missiles are getting harder to distract). A machine gun sealed against seawater could warn off boarders, at least when the boat was under the positive control of the cubicle-crew ashore.

Doctrine will catch up, and as David Blagden of the Royal Naval Reserve noted on War On The Rocks last year, the strategic implications will be profound. If you have enough small ships, the lack of a towed array can be mitigated with numbers and triangulation. Picket rings can expand outward from protected units. A submarine captain might hazard his ship to stalk a carrier, but what if his targets came surrounded by armed, loyal sea dogs like the Sea Hunter? Upon torpedoing a destroyer or frigate, he could find himself on the receiving end of multiple snapshots along several bearings. Convoy protection could thus get a bit easier—with naval parties embarked and some line-of-sight command links, cargo ships could trail along their own protection with armed sea drones.

The “substantial proviso,” Blagden noted, is whether this can be made to work. In a recent video interview, Littlefield stated the single biggest issue remains reliability. The software engineers think that they have written the COLREGs into computer code, and that the control system may be fairly hack-proof. Just in case, DARPA has added a pilothouse to the ship for the sea trials. If the Navy takes up the ACTUV, as the Air Force took up DARPA's Predator, the service might consider retaining that fixture, or even expanding it. Smaller drone designs can pay performance penalties from optional manning, but 145 tons provides a lot of room. Just a few chiefs and junior officers could make a big difference in the operation of a modern submarine chaser. Expand the next armed Sea Hunter a bit, and the Navy might get that Streetfighter that Cebrowski wanted.

<http://www.nationalinterest.org/blog/the-skeptics/sea-hunter-how-america-could-revolutionize-naval-warfare-15783>

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New Report Calls for Ban on 'Killer Robots' Amid UN Meeting

Technology allowing a pre-programmed robot to shoot to kill, or a tank to fire at a target with no human involvement, is only years away, experts say. A new report called Monday for a ban on such "killer robots."

The report by Human Rights Watch and the Harvard Law School International Human Rights Clinic was released as the United Nations kicked off a week-long meeting on such weapons in Geneva.

The report calls for humans to remain in control over all weapons systems at a time of rapid technological advances. It says that requiring humans to remain in control of critical functions during combat, including the selection of targets, saves lives and ensures that fighters comply with international law.

Some have argued in favor of robots on the battlefield, saying their use could save lives.

But last year, more than 1,000 technology and robotics experts — including scientist Stephen Hawking, Tesla Motors CEO Elon Musk and Apple co-founder Steve Wozniak — warned that such weapons could be developed within years, not decades.

In an open letter, they argued that if any major military power pushes ahead with development of autonomous weapons, "a global arms race is virtually inevitable, and the endpoint of this technological trajectory is obvious: autonomous weapons will become the Kalashnikovs of tomorrow."

According to the London-based organization Campaign to Stop Killer Robots, the United States, China, Israel, South Korea, Russia, and Britain are moving toward systems that would give machines greater combat autonomy. Human Rights Watch is a co-founder of the organization.

The U.N. meeting of experts on the issue, chaired by Germany, continues talks that took place in April 2015 and May 2014.

<http://abcnews.go.com/US/wireStory/report-calls-ban-killer-robots-amid-meeting-38316146>

<http://www.militarytimes.com/story/military/tech/2016/04/11/new-report-calls-ban-killer-robots-amid-un-meeting/82916858/>

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A Rookie Learns to Fly a Drone

LONDON — My wife, Alexa, has made something of a profession out of getting me great birthday presents. Over the years, her gifts have included an old Sports Illustrated with a hologram of Michael Jordan on the cover and a photography tour of a particularly photogenic part of southern China.

So for my most recent birthday, I had no idea what to expect when she handed me a large box. Inside, I found a new drone.

The only problem: I had to learn how to fly it.

This may not be easy for many people. First, there is the matter of figuring out the capabilities of the drone. Consumer drones come in different sizes and prices. You can build your own drone, attach a GoPro camera and customize a range of options. Or you can get one that works right out of the box.

Flying the drone is daunting. There are regulations to know. In the United States, because the industry is relatively new, federal rules are sometimes at odds with regulations set by states and local authorities.

In Britain, where I live, rules for flying hobbyist drones are mercifully more straightforward, and the Civil Aviation Authority has taken steps to translate often dense guidance into easier-to-understand language. In July, it released “The Dronecode” and has published an animated video summarizing the rules.

There is also the safety of others to consider. British aviation authorities recorded 39 “airprox” incidents, or aerial near-misses, in 2015, and those are just ones that involve a drone and another aircraft. I did not want to make headlines.

But there are ways to ease into it. Commercial drone operators and those taking professional videos can take short courses to ensure they know what they are doing. For novices like myself, YouTube videos abound, offering tips and explainers.

“Not everybody who can control things on the ground has 3-D spatial awareness,” said Jonathan Carter, a director of the Aerial Academy, which conducts courses to help professional drone users get licensed by the Civil Aviation Authority. Mr. Carter, who first strapped a compact camera to a single-rotor drone in 2010 out of curiosity, said the courses could be completed in as little as a week and cost about \$1,600.

More Than 180,000 Drone Users Registered in F.A.A. Database JAN. 6, 2016

For me, the first step was evaluating my drone, a DJI Phantom 3. DJI, which is based in Shenzhen in southern China, makes more small-scale drones than any other manufacturer, and the Phantom series has been the world’s best-selling consumer drone. The company was founded in 2006 and has been valued at around \$8 billion.

My Phantom 3 Standard cost about \$635. Weighing less than three pounds, it is a white plastic quadcopter with an attached camera that shoots video at 2.7K and captures 12 megapixel photos. I

could fit the entire system — the drone, detachable propellers and the remote control — in my backpack.

The instructions for flying the drone were straightforward. Simply download DJI's mobile phone app, attach the propellers to the machine, turn the drone and remote controller on and the app guides you through the setup process.

For beginners, DJI's app offers a basic mode that restricts the drone to an altitude and distance of 100 feet. All you need to do to initiate takeoff is tap an on-screen button on your smartphone and then swipe to confirm. After that, you are airborne.

Everything is controlled with the mobile app in tandem with the remote controller, and you can have as much, or as little, assistance as you want. Landing can be completed manually or automatically. While in the air, you can control the drone yourself or use one of a handful of "intelligent modes" that let you instruct it to circle a single point, follow you without changing distance or altitude or trace a predetermined set of directions. If your battery is about to run out, it immediately comes back to its takeoff point.

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Crucially, it was fun. Seeing your surroundings from a different angle is interesting and adds a cool element to the experience. I have lived here for several years, on and off, but I now want to re-explore places I have already been to just to use the Phantom and see them from above.

The drone is not without its limitations. The battery life is frustratingly short. In all, I got about 20 minutes of HD video capture on a full charge, a number that is in line with DJI's advertised battery capacity. At various points, the camera's real-time display also would disconnect, and on another clear day in the park, the app told me I did not have a strong enough GPS connection to use some of the intelligent modes.

DJI said this was most likely because of the Phantom 3 Standard's reliance on Wi-Fi, rather than Lightbridge, the company's wireless communication technology, which has a longer range. The technology is used in DJI's newer and more advanced models.

Windy days also made flying a little tougher, though by no means very difficult. Being in an urban setting, I tried to fly the quadcopter high enough to make sure people in the area did not feel as though I was spying on them, restricting the things I could try out.

Partly because of the drone's own stability and an overabundance of caution on my part, I never crashed it, but it did flip over once because I landed too quickly while trying to keep it from being grabbed by a curious dog.

http://www.nytimes.com/2016/04/14/technology/personaltech/a-rookie-learns-to-fly-a-drone.html?nl=todaysheadlines&emc=edit_th_20160414&r=0

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The Enemy of Good Enough, a Different Way to Look at Emerging Technology – UAS

Exactly when is technology ready for operational use? It depends on whom, and when, you ask. People will come up with an answer based on their perspective, a viewpoint informed by their environment.

Some say an advanced technology is ready when it meets the threshold requirements, or key performance parameters, specified in a validated requirement document. That assumes the requirements are known. In the case of KPPs, it assumes select requirements are absolute minimal necessities — without which a technology should not be fielded. Additionally, it should meet all the other key attributes. That's a good starting point, but it shouldn't necessarily be the final determination.

As far as documented requirements are concerned, one might ask, why is the minimum, or threshold, capability the minimum? Likewise, what does the objective capability mean? Is that the capability we would rather have if it were feasible? Is that the best we can expect to achieve from a technology? Is it all we're willing to pay for? Or is it the limit of our vision?

We generate requirements based on our experience. Generally, requirements are written to describe what we can't presently do, and what we would like to be able to do — essentially, where we see a capability gap. Right or wrong, requirements are also influenced by what we think technology can and can't achieve. In reality, the upper and lower limits of what a technology is operationally capable of can only be determined during operations.

Others may say an advanced technology is ready for use even when it has only limited value — perhaps just an incremental increase in a capability we don't currently possess, a cost improvement, reliability or ease of use — that replaces what we use now. What if it provides a capability that is totally different than what we have now — an additional capability? We are routinely asked if the added capability is worth the investment. To some, this leads to the notion of a need for cost-benefit analysis.

The pursuit of an undeniable positive cost benefit can often result in continuous investment in research and development, driven by the desire to make the solution perfect, which ultimately results in deferring operational use. Then, after long, drawn out investments in technology development, we think of other creative things the technology should be able to do before we field it, further delaying fielding.

Sometimes we find that after we have invested so much time, money and effort — and have still not “perfected” the solution — we are afraid to, or can no longer afford to, procure even one system. In the end, because we are unable to achieve a certain performance, we just walk away from a capability we could employ, never to use it.

Is it possible that we need to reconsider our vision and values when assessing technology readiness for use?

I submit that a new technology might be ready to use when it demonstrates it has utility. Can it do something that we can't presently do? If the answer is yes, more questions are likely. How much more? How much better? How valuable is it to be able to do that? Is it worth the investment?

Then it gets more interesting.

The next thing we get to decide is how we measure the value of having the additional capability. Sometimes we might be able to calculate a dollar value of benefit. But in our business that's rarely the case. We rate ourselves by the capabilities we possess. The value is normally in the form of our ability to do things, such as getting to an objective, saving lives, protecting an aircraft and crew, better precision, and deterring or disrupting adversaries. Without some pretty creative math, these benefits are difficult to quantify. So, for the case of this discussion, let's assume there is operational value in the capability.

Now there is an additional layer of value we must consider. We need to assess whether we should wait to use the technology until it can do more than it can presently do. If that is the decision, it assumes we are willing to forego today's utility in the hope that someday the technology will be more capable. What we would be doing is deferring a capability available today, while more is invested in the hope for additional unquantifiable benefit.

This brings us to unmanned aerial vehicles. UAVs provide a long and tortuous example of chasing a match between missions and acceptable technological capability. For decades we toyed with the idea of fielding UAVs for various missions. Among the first modern day uses of unmanned air vehicle technology was the successful employment of the Lightning Bug in Southeast Asia. We then studied and considered the use of UAVs for about 30 years. A lot of technological advancement happened in those 30 years, most of which was not specifically for the purpose of advancing the capabilities of unmanned aircraft.

Partly as a result of those ancillary developments, we resurrected UAVs. We fielded them as the Gnat, then Predator, then armed Predator and Reaper, then Global Hawk. It has been a continuous spiral of learned requirements. It's interesting to note that the Global Hawk's operational requirement document and concept of operations were developed almost as Global Hawk was preparing to deploy to Tora Bora, which tells us the requirement documents were not driving fielding. At least one of its KPPs had not even been met.

In retrospect, we envisioned these UAVs to have limited capabilities: collection of intelligence, surveillance and reconnaissance. We now know the rest of the story, so far.

If we field a technology, even though it has not reached the limits of its capability, we may find it does things we can't be without. By fielding not quite fully mature capabilities, we may also find that we are moving the ball down the field both operationally and technologically. We can move the ball while achieving greater advantage over our adversaries.

The fielding of the joint surveillance target attack radar system, or JSTARS, is a good vignette. We deployed a developmental test aircraft, and the complementary ground stations, in support of Operation Desert Storm. Only four months earlier, the JSTARS development program had just conducted a successful operational fielding feasibility demonstration. In fact, we used JSTARS operationally in two theaters before the first production aircraft was even delivered in 1996. This is a great example of bringing a new technology to the battlefield that provided a capability we didn't even know we needed.

By simultaneously gaining operational experience and technology development, we can have operational capability while technology matures. Just as has been the case with UAVs, added capability has spurred development. Employing advanced technology stimulates technology development, and creates a spiral of ever-increasing potential capability.

Air Force Special Operations Command has a history of fielding burgeoning technology quickly and incrementally in an effort to get operationally relevant capabilities to the warfighter as soon as possible. That is our heritage and in our DNA.

Today we are exploring directed energy and off-board sensing, both technologies that may not have reached their full maturity yet. However, we feel the potential benefit is worth the effort. We don't even know yet what additional utility these potential game changers bring to the table, but we know the cost of not pursuing innovative approaches is stagnation, something we can't afford by any cost-benefit analysis.

This is not to say we should commit to every new bright idea. But we must continue to expand the envelope so that we advance the ball, increasing our operational advantage, while fostering further technology development.

Brig. Gen. Kirk W. Smith is director of strategic plans, programs and requirements at U.S. Air Force Special Operations Command.

<http://www.nationaldefensemagazine.org/archive/2016/May/Pages/TheEnemyofGoodEnoughADifferentWaytoLookatEmergingTechnology.aspx>

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Robots Poised to Challenge UAVs for E-Commerce Delivery

Droids Not Drones Are the Future of E-Commerce Deliveries

In the shadow of Greenwich's O2 Arena - the futuristic dome originally built as London's showpiece for the Millennium - what looks like a picnic cooler on wheels zips among groups of gawking children. This

little delivery robot, designed to autonomously navigate sidewalks, not roads, later this year will begin making deliveries from local businesses direct to customers.

In doing so, it may just conquer e-commerce's final frontier: the Last Mile, the least efficient and most problematic step in the delivery process.

"Thirty to forty percent of the cost of delivery comes in the last mile," says Allan Martinson, the chief operating officer of Starship Technologies, the company building this robot. The venture is the brainchild of Ahti Heinla, one of Skype's original developers, and is backed by billionaire Skype co-founder and tech investor Janus Friis.

The little delivery robots designed by Starship and a competing U.S. startup called Dispatch are the BB-8s and Wall-E's of e-commerce. These scrappy droids are up against tech's strongest forces. Amazon is testing airborne drones, as are Wal-Mart and Google. Google has also sought patents for a driverless truck that would carry an array of storage lockers that unlock with a text message. And Uber is deploying drivers for food delivery, a concept that could be expanded to other products. And don't forget incumbents from Federal Express and UPS to government postal services.

While Starship's robot may be first to market, victory isn't assured. The droids have limitations, with economic viability confined urban areas. Drones have a higher sticker price and bigger regulatory hurdles to surmount, but may prove less expensive on a per-mile basis. And for the foreseeable future, some logistics experts say, humans still have the edge over any sci-fi inspired contenders.

Heinla, a tall, gaunt Estonian with shaggy blond hair and the disheveled look of an engineer for whom form matters more than fashion, says delivery droids have their advantages. Smaller robots are easier and cheaper to build. Because Starship's droid weighs less than 35 pounds and travels slowly, it's less likely to cause damage. As a wheeled vehicle, there are no spinning rotorblades that could cause injury - unlike drones.

Most importantly it travels on sidewalks not roads, which simplifies getting regulatory approval to operate. Starship robots have already covered more than 1,900 miles in the U.K., Germany, Belgium, Estonia and the U.S., with more than 50,000 miles planned this year. In comparison, drones are being tested in highly-controlled environments, with commercial deliveries on hold until regulators work out safety, liability, air rights and privacy issues. Autonomous vehicles are so far only allowed limited tests on public roads.

"We've tested it in snow, slush, ice and rain - you name it," Martinson says. In the U.S., Starship is testing its robot in Fayetteville, Arkansas, about 35 miles from Wal-Mart's Bentonville headquarters, in conjunction with an innovation lab at the University of Arkansas named after the family of Wal-Mart chief executive Doug McMillon. This has led to speculation the giant retailer may be interested in the little robot. Wal-Mart's 415C Lab, an internal unit investigating various disruptive technologies, has said it is monitoring the testing program. Starship won't comment on a possible tie-up with Wal-Mart. But Martinson says he expects the first e-commerce customers to start using the robots later this year.

San Francisco-based Dispatch, which was founded by former computer scientists from the University of Pennsylvania and the Massachusetts Institute of Technology and is backed by Silicon Valley venture firm Andreessen Horowitz, is also testing its own ground drone called Carry.

Gur Kimchi, the Amazon executive in charge of its Prime Air drone project, says they considered delivery robots and driverless trucks too. But Amazon decided drones were a better bet. “The other options cannot guarantee very fast, very economic and very safe delivery,” he says. Drones, he says, can serve a range of rural, suburban and even urban environments – while delivery robots work best only in urban areas. And autonomous trucks or delivery drivers only add to already congested roads, he says.

Kimchi says that Amazon’s drones, which can carry up to five pounds for 15 miles at speeds of up to 60 miles per hour, will cover 80 percent to 90 percent of its shipments. “It is a surprisingly large subset of our selection,” he says. In a May 2015 analysis by investment research firm ARK Invest, analyst Tasha Keeney estimated that by using drones, Amazon could reduce its delivery costs to less than \$1 per package, or as little as 10 cents per mile.

To ensure safety, drones have “sense and avoid” technology that will steer clear of obstacles – or potential hazards – including even the family dog. “If the drone cannot make the delivery safely it is programmed to abort and fly back home,” Kimchi says.

Without a clear regulatory framework, Amazon can't start using its drones commercially. So the company has proposed that a segment of airspace between 200 and 400 feet be reserved for autonomous drones with sophisticated collision avoidance and safety features, while lower-tech craft be restricted to the airspace beneath 200 feet, which is about the height of an 18-story building. Manned aircraft would stay above 500 feet, or about the height of the Washington Monument.

So far this type of regulation doesn't exist anywhere, and it's anyone's guess how soon it might. “I am generally impatient and would love to get into the market,” Kimchi says, adding that he thinks the regulatory framework will be in place “in much less than 10 years.”

This uncertainty is why Burton White, a consultant at Chainanalytics, an Atlanta-based logistics consultant, says retailers should wait for a shakeout. “This is still the wild west,” he says. “Automation and drones are something to keep your eye on but they are further out.”

Because population density is the biggest factor in determining Last Mile costs, there may not be one solution. In crowded cities a network of bicycle couriers might be the best option, White says, while in rural areas drones may be most efficient. Starship says its ideal delivery area isn't as densely populated as a city like New York or London, which have more than 5,000 households per square mile. But many suburbs and smaller cities, like Montreal or Copenhagen, are in Starship's target zone.

Heinla had long been interested in robots, even competing in a NASA competition to make a robot that could bring back soil samples from Mars missions. But in 2014, Heinla had his Last Mile eureka moment. “I knew it was technically possible to build a small robot that would still go fast enough, that you wouldn't need a big vehicle to do the job that is done by big vehicles today,” he says.

Because small robots are less expensive to build than trucks or drones, Starship anticipates being able to offer them to local shopkeepers on a leased basis – essentially “robot-delivery-as-a-service,” says Martinson, the chief operating officer. With a target delivery cost of £1 to £3 per delivery (\$1.40 to \$4.20), the robots will allow these businesses, which have often been shut out of e-commerce by high delivery costs, to begin selling online, he says. A business might break even on a robot if it did just 15 deliveries a day, he says.

Starship’s prototype design will deliver up to 20 pounds of goods, traveling 4 miles per hour. “It’s basically designed to carry the equivalent of three good-sized bags of groceries,” Martinson says. Also, because the robot has a simple cargo hold, customers could use the robot to return items to the retailer. An electronic lock keeps cargo safe en route, while the robot’s ability to transmit its current location and live video feed from its cameras is designed to deter thieves.

The company has planned the robots to cover deliveries within a three-mile radius of a central logistics hub, navigating using a 3G GPS signal. Nine cameras provide a fly-eye view of its environment, and sensors help avoid tree roots, toddlers and dog poo. And a human can drive remotely if the robot encounters trouble.

With its current battery design, the little robot can operate for more than two hours continuously before needing to recharge or have a fresh battery pack swapped in. Martinson says the company chose a relatively low-capacity battery to save weight but might consider a longer-life one later.

In its trials so far, Martinson estimates that the Starship robots have encountered some 120,000 pedestrians, including thousands of children. So far, no one has tried to abuse it. “Children are curious but they love it,” he says. Starship co-founder Friis says that people of all ages seem to greet the small machine with a sense of awe. “It is really amazing but people seem to have an instant emotional connection to the robot,” he says. Emotional connection? Just try delivering that with a drone.

<http://www.bloomberg.com/news/articles/2016-04-18/droids-not-drones-are-the-future-of-e-commerce-deliveries>

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