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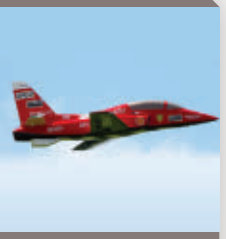

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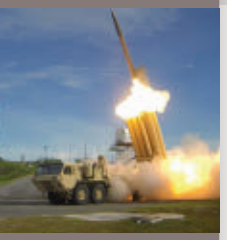

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BY **JOHN KELLER**, EDITOR IN CHIEF

The military's role in containing the Coronavirus Disease (COVID-19)

Coronavirus Disease (COVID-19), as everyone knows, is changing life as we know it, and its effects will be felt for years, if not for decades, to come. People are huddling at home, with little hint of when life will get back to normal. Work has ceased or is altered heavily, sporting events on all levels have disappeared. Even a trip to the grocery story is fraught with fear and anxiety.

U.S. military forces are not exempt from the physical and cultural effects of the virus reverberating through society. So how might the military play a role in bringing this pandemic under control? Certainly military leaders have an interest in taking part. Warfighters by the thousands can move quickly and widely in the world, through areas widely infected with the virus, and run a big risk of spreading the virus if leaders fail to take the proper precautions.

History shows that the military played an unenviable role in virus spread in previous pandemics — most notably the Spanish Flu outbreak in 1918, which killed between 50 million and 100 million people. One range of speculation has it that the Spanish Flu actually began in the U.S., not Spain, in Haskell County, Kan. Young men infected with the virus spread it to Camp Funston, Kan., outside of Fort Riley, which was a training site for U.S. recruits gathering to fight in World War I.

From Camp Funston the virus quickly made its way to other U.S. installations, and then to Europe with the first Doughboys heading to the trenches of the Western Front. The Spanish Flu, some speculate, may have started in a military hospital camp in Étaples in France, and spread from there to the trenches. Either way, the military was a major culprit in the virus's spread.

No one wants to see that again. Today, in fact, the military is taking measures to control and mitigate the spread of COVID-19. U.S. Army researchers released a solicitation in March asking industry to develop technologies to slow the spread of, and treat those with the virus.

The solicitation, MTEC-Presolicitation-COVID-19, is called Prototype Development to Combat Novel Coronavirus Disease COVID-19. It was released on 15 March 2020 by the Medical Research Acquisition Activity of the U.S. Army Medical Command at Fort Detrick, Md. The solicitation is on behalf of the Medical Technology Enterprise Consortium (MTEC) in Summerville, S.C., and seeks to develop prototypes aimed to combat COVID-19.

To do that, researchers want rapid new ways to accelerate the inquiry, testing, and fielding of new ways to detect, prevent, contain, and treat COVID-19 and similar future emerging medical threats. The project is fast, too; researchers want solutions as soon as possible, and no later than the end of December.

In a separate project, military researchers launched the Pandemic Prevention Platform (P3) program (DARPA-SN-17-20) in February to develop pandemic-prevention countermeasures to patients within 60 days of an outbreak.

The P3 program of the Biological Technologies Office of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., aims to revolutionize outbreak response by enabling rapid discovery, characterization, production, and testing of medical countermeasures to counter biological threats like COVID-19. The program seeks to generate virus stock, evolve antibodies, and develop gene-encoded antibody delivery methods.

DARPA briefed industry on the P3 program in late February and early March at two separate locations on the East and West Coasts. Doubtless these are only some of the first military initiatives to combat the COVID-19 virus.

In this spirit, Military & Aerospace Electronics will continue with its online communities and products to provide industry updates and key information to readers during the current social-isolation periods to contain COVID-19. Military & Aerospace Electronics continues to offer multiple social channels and websites, along with digital products such as webinars, white papers, and eBooks to keep readers informed of the global business effects of COVID-19.

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The U.S. still needs to keep strategic surveillance systems like the Solid State Phased Array Radar Systems (SSPARS) in good repair, and has chosen InDyne to do this job.

InDyne to upgrade, maintain, and operate long-range missile-defense radar system

BY **John Keller**

PETERSON AFB, Colo. — Radar experts at InDyne Inc. will maintain, upgrade, and operate a global distributed radar network in place to provide missile-defense and early warning of enemy ballistic missile launches and potential threats in space.

Officials of the U.S. Air Force 21st Contracting Squadron at Peterson Air Force Base, Colo., announced a $51.4 million order to InDyne in Sterling, Va., to exercise option year two for the management, operation, maintenance, and logistical support of the Solid State Phased Array Radar Systems (SSPARS).

These radar systems — once referred to as the Phased Array Warning System (PAVE PAWS) and the Ballistic Missile Early Warning System (BMEWS) — represent a radar, computer, and communications system for missile warning and space surveillance.

SSPARS sites are located at five separate locations: Beale Air Force Base, Calif.; Cape Cod, Air Force Station, Mass.; Clear Air Force Station, Alaska; Royal Air Force Station Fylingdales, England; and Thule Air Base, Greenland.

Air Force radar experts have been considering technology refresh for the front-end and remoting capabilities of those radar systems, and have received significant upgrades to their data- and signal-processing subsystems.

The SSPARS ballistic missile defense radar provides U.S. Strategic Command (USSTRATCOM) at Offutt Air Force Base near Omaha, Neb., with warning and attack-assessment information on all intercontinental ballistic missiles (ICBMs) launched throughout the world that might be headed for U.S. territory.

The system also helps warn USSTRATCOM and NATO authorities of submarine- and sea-launched ballistic missile (SLBM) attacks and provides data to help evaluate the severity of ballistic missile attacks.

A sister system — the Perimeter Acquisition Radar Attack Characterization System (PARCS) is a large radar installation in North Dakota that provides ballistic missile warning and attack assessment, as well as space surveillance data to the North American Aerospace Defense Command (NORAD) at Peterson Air Force Base, Colo., as well as to USSTRATCOM and regional combatant commanders.

On this order InDyne will do the work at Beale Air Force Base; Cape Cod Air Force Station; Clear Air Force Station; Thule Air Base; and Royal Air Force Fylingdales, and will be finished by April 2021.

For more information contact InDyne Inc. online at www.indyneinc.com, or the Air Force 21st Contracting Squadron at www.peterson.af.mil.

Could DARPA program pave the way to containing the COVID-19 pandemic?

Starting in 2017, the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., launched the Pandemic Prevention Platform (P3) program to create a new medicine to treat infections within 60 days and prevent spread of the infection. Now the P3 program could play a role in ending the disruptions caused by the COVID-19 pandemic and decrease disruptions to the military and homeland. These disruptions have hit the military, with everything from strained telework resources to canceled exercises to actual infections among service members. One of the companies awarded contracts by DARPA was AbCellera Biologics Inc. in Vancouver, B.C., which through the program refined its approach to the discovery and manufacture of antibodies that are most effective in containing a novel infection. While DARPA projects often anticipate the future, it has been a fast turnaround from anticipating greater pandemics in 2017 and 2018 to tackling one in 2020. AbCellera announced it is partnering with Eli Lilly to develop and manufacture an antibody treatment that can bind and neutralize COVID-19.

Lockheed Martin to build additional Trident II D5 nuclear missiles

Strategic weapons experts at Lockheed Martin Corp. will build additional UGM-133A Trident II D5 submarine-launched ballistic nuclear missiles and support deployed D5 nuclear weapons under terms of a half-billion-dollar order announced in March. Officials of the U.S. Navy Strategic Systems Programs (SSP) office in Washington are awarding a $601.3 million contract modification to the Lockheed Martin Space Systems segment in Titusville, Fla., to provide for Trident II (D5) missile production and deployed systems support. The Trident II D5 is one of the most advanced long-range submarine-launched nuclear missiles in the world. It is the primary U.S. sea-based nuclear ballistic missile, and is deployed aboard U.S. Navy Ohio-class ballistic missile submarines. The U.S. Navy operates 14 of these ballistic missile submarines, each of which can carry as many as 24 Trident II missiles. Although the Trident II is designed to carry as many as 12 multiple independently targetable reentry vehicle

Military seeks AI algorithms for future unmanned jet fighters

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry to develop artificial intelligence (AI) algorithms for future experimental high-performance unmanned combat aircraft, with an eye to creating future teams of manned and unmanned jet fighters.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have released a broad agency announcement (HR001120S0028) for the Air Combat Evolution (ACE) Technical Area 1: Build Combat Autonomy project.

This project seeks to increase warfighter trust in combat autonomy by automating aerial within-visual-range maneuvering using realistic aircraft.

The ACE Build Combat Autonomy project seeks to advance artificial intelligence technologies for individual and team aerial dogfighting tactics. To do this, DARPA wants to develop an aircraft autonomy able to move to progressively more realistic environments, including live subscale unmanned aerial vehicles (UAVs), and ultimately to full-scale combat aircraft.

DARPA researchers are asking industry to develop technologies to enable unmanned jet fighter aircraft to maneuver just as if they had human pilots.

The project will develop air combat maneuvering algorithms for within-visual-range air combat maneuvering that involve one-versus-one, two-versus-one, and two-versus-two engagements against adversaries with a broad spectrum of performance.

The ACE program overall seeks to increase trust in combat autonomy using human-machine collaboration in aircraft dogfighting, as well as develop enabling technologies to enhance collaboration among humans and unmanned combat aircraft in a variety of combat scenarios.

The idea is to enable one human pilot to become a more deadly warfighter by leading several semi-autonomous artificially intelligent unmanned aircraft, all from his own cockpit. This would shift the human role from sole operator to system mission commander.

In particular, ACE aims to enable a pilot to handle a broad, global air command mission while his aircraft and unmanned aircraft team members attack enemy aircraft and ground targets.

Companies interested in participating in the ACE Build Combat Autonomy project should upload full proposals no later than 30 April 2020 to the DARPA BAA Website at https://baa.darpa.mil.

Email questions or concerns to DARPA at HR001120S0028@darpa.mil. More information is online at https://beta.sam.gov/opp/06abac37e9f0483181f6d3903542843b/view.

(MIRV) warheads, current treaties reduce this number to four or five. Each Trident II missile has a range of 4,000 to 7,000 miles. The Trident II D5 was first deployed in 1990 and is scheduled to remain in service until at least 2027.

Northrop Grumman to build AARGM anti-radar missile for EW combat jets

U.S. Navy air warfare experts are ordering another batch of the AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) to equip the service's carrier-based fighter-bombers and electronic warfare (EW) jets. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $165 million order last week to the Northrop Grumman Corp. Innovation Systems segment (formerly Orbital ATK) in Northridge, Calif., for lot nine full-rate-production of the AARGM anti-radar missile. The order includes converting Advanced Guided Missile-88B High Speed Anti-Radiation Missiles (HARM) into 253 AGM-88E AARGM all up rounds for the Navy, and two captive air training missiles for Germany. AARGM is the newest version of the AGM-88 missile, and is compatible with U.S. and allied strike aircraft, including the F/A-18 fighter bomber, EA-18G electronic warfare jet, Tornado, F-16, and F-35. The AARGM features an advanced digital anti-radiation homing sensor, millimeter wave radar terminal seeker, global positioning system/inertial navigation system (GPS/INS) guidance, net-centric connectivity, and weapon-impact-assessment transmit (WIA).

Marines ask the Navy MUOS satellites could handle electronic jamming

Maj. Gen. Robert Castellvi, commanding general of the 1st Marine Division, said March 2 that the Navy's narrowband communications satellites were able to withstand significant interference during a December exercise at Camp Pendleton, Calif. Marine Corps leaders asked the Army's Threat Systems Management Office to intentionally jam parts of the spectrum that the Navy's Mobile User Objective System operates in for the Steel Knight 20 exercise at Camp Pendleton north of San Diego. MUOS, a constellation of five on-orbit communications satellites built by Lockheed Martin, operates over a span of about 20 MHz. Marines learned that the signal could survive jamming as strong as about 50 percent of that threshold. That's a significant amount, officials said, because jamming a greater portion of the spectrum more would require more power and, in turn, compromise an enemy's position.

Navy to upgrade electro-optical surveillance system for submarine fleet

Submarine combat systems experts at Lockheed Martin Corp. will upgrade and support a U.S. Navy electro-optical surveillance system designed for several classes of attack and guided-missile submarines. Officials of the Naval Sea Systems Command in Washington announced an $8.8 million order to the Lockheed Martin Rotary and Mission Systems activities in Manassas, Va., and in Syracuse, N.Y., to provide kits and spares for the AN/BVY-1 Integrated Submarine Imaging System (ISIS). These kits and spares will be for the AN/BLQ-10 submarine electronic warfare (EW) system, technology insertion 18 (TI-18), versions. ISIS provides mission critical, all-weather, visual, and electronic search, digital image management, indication, warning, and platform architecture interface capabilities for Los Angeles-, Ohio-, and Virginia-class submarines, Navy officials say. The system has the potential for installation on Ohio-class ballistic missile submarines and other kinds of submarines.

Military wants to develop rugged materials for hypersonic radomes and infrared windows

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry to develop rugged RF radomes and infrared windows able to withstand the severe heat, shock, and vibration of hypersonic flight.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001120S0038) for the High Enthalpy Aperture Technology (HEAT) project.

HEAT seeks to demonstrate new material approaches and solutions to enable RF and IR apertures on hypersonic missiles and aircraft to withstand extremes in heat and dynamic pressure. Hypersonic vehicles typically fly faster than five times the speed of sound.

The HEAT program is a classified effort, so any contractors participating must have facility clearance licenses and personnel with collateral secret security clearances.

High speed aerospace systems like hypersonics require RF radomes or IR windows to protect sensitive electronics from the environmental extremes of high-speed flight while providing transparency for radar and RF communications transceivers, as well as infrared sensors used for guidance, communications, and sensing.

These aperture materials must withstand extreme thermal, mechanical, and chemical environments during hypersonic flight that can limit their performance. For example, shock waves and high heat loads can impose wavefront distortions and boresight errors on guidance electronics.

Solutions may involve affordable and manufacturable means of controlling thermo-optical and elastic-optical effects; maintaining desired transmission amplitude and bandwidth; and reducing thermal deformation, mismatch, and radiation.

HEAT program is a four-year, two-phase effort, which is divided into three technical areas: integrated RF aperture materials; infrared aperture materials; and next-generation aperture materials.

Performers should consider new materials approaches that combine metals, ceramics, and coatings into innovative high-performance structures, as well as new computational capabilities necessary to develop these materials.

The program's first phase will develop integrated aperture materials, and the second phase will involve ground testing.

Companies interested were asked to submit abstracts no later than 9 April 2020, and full proposals no later than 21 May 2020. Email questions or concerns to the HEAT program manager, William Carter, at HEAT@darpa.mil.

More information is online at https://beta.sam.gov/opp/46a722b19a2a486196648e2ddc0478ea/view.

The intense heat and vibration of hypersonic flight is focusing attention on how to protect sensitive electronics like radar and electro-optical guidance sensors.

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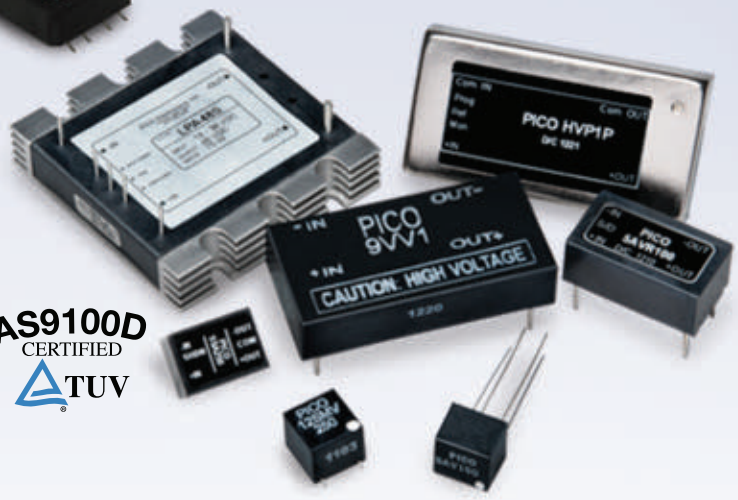

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Lockheed Martin to build AN/SQQ-89 shipboard ASW and counter-mine systems

BY **John Keller**

WASHINGTON — Undersea warfare experts at the Lockheed Martin Corp. Rotary and Mission Systems segment in Manassas, Va., will provide the U.S. Navy with AN/SQQ-89A(V)15 anti-submarine warfare (ASW) systems for surface warships under terms of a $65.8 million order.

Officials of the Naval Sea Systems Command in Washington are asking Lockheed Martin to for production and engineering services for the AN/SQQ-89A(V)15 shipboard ASW system.

The AN/SQQ-89A(V)15 is an undersea combat system designed to search, detect, classify, localize, and track underwater contacts, and to attack or avoid enemy submarines, floating, tethered, or bottom-attacked mines, and torpedoes. This contract combines purchases for the U.S. Navy and the government of Japan.

The AN/SQQ-89A(V)15 uses active and passive sonar to enable Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers to detect, locate, track, and attack hostile submarines, mines, and torpedoes.

The counter-mine and anti-torpedo system provides multi-sensor track correlation and target track management control, and forwards data to the ship's weapons and decision-support systems. The AN/SQQ-89A(V)15 works together with the ship's active and passive hull sonar, multi-function towed array, sonobuoy processing, torpedo alerts, fire-control system, sensor performance predictions, embedded operator, and team training systems.

Lockheed Martin is building additional AN/SQQ-89A(V)15 systems to help surface warships like the Arleigh Burke-class destroyer to detect enemy submarines, mines, and torpedoes.

The AN/SQQ-89A(V)15 has an open electronics architecture to accommodate system upgrades, and makes the most of data accessibility and system modules, Lockheed Martin officials say. Its software application programs are isolated from hardware with open middleware to render applications processor-independent.

The system uses POSIX-compliant system calls and Motif and X-compliant display service calls. Symmetric multi-processors (SMPs) using Linux-based processing handle signal, data, display, and interface processing.

Virtual Network Computing (VNC) enables rapid re-allocation of operator console displays to suit the tactical situation, Lockheed Martin officials say.

Recent and planned upgrades to the AN/SQQ-89A(V)15 include improved automated torpedo detection, sonar performance prediction, advanced active sonar processing, re-designed active displays to reduce operator loading, and integrated training and logistics.

The AN/SQQ-89 is integrated with the Aegis combat system, vertical launch anti-submarine rocket (ASROC) system. A variant of the AN/SQQ-89A(V)15 is integrated with late-version Aegis combat systems being installed onboard new Arleigh Burke-class destroyers. A back-fit program is in place to retrofit existing DDG-51 class ships and Ticonderoga-class cruisers.

On this contract modification Lockheed Martin will do the work in Lemont Furnace, Pa.; Clearwater, Fla.; Syracuse, Hauppauge, and Owego, N.Y.; Manassas, Va.; and Tewksbury, Mass., and should be finished by May 2022.

For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Military & Aerospace Electronics continues providing important news and information amid social distancing

To the loyal followers and friends of *Military & Aerospace Electronics*,

As we are all feeling the impact of in-person social distancing, we wanted to reach out to you to let you know you can count on the *Military & Aerospace Electronics* online communities and products to continue providing industry updates and key information you need to continue to do your job.

Military & Aerospace Electronics provides our news and information through multiple social channels and websites, along with digital products such as webinars, white papers, and eBooks — all with the intent of helping to keep you informed of the global impact of today's evolving business environment.

At *Military & Aerospace Electronics*, we want you and your families to stay safe and healthy. As a community, we will make it through these turbulent times.

John Keller, chief editor
Military & Aerospace Electronics

U.S. Marine Corps Lance Cpl. Isaiah Trujillo, an unmanned aircraft system maintenance technician, recovers a U.S. Marine Corps RQ-21A Blackjack unmanned aircraft at Canon Air Defense Complex in Yuma, Ariz.

Artificial intelligence and embedded computing for unmanned vehicles

The latest generation of unmanned vehicles operating on land, in the air, and at sea no longer simply are remotely operated. These advanced systems have built-in intelligence to learn from their experiences and make their own decisions.

BY **J.R. Wilson**

The two most prevalent terms in military and civilian technology represented little more than science fiction a generation ago. But today, unmanned vehicles and artificial intelligence (AI) command center stage in any discussion of future military requirements for platforms, tactics, techniques, and procedures.

Unmanned vehicles, in the form of unmanned aerial vehicles (UAVs), arrived on the scene first, but how the military wants to use them and other platforms — unmanned ground vehicles (UGVs), unmanned surface vehicles (USVs), unmanned underwater vehicles (UUVs) and unmanned space vehicles (USVs) — in the future had to wait for at least rudimentary AI.

Each of those has its own unique operational environments that require specific AI capabilities to make autonomous underwater vehicles (AUVs) practical. Sandeep Neema, program manager in the U.S. Defense Advanced Research Project Agency (DARPA) Information Innovation Office (I2O) in Arlington, Va., says some of the most difficult unmanned technology challenges involve UUVs.

"While each evaluation environment is distinctive, undersea environments present a unique set of challenges," Neema explains. "In these environments, things move much more slowly, missions can take longer due to

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DARPA has completed its Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) program and has officially transferred the technology demonstration vessel, christened Sea Hunter I, to the Office of Naval Research (ONR).

harsh environmental conditions, and the limits of physics and navigation/sensing/communications issues exacerbate the challenges. Advanced autonomy could significantly aid operations in the underwater domain."

Smaller, faster processors and enhanced onboard memory have expanded the capabilities of embedded computing greatly across the range of unmanned vehicles, but especially on smaller platforms like hand-launched UAVs, UUVs, and UGVs operating underground.

"Big data processing is increasingly being deployed in edge applications for autonomy, quick reaction capability, and untethered cognitive functionality remote from fixed resources," explains John Bratton, director of product marketing at Mercury Systems in Andover, Mass. "Nowhere is this more pronounced than in the rapidly emerging and well-funded autonomous platform domain."

To scale the data center across smart fog and edge layers requires their composing servers to become smaller, resilient to harsh environments, and human attempts to tamper with them. Distributed deployment requires servers to be miniaturized, while remaining well-cooled; protected from hostile environments and conditions; secure and resilient to reverse engineering, tampering, and cyber threats; trusted across hardware, software, middleware, and other intellectual property; deterministic for mission- and safety-critical effector control and edge layers; and affordable through the leverage of the best commercial intellectual property, independent research and development, and manufacturing capabilities.

Sea Hunter II, designed by Leidos and under construction by U.S. Marine Inc. in Gulfport, Miss., is the Office of Naval Research's second Medium Displacement Unmanned Surface Vehicle Program prototype.

The need for big processing

"As platforms become smarter and more capable, greater on-board AI and big processing in general is required to handle the torrents of sensor and situational awareness data for autonomous decision-making and effector control," Mercury's Bratton says. "Effectors being the highly deterministic, reliable and safe vetronics, avionics and other safety- and mission-critical functions required for platform control and mission success within the defense domain. As the number of smart platforms grows, so does the need for a greatly expanded, distributed fog layer with big processing capability that safely and efficiently manages the increased traffic."

The evolutionary range of artificial intelligence, from machine learning to total AI, requires more and faster embedded computing as its capability increases. As the size, weight, and power consumption (SWaP) of embedded computing improves at a rapid pace, so does the ability to place more and better levels of AI on smaller and smaller platforms.

"We can recreate in an Open VPX system at the tactical edge," Bratton says. "Miniaturization and cooling are critical. You need very sophisticated cooling to remove the heat associated with smaller processors. The support they need includes the ability to reduce the footprint of the circuit board. Then you have to get the heat away from that and all the components it interacts with."

Using independent research and development (IRAD) funds, the Leidos Innovations Center (LInC) in Reston, Va., is charged with advancing the state of the art of embedded computing and AI for unmanned vehicle applications.

"Embedded computing has gotten more and more advanced, especially SWaP constraints and being able to fit into smaller packages, says Richard Bowers, lead software engineer for unmanned surface vessels at Leidos. "The more advanced systems are much better at handling hard environments. We're testing in the Arctic circle, in high sea states, ensuring whatever we build can work in any environment"

Field-programmable gate array (FPGA) embedded computing is a chief enabling technology for these kinds of unmanned vehicles. "We've been doing a lot with high-power FPGAs to improve our sensing capabilities, especially for smaller vehicles," Bowers says. "Embedded computing has really been pushing the envelope of what's possible in terms of fast response and high-level computing, which is giving us a lot more capability. We're still using other embedded techniques — traditional computing in a smaller form factor — but the FPGAs are almost transformative rather than just shrinking the size of the computer."

Harvesting commercial technology

Technology advances in computing, sensors, and other areas once were led by the military. Today's techno-world, however, sees commercial companies pushing enabling technologies in applications ranging from smartphones

Unmanned vehicles equipped with artificial intelligence are becoming a hot commodity for explosives ordnance disposal applications in the arctic and in other extreme environments.

to self-driving vehicles. Commercial companies today provide the fastest, least expensive path to solving military problems.

"The state-of-the-art today is in the commercial market," notes Greg Tiedemann, product line director for mission systems at Mercury Systems. "There are companies that have developed very-low-power sensors behind cameras to do facial recognition, for example. How do we take those devices, put them behind huge imaging cameras, and look for objects on the ground or in the air? We've also deployed massive graphics processing units [GPUs] into exploitation applications. Those GPUs are very powerful to do some of the AI algorithms. So we're doing a lot of work to apply what's best in industry today to military problems."

However, some chip makers do not want to sell chips directly — especially to the military — and have to support someone else putting those on an embedded card; instead, they will make the module themselves and sell those.

"There's nothing magical to make AI deployable," says David Jedynak, chief technology officer at the Curtiss-Wright Corp. Defense Solutions segment in Ashburn, Va. "It comes down to are there chips that can run what we need to run and fit on the platform? Are the parts available from industry and are we allowed to use them in the defense market? There are some chip makers in the broad tech industry that aren't interested in the defense market and they just won't talk to you. So we can't just do anything we want with those chips. At the end of the day, it's about the engineering support.

"The whole point of AI is the upper level DOD [U.S. Department of Defense] policy — the third offset strategy — which is why we are doing a lot of this. The DOD strategy is we are going to get machine learning and cyber-hardened equipment to the services, such as man-machine interfaces. That's a huge driving policy force behind all this, getting AI to the battlefield to help the warfighter be more effective, using machine learning to provide greater capabilities beyond what the individual warfighter can do now."

Embedded computing and AI

The military no longer can afford service-specific answers that may not work or may even be in conflict with inter-service and allied/coalition operations — especially given the rapid pace of technology development. That is markedly the case with embedded computing and AI.

"The point is, we try to get these capabilities into the warfighters' hands as quickly as possible to save lives and make our defense more effective," says Stephen Kracinovich, director of autonomy strategy at the Naval Air Systems Command (NAVAIR) Aircraft Division at Patuxent River Naval Air Station, Md.

"We in naval aviation do a great job, but collaborating with industry, academia, other government entities and the other services and domains is part of our strategy to move forward," Kracinovich says.

"To implement these capabilities, you have to have a business strategy that allows you to rapidly add new functionality."

The trick is finding the right mix of defense industry expertise to meet design goals; no one company can go it alone. "No defense contractor can be the best of breed in everything," Kracinovich points out. "So one goal is to make it possible to bring in third parties by designing our systems to rapidly take an automated capability and integrate it into our systems, whether from the original defense contractors or not. A lot of our warfighters know what's out there and they expect it in the systems they use. So the idea of having a well-defined, modular architecture that allows automated capabilities and an acquisition strategy that allows us to bring in new capabilities as they come up is fundamental to what we're doing."

DARPA remains DOD's primary source for advanced military technologies, and typically pursues what one former director called "Far-Out" technologies that might not become mainstream for decades. Yet in recent years, the agency has put more effort into technological breakthroughs and advanced prototypes that could be deployed to warfighters quickly. While that includes embedded computing and AI, Neema says one of the biggest areas of concern for AI is safety, to ensure that an unmanned vehicle with no human operator does what its operators intend.

Systems like this help U.S. Marines test out an unmanned underwater vehicle to evaluate its hydrographic survey capability.

Trusted artificial intelligence

That does not reflect a fear that AI might follow the path of "The Terminator's" Skynet controller. Still, there is concern that one or more components might fail, and cause unintended consequences. That is the goal of two of Neema's programs: Assured Autonomy, which is taking an assurance approach, fixing things they know are not working properly; and Symbiotic Design for Cyber-Physical Systems (SDCPS), which will launch later this year with a focus on using AI-based approaches to design systems and build more complex and innovative designs than today's traditional designs.

"DARPA's role is building some of the early stage technologies," Neema says. "With Assured Autonomy, we focus on looking at safety and correctness of systems that will use AI components. Past unmanned systems are, for the most part, remotely manned. To make them truly autonomous and unmanned, we need to use learning techniques in their operation. We currently don't have the safety and correctness elements in place," he explains.

"These kinds of systems have a complex design, which needs to be optimized for multiple applications," Neema continues. "To get good, efficient, higher-performing designs, you need to co-optimize across all the designs."

Within those safety and higher level design goals, DARPA is working to improve the SWaP parameters of embedded computing and enable the use of appropriate levels of AI in a range of unmanned vehicles — all sizes, all domains, all services, all environments, and all missions.

"We are able to put more powerful computing capabilities onboard now, but are limited by power and other constraints. From a software perspective, there are multiple classes we try to deploy on these systems — planning software, high-level control, etc. — but the state of the effort does not use AI. Collecting data onboard and bringing it back to a ground station is where we are today," Neema says. "The main AI technique currently being used is to extrapolate data, using COTS components; other AI techniques employ machine learning to guide the vehicle in operation.

"Embedded computing is part of a larger system. The base layer is some degree of embedded control," DARPA's Neema continues. "The next step is the autonomy layer that provides some higher-level planning. These are the core in employing any unmanned system. AI is potentially game-changing. In a lot of manned systems, the high level integration of complex functions is provided by human operators. These typically are not possible to implement autonomously."

AI in dogfighting

DARPA and the U.S. Air Force also are conducting three AlphaDogfight Trials, with eight teams in a virtual competition designed to demonstrate advanced AI algorithms that can perform simulated within-visual-range air combat maneuvering. The first two competitions were in November 2019 and January 2020, with the final in early April in Las Vegas at the Air Force's innovation hub, AFWERX, and nearby Nellis Air Force Base.

"The Trials aim to energize and expand a base of AI developers and potential proposers prior to an anticipated algorithm-development solicitation to be

released under DARPA's Air Combat Evolution (ACE) program," according to the lab. "ACE seeks to automate air-to-air combat and build human trust in AI as a step toward improved human-machine teaming. DARPA's vision is that with trusted AI able to manage lower-order operations, pilots could focus on higher-order strategic challenges, such as orchestrating teams of unmanned aircraft across the battlespace under the Mosaic Warfare concept.

The AlphaDogfight Trials are related to the ACE program but are not formally part of it. Those participating in the Trials represent a wide range of research entities — Aurora Flight Sciences in Manassas, Va.; EpiSci Science Inc. in Poway, Calif.;, Georgia Tech Research Institute in Atlanta; Heron Systems Inc. in California, Md.; Lockheed Martin Corp. in Bethesda, Md.; Perspecta Labs in Basking Ridge, N.J; physicsAI in Pacifica, Calif.; and SoarTech in Ann Arbor, Mich.

"Warfighters trust things that work and this contest is the first step along the road to trusting this new kind of autonomy," notes Lt. Col. Dan Javorsek, ACE program manager in DARPA's Strategic Technology Office. "In the larger ACE program, we want to demonstrate that human pilots teamed with AI can achieve greater effects in aerial combat than either could achieve alone. Ultimately, ACE is about enabling human-machine teaming for complex air combat scenarios."

In February, DOD officially adopted ethical principles guidelines for AI, based on recommendations Secretary of Defense Mark Esper received from the Defense Innovation Board in October 2019. Those recommendations were the result of 15 months of discussions with AI experts in commercial industry, government and academia, as well as public input.

Ethics and AI

"The United States, together with our allies and partners, must accelerate the adoption of AI and lead in its national security applications to maintain our strategic position, prevail on future battlefields and safeguard the rules-based international order," Esper said at the time.

"AI technology will change much about the battlefield of the future, but nothing will change America's steadfast commitment to responsible and lawful behavior. The adoption of AI ethical principles will enhance the department's commitment to upholding the highest ethical standards as outlined in the DOD AI Strategy, while embracing the U.S. military's strong history of applying rigorous testing and fielding standards for technology innovations."

According to DOD, the Department's AI ethical principles encompass five major areas: responsible, equitable, traceable, reliable, and governable.

Responsible — DOD personnel will exercise appropriate levels of judgment and care, while remaining responsible for the development, deployment and use of AI capabilities

Equitable — The Department will take deliberate steps to minimize unintended bias in AI capabilities

Traceable — The Department's AI capabilities will be developed and deployed such that relevant personnel possess an appropriate understanding of the technology, development processes and operational methods applicable to AI capabilities, including with transparent and auditable methodologies, data sources and design procedure and documentation

Reliable — The Department's AI capabilities will have explicit, well-defined uses and the safety, security and effectiveness of such capabilities will be subject to testing and assurance within those defined uses across their entire life-cycles

Governable — The Department will design and engineer AI capabilities to fulfill their intended functions while possessing the ability to detect and avoid unintended consequences and the ability to disengage or deactivate deployed systems that demonstrate unintended behavior

While the new guidelines align with President Donald Trump's 2019 American AI Initiative to advance trustworthy AI technologies and encourage U.S. allies to do the same, some nations — notably China, Russia, Iran, and North Korea — have not implemented similar principals. That could enable them to move forward more quickly with what is considered one of the most critical developments in human history, but with significantly higher risk of unintended consequences, especially with armed unmanned vehicles.

Leading AI development

"The United States currently leads in AI research, but the race is on to develop and wield AI advances," warned retired Marine Corps Lt. Gen. Robert M. Shea, president of the Armed Forces Communications and Electronics Association (AFCEA), in July 2018. "China has made no secret of its long-term plans to lead the world in AI by 2025, at the latest. It has its eyes on the prize and considers AI a national priority. What's bothersome about this is that China does not follow global behavioral norms."

One of the most ambitious U.S. efforts is Sea Hunter II, being built by Leidos as the second fully autonomous vessel in a program to develop unmanned, AI-operated ships for the U.S. Navy. It is a trimaran — a main

hull and two smaller outrigger hulls — capable of autonomous navigation as it spends weeks at sea. Its mission designs include tracking enemy submarines, removing mines, detecting torpedoes, and acting as a communication relay before it has to return to port — all at a fraction of the cost of a manned ship.

With updated embedded computing throughout, Sea Hunter II will incorporate what was learned from Sea Hunter I to further develop and mature autonomy, both as a stand-alone mission vessel and in cooperation with Sea Hunter I, which remains an active part of the program, as part of the Navy's goal of deploying collaborative ships, manned and unmanned.

"We're looking at attributable systems, unmanned systems that might go into harm's way and might not come back, so there is a lot of push for lower cost, higher power systems. We look at virtualization systems and quantum computing," Bowers says. "Customer demands are pushing forward on all kinds of AI — perception, decision-making, preventative maintenance, checking the health of the vehicle. There also is a lot of work on AI verification, making sure it's doing the right thing. The harder you work to make a computer smart, the harder it is to figure out if it is doing the right thing.

"You can't do without AI for a lot of solutions. I love the definition that AI is teaching a computer to do things that right now a person does better, Leidos's Bowers continues. "You're always trying to figure out how to do that. When doing unmanned systems, you are getting people off the plane and away from the vehicle. AI enables you to do that without having to do monitoring. We're pushing for vehicles to do high-performance in harsh environments without having someone involved at every step, watching how everything works."

WHO'S WHO IN AI-BASED UNMANNED VEHICLES

Aurora Flight Sciences
Manassas, Va.
https://www.aurora.aero

Curtiss-Wright Corp. Defense Solutions
Ashburn, Va.
https://www.curtisswrightds.com

EpiSys Science Inc.
Poway, Calif.
https://www.episci.com

Georgia Tech Research Institute
Atlanta
https://www.gtri.gatech.edu

Heron Systems Inc.
California, Md.
https://heronsystems.com

Leidos Innovations Center (LInC)
Reston, Va.
https://www.leidos.com/company/our-business/leidos-innovations-center

Lockheed Martin Corp.
Bethesda, Md.
https://www.lockheedmartin.com

Mercury Systems Inc.
Andover, Mass.
https://www.mrcy.com

Perspecta Labs
Basking Ridge, N.J.
https://www.perspectalabs.com

physicsAI
Pacifica, Calif.
https://physics-ai.com

SoarTech
Ann Arbor, Mich.
https://soartech.com

U.S. Defense Advanced Research Projects Agency (DARPA)
Information Innovation Office (I2O) Arlington, Va.
https://www.darpa.mil/about-us/offices/i2o

U.S. Naval Air Systems Command Aircraft Division
Patuxent River Naval Air Station, Md.
https://www.navair.navy.mil

Working as a team

Of growing importance as AI advances and becomes an integral part of unmanned vehicles across all domains is not only the ability of the different platforms to communicate and coordinate, regardless of service, but the ability of an AUV to learn on its own, without human intervention, then pass what it has learned on to other AUVs. While considered invaluable capabilities, they also represent a further removal of humans from the training and operations chain and an even greater demand for safety and assurance.

"We want to be able to extract information from their operations and utilize them in learning situations. But how do we maintain the safety guarantees as these systems learn and evolve?" DARPA's Neema says. "That learning by one should be able to be shared is the expected goal, but it is not currently available."

In combat or hazardous environments, fully autonomous platforms almost certainly will encounter times when communications with other unmanned vehicles, manned mission components, or higher command become compromised.

"One thing the AI community has not really understood about the unmanned environment is what happens when you have no access to communications," says Karen Zita Haigh, fellow chief technologist at Mercury Systems. "For example, the Mars Rover has communications [with Earth], but with a significant temporal delay. Underwater, you have an acoustic modem, but the amount of data it can handle is very small and there also is latency. Being able to act without communications is critical."

Leidos's Bowers summed up the status and future of military embedded computing and AI research by corporations, government labs, and academia: "We push a lot of boundaries, but a lot of the really exciting work is classified."

Next-generation vehicle power generation like the Titan On-Board Vehicle Power (OBVP) from Leonardo DRS might enable military vehicles to set up their own remote power grids.

Power supplies grapple with open systems, and the need for more power

The emerging SOSA standard seeks to promote interoperable 12-volt embedded power systems, yet this level may not be enough. Is there a need for 28, or 48-, or even higher voltages?

BY **John Keller**

Electrical power aboard military ships, planes, combat vehicles, and command posts typically is a design afterthought, and rarely gets widespread consideration alongside headliners like laser weapons, computerized avionics, and hypersonic weapons.

Still, something as fundamental as electronic power simply cannot be ignored, because without it the military's infrastructure grinds to a halt. "Power isn't sexy," says Carlos Aguirre, business development manager for operational energy at the Leonardo DRS Network & Imaging Systems segment in Melbourne, Fla. "Power doesn't shoot or communicate, but you can't do either of those things without power."

Electronic systems designers can't ignore power. They know they have to generate it, control it, and provide ever-increasing amounts of it to satisfy the voracious and growing appetites of new and emerging aerospace and defense electronics for electricity to power powerful new microprocessors, radar systems, electronic warfare (EW), propulsion, and future applications no one's even considered yet.

Power keeps systems designers awake at night because they know that even the leading edge of today's power electronics technologies is nowhere close to satisfying expected needs for power as the U.S. military moves into the 2020s.

Generating adequate power

The technological challenges for mili-

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The OBVP power-generation system creates power at the vehicle transmission, and can provide 55 to 120 kilowatts of power — far more than a typical vehicle alternator.

tary systems designers begin the second an applications move away from the established power grid — namely to mobile systems like aircraft, combat vehicles, unmanned systems, and to a lesser extent to surface warships and submarines. "Electric power can be considered a commodity, but the warfighter doesn't have that luxury," says DRS's Aguirre. "Power for him is not always at the ready."

Leonardo DRS experts are focusing on providing power to military vehicles, which increasingly are under pressure not only to support power-hungry on-board systems like high-performance computing, laser weapons, and silent operations, but also to serve as mobile power stations to run deployed command posts and power batteries for the warfighter's wearable electronics.

DRS's Aguirre claims that traditional vehicle power systems built around alternators simply are not up to the task. "We need to generate more efficient power than we do today, and that's where the DOD [U.S. Department of Defense] has not focused enough attention. Every combat vehicle seems to be suffering from what I call a power gap. If we look at MRAPs and Bradleys, we are looking at bigger alternators to generate electrical power, and it's still not enough."

As an example, Aguirre points to directed-energy weapons, such as high-energy lasers, high-power microwaves, and similar systems that military planners will depend on to defend forward-deployed warfighters from enemy unmanned aerial vehicles (UAVs), rockets, mortars, artillery shells, and low-flying aircraft like helicopters.

Directed-energy systems "are not that efficient today, so that translates into power loss," Aguirre says. "We need at least 90 kilowatts of power for a counter-UAV laser. So where do we get that power on a combat vehicle? Alternators simply are not powerful enough, and if a belt breaks, we are out of power." Towing gasoline-powered generators into the field isn't always a viable alternative because they limit a vehicle's speed and maneuverability.

Emerging standards like SOSA are pushing power suppliers for military systems to backplane-type architectures, which promote economy and interoperability.

Enhancing on-board power

DRS engineers have designed the Titan On-Board Vehicle Power (OBVP) system. "Every vehicle has an engine that spins something," Aguirre explains. "There is a lot of power being transferred from the engine to the transmission. If I can convert that power into electrical energy, there is a lot of potential to change the dynamic. It might not require an alternator."

The DRS OBVP system can generate upwards of 120 kilowatts of power inside the transmission, which Aguirre says could power a medium-to-large-

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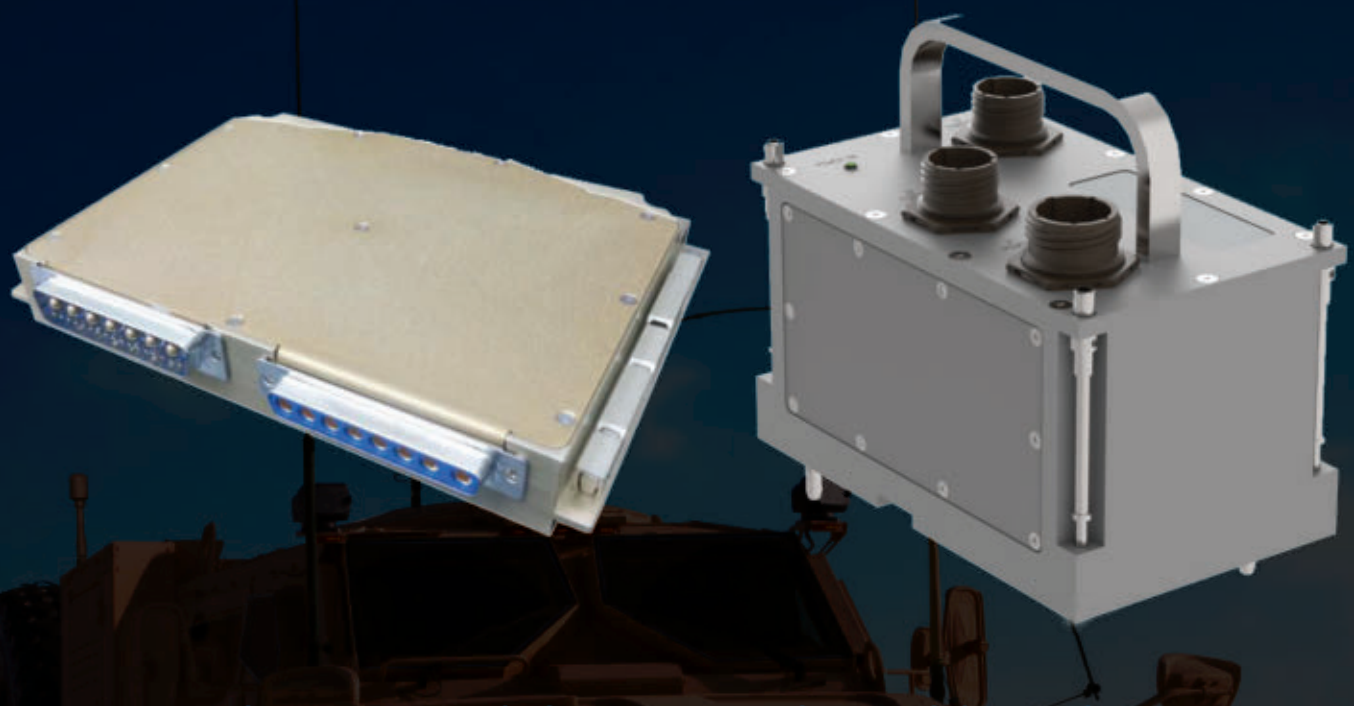

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size pharmacy, a nursing home, a medical facility, or even a residential neighborhood. The system can generate as much as 55 kilowatts of power when the vehicle is moving, and as much as 120 kilowatts when the vehicle is stationary.

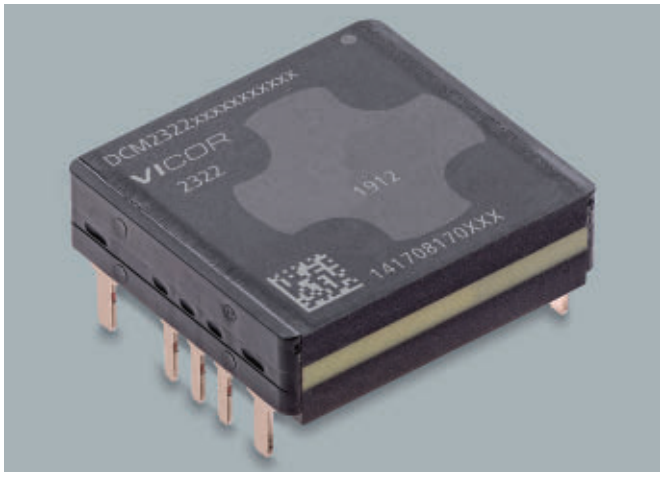
"Unique is the packaging," Aguirre says. "We make these fit in places never intended for electrical machines. We just shrank the size to fit inside the transmission. DRS partners with Allison Transmission Inc. in Indianapolis to provide the OBVP system, which is seeing limited deployment on military vehicles like the U.S. Army's Terminal High Altitude Area Defense (THAAD) missile battery command and control, and launcher vehicle, which is a version of the Heavy Expanded Mobility Tactical Truck (HEMTT) from Oshkosh Defense in Oshkosh, Wis.

With OBVP "a vehicle can leave the airport tarmac operationally read to go, because power is at the ready," Aguirre says. Although the system still is in the prototype stage, he says it is applicable not only to the Oshkosh HEMTT, but also for the Stryker wheeled combat vehicle, which can carry the Short Range Air Defense (SHORAD) anti-aircraft weapon for defense against low-altitude air threats like helicopters, air-interdiction jets, and UAVs.

Although still in prototype phase, the OBVP power system from Leonardo DRS is seeing limited military deployment in systems like the U.S. Army's Terminal High Altitude Area Defense (THAAD) missile battery command and control, and launcher vehicle.

The OBVP also could be adapted to the Joint Light Tactical Vehicle (JLTV) of the Army and U.S. Marine Corps to provide several new battlefield capabilities such as mobile server center or mobile battery charger.

"A group of vehicles could start their own power grid in a forward-deployed area, share power with other vehicles, and as the military logistics tail catches up could go back to their primary missions," Aguirre says. "I'm hopeful that within the next five to seven years the OBVP could deployed widely." The system's benefits could extend beyond military operations to humanitarian assistance and disaster recovery, he says.



The Vicor DCM2322 ChiP family of isolated, regulated DC-DC converters for military and transportation applications like unmanned vehicles, communications, and rail.

Open systems

After military systems can generate sufficient electrical power, the next challenge is controlling that power efficiently and economically. One way to that goal is open-systems architectures like the emerging Sensor Open Systems Architecture (SOSA) standard, administered by the Open Group in San Francisco.

SOSA seeks to specify a limited number of established industry standards for power control, embedded computing, communications, and software to promote interoperability among components from different vendors to enable military systems designers to achieve economies of scale, while enabling suppliers to capitalize on their value-added technologies.

SOSA also seeks to settle on 12-volt power systems to make it less likely that systems designers will need custom-designed power conditioning and control. It's the hope that standardized 12-volt power systems will provide sufficient power to satisfy the needs of high-performance computing and sensors, while promoting systems interoperability. "12 volts can deliver more power, as opposed to 5-volt systems," says Joseph Pozzolano, vice president of sales and marketing at Behlman Electronics Inc. in Hauppauge, N.Y.

"The military wants to standardize on a certain number of voltages, and there is a transition in industry to get away from 5-volt devices," says "The driving force from the military is open systems such as MOSA, SOSA, HOST, and all those open systems.

Behlman has been in business for more than 60 years, and provides open-systems and custom AC power sources, frequency converters, inverters, DC-DC, AC-DC, and DC-AC power systems for military mission-critical applications, as well as for industrial and commercial installations.

"We are making a number of products in alignment with the SOSA guidelines," Pozzolano says. The first official version of SOSA should be approved by industry committees and ready for use as early as the end of this year.

SOSA also seeks to blend digital and analog power electronics in a way to create interoperable, affordable smart power. "The military wants intelligence on these power devices," Behlman's Pozzolano says. "This is all part of the SOSA technical standard. Intelligence enables an embedded computer to

send a signal to whatever power device it wants, and get a response back. From the power perspective, the system can query for input power and output power, and monitor for temperatures; if it's outside the normal range, there might be something wrong."

SOSA also is starting to catch-on in the power industry, as well as among embedded computing suppliers. "We have had a massive number of requests for SOSA-aligned cards," says Brian Paul, general manager at MilPower Source Inc. in Belmont, N.H., a specialist in custom and tailorable power supplies for mission-critical military and industrial applications.

Serving customer requests for SOSA, however, can be easier said than done. "SOSA means so many things to so many different people," Paul points out. "We are trying to counsel our customers on what SOSA-aligned mean, and help them understand how that standard can impact their systems." Officials of the Open Group insist that "SOSA-aligned," rather than "SOSA-compliant" must describe SOSA-like components before the standard becomes official.

Likewise power-control specialist Vicor Corp. in Andover, Mass., is fielding SOSA requests from customers. "SOSA fits into our plans quite prominently," says Rob Russell, vice president of aerospace and defense marketing at Vicor. "We released two 3U and are about to release a 6U SOSA power supply . We have designed these parts to be fairly modular, and we intend to provide SOSA-compatible parts."

SOSA: more work to be done

While SOSA widely is considered to be a promising step toward system interoperability and affordable technologies, some in industry point out that more needs to be done for the standard to be successful in its aims.

Embedded computing General Micro Systems Inc. in Rancho Cucamonga, Calif., designs power-control electronics for internal use only, but eventually may expand its offerings to include off-the shelf power, says Chris Ciufo, the company's chief technology officer.

WHO'S WHO IN POWER ELECTRONICS

Absopulse Electronics Ltd.
Ottawa
https://absopulse.com

Advanced Energy Industries Inc.
Fort Collins, Colo.
www.advanced-energy.com

Aegis Power Systems Inc.
Murphy, N.C.
www.aegispower.com

AMETEK VTI Instruments
Irvine, Calif.
www.vtiinstruments.com

Analytic Systems Ware Ltd.
Delta, British Columbia
www.analyticsystems.com

Anaren Inc.
Syracuse, N.Y.
www.anaren.com

Astrodyne TDI
Nashua, N.H.
www.astrodynetdi.com

AVX Corp.
Fountain Inn, S.C.
www.avx.com

Behlman Electronics Inc.
Hauppauge, N.Y.
www.behlmanpower.com

Calex Mfg. Co. Inc.
Concord, Calif.
www.calex.com

Coilcraft Inc.
Cary, Ill.
www.coilcraft.com

Comdel Inc.
Gloucester, Mass.
www.comdel.com

ConTech
Concord, Calif.
www.contech-us.com

Cornell Dubilier Electronics Inc.
Liberty, S.C
www.cde.com

Crane Aerospace & Electronics
Redmond, Wash.
www.craneae.com

Crystal Group
Hiawatha, Iowa
www.crystalrugged.com

D6 Industries Inc.
Lawrence, Mass.
https://d6industries.com

Data Device Corp. (DDC)
Bohemia, N.Y.
www.ddc-web.com

Energy Technologies Inc.
Mansfield, Ohio
www.ruggedsystems.com

Falcon Electric Inc.
Irwindale, Calif.
www.falconups.com

Gaia Converter Inc.
Le Haillan, France
www.gaia-converter.com

General Atomics Electromagnetic Systems Group
San Diego
www.ga.com/ems
General Micro Systems Inc.
Rancho Cucamonga, Calif.
https://www.gms4sbc.com

Infineon technologies (formerly International Rectifier)
El Segundo, Calif.
https://www.infineon.com

Intellipower Inc.
Orange, Calif.
https://www.intellipower.com

Lind Electronics Inc.
Minnetonka, Minn.
www.lindelectronics.com

Maxim Integrated Products Inc
Chelmsford, Mass.
www.maximintegrated.com

MilPower Source
Belmont, N.H.
www.milpower.com

MilSource
El Segundo, Calif.
https://militaryethernet.com

Murata Power Solutions
Mansfield, Mass.
www.murata-ps.com

North Atlantic Industries
Bohemia, N.Y.
www.naii.com

Nova Electric
Bergenfield, N.J.
https://novaelectric.com

Nova Power Solutions Inc.
Sterling, Va.
www.novapower.com

Pico Electronics Inc.
Pelham, N.Y.
www.picoelectronics.com

Rantec Power Systems Inc.
Los Osos, Calif.
www.rantec.com

Raycom Electronics Inc.
Dover, Pa.
www.raycomelectronics.com

Renesas Electronics Corp. (formerly Intersil)
Milpitas, Calif.
https://www.renesas.com/us/en/
Solitron Devices, Inc.
West Palm Beach, Fla.
www.solitrondevices.com

SynQor
Boxborough, Mass.
www.synqor.com

TDI Power
Hackettstown, N.J.
http://tdipower.com

TDK-Lambda Americas Inc.
San Diego
www.us.tdk-lambda.com

Vicor Corp.
Andover, Mass.
www.vicr.com

VPT Inc.
Bothell, Wash.
www.vptpower.com

Although supportive of SOSA and its overall aims, Ciufo says the emerging standards "does not go far enough in giving the right output voltages and correct input voltages into the system, and cannot provide the right amount of power for next-generation systems in 3U and 6U embedded systems."

Ciufo says a quick calculation of power needs shows how SOSA in its current form may fall short for demanding embedded computing. "Today a 6U VPX power supply is on the order of 1,000 Watts, with a notional top of end of 1,500 Watts — that is one card supplying a whole backplane."

Yet Ciufo points to the power-hungry computing components being chosen or considered for high-performance embedded computing. "With one power supply, you top-out quickly. One Xeon processor card is 150 Watts. You add other processors, memory, and 40 Gigabit Ethernet, and soon your 6U single-CPU card with a mezzanine card is approaching 1,500 Watts all by itself — just one processor card."

The picture can get even bleaker for the power engineer, however, Ciufo says. "If you add what people really want — artificially intelligent cards like GPGPU and FPGA, those cards will be 250 to 600 Watts each. Now you are out of power from that single 6U OpenVPX power supply."

So what's the solution? "We need to be able to increase the power output of that 6U OpenVPX power supply," Ciufo says. "It's being talked about to bring it up to 2,000 Watts, but beyond that it becomes difficult to cool. If we increase the pitch in those cards, we can increase the size of the wedge locks and can move more heat off the cards. If you do that you can increase from 1,500 Watts to 2,000 Watts.

Perhaps one place to look for relief might involve increasing the voltage of the system. Current OpenVPX-standard power specify three voltages: 3.3, 5, and 12 volts, Ciufo says. "Next-generation power supplies need to output more power. Instead of sending 12, 4, and 3.3 volts, they should send out 28 or 48 volts, or something even higher than that."

Without open-systems support for higher voltage levels, systems designers could face a wiring nightmare that simply couldn't be supported. "We had a customer who asked us about our rackmount server for a vehicle," Ciufo says. "It has 28 volts DC typical vehicle power for a 2,500-Watt server. That would require wires bigger than battery cables."

One solution is designing-in several power inverters, but these kinds of components are relatively inefficient and generate a lot of heat. Instead, perhaps the answer involves the creative use of point-of-load regulators.

"The 12-, 5-, and 3.3-volt designs are not typically used in digital electronics anymore," Ciufo points out. "Yet now we have these point-of-load DC-DC regulators that convert from a higher load on one side to a smaller load on the other. You can take these higher voltages, and then apply point-of-load regulators for the voltages needed. The less current you have on your wiring board, the smaller those traces can be.

The Vicor DCM family for military commercial off-the-shelf power applications consists of high-density DC-DC modules that are isolated and regulated, and which work for 28- and 270-volt line inputs.

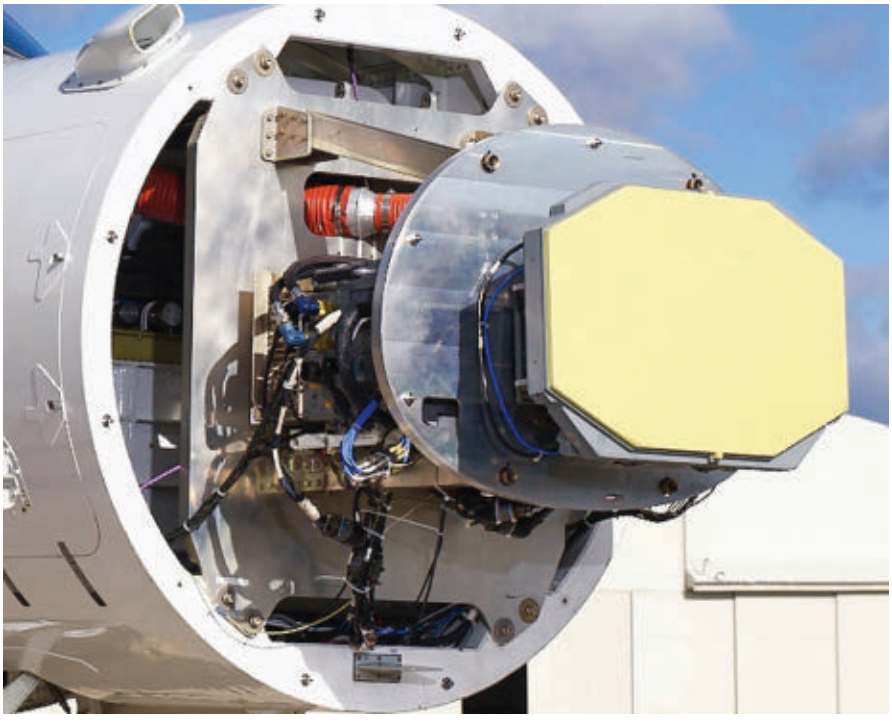
Air Force increases buy of F-16 jet fighter radar avionics

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — U.S. Air Force aerial warfare experts are ordering additional modern active electronically scanned array (AESA) radar for F-16 jet fighter aircraft under terms of an order worth more than a quarter billion dollars.

Officials of the Air Force Life Cycle Management Center, Fighter Bomber Directorate, F-16 Division, at Wright Patterson Air Force Base, Ohio, announced a $262.3 million order to the Northrop Grumman Corp. Mission Systems segment in Linthicum Heights, Md., for 15 developmental-models, 90 production radars, spare parts, and avionics support equipment.

The APG-83 AESA fire-control scalable agile-beam radar (SABR) integrates within the F-16's structural, power, and cooling constraints without Group A aircraft modification, Northrop Grumman officials say. The company leverages technology developed for the APG-77 and APG-81 radar systems on the U.S. F-22 and F-35 combat aircraft.



The Northrop Grumman APG-83 AESA fire-control scalable agile-beam radar (SABR) offers enhanced bandwidth, speed, and agility to detect, track, and identify many targets quickly and at long ranges.

Last December Northrop Grumman won a $1 billion order for as many as 372 AN/APG-83 AESA radar systems for the F-16. This order is a modification to a $243.9 million Air Force contract to Northrop Grumman in May 2017 for 72 APG-83 radars.

In a 2013 competition, Lockheed Martin Corp., the F-16 manufacturer, selected the APG-83 as the AESA radar avionics for the F-16 modernization and update programs of the U.S. Air Force and Taiwan air force.

The bandwidth, speed, and agility of AESA radars enable legacy fighter aircraft like the F-16 to detect, track, and identify many targets quickly and at long ranges, and to operate in hostile electronic warfare (EW) environments.

Northrop Grumman is building APG-83 radar systems for global F-16 upgrades and new aircraft production, as well as for the U.S. Air National Guard. Northrop Grumman also has installed a production APG-83 SABR on a U.S. Marine Corps F/A-18C Hornet jet fighter-bomber, company officials say.

On this order Northrop Grumman will do the work in Linthicum Heights, Md., and should be finished by December 2022. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Military must coordinate on EW and the electromagnetic spectrum

The Pentagon is expected to spend $47 billion over the next five years to modernize its electronic warfare (EW) systems. Without this funding, experts say that the U.S. military, already trailing Russia and China in some areas, would struggle on a future battlefield. But several experts and government personnel now insist the U.S. Department of Defense (DOD) needs a top-down vision to the services that would help guide operations, investments and capabilities within the electromagnetic spectrum. Leaders from Russia and China have said that in future conflicts they will target communications systems first to prevent opponents from coordinating and to stop radars from detecting threats. "To start a war without controlling the electromagnetic spectrum is tantamount to defeat," said Anatoly Tsyganok, a retired colonel and member of the Russian Center for Political-Military Studies.

5G set to revolutionize mobile communications

5G is set to revolutionize the mobile communications industry — offering high data rates, low-latency, and ubiquitous connectivity with levels of reliability not previously seen. This will enable new services and use cases that go far beyond communication between individuals. The rapid progression of 5G deployments has huge potential for connecting economies at scale, while simultaneously exposing potential vulnerabilities that must be addressed. To deliver higher performance and lower cost, 5G networks are leveraging technologies that are software-centric and virtualized, moving from custom hardware to software components running on commercial off-the-shelf (COTS) hardware. This increase in software content across 5G deployments continues to fuel an exciting faster development pace. But with this comes some challenges since these 5G technology innovations are also expanding the attack surface of the system. While 5G core network functions are making use of a new and different software architecture, common technologies like HTTP and REST APIs that are well known are replacing proprietary interfaces of the past.

SATCOM vision for maintaining communications in degraded, limited environments

The U.S. Space Force released its new Enterprise SATCOM Vision Feb. 19, formally laying out a desire for a single satellite communication architecture that is capable of keeping warfighters connected even in contested, degraded, and operationally limited environments. Under this SATCOM vision, military and commercial satellite providers would be integrated, allowing warfighters to switch seamlessly to whatever network or signal is available while maintaining connectivity. The Space Force refers to this approach to maintaining communications even in degraded or contested environments as "Fighting SATCOM," and the nascent service has asked for $43 million in research, development, test & evaluation funding to develop the Fighting SATCOM Enterprise in its budget request for fiscal year 2021. Under the new vision, all SATCOM requirements collection, planning, allocation, and operational management processes will be brought under a single command to exploit efficiencies.

Navy moves to low-rate initial production of minehunting unmanned surface vessel

BY **John Keller**

WASHINGTON — U.S. Navy unmanned surface vessel (USV) experts are making one of the first low-quantity production purchases of quickly deployable fast-moving unmanned boats for the littoral combat ship (LCS) to clear large ocean areas of sea mines that could threaten aircraft carrier battle groups, commercial ship traffic, and other ocean assets.

Officials of the Naval Sea Systems Command have announced a $21.8 million order to the Textron Systems Corp. Unmanned Systems segment in Hunt Valley, Md., for low rate initial production (LRIP) of the Unmanned Influence Sweep System (UISS) unmanned patrol boat.

The UISS is one of the minehunting systems that will enable the LCS to perform mine warfare sweep missions. UISS will target acoustic, magnetic, and magnetic and acoustic combination mine types only. The UISS program provides rapid wide-area mine clearance to neutralize magnetic and acoustic sea mines in a small, lightweight package.

The U.S. Navy is nearing production for the Unmanned Influence Sweep System (UISS) unmanned patrol boat.

LRIP describes the phase of initial, small-quantity production of military weapons and platforms. LRIP gives the Navy time to determine if the UISS performs to requirements before agreeing to mass-production contracts.

The UISS uses the Textron Common Unmanned Surface Vessel (CUSV), and will travel aboard the LCS to deploy as necessary to detect, pinpoint, and trigger explosive sea mines hidden under the surface to damage or destroy surface warships or commercial shipping.

The system consists of the CUSV unmanned power boat that tows an acoustic and magnetic minesweep system that emits acoustic and magnetic signals that provide a false signature that triggers mines. The surface vessel while operating will be far enough away so that it will not be damaged by a detonating mine, Navy officials say.

The UISS uses the Navy's Multiple Vehicle Communications System (MVCS) aboard the LCS, which handles communications between the LCS surface ship and different mission packages, including the UISS, that involve mine countermeasures, anti-submarine warfare, and surface warfare.

For the MVCS the Navy is using the AB3100H embedded computer from Astronics Ballard Technology in Everett, Wash. The AB3100H rugged computer is part of the company's AB3000 line of small, lightweight embedded computers with the Intel E680T processor, MIL-STD-1553 and ARINC 429/708/717 interfaces, Ethernet, USB, video, audio, and PMC expansion.

The AB3000 series from Astronics Ballard Technology comes with factory-installed PCI mezzanine card (PMC) modules that enable designers to add an Ethernet switch, synchronous and asynchronous serial interfaces, and isolated double-throw relays.

The Textron CUSV and its unmanned maritime command and control station use a modular architecture that accommodates platform reconfiguration and interchangeable payloads.

This CUSV unmanned boat can execute mine warfare; anti-submarine warfare; communications relay; intelligence, surveillance and reconnaissance; anti-surface warfare; and UAS/UUV launch and recovery missions.

On this order Textron will do the work in Hunt Valley, Md., and Slidell, La., and should be finished by August 2021. For more information contact Textron Unmanned Systems online at www.textronsystems.com, Astronics Ballard Technology at www.astronics.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Army to recompete robotic mule unmanned ground vehicle (UGV) for infantry

The U.S. Army has renewed a competition to acquire unmanned ground vehicle (UGV) for light infantry after leaders canceled a previous award following a protest. The service posted a new Request for Proposals (RFP) in February, allowing the four finalists in the original ground vehicle competition to recompete for a chance to build the Small Multipurpose Equipment Transport (SMET) ground robotic vehicle. The General Dynamics Land Systems Multi-Utility Tactical Transport, or MUTT, won the original contract to build SMET at the end of October, but Textron, one of the other three competing companies, filed a protest claiming that GDLS had been allowed to change its vehicle significantly following a soldier evaluation. Four companies were chosen from a larger pool in 2017 to compete to build the robotic vehicle: GDLS, a Textron offering from its subsidiary Howe & Howe, a team of Applied Research Associates and Polaris Defense, and HDT Expeditionary Systems. Each team built 20 platforms issued to infantry brigade combat teams for testing and analysis.

Army could save lives with machine autonomy and unmanned ground vehicles (UGVs)

U.S. Army convoys could be made safer for soldiers by implementing unmanned ground vehicle (UGV) technology to reduce the number of service members needed to operate the vehicles, according to a new study from the RAND Corp. in Santa Monica, Calif. RAND experts examined three different autonomous vehicle concepts: the fully autonomous employment concept, where all the vehicles are unmanned; the partially unmanned employment concept, featuring a lead truck with soldiers followed by unmanned vehicles in a convoy; and minimally manned, a "bridging" concept featuring a soldier in the driver's seat of each of the follower trucks to monitor the automated system and driving environment. Minimally manned Army convoys could enhance safety by putting 28 percent fewer soldiers at risk compared to current practices. A partially unmanned convoy would put 37 percent fewer soldiers at risk, and a fully autonomous convoy would put 78 percent fewer soldiers at risk. The machine autonomy technology to make an Army convoy fully autonomous doesn't exist yet. Part of the challenge for the Army is that current automated technology is still limited and has mainly been tested in settings with well-manicured infrastructure, including standardized road markings and signs.

2021 DOD budget emphasizes critical technologies in artificial intelligence (AI)

The Pentagon wants to focus its 2021 investments on four emerging critical technologies that will increase the United States' comparative advantage against near peer adversaries. With $106.6 billion set aside for research and development, U.S. Department of Defense (DOD) officials claim their fiscal year 2021 budget request, which was released Feb. 10, includes the largest research funding request in more than 70 years. This is spearheaded by $7 billion in investments in four areas that leaders are calling the "advanced capability enablers." These include hypersonics, artificial intelligence (AI), 5G and microelectronics, and autonomous platforms. For 5G and microelectronics, the Pentagon is asking Congress for $1.5 billion next year; $841 million for artificial intelligence; $1.7 billion in autonomy; and $3.2 billion for hypersonics.

Border Patrol asks industry for sensors to watch difficult-to-monitor waterways

BY **John Keller**

WASHINGTON — U.S. border security experts are asking the sensors industry for new ways to monitor ship and boat traffic on streams, rivers, and lakes.

Officials of the Border, Immigration and Maritime Division of the U.S. Department of Homeland Security (DHS) Science and Technology Directorate in Washington have issued a request for information (70RSAT20RFI000004) for the Unattended Sensor Technologies for Monitoring Riverine and Littoral Zone Vessel Traffic project.

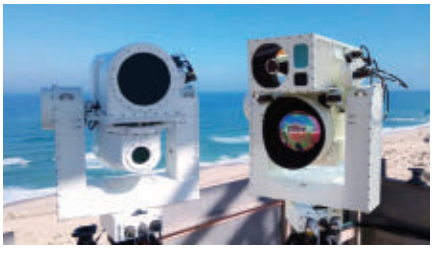
Solutions should involve automated detection, identification, classification, tracking, and alerting Border Patrol agents who are monitoring waterways for interdiction of suspicious activity.

Border Patrol agents who monitor waterways along international borders often have limited or no surveillance capabilities. Complicating keeping watch on these areas can be ridges along banks or deviated shorelines that provide naturally occurring concealment opportunities such as coves and isles and overgrown vegetation.

These conditions can limit the effectiveness of existing short-, mid-, and long-range surveillance technologies. To overcome these limitations, DHS officials want technologies for improved situational awareness of mechanized surface watercraft passing through remote, difficult-to-monitor border waterways.

Technology solutions should be affordable; quick to transport and deploy; offer unattended remote operations; connect to Border Patrol command centers; able to detect, identify, classify, track, and alert on vessels of interest autonomously — including location, range, bearing, and speed.

Technologies should be able to operate year-round, day and night; be easy to use; foil computer hackers; scale from small to large installations; and over open architectures and data sharing.



Border Patrol agents are looking for sensors to help monitor concealed areas along remote rivers, lakes, and streams.

Companies interested were asked to email five-page white papers about their systems to DHS by 25 March 2020 at WaterwaysUSS_RFI@hq.dhs.gov. Email questions or concerns to WaterwaysUSS_RFI@hq.dhs.gov. More information is online at https://beta.sam.gov/opp/831c684923b54979b3edc1cd95633e60/view.

Raytheon enters full-scale development of bunker-busting Tomahawk missile

U.S. Navy land-attack experts are asking the Raytheon Co. to start full-scale development of a blast and penetration warhead to enable the Tomahawk missile to destroy bunkers and other hardened targets. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $90.4 million contract to the Raytheon Missile Systems segment in Tucson, Ariz., for the engineering and manufacturing development (EMD) phase of the Joint Multiple Effects Warhead System (JMEWS). The JMEWS project seeks to improve the Tactical Tomahawk Land-Attack Missile for bunker busting and large-area target capability. EMD is the final phase of weapons development before full-scale production. JMEWS is developing a warhead that combines blast-fragmentation and enhanced penetration in one warhead. This would enable the Tomahawk to attack soft targets like parked aircraft, vehicles, and formations of soldiers, as well as hardened targets like bunkers,

underground command posts, and aircraft in hardened shelters. For more information contact Raytheon Missile Systems online at www.raytheon.com, or Naval Air Systems Command at www.navair.navy.mil.

Navy installs laser weapon on destroyer to attack enemy drones

Enemy drones over the ocean could track and surveil U.S. Navy ships, designate targets for aircraft or maritime attacks, or even fire dangerous weapons themselves at surface ships. This reality is one of many key reasons the Navy has now installed a new counter drone "dazzler" laser weapon aboard one of its destroyers for the first time, bringing new offensive and defensive warfare possibilities to the fleet. The Navy's Optical Dazzling Interdictor, or ODIN laser weapon, has been installed on the Navy destroyer USS Dewey, a report from Naval Sea Systems Command said. The ODIN is configured to track and disable enemy drones by throwing them off course and jamming their sensors, says a December 2019 Congressional Research Service report called Navy Lasers, Railgun, and Gun-Launched Guided Projectile.

Army's top enlisted soldier field-tests augmented reality goggle

Rushing into the room, an infantry soldier sees a dog to his right his attention quickly turns to two men firing from behind a waist-high barricade. He takes cover with another soldier behind a wall a few feet away. This is just a piece of a larger demonstration that the lead shooter, and top Army enlisted soldier, Sergeant Major of the Army Michael Grinston, tested in February on his visit to explore the Integrated Visual Augmentation System, or IVAS. The IVAS consists of 'mixed reality' goggles in development to give individual soldiers a wealth of information from navigation aids to location of friendly troops, weapons sights' views, facial recognition software and augmented reality avatars for training scenarios. With tens of thousands of new soldiers arriving to Army units every year, the goggle gives squad leaders a chance to put the new soldier into a unit and run through battle drills, keeping the small unit ready at the lowest levels.

IARPA eyes satellite electro-optical sensors to detect events over time

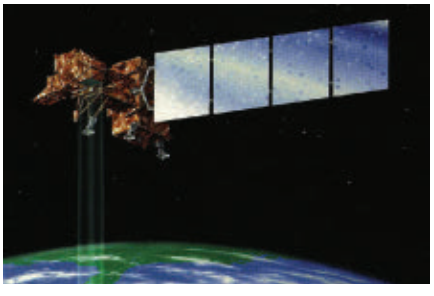
BY **John Keller**

WASHINGTON — U.S. intelligence experts are asking industry to blend data from satellite-based multispectral imaging sensors and visible-light sensors to detect heavy building projects and highway construction from space.

Officials of the U.S. Intelligence Advanced Projects Agency (IARPA) in Washington has released a broad-agency announcement (IARPA-BAA-19-04) for the Space-based Machine Automated Recognition Technique (SMART) project.

SMART will rely on geographical information from satellite cameras, and develop multi—spectral and multi—temporal sensor processing to overlay data from infrared and multispectral sensors to make the intelligence analyst's job easier. IARPA is the research arm of the U.S. Director of National Intelligence.

Many space and airborne sensors today can provide imagery suitable for geographical intelligence (GEOINT). SMART will demonstrate that GEOINT gleaned through data fusion is greater than the simple sum of GEOINT gleaned from several electro-optical sensor images analyzed in the absence of other imagery.



U.S. intelligence analysts are looking for satellite-based electro-optical sensors that can detect and characterize big events over time.

The idea is to reduce uncertainties inherent in single-sensor data, and reduce the sheer amount of intelligence imagery data that can overwhelm intelligence analysts by developing tools to help analysts analyze intelligence imagery using Big Data, IARPA officials say.

The volume of GEOINT data continues to grow, while analysts struggle with the volume, variety, and velocity of space-based data. IARPA is seeking automated broad-area search, monitoring, and analysis of man-made activities based on data fusion of spectral and temporal space-based imagery.

While one sensor may have resolution sufficient to detect changes and man-made disturbances, intelligence experts still struggle with the inability to analyze images over time because of infrequent satellite orbits or weather cover.

IARPA experts want to push the technology state of the art in high-performance analytics that scales to extremely large data sets; data mining, ranking and visualization; and image analyst tools like automated broad-area search of man-made processes.

By blending data from several different electro-optical sensors, IARPA experts want to improve the ability to detect and monitor man-made disturbances to track the progress of major construction projects.

The SMART program's primary objective is to develop tools and techniques for automated broad-area search to detect, monitor, and characterize the progression of natural or man-made events or activities using time-series spectral imagery from several space-based or airborne sensors.

Examples include heavy construction; real estate or urban development; crop disease propagation; forest fires, severe weather consequences such as flooding and mudslides; insect or battle damage; human migration; mining, logging, farming; and earthquakes.

Applications range from geospatial intelligence, disaster recovery, and humanitarian aid, to automated assessment of land-use for commercial purposes. The project has two technical areas: data fusion, and algorithms to detect and characterize natural and man-made events.

Data fusions seeks to quantify data quality and cross-sensor inconsistencies in time-series satellite imagery, and develop automated data calibration techniques. Algorithms seeks to develop algorithms capable of broad-area search over areas larger than 8,000 square meters.

Algorithms will use spaced-based time-series imagery to detect and locate evolving natural or man-made events, and analyze the progression of these activities.

Companies interested were asked to submit proposals by than 7 April 2020 to the IARPA Distribution and Evaluation System online at https://iarpa-ideas.gov. Email questions or concerns to Torreon Creekmore, the SMART program manager, at dni-IARPA-BAA-19-04@iarpa.gov. More information is online at https://beta.sam.gov/opp/103b342c8a864c45843bc93d321ed47f/view.

RADAR

Navy asks Raytheon to upgrade radar RF sensors for maritime surveillance

U.S. Navy reconnaissance experts needed improved radar for surveillance applications, they found their solution from the Raytheon Co. Space and Airborne Systems segment in McKinney, Texas.

Officials of the Office of Naval Research in Arlington, Texas, announced a $23.3 million four-year contract to Raytheon in February for the naval surveillance application upgrade.

The contract calls for Raytheon to improve RF sensors for naval surveillance applications. These improvements potentially will enhance size, weight, power, and cooling; modular open-systems architectures; and resolution against small ocean vessel and aircraft targets.

These improvements also are to enhance the detection of moving targets in synthetic aperture radar, as well as form and extract imagery and other detection and classification features, and demonstrate multi-source autonomous surveillance capabilities, Navy officials say.

This contract is part of an overall Navy technology research program called Long Range Broad Agency Announcement (BAA) for Navy and Marine Corps Science & Technology.

On this contract Raytheon will do the work in McKinney, Texas, and should be finished by February 2023. For more information contact Raytheon Space and Airborne Systems online at www.raytheon.com, or the Office of Naval Research at www.onr.navy.mil.

ELECTRONIC WARFARE (EW)

Elbit to provide infrared missile warning in upgrades to F-16 jet fighters

U.S. Air Force aerial warfare experts needed infrared missile warning systems for upgrades to the Air Force fleet of F-16 jet fighters. They found their solution from Elbit Systems of America in Fort Worth, Texas.

Officials of the Air Force Life Cycle Management Center at Hill Air Force Base, Utah, announced a potential $471.6 million contract to Elbit for a pylon-based infrared missile warning system for F-16 sustainment.

Elbit manufacturers the Passive Airborne Warning System (PAWS) family of aircraft missile-defense systems.

PAWS provides early warning of threatening missiles and by automatic management of onboard countermeasures. It uses digital signal processing and algorithms to detect and track incoming missiles, identify threatening ones, alert the aircrew with audio-visual warning signals, dispense flares, and cue directional IR countermeasures.

The PAWS processing unit supports radar warning and laser warning, and hands-off threat information to other electronic warfare (EW) and defensive avionics.

The Elbit PAWS systems are suitable for fixed-wing combat aircraft, helicopters, and commercial passenger jets. It can fit on the AH-1 Cobra, AH-64D Apache Longbow, AW-101, 412, CH-47 Chinook, Mi-8/17/24, Super-Puma, and UH-60 Black Hawk helicopters; the A-1M, F-15, F-16, and F-18 combat jets; the 737, 747, 767, 777 passenger jets; and the C-130B, C-130H, C-130J, CN-235, and Il-76 military utility aircraft.

On this contract Elbit will do the work in Fort Worth, Texas, and should be finished by February 2030. For more information contact Elbit Systems of America online at www.elbitsystems-us.com, or the Air Force Life Cycle Management Center-Hill Air Force Base at www.hill.af.mil.

UNMANNED AIRCRAFT

Army chooses Griffon to provide unmanned aircraft for aerial targets and training

U.S. Army fire-control experts needed two kinds of unmanned aerial vehicle (UAV) targets to help ground forces train to attack and defeat enemy UAVs. They found their solution from Griffon Aerospace Inc. in Madison, Ala.

Officials of the Army Contracting Command in Orlando, Fla., announced a $50 million contract to Griffon Aerospace for MQM-170 Outlaw remotely piloted vehicle targets, and MQM-171 Broadsword unmanned aerial targets.

The MQM-170 Outlaw comes in two versions — the MQM-170C Outlaw G2, and the MQM-170 G1. The Outlaw G1 weighs 120 pounds gross weight, and was designed in 2004 as a low-cost UAV target. The UAV also is for intelligence, surveillance, and reconnaissance; and UAV flight training.

This legacy UAV target has a low radar cross section, and available sensor payload bays, which can be configured interchangeably for fuel or sensors. It typically launches from a pneumatic launcher and then it is recovered by skid landing.

The Outlaw G2 is the successor to the Outlaw G1, and is the basic UAV for U.S. military UAV targets. It integrates the G1 engine, radio, autopilot control, and servos into a larger, and more aerodynamically efficient fuselage.

The G2 uses an inexpensive pneumatic launcher, and offers enhanced visual signature and increased hit area. Operators also can use it as an inexpensive payload development platform.

The Broadsword UAV target is a larger derivative of the MQM-170A. It weighs 400 to 500 pounds, and is designed as an aerial target, and to evaluate new sensors, payloads, propulsion systems and other UAV components.

The Broadsword uses a large pneumatic launcher and then is recovered by skid landing. It also can have an optional landing gear for sensitive payloads.

The Army contract includes depot repair and maintenance; storage; base operations; field operations; qualification training; and inventory support.

For more information contact Griffon Aerospace online at www.griffonaerospace.com, or the Army Contracting Command-Orlando at https://acc.army.mil/contractingcenters/acc-orl/PALT_update.html.

FIRE CONTROL

Marine Corps picks optical rifle sight from Trijicon to provide electro-optical guidance for infantry rifle

U.S. Marine Corps infantry weapons experts needed a common optical sight for the M27 and other infantry assault rifles. They found their solution from Trijicon Inc. Wixom, Mich.

Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., announced a potential $64 million five-year contract to Trijicon for the Squad Common Optic (SCO) system.

The SCO is to be a magnified optic for infantry rifle systems to improve target acquisition and probability of hit at ranges from zero to nearly 2,000 feet. The Marines want to buy between 18,000 and 30,000 systems.

The SCO will include a non-caliber-specific reticle, is variable power, and will have a user selectable illuminated or non-illuminated aim-point.

The Marine Corps is asking Trijicon to allow for future reticle designs; changes in magnification; and allow for attachable or integrated field-adjustable magnification change capability for quick magnification changes.

On this contract Trijicon will do the work in Wixom, Mich., and should be finished by February 2025. For more information contact Trijicon online at www.trijicon.com, or Marine Corps Systems Command at www.marcorsyscom.marines.mil.

COMMUNICATIONS

Persistent Systems to provide networking communications for manned and unmanned vehicles

U.S. Army needed secure communications to help enable soldiers to work together with unmanned vehicles. They found their solution from Persistent Systems LLC in New York.

Persistent Systems officials have announced that the Army Combat Capabilities Development Command C5ISR Center at Aberdeen Proving Ground, Md., has awarded the company a $5.4 million contract to develop Protected Communications for Manned-Unmanned Teams (MUM-T).

Army officials say they envision a next-generation optionally manned fighting vehicle (OMFV) that can network with as many as four unmanned remote combat vehicles (RCVs), sensors, and weapons. In turn the Army will network these optionally manned vehicles with the broader force and command structure.

For that to happen, these manned-unmanned teams will need a robust, secure, and high-throughput communications network.

"The Army wants RCVs that can be remotely operated in groups over very long distances, in cities, forests, and open terrain," says Brian Soles, vice president of business development at Persistent. "These manned-unmanned teams also will have to deal with the threat of enemy hacking and jamming."

The Persistent Systems MPU5 with its Wave Relay mobile ad hoc networking (MANET) radio was selected previously by the Next Generation Combat Vehicle cross functional team (NGCV-CFT) and the Ground Vehicle Systems Center (GVSC) as the MANET network of choice for RCV Phase 1 and has been under evaluation by the U.S. Army for over a year.

As part of its 14-month-long contract, Persistent is working with the Army C5ISR Center's Space and Terrestrial Communications Directorate to adapt the MPU5 to meet the anti-jam and cyber hardening demands of MUM-T operations.

"The application of the work done under this contract won't be limited to vehicles," Soles says. "The idea is to get these same hardened capabilities to dismounted soldiers, which will greatly enhance our ability to operate against more sophisticated adversaries."

For more information contact Persistent Systems online at www.persistentsystems.com, or the Army Combat Capabilities Development Command C5ISR Center at www.army.mil/article/157832/ccdc_c5isr_center.

CONNECTORS

USB Type-C connectors for laptop computers introduced by Stewart

Stewart Connector, a Bel group company in Glen Rock, Pa., is introducing two USB connectors with Type-C right-angle receptacles for Internet of Things (IoT), laptop computers, and other applications where space and faster data rates are a premium. The connector receptacles have different PCB thickness options that include SMT and through-hole signal pins. Stewart USB Type-C connectors are designed to support data speeds to 10 gigabits per second for USB 3.1 Gen 2. The USB Type-C connectors have plug-and-play capabilities where hot insertion and ejection may occur without issue, under a load. USB Type-C connectors are rated to withstand a peak current of 1.5 amps per contact. The Stewart USB Type-C connectors are in stock with Digi-Key, Mouser, and Newark. For more information contact Stewart Connector online at https://belfuse.com/stewart-connector.

ANTENNAS

11 GHz parabolic antennas for point-to-point communications introduced by KP

KP Performance Antennas in Irvine, Calif., is introducing the ProLine 11 GHz parabolic antennas for high-density, point-to-point RF and microwave backhaul applications or client-premises. The antennas operate in the 10.7 GHz to 11.7 GHz frequency range, and come in 2- and 3-foot diameters. They deliver gain performance of 34.4 dBi and 39 dBi respectively, and are engineered to suppress side-lobes and back-lobes. The communications antennas are designed to reject interference, and feature

rugged construction with a six—point mounting connection for set-and-forget installation. These antennas deliver SISO or 2x2 MIMO for increased capacity and can survive in 155-mile-per-hour winds, and come with dual-polarized N-type connector options. The 2-foot model is a high-performance ETSI Class 2, FCC Cat B antenna and the 3-foot model is an ETSI Class 3, FCC Cat A antenna. Both models include a Ubiquiti airFiber 11FX mounting kit. For more information contact KP Performance Antennas online at www.kpperformance.com.

DATA RECORDERS

Low-cost data recorder for expendable applications introduced by Ampex Data

Ampex Data Systems in Hayward, Calif., is introducing the Common Architecture Recorder (CAR) to meet demands for low-cost data acquisition, recording, and network attached storage (NAS). The CAR is for expendable systems like unmanned aerial vehicles (UAVs) or unmanned ground vehicles (UGVs). The CAR offers low cost, small size, and scalability. It weighs two pounds, has a volume of 62 cubic inches, and offers as much as 2 terabytes of data storage. The non-proprietary modular, extensible, Linux-based open-architecture, providing the flexibility to add third-party applications without exclusionary constraints. Its two mini-PCI Express sites enable data options like video with H.264 encoding, MIL-STD 1553, and

Gigabit Ethernet with fiber or dual copper interconnects. The data recorder USB Type C interface provides direct download to the embedded storage and carries a 5-gigabit-per-second USB 3.1 link with ISB PD2 Power Delivery, which enables the CAR to switch roles automatically and function as either standard USB storage or as the host computer. For more information contact Ampex Data Systems online at www.ampex.com.

DATA STORAGE

Rugged data recorder for aircraft and vehicles offered by Pentek

Pentek Inc. in Upper Saddle River, N.J., is introducing the RTX 2684 26 GHz RF Sentinel intelligent signal scanning small-form-factor data recorder for mobile and space-limited military signals intelligence (SIGINT) applications. The RTX 2684 is for use in extreme operating environments, combines the Pentek Talon Recording System with a 26 GHz RF tuner and Sentinel

intelligent signal scanning software, and comes in an extremely rugged, small-form-factor half-ATR chassis. The system operates in temperatures from -40 to 50 degrees Celsius, and can handle most thermal environments, making them suitable for unmanned aircraft, aircraft pods, tight equipment bays, military vehicles, and most outdoor environments. The recorder weighs 23 pounds and is optimized for small size, weight and power consumption (SWaP). It is available with to 61 terabytes of removable solid-state-drive data storage. A Pentek model 78141A Jade transceiver module serves as the data acquisition engine of the Talon RTX 2684 data recorder. One of its dual 3.2-gigabit-per-second 12-bit A/D converters operates at a sample rate of 2.8 gigabits per second. For more information contact Pentek online at www.pentek.com.

POWER ELECTRONICS

Solid-state power amplifiers for military and commercial satellite command systems from Paradise Datacom

The Teledyne Defense Electronics Paradise Datacom segment in State College, Pa., is introducing dual L- and S-band solid-state power amplifiers for military and commercial satellite command systems. The L/S dual-band amplifier is available in two power levels in rugged outdoor-rated enclosures. Power levels to 800 Watts are available in the HPAS2800GHXXXXXG high-power outdoor amplifier package, and to 400 Watts in the HPAS2400GCXXXXXG compact outdoor amplifier enclosure. Both units are available covering 1.75 to 2.12 GHz. A fit for military and commercial command and control environments, the L/S-band amplifier provides the high reliability of solid-state technology to support critical communications between the Earth and satellites, in a rugged outdoor-rated enclosure. Compared to older vacuum-based technology, the enhanced reliability and ease-of-use gives operators the opportunity to support command and control facilities with non- or semi-technical staff. S- and L-band frequencies have been the industry's bands of choice for satellite command positioning and tracking applications like global positioning systems (GPS) and tracking, telemetry, and control ground stations. For more information contact Teledyne Defense Electronics Paradise Datacom online at www.teledynedefenseelectronics.com/paradisedatacom.

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BPA WORLDWIDE Connectiv

RF AND MICROWAVE

RF detector to convert an RF input signal to a DC output signal from BroadWave

BroadWave Technologies Inc. in Greenwood, Ind., is introducing the model 854-142-POS RF detector designed to convert a RF input signal to a DC output signal. The model 854-142-POS is a positive-polarity 50 Ohm RF detector that operates from 200 kHz to 1500 MHz. Input power is +20 dBm maximum, voltage standing wave ratio (VSWR) is 1.40:1 maximum, and flatness is +/- 0.3 dB maximum. The RF input connector is BNC male while the DC output connector is BNC female. The output capacitance is 1000 pf maximum and the operating temperature range is 0 to 70 degrees Celsius. BroadWave manufactures negative and positive polarity RF detectors. Other connector types and 75 Ohm RF detectors are available. Please contact us with your unique requirement for the appropriate model number. For more information contact BroadWave Technologies online at www.broadwavetechnologies.com.

CONNECTORS

iCONN to introduce wet-mateable connectors for undersea military uses

Officials of the Northrop Grumman Corp. Navigation & Maritime Systems segment in Annapolis, Md., have signed a non-exclusive agreement to manufacture niobium-based connectors (NiobiCon) for use in harsh underwater environments. NiobiCon makes electrical connections underwater to transfer power and exchange data without using seals, oil, or moving parts. This technology was developed to address the inefficient recharging of unmanned vehicles in underwater environments. When the niobium connector contacts the water, it creates its own thin isolating layer, which the connection scrapes off. Once disconnected, the layer instantly regenerates. Northrop Grumman has entered into an agreement with iCONN Systems LLC in Lombard, Ill., which makes connectors for harsh environments. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or iCONN Systems at www.iconnsystems.com.

EMBEDDED DATA STORAGE

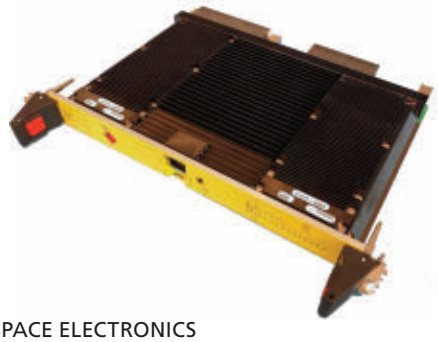
Rugged embedded computing data storage from Annapolis Micro Systems

Annapolis Micro Systems Inc. in Annapolis, Md., is introducing the rugged WILDSTAR OpenVPX embedded computing data storage boards to handle high-bandwidth and high-density data recording systems that operate in harsh environments. These next-generation 100 Gigabit Ethernet storage boards are aligned to the emerging Sensor Open Systems Architecture (SOSA) and VITA 65 open-systems standards. The WILDSTAR 6SN0 6U OpenVPX data storage board features 64 terabytes of capacity in one 1-inch 6U slot, and as much as 10 gigabytes per second read/write bandwidth. The 6SN0 is now shipping. The WILDSTAR 3SN0 3U OpenVPX storage board features 32 terabytes of capacity in one 1-inch 3U slot, and as much as 5 gigabytes per second read/write bandwidth. Orders are now being accepted, with shipping starting in June 2020. These embedded computing boards feature the Xilinx Zynq UltraScale+ MPSoC, which allows for standalone operation, and for several interfaces that can operate simultaneously. Options include PCI Express, Aurora, 40/100 Gigabit Ethernet, and user-defined protocols. For more information contact Annapolis Micro Systems online at www.annapmicro.com.

TITLE

3U VPX SOSA-aligned rugged embedded computing introduced by Concurrent

Concurrent Technologies Inc. in Woburn, Mass., is introducing the TR J4x/6sd-RCx rugged 3U VPX embedded computing board that aligns with the evolving Sensor Open Systems Architecture (SOSA) for compute intensive aerospace and defense applications. The SOSA-aligned TR J4x/6sd-RCx has a 40G Optical Ethernet Interface, and is fitted with a 12-core Intel Xeon Processor D-1559 and 64 gigabytes of soldered-down DDR4 memory for server-grade applications and workload consolidation in challenging environments. The embedded computing board has two 10GBASE-KR Ethernet connections and as many as eight lanes of Gen 3 PCI Express for high-speed point-to-point connectivity with adjacent accelerator boards. A front connection with VGA and USB ports enables setup with Linux or Windows Server operating systems or hypervisors from vendors like VMware. Concurrent Technologies offers several security enhancement utilities, such as secure boot and sanitization, and Guardian, a security package that can be tailored to customer needs. For more information contact Concurrent Technologies online at www.gocct.com.



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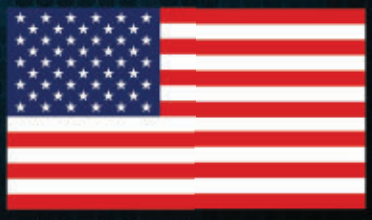

"Server hardware exploits, banned Chinese electronics and a trade war are a wake-up call." *Ben Sharfi, GMS CEO*

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