JANUARY 2019

Military & Aerospace Electronics

RELEVANT. TRUSTED. ENABLING TECHNOLOGIES.

Advanced embedded computing

Digital signal processing for improved SIGINT and cyber intelligence. PAGE 4

The latest in rugged computers

SWaP considerations for today's rugged computer systems, boards, and backplanes. PAGE 22

militaryaerospace.com

Visualizing the unseeable

Electro-optics evolves quickly for surveillance, and reconnaissance.

PAGE 10

PennWell

FAILURE IS NOT AN OPTION.

- FIPS 140-2
- NIAP
- Rugged
- NIST
- U.S. Supply Chain
- Tamper Evident

RUGGED *AND* SECURE.

Crystal Group **PASS – Platform Agnostic Security Solutions** – includes the world's first rugged FIPS 140-2 compliant data-at-rest storage devices with exclusively conformal-coated Seagate 2.5-inch, dual-port SAS drives compatible with any Crystal Group server, workstation, and JBOD or RAID storage system. Crystal Group rugged switches include NIAP-certified, IP-security modules for network encryption. All products are manufactured in Crystal Group's vertically integrated, NIST compliant, AS9100D certified, U.S.-based facilities. To prevent security vulnerabilities, components are traced from procurement through production processes to the delivery of the final warrantied product. Crystal Group servers support TPM technologies with key management capability ensuring secure BOOT, as well as chassis intrusion alarms and tamper evident packaging. To request more information or receive a quote, visit **crystalrugged.com**.

CRYSTAL

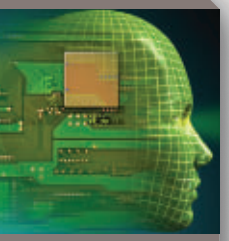
A clear advantage.

SERVERS | DISPLAYS | STORAGE | NETWORKING | EMBEDDED | CARBON FIBER

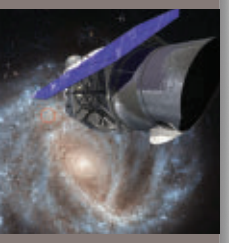
sales@crystalrugged.com | 800.378.1636 | crystalrugged.com

JANUARY 2019
VOL. 30, NO. 1

Military & Aerospace Electronics



COVER STORY



Military & Aerospace Electronics® (ISSN 1046-9079), Volume 30, No. 1. Military & Aerospace Electronics is published 12 times a year, Januaryly by PennWell® Corporation, 1421 S. Sheridan, Tulsa, OK 74112. Periodicals postage paid at Tulsa, OK 74112 and at additional mailing offices. SUBSCRIPTION PRICES: USA $185 1yr., $327 2 yr., $466 3 yr.; Canada $280 1 yr., $479 2 yr., $618 3 yr.; International $335 1 yr., $638 2 yr., $834 3 yr. POSTMASTER: Send address corrections to Military & Aerospace Electronics, P.O. Box 47570, Plymouth, MN 55447. Military & Aerospace Electronics is a registered trademark.

BY **JOHN KELLER**, EDITOR IN CHIEF

Democratic House will have a major influence on U.S. military spending; may kill Space Force

U.S. military spending, which only a few months ago looked like it would remain historically high for perhaps the next six years, or even longer, may take a sharp turn this month as the new Congress is seated.

That's when the House leadership turns over to the Democratic party, leaving Congress split between a pro-military Republican Senate and a Democratic House that's likely to turn its focus toward non-defense domestic programs.

Probably the most immediate result of the November congressional election will be the much-talked-about U.S. Space Force; it's likely dead, to put it bluntly. Creating a whole new U.S. military service, with its costly reorganizations and program shifts just isn't in the cards in a year when the larger of the two chambers of Congress just won't support it.

The initiative to create a Space Force has been on shaky ground from the beginning. Top leaders in the Pentagon were tepid on creating a new service branch; it really wasn't on their radar until President Trump proposed it early in his first term.

The Space Force never had a solid constituency to begin with. Individual presidents are temporary, serving only for four or eight years. It would take more than that to get a Space Force started. A majority of incoming Democratic House representatives, whose leaders have pledged to fight creation of a Space Force, was the final nail in the coffin.

A Space Force, were it to happen, would have control over military operations in space. It most likely would absorb Air Force Space Command, the Army's 1st Space Brigade, and the Navy's Space and Naval Warfare Systems Command and Naval Satellite Operations Center. The National Reconnaissance Office eventually would join.

Space Force missions would include space situational advantage; command and control of space forces; space lift and range operations; space support to nuclear command and control; missile warning; satellite communications; and position, navigation and timing (PNT).

There are a few reasons for creating a Space Force. First, responsibility for space acquisitions today is fragmented between about 60 organizations in the Department of Defense (DOD) and intelligence community.

Second, space personnel are scattered across the military and intelligence community, with too few people to create a viable career track for space professionals. Finally, the Army, Marine Corps, Navy, Air Force, and Coast Guard all focus on their own domains, and consider space as a secondary support function. Creation of a Space Force would consolidate missions and budgets, and give critical mass to U.S. military space missions.

Just as important, however, is what a new Space Force might do to the existing military services — particularly to the Air Force, which has taken on the lion's share of U.S. military space missions. Without space, the Air Force might become too small of a service, which could trigger future military reorganizations, with all the money, time, and headaches that come with that.

It's hard to tell how a Democratic-led House might influence military budgets and missions in the near future. Established expensive programs like the F-35 joint strike fighter could be scaled back beyond where top military leaders want it. It will represent a bigger fight in Congress, that's for sure.

There will be resistance in Congress to continued large military budgets. This will come at a time when military leaders are establishing new national defense priorities that include new generations of hypersonic weapons, laser weapons, and perhaps a new air-superiority jet fighter.

How it will shake out is anyone's guess. ←

REDEFINING WHAT IS POSSIBLE IN AN EMBEDDED, SWAP-OPTIMIZED SYSTEM

XPand6215

Featuring multiple high-speed optical links, an Intel® Xeon® D-1500 processor, and a Xilinx Kintex® UltraScale™ FPGA, the XPand6215 offers uncompromising performance and reliability in a SWaP-optimized two-slot system.

X-ES
Extreme Engineering Solutions
608.833.1155 www.xes-inc.com

MADE IN THE USA
Designed, manufactured, and supported in the USA

news

BAE Systems to build 30 more ACV 1.1 amphibious armored combat vehicles and vetronics

U.S. Marine Corps amphibious warfare experts are ordering 30 Amphibious Combat Vehicles and accompanying vetronics to replace the Corps ageing fleet of amphibious assault vehicles (AAVs). Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., announced A $140.4 million contract in December to the BAE Systems Platforms & Services segment in Sterling Heights, Mich., for 30 more Amphibious Combat Vehicles (ACVs) in a program called ACV 1.1. Earlier this year the Marine Corps chose BAE Systems as the ACV prime contractor over competitor Science Applications International Corporation (SAIC) in Reston, Va. The ACV is a wheeled armored combat vehicle able to move Marine infantry warfighters from ships offshore to fight their way onto invasion beaches. The Marine Corps could end up purchasing as many as 204 vehicles over the next few years to outfit some of its 10 amphibious assault companies — the first phase of an incremental approach to replacing the AAV, which entered service in 1972. For more information contact **BAE Systems Platforms & Services** online at www.baesystems.com, or **Marine Corps Systems Command** at www.marcorsyscom.marines.mil.

Is the Navy's killer electromagnetic railgun losing its status as a top priority?

The U.S. Navy will continue to fund research and development efforts related to the service's much-hyped electromagnetic railgun. Navy leaders, however, are likely not to pursue an electromagnetic railgun shipboard tactical demonstrator, which likely will likely condemn the more than $500 million project

Air Force considers digital signal processing for improved SIGINT and cyber intelligence

BY **John Keller**

ROME, N.Y. — U.S. Air Force researchers are asking for industry's help in enhancing today's cyber intelligence and signals intelligence (SIGINT) capabilities by improving real-time digital signal processing to detect, identify, sort, track, prioritize, classify, and geolocate signals of interest automatically.

Military researchers see improvements in digital signal processing as key enablers for signals intelligence and cyber intelligence.

Officials of the Air Force Research Laboratory Information Directorate in Rome, N.Y., have issued a solicitation (FA875019S7002) for the Cyber/SIGINT Collection, Processing Techniques, and Enablers project.

The objective is to protect U.S. and allied command and control, intelligence gathering, and tactical networking capabilities, and to support battlespace awareness for the warfighter.

Researchers are looking for new ways to intercept, acquire, access, exploit, process, and locate covert signals and network data with real-time processing to improve the extraction, identification, analysis, and reporting of enemy tactical information.

The project also seeks to develop algorithms to help identify, collect, process, exploit, and geolocate, and manipulate enemy electronic communications signals in a moderate-to-dense co-channel environment potentially with significant Doppler effects. Proposals should focus on open-architecture solutions with scalable technologies.

The automation of SIGINT is a major goal, and focuses on information extraction; digital signal processing; and automation enhancements. Information extraction takes information from broadband signals to identify signals of interest. Signal processing removes noise and interference. Automation enhancements, meanwhile, use signal processing technologies to automate the manipulation of signals of interest for storage and transmission.

In addition, the project seeks the ability to characterize cognitive software-defined radios from aircraft, ground vehicles, or infantry warfighters.

Total funding for this project is about $100 million, and will be divided among several contractors over about three years. Individual awards will be for about four years and be worth from $250,000 to $4.5 million apiece.

Companies interested should submit white papers by 29 Jan. 2019, by 28 Jan.

You Engineer the Future.
We'll Supply the Components... Today!

Largest Selection ✓ Same-Day Shipping ✓ Expert Technical Support ✓

Armed with the world's largest selection of in-stock, ready to ship RF components, and the brains to back them up, Pasternack Applications Engineers stand ready to troubleshoot your technical issues and think creatively to deliver solutions for all your RF project needs. Whether you've hit a design snag, you're looking for a hard to find part or simply need it by tomorrow, our Applications Engineers are at your service. Call or visit us at pasternack.com to learn more.

866.727.8376
Pasternack.com

an INFINITE company

PASTERNACK®
THE ENGINEER'S RF SOURCE

to a military research limbo as the Pentagon focuses on other directed-energy programs. An innovative naval prototypes line item from the Navy's fiscal 2019 budget proposal last February explicitly sets aside $45.8 million to the railgun prototypes being tested at the Office of Naval Research and Naval Sea Systems Command. This line item is just one of several that shape funding for the Pentagon's directed-energy weapons projects, like solid-state lasers and the hypervelocity projectile, both of which have emerged as higher priorities than the railgun. The explicit budget line indicates that the Navy hasn't completely given up on idea of developing a supergun capable of liquefying enemy armor from miles away — even if the service did request $10 million less than in fiscal 2018.

Special Operations, Army, eye biometrics to authenticate identities of deployed warfighters

A Request for Information (RFI) on methods of continuously authenticating user identity by a person's distinctive characteristics using software-based biometrics or behavioral profiling is being sought by the Army Contracting Command-Aberdeen Proving Ground (ACC-APG), Huachuca Division, Fort Huachuca, Arizona. Meanwhile, under a continuing Broad Agency Announcement (BAA), the U.S. Special Operations Command's (USSOCOM) Program Executive Office (PEO) for Special Reconnaissance, Surveillance, and Exploitation (PEO-SRSE) — a component of USSCOM Special Operations Forces Acquisitions, Technology & Logistics (SOF AT&L-SR) — has requested "White Papers" from the biometrics industry for a biometric product line of "technologies to collect, analyze, and distribute various physical parameters that can be used to identify personnel." Both actions to authenticate the identities of warfighters are connected, though you wouldn't necessarily understand the 2020, and by 26 Jan. 2021. Email unclassified white papers to the Air Force's Douglas Smith at Douglas.smith.44@us.af.mil.

Submit classified white papers by post to Douglas Smith to AFRL/RIGB, 525 Brooks Road, Rome, N.Y. 13441-4505. For questions or concerns contact Douglas Smith by phone at 315-330-3474, or by email at Douglas.smith.44@us.af.mil. ←

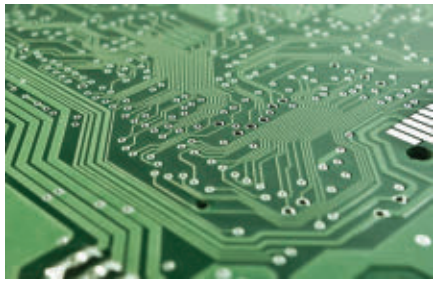
More information is online at https://www.fbo.gov/spg/USAF/AFMC/AFRLRRS/FA875019S7002/listing.html.

Raytheon eyes advanced heterogeneous computing architectures packaged in system-on-chip

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — U.S. military researchers are working together with the Raytheon Co. to develop heterogeneous computing systems that provide the performance of specialized processors, while maintaining the programmability of general-purpose processors.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced a $4.6 million contract on Wednesday to the Raytheon Space and Airborne Systems segment in El Segundo, Calif., for the Run-Time Configurable Accelerator (RCA), Domain-specific System on Chip (DSSoC) Program.



Raytheon is developing heterogeneous computing systems that provide the performance of specialized processors, while maintaining the programmability of general-purpose processors.

The Air Force awarded the contract on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., which runs the DSSoC project as part of the DARPA Electronics Resurgence Initiative (ERI).

The RCA DSSoC program seeks to capitalize on machine learning, advanced heterogeneous processor capability, general-purpose processors, and on ARM computing software and hardware capabilities to develop new tools, and hardware technologies.

The DSSoC program seeks to develop a heterogeneous system-on-chip (SoC) composed of many cores that mix general-purpose processors, special-purpose processors, hardware accelerators, solid-state memory, and input/output (I/O).

The project seeks to enable rapid development of multi-application systems through a single programmable device.

This effort involves building run-time-reconfigurable hardware and software that enable near application-specific integrated circuit (ASIC) performance without sacrificing programmability for data-intensive algorithms.

Raytheon experts will try to create a hardware and software system that

enables data-intensive algorithms to run at near ASIC efficiency without the cost, development time, or single-application limitations typically found in ASIC development.

The DARPA Electronics Resurgence Initiative seeks to ensure far-reaching improvements in electronics performance well beyond the limits of traditional scaling. It focuses on architectures; design; and materials and integration for the next wave of U.S. semiconductor advancement. ←

For more information contact ***Raytheon Space and Airborne Systems*** *online at* www.raytheon.com, *the* ***Air Force Research Laboratory*** *at* www.wpafb.af.mil/afrl, *or* ***DARPA*** *at* www.darpa.mil.

DARPA eyes trusted computing, secure chip use, and semiconductor manufacturing

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers briefed industry in December on a new initiative to help develop secure integrated circuit technology for trusted computing applications, ranging from manufacturing to systems integration.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., briefed industry on the upcoming Electronics Resurgence Initiative: Defense Applications (ERI:DA) project.

ERI:DA is one of several potential broad agency announcements under the recently announced second phase of the DARPA Electronics Resurgence Initiative.

The ERI-DA project seeks to develop revolutionary national defense capabilities that capitalize on technologies developed in existing ERI thrusts — namely, the need to support domestic secure chip manufacturing; invest in chip security; and demonstrate new ERI technologies for defense applications.

The ERI Phase II will build on existing ERI programs to help support domestic semiconductor manufacturing processes that can help defense electronics systems integrators implement specialized circuits.

Further, this effort aims to ensure that those electronic circuits can be

connection until both the RFI and the "White Paper" are viewed in the perspective and context of The U.S. Army Concept for Cyberspace and Electronic Warfare Operations 2025-2040 strategy document.

Navy carrier flight deck crews use simulation to train in virtual reality

The chaotic nature of the flight deck brings high winds, dangerous equipment, engines, and propellers, all while the crew tries to guide aircraft pilots toward a safe landing. In the past, the crew first would learn the ins and outs of deck life while performing these dangerous jobs. Today, however, they can receive training in computer simulation with the Flight Deck Crew Refresher Training Expansion Packs (TEPs). The system enables individuals, teams, and multi-teams to exercise and rehearse flight-deck operations within an expandable framework of game-based, immersive 3D technologies, ONR officials say.

Electronic warfare (EW) spending up, but can't make up for years of neglect

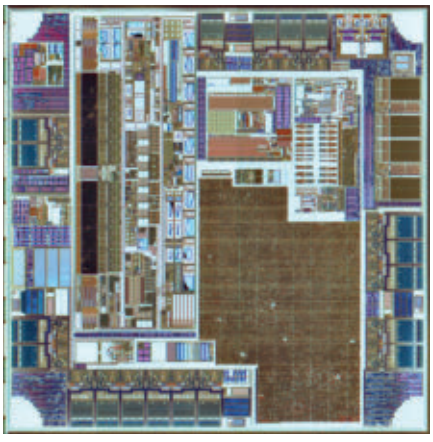
Electronic warfare (EW) has come a long way since Pentagon legend Paul Kaminski warned that "years of neglect" had left the U.S. dangerously behind Russia and China. But has the Defense Department made the $2.3 billion a year increases in EW spending that Kaminski and the respected Defense Science Board said was necessary? No — not yet. "We have not achieved $2.3 billion in budget growth," says Pentagon EW acquisitions director Bill Conley. How much is the Defense Department spending on EW? Research spending totals about $5 billion a year, Conley says, but the best technology is useless if it doesn't get bought and fielded. When it comes to EW procurement, however, so much money is classified, and so much is in flux, that Conley can't give a public number for how much the Defense Department is actually spending. ←

trusted through the supply chain and are built with security in mind, making certain that technological advances ultimately are applied to national security.

DARPA researchers are looking for ways to apply advanced electronics to machine autonomy and artificial intelligence; large-scale emulation; cyber security; space applications; cognitive electronic warfare; and intelligence, surveillance and reconnaissance (ISR).

Eligible ERI programs could include Common Heterogeneous Integration and Intellectual Property Reuse Strategies (CHIPS); Three-Dimensional Monolithic System-on-a-Chip (3DSoC); Foundations Required for Novel Compute (FRANC); Software Defined Hardware (SDH); Domain-specific System on Chip (DSSoC); Intelligent Design of Electronic Assets (IDEA); Posh Open Source Hardware (POSH); and the Joint University Microelectronics Program (JUMP).

DARPA announced the Electronic Resurgence Initiative's first phase in June 2017, which has spent upwards of $1.5 billion to advance microelectronics



Researchers are sending out feelers to industry for new technologies in secure integrated circuits and trusted computing.

performance beyond the limits of traditional transistor scaling, and demonstrate the influence of this research on national defense. DARPA announced competitive awards for the first group of six new ERI programs in July 2018.

Email questions or concerns to DARPA-SN-19-15@darpa.mil ←

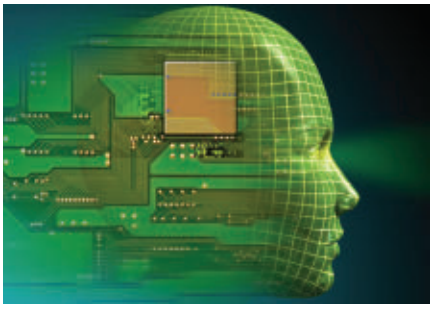
More information is online at https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-SN-19-15/listing.html.

IARPA seeks to apply trusted computing to artificial intelligence and machine learning models

BY **John Keller**

WASHINGTON — U.S. intelligence experts are asking industry to develop trusted computing methods of safeguarding models used to create artificial intelligence and machine learning systems to ensure that models compromised by cyber attacks do not inadvertently reveal sensitive information.

Officials of the U.S. Intelligence Advanced Research Projects Agency



Intelligence experts are looking for new ways to capitalize on trusted computing in artificial intelligence and machine learning.

(IARPA) in Washington began releasing details of the upcoming Secure, Assured, Intelligent Learning Systems (SAILS) program this week for industry comment. Solicitations will come later in early 2019.

Artificial intelligence and machine learning technologies can help streamline business processes and aid in decision making, yet these systems are vulnerable to cyber attacks that can compromise people's privacy, IARPA researchers say.

Attacks against privacy aim to reveal information used to train artificial intelligence and machine learning models — particularly in what researchers refer to as model inversion attacks and membership inference attacks.

Model inversion attacks aim to reconstruct the data used to train a model, like a recognizable feature of an individual's face. Membership inference attacks, meanwhile, aim to determine whether a specific person's data was used in training the model, which has the potential to reveal the identity of that person.

Related: DISA asks industry for trusted computing ways of using artificial intelligence (AI) to detect malware

The SAILS program is looking for ways to create artificial intelligence and machine learning models able to resist attacks against privacy, and give model creators confidence that their trained models will not inadvertently reveal sensitive information.

SAILS will focus on speech, text, and images as potential attack avenues. Those chosen for the program will develop training procedures, model architectures, or pre- and post-processing procedures to defend against attacks. New cyber defensives could include new model architectures, new training procedures, or new pre- /post-processing steps.

For now, IARPA researchers want industry to review comment on the draft broad agency announcement for the SAILS program, which can be found online at https://www.fbo.gov/index?s=opportunity&mode=-form&tab=core&id=ff29abbc3c77100b0d55c441fbe9b0ff.

Comments and concerns are due by 31 Jan. 2019 by email at dni-iarpa-baa-19-02@iarpa.gov. ←

More information is online at https://www.fbo.gov/notices/ff29abbc3c77100b0d55c441fbe9b0ff.

PROBING WHAT THE HUMAN EYE CANNOT SEE

Military electro-optical technologies are evolving quickly for intelligence, surveillance, and reconnaissance missions from small platforms like unmanned aircraft.

BY **J.R. Wilson**

An Air Force officer adjusts his night vision goggles during a night training mission.

Electro-optical (EO) sensors, which passively sense energy emitted by or reflected from a target, have been in use by the U.S. military since the Vietnam War, beginning with forward looking infrared (FLIR) systems that provided gunship crews with night vision and later the stabilized TV telescope.

Advances in range, size, power requirements, and ruggedization have mirrored the evolution of computing and other technologies through the 1990s and into the 21st century. As those components evolved more quickly with each passing year, the application of electro-optical sensors across a wide range of manned and unmanned aircraft have greatly enhanced intelligence, surveillance and reconnaissance (ISR) missions.

"Surging demand for high-resolution and high-throughput sensors for gaining superior situational awareness, countermeasures, and reconnaissance is the key driver for the military EO/IR systems sector globally. To tackle conventional as well as newly evolved threats, militaries worldwide are focusing on installation of advanced sensor-based systems, which can provide intelligence in real time for necessary actions," according to the report Global Military Electro-Optical/Infrared Systems Market 2018-2028.

"The increasing complexities in modern-day war techniques have resulted in a heightened requirement for ISR activities, which has resulted in several key defense spenders to invest heavily in the research and development of equipment such as thermal sights, infrared vision systems and laser target designators," the report says. "The rising demand for new sighting devices as well as wearable night vision and thermal imaging systems is therefore contributing significantly to the growth of the global military EO/IR systems market."

The state-of-the-art in turreted electro-optical infrared systems is a multi-spectral, multi-sensor system with a steerable and stabilized line-of-sight, say industry experts.

Modern systems include sensors that image effectively under all illumination conditions, from daylight to full darkness. A combination of small pixel size and long optical focal lengths also enables color daylight cameras to provide extended range under full illumination conditions.

Low-light imaging

As light levels start to drop, at dusk and in overcast conditions, low-light cameras are necessary. These cameras generally have a

The Right RF Parts.
Right Away.

We're RF On Demand, with over one million RF and microwave components in stock and ready to ship. You can count on us to stock the RF parts you need and reliably ship them when you need them. Add Fairview Microwave to your team and consider it done.

Fairviewmicrowave.com
1.800.715.4396

an INFINITE company

Fairview Microwave
RF COMPONENTS ON DEMAND. Done!

The Air Force AgilePod is a multi-intelligence, open architecture, reconfigurable prototype pod for the ISR and Air Force Special Operations communities.

sensitivity band covering visible and near-infrared light. Under completely dark conditions, a thermal imager can image using radiated heat.

Midwave infrared, which provides better sensitivity and resolution than longwave infrared, is considered preferable to longwave for most military scenarios. In surveillance missions, shortwave infrared (SWIR) imagers can image effectively at the limits of atmospheric visibility. For all types of imagers, high-definition (HD) arrays represent the state-of-the-art.

"Without ISR, we are useless," observed retired U.S. Air Force Maj. Gen. George Harrison in opening remarks to the "Airborne ISR" conference in London in October 2015, adding that electro-optical sensors are key to maintaining a battlespace edge in ISR — growing to equal radar.

The growing importance of electro-optical technologies and ISR capabilities can be seen in Air Force and Army contract awards during 2018, including three Air Force Research Laboratory (AFRL) contracts to help develop new enabling technologies for next-generation electro-optical and RF (radio frequency) sensors, communications, information processing, imaging, and signals intelligence (SIGINT).

Defense Engineering Corp. in Beavercreek, Ohio; optX Imaging Systems LLC in Lorton, Va.; and Lockheed Martin Space Systems in Louisville, Colo. each are working on different elements of the Research and Development of Electro-Optical and Radio Frequency Sensors (RADERS) project.

Key technologies

According to the Air Force Research Lab, RADERS comprises 12 electro-optical and RF technology areas:

- antenna technologies and electromagnetic scattering;
- electro-optic and infrared sensor technology;
- sensor information processing and integration;
- electro-optical infrared, spectral and common-aperture electro-optic/radio-frequency hardware and algorithms;
- waveform phenomenology, design and applications;
- ultra-sensitive receivers for signals intelligence;
- long-range day and night hyperspectral imaging research;
- standoff high-resolution imaging;
- infrared search and track (IRST) technology;
- passive concept exploration;
- laser radar (ladar) imaging, systems, components and applications; and
- RF sensor systems

The first of those is designed to advance antenna and electromagnetic technology for air, ground, and space-based applications, including radar, communications, satellite operations, and ISR systems from HF to W-band frequencies, with an emphasis on detection, tracking, and data fusion for difficult targets.

The second centers on sensors and algorithms for target sensing, detection, recognition, and tracking with thermal imaging, single-aperture electro-optical/RF sensing, hyperspectral imaging, and multispectral sensing.

Electro-optical infrared, spectral, and common-aperture electro-optical/RF hardware and algorithms will help develop the ability to detect low-signal targets in noisy and cluttered environments using electro-optical, infrared, hyperspectral, multispectral, and common-aperture electro-optical/RF sensors — including focal-plane arrays, hybrid focal plane arrays, and infrared cameras for high-resolution low-power portable midwave and longwave IR sensing.

Laser radar (ladar) imaging, systems, components, and applications will apply ladar to ISR, precision attack, and air-to-air engagements — particularly to detect, track, and identify difficult air and ground targets in challenging environments.

Another the Air Force Research Lab program — Precision Real-time Engagement Combat Identification Sensor Exploitation (PRECISE) — is a $33.6 million, five-year sensor-fusion effort to enhance the effectiveness of surveillance radar by blending in electro-optical technologies such as visible light, IR, multispectral, and hyperspectral sensors.

Electro-optical sensor payloads

In what some are calling a "game-changer" for ISR, the Air Force Research Lab is working with other research organizations in government, industry,

and academia to develop the AgilePod — a modular, plug-and-play sensor subsystem designed for rapid sensor exchange and a variety of sizes to fit a wide range of manned and unmanned aircraft. On June 2018, the AgilePod flew three demonstration missions on an MQ-9 Reaper medium-size military unmanned attack aerial vehicle (UAV) — its first on a major Air Force weapons platform.

"The AgilePod program began with a desire to bring agile manufacturing practices to the ISR enterprise, culminating in a wholly government-owned, open architecture ISR capability that was payload- and platform-agnostic," Andrew Soine, a program manager with the Air Force Research Lab's Materials and Manufacturing Directorate, said during the test flights.

and cost when faced with emergent user needs."

In October, the Army awarded a $454 million contract to L3 Technologies for a next-generation WESCAM MX-10D electro-optical infrared and laser designator sensor suite for the Army's RQ-7Bv2 Shadow UAV.

"We are focused on developing new state-of-the-art multi-domain C6ISR [Command, Control, Communications, Computers, Cyber defense, Combat systems and ISR] technologies in support of the U.S. Army's Modernization Strategy," L3 CEO Christopher E. Kubasik said in the announcement.

"The market is demanding greater levels of sensor automation and integration," says Cameron McKenzie, L3 Wescam vice president for global business development. "The object tracking

The AeroVironment Mantis i45 EO/IR gimbal payload on the Puma AE small unmanned aircraft can target with great detail while operating at extreme long ranges.

"The program is really taking off, with proposed ISR and non-ISR applications that we couldn't have foreseen only a few years ago. By owning the technical baseline, we've shown what can be done in relatively little time

function in MX products has recently undergone a significant upgrade. Operator burden has been significantly reduced as the system will automatically detect potential targets based on motion, and will annotate them."

"This allows the operator to select which is to be tracked," McKenzie continues. "As well, tracking robustness is significantly improved. This is of special importance to the unmanned aerial surveillance market as manual target tracking can be challenging due to the inherent latencies in remote UAS and payload control."

Expanding ISR

ISR, still predominantly air- and space-based, is expanding in ground-based, down to the individual warfighter, and maritime applications, from Navy aircraft carriers to Coast Guard small boats.

"In terms of ground combat ISR applications, electro-optical sensors are well-suited to forward observer roles, such as directing artillery fire, directing close air support, and observation post vehicle," McKenzie says. "In such installations, the sensor can be mounted either directly to the vehicle or on a mast. The emphasis in the ISR role is on optical range performance and target geo-location performance."

Elbit Systems Electro-Optics (Elop) in Haifa, Israel, is the world's largest electro-optical provider outside the U.S., and produces a range of advanced electro-optical sensors for airborne, ground and naval applications, from position and orientation data to ISR.

Elop's electro-optical land applications range from night sights and target-acquisition systems to payloads and perimeter security to laser designators and thermal imagers. These sensors are designed for extended early warning and rapid response capabilities for ground forces.

Thermal imagers, hyperspectral cameras, and similar sensors offer ISR solutions for aviation, such as the Multi-Spectral Infrared Countermeasure (MUSIC) family of direct infrared

counter measures (DIRCM) solutions and the Surveillance, Warning, Obstacle Ranging and Display (SWORD) laser radar system. The Elop Compact Multi-Purpose Advanced Stabilized System (CoMPASS) family of electro-optical payloads feature day and night imaging sensors and laser designators for sea-based ISR, target acquisition and target designation.

According to the Air National Guard's 2018 Weapons Systems Modernization Priorities, the service's MC-12W medium-to-low altitude twin-engine turboprop aircraft requires an additional electro-optical infrared sensor to meet the demanding ISR tasks required by combatant and task force commanders.

"The ANG MC-12W mission heavily relies on the ability of the crews to see the smallest details on the ground from miles away. Currently, the MC-12W is outfitted with a single MX-15DiD sensor on each aircraft. While this allows the MC-12W to complete a wide range of ISR tasks, it is extremely limited when it comes to fidelity and flexibility. This added system will double the amount of area to be seen by MC-12W crews and provide a substantial amount of situational awareness to the commanders on the battlefield," the report said.

The Massachusetts Institute of Technology's Lincoln Laboratory in Lexington, Mass., is capitalizing on recent advances in imaging architectures and real-time processing to develop a miniature 3D ladar sensor for small UAVs. The tennis ball-sized sensor is being designed to provide a one-billionth reduction in size, weight and power (SWaP) to generate 3D terrain and structure imagery through dense foliage.

By integrating the micro-ladar system on a UAV as small as a quadrotor, 3D imaging can become a feasible option for users who cannot afford large aircraft necessary for other systems, Lincoln Lab officials say. The micro-ladar could be used under clear and heavy foliage conditions for surveillance and reconnaissance missions as well as for humanitarian assistance and disaster relief operations.

An Air Force sergeant launches a small unmanned aircraft system during training at Eglin Air Force Base, Fla.

Evolving user requirements

User requirements for electro-optical technologies constantly are evolving and expanding.

"Customers are also demanding entire mission solutions that include not just the sensor, but mounts and consoles," says L3 Wescam's McKenzie. "Consoles typically include advanced human-machine interface (HMI) and sensor automation functions, as well as displays, recorders, and microwave communications equipment. L3 has responded to this with the development of the MatriX package, a pre-engineered kit for specific aircraft platforms. MatriX currently supports UH-60 Black Hawk and C-130 Hercules platforms, with more to come in the future."

The Marine Corps has electro-optical ISR projects in progress for UAV sensor payloads. The goal is to take advantage of reduced SWaP to give small UAVs modular, tailored, and specific mission capabilities that have been limited to large UAVs used by the Air Force and Navy. That will enhance the Marine Air-Ground Task Force's (MAGTF) ISR collections, using RQ-21 Group 3 and RQ-20 Group 1 UAVs supporting Marine Expeditionary Units (MEUs), Marine Special Operations, infantry regiments, battalion and lower echelon operations.

Several research, development, and procurement efforts are in progress, says the Marine Corps Concepts & Programs 2018 report to Congress.

First is the Tactical electro-optical/IR SIGINT Integrated for Targeting (TEISIT) sensor, a Group 3 payload that is part of the Wide Area Surveillance and Persistent Surveillance (WASPS) program. The payload includes signals intelligence and electronic support; synthetic aperture radar (SAR) and electro-optical modalities. The sensor also will incorporate advanced processing algorithms to perform on-board data fusion, exploitation and an autonomous sensor control modality.

Second is the Spectral and Reconnaissance Imagery for Tactical Exploitation (SPRITE) project that provides

wide-area ISR capability with simultaneous high spatial and spectral resolution. The system is capable of wide area electro-optical infrared and hyperspectral imaging.

Next is the AN/DSY-4 Spectral Bat sensor payload providing SIGINT and electronic support capability, including signals detection, geo-location, and a communications relay. These payloads complement the UAV's organic electro-optical capability.

Image enhancement

Modern sensors include image enhancement functions for noise reduction, sharpening, and local area contrast enhancement, which help improve feature recognition and bring detail out of shadows. They also include advanced functions like object tracking, image blending, a laser rangefinder, one or more laser illuminators, and possibly a laser target designator. The laser rangefinder enables the operator to stay at a covert distance from the target and aids in target geo-location accuracy.

"The imaging and laser payload is supported by a four- or five-axis gimbal that steers and stabilizes the optical line-of-sight. Many low-cost turreted electro-optical/IR systems consist of only a two-axis gimbal. These feature poor stabilization performance as the servo-mechanism that performs the fast and fine motion required to stabilize the payload is directly loaded by the external airstream and other factors. A four- or five-axis configuration isolates the stabilization gimbal from the outer housing gimbal," says L3 Wescam's McKenzie."The electronics responsible for image processing, tracking, and moving target indication, is integrated into the turret unit of a state-of-the-art sensor. This significantly reduces overall system weight as it eliminates an external electronics box and associated cabling, which simplifies aircraft/vehicle integration."

ISR operators generally are interested in sensor range performance and automation features. When executing a surveillance or reconnaissance flight pattern, for example, longer target detection range enables the operator to execute wide leg spacing, while longer recognition and identification range performance means fewer deviations from the search pattern, resulting in shorter, more economical and more effective missions requiring fewer aircraft and fewer mission personnel.

"The primary contributors to better range performance have been the advent of HD cameras and better stabilization. Better image processing has resulted in better feature extraction," McKenzie adds.

The last five years have seen a greater relative uptake of targeting sensors due to an increased emphasis on multi-role aircraft in fleets around the world. That has led to a renewed interest in large sensors for long standoff multi-mission surveillance and tactical platforms as well as small sensors for smaller, lower altitude platforms.

Complementary technologies

"Electro-optical sensors are a complementary technology to other technologies found in an ISR mission equipment package. Ground moving target indication and imaging radars are very useful in target detection given their long range and ability to penetrate atmospheric obscuration and foliage. That said, their resolution is limited, so they are not very useful for target identification," says L3 Wescam's McKenzie.

Israeli electronics company Elbit Systems designs a variety of electro-optical night-vision systems for use in aircraft cockpits.

"That is the forte of a sensor that operates in the electro-optic band. Similarly, wide area motion imagery, signals intelligence and acoustical detection sensors can all be used to cue a directional electro-optical/IR sensor

An MQ-1C Gray Eagle unmanned aerial system, equipped with 3rd Gen FLIR sensors prepares to conduct a mission from Al Asad Air Base, Iraq

for target recognition and identification tasks."

The Pentagon recently changed contractors to upgrade the F-35's AN/AAQ-37 electro-optical Distributed Aperture System (DAS). When the original supplier, Northrop Grumman, elected not to bid on future DAS production, the Air Force awarded the contract to Raytheon, which offered a 45 percent reduction in cost per unit and 50 percent cut in sustainment costs. And, according to Lockheed Martin, five times the reliability and twice the performance.

The electro-optical DAS collects real-time, high-resolution imagery from six IR cameras mounted around the aircraft and sends it to the pilot's helmet-mounted display, providing a 360-degree spherical view of the environment.

"The next generation is expected to be a continuation of recent trends in electro-optical/IR systems. We expect to see the incorporation of newer, higher resolution camera detector technology as chip production levels increase and costs decline to the point where it makes economic sense," says L3 Wescam's McKenzie.

"We expect to see more advanced image processing capabilities, with an objective to further reduce the operator's workload. Finally, we expect to see higher levels of integration of electronic functions in the imaging," McKenzie concluded.

COMPANY LIST

Arete Associates
Northridge, Calif.
http://arete.com

Clear Align
Norristown, Pa.
http://www.clearalign.com

Defense Engineering Corp.
Beavercreek, Ohio
http://defengcorp.com

FLIR Systems Inc.
Wilsonville, Ore.
https://www.flir.com

Kongsberg Defence & Aerospace AS
Kongsberg, Norway
https://www.kongsberg.com/en/kds/

L-3 Integrated Land Systems
Londonderry, N.H.
https://www.l3t.com/integratedlandsystems/

L-3 Space & Sensors SSG
Wilmington, Mass.
https://www2.l3t.com/advancedprograms/wilmington/index.htm

L-3 Technologies Sonoma EO
Santa Rosa, Calif.
https://www2.l3t.com/sonomaeo/

L-3 WESCAM
Burlington, Ontario
https://www.wescam.com

Leonardo DRS Network & Imagining Systems
Melbourne, Fla.
https://www.leonardodrs.com

Lockheed Martin Missiles and Fire Control
Orlando, Fla.
https://www.lockheedmartin.com/

Lockheed Martin Space Systems
Louisville, Colo.
https://www.lockheedmartin.com/en-us/capabilities/space.html

Marktech Optoelectronics Inc.
Latham, N.Y.
https://www.marktechopto.com

Northrop Grumman Corp. Mission Systems
Linthicum, Md.
http://www.northropgrumman.com/

optX Imaging Systems LLC
Lorton, Va.
http://www.optximaging.com

Sierra-Olympic Systems Inc.
Hood River, Ore.
https://www.sierraolympic.com

SWaP considerations for today's rugged computers

Systems integrators require small size, weight, and power consumption (SWaP) for today's rugged computer systems, embedded computing boards, and rugged backplanes, which is pushing vendor innovation to the limit.

BY **Jamie Whitney**

Industry innovators are accomplishing breakthroughs with commercial off-the-shelf (COTS) solutions to tackle specialized problems in military systems that must operate in extreme conditions. By using off-the-shelf components, manufacturers can mate affordable, proven technology into proprietary designs that can stand up to the conditions of the modern battlefield on land, in the air, or at sea.

With COTS components, manufactures and contractors of mil-spec hardware can continue to do what they do best: put rugged and ready equipment onto the battlefield.

Cooled with COTS

This fall, rugged embedded computing specialist General Micro Systems (GMS) in Rancho Cucamonga, Calif., introduced one of the industry's first rugged, conduction-cooled COTS deep learning and artificial intelligence to provide real-time data analysis and decision making on the modern battlefield with its X422 Lightning system. It integrates two Nvidia V100 Tesla data center accelerators into a sealed, conduction-cooled chassis that enables it to function in extreme conditions.

Systel Inc. Raven-Strike rugged multi-mission computer

The X422 is a forward deployed, vehicle-mounted, high-performance general-purpose graphics processing unit (GPGPU) co-processing system. Applications include computing clusters and parallel computing, digital signal processing, digital image processing, video processing, neural networks, data mining, cryptography, and intrusion detection.

Traditionally, sensors on military vehicles collect massive amounts of battlefield data and store it locally before transporting it for analysis and interpretation by sophisticated remote deep-learning systems. Transporting this raw data saturates networks and satellite communications uplinks, slowing them to a crawl and preventing access from other users. To work around the network, warfighters often transport removable hard disk drives from the front lines, leaving the data subject to theft or loss during transport and introducing additional lag time.

"The X422 GPGPU system allows extraordinary quantities of data to be collected and processed right on the battlefield in real time, significantly shortening the decision loop for providing solutions and recommendations to warfighters," says Ben Sharfi, chief architect and CEO at General Micro Systems. "Ultimately, the X422 enables live targets to be identified, flagged, and even fired upon in record time. It represents a complete paradigm shift in electronic warfare, SIGINT [signals intelligence], and C4ISR [command, control, communications, computers, intelligence, surveillance, and reconnaissance]."

Advanced GPGPUs

The X422 fits its GPGPU system into an approximately 12-by-12-inch square sealed enclosure that sits approximately three inches high. It includes dual x16 PCI Express Gen 3 slots for the GMS-ruggedized PCI Express deep learning cards, including Nvidia's V100 Tesla (computation only)—what Nvidia calls the "most advanced data center GPU ever built,"—or Nvidia's Titan V (computation with graphics outputs). Each card boasts 5120 CUDA processing cores, giving X422 over 10,200 GPGPU cores and more than 225 teraFLOPs for deep learning.

Priority

Source High-Reliability RF Cables

Need(s):

- ☑ Reliability
- ☑ J-STD Soldering
- ☑ Test Reports
- ☑ Lot Traceability

Tomorrow?

Pasternack

Complete Line of High-Reliability RF Cables Shipped Same-Day!

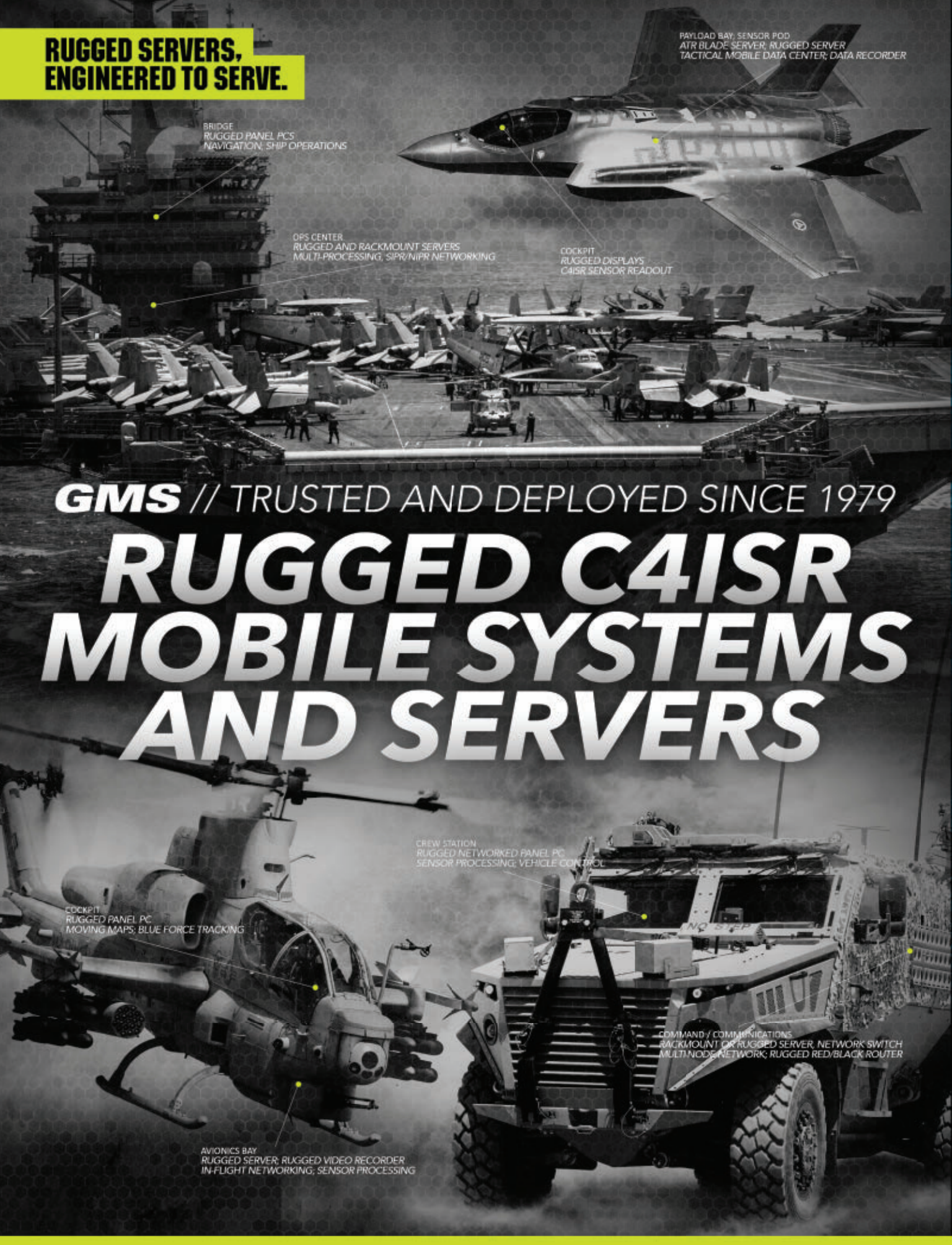
Our new portfolio of commercial-off-the-shelf (COTS), high-reliability RF cable assemblies are designed and processed to stand the test of time. These new cables are assembled using J-STD soldering processes and WHMA-A-620 workmanship. Inspection data, test data and material traceability are all included as part of the package. The combination of materials, processing and supporting data work together to create a dependable, fieldable cable assembly for applications where performance over time is critical and the cost of failure is high. Call or visit us at pasternack.com to learn more.

866.727.8376
Pasternack.com

an INFINITE company

PASTERNACK®
THE ENGINEER'S RF SOURCE

RUGGED SERVERS, ENGINEERED TO SERVE.



GMS // TRUSTED AND DEPLOYED SINCE 1979

RUGGED C4ISR MOBILE SYSTEMS AND SERVERS

TIGER S402-SW THE WORLD'S MOST ADVANCED RUGGED MOBILE SERVER

Intel®
22 CORES
Xeon® E5 v4

Nvidia® Quadro®
1.32 TFLOPS
M2200M MXM

Layer 2/3
14 PORT
Managed Switch

Add-in I/O
4 I/O SITES
SAM™ I/O, MXM or XMC

KEY FEATURES

- Intel® Xeon® E5 v4 CPU with up to 22 cores
- Hyper-Threading on each core for total of 44 logical cores
- Supports up to 128 GB of DDR4 memory with ECC
- Up to two fixed mSATA SSD or SAM™ I/O
- Optional fixed M.2 or NVMe SSD for OS boot (Optional for I/O)
- Up to four 10 GbE plus twelve 1 GbE Ethernet ports
- Personal Profile Module™ (PPM) uses SD card authentication
- Two removable 2.5" SATA or NVMe SSD (Four Optional)
- Drive(s) and SD card secured behind EMI/IP-rated door
- SSD drives support optional encrypt/Secure Erase/Write Protect

GMS PATENTED

RUGGEDCOOL™

-40° to +85° C
Extended Temperature
Full Operation w/out Throttling

GMS
GENERAL MICRO SYSTEMS, INC.
TRUSTED AND DEPLOYED SINCE 1979
(800) 307-4863 / GMS4SBC.COM

All General Micro Systems, Inc. products are proudly designed and manufactured in the U.S.A.

In addition to using Nvidia GPGPU co-processors, the X422 can accommodate other co-processors, different deep learning cards, and high-performance computers (HPC) based upon FPGAs from Xilinx or Altera, or ASICs up to a total of 250 Watts per slot (500 Watts total).

An industry first for deep learning and artificial intelligence, the X422 includes no fans or moving parts, promising wide temperature operation and data movement via an external PCI Express fabric in ground vehicles, tactical command posts, UAV and UAS, or other remote locations.

"No one besides GMS has done this before because we own the technology that makes it possible," Sharfi says. "The X422 not only keeps the V100s or other 250-Watt GPGPU cards cool on the battlefield, but our unique x16 PCI Express Gen 3 FlexVPX fabric streams real-time data between the X422 and host processor and server at an astounding 32 gigabytes per second all day long. From sensor to deep learning co-processor to host: X422 accelerates the fastest and most complete data analysis and decision making possible."

Elma Electronic high-speed 3U VPX backplane

Unique to X422 are the pair of X422's two PCI Express deep-learning cards that can operate independently or work together as a high-performance computer (HPC) using the user-programmable onboard, non-blocking low-latency PCI Express switch fabric. For PCI Express cards with outputs — such as the Titan V's DisplayPorts — these are routed to separate A and B front panel connectors.

Another first of its kind

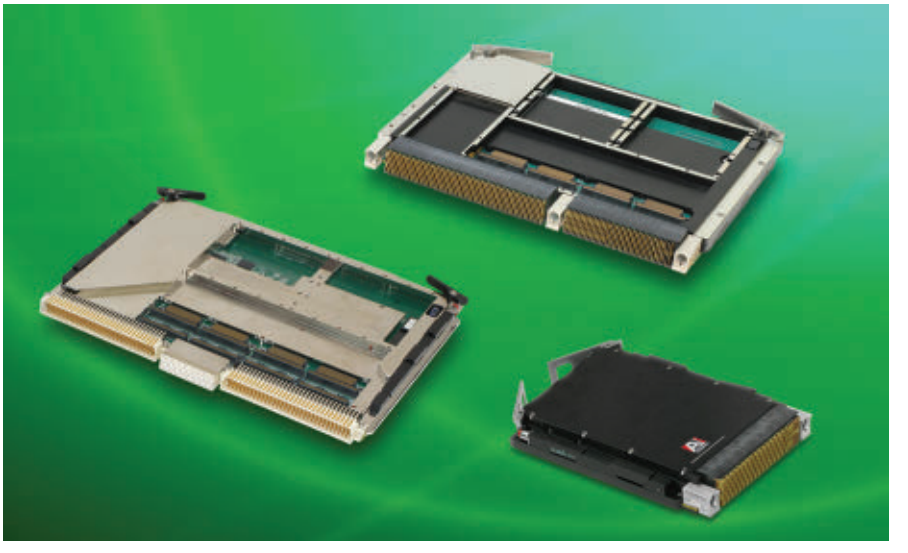
Elma Electronic in Fremont, Calif., also unveiled ground-breaking technology this fall with its 3U OpenVPX backplanes. These backplanes support integration of mixed payload modules — including COTS single-board computers, switches, and RF payloads used by the U.S. Department of Defense (DOD) Hardware and Software Convergence Initiative.

Unique to this backplane is its support of high-speed signals on all the data paths as well as leading-edge VITA 67.3 connectors compatible with legacy VITA 67.1 and VITA 66.4 RF and optical I/O connectors.

Designed to align with the DOD's Hardware and Software Convergence Initiative, which aims to develop a common, modular hardware architecture across C4ISR and electronic warfare (EW) systems, the backplane contributes to optimized size, weight, and power consumption (SWaP) requirements and relatively low life cycle costs to enable rapid technology insertion for the soldier.

Ken Grob, director of embedded computing development at Elma says, "This latest backplane incorporates new VPX features, unmatched by any other embedded backplane architecture to date, that will allow the VPX architecture to address a range of applications."

This 3U 12-slot VPX backplane has a radial slot card for timing and



Aitech Defense Systems Inc. NXP T4xx1 Series multicore QorIQ PowerPCs

synchronization, and includes seven slots that receive radial clock signals (Aux Clk and Ref Clk) driven independently from a radial clock timing card. The remaining five slots receive standard VPX bused Aux_Clk and Ref_Clk signals. The timing card slot also supports a VITA 67.3c connector with 10 simultaneous multi-protocol management (SMPM) cavities.

Four payload slots, each equipped with a combination VITA 67.3c optical and RF connector in the J2 position also are featured on the backplane. The slot 2 switch supports a VITA 67.3d connector module compatible with a payload module fitted with a VITA 66.4 MT optical ribbon connector or a VITA 67.1 RF coaxial connector.

When equipped with optical interfaces, the VPX architecture now allows data rates across the backplane far greater than any copper interconnect, with the additional benefit of relatively low design complexity. The VPX optical interface ensures that this backplane will be able to meet future bandwidth requirements.

Systel Inc. Falcon-Strike rugged multi-mission computer

Also included on the backplane is a 12-cavity, VITA 67.3e connector to support an RF switch card. The new VITA 67.3 connectors allow mating and removal of high speed optical and RF interfaces on payload modules from the backplane. The scheme allows different types of I/O cabling routed to a slot to remain connected to the rear of the backplane to distribute interfaces.

Rugged and ready

Extreme Engineering Solutions (X-ES) in Verona, Wis., also is bringing its own COTS solution to the 3U VPX field as its XPand6215 allows for high-bandwidth data acquisition and signal processing in harsh environments thanks to multiple high-speed optical links. The XPand6215 is a COTS rugged system based on the Intel Xeon D-1500 family of processors and the Xilinx Kintex Ultrascale field-programmable gate array (FPGA).

The XPand6215 is a small form factor (SFF) system composed of two 3U VPX modules. In the first slot, the XPedite7670 single-board computer features an Intel Xeon D-1500 (formerly Broadwell-DE) processor, offering as many as 16 Xeon-class cores in one power-efficient system-on-chip (SoC) package. The XPedite7670 hosts an XPort3305 10 Gigabit Ethernet XMC module, which provides a 10GBASE-SR Ethernet port through a fiber connector on the XPand6215 front panel.

Eight lanes of PCI Express Gen3 connect the XPedite7670 to the XPedite2570 in the second slot. This high-performance reconfigurable FPGA processing module is based on the Xilinx Kintex Ultrascale XCKU115 FPGA. The XPedite2570 provides 12 fast protocol-independent fiber-optic transmitters and receivers, accessible through a second fiber connector on the XPand6215 front panel.

The XPand6215 meets MIL-STD-810 and DO-160 standards while integrating power-saving and performance-enhancing technology. The heat from the internal conduction-cooled modules moves to sidewall heat exchangers, where dissipates to the ambient environment by conduction cooling and to an attached cold plate by conduction cooling. The system includes an integrated 28-volt DC power supply and MIL-STD-461 electro-magnetic interference (EMI) filtering.

Systel Inc. HR3000 rugged rack-mounted server

High performance, low power

Thanks to the ultra-low power T4xx1 processor integrated into four of its high-performing single-board computers, Aitech Defense Systems Inc. in Chatsworth, Calif., has further reduced power conception in its 3U and 6U VPX; 6U VME, and 3U VPX bundled computer boards.

Aitech officials say power consumption on the four single-board computers can be reduced up to 21 percent. By further reducing power

consumption within the board itself, Aitech helps designers meet the challenges of SWaP-C optimization throughout several rugged and mobile environments.

"Our customers face new and challenging design obstacles every day," says Emil Kheyfets, Aitech's director of military and aerospace product management. "As system size shrinks and electronics density increases, it's our job to provide solutions to solve these challenges, while keeping costs in line with budget requirements. Developing a range of powerful multicore single-board computers with cost-effective, relatively low cost-per-watt options enables them to meet the thermal profiles of today's highly integrated, embedded systems."

The low-power Aitech embedded computing series is available on the C912 3U VPX single-board computer, which offers as many as 12 e6500 PowerPC cores, as well as on the C111 6U VME and C112 6U VPX single-board computers, all of which have NXP's Trust Architecture 2.0.

This technology provides a high-trust cyber security processing environment for sensitive data security and supervisory control, a typical requirement for manned and unmanned space, air and ground vehicles.

The T4xx1 Series is 100 percent software compatible with the original T4xx0 family, meaning designers can use either on the Aitech COTS single-board computers, depending on their individual application requirements. The low-power processors offer an extended temperature range of -40 to 105 degrees Celsius on all 1.8 GHz speed bins as well as thermal power reduction of as much as 21 percent, depending on the device and speed bin selected.

Ready to 'Strike'

Systel Inc. in Sugar Land, Texas, was able to harness the processing power of Intel's Xenon scalable microprocessor and NVIDIA's GPGPU in its new Raven-Strike combat vehicle computing system. The rugged mission computer is purpose-built for modern fighting vehicles, and records full HD video with capture and encode, and sensor integration and data fusion. Raven-Strike is a SWaP optimized system, company officials say.

The computer integrates maximum compute and networking throughput and enables deep learning and artificial

intelligence capability through the use of neural networks. Systel's advanced thermal management ensures survival in extreme operating conditions, and Raven-Strike is built to exceed harsh military specifications including shock, vibration, dust, water, EMI, and EMC.

"Raven-Strike is a best-in-class rugged computing solution," says Aneesh Kothari, vice president of marketing for Systel. "It provides minimal SWaP with maximum CPU and GPU core density and acts as a single point for all sensor ingest and data fusion. Raven-Strike is the next-generation of computing technology demanded by emerging mission demands."

The sealed unit can operate in -40 to 55 C temperatures and withstand mil-standard 810 G-level shock and vibration as well as the mil-standard 461 EMI, all in a 14.2-by-20.6-inch sealed enclosure that stands 7.6 inches high.

Second 'Strike'

Systel also offers the Falcon-Strike combat vehicle computing system

in a smaller package. While the Falcon-Strike also meets the same mil-spec requirements of the Raven-Strike, it fits the system in an 8-by-9.5-inch enclosure that stands 6 inches tall. The Falcon-Strike uses either an Intel Xeon E3-1505L Quad-Core or i7-6822EQ Quad-Core microprocessor with a NVIDIA GeForce GTX 1050Ti 768-core CUDA GPU.

"Falcon-Strike exceeds the technology challenges and performance specifications demanded by modern Defense programs and platforms," says Systel's Kothari. "It provides an unmatched processing combination of high-performance CPU and GPU, ultra-efficient multi-sensor capture and encode, I/O and board scalability, and secure storage — all in a SWaP-optimized, single line-replaceable unit."

Falcon-Strike is for mission-critical military operations involving intelligence, surveillance, and reconnaissance (ISR), counter-unmanned aircraft, persistent surveillance, airborne law Enforcement, search and rescue (SAR), and land and marine based missions.

Mount up

The BR3000 rackmount server from Systel in its Puma-Bolt class also brings COTS value in a durable mil-spec package. HR3000 offers great value and performance without high cost. Custom integration and testing are available for dock-to-stock solutions for varied sectors, including military, oil field, and industrial applications.

The HR3000 is a SWaP-optimized 3U server with the latest Intel Xeon scalable processor and NVIDIA GPGPU and has the capability for PCI Express 3.0 add-in cards. The server has three hot-swap removable high-density SSDs. It is a half-rack width and short depth system. HR3000 is actively used in expeditionary warfare missions. ←

COMPANY LIST

Aitech
Chatsworth, Calif.
http://www.rugged.com

Crystal Group
Hiawatha, Iowa
https://www.crystalrugged.com

Curtiss-Wright
Ashburn, Va.
http://www.curtisswrightds.com

Extreme Engineering Solutions
Middleton, Wis.
https://www.xes-inc.com

General Micro Systems
Rancho Cucamonga, Calif.
https://www.gms4sbc.com

Kontron
Fremont, Calif.
https://www.kontron.com

Mercury Systems
Andover, Mass.
http://www.mc.com

Panasonic USA
Newark, N.J.
http://www.toughbook.com

Systel
Sugar Land, Texas
http://www.systelusa.com

Acromag
Wixom, Mich.
https://www.acromag.com

ADLINK Technology
San Jose, Calif.
http://www.adlinktech.com

Chassis-Plans
San Jose, Calif.
http://www.chassis-plans.com/

Core Systems
Poway, Calif.
https://core-systems.com

Diamond Systems
Sunnyvale, Calif.
http://www.diamondsystems.com/

Ecrin
Crolles, France
http://www.ecrin.com/en

Elma
Fremont, Calif.
http://www.elma.com

GammaTech Computer Corp.
Fremont, Calif.
https://www.gammatechusa.com

Getac
Irvine, Calif.
http://www.getac.com

HHCS Handheld USA Inc.
Corvallis, Ore.
https://www.handheldgroup.com

MilDef Inc.
Alexandria, Va.
https://www.mildef.com

Sparton Rugged Electronics
Woodbridge, Ontario
https://www.spartonre.com

Technology Advancement Group (TAG) Inc.
Dulles, Va.
https://www.tag.com

V Rose Microsystems
Johnstown, N.Y.
http://www.vrosemicrosystems.com

Xplore
Austin, Texas
https://www.xploretech.com

China reveals prototype configuration of jam-resistant and counter-stealth quantum radar

China claims to have revealed a prototype of an advanced quantum radar that is resistant to jamming and may be able to detect stealth aircraft. The system's operation is rooted in proven science and could be game-changing, but the Chinese still face significant development challenges in turning it into an operational capability. The state-owned China Electronics Technology Group Corporation (CETC) in Beijing brought a mockup of their counter-stealth quantum radar, which might have also been only a smaller scale model, to the biennial Zhuhai Airshow, which opened its doors on Tuesday, and has military technology on display. CETC says that its 14th Research Institute has been working on the system for years and first tested it in 2015. The new type of radar "is expected to solve the traditional bottleneck [of] detection of low-observable target detection, survival under electronic warfare conditions, platform load limitations, etc.," according to a CETC brochure, which a reporter for Aviation Week obtained at Zhuhai. That same journalist attempted to attend a press conference about the system, but was asked to leave after officials informed them it was for Chinese media only.

Directed-energy weapons like lasers and microwaves are the future of defense

If the Pentagon intends to be laser-focused in its goal to improve directed-energy weapons, it has just a few years to decide whether it wants to invest heavily in the new technology, according to the former director of the Missile Defense

Collins Aerospace to provide secure radio communications cryptography

BY **John Keller**

PATUXENT RIVER NAS, Md. — Secure radio communications experts at Collins Aerospace in Cedar Rapids, Iowa (formerly Rockwell Collins) will provide advanced cryptography for U.S. military aircraft radios under terms of a $10.8 million order announced in December.

Officials of the U.S. Naval Air Warfare Center Aircraft Division at Patuxent River Naval Air Station, Md., are asking Collins Aerospace to integrate the company's programmable crypto engine in versions of the company's AN/ARC-210 airborne radios.

Radios involved in this order are the Collins Aerospace AN/ARC-210 RT-1939A(C), RT-1990A(C), and RT-2036(C). United Technologies Corp. acquired Rockwell Collins for $30 billion this year and changed the company's name to Collins Aerospace.

Collins cryptography experts will use Tactical Secure Voice Suite B algorithms to secure the ARC-210 radios. Company military communications experts launched a program in about 2005 to develop the company's own programmable crypto engine and embed it in products ARC-210. Embedding crypto in the radio saves space and weight, and enables the company either to make more lightweight radios or add capability.

Tactical Secure Voice Suite B algorithms are approved by the U.S. National Security Agency (NSA) at Fort Mead, Md. Suite B non-classified crypto algorithms are developed in private industry, not in government. NSA experts verify the effectiveness of these algorithms and certify them for deployed military systems.

The NSA formed the Tactical Secure Voice Working Group in 2008 to ensure that modernized tactical secure voice devices are interoperable across the U.S. Department of Defense (DOD). This group's work led to the Tactical Secure Voice Cryptographic Interoperability Specification (TSVCIS), which became an official NSA document in July 2009.

Collins Aerospace is providing cryptography to secure U.S. military airborne radios like the AN/ARC-210, shown above.

The TSVCIS consists of two documents — one classified and the other unclassified — that define the voice encoding, encryption, framing, synchronization, key management, and other functions for tactical secure voice and data radio communications. Suite B cryptography follows the unclassified document.

Agency. "There are some things that kinetic weapons will not be able to do" now or in the future, says Henry "Trey" Obering, an executive vice president at consulting firm Booz Allen Hamilton in McLean, Va., who leads the company's directed energy innovation team. Directed-energy weapons attack their targets with focused energy, and include including laser weapons, microwave weapons, and particle beam weapons. Obering says the Pentagon — should it get its $700-billion-plus spending boost — could afford to throw additional resources toward the laser weapons and the like. It's an investment, much like the one the Pentagon made years ago to smart, laser- or GPS-guided munitions as opposed to dumb bombs that paid off, starting with Operation Desert Storm.

Global Ku-Band HTS satellites provide unprecedented SATCOM network solutions

Government customers require reliable and resilient satellite communications (SATCOM) wherever missions take them. With launch of Horizons 3e, the Intelsat EpicNG global high-throughput satellite (HTS) constellation is complete. For the U.S. military and NATO allies this means that they will have immediate access to a high performing, resilient and redundant network for mobility missions at sea, on land and in the air–whenever or wherever they need it. The sixth and final of the first-generation Intelsat EpicNG satellites, Horizons 3e, brings the most advanced digital payload, C- and Ku-band interconnectivity and optimized power sharing technology to the Asia Pacific and Pacific Ocean regions. One of the advanced features on Horizons 3e is the multiport amplifier that optimizes power across the satellite. With the multiport amplifier, if one spot beam is idle, its allocated power can be distributed to other beams to meet customer throughput demands.

NSA allows use of Suite B unclassified industry-developed crypto algorithms for certain kinds of military communications. Suite B algorithms are openly published and understood. Since Suite B crypto algorithms are unclassified, personnel without security clearances can operate equipment using Suite B encryption, which opens up its use to a broad variety of warfighters — particularly those on the front lines.

Suite B crypto often is appropriate for secret or otherwise sensitive information with a short shelf life—such as a position report on a moving enemy force. In addition to Suite B algorithms, NSA allows Suite A crypto for the military's most secret and sensitive communications. NSA also allows a certifiable crypto approach that layers different security products from different commercial vendors in a "good-enough" approach where appropriate.

Suite A crypto has limited use, layered COTS crypto still is in its infancy, and most of industry's attention in cryptography and crypto modernization is on Suite B, industry experts say. In the recent past, most U.S. military cryptography involved hard-coded devices that were difficult and costly to upgrade.

On this order, Collins Aerospace will do the work in Cedar Rapids, Iowa, and will be finished by January 2022.

For more information contact ***Collins Aerospace*** *online at www.rockwellcollins.com, or the* ***Naval Air Warfare Center Aircraft Division*** *at www.navair.navy.mil/nawcad.*

Air Force eyes secure networking for shared situational awareness in SATCOM-denied environments

BY **John Keller**

ROME, N.Y. — U.S. Air Force researchers are kicking off a potential half-billion-dollar program to develop secure networking for battlefield data that intelligently distributes information for shared situational awareness and timely decision-making.

Industry is considering new secure networking for battlefield data that intelligently distributes information for shared situational awareness and timely decision-making.

Officials of the Air Force Research Laboratory's Information Directorate in Rome, N.Y., issued a broad agency announcement in December (FA875019S7001) for the Timely, Secure, and Mission-Responsive Aerial Warfighting Network Capabilities program to develop a mission-responsive network to translate sensory data into actionable information.

The network enables commanders to control lines of communication from the command post to the contested tactical edge, and bring together platforms, sensors, and shooters to respond to evolving military situations in today's information-dominated environment, Air Force researchers explain.

Military forces today, however, cannot rely on a data-neutral network; they

need an affordable, extensible, interoperable communications architecture that intelligently shares situational awareness, researchers say.

For now, the Air Force wants three-to-five-page white papers on experimental computer hardware and software development; ways to validate with model-based systems; and demonstrations of experimental computer hardware and antennas that might lead to such an intelligent tactical network, and help the Air Force solve some of today's aerial network connectivity problems.

Researchers particularly are interested in agile, resilient, affordable, and IP-capable battlefield networking that uses alternative positioning, navigation and timing (PNT); agile communication links and networks; and tactical network security.

Alternative PNT battlefield networking involves using existing technologies to operate effectively in areas where satellite communications (SATCOM) and Global Positioning System (GPS) satellite navigation are unavailable.

Agile communication links and networks involves developing reliable wideband connectivity for secure, low-probability-of-intercept, and anti-jam multi-mission radio for line-of-sight and beyond-line-of-site communications.

Tactical network security involves sharing voice, video, and text files at several levels of classification. Securing information is by data inspection and other techniques to prevent data spills and cyber attacks.

Air Force officials say they may spend as much on this project as $500 million through 2023: $105.5 million each year from 2019 through 2021, $100.5 million in 2022, and $83 million in 2023. Several contractors will be involved in the program, and the typical award will be for between $250,000 and $100 million.

Companies interested should email unclassified white papers no later than 18 Jan. 2019 to the Air Force's Howard Beyer at Howard.Beyer.1@us.af.mil. Send classified white papers by post or by courier to AFRL/RITE, 525 Brooks Road, Rome NY 13441-4505. Those submitting promising white papers will be asked to submit formal proposals.

For questions or concerns contact Howard Beyer by email at Howard.Beyer.1@us.af.mil, or by phone at 315-330-4718. Also contact Amber Buckley by email at amber.buckley@us.af.mil, or by phone at 315-330-3605.

More information is online at https://www.fbo.gov/spg/USAF/AFMC/AFRLRRS/FA875019S7001/listing.html.

Russian GPS jamming suspected: Norway, Finland warn pilots Russia may blind their navigation systems

In recent weeks, NATO conducted its largest military exercises in decades in the frigid waters and icy mountains of Norway. But something odd happened. The GPS signals guiding ships, aircraft, tanks, trucks and troops started to fail. Civilian airliners, cars, trucks, cargo ships and smart phones operating in and around Norway and Finland experienced similar GPS jamming disruptions. Why? Russia is the chief suspect. It was riled by the scale and location of NATO's Trident Juncture maneuvers — despite having itself conducted several massive military exercises in the Baltics recently. And Moscow is known to be avidly experimenting with ways to disrupt military forces — and the global economy — through sabotaging or destroying the now vital GPS navigation network.

Airbus uses advanced flight control in unprecedented drone swarm demonstration

Over the Baltic Sea in a test zone controlled by Germany, European aerospace and defense giant Airbus has demonstrated the ability of a drone team to interact intelligently with a manned aircraft in what it described as an unprecedented swarm achievement for Europe. Computer Business Review reports. The swarm of Do-DT25 unmanned aerial vehicles (UAVs) could provide situational awareness to a mission group commander located a safe distance away aboard the manned aircraft, company officials say — a taste of a smart, modular and connected future in which such interactions are a crucial air power force multiplier. To make this manned-unmanned teaming happen, several capabilities and enabling technologies are necessary at sufficient maturity levels Airbus officials say — "from teaming/swarming algorithms and new sensors to mission management systems for command and control assistance by the manned aircraft's crew." An important factor being tested as part of the trials was the Airbus flight management and flight control systems designed in-house for specific use in unmanned air vehicles.

Marines want robot vehicles to carry infantry packs into battle

The U.S. Marine Corps has put out a request to industry to learn whether defense firms can build an unmanned ground vehicle (UGV) designed to carry extra ammo, packs, food, and water for infantry squads. The effort follows an Army initiative to select an unmanned squad vehicle that can partner with infantrymen to lighten their loads. The intent is to define what it will take to prototype and deliver such an unmanned vehicle. Contractors will need to build and deliver up to three

Northrop Grumman to build three Global Hawk long-range surveillance UAVs for Japan

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — Unmanned aerial vehicle (UAV) experts at Northrop Grumman Corp. will build three RQ-4 Global Hawk Block 30i long-range surveillance unmanned aerial vehicles (UAVs) for the government of Japan under terms of a $489.9 million U.S. Air Force contract.

Officials of the Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, are asking the Northrop Grumman Aerospace Systems segment in San Diego to build the three Global Hawk UAVs for Japan, as well as enhanced sensor suites for each UAV, and two ground-control systems.

Global Hawk is a high-altitude, long-range UAV that provides near-real-time intelligence, surveillance and reconnaissance (ISR) over large areas. The Block 30 Global Hawk carries sophisticated imaging and electronic signals sensors on missions that can exceed 32 hours.

The Block 30M Global Hawk is configured to carry the Raytheon Enhanced Integrated Sensor Suite (EISS) and the Northrop Grumman Airborne Signals Intelligence Payloads (ASIP) for situational awareness and intelligence-gathering across huge areas of land, Northrop Grumman officials say.

The Block 30 Global Hawk with its ISR capabilities is designed to augment or replace the Air Force U-2 high-altitude manned reconnaissance aircraft.

The EISS on the Global Hawk provides reconnaissance imagery using an all-weather synthetic aperture radar/moving target indicator (SAR/MTI), a high-resolution electro-optical (EO) digital camera, and a third-generation infrared (IR) sensor, all operating through a common signal processor.

The Raytheon EISS enables Global Hawk to survey vast geographic regions with image quality that can distinguish various types of vehicles, aircraft, people, and missiles, even through bad weather, day or night.

The EISS transmits imagery and position information from altitudes as high as 60,000 feet with near real-time speed with night vision and radar detection capabilities.

The Global Hawk Block 30 is 47.6 feet long, has a wingspan of 130.9 feet, can fly as high as 60,000 feet, can carry payloads as heavy as 3,000 pounds, and can fly for as long as 32 hours on one load of fuel.

On this contract Northrop Grumman will do the work in San Diego, and should be finished by September 2022. ←

For more information contact ***Northrop Grumman Aerospace Systems*** *online at* www.northropgrumman.com, *or the* ***Air Force Life Cycle Management Center*** *at* www.wpafb.af.mil/aflcmc.

Navy sponsors experiment to demonstrate UAV technology to deliver cargo to ships at sea

BY **John Keller**

PATUXENT RIVER NAS, Md. — U.S. Navy unmanned aerial vehicle (UAV) experts are inviting industry to participate in experiments in March to demonstrate ways of using UAVs to deliver cargo to and from ships at sea.

Officials of the Naval Air Warfare Center Aircraft Division at Patuxent River Naval Air Station, Md., will sponsor a limited-objective experiment the week of 25 March 2019 Patuxent River NAS to assess the state of cargo UAV technologies.

Navy leaders want the ability to deliver cargo autonomously with UAVs between shore-to-ship, ship-to-ship, and ship-to-shore. The March experiment will demonstrate the ability to transport a 50-pound payload with a UAV.

The UAV will launch from a fixed shore base, navigate through two waypoints to a towed barge in open water making bare steerageway at 3-5 knots located at least 25 nautical miles away. The UAV must loiter for 10 minutes, then autonomously land aboard the barge.

The U.S. Navy is asking for technology demonstrations this spring of future unmanned aerial vehicles (UAVs) that can deliver cargo to and from surface ships at sea.

After that, the UAV will launch from the barge with the same 50-pound payload and return to the initial shore-based launch site, without refueling or recharging on the barge. Back on shore, participants must demonstrate refueling or recharging.

En-route, the UAV may have GPS navigation, but Navy researchers prefer navigation that does not rely on GPS satellite navigation, and that has a low probability of intercept. No cargo UAVs will be allowed that are longer than 13 feet.

The UAV must fly at speeds of at least 40 knots at altitudes no higher

prototype unmanned systems for evaluation by the rapid capabilities office, the draft statement of objectives reads. The Marine Corps effort "will evaluate systems capable of maneuvering with a foot-mobile squad (12 Marines) from the assembly area to the objective area," according to the solicitation.

Squad X uses unmanned vehicles to improve situational awareness for infantry

The first test of DARPA's Squad X Experimentation program demonstrated the ability to extend and enhance the situational awareness of infantry squads. In a weeklong test series at the U.S. Marine Corps Air Ground Combat Center at Twentynine Palms, Calif., Marine squads improved their ability to synchronize maneuvers and provide intelligence gathering. They did this by using unmanned aerial vehicles (UAVs) and unmanned ground vehicles (UGVs) to detect threats from several domains — physical, electromagnetic, and cyber — as the squads moved through field exercises. Squad X provides Army and Marine infantrymen with unmanned systems equipped with off-the-shelf technologies and sensing tools developed via DARPA's Squad X Core Technologies program. Technologies aim to increase situational awareness and lethality to engage the enemy quickly and at long ranges.

Air Force unmanned aerial vehicles and jet fighters to fire lasers by early 2020s

The U.S. Air Force one day will fire laser weapons from unmanned aerial vehicles (UAVs) and jet fighters to destroy high-value targets, conduct precision strikes, and incinerate enemy locations from the sky. The first airborne tests are expected to be in 2021, Air Force officials say. Development focuses on increasing the power, precision, and guidance of existing laser weapons, and move

than 2,000 feet. It must launch and recover with a catapult, arresting net, cable, or other mechanical equipment. The UAV must have a transponder with at least Mode-3/C capability. Successful participants may be awarded procurement contracts for more experiments.

Companies interested may apply to participate online at http://impax.tech/cargo-uas-experiment. For technical questions or concerns contact Bill Macchione by email at William.macchione@navy.mil, or by phone at 301-247-4008. ←

More information is online at https://www.fbo.gov/spg/DON/NAVAIR/N00421/NAWCAD-SN-19-008/listing.html.

Northrop Grumman to build 15 supersonic target drones for missile defense

BY **John Keller**

PATUXENT RIVER NAS, Md. — The Northrop Grumman Innovation Systems segment (formerly Orbital ATK) in Dulles, Va., are building supersonic target drones for the U.S. Navy and Army to help hone missile-defense skills and technologies.

U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $46.5 million order to Northrop Grumman in December to build 15 GQM-163A lot 13 Coyote sea-skimming target base vehicles — 14 for the U.S. Navy and one for the Army.

The Navy will use the supersonic target drones to help surface warship crews practice how to detect and defeat incoming anti-ship missiles. The Army, meanwhile, will use its Coyote to test and evaluate the Lower Tier Air and Missile Defense Sensor (LTAMDS) limited user test target system.

The target drone could help surface warship crews and land-based counter-missile battery crews learn to fight effectively against a new generation of hypersonic cruise missiles that could reach speeds of Mach 5 or faster.

GQM-163A Coyote is a non-recoverable, supersonic aerial target, capable of speeds of Mach 2 or greater and altitudes from 13 to 66 feet above the surface of the ocean. It flies faster than twice the speed of sound, and as low as 12 feet off the surface of the ocean. The target drone also can simulate high-altitude cruise missile attacks that plunge down at ships from higher than 30,000 feet.

The GQM-163A Coyote sea-skimming supersonic target drone will help surface warship crews practice how to detect and defeat incoming anti-ship missiles.

On this order Northrop Grumman Innovation Systems will do the work in Chandler, Ariz.; Camden, Ark.; Vergennes, Vt.; Lancaster, Pa.; and Hollister, Calif.; and should be finished by December 2022. ←

For more information contact ***Northrop Grumman Innovation Systems*** *online at* www.northropgrumman.com, *or* ***Naval Air Systems Command*** *at* www.navair.navy.mil.

from 10 kilowatts up to 100 kilowatts. Air Force weapons developers also are working on the guidance mechanisms to enable laser weapons to stay on-track on a particular target. Air Force leaders say they plan to begin firing laser weapons from large aircraft like C-17s and C-130s until the technology matures sufficiently to fire them from jet fighters like an F-15, F-16 or F-35. Given the state of current technology, cargo planes are better equipped in the short term to transport the requisite amount of mobile on-board power needed for airborne lasers.

Next Pentagon budget may trade new weapons development for readiness

The Fiscal Year 2020 U.S. Department of Defense (DOD) budget may slow down modernization efforts and research into next-generation weapons, like hypersonic missiles, but will still invest in growing the military force and boosting readiness for aircraft such as the F/A-18E/F Super Hornets, says Patrick Shanahan, deputy secretary of defense. Shanahan says the U.S. Office of Budget and Management told the Pentagon to prepare a $700-billion national security budget for fiscal year 2020, whereas the Defense Department had previously been given a $733-billion topline. As a result, Pentagon comptroller David Norquist is building two budgets even as the services are moving forward with a single budget request to submit to the Office of the Secretary of Defense. The more constrained $700-billion budget does not just apply the lower topline to 2020, but also to the whole five-year future years defense program. Because the topline doesn't immediate bounce back up, investment in hypersonics and other technologies "comes down to a judgment call, how fast we modernize – that's probably going to be the biggest knob we have to turn" to adjust to a lower topline, Shanahan says. ←

China developing lidar-based satellite to detect deep-diving submarines

As China develops cutting-edge deep-sea surveillance, the nation's navy is concurrently designing a satellite-mounted laser to locate and destroy enemy submarines. Space War reports. The satellite, which will be able to spot targets deeper than 1,600 feet below the surface, also would gather data on the world's oceans, the South China Morning Post (SCMP) reported. For more than half a century, weapons designers around the globe have been attempting to build a light detection and ranging (lidar) laser that would target submerged submarine forces. When a laser beam hits a submarine, some of the light-energy pulses bounce back. Those pulses are detected by sensors and analyzed by software to discern a target's location, speed and physical dimensions. In real-world applications, however, lidar technology is easily affected by a device's power limitations, as well as cloud, fog, murky water and marine life.

High-energy laser weapons, anti-drone systems, and the future of warfare

One of the defense world's newest and most promising innovations is the high-energy laser weapon system. It is the most advanced and capable concept for a tactical, ground-based defensive laser system, capable of being mounted on a variety of air, land, or sea-based platforms. Of course, lasers themselves are not a new technology. Lasers have been studied and tested for military use for decades. Recently, companies such as Lockheed-Martin, Boeing, and Raytheon have taken this existing technology, scaled it down, and adapted laser weapons for a variety of platforms with a new purpose: to shoot down weaponized

Multispectral UAV sensor payloads help Marines find hidden beach mines

BY **John Keller**

PANAMA CITY, Fla. — Electro-optics experts at Arete Associates in Northridge, Calif., are building multispectral unmanned aircraft sensor payloads to help unmanned helicopters detect and pinpoint enemy mines and obstacles in beach surf zones to help keep Marines safe during amphibious attacks.

Officials of the Naval Surface Warfare Center Panama City Division in Panama City, Fla., announced a $17.1 million order to build AN/DVS-1 Coastal Battlefield Reconnaissance and Analysis (COBRA) systems.

Carried onan unmanned helicopter, the sensor system has limited detection capability in the surf zone. COBRA will be deployed from the littoral combat ship and is an integral part of the ship's mine countermeasures mission package.

COBRA uses multispectral sensors to conduct unmanned aerial tactical reconnaissance to detect and localize mine fields and obstacles in the surf zone and beach zone prior to amphibious assault.

A multispectral image contains data within specific wavelength ranges to extract information the human eye fails to capture with its receptors for red, green and blue. It measures light in 3 to 15 spectral bands to help detect otherwise-invisible mines.

The AN/DVS-1 COBRA passive multispectral sensor system is for unmanned helicopters to perform daytime surface-laid mine line and obstacle detection in the beach zone, and has offboard processing, Arete experts say.

The COBRA payload includes stabilized step stare digital gimbal,

Arete Associates in Northridge, Calif., is building multispectral unmanned aircraft sensor payloads to help unmanned helicopters detect enemy mines and obstacles.

high-resolution multispectral imaging digital camera with spinning six-color filter wheel, and a processing unit.

The gimbal is about 19 inches long and 11 inches in diameter, and collects six different color-band images across a large area using a step-stare pattern. At the mission, personnel load its data storage unit into a post mission analysis station.

COBRA began as a U.S. Marine Corps advanced technology program in the 1990s. The system uses incremental development, with three initial blocks of development planned with each introducing new or enhanced capabilities. On this order Arete Associates will do the work in Tucson, Ariz.; Destin, Fla.; and Santa Rosa, Calif., and should be finished by July 2021. ←

For more information contact ***Arete Associates*** *online at* http://arete.com, *or the* ***Naval Surface Warfare Center Panama City Division*** *at* www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Panama-City.

Researchers seek thermal management for smart phones under heavy sensor processing loads

BY **John Keller**

WASHINGTON — U.S. Intelligence researchers are asking industry to find new ways of cooling smart phones and other small mobile devices to prevent damage to them from heat generated by heavy use, as well as from the solar heat in parked vehicles.

Researchers are trying to find ways of operating cell phones at safe temperatures under heavy processing loads inside closed cars.

Officials of the U.S. Intelligence Advanced Research Projects Agency (IARPA) in Washington issued a request for information on Friday (IARPA-BAA-19-02) for the Portable Electronic Cooling (PEC) project to shield mobile devices from heat when they function as sensors and sensor networks.

The sensor processing power and number of sensors available on smart phones is increasing exponentially, such that modern smart phones can function as microphones, cameras, proximity sensors, ambient light sensors, motion sensors, gyroscopes, among others, IARPA officials explain.

Additionally, the intrinsic connectivity, processing power, and proliferation of specialized apps and smart phone-compatible software enables the smart phone to function to act as a component of distributed and mobile sensing networks.

Yet using smart phones for data processing, data streaming, and positioning can place a significant thermal management burden on the smart phone's electronics — especially when the phone operates in challenging ambient conditions like a vehicle parked in the sun, where temperatures can climb quickly to between 114 and 170 degrees Fahrenheit.

The internal temperature of a smart phone under steady use, moreover, can be significantly hotter than the ambient temperature.

To help solve this problem, IARPA officials are asking industry to develop approaches to cool mobile devices like smart phones to mitigate the internal heat load from the device's electronics, and shield the device from ambient temperatures as hot as 170 F. At that temperature, the battery may rupture, catch fire, or even explode, leading to destruction of the phone and even the vehicle itself.

If proposed cooling solutions require power, the power cannot tap the phone's battery. IARPA researchers are encouraging cooling solutions that do not use power, and must be small enough for a G5 Plus or Samsung Galaxy S8+ smart phone while running an application over the cellular network for eight hours without causing the phone to overheat or shut down.

Companies interested were asked to email .PDF responses by 14 Jan. 2019 to dni-iarpa-rfi-19-02@iarpa.gov. Email questions or concerns to IARPA's Kristin DeWitt at the same address. ←

More information is online at https://www.fbo.gov/notices/7da7a2aab349b91345205f39bac55b89.

drones and small munitions. This new mission set for the tactical laser offers the military a drone-killing weapon system that could keep the U.S. ahead of the power curve on the modern battlefield, especially in the fight against non-state actors and armies increasingly using drones for combat operations. Such new anti-drone weaponry would ensure U.S. and coalition troops engaged in irregular warfare can maintain tactical air supremacy. America's adversaries are developing new techniques like swarming and obtaining cheaper technology like commercially available drones to overcome, or at least deny, the preponderant American overmatch in the burgeoning field of unmanned vehicles in all domains.

Electro-optical PIN diodes for high-speed communications introduced by Marktech Optoelectronics

Marktech Optoelectronics Inc. in Latham, N.Y., is introducing the MTPD1346D-xx family of indium gallium arsenide (InGaAs) and indium phosphide (InP) broadband PIN photodiodes for applications in aerospace, automation, autonomous vehicles, high-speed communications, LIDAR, and wearable electronics. The InGaAs/InP PIN photodiodes are designed to convert broadband light into photocurrents within the visible-light and shortwave-infrared spectra. They offer low noise, high sensitivity, high-speed response, and feature wide spectral ranges of 0.6 to 1.7 microns, low dark current, and high efficiency. These electro-optical devices come in active area sizes from 0.1 to 3.0 millimeters. Each is packaged within a hermetically sealed 3-pin TO-46 metal can with flat lens cap, and with choice of either thru-hole or surface mounting. For more information contact **Marktech Optoelectronics** online at www.marktechopto.com. ←

PRODUCT applications

AVIONICS

Navy orders identification friend-or-foe (IFF) avionics from Telephonics for P-8A Poseidon

U.S. Navy U.S. Navy aircraft avionics experts are turning to Telephonics Corp. in Farmingdale, N.Y., to provide as many as 50 identification friend-or-foe (IFF) avionics systems for the P-8A Poseidon maritime patrol jet.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.Y., have announced a $15.1 million contract to Telephonics for a maximum of 50 AN/UPX-43(V)1 Identification Friend or Foe Interrogators (IFFI), 50 IFFI mounting trays, and repairs in support of P-8A Poseidon production lots 9, 10, and 11 for the Navy and U.S. allies.

The AN/UPX-43 is a Mark XIIA monopulse and AIMS-certified IFF interrogator for command and control. The avionics subsystem enables air traffic controllers and air defenders to identify military and civilian aircraft, verify forces as friendly, and determine their bearing and range.

The AN/UPX-43 also provides multi-channel automatic dependent surveillance-broadcast (ADS-B). It complies with U.S. and international specifications that define interrogator modes, performance, control, reporting and interface.

Telephonics engineers can upgrade the AN/UPX-43 relatively easily because the system uses common-module hardware and software for the detection, interrogation, identification, tracking and data extraction of small targets in severe environments, company officials say.

Telephonics is the sole designer, developer, and manufacturer of the AN/UPX-43(V)1 shipset for use in the P-8A Poseidon military aircraft — a modified Boeing 737 narrow-body passenger jet optimized for maritime patrol, surveillance, and anti-submarine warfare.

Navy officials are awarding the contract to Telephonics sole-source because the company is the only known source with the knowledge of the design, technical data, fabrication, performance, and operational characteristics of the AN/UPX-43(V)1 shipset compatible with the P-8A antenna, airframe infrastructure, and aircraft interfaces, Navy officials say.

On this contract Telephonics will do the work will be performed in Farmingdale, N.Y., and should be finished by November 2021. For more information contact **Telephonics** online at *www.telephonics.com*, or the **Naval Air Warfare Center Aircraft Division Lakehurst** at *www.navair.navy.mil/nawcad/lakehurst.* ←

SHIPBOARD NAVIGATION

Northrop Grumman Sperry Marine to provide shipboard bridge navigation for Burke-class destroyers

U.S. Navy shipboard electronics experts needed bridge navigation systems for new-build Arleigh Burke-class (DDG 51) guided missile destroyers, as well as for upgrades on existing Burke-class destroyers. They found their solution from the Northrop Grumman Sperry Marine B.V. in Charlottesville, Va.

Officials of the Naval Sea Systems Command in Washington announced an $18.2 million contract to Northrop Grumman Sperry Marine on Wednesday to provide common integrated bridge and navigation systems (IBNS) for Burke-class destroyers.

These integrated bridge and navigation systems are part of the DDG-51 destroyers New Construction Ship program and DDG-51 Midlife Modernization program, Navy officials say.

The IBNS is a hull, mechanical, and electrical upgrade to modernize Burke-class destroyers to ensure the ships remain combat relevant and affordable throughout their life cycles, Navy officials say, adding that this contract will serve as the base hardware production contract for IBNS systems.

Sperry Marine military integrated bridge systems handle automated collection, processing, control, and display of ship control and navigation sensor data to help make the most of bridge watch efficiency and ship control safety.

These systems blend voyage planning and real-time bridge navigation tracking; track steering ship control; radar contact track and video overlay; interfaces to the machinery control systems; moving haven and water space

management; position uncertainty fix expansion; lines of position navigation fix capability; commanding officer password protect of approved voyage plans; electronic bearing lines and variable range; chart markup; operator text overlay; operating areas; over-the-horizon areas of uncertainty; joint tactical action areas; and submarine-generated search areas.

Integrated bridge system components include the Voyage Management System (VMS), a computer based navigation, planning, and monitoring system. It meets U.S. Navy's Electronic Chart Display and Information System–Navy (ECDIS-N) requirements, and provides tools for the ship's crew to navigate electronically.

Also part of the IBS is the Automated Radar Plotting Aid (ARPA) system that automatically acquires and tracks contacts for the ship's bridge watch team.

The IBS also has the Ship Control System (SCS) that provides command and control signals to the ship control and propulsion systems and monitors their performance.

Sperry Marine military integrated bridge systems are fielded aboard U.S. Navy aircraft carriers, cruisers, destroyers, amphibious assault ships, submarines, and landing craft, as well as aboard NOAA ships, Coast Guard ice breakers, and international naval vessels.

On this contract Northrop Grumman Sperry Marine will do the work in Charlottesville, Va., and should be finished by February 2020. For more information contact **Northrop Grumman Sperry Marine** online at *www.sperrymarine.com*, or **Naval Sea Systems Command** at *www.navsea.navy.mil*.

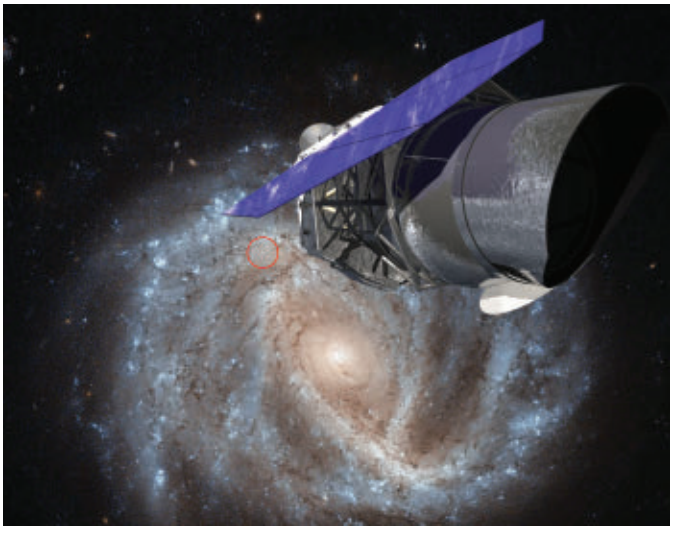
ELECTRO-OPTICS

NASA scientists choose Harris Precision Optics to build WFIRST space optical imaging telescope

U.S. space scientists needed a precision optical instrument to be the core imager of the nation's next-generation orbiting deep-space observation system. They found their solution from the Harris Corp. Precision Optics segment in Rochester, N.Y.

Officials of the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center in Greenbelt, Md., in December announced a $195.9 million eight-year contract to Harris Precision Optics to design and build the optical telescope assembly (OTA) for the future Wide Field Infrared Survey Telescope (WFIRST).

The future WFIRST orbiting space-observation instrument will have nearly 300 times as many pixels as the infrared camera of the Hubble Space Telescope, and will be able to take images with 100 times the field of view of Hubble. Also



working on this contract is the Harris Space and Intelligence Systems segment in Palm Bay, Fla.

This large field of view will enable WFIRST to survey large areas of the sky to measure the effects of dark matter and dark energy on the distribution of galaxies in the universe.

The Harris Precision Optics optical telescope assembly for the WFIRST spacecraft will include the inherited primary and secondary mirrors with precision metering structures that are to be integrated to new mirror assemblies to provide optical feeds to the WFIRST instruments.

Harris will provide the personnel, services, materials, equipment, and facilities to build, refurbish, or modify the WFIRST optical telescope, as well as fabricate align, test, verify, and deliver the telescope to NASA Goddard Space Flight Center.

Harris also will handle post-delivery support for the observatory integration and test program, as well as for on-orbit observatory checkout and commissioning.

WFIRST will be a NASA observatory to perform wide-field imaging and surveys of the near infrared sky. WFIRST will be six-year mission, and is scheduled for launch in 2025 to orbit at the Sun-Earth L2 point.

WFIRST to study the newly discovered phenomenon of dark energy, measuring the history of cosmic acceleration, completing the exoplanet census begun by NASA's Kepler Space Telescope and demonstrating technology for direct imaging and characterization of exoplanets.

The U.S. National Research Council has rated WFIRST as one of NASA's top-priority large-scale missions. Last May WFIRST entered its preliminary design phase to begin major procurements for flight hardware.

In addition to the optical telescope assembly, the WFIRST space observatory will have a wide-field instrument with two channels: a combination of wide-field imaging and spectrographic channels called the wide field channel; and a narrow-field spectrographic channel — the integral field channel.

The two channels, with their optics and science data electronics are to be in an on-orbit replaceable cold-sensing module beneath the WFIRST optical telescope assembly.

On this contract Harris Optical Systems and Space and Intelligence Systems will do the work in Rochester, N.Y., Palm Bay, Fla., and at Goddard Space Flight Center, Md., and should be finished by December 2025. For more information contact **Harris Precision Optics** online at *www.harris.com/solution/precision-optics*, **Harris Space and Intelligence Systems** at *www.harris.com/sis*, or **NASA Goddard Space Flight Center** at *www.nasa.gov/goddard.* ←

To submit new products for consideration, contact John Keller at jkeller@pennwell.com.

CONNECTORS

High-frequency nanominiature contact for rugged VPX uses introduced by TE Connectivity

TE Connectivity in Harrisburg, Pa., is introducing the NanoRF modules and contacts, which double the density of today's VITA 67 RF modules for VPX embedded computing applications. This high-frequency nanominiature coax contact is engineered with small contacts and a high RF contact density within a multi-position module. This design enables relatively small packaging and saves valuable space. Half-size modules can support as many as 12 RF contacts and full-size modules can support 18 or more contacts, with the option to customize contact count and position. TE's NanoRF modules offer blind-mateable, float-mounted backplane contacts that support module-to-module or box-to-box architectures. The nanominiature contact is designed for 0.047-inch coax cable, yet several cable types are available. To bring high-frequency capability into a high-density modular package, the contacts are optimized for signal integrity and support frequencies as high as 70 GHz. For more information contact **TE Connectivity** online at *www.te.com*.

DATA ACQUISITION

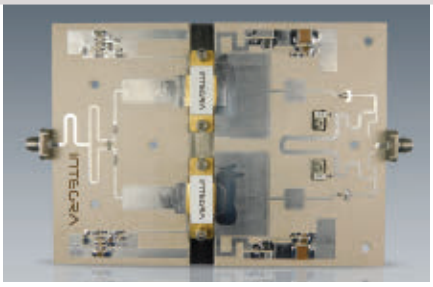
Curtiss-Wright offers data acquisition power monitor for military aviation

The Aerospace Instrumentation business unit of the Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the AXN/ADC/408 three-phase data acquisition unit (DAU) power monitor module for commercial and military aviation. As aircraft design shifts from constant to variable-frequency electrical power requirements, flight test instrumentation engineers increasingly need power monitoring able to collect data from generators that output power at up to 1 kHz. What's more, variable frequency data acquisition must be able to capture unexpected fluctuations in power frequency. Data transfers over the AXN/ADC/408 backplane at rates as fast as 800 megabits per second. The rugged AXN/ADC/408 is designed to monitor transients while supporting ISO 12384 data capture rates. The module detects the presence of power transients based on preset voltage, current, and frequency threshold parameters. For more information contact *www.curtisswrightds.com*.

POWER AMPLIFIERS

GaN-on-SiC power amplifier for L-band Mode S avionics introduced by Integra

Integra Technologies Inc. in El Segundo, Calif., is introducing the IGNP1011L2400 RF and microwave power amplifier module/pallet for size, weight, power, and cost challenges (SWaP-C) in high-performance L-band avionics systems. The IGNP1011L2400 is a high-power gallium nitride (GaN)-on-silicon carbide (SiC) that is for identification-friend-or-foe (IFF) and secondary surveillance radar (SSR) avionics systems operating under either Mode S extended-length messages (ELM) or standard Mode S pulse conditions. The power amplifier supplies a minimum



of 2200 Watts of peak output power, with typically less than 16 dB of gain and 57 percent efficiency and operates from a 50-volt supply voltage. This RF power amplifier module/pallet is matched to 50-ohms at input and output and is suitable for 1030 and 1090 MHz. For more information contact **Integra Technologies** online at *www.integratech.com*.

POWER ELECTRONICS

Rugged DC-DC converters for aerospace and defense introduced by Crane

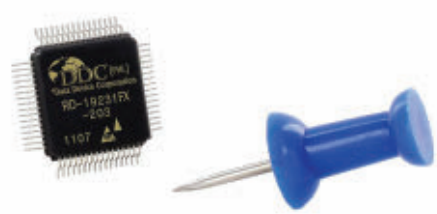
Crane Aerospace & Electronics in Redmond, Wash., is introducing the GFM series of isolated DC-DC converters for a variety of rugged defense and aerospace applications. The GFM series provides 30 Watts of power with a 15-volt output and as much as 90 percent typical efficiency. The converters have an input voltage range of 8 to 50 volts and 80-volt transient protection. The devices also operate under harsh conditions, have a compact footprint, and operate over a temperature range of -55 to 105 degrees Celsius. The hermetically sealed, nickel

plated, steel cases for these power electronics devices are 2.84 by 1.110 by 0.400 inches for the flanged case. Additional outputs will be offered. Assembled in the company's MIL-PRF-38534 facilities, the rugged GFM series delivers conversion performance with operational analysis, design stability, and engineering support. For more information contact **Crane Aerospace & Electronics** online at *www.interpoint.com*.

MOTION CONTROL

Resolver-to-digital converters for position feedback introduced by DDC

Data Device Corp. (DDC) in Bohemia, N.Y., is introducing the RD-19231 series of 16-bit resolver-to-digital (R/D) converters for high-performance aerospace, industrial,

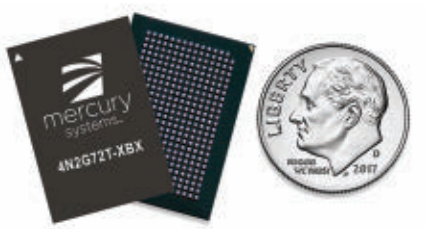


and commercial positioning systems. The motion-control device is for applications like servo motor controls, antenna positioning, aircraft position feedback systems, machine tool and robotic positioning controls, and manufacturing process control systems. These R/D converters offer 3.3- or 5-volt compatibility and are contained in a small 64-pin plastic quad flat pack that measures 10 by 10 millimeters. It is a drop-in replacement to all RD-19230 legacy designs, and replacement requires no modification of the circuit board. This single SOI CMOS monolithic motion control chip merges precision analog circuitry with digital logic, and offers accuracy to 1 arc minute. The RD-19231 offers user programmable encoder emulation, resolution, bandwidth, tracking rate, and velocity scaling. The RD-19231 series operates in temperatures ranging from -40 to 85 degrees Celsius, and is available in lead and RoHS lead-free versions. For more information contact **DDC** online at *www.ddc-web.com*.

SECURE MEMORY

Rugged secure SDRAM for unmanned systems and artificial intelligence (AI) introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing the BuiltSECURE 16-gigabyte high-density double-data-rate fourth-generation synchronous dynamic random-access memory (DDR4 SDRAM) for space-constrained military unmanned systems and real-time artificial intelligence (AI). The product, packaged in a rugged compact ball grid array



ADVERTISERS INDEX

Military & Aerospace Electronics

SUBSCRIPTION INQUIRIES
Phone: 1-800-869-6882 / International Callers: +1 512-982-4277
E-mail: MAEM@kmpsgroup.com
Web: www.mae-subscribe.com

(BGA), doubles the number of the devices embedded in one package without compromising performance or reliability. It also provides a low-risk way to commercialize fifth-generation (DDR5) memory devices with 5-gigabyte-per-second data transfer speeds. The packaging technology commercialized in the 16-gigabyte BuiltSECURE DDR4 SDRAM reduces crosstalk, returns loss, and doubles the number of devices embedded in one package. For more information contact **Mercury Systems** online at *www.mrcy.com*.

TEST AND MEASUREMENT

Multimode telemetry transmitter for military test and measurement introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the TTS-9800-2 programmable tri-band multimode transmitter for aerospace and defense test and measurement instrumentation applications like flight test, remotely piloted vehicle communications, and launch vehicle telemetry.

The TTS-9800-2 delivers high RF power efficiency, and its user-programmable multimode transmitters speed and simplify RF band selection in the field for flight test applications. The TTS-9800-2 supports transmission in L-band, S-band, and lower and middle C-band, and is designed to operate in the harsh environmental rugged conditions of aerospace test applications. The transmitter also provides modulation, forward error correction, and space-time coding compatibility to the IRIG-106-17 telemetry standard. For more information contact **Curtiss-Wright Defense Solutions** online at *www.curtisswrightds.com*.

CONNECTORS

Power connectors to deliver high current density for mass-storage introduced by TE Connectivity

TE Connectivity in Harrisburg, Pa., is introducing the high density plus (HD+) card edge power connectors to deliver high current density to card edge power connectors in server, switch, and mass-storage system applications. Capable of

supporting power supplies as strong as 3 kilowatts, these connectors are designed to deliver current density at 15 amps per 2.54 millimeters, and support 2000-to-3000-Watt power supplies for data center equipment. The connectors have a 1.27-millimeter signal contact pitch and a 5.08-millimeter power contact pitch with a working voltage of 60 volts DC. TE's HD+ card edge power connectors offer low contact resistance due to a unique dual-layer design of DC power contacts and pass-through pins, which provide multiple mating and contact points to the circuit board. For more information contact **TE Connectivity** online at *www.te.com*.

DATA RECORDERS

Rugged RF signal data recorder for UAVs, aircraft pods, and military vehicles introduced by Pentek

Pentek Inc. in Upper Saddle River, N.J., is introducing the Talon RTX 25xx series high-performance small form factor (SFF) data recorder for unmanned aerial vehicles (UAVs), aircraft pods, tight equipment bays, military vehicles, and most outdoor environments. Optimized for small size, weight, and power consumption (SWaP), the rugged sealed half-ATR recorders are available with several input options and as much as 30.7 terabytes of removable solid-state drive storage. These SFF recorders provide real-time streaming data rates as fast as 4 gigabytes per second for multi-channel, wide bandwidth RF signal recording. The model

RTX 2590 provides eight phase-coherent 250 MHz 16-bit A/D channels for recording RF/IF signal bandwidth at speeds to 100 MHz per channel with dynamic range. It can sample RF/IF signals at speeds to 700 MHz and provides digital downconverters with output bandwidths selectable from 5 kHz to 100 MHz. For more information contact **Pentek** online at *www.pentek.com*.

I/O BOARDS

Rugged embedded computing I/O board for military applications introduced by North Atlantic

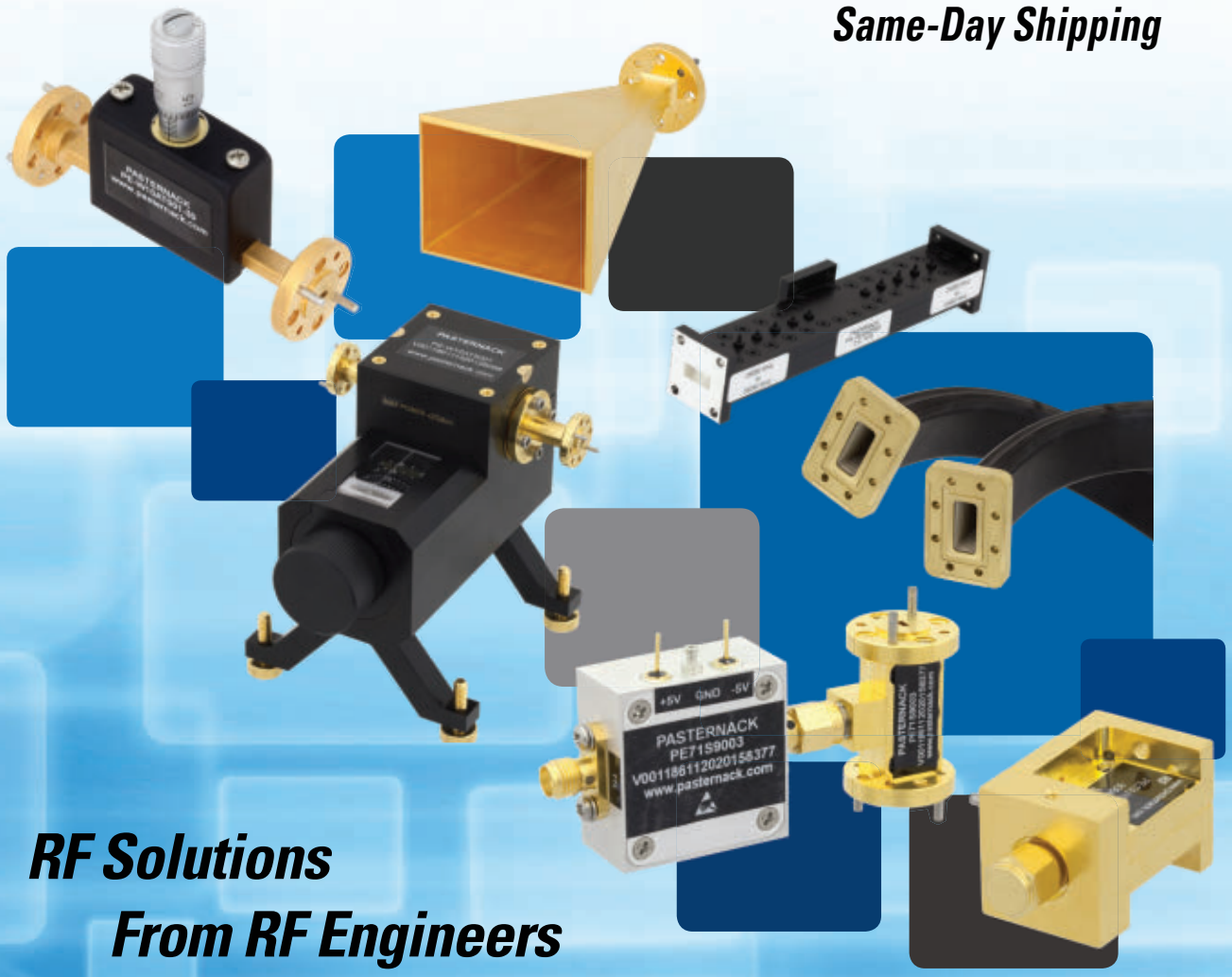
North Atlantic Industries Inc. (NAI) in Bohemia, N.Y., is introducing the 68G5 3U OpenVPX multifunction I/O board for rugged defense, industrial, and commercial applications. The 68G5 employs NAI's Configurable Open Systems Architecture (COSA) to enable designers to combine pre-existing, tested functions in many ways. Each I/O function has dedicated processing to unburden

the system single-board computer from unnecessary data management overhead. The I/O board has three embedded computing function module slots that designers can populate with more than 40 types of NAI's intelligent I/O, communications, measurement, and simulation modules to provide high packaging density and flexibility. The 68G5 provides cost benefits and delivers a COTS solution meeting a standard SOSA platform profile that accelerates deployment of SWaP-optimized air, land, and sea systems. For more information contact **North Atlantic Industries** online at *www.naii.com*.

Largest In-Stock Selection of

Waveguide Components

All Available for Same-Day Shipping



RF Solutions From RF Engineers

Pasternack's RF Engineering team has assembled the largest selection of in-stock and ready to ship waveguide components covering RF, microwave and millimeter-wave bands up to 110 GHz. With 20 different waveguide categories and over 500 designs including adapters, power amplifiers, detectors, bandpass filters, PIN diode switches, attenuators, horn antennas and more, Pasternack has the waveguide components you are looking for. Whether it's waveguide products or any of the other 40,000 in-stock components we carry, our Application Engineers stand ready to deliver solutions for all your RF project needs.

866.727.8376
visit pasternack.com today!

PASTERNACK®
THE ENGINEER'S RF SOURCE

We didn't break the mold.
We shattered it.

RFSoC | Unparalleled Performance | Unbelievably Fast Integration

The combination of Pentek's new Quartz™ architecture, and the processing power packed into the new Zynq® UltraScale+™ RFSoC FPGA, smashes the boundaries of high-performance embedded computing.

Pre-loaded with a host of IP modules, this OpenVPX board is ready for out-of-the-box integration into high-performance systems. Optical streaming interfaces, a unique modular design and the Navigator™ development platform means fast, high-speed deployment.

- **Powerful Zynq Ultrascale+ FPGA** with built-in wideband A/Ds, D/As & ARM processors
- **Dual Optical 100 GigE** interfaces for extreme system connectivity
- **Robust Factory-installed IP** for DRFM,radar range gate engine, waveform and chirp generation, real-time data acquisition and more
- **QuartzXM™ eXpress Module** speeds migration to other form factors
- **Board Resources** include PCIe Gen.3 x8 and 18 GB DDR4 SDRAM
- **Navigator Design Suite** BSP and FPGA design kit for seamless integration with Xilinx Vivado®

All this plus FREE lifetime applications support!

Model 5950
Eight-Channel A/D
& D/A RFSoC in
3U VPX Conduction
Cooled

QUARTZ

NAVIGATOR
Design Suite

Unleash the Power of the RFSoC.
Download the FREE White Paper!
https:/www.pentek.com/go/marfsoc

PENTEK
Setting the Standard for Digital Signal Processing

Pentek, Inc., One Park Way, Upper Saddle River, NJ 07458
Phone: 201-818-5900 • Fax: 201-818-5904 • email: info@pentek.com • www.pentek.com

30 YEARS