JUNE 2021

Military & Aerospace Electronics

RELEVANT. TRUSTED.
ENABLING TECHNOLOGIES.

Electronic warfare

Navy eyes next-generation electronic warfare for surface warships. PAGE 4

Electronics in space

The evolving world of radiation-hardened electronics for space. PAGE 18

militaryaerospace.com

3D PRINTING AND ADDITIVE MANUFACTURING

Military pursues applications that range from quick prototyping to spare parts logistics support. PAGE 10

ENDEAVOR BUSINESS MEDIA

Breakthrough Performance...

Weight No More!

Wideband RF Signal Recorders | Rugged ½ ATR | Built for SWaP

Designed for harsh environments and weighing only 18 pounds, the new Talon RTX SFF series captures real-time RF bandwidths of a gigahertz or more. Complete with a removable QuickPac™ drive pack holding terabytes of data, these units offer flexible I/O options and sustained real-time recording rates up to 4 GB/sec!

The RTX SFF series is the latest in our COTS Talon recording systems that deliver the industry's highest levels of performance in the harshest, space-constrained environments. You'll get high dynamic range, exceptional recording speeds and ample storage capacity for extended missions—all in this compact solution.

- **Sealed, rugged, ½ ATR chassis** for MIL-STD 810 and 461
- **Multi-channel recording,** A/Ds from 200 MS/s to 6.4 GS/s
- **Easily removable 61 TB SSD QuickPac** drive pack
- **Ideal for UAVs, military vehicles, aircraft pods** and more
- **Operating temperature** from -40°C to +60°C
- **sFPDP and Ethernet** models available

All this plus FREE lifetime applications support!

Model RTX 2589 with removable QuickPac drive

Download the FREE Development Tactics & Techniques for SFF Recorders White Paper

www.pentek.com/go/masff

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

JUNE 2021
VOL. 32, NO. 6

Military & Aerospace Electronics

COVER STORY

FOLLOW US

FACEBOOK.com /MilitaryAerospaceElectronics
TWITTER @MilAero
LINKEDIN.com /showcase/military-&-aerospace-electronics

Military & Aerospace Electronics® (ISSN 1046-9079, print; 2688-366X, digital / USPS 005-901) is published 12 times a year by Endeavor Business Media, LLC, 1233 Janesville Avenue, Fort Atkinson WI 53538. Periodicals postage paid at Fort Atkinson, WI 53538 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 3257, Northbrook, IL 60065-3257. Military & Aerospace Electronics is a registered trademark. Printed in the USA. GST No. 126813153. Publications Mail Agreement no. 875376.

BY **JOHN KELLER**, EDITOR IN CHIEF

Are climbing robots the answer to helping infantry communicate in the jungle?

For infantry, fighting in the jungle never has been easy. It's hot, wet, buggy, hard to navigate, and full of potentially fatal microorganisms. Something else that can make jungle fighting a nightmare is communications — or the lack of it.

Jungles are tropical rain forests; that's what makes jungle foliage so thick. It can rain in these regions every day, and sometimes days on end without end. It's just this combination — persistent dripping-wet foliate — that makes radio communications in the jungle such a problem. All those countless droplets of water coating everything attenuates radio signals to a surprising extent.

These conditions can make it nearly impossible for members of small military units to communicate with one another while operating in the jungle, much less for these small military forces to communicate with their commanders behind the lines.

So what to do? Today's infantry warfighters have to do more than just talk to one another on the radio. They must relay video, still images, text, positioning information, and their health status to keep each other safe, and to let command authorities know what's happening.

Are satellite communications an answer? Maybe, but not always. It's tough to get a clear radio signal through the dense wet foliage of a triple-canopy rainforest. Sometimes the only thing that comes back is static, or worse ... silence.

U.S. military researchers have come up with an idea, and they're reaching out to industry for enabling technologies to flesh-out their vision. It's called the SQUad Intelligent Robotic Radio Enhancing Links (SQUIRREL) project of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

This project envisions equipping a team of one-pound flying and climbing robots with radio communications relays. These robots would work together to follow small military units throughout the jungle, keeping unit members in touch with one another, and relaying command information via one of these relays located high in the trees to command authorities via satellite links, or by communicating with orbiting unmanned aerial vehicles (UAVs).

These robots would have to be tough enough to resist the effects of water and mud, slippery tree branches, drops and falls, jungle predators, and rough treatment from the infantrymen who tote them into the rainforest with them.

These robots essentially would create a continuously operating ad-hoc 3D mesh network to extend the range of wireless mobile communication in triple-canopy tropical rainforest. This network would keep small teams of four to six warfighters connected while in the field.

Researchers envision this kind of robot-based ad-hoc mesh network for missions like hostage rescue, scouting, and training allies. From industry, DARPA experts want robot-assisted 3D mesh communications networks that are easy to deploy; function on long missions; offer low noise; are low observable; and offer low probability of detection or intercept.

SQUIRREL also could be useful in public service roles such as search and rescue in densely wooded areas in temperate zones — particularly in its reachback role. SQUIRREL also could provide commercial communications nodes in dense forests for drug formulation and counting endangered species.

The SQUIRREL mesh must adapt continuously to new settings as it follows and supports the team. To avoid using RF power levels high enough to escape the jungle canopy, SQUIRREL nodes should use low-power RF and free-space optical communications as they move.

Some of these robots must include capabilities for locating, self-positioning, and free-space optical means to reach orbiting unmanned aerial vehicles (UAVs) or other overhead assets for reachback communications. Companies interested in trying their hands at such a project were asked to send proposals to DARPA by late this month.

5G Solutions

RF Components for the Next Generation

Whether you're building the future of enhanced mobile broadband or designing applications for IoT and mission-critical communications, Pasternack offers the most extensive portfolio of in-stock and ready-to-ship 5G RF components and cable assemblies. Pasternack is ready to support 5G innovation, testing, and deployments, through an expansive product offering, product support, and a commitment to same-day shipping.

Pastnernack offers thousands of active, passive, interconnect, and antenna products for global sub-6 GHz and mmWave frequency bands as well as technical service and application engineers are standing by to answer.

In-Stock and Shipped Same-Day

USA & Canada +1 (866) 727-8376
International +1 (949) 261-1920
pasternack.com

PASTERNACK®
an INFINITE brand

Scientists at the U.S. Naval Research Laboratory are asking industry for enabling technologies for next-generation surface warship electronic warfare (EW) systems.

Navy asks industry for next-generation electronic warfare for surface warships

BY **John Keller**

WASHINGTON — U.S. Navy researchers are surveying industry to find companies able to develop embarkable electronic warfare (EW) systems within the next five years to augment today's Navy capabilities in EW system performance, reliability, and maintainability.

Officials of the Naval Research Laboratory (NRL) in Washington have issued a special notice (N00173-21-R-DH02) for the Surface Electronic Warfare Embarkable Prototype System (EPS) Development project.

Researchers in the Surface Electronic Warfare Branch of the NRL Tactical Electronic Warfare Division needs to design, develop, and demonstrate the effectiveness of embarkable prototype systems that function complete ship set—embarkable units and cables.

System prototypes will be part of developing a next-generation Navy EW system. Researchers also would like to fabricate additional legacy systems to ensure carrier support group continuity of coverage.

Researchers are looking for companies able to support requirements development; system modeling and simulation; component design and software development; prototype assembly; a component and prototype laboratory; and field testing within the first two years of contract award.

Companies also should be able to design and test RF components; develop software; provide configuration management; and provide field testing within four years of contract development. In five years of contract award the project will focus on building, testing, and installing components and line-replaceable units aboard Navy platforms.

Ultimately, Navy researchers want to deliver eight next-generation embarkable prototype systems for two different classes of surface warships. In addition, researchers want an additional seven embarkable EW prototypes for forward-deployed naval forces.

Companies that wish to participate were asked to email their expertise and intentions of interest by 14 May 2021 to the NRL's Deirdre Hughes at deirdre.hughes@nrl.navy.mil or Kristopher Ramsey at kristopher.ramsey@nrl.navy.mil. More information is online at https://beta.sam.gov/opp/eeef347d90b44f4cb-27888dccfd3dfe0/view.

Four power companies to develop and build wearable battery for the battlefield

BY **John Keller**

ABERDEEN PROVING GROUND, Md. — U.S. Army power electronics experts are asking four defense contractors to develop a wearable battery to enable infantry warfighters to fight while powering a variety of wearable computers, sensors, and communications devices.

Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., have announced that four battery companies will compete for orders potentially worth nearly $1.3 billion over the next nine years to build the Conformal Wearable Battery (CWB).

Companies chosen to develop and build the CWB are:

- Bren-Tronics Inc. in Commack, N.Y.;
- Inventus Power LLC in Woodridge, Ill.;
- Navitas Advanced Solutions Group LLC in Ann Arbor, Mich.; and
- Ultralife Corp. in Newark, N.Y.

The CWB will be a rechargeable lithium-ion battery that integrates into a soldier's body armor. The thin, lightweight, and flexible battery will conform to the warfighter's body and be worn in either the side, chest, or back pouches with ballistic protective plates.

Army officials have tested preliminary CWB designs to ensure the battery does not catch fire if hit by enemy bullets or shrapnel.

The CWB is to be a centralized energy source that can power smart phones and computers, the Integrated Visual Augmentation System (IVAS), and the Next Generation Squad Weapon (NGSW), while also providing recharging capability to the batteries in these devices.

The Conformal Wearable Battery will be able to increase infantry mission time without stopping for battery resupply; and eliminate the need to swap-out the batteries in each device.

The idea is for the battery to be virtually invisible and transparent to the soldier. The Army Contracting Command awarded these contracts on behalf of the Power Division of the Army Communications-Electronics Research, Development and Engineering Center's Command, Power and Integration Directorate at Aberdeen Proving Ground to meet the demands of an increased infantry power burden.

The Conformal Wearable Battery (CWB) will fit beside an infantryman's body armor, and will be able to power and recharge several different electronic devices.

The CWB is to reduce significantly the battery types and quantities the soldier has to carry, and will reduce the carried battery weight attributed to the size, weight, and power (SWaP) necessary to support a mission. The CWB is part of the Tactical Power Generation Program.

The CWB will have a state of charge indicator; generate power continuously for as long as 24 hours; enable infantry operations in remote areas; reduce the need for infantrymen to carry many spare batteries; reduce weight; and increase infantry mobility.

The 150-Watt-hour battery will hold from 10 to 16.8 volts, with nominal voltage of 14. 8 volts; weigh 2.6 pounds; measure 8.7 by 7.66 by 0.7 inches; resist the effects of bullet penetration; and operate in temperatures from -2 to 60 degrees Celsius.

On these contracts Bren-Tronics, Inventus Power, Navitas Advanced Solutions, and Ultralife will compete for each order, and will do the work at sites to be determined with each order, and should be finished by May 2030.

For more information contact the Army Communications-Electronics Command online at https://cecom.army.mil, or the Army Contracting Command at Aberdeen Proving Ground at https://acc.army.mil/contractingcenters/acc-apg/.

Wanted: secure networking software to connect sensors to shooters

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry for fast self-healing web-like networking that connect sensors and weapons on land, on and under the sea, in the air, in space, and in cyberspace.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001121S0028) for the Mission-Integrated Network Control (MINC) project.

MINC seeks to build and demonstrate software that creates a secure network overlay with control mechanisms that enable distributed management of agile, self-healing networks of networks to support multi-domain kill webs in contested dynamic environments.

The program is a vital part of mosaic warfare, which seeks to assemble individual warfighting platforms like the ceramic tiles in mosaics to make a larger intelligence picture and a larger force package. The idea will be to send so many weapons and sensors at the enemy that its forces are overwhelmed.

The MINC program seeks to ensure that critical data finds a path to the right user at the right time in contested environments using secure control of any available communications or networking resources, DARPA officials say.

This capability of connecting sensors to shooters replaces the manual, static configuration of individual, tactical networks and limited internetworking capabilities.

MINC will culminate in this paradigm shift from static manual configuration of closed rigid architectures by moving towards autonomous approaches where applications and networks adapt to changing military conditions.

The MINC program does not intend to develop any new communications and network resource hardware, but rather will develop the network and communications systems algorithms and software to configure and control available resources opportunistically.

The MINC program will address three key challenges tactical networks face today as they operate in extreme networking environments: the lack of network interoperability across heterogeneous communications systems at scale; insufficient network capacity to support missions; and the inability to reconfigure networks autonomously to align with military missions.

DARPA wants the defense industry to develop fast self-healing web-like networking that connect sensors and weapons on land, on and under the sea, in the air, in space, and in cyberspace.

The project seeks to develop on-demand connectivity between sensor-to-shooter networks by focusing on three key capabilities: developing an always-on network overlay to access available networking and communications resources and control parameters; using a cross-network approach for managing network configuration; and creating ways to determine the best information flows for kill web services.

MINC seeks to capitalize on networking advances in software-defined networking; network function virtualization for decoupling network functions from hardware; information-centric networking to discover and retrieve data securely; and intent-driven networking for autonomous mapping of objectives to network management policies.

Companies interested should upload proposals to the DARPA BAA website no later than 29 June 2021 at https://baa.darpa.mil. Email questions or concerns to HR001121S0028@darpa.mil. More information is online at https://beta.sam.gov/opp/5cff048a105b425c-ba09639f0f7f8c28/view.

Lockheed Martin starts building future long-range precision-attack missiles

BY **John Keller**

REDSTONE ARSENAL, Ala. — Tactical missile designers at Lockheed Martin Corp. are preparing to build some of the first U.S. Army long-range Precision Strike Missile (PrSM) systems to destroy enemy targets as far away as 300 miles.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., have announced a $20 million contract to the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, for long-lead item materials for PrSM development, testing and qualification.

The PrSM, which should enter service in 2023, will be a surface-to-surface, all weather, precision-strike guided missile fired from the M270A1 Multiple Launch Rocket System (MLRS) and the M142 High Mobility Artillery Rocket System (HIMARS).

The long-range precision-attack PrSM is to replace non-insensitive and cluster munition versions of the Army MGM-140 Army Tactical Missile System (ATACMS).

Long-lead items either are difficult and time-consuming to obtain, and are funded early in the design process to keep overall production on schedule. Contracts to build the missile will come later.

PrSM will provide Army and Marine Corps field artillery units with long range and deep strike capability. The PrSM will destroy, neutralize, or suppress targets at ranges from 43 to 250 miles using indirect precision fires.

The baseline missiles will be able to engage a wide variety of targets at ranges as long as 310 miles. It will emphasize imprecisely located area and point targets. Primary emphasis for follow-on upgrades will be on increased range, lethality, and ability to attack time-sensitive, moving, hardened, and fleeting targets.

By 2025 the Army will be able to use PrSM to attack and destroy moving enemy ships operating offshore at ranges out to about 310 miles. While the weapon primarily has surface-to-surface applications for use against enemy air defenses, troop fortifications, and armored vehicle columns, the PrSM is being configured with an advanced targeting multi-mode seeker to include maritime strike.

The new targeting seeker has completed a captive carry test wherein it flew aboard an aircraft against representative targets in preparation for further testing and ultimate deployment.

Lockheed Martin is starting to build some of the first U.S. Army long-range Precision Strike Missile (PrSM) systems to destroy enemy targets as far away as 300 miles.

On this contract Lockheed Martin will do the work in Grand Prairie, Texas, and should be finished by April 2025. For more information contact Lockheed Martin Missiles and fire control online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at https://acc.army.mil/contractingcenters/acc-rsa.

Raytheon to build lot-seven StormBreaker air-to-ground missiles

Smart munitions designers at Raytheon Technologies Corp. will provide the U.S. Air Force with more than 1,000 radar- and infrared-guided air-to-ground missiles under terms of a $212.7 million order. Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., are asking the Raytheon Missiles & Defense segment in Tucson, Ariz., to provide product lot seven of the GBU-53/B StormBreaker — also known as the Small Diameter Bomb (SDB) II. Like the GPS-guided GBU-39 SDB I already integrated on the F-35 joint strike fighter, the 208-pound StormBreaker

Continued on page 9

Researchers eye algorithms that recognize moving targets in synthetic aperture radar

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — U.S. military researchers are asking two more signal-processing companies to develop algorithms and collection techniques to enable synthetic aperture radar (SAR) sensors to detect, geolocate, and image moving targets on the ground.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, have announced a $5.2 million contract to the BAE Systems Electronic Systems segment in San Diego and a $4.1 million contract to the Utah State University Space Dynamics Laboratory in Logan, Utah, for the Moving Target Recognition (MTR) project.

MTR revolves around developing algorithms that recognize slow-moving military vehicle targets with synthetic aperture radar (SAR) signatures that are superimposed on clutter. The Air Force awarded the contract on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

BAE Systems and Utah State join the KBR Inc. Centauri segment in Chantilly, Va., on the MTR program. KBR won an $11.1 million MTR contract in April.

MTR will include airborne data collection experiments to test and evaluate algorithms to detect moving ground targets. The MTR contractors will be responsible for the airborne radar sensors and flight services, while DARPA will handle designing experiments that involve moving ground vehicles, instrumented to provide ground truth.

If the project succeeds at moving target detection, geolocation, and imaging, MTR will start developing ATR algorithms for moving target images.

The MTR program is part of the DARPA Mosaic Warfare vision, which seeks to create rapidly reconfigurable military forces that are fast, unpredictable, flexible, and adaptable — more like the pieces in a mosaic piece of art, rather than a collection of rigidly designed pieces of a puzzle.

The MTR program has two phases: a two-year effort that focuses on locating moving targets, as well as detection and imaging; and automatic target recognition (ATR) of the moving target images.

Photo (above): Researchers are developing new kinds of software algorithms that can identify moving targets in synthetic-aperture radar imaging.

For more information contact BAE Systems Electronic Systems online at www.baesystems.com, the Utah State Space Dynamics Laboratory at www.sdl.usu.edu, KBR Centauri online at www.kbr.com/en/centauri, the Air Force Research Laboratory at www.afrl.af.mil,, or DARPA at www.darpa.mil.

Continued from page 7

is six to seven inches in diameter. This size can fit eight StormBreaker munitions in the F-35's confined internal weapon bays. If stealth is not a factor, about 16 more can fit on the F-35's wings. The StormBreaker air-to-ground smart weapon with multimode seeker can hit moving targets in bad weather. The winged munition autonomously detects and classifies moving targets in darkness, rain, fog, smoke or dust.

Army orders electro-optically guided anti-armor missiles for Lithuania and Taiwan

Missiles experts at Lockheed Martin Corp. and Raytheon Co., are building Javelin anti-armor missiles for the militaries of Lithuania and Taiwan under terms of a $175.9 million order. Officials of the Army Contracting Command at Redstone Arsenal, Ala., are asking the Raytheon/Lockheed Martin Javelin Joint Venture based in Tucson, Ariz., to build Javelin weapon systems for Lithuania and Taiwan under the Foreign Military Sales (FMS) program. The electro-optically guided Javelin anti-armor weapon is an infantry fire-and-forget missile with lock-on before launch and automatic self-guidance designed to destroy main battle tanks, armored personnel carriers, and other armored combat vehicles. The missile also is effective against buildings and enemy helicopters. The contract includes all up rounds, command launch unit retrofits, battery coolant units, Javelin outdoor trainers, outdoor trainer instruction station, tripods, Javelin vehicle launcher, and electronics. Javelin has an imaging infrared-guided seeker to guide the warhead to its target. The tandem warhead has two shaped charges: a precursor warhead to detonate any explosive reactive armor, and a primary warhead to penetrate base armor.

Lockheed Martin to upgrade avionics and electronic systems on Taiwan F-16A/B jet fighters

Combat jet avionics experts at Lockheed Martin Corp. will upgrade electronic systems aboard Taiwan's fleet of 144 F-16 A/B Block 20 Fighting Falcon jet fighters to the F-16V configuration under terms of a $138 million order. Officials of the U.S. Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio., are asking the Lockheed Martin Aeronautics segment in Fort Worth, Texas, upgrade avionics subsystems on Taiwan's legacy F-16 jet fighters. The order calls for Lockheed Martin to upgrade Taiwan F-16 automatic ground collision avoidance system and AGM-88 high-speed anti-radiation missile (HARM); improve radar software maturity; update data acquisition systems; and upgrade the advanced identification friend or foe avionics for the Taiwan Retrofit Program F-16 Block 20 fleet. Taiwan received its first upgraded F-16 in 2018, and the project should be completed by 2023.

Congressional think tank questions need for hypersonic weapons

The U.S. Congressional Research Service is calling into question the U.S. military need for hypersonic weapons and how they should be used in the future. Specifically, the Congressional Research Service — the congressional think-tank — is asking what are the missions for hypersonic weapons; given their lack of defined mission requirements, how should Congress evaluate funding requests for hypersonic weapons programs, enabling technologies, and supporting test infrastructure; how will fielding hypersonic weapons affect strategic stability; and is there a need for new multilateral hypersonic arms-control agreements? Top U.S. military commanders say hypersonic weapons could enable long-range, strike options against distant, defended, and/or time-critical threats like road-mobile missiles when other forces are unavailable, denied access, or not preferred.

Navy seeks to use cloud storage to deliver software tools quickly

Members of the U.S. Navy's shipboard networking team want to deliver software to sailors quickly by using cloud computing and cloud storage. As part of the network, called the Consolidated Afloat Networks and Enterprise Services, Navy officials want to increase sailors' access to software tools. To test the software and train sailors on CANES, the service is turning to digital twin platforms that replicate the network infrastructure aboard a ship. Navy information technology experts are switching as much of Navy software to cloud storage as possible to reduce reliance on physical lab environments and enabling increased collaboration among dispersed teams. The service is using the cloud to test the integration of software applications before installing them on a ship and using digital twins that represent aircraft carriers Abraham Lincoln and Theodore Roosevelt to enable continuous development, verification, troubleshooting, configuration control, and virtual training.

U.S. Marine Corps technicians discuss the process of producing mask frames and face shields for use in the fight against COVID-19. Marine Corps photo

Military starts to run with 3D printing and additive manufacturing

Defense and aerospace uses for additive manufacturing range from quick prototyping to spare parts logistics support at sea and in other remote locations.

BY **Megan Crouse**

Even within heavy industries, people often speak of 3D printing in terms of science fiction. With the allure of creating something from nothing, it has been poised to revolutionize prototyping, manufacturing, and resupplying for decades. However, additive manufacturing — another name for 3D printing — also is a reality here and now.

Numerous 3D printing companies offer ready-made menus of different materials and techniques. Some experts say it's still the way of the future, while others say no one process (or array of sub-processes) can do all the things 3D printing promises to do. So which is it: practical or over-promised?

First, what's the difference between 3D printing and additive manufacturing? The term 3D printing is used more often in hobbyist spaces. You can find commercial and hobbyist printers using inexpensive plastics in elementary schools and public libraries. It's in relatively common use in manufacturing facilities

5G RF Components & Cable Assemblies

Whether you're building the future of enhanced mobile broadband or designing applications for IoT and mission-critical communications, Fairview Microwave offers the most extensive portfolio of in-stock and ready-to-ship 5G RF components and cable assemblies. Fairview Microwave is ready to support 5G innovation, testing, and deployments, through an expansive product offering, product support, and a commitment to same-day shipping.

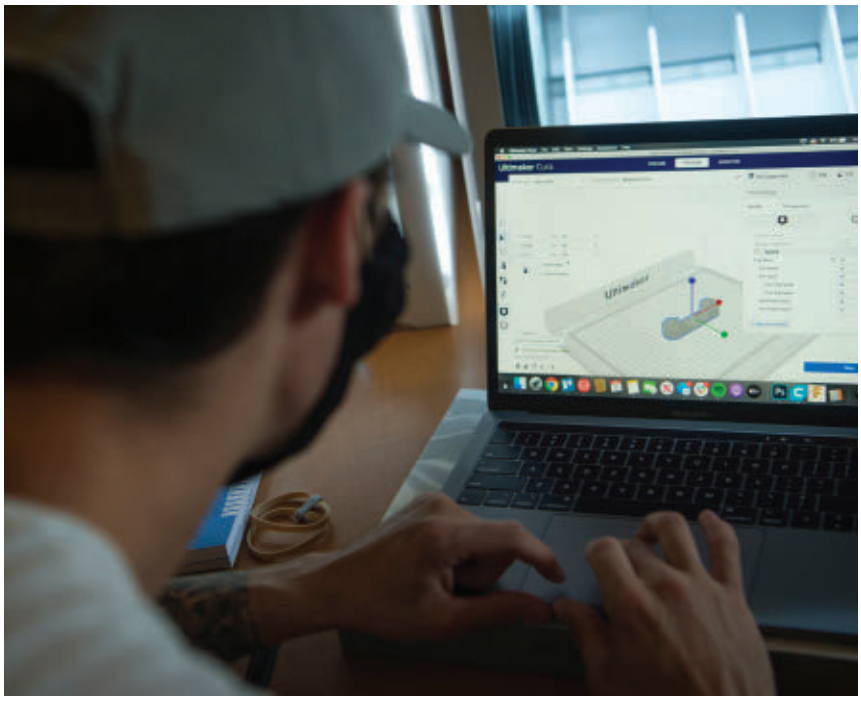
Fairview Microwave offers thousands of active, passive, interconnect, and antenna products for global sub-6 GHz and mmWave frequency bands as well as technical service and application engineers are standing by to answer.

All 5G RF Components are in-stock and available for immediate shipping!

The Right RF Parts Right Away

fairviewmicrowave.com
+1 (800) 715-4396
+1 (972) 649-6678

Fairview Microwave™
an INFINITE brand



Air Force explosive ordnance disposal experts use 3D printing technology to produce parts for a face shield to support essential personnel and minimize health risks of the COVID-19 pandemic. Air Force photo

and the schools that train the workers who use them. Broadly speaking, the process of laying down material from the top down onto a print bed is 3D printing.

Different sources argue over whether additive manufacturing is a more general or a more specific description. What people tend to agree on, however, is that additive manufacturing is the more professional term, implying the product that results is part of a larger mechanical or electronics project, rather than a novelty.

Manufacturers provide many different types of additive manufacturing: powder bed fusion, binder jetting, material extrusion, or directed energy deposition are just some of the different types. Additively manufactured products fall under specific categories named under American Society for Testing and Materials (ASTM) standards. So, all additive manufacturing involves 3D printing, but not all 3D printing is for additive manufacturing.

Military additive manufacturing

Using it in military applications adds even more specific sets of standards and requirements. This process helps to create replacement or original parts, as well as create prototypes. All of those uses means additive manufacturing has an influence on military logistics, too, changing the way in which parts can be delivered into service.

It's an area in which the industry is putting a lot of attention and money. Many companies either are throwing their metaphorical hats into the ring to adapt to additive manufacturing or have solid standing in the sector already and are generating profits.

The U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., recently concluded the Transformative Design (TRADES) program, which ran from 2017 to 2020. The project sought to approach additive manufacturing from the software side, to "advance the foundational mathematics and computational tools required to generate and better manage the enormous complexity of design."

Experts from the American Society of Mechanical Engineers in New York traced the origins of 3D printing to the 1980s. They credit Hideo Kodama of Nagoya Municipal Industrial Research Institute in Nagoya, Japan, with the first patent for a recognizable modern 3D printer in 1980. However, his invention did not receive wide attention or adoption.

But from there, more and more people pursued the idea of commercializing a similar idea. Companies still known widely in the industry began in this era, such as Stratasys Inc. in Eden Prairie, Minn. Founders Scott and Lisa Crump filed a patent for a fused deposition modeling machine in 1989. EOS GmbH in Krailling, Germany, was another major player, where laser sintering research work started in 1989. AeroMet, a division of MTS Systems in Eden Prairie, Minn., performed the first public metal printing process, using lasers to fuse titanium alloys, in 1997.

Since then, use of additive manufacturing has expanded through medical devices, aerospace, automotive engineering, the arts, and other fields. Military applications have proliferated as well, from parts to shelters for storing vehicles to small submarines. Packaging, heat sinks, RF antennae, the internals of PC boards, and more are all being printed for use in the defense industry today.

"We're seeing it all over the airplane," says Dale Tutt, vice president

of aerospace and defense for Siemens Digital Industries Software in Plano, Texas. "I first started using some printed parts when we were needing special shapes of ducts for environmental control systems. It was easier to 3D print those parts to get the shape we needed in the space we had available to us. In space you're seeing engine nozzles and even entire rockets being 3D printed now. I'm even starting to see some pretty substantial parts in large titanium frames, major structural elements."

Additive Manufacturing drawbacks

Before designers can start working with 3D printing, they need to be able to set the machines up, align the process with standards, and know how to validate the end product. This has proven a challenge, as it might with any new technology. So-called "cultural rigidity" is holding additive manufacturing back in the world of military applications. After all, military work tends to rely on proven, staid standards — which helps when it comes to the safety and reliability of the equipment, but can hurt innovation.

The hype itself has been a problem, because only about 5 percent of the additive manufacturing industry is active in aerospace and defense, suggests Aviation Week and industry advisor Lauren Ely. In addition, insufficient training, challenging business cases, and a lack of 3D-printed applications suited to aerospace and defense create a gap between ability and reality, or even between reality and what sells.

In a June 2020 article, Aviation Week noted that several barriers remain in place between military aerospace applications and additive manufacturing. Printers are proving not to be up to snuff, and standards and training are both lacking. Many printed products require further finishing, which can be time- and money-consuming.

During the COVID-19 pandemic, the manufacturing powers of companies using additive manufacturing for military applications turned toward personal protection equipment (PPE) instead. Boeing plants across the country produced printed products, but they weren't for planes — they were for face shields. Airbus and Raytheon Technologies similarly retooled to produce face shield headbands and other PPE.

Prototype parts are 3D printed in the new Advanced and Additive Manufacturing Center of Excellence to troubleshoot the machines at Rock Island Arsenal, Ill. Army photo

Lack of standards also can be a problem. Siemens's Tutt says his company is trying to make this easier as part of the build process itself. "Another trend is how do we accelerate some of the regulatory processes? When you're developing parts using additive tech there are still some regulatory hurdles. It gets down to how well you can design and analyze the parts, how well you can control the allowables, how well you can document the process."

To that effort, they are using machine learning to develop the allowables from a particular additive manufacturing process and machine, which in the end means they need to do fewer tests on that product.

Tutt says systems designers who may be excited about adoptive additive manufacturing tend to ask a lot of questions about how their tools overcome regulatory hurdles.

"Our customers often ask how do we use simulation, how do we use the design tools and even the manufacturing analysis tools to help overcome that. I think that's the most common barrier to adoption. [But] there's a lot of excitement around wanting to adopt additive."

The newness of the processes presents opportunity and challenges. "We don't have the 50 years of learning we have with other materials out there," Tutt says. "I think confidence will continue to increase, regulatory confidence will increase."

The upside to additive manufacturing

Speed of use and versatility sum up what makes additive manufacturing different. It can produce complex internal geometry that would be too difficult to design and manufacture on traditional machines. Using relatively inexpensive prints, designers can make prototyping quickly because iteration is limited only by the speed of the print.

When it comes to aerospace electronics, the space sector is one of the areas finding the widest use of additive manufacturing. Since commercial low-Earth products are themselves cutting-edge, the standards for their creation and the standards for additive manufacturing can be developed hand-in-hand.

"In the U.S., we think in the very near term we'd be on space platforms because of the benefit of SWAP needs and the embracing of complexity to solve those problems," says Emile de Rijk, CEO of SWISSto12 SA in Renens, Switzerland.

Cobham Advanced Electronic Solutions (CAES) in Arlington, Va., and SWISSto12 have bet big on additive manufacturing with an agreement to bring RF applications for the aerospace and defense industry to U.S. customers. By the end of the year, CAES officials say they plan to set up a new manufacturing facility using SWISSto12 technology and intellectual property.

With additive manufacturing "you break free from a lot of manufacturing limitations that you had that would constrain your design space," says SWISSto12's de Rijk. "That enables you to design products to be more complex, more lightweight, with more RF features for extra performance."

This helps solve the traditional problem where an RF designer takes a plan to a mechanical designer, who says "no way we're doing this," de Rijk says. Often that designer will impose limitations that can restrict the product to half of its functionality in the process. Additive manufacturing can help solve that problem for several reasons.

Starting at the design stage, de Rijk says, additive manufacturing can help designers create products that solve a lot of problems all at the same time. "Have an RF problem solve a mechanical problem solve a thermal

problem" rather than having three different parts, he says. He predicts this will become more practical in the next couple years as designers become more comfortable with the interconnects; the engineers themselves need to see more of what is possible in connecting them. At the same time, the industry is seeking smaller and smaller satellites, and smaller and smaller radars. Companies like SWISSto12 are angling to be ready when the prime contractors go looking for ways to interconnect those things.

Designing-in interconnects

Dave Young, chief technology officer of CAES, also notes that additive manufacturing allows for combining different parts into one product. It makes designing interconnects easier, he says. And defense industry prime contractors have expressed interest, Young says, because while they may be set in their ways, trusted secondary vendors have more flexibility to experiment with new things.

Experts at his company have been working with additive manufacturing long enough that there isn't a case of something that might happen in the future; it's something they know how to work with well now, but still are looking for new use cases.

"We could do it in the past, but there were performance [problems]," CAES's Young says. "The weapons systems never wanted to trade performance for any of the other factors ... With Emile's tech, we've demonstrated we can increase the performance or at least be on par with the same agility additive manufacturing brings to other elements and the same cost reductions they bring to other elements."

In aerospace and defense, we build things that need to work, Young continues. "When there's a need to build something state-of-the-art we do that and are comfortable with the risk."

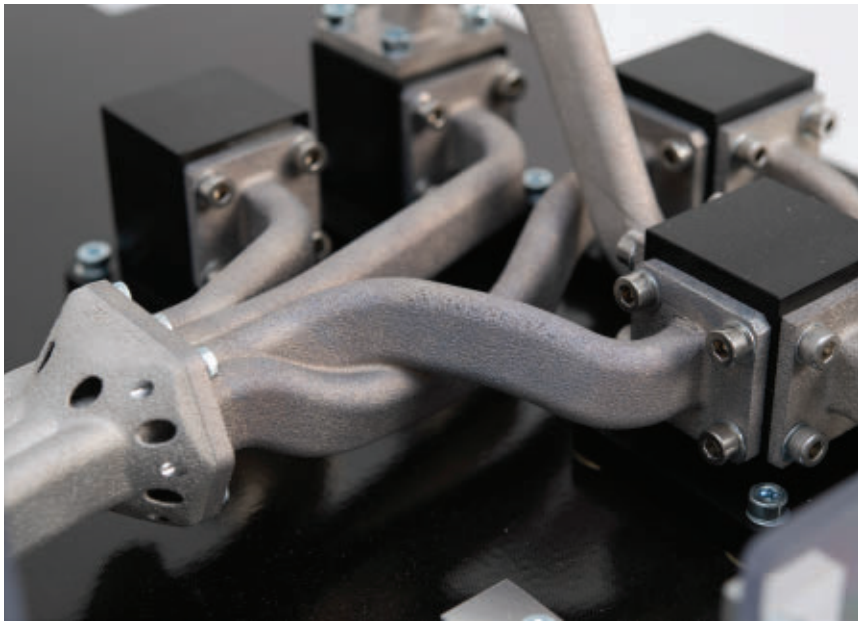
This returns us to the cons: sometimes, a potential additive manufacturing project is not worth the risk. If designers can build a piece with subtractive manufacturing just as well, adding the risk of additive isn't appealing.

However, he says, in the last five to seven years there have been more cases of metal printing and other breakthroughs that mean additive works well in aerospace. Now, "It's just part of our toolset. We don't talk about whether we're using a lathe or a 3D-capable machine. It's just machining ... It's a different arrow in our quiver."

This works particularly well for RF applications, de Rijk says, because of the mechanical complexity inherent in RF designs. RF relies on different signal pipelines, which are "very intricate, very small, quite small tolerances." This is buried inside the structure. Additive manufacturing gives them the ability to cut metal inside something else "after three bends and still be precise," de Rijk says. "We don't have to break it into pieces, machine it off, and build it together ... Generating interfaces, accommodating screws ... additive manufacturing can build hollow structures with a lot of complexity."

When it comes to military applications, RF electronics must be small enough to sit inside a small nosecone and survive launch conditions. Additive manufacturing can improve some of what can be done inside that format. Designers can "solve problems with simplicity instead of complexity," Young says.

Army personnel observe additive manufacturing at the U.S. military Joint Manufacturing and Technology Center at Rock Island Arsenal, Ill. Army photo



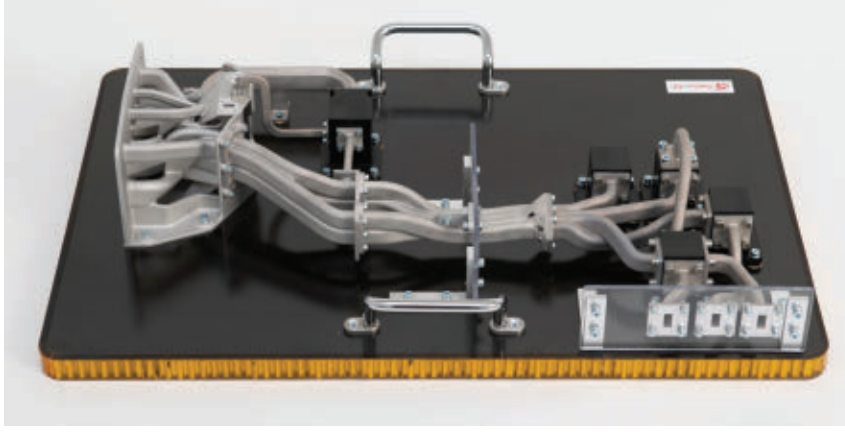
This is a military product of additive manufacturing from CAES.

More applications

That drive toward simplicity extends to the traceability of the product as well, says Siemens's Tutt. As part of this role, his team looks for intersection points where designers' needs match the company's product lines.

Siemens is one of many companies arguing for a digital thread tactic with greater connection and traceability between stages of production, powered by additive manufacturing.

"The beauty of additive engineering, design, and manufacturing with Siemens products is the fact that you have that vital thread from when you first start designing the part, analyzing it, doing topology optimization, light-weighting, printing, finishing and inspecting," Tutt says. "We've been able to connect all of those processes together and provide a complete digital thread with traceability from the design part to the manufacturing part. That's something that makes [Siemens] unique: we have the design, engineering and manufacturing pieces.



This is a military product of additive manufacturing from CAES.

"The benefits that we see in a couple different areas, speaking specifically to electronics packaging, is the ability to get form factors and shapes you wouldn't usually get from packaging," Tutt continues. "Where we see customers looking now is 3D printing antennae for commercial applications that instead of producing it flat you're now producing it in shapes more tailored for the need of the antenna maybe, as well to the shape of where you would install it on an aircraft. It's still early days, but that's one application."

Additive manufacturing also can help designers with thermal management and electronics cooling. "Electronics have so much heat, and need usually pretty elaborate heat sinks," Tutt says. "They're trying to produce these heat sinks in sometimes pretty confined spaces and get that heat to outside of the box so they can cool the box off. Instead of machining channels and then creating an assembly of a heat sink you can print those right into a heat sink. So it's a one-step process now."

Military and aerospace electronics designers are asking for more material options and solutions scaled to fit most effectively in limited spaces. Siemens is working on combining topology optimization software and the intricate inner architecture enabled by additive manufacturing.

"Everyone's always trying to bring the size of the products down. Sometimes the size is driven by the thermal dissipation and the size of the boards, obviously, but often they have contrasts in size. They're always trying to bring weight down and additive offers opportunity for [lightweighting by using fewer parts]," Tutt says.

Additive manufacturing in the future

So, what's next? The additive manufacturing machines themselves are improving. Meanwhile, Tutt is seeing a need for his people to work on how companies can do a better job of predicting the allowables and the processes of the manufacturing. That would mean they can design the parts better from the jump, and, hopefully, therefore produce the parts better by the end of the line as well.

Another area in which cutting-edge work is still being done is with printing metals. In this area, there are some persistent thermal management problems that tend to come up in the manufacturing process. Siemens is one of many companies that have worked on and overcome them relatively recently.

When discussing what 3D-printed products might be able to offer that conventional ones cannot, Tutt returns to the idea of digital traceability.

"Traceability in the process is key — simulation and analysis tools to predict not just the behavior of the part in the field but to predict the manufacturing process. And that's going to be critical — that understanding and that traceability — as we move into verifying the part and certifying it and overcoming regulatory hurdles. Even as you transition into sustainment over time you now have the part data and can just print off a new part if you need to."

Over time, companies will learn culture or process lessons from the development of composite materials as they move on from early adoption. As more companies started to develop them, they created a roadmap for clearing hurdles.

Most people in the business world know the saying: you can only find a product that does two out of three when it comes to making something high-quality, fast, and inexpensive. For Tutt's part, Siemens sees two major factors — cost and time to produce — that could go down because of the opportunities presented by additive manufacturing.

"As we've seen over time, maybe this is a bit of an industry perspective from me leading engineering programs for a long time, it's not just digital connotations of the additive point of view but we're seeing benefits from SWaP ... but we're also seeing the price coming down. The crossover points are starting to change. Maybe in the past due to cost the numbers of parts you needed to print was large compared to the number that would need to be printed for aerospace. But, now, the cost of the machines are coming down, so the cost is becoming much more manageable."

In some cases, Tutt has seen production time going from 100 days to 100 hours. That speed is just one of the factors that organizations must keep in mind when considering whether to integrate additive manufacturing into their processes and purchases.

WHO'S WHO IN ADDITIVE MANUFACTURING

Stratasys
Eden Prairie, Minn.
www.stratasys.com

EOS GmbH
Krailling, Germany
www.eos.info/en

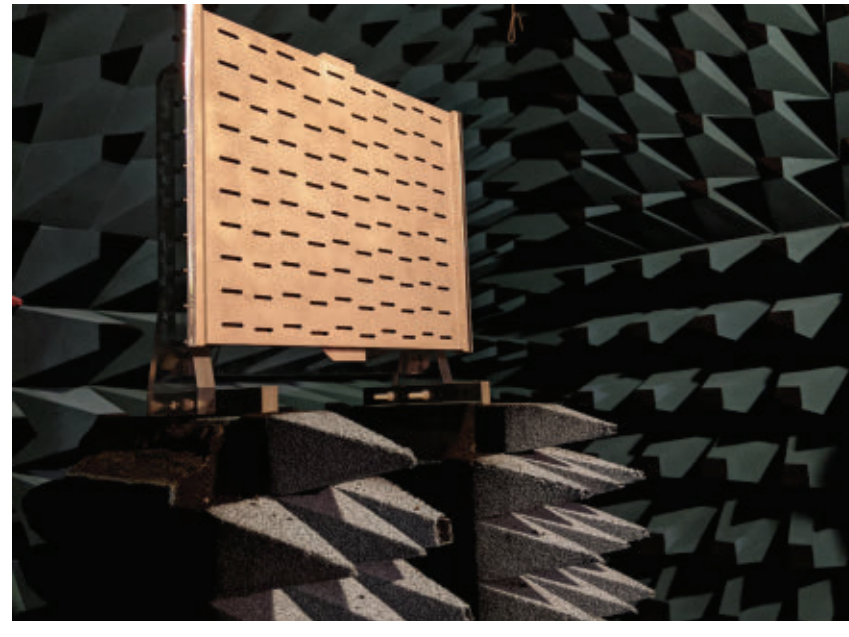
AeroMet - a division of MTS Systems
Eden Prairie, Minn.
www.mts.com

Siemens AG
Munich, Germany
www.siemens.com/global/en.html

Boeing
Chicago
www.boeing.com

SWISSto12 SA
Renens, Switzerland
swissto12.com

Cobham Advanced Electronic Solutions (CAES)
Arlington, VA
caes.com



This military slot antenna was built with additive manufacturing.

The evolving world of radiation-hardened electronics for space

Space electronics devices are becoming smaller and more complex, which is putting pressure on designers to move to plastic packaging, and invest in new test and upscreening technologies.

BY **John Keller**

Global demand for affordable satellite communications for applications ranging from cell phone connectivity and television content, to space-based military and agriculture surveillance and monitoring are driving huge increases in small satellites and the radiation-hardened electronics that make them function effectively.

It is this need for radiation hardening that focuses the electronics industry's efforts on developing components like microprocessors, power-management devices, and solid-state memory that are inexpensive to buy, yet resilient enough to survive in space for periods ranging from weeks to years.

The VORAGO Technologies VA41630 is a radiation-hardened Arm Cortex-M4 microprocessor with floating point unit microcontroller with integrated 256 kilobytes of non-volatile memory NVM with HARDSIL protection from radiation and heat.

"We are really starting to see four quantums in the satellite space marketplace," explains Anthony Jordan, director of business development at Cobham Advanced Electronic Solutions Inc. (CAES) in Colorado Springs, Colo. These four quantums consist of small cubesats with mission durations of only 12 to 18 months; business satellites with life spans of two or three years of mission life; so-called "constellation space" with each satellite expected to last in orbit for five to seven years; and finally the long-duration satellites that will operate in geosynchronous orbits for decades.

Four space segments

The first quantum primarily is for proof-of-concept research projects and can accept non-rad-hard components. The second quantum must have limited radiation hardening for short durations in low- or medium-Earth orbits. The third quantum must have some serious radiation hardening for multi-year missions; and the fourth quantum must have the most extensive levels of radiation hardening for decades of operation in harsh geosynchronous and polar orbits.

The whole idea is to design, test, or upscreen electronic components that are good enough for their intended applications, while keeping size, weight, power consumption, and cost (SWaP-C) to a minimum to meet mission goals.

For the first two quantums little or no radiation hardening is necessary. Radiation shielding and special packaging for tier 2 often is all that's needed, while for tier one developers most often choose commercial-grade electronic parts from distributors. "We're talking quick-turn and low-budget," Jordan says. This tier represents perhaps 20 percent of the space parts market.

Tier 2 sees a lot of specially packaged 6U and 3U electronics subsystems using commercial electronic parts that have been upscreened for enhanced reliability, or automotive parts designed and upscreened for the harsh environmental conditions of passenger cars or commercial trucks.

5G Solutions

RF Components for the Next Generation

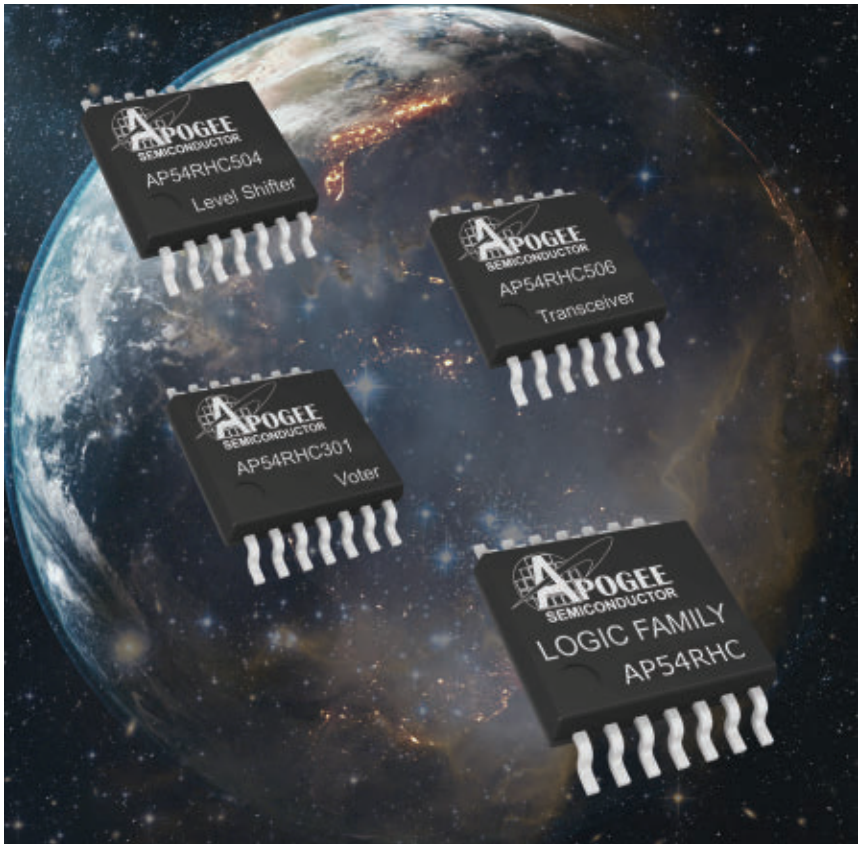
Whether you're building the future of enhanced mobile broadband or designing applications for IoT and mission-critical communications, Pasternack offers the most extensive portfolio of in-stock and ready-to-ship 5G RF components and cable assemblies. Pasternack is ready to support 5G innovation, testing, and deployments, through an expansive product offering, product support, and a commitment to same-day shipping.

Pastnernack offers thousands of active, passive, interconnect, and antenna products for global sub-6 GHz and mmWave frequency bands as well as technical service and application engineers are standing by to answer.

In-Stock and Shipped Same-Day

USA & Canada +1 (866) 727-8376
International +1 (949) 261-1920
pasternack.com

PASTERNACK®
an INFINITE brand



Apogee Semiconductor offers radiation-hardened integrated circuits in several plastic-packaged flows to meet a variety of space mission profiles.

Satellite failures due to space radiation or other environmental conditions are tolerable for tiers 1 and 2 because the relatively low costs of these spacecraft enable periodic replacement. On-orbit failures become more problematic, however, for tiers 3 and 4.

Tier 3 is among the most interesting space segments because its practitioners aim to deploy and operate economically, but also offer reliable service for each satellite for five to seven years. Tier 4, also called "exquisite space," is for the most expensive and long-lasting satellites. Often these spacecraft are for military communications and surveillance, and many aspects of their missions are kept secret. The first three tiers often are referred to as "new space."

Where the money is

When analysts look at the four space segments, "the meat is in the middle," CAES's Jordan says. "Quantum two and three are probably the strongest segments for growth, and they represent about 60 percent of the market. Over the next five years I wouldn't expect to see a lot of growth in Tier 4, and I wouldn't expect to see a lot of growth in tier 1."

Jordan points out that many of the high-profile commercial satellite constellation projects are in the second and third tiers — particularly tier 3, which contains the Blackjack project of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.; the Lightspeed data communications satellite constellation of Telesat in Ottawa; the Kuiper satellite constellation for global broadband communications from Amazon in Seattle; the Starlink constellation for broadband communications from SpaceX in Hawthorne, Calif.; and the OneWeb broadband communications satellite constellation from a joint venture of Airbus in Leiden, the Netherlands, and OneWeb in London.

"I find amazing the number of satellites that are going up," says Jim Kemerling, chief technology officer of Triad Semiconductor Inc. in Winston-Salem, N.C., which specializes in radiation-hardened electronic components like general-purpose input/output devices, A/D converters, and sensor interfaces.

"Elon Musk said in March that the Starlink system may have 1,200 to 1,300 satellites," Kemerling says. "But the market has been very fragmented, and still is." Echoes Malcolm Thomson, president of Radiation Test Solutions (RTS) in Colorado Springs, Colo., "We see continued growth in space applications." RTS specializes in affordable test and measurement solutions to qualify components for space uses.

Those who will succeed in radiation-hardened space electronics will be those who can ensure reliability, affordability, quick-turnaround designs, and access to the latest semiconductor technologies. Typically that will mean plastic-encapsulated parts, rather than the more expensive hermetically sealed ceramic parts that have been a staple of rad-hard space electronics for decades.

Plastic packaging for space

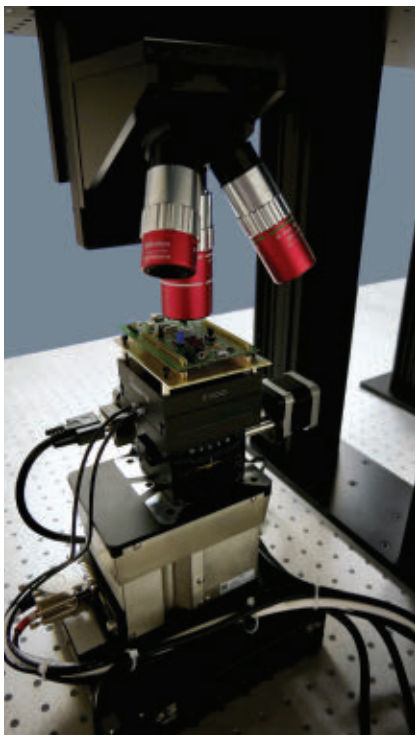
Apogee Semiconductor in Plano, Texas, specializes in radiation-hardened plastic-encapsulated parts for

space applications. "We are space plastics from the ground-up; we don't have any hermetic ceramic parts in our portfolio," says Apogee CEO Anton Quiroz. "There are too many performance tradeoffs — in a bad way — with hermetic."

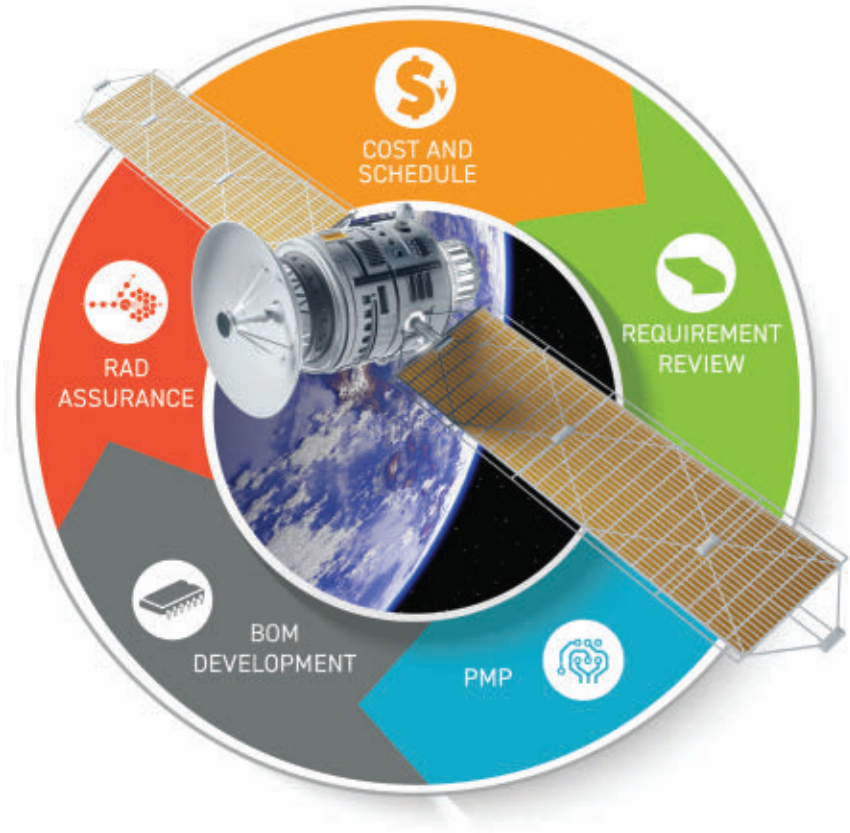
Perhaps the best aspect of plastic parts is relatively low costs and access to the latest generations of microprocessors, field-programmable gate arrays (FPGAs), solid-state memory, and other electronic components. While ceramic hermetic parts have a reputation for high reliability, they also are expensive, difficult to obtain, and typically lag at least a generation behind their equivalents in plastic-encapsulated parts.

"Plastic is starting to proliferate for space applications," Quiroz says, adding that factors driving space systems designers to plastic packages are a push for higher performance, lower cost, and SWaP.

Relying on plastic-encapsulated space parts, however, can be a double-edge sword, Quiroz points out. "Companies are buying a lot of plastic parts and doing a lot of upscreening, which can lead to unknown performance." The costs of upscreening plastic parts, he says, can be like "wrapping a hundred-dollar bill around that five-dollar part. A big risk is they do not have a controlled baseline, and need to do a requalification with the next lot."



Radiation Test Solutions offers the SEREEL2 laser-based single-event upset tester to help save time and cost for radiation-hardened electronics testing.



The Scientic Inc. Parts, Materials, Processes (PMP) program can help reduce a space system designer's risk, cost, and schedule.

One solution to the problem of high costs of upscreened parts may be in standardized design approaches with known performance. Today Apogee relies on the company's reputation for high-reliability in plastic space parts, but industry is getting the ball rolling on developing open-systems reliability standards for plastic parts for space.

The JEDEC Solid State Technology Association in Arlington, Va., has formed the JC-13.2 microelectronic devices committee, led by The Aerospace Corporation in El Segundo, Calif., that in as little as two years is expected to lead to a new U.S. government-backed qualification for high-performance plastic space parts, Quiroz says.

The future standard will be MIL-PRF-38535 Qualified Manufacturing List (QML) Class P, and will be administered by the U.S. Defense Logistics Agency (DLA) in Columbus, Ohio. MIL-PRF-38535 is a U.S. military performance specification that establishes the general performance and verification requirements of single-die integrated circuits. It defines quality assurance and reliability requirements for integrated circuits used in military applications and other high-reliability microcircuit applications.

MIL-PRF-38535 space-qualified parts today typically are QML class V, for space-grade parts. These typically are high-performance and high-cost ceramic parts that are difficult to obtain. The future QML class P qualification should make a wide variety of space-grade parts available that are lower cost and higher performance.

For now, however, Apogee manufactures logic function circuits, level translators, and transceivers to the company's own space-qualification standard, which is based on AS6294/1 for plastic encapsulated microcircuits in space applications, published by SAE International in Warrendale, Pa. Quiroz says these parts will have many similarities to the future QML class P parts. "The reason we are doing plastic is because they will get higher performance than QML class V," Quiroz says.

Although plastic-encapsulated parts are coming to dominate many space applications, there is still room in the market for the older QML Class V parts. "There will be programs where they will need the hermeticity for storage," Quiroz says. "There will still be a need for ceramic, but ceramic volumes will continue to decrease."

There's a simple reason for the move to QML class P and other plastic packaging for space, says CAES's Jordan. "The customer wants more capability, and with more capability that means more speed. The organic plastic packages enable us to move things at higher rates."

Unfortunately ceramic parts run counter to that trend, Jordan says. "In ceramic we see limitations to speed and transfers per second, in a memory device or wired interface. You can't push 50 gigabits per second through a ceramic package; you really need an organic package like plastic."

Rad-hard enabling technologies

VORAGO Technologies in Austin, Texas, specializes in radiation-hardened and

extreme-temperature solutions for space and high-reliability applications. The company's patented HARDSIL technology uses high-volume manufacturing to harden commercially designed semiconductor components for aerospace, defense, and industrial applications.

"We implement radiation hardening to existing and commercial parts," says Garry Nash, chief operating officer at VORAGO. The company's HARDSIL technology — short for hardened silicon — is a process enhancement, but not a design for radiation hardening, he says.

This process enables VORAGO experts to fabricate microcontrollers, solid-state memories, and provide design and development tools for rad-hard electronic components that will operate even at higher orbits than low-Earth orbit. "It allows us to provide rad-hard parts up to 300 kilorads, at design times that are close to commercially designed parts," Nash says. "It costs substantially less."

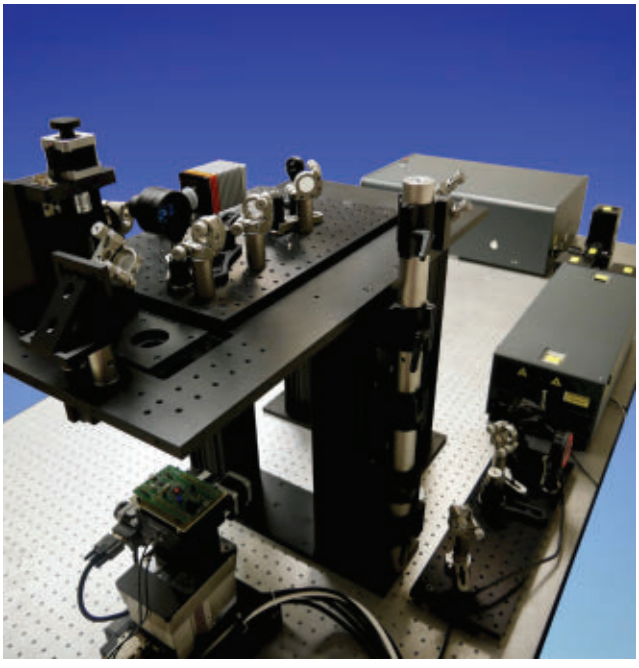
VORAGO's newest product is the VA416XX ARM Cortex microcontroller, which Nash says "has a lot of interest in the space market because it is the most powerful space microcontroller today." The company also provides radiation-hardened communications for Spacewire, CAN, and Space Ethernet.

VORAGO also offers design analysis tools that can monitor space subsystems to detect and prevent a latchup conditions in non-rad-hard parts. "It allows designers to use non-rad-hard parts in an overall system that will see radiation," Nash says.

Triad Semiconductor offers what Kemerling says is called a via-configurable array, which is an analog mixed-signal array configured with a via layer. "The key to it working is it is configured with a via layer, but it is mask-programmable, not field-programmable."

Advanced space packaging

As the size, weight, and power consumption of space electronics components continue to shrink, CAES's Jordan says systems integrators can expect new kinds of packaging in their electronic components. "We will start to see more use of chiplets and heterogeneous packaging of die," he says. "We are now bringing microprocessor, serial interconnect, and memory in pieces and putting them together in a system package. Designers also are bringing in A/D converters, D/A converters, and RF components into the package. Now I'm starting to bring the system level together, which involves advanced packaging."



Radiation Test Solutions offers the SEREEL2 laser-based single-event upset tester to help save time and cost for radiation-hardened electronics testing.

WHO'S WHO IN RAD-HARD ELECTRONICS

3D Plus, a Heico company
San Leandro, Calif.
www.3d-plus.com/index.php

Aitech
Chatsworth, Calif.
https://aitechsystems.com

Apogee Semiconductor
Plano, Texas
apogeesemi.com

BAE Systems
Manassas, Va.
www.baesystems.com/en-us/productfamily/space-systems

Cicoil Corp.
Valencia, Calif.
www.cicoil.com

Cobham Advanced Electronic Solutions Inc. (CAES)
Colorado Springs, Colo.
caes.com

Curtiss-Wright Defense Solutions Aerospace Instrumentation
Newtown, Pa.
www.curtisswrightds.com/company/locations-newtown.html

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

GSI Technology Inc.
Sunnyvale, Calif.
www.gsitechnology.com

Honeywell Aerospace
Clearwater, Fla.
aerospace.honeywell.com/en/markets/space

Infineon Technologies
El Segundo, Calif.
www.infineon.com

Maxwell Technologies
San Diego
www.maxwell.com

Mercury Systems
Phoenix
www.mrcy.com

Microchip Technology Inc.
Chandler, Ariz.
www.microchip.com

Microelectronics Research Development Corp.
Colorado Springs, Colo.
www.micro-rdc.com/index.htm

Micropac Industries Inc.
Garland, Texas
www.micropac.com/markets/space

Microsemi
Aliso Viejo, Calif
www.microsemi.com

Nissha GSI Technologies
Burr Ridge, Ill.
www.gsitech.com

Northrop Grumman Corp.
Manhattan Beach, Calif.
www.northropgrumman.com

pSemi Corp.
San Diego
www.psemi.com

Radiation Test Solutions Inc.
Colorado Springs, Colo.
www.radiationtestsolutions.com/home

Renesas Electronics Corp.
Milpitas, Calif.
www.renesas.com/us/en/

Scientic Inc.
Huntsville, Ala.
www.scientic.com

Space Micro
San Diego
www.spacemicro.com/index.html

Spirit Electronics
Phoenix
www.spiritelectronics.com

Triad Semiconductor Inc.
Winston-Salem, N.C.
www.triadsemi.com

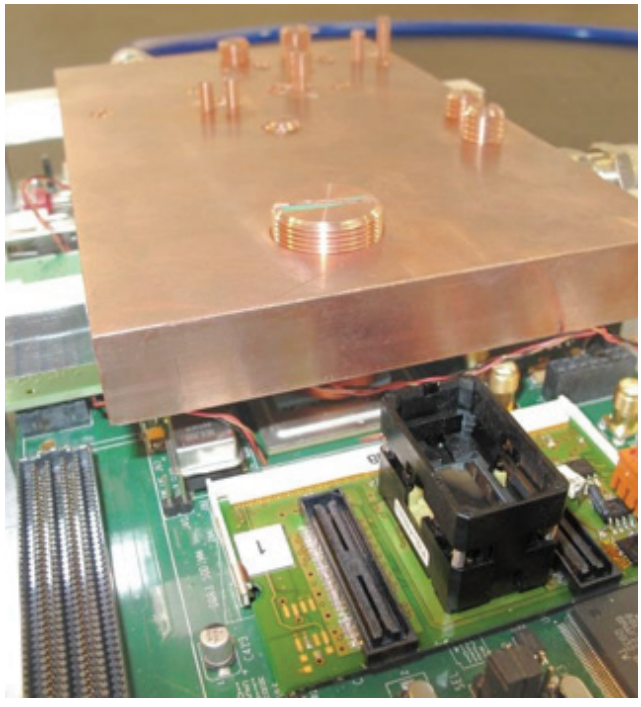
VORAGO Technologies Inc.
Austin, Texas
www.voragotech.com

VPT Components
Lawrence, Mass.
www.vptcomponents.com

VPT Inc.
Blacksburg, Va.
www.vptpower.com

VPT Rad
Chelmsford, Mass.
www.vptrad.com

Xilinx Inc.
San Jose, Calif.
https://www.xilinx.com



The 3D-Plus BI and radiation test fixtures help test increasingly complex radiation-hardened integrated circuits.

Jordan says multicore microprocessors for space have evolved from two, to four, and now to eight cores for low-Earth orbit applications. CAES offers the quad-core GR740 processor, and is developing the eight-core GR765 microprocessor. "The single-, dual-, and quad-core versions all are in production at various levels of life," Jordan says. "The quad-core processors have flown on spacecraft, and the octal-cores are in development."

Providing the proper levels of power to these advanced space components will be difficult to develop, Jordan says. "One of the challenges we are seeing is today's FPGAs are running off of 0.8- and 0.7-volt cores. They are burning 30 to 50 amps at 0.8 volts; that is an interesting challenge.

"CAES has been working to find high-efficiency solutions in this realm," Jordan continues. "We start with a satellite that we are lucky if it has a 28-volt bus. We have to convert from a 28-volt bus all the way down to 0.8 volts through a couple of conversions. You want efficiencies up around 95 percent, but how do you get that efficiency? That's a huge engineering challenge."

Test and upscreening

A common solution for radiation-hardened electronic components is testing and upscreening commercial-grade parts to find those able to withstand the space environment. There are several test and measurement companies that specialize in just that.

Scientic Inc. in Huntsville, Ala., specializes in radiation survivability; radiation-hardened electronics development and test; parts, materials and processes; and high energy laser test and evaluation for space electronics.

"We offer not only radiation-effects modeling, but also understand the requirements," says Barry Posey, director of component engineering at Scientic. "You need to understand quality and reliability levels, and the radiation capability of parts that you plan to add to your system. We also bring radiation-effects testing, which is necessary to guarantee a product in a nuclear environment. That's what we offer."

Scientic experts have experience not only in characterizing electronic components, but also in the several kinds of radiation environments that today's satellites will face in different orbits.

"In the geosynchronous space area you worry most about cosmic rays and some proton levels. But in new space that is variable. For new space low- and medium-Earth orbits you need to be concerned with the orbital inclination and altitude you will fly at," Posey says. "In addition you may have a lot of the radioactive particles being trapped that you have to worry about. The models we use try to give us an idea what the environment will be at any orbit and altitude we might be flying at."

3D Plus, a HEICO company in San Leandro, Calif., also specializes in radiation-hardened electronics test and measurement for space, but the job is getting progressively difficult. "What is changing is we are using more and more complex technologies," says Timothee Dargnies, chief executive officer at 3D Plus.

"Frequencies are faster, and for space electronics the challenges are that those devices are more and more complex to evaluate. You see that across the industry. People need more devices that perform even better. Evaluation of radiation is getting more and more complicated."

Radiation Test Solutions specializes in radiation-hardened test and evaluation methods that are substantially less expensive than traditional radiation testing, which must be done at places like University of California at Berkeley, Texas A&M University in College Station, Texas, and at Brookhaven National Laboratory in Upton, N.Y.

At places such as this, "there is more work than there is available time," RTS's Thomson says. Instead, RTS experts test for single-event upset resistance with lasers, rather than with actual radiation. "There are a lot of advantages of using lasers," Thomson says. "You don't have to have a special facility, and with a laser system you can do that evaluation very quickly early on."

The disadvantage, however, is laser and actual radiation testing do not compare exactly. Still, laser screening can work for components intended for low-Earth orbit, because lasers give a good-enough result for the LEO environment. "Lasers are a screening tool, but they also are a part qualification tool for the LEO folks who need an approximate result," Thomson says. RTS now is installing laser test equipment at the company's facility in Colorado Springs, Colo.

"I do believe this test method will be used heavily in the future, and will be sufficient for many satellite applications, particularly for new space, as well as for traditional space for silicon designers, to quicken the design process early on," Thomson says.

BAE Systems is providing IFF transponders for jet fighter-bombers, helicopters, trainer aircraft, and transport aircraft.

BAE Systems to provide avionics IFF transponders in $18.3 million deal

BY **John Keller**

PATUXENT RIVER NAS, Md. — U.S. Navy avionics experts are asking the BAE Systems Electronic Systems segment in Greenlawn, N.Y., to provide hundreds of identification-friend-or-foe (IFF) transponders for military aircraft under terms of an $18.3 million order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are awarding this contract modification to BAE Systems, which involves IFF transponders for jet fighter-bombers, helicopters, trainer aircraft, and transport aircraft. IFF transponders transmit coded messages that identify aircraft as friendly and determines their range and bearing from ground- or air-based interrogators.

The order calls for BAE Systems to provide 300 Mode 5 capable AN/APX-117A, 118A, and 123A(V) common identification friend or foe digital transponder systems and shop-replaceable assemblies for Navy and U.S. Army aircraft.

The AN/APX-117A(V), AN/APX-118A(V), and AN/APX-123A(V) are part of the BAE Systems common transponder (CXP) family that is the Navy's and Army's standard transponder for all new military aircraft and aircraft upgrades.

The transponders are built on an open-system architecture and high-density field-programmable gate array (FPGA) technology that provides for system flexibility and future systems improvements through software-only upgrades.

The CXP family of IFF transponders is configured to replace all AN/APX-100, AN/APX-101, AN/APX-108, AN/APX-64, AN/APX-72 and AN/UPX-28 transponders. Each CXP transponder weighs less than 12 pounds with embedded cryptography, and measures 5.375 by 5.375 by 8.375 inches. Their radio control units measure 5.25 by 5.75 by 3 inches.

On this contract BAE Systems will do the work in Greenlawn, N.Y.; and Austin, Texas, and should be finished by May 2023. For more information contact BAE Systems Electronic Systems online at www.baesystems.com, or Naval Air Systems Command at www.navair.navy.mil.

RF and microwave filters that meet MIL-PRF-28861 introduced by TTE Filters

TTE Filters in Gowanda, N.Y., is introducing Instec Filters brand ML61 EMI/RFI filters for high-performance military electronic systems to suppress and reduce broadband radio frequency interference which otherwise would compromise system performance. ML61 EMI/RFI filters are qualified to the U.S. military MIL-PRF-28861 military standard, and are for military communications devices, oscillators, attenuators, and low-noise amplifiers. The electrical characteristic ranges of these lowpass, feed-through, C-circuit, solder-in ML61 filters include rated voltage from 50 volts DC to 200 volts DC, capacitance from 10 to 15,000 picofarads, and minimum insertion loss from 3 to 60 decibels. The RF and microwave filters operate in temperatures from -55 to 125 degrees Celsius, and are hermetically glass sealed at one end and epoxied at the other end, with the location of the glass seal dependent on the particular configuration. In conformance with the MIL-PRF-28861, the company can provide these filters in configuration A (ML610) or configuration B (ML611). The main body of each part measures 0.128 inches in diameter, the main body height is 0.110 inches, and the overall tip-to-tip length is 0.625 inches. For more information contact TTE Filters online at www.tte.com.

Signal amplifier for HF low-distortion waveform uses offered by Saelig

Electronics distributor Saelig Co. Inc. in Fairport, N.Y., is introducing the Tabor A10200-DST wideband signal amplifier for high frequency, low-distortion waveform amplification for any signal source that needs an extended power boost. The high-frequency amplifier module has 100 kHz to 20 GHz bandwidth, a gain of 8-10x, an output power of +30dBm into 50 ohms, and transition times shorter than 10 nanoseconds. Housed in a compact all-metal case, the stand-alone A10200-DST HF amplifier is an RF signal generator accessory for arbitrary and other signal generators with output limitations that can be prohibitive for applications requiring larger output. The A10200-DST HF amplifier can expand the usefulness of many RF signal generators. The A10200-DST comes with a factory-supplied 100-to-240-volt AC power supply and is made in Israel by Tabor Electronics. For more information contact Saelig online at www.saelig.com.

RF over fiber communications chassis introduced by ViaLite

ViaLite Communications in Washington is introducing a Blue OEM RF over fiber 1U chassis able to hold as many as eight ViaLite Blue OEM modules for fixed satellite communications (SATCOM) earth stations and teleports; telemetry, tracking and command; timing and synchronization; marine antennas; and broadcast facilities. The chassis operates as an RF over fiber transmitter, receiver, or both for uplink and downlink operations. It is a 1U high chassis, and supports high-throughput operations and enables signal transmission across longer distances that is possible with coaxial cable. The high-speed communications chassis has a removable rear tray for hot-swapping the fiber modules, which can be removed and inserted without shutting down the system. Using an external 12-volt power supply means powering the chassis can be done by 12-volt laptop-style power supplies with a 2.1-millimeter jack power connector. For more information contact ViaLite Communications online at www.vialite.com.

Saab to build air traffic control radar for carriers and big-deck amphibs

BY **John Keller**

PATUXENT RIVER NAS, Md. — U.S. Navy shipboard surveillance experts are ordering three AN/SPN-50(V) 1 shipboard air traffic radar systems from Saab Inc. in East Syracuse, N.Y., to replace the Navy's AN/SPN-43C radar aboard aircraft carriers and amphibious assault ships.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $31.7 million order to Saab as part of the AN/SPN-50(V) 1 radar low-rate initial production (LRIP).

The AN/SPN-50(V) 1 radar enables shipboard air traffic controllers to identify, marshal, and direct aircraft within a 50-nautical-mile radius of the ship.

In recent years, the top 25 percent of the AN/SPN-43C frequency band has been reallocated to the fixed wireless access community prohibiting air traffic control and air search radar operation within 50 nautical miles of the coast, Navy officials say.

The AN/SPN-50(V)1 radar is one of the U.S. versions of Saab's Sea Giraffe agile multi beam radar, functions as the primary air traffic control surveillance radar for manned and unmanned aviation aboard the Navy's aircraft carriers and large-deck amphibious assault ships

On this contract Saab will do the work in Syracuse, N.Y., and should be finished by December 2022. For more information contact Saab Inc. online at www.saab.com, or Naval Air Systems Command at www.navair.navy.mil.

Saab is building three AN/SPN-50(V) 1 shipboard air traffic radar systems to replace the Navy's AN/SPN-43C radar aboard aircraft carriers and amphibious assault ships.

Northrop Grumman to build EW with soft kill capability for surface warships

BY **John Keller**

WASHINGTON — U.S. Navy surface warfare experts are ordering advanced electronic warfare (EW)systems for aircraft carriers and amphibious assault ships under terms of a $74.8 million contract announced in May.

Officials of the Naval Sea Systems Command in Washington are asking engineers at the Northrop Grumman Corp. Mission Systems segment in Linthicum Heights, Md., to build the Surface Electronic Warfare Improvement Program (SEWIP) Block 3 electronic attack systems and hardware design modifications for aircraft carriers and amphibious assault ships.

SEWIP is an evolutionary acquisition program to upgrade the existing out-of-production AN/SLQ-32(V) surface warship EW system and provide improved anti-ship missile defense and situational awareness.

Northrop Grumman won $267 million Navy contract in 2015 to develop and build SEWIP Block 3 to make further upgrades to the AN/SLQ-32 with new technologies for early detection, signal analysis, threat warning, and protection from anti-ship missiles. There are three established SEWIP block upgrades and a fourth is planned.

The SEWIP Block 3 uses active electronically scanned array (AESA) antennas based on gallium nitride (GaN) transmit and receive modules.

Soft kill refers to altering the electromagnetic signature of friendly ships and other targets to confuse or interfere with enemy radar targeting systems.

The Lockheed Martin Rotary and Mission Systems segment in Liverpool, N.Y., is building the SEWIP Block 2 surface warfare EW system, which provides improved electronic support receivers and combat system interface and expands the receiver and antenna group to help surface electronic warfare capabilities keep pace with growing threats.

On this contract Northrop Grumman will do the work in Baltimore and White Marsh, Md.; Tampa, Fla.; Andover and Chelmsford, Mass.; Rochester, N.Y.; San Diego, El Cajon, Los Angeles, and Glendale, Calif.; Winona and Minneapolis, Minn.; Stafford Springs, Conn; Glendale, Ariz.; Nashua, N.H.; Elk Grove Village and Woodridge, Ill.; Tucson and Chandler, Ariz.; Washington, N.C.; Richardson, Texas; Hiawatha, Iowa; Littleton, Colo., and other U.S. locations, and should be finished by October 2023.

For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Navy orders six Raytheon airborne radar systems for Marine Corps aircraft

BY **John Keller**

PATUXENT RIVER NAS, Md. — Radar experts at Raytheon Technologies Corp. will provide the U.S. Marine Corps with six AN/APG-79(V)4 active electronically scanned array (AESA) airborne radar systems under terms of a $20 million order.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Raytheon Intelligence & Space segment in El Segundo, Calif., for replacement AESA radar systems for the Marine Corps F/A-18C/D Hornet carrier-based jet fighter-bomber.

The AN/APG-79(V)4 is a scaled version of the AN/APG-79 AESA radar for the U.S. Navy Boeing F/A-18E/F fighter-bomber and EA-18G Growler carrier-based electronic warfare jet. It provides aircrew situational awareness, near-instantaneous track updates, and multi-target tracking capability.

The order includes software, obsolescence management, engineering support, and technical, financial, and administrative data necessary for retrofit integration into the Marine Corps F/A-18C/D combat aircraft.

The AN/APG-79(V)4 radar is 90 percent compatible with the larger AN/APG-79 radar, and is designed to fit into the Navy Boeing F/A-18E/F Super Hornet and EA-18G Growler aircraft as part of a modernization program. It provides extended detection range, simultaneous air-to-air and air-to-ground mode capabilities, high resolution synthetic aperture radar (SAR) mapping, and high reliability.

The APG-79 radar has an open-systems architecture and rugged commercial-off-the-shelf (R-COTS) parts. Its array has solid-state transmit and receive modules for enhanced reliability, as well as an advanced receiver/exciter, ruggedized R-COTS processor, and power supplies.

The APG-79 AESA airborne radar uses transmit/receive (TR) modules populated with gallium arsenide (GaAs) monolithic microwave integrated circuits (MMICs). Presumable these are some of the electronic modules that Boeing experts will modify with updated electronics to mitigate obsolescence issues.

The radar's active electronic beam scanning helps steer the radar beam at nearly the speed of light to optimize situational awareness and air-to-air and air-to-surface capability, Raytheon officials say. The agile beam enables the multimode radar to interleave in near-real time, so that pilot and crew can use both modes simultaneously.

The first flight of a C/D Hornet fitted with this AESA radar was in January 2015, and the Marine Corps chose the AN/APG-79(V)4 radar in January 2019 to upgrade its legacy F/A-18C/D aircraft fleet. The radar enables the Hornet jet to fire several missiles at once and guide them to different targets that are widely spaced in azimuth, elevation, or range.

Raytheon is building six replacement AESA radar systems for Marine Corps F/A-18C/D Hornet carrier-based jet fighter-bombers.

On this order Raytheon will do the work in Forest, Miss.; El Segundo, Calif.; Andover, Mass.; and Dallas, and should be finished by next November. For more information contact Raytheon Intelligence & Space online at www.rtx.com/Our-Company/Our-Businesses/RIS, or Naval Air Systems Command at www.navair.navy.mil.

Lockheed Martin to design submarine electronic warfare (EW) to detect enemy radar

BY **John Keller**

WASHINGTON — Submarine combat systems experts at Lockheed Martin Corp. will design and test U.S. Navy AN/BLQ-10 electronic warfare (EW) systems for Navy submarines under terms of an $11.7 million order announced in April.

Officials of the Naval Sea Systems Command in Washington are asking the Lockheed Martin Rotary and Mission Systems segment in Syracuse, N.Y., for the design, prototyping, and qualification testing of submarine electronic warfare equipment.

The order involves a modification to a potential $970.1 million 10-year contract announced in February 2.19 for Lockheed Martin to design, upgrade, and support the AN/BLQ-10 submarine EW system technology insertion cycles TI-20, TI-22, and TI-24.

The AN/BLQ-10 provides automatic detection, classification, localization, and identification of potentially hostile radar and communications signals at sea.

The AN/BLQ-10 helps Virginia-, Los Angeles-, and Seawolf-class fast-attack submarines, Ohio-class conventional guided-missile submarines, and future Columbia-class ballistic-missile submarines detect enemy radar and communications. It is not for existing Ohio-class ballistic-missile submarines.

The AN/BLQ-10 processes signals from the submarine's imaging mast or periscope when the boat is at periscope depth. It provides threat warning to avoid counter-detection and collision; determines the number and location of targets for subsequent prosecution; and conducts intelligence, surveillance, and reconnaissance (ISR) to support the fleet or battle group.

The AN/BLQ-10 provides automatic detection, classification, localization, and identification of potentially hostile radar and communications signals at sea.

The program is adopting an open-architecture, incremental development process that fields hardware and software technology insertions every two years. The AN/BLQ-10 blends modular interoperable systems that adhere to open standards with published interfaces.

The system's first technology insertion in 2008 added a subsystem to intercept some low-probability-of-intercept radar signals. Fielded upgrades from the 2010 technology insertions updated commercial off-the-shelf (COTS) processors and displays, and Improved Communications Acquisition and Direction Finding (ICADF) system.

For TI-20, Lockheed Martin built an upgraded AN/BLQ-10 for Virginia- and Columbia-class submarine new construction, and in-service Virginia-class modernization.

TI-22 work upgraded AN/BLQ-10 systems for in-service Los Angeles- and Seawolf-class attack submarines, as well as for Ohio-class conventional missile submarines. TI-24 work builds an upgraded AN/BLQ-10 for Virginia-class and Columbia-class new construction, as well as for in-service Virginia-class modernization.

On this order Lockheed Martin will do the work in Syracuse, N.Y., and should be finished by February 2022. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or Naval Sea Systems Command at www.navsea.navy.mil.

EMBEDDED COMPUTING

Northrop Grumman to use open-systems architecture in missile guidance processor card

Missile experts at Northrop Grumman Corp. will design a new guidance processor circuit card assembly for the U.S. military AGM-88G radar-killing missile, according to a sole-source order announced in April.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Northrop Grumman Mission Systems segment in Woodland Hills, Calif., to design, develop, and complete prototype testing of a new guidance processor circuit card for the AGM-88G Advanced Anti-Radiation Guided Missile-Extended Range (AARGM-ER).

The new circuit card is part of a form, fit, and function replacement in the control section of the AARGM-ER. For this project Northrop Grumman experts will use the open-systems architecture approach. The value of the order has yet to be negotiated.

The missile upgrade project also includes the integration and delta qualification of the NAVSTRIKE-M Global Positioning System (GPS) receiver and reprogramablity functionality on completion of an advanced configuration of the AGM-88E anti-radar missile.

The new circuit board design for the AARGM-ER will address parts obsolescence, system security enhancements, reprogramablity, and support future growth capabilities using an open-systems architecture. Improvements will be cut into the AGM-88G production during low-rate initial production (LRIP) III.

The Navy is awarding this order to Northrop-Grumman sole-source because the company, as the AARGM-ER prime contractor, is considered to be the only responsible source and no other supplies or services will satisfy military requirements.

The AGM-88G AARGM-ER is a new and advanced radar-killing missile designed to enable the Navy F/A-18G Growler and F-35C jet fighter-bombers, as well as the U.S. Air Force F-35A jet fighter-bomber, to suppress enemy air defenses preceding bomber attacks.

The AARGM-ER is an advanced and extended-range version of the High-Speed Anti-Radiation Missile (HARM). It is a new variant of the AGM-88E missile that equips Navy carrier-based fighter-bombers and electronic warfare jets. HARM was a replacement for the AGM-45 Shrike anti-radiation missile, which was in service from 1965 to 1992.

AARGM is a supersonic, medium-range, air-launched tactical missile compatible with U.S. and allied strike aircraft. The AARGM-ER missile features several upgrades to the AGM-88E that focus on extending the weapon's operational range and survivability.

The AARGM-ER replaces the missile's rocket motor and tail to increase its range, while keeping the sensors and electronics of the AARGM-88E, which are being upgraded in a separate project. The AARGM-ER missile is scheduled to achieve initial operating capability (IOC) and start being fielded to Navy squadrons in 2023.

AARGM-ER uses the existing guidance system and warhead of the AGM-88E with a solid integrated rocket-ramjet for double the range. The new missile uses the AARGM's warhead and guidance systems, and uses a more powerful propulsion system that reportedly increases range over the AGM-88E by 20 to 50 percent, which would give the AGM-88G a range of about 96 to 120 nautical miles.

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

AVIONICS

Collins Aerospace to build tactical air navigation receiver transmitter avionics

U.S. military avionics experts needed tactical air navigation receiver-transmitters for a variety of Air Force aircraft. They found their solution from Raytheon Technologies Corp.

Officials of the Defense Logistics Agency (DLA) in Warner Robins, Ga., announced a $12 million contract to the Raytheon Collins Aerospace segment in Cedar Rapids, Iowa, last month to build ARN-153 Tactical Air Navigation receiver transmitters.

The AN/ARN-153, which Collins Aerospace calls the TCN-500, is an airborne receiver-transmitter component of the Tactical Airborne Navigation (TACAN) avionics system. It measures the slant-range distance and relative bearing to a selected ground station or an airborne beacon and computes velocity and time-to-go to that station.

The TCN-500 has been installed in cargo, fighter, bomber, trainer, and rotary-wing aircraft for the U.S. military services and for militaries around the world.

The AN/ARN-153(V) supports four modes of operation: receive mode; transmit-receive mode; air-to-air receive mode; and air-to-air transmit-receive mode.

When used with the optional 938Y-1 rotating antenna and a control unit, the receiver-transmitter system also provides bearing to an air-to-air TACAN that is transmitting an unmodulated squitter, and bearing to DME-only ground stations.

Digital interfaces include dual MIL-STD-1553B buses and ARINC 429, 568, or 582 buses providing range, bearing, frequency, velocity, and time-to-station.

For more information contact Raytheon Collins Aerospace online at www.rtx.com/our-company/our-businesses/ca, or the Defense Logistics Agency-Warner Robins at www.dla.mil/Distribution/Locations/WarnerRobins.

SPACE ELECTRONICS

Northrop Grumman to advance PNT technologies for secure communications satellites

Satellite systems designers at Northrop Grumman Corp. will help U.S. military researchers design a position, navigation, and timing (PNT) satellite payload for a future constellation of affordable communications and surveillance spacecraft.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $13.3 million contract in late April to the Northrop Grumman Mission Systems segment in Linthicum, Md., for phase 2 of the DARPA Blackjack initiative to orbit a constellation of small, secure, and affordable military satellites that capitalize on modern commercial satellite technologies.

PNT payloads will enable future Blackjack satellites to determine their positions above the Earth, as well as in relation to one another. Timing is crucial for satellite networks to send and receive accurate data.

The contract calls for Northrop Grumman to support phase 2 of the Blackjack program by advancing the company's PNT through emulation and critical design review, and build

PNT payload units destined for space flight, DARPA officials say.

Blackjack has three phases: defining bus and payload requirements; developing bus and payloads for a two satellite on-orbit demonstration; and demonstrating a two-plane system in low-Earth orbit for six months. A future Blackjack demonstration constellation will involve 20 spacecraft in two planes with one or more payloads on each satellite.

Also working on Blackjack phase 2 are Blue Canyon Technologies Inc. in Boulder Colo.; SA photonics Inc. in Los Gatos Calif.; and Systems & Technology Research LLC in Woburn Mass.

Blackjack seeks to develop low-cost space payloads and commoditized satellite buses with low size, weight, power, and cost (SWaP-C) with similar capabilities to today's military communications that operate at geosynchronous orbit (GEO), but at a fraction of the cost.

Military satellites are critical to U.S. warfighting capabilities. Traditionally they are placed in GEO to deliver persistent overhead access to any point on the globe.

Yet in the increasingly contested space environment, these costly and monolithic systems are vulnerable targets that would take years to replace if degraded or destroyed. Moreover, their long development schedules make it difficult or impossible to respond quickly to new threats.

The Blackjack program seeks to develop enabling technologies for a global high-speed network backbone in LEO that enables networked, resilient, and persistent military payloads that provide infinite over-the-horizon sensing, signals, and communications capabilities.

Historically, U.S. Department of Defense (DOD) satellites have been custom-designed, with lengthy and expensive design and upgrade cycles. The evolution of commercial space, however, has led to LEO broadband Internet communications satellites that could offer attractive economies of scale.

The Blackjack program emphasizes a commoditized bus and low-cost interchangeable payloads with short design cycles and frequent technology upgrades, based on a 'good enough' payloads optimized for more than one type of bus.

Commoditized satellite buses based on open-architecture electrical, software, and mesh network interface control could provide a way for dozens or hundreds of different types of military satellite payloads to operate in low-Earth orbit, DARPA officials say.

For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or DARPA at www.darpa.mil.

SIMULATION AND TRAINING

Top Aces provides combat simulation and training for German military pilots

The Bundeswehr German armed forces needed fast-speed adversary air training services for the nation's combat pilots. They found their solution from Top Aces Inc. in Dorval, Quebec.

Top Aces will provide advanced airborne training to the Bundeswehr starting on 1 Jan. 2022 at Wittmundhafen Air Base in Wittmund, Germany.

Top Aces specializes in air combat training by providing adversary air services, which the company provides to the German and Canadian armed forces. The company will add more than 20 employees to carry out air training in Germany, company officials say.

Top Aces uses the Lockheed Martin F-16A jet fighter, Douglas A-4 Skyhawk light-attack

jet, the Dornier Alpha Jet light-attack aircraft and jet trainer, and the Bombardier Learjet 35A business jet to carry out combat pilot training.

Top Aces is introducing advanced new capabilities for adversary air industry, including a proprietary Advanced Aggressor Mission System (AAMS) with active electronically scanned array (AESA) radar and infrared search-and-track (IRST) systems on a variety of aircraft.

The AAMS provides its host aircraft with simulation of advanced capabilities for modern-day opponents in air-to-air combat. The company is delivering AAMS missions to Germany and is demonstrating this capability to potential customers in North America and Europe.

Top Aces also provides joint terminal attack controller (JTAC) training. For more information contact Top Aces online at www.topaces.com.

MISSION COMPUTERS

General Dynamics to add fourth processor to Super Hornet avionics computers

Military avionics experts at General Dynamics Corp. will upgrade U.S. Navy upgrade aircraft computers for the F/A-18E/F Super Hornet and EA-18G Growler combat aircraft under terms of a $13.1 million contract announced last month.

Officials of the Naval Air Warfare Center's Aircraft Division at Patuxent River Naval Air Station, Md., are asking the General Dynamics Mission Systems segment in Minneapolis to add a fourth general purpose processor (GPP) to Navy-owned Type 3 Advanced Mission Computers (AMC) to create a Type 3 extra processor.

The contract also asks General Dynamics to upgrade of all the Warfare Management Computer A11 cards with mission system computer equivalent GPPs in support of Advanced Mission Computer and Display.

The General Dynamics Type 3 AMC is for the Super Hornet and Growler aircraft, as well as The Mission Systems Computer (MSC) for the AV-8B Harrier jump jet.

The AMC is a rugged embedded computer that performs general-purpose, I/O, video, voice, and graphics processing. Communication is over several buses, including 1553, Fibre Optic Fibre Channel, and Local PCI.

Single-board computers and other modules in the AMC fit in an industry standard 6U VME backplane, and the I/O configuration may be tailored with PMC mezzanine card (PMC) modules. An Ethernet interface supports software development and system maintenance.

The AMC's core system software (CSS) is a real-time operating system with embedded system software, application program interface, and diagnostic software set for the AMC. The computer's I/O includes MIL-STD-1553 drivers, Fibre Channel drivers, VMEbus drivers, and discrete and serial I/O drivers.

The AV-8B's mission computer is a VME-based processing system based on the Freescale Power-PC open-systems processor architecture. The mission computer can control mission computers and displays, digital maps, network processors, and servers.

The latest version of the F/A-18 mission computer is the AMC Type 4, which first was flight tested in 2012. Type 4 AMC increases computing power and accelerates image and mission processing functions, Boeing officials say.

Those advances will support new systems and future systems aboard the aircraft, including a distributed targeting system, infrared search and track, and a new high-definition touch-screen display.

The AMC is the nerve center of the Navy Super Hornet. The commercial off-the-shelf (COTS)-based, open-systems architecture product is configurable to many operating environments.

The flight and mission computer is designed to handle mission processing; sensor processing; display processing; stores management; and information management.

On this contract General Dynamics will do the work in Minneapolis and should be finished by April 2023. For more information contact General Dynamics Mission Systems online at https://gdmissionsystems.com, or the Naval Air Warfare Center Aircraft Division at www.navair.navy.mil/nawcad.

SENSORS

Navy asks Thales to build AN/AQS-22 dipping sonar for MH-60 ASW helicopters

Airborne anti-submarine warfare (ASW) experts at the Thales Group will build AN/AQS-22 Airborne Low Frequency Sonar (ALFS) systems for U.S. Navy MH-60R helicopter under terms of a $31 million contract.

Officials of the U.S. Defense Logistics Agency aviation branch in Richmond, Va., are asking Thales Defense & Security Inc. in Clarksburg, Md., to build airborne low frequency sonar system (ALFS) for the Navy MH-60R helicopters.

Thales designs and builds the AN/AQS-22 ALFS dipping sonar in partnership with the Raytheon Technologies Corp. Missiles & Defense segment in Portsmouth, R.I.

The AN/AQS-22 ALFS is the primary undersea warfare sensor of the MH-60R multi-mission helicopter. This integrated dipping sonar system enables the MH-60R to detect, pinpoint, track, and classify enemy submarines, and perform acoustic intercept, underwater communications, and environmental data acquisition.

The AN/AQS-22 has multi-frequency capability that enables the system to adapt its

performance to varying environmental conditions. With a rapid search rate, the AN/AQS-22 identifies and neutralizes threats quickly, and to cover a large area.

The AN/AQS-22 also permits a long detection range over a wide area, reducing the number of helicopter sorties necessary to perform active airborne ASW screening. The dipping sonar system weighs 600 pounds, has a strong, safe, and reliable reeling system, and built-in fault monitoring.

On this order Thales will do the work in France and Maryland, and should be finished by March 2024. For more information contact Thales Defense & Security online at www.thalesdsi.com, or the Defense Logistics Agency-Aviation at www.dla.mil/Aviation.

DATA RECORDERS

NASA picks Mercury Systems for data recorders on International Space Station

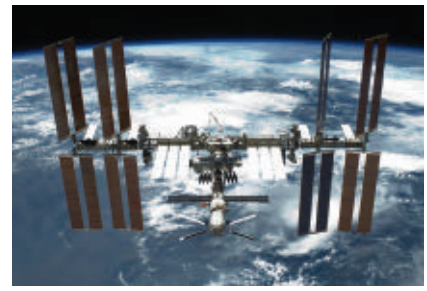
Space exploration experts at the U.S. National Aeronautics and Space Administration (NASA) in Washington needed solid-state data recorders for the NASA Earth Surface Mineral Dust Source Investigation (EMIT) science mission. They found their solution from Mercury Systems Inc. in Andover, Mass.

Officials of the NASA Jet Propulsion Laboratory (JPL) in Pasadena, Calif., have chosen Mercury to provide solid-state data recorders for the Earth Imaging Spectrometer test and measurement instrument, which is scheduled for launch to the International Space Station (ISS) in 2022.

The EMIT mission maps the surface mineralogy of arid dust source regions and aids in improving forecasts of the role of mineral dust in the warming or cooling of the Earth's atmosphere.

By mapping the composition from space of areas that produce mineral dust, EMIT will advance the understanding of dust's effects to the Earth system and to human populations now and in the future.

"Mercury's solid-state data recorders are purpose-built to support the need for



ultra-reliable and agile radiation-tolerant storage devices," says Chris Opoczynski, vice president and general manager of Mercury's data segment.

For more information contact Mercury Systems online at www.mrcy.com, or NASA JPL at https://earth.jpl.nasa.gov/emit.

RADIO COMMUNICATIONS

CACI, Perspecta Labs to develop enabling technologies for next-gen tactical radios

U.S. military researchers are asking two U.S. companies to develop secure radio frequency (RF) transmitter and receiver technologies to enable the next generation of secure military tactical radio systems.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has awarded contracts to CACI International Inc. in Florham Park, N.J.; and to Perspecta Labs Inc. in Basking Ridge, N.J., for the Wideband Secure and Protected Emitter and Receiver (WiSPER) project.

CACI won a $30.7 million contract, and Perspecta Labs won a $19.2 million contract. The companies are participating in the project's first phase, by carrying the WiSPER system architecture through a conceptual design supported by modeling and simulation, culminating in a benchtop implementation and lab test. More WiSPER phase-one contracts may be awarded.

Today's military secure tactical radios achieve security by spreading transmitted content over time and operating frequency in attempts to reduce transmitted power density and operate below the adversary's receiver detection limit.

Still, spread-spectrum techniques lack sufficient complexity to evade detection by modern signals intelligence (SIGINT) receivers or interception by compromised devices. Today's secure military tactical radio systems are vulnerable to hypersensitive and collaborative receivers.

Hypersensitive receivers use cryogenic-cooled energy detectors and cyclostationary processing over prolonged observation time to increase detection sensitivity by reducing uncorrelated noise. This technique reveals chip rate and modulation format to establish spread-spectrum transmissions. Collaborative receivers, meanwhile, involve multi-receiver networks that coherently recombine power to detect the transmitter.

Today's spread-spectrum approaches have several limitations. Narrowband signals are only spread in the time and frequency domains and contain cyclic features, for example. Narrowband RF waveform typically use fixed and limited dynamic range of less than 30 decibels, leading to the inability to remain undetectable while providing persistent communications.

New chaotic waveforms that reduce cyclic features only provide marginal reduction of detectability, require higher signal-to-noise ratios to synchronize and operate, and are not sufficiently featureless to evade detection. Directional beams and reconstruction of coherent scattered signals, in addition, are impractical for today's tactical radios.

While spread-spectrum techniques minimize the signal strength to avoid detection, today's tactical radios face additional operational challenges from channel impairments that reduce the link margin of the radio.

With fixed operational frequency and bandwidth, existing tactical radios provide limited options and margins to sustain persistent transceiver operations under varying and unpredictable natural and man-made channel impairments.

Instead, the WiSPER program seeks to develop fundamentally disruptive wireless air interface transceiver technology to enable and sustain secure high-bandwidth RF communication links. The WiSPER wideband adaptive air interface also will mitigate impairment from dynamic harsh and contested environments to maintain a stable communication link.

DARPA researchers anticipate that WiSPER capabilities also will provide future U.S. warfighters with a dominant technology advantage over their adversaries. Researchers want radios small enough for portable or ground installations.

WiSPER will be a four-year, three-phase program with an 18-month first phase, an 18-month second phase, and yearlong third phase. Several phase-one contracts are expected, with a reduced number of participants in the second and third phases.

Phase 1 performers will carry the WiSPER system architecture through a conceptual design supported by modeling and simulation, culminating in a benchtop implementation and lab test.

Phase 2 performers will improve the design, culminating in a transportable implementation and field test. Phase 3 performers will further optimize the air interface to demonstrate adaptation to weather and other impairments in a portable prototype implementation.

For more information contact CACI International online at www.caci.com, Perspecta Labs at https://www.peratonlabs.com, or DARPA at www.darpa.mil.

REAL-TIME SOFTWARE

Green Hills helps usher-in new era of safety-critical software for multicore avionics

The INTEGRITY-178 tuMP multicore real-time software represents a new chapter in certifying multicore computer processors for safety-critical commercial and military avionics systems.

The INTEGRITY-178 tuMP developer, Green Hills Software in Santa Barbara, Calif., has announced that the INTEGRITY-178 tuMP multicore real-time operating system (RTOS) software is part of a multicore certification to RCTA/DO-178C and CAST-32A international commercial aviation standards.

The certification is part of a Technical Standing Order (TSO) authorization for the PU-3000 avionics computer from CMC Electronics Inc. in Montreal. The certification included evidence of meeting all CAST-32A requirements for multicore processors.

The RCTA/DO-178C and CAST-32A standards certify avionics subsystems like flight computers for safety-critical uses aboard commercial passenger aircraft used throughout the world. These certifications rarely, if ever, have applied to multicore processors before now.

Historically, avionics for commercial passenger aircraft have been discouraged from using today's advanced multicore processors because of the difficulty in certifying these powerful computer chips for safe operation on commercial planes.

The PU-3000 series of avionics computers is the fourth generation of avionics computers from CMC Electronics and is fit for the civil and military retrofit markets. Modular by design, the multicore PU-3000 is suitable for use as a computer in a large variety of functions.

"CMC Electronics selected the INTEGRITY-178 tuMP RTOS after determining that it uniquely provides the robust partitioning, resource configuration, and certification support required for CMC's next-generation of multicore avionics products," says Don Paolucci, vice president of engineering, at CMC Electronics.

"INTEGRITY-178 tuMP reduces development and integration costs for CMC and our customers by providing full support for multicore processing with mixed-criticality applications up to DO-178C DAL A airborne safety requirements and certified conformance to the FACE Technical Standard," Paolucci says.

The CMC PU-3000 enables commercial aircraft avionics to host combinations of several levels of applications simultaneously into one box varying from primary flight display, navigation display, flight management systems, radio management systems, and flight director systems.

The PU-3000-series certification came from Transport Canada Civil Aviation (TCCA), with reciprocal acceptance from the U.S. Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA).

CMC's avionics computers can host several high-performance software applications developed to design assurance levels ranging up to RTCA DO-254 and EUROCAE Document ED-80 Design Assurance Levels (DAL) A — flight electronics hardware whose failure or malfunction could cause a catastrophic, hazardous, or severe condition that would result in the deaths of everyone aboard the aircraft.

INTEGRITY-178 tuMP is a multicore RTOS with support for running a multi-threaded DAL A application across multiple processor cores in symmetric multi-processing (SMP) or bound multi-processing (BMP) configurations, as well as supporting the more basic asymmetric multi-processing (AMP).

INTEGRITY-178 tuMP is certified to the FACE Technical Standard, edition 3.0, and offers multicore interference mitigation for all shared resources. Multicore interference happens when more than one processor core attempts simultaneous access of a shared resource, such as system memory, I/O, or the on-chip interconnect.

For more information contact Green Hills Software online at www.ghs.com, or CMC Electronics at https://cmcelectronics.ca.

DARPA eyes artificial intelligence (AI) for high-end video processing at the edge

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are trying to reduce the complexity and enhance the efficiency of artificial intelligence (AI) video processing to enable the use of high-end vision sensing with embedded computing hardware at the leading edge of the battlefield.

Experts aim to do this by designing front-end AI algorithms into imaging sensor pixels to reduce the high data streams typical in conventional image processing by at least 10 times.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a solicitation last month (DARPA-PA-20-02-09) for the In-Pixel Intelligent Processing (IP2) project.

The solicitation, called an artificial intelligence exploration opportunity, focuses on low-power data extraction at the tactical edge.

The IP2 video processing project seeks to reclaim the accuracy and functionality of deep neural networks in power-constrained sensing by developing AI algorithms matched to in-pixel mesh processing layers to bring the front end of the neural network into the sensor pixels and inject intelligence into the data stream at the sensor edge.

IP2 will enable efficient and embedded 3rd-wave AI for object detection and tracking in large-format high-frame-rate vision sensors. New front-end AI algorithms designed into the sensor pixels will learn saliency through the statistics in the data to create a reduced data-stream that enables 10x more efficient compact AI processing.

Experts want to design front-end AI algorithms into imaging sensor pixels to reduce the high data streams typical in conventional image processing by at least 10 times.

The IP2 program seeks to bring the front end of the neural network into the pixel, to identify salient information, and simplify video data at the source. Recent simulations have shown it may be possible to create in-pixel neural network structures that identify salient information and reduce the data complexity at low power and within the footprint of an individual pixel.

IP2 also will implement closed-loop task-oriented algorithms on embedded computing hardware like field-programmable gate arrays (FPGAs). Recent evidence from a DARPA Joint University Microelectronics Program (JUMP) exploration suggests that creating structure in the video data stream can enable hardware specialization, higher efficiency, and new functionality for processing 3rd-wave AI perception models.

The first phase of the IP2 project will develop front-end AI task-oriented saliency and dimensionality reduction algorithms and train neural network architecture on full HD frames showing a 10x reduction in dimensionality and data bandwidth; and design in-pixel neural network circuits able to run these algorithms.

The project's second phase will design an in-pixel mesh hardware emulation; demonstrate emulated 250 milliwatt per megapixel for a full-format sensor with programmable in- pixel circuitry; develop a test bed; and make plans to fabricate the full-format sensor.

Companies interested were asked to upload proposals by 3 June 2021 to the DARPA BAA website at https://baa.darpa.mil. Email questions or concerns to Whitney Mason, the IP2 program manager, at IP2@darpa.mil. More information is online at https://beta.sam.gov/opp/64ae26eed1f446588bf2bdc5e1e2c936/view.

Kongsberg to build remote-control weapons stations for combat vehicles

BY **John Keller**

NEWARK, N.J. — Weapons automation experts at Kongsberg Defence & Aerospace AS in Kongsberg, Norway, will build remote-control weapons stations for U.S. Army armored combat vehicles under terms of a $499.2 million order announced in May.

Officials of the U.S. Army Contracting Command in Newark, N.J., are asking Kongsberg to build the Common Remotely Operated Weapon Station (CROWS) system, which company experts refer to as the Protector family of remote weapon systems.

The Kongsberg Protector system is suitable for many kinds of military missions, whether on land or at sea. Integrated as mobile or static versions, CROWS enables warfighters to operate several kinds of weapons remotely from safely inside the vehicles.

The Protector family includes the RS2, RS4, and RS6 remote weapon stations, which accommodate weapons that range from 5.56-millimeter light machine guns to 30-millimeter light cannons. The system also includes the remote turrets.

Among the Protector family is the U.S. military CROWS system of remote weapon stations for U.S. Army vehicle programs. CROWS is a stabilized weapons mount that contains an electro-optical sensor suite and fire-control software to enable on-the-move target acquisition and first-burst target engagement.

The CROWS system for armored combat vehicles also features programmable target reference points for several locations, programmable sector surveillance scanning, automatic target ballistic lead, automatic target tracking, and programmable no-fire zones.

Future enhancements will include integration of other weapons, escalation-of-force systems, sniper detection, integrated 360-degree situational awareness, increased weapon elevation and commander's display.

CROWS enables the warfighter to engage targets remotely from safely inside their vehicles with precision fire while on the move or stationary to the maximum effective range of the weapon.

Able to attack targets day or night, the CROWS sensor suite includes a thermal camera, and laser rangefinder. CROWS is designed to mount on any Army tactical vehicle and supports the MK19 grenade machine gun, M2 .50 caliber machine gun, M240B machine gun, and M249 squad automatic weapon.

CROWS is a stabilized weapons mount with electro-optical sensor suite and fire-control software to enable on-the-move target acquisition and engagement.

On this order Kongsberg will do the work at locations to be determined with each order, and should be finished by September 2023. For more information contact Kongsberg Defence & Aerospace online at www.kongsberg.com/kda.

Lockheed Martin to build AGM-114 laser-guided Hellfire II air-to-ground missiles

BY **John Keller**

REDSTONE ARSENAL, Ala. — U.S. Army missile experts are asking Lockheed Martin Corp to build more than half a billion dollars worth of AGM-114 laser-guided Hellfire II missiles, which can be launched from manned and unmanned aircraft, surface ships, and military ground vehicles.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., announced a $663.7 million contract to the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., to provide Hellfire II missiles.

The AGM-114R is the latest Hellfire II variant, and is equipped with semi—active laser seekers to defeat many kinds of targets. The AGM-114R can be launched from several different kinds of fixed-wing aircraft and helicopters, surface ships, and military ground vehicles.

Hellfire II also is the missile of choice for several kinds of unmanned aerial vehicles (UAVs) such as the MQ-1B Predator, MQ-9 Reaper, and MQ-1C Grey Eagle. Eventually these missiles may arm U.S. military unmanned helicopters.

The Hellfire II will be replaced early this decade by the Lockheed Martin AGM-179 Joint Air-to-Ground Missile (JAGM) semi-active-laser- and millimeter-wave-radar-guided missile. JAGM also will replace the BGM-71 TOW, and AGM-65 Maverick missiles for launch from Army AH-64 Apache attack helicopters, the Army MQ-1C Gray Eagle UAV, the Navy MH-60R helicopter, and the Marine Corps AH-1Z Viper attack helicopter.

The Hellfire missile weighs 106 pounds, and has high-explosive variants designed to destroy tanks and other armored vehicles, and blast fragmentation versions designed to destroy trucks, antenna sites, concentrations of enemy troops, and other soft targets.

Photo (above): The AGM-114R missile uses a semi-active laser guidance system and an integrated blast fragmentation sleeve warhead to engage targets that previously needed several Hellfire variants to destroy.

The AGM-114R Hellfire II Romeo RX missile uses a semi-active laser guidance system and an integrated blast fragmentation sleeve warhead to engage targets that previously needed several Hellfire variants to destroy.

These missiles can seek out their targets autonomously or with designation from remote laser designators. The missile has a three—axis inertial measurement unit to enable it to attack targets from the side and behind.

The AGM-114R can be launched from higher altitudes than previous variants because of its enhanced guidance and navigation capabilities. With its multi—purpose warhead, the missile can destroy hard, soft, and enclosed targets.

Originally developed as an anti-tank missile for the Army's AH-64 Apache attack helicopter, the Hellfire homes-in on the reflected light of a laser designator. Other versions of the Hellfire are radar-guided fire-and-forget weapons.

Development of the AGM-114R Hellfire missile became necessary after the Pentagon canceled the Joint Common Missile (JCM) project, which was to replace Hellfire, as well as the AGM-65 Maverick air-to-ground missile.

On this order Lockheed Martin will do the work in Orlando, Fla., and should be finished by September 2024. For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at https://acc.army.mil/contractingcenters/acc-rsa/.

Lockheed Martin to build electro-optical targeting for attack helicopters

BY **John Keller**

PATUXENT RIVER NAS, Md. — Electro-optics experts at Lockheed Martin Corp. are building 19 multi-sensor electro-optical and infrared (EO/IR) fire-control systems for AH-1Z Viper attack helicopters operated by Bahrain and the Czech Republic.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $49.7 million order to the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., for 19 AN/AAQ-30A target sight systems (TSS).

The TSS equipment was developed for U.S. Marine Corps Viper helicopter gunships as part of the Marine Corps H-1 upgrades program for the remanufacture of legacy aircraft with state-of-the-art designs to convert existing AH-1W SuperCobra attack helicopters to the AH-1Z Viper, Navy officials say.

The Lockheed Martin AN/AAQ-30 TSS provides target identification and tracking, passive targeting for integrated weapons — including Hellfire missiles — and a laser designation for laser-guided weapons. TSS provides can identify and laser-designate targets at the maximum ranges of Viper helicopter weapons.

The AN/AAQ-30 targeting system is a large-aperture midwave forward-looking infrared (FLIR) sensor, color TV, laser designator and rangefinder (with eyesafe mode), and on-gimbal inertial measurement unit integrated into a stabilized turret on the nose of the helicopter.

The AN/AAQ-30 has an 8.55-inch aperture, midwave staring FLIR with four fields-of-view for image resolution and long-range performance. Its gimbal is stabilized to less than 15 microradians.

The sensor suite has a multi-mode, multi-target tracker with coast-through-obscuration capability; on-gimbal inertial measurement unit for reduced image blur from jitter; and precise line pointing.

The sensor also has advanced image processing for sharp imagery; algorithms for enhanced image recognition and identification; high magnification; continuous zoom; and color TV with field-of-view matched to the FLIR.

The AN/AAQ-30 also has a cooled 640-by-512-pixel indium antimonide detector, as well as a modular architecture for future growth, Lockheed Martin officials say.

On this order Lockheed Martin will do the work in Orlando and Ocala, Fla.; Burlington, Ontario; Merrimack, N.H.; Santa Barbara, Calif., and other U.S. locations, and should be finished by January 2023.

Lockheed Martin is building electro-optical and infrared (EO/IR) fire-control systems for AH-1Z Viper attack helicopters.

For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com, or Naval Air Systems Command at www.navair.navy.mil.

Army seeks to move power of laser weapons from kilowatts to terawatts

The U.S. Army wants deadlier laser weapons that won't just burn a target, but rather will slice it up. Instead of low-power continuous-wave lasers that emit a steady stream of energy, the Army wants pulsed lasers that shoot intermittent but intense bursts that can quickly destroy a target. Pulsed lasers are already used commercially for precision cutting and etching. How big a difference will this make? Consider this: the Army plans to mount 50-kilowatt continuous-wave laser weapons on Stryker armored vehicles by 2023. A kilowatt is 1,000 Watts. The Army now wants to develop tactical ultrashort pulsed lasers with minimum peak power of one terawatt and a maximum of five terawatts. A terawatt is a trillion Watts. What makes laser weapons effective is how long the beam has to remain focused on the target. The ability to deliver a quick, intense burst of energy on a moving target is vital. While continuous-wave lasers can be useful, lasers with pulse widths in femtoseconds provide tactical capabilities due to their rapid discharge of enormous power, Army officials say.

Army's night vision goggles have sensors that outline targets

The U.S. Army Lancer Brigade tweeted footage of the new Enhanced Night Vision Goggle-Binoculars, showing troops walking in a field, and firing mortars and machine guns. Sensors in the Enhanced Night Vision Goggle-Binocular (ENVG) enable users to see through rain, fog, sleet, or dust, and also have a thermal setting that makes it effective during the day. The U.S. military does not have the monopoly on night vision that it once had, and now America's adversaries have easy access to some of the same technology. That means the Army produce better, more useful devices that can see better at night, share video feeds with other operators, and relay data from the battlefield. The ENVG's ability to outline silhouettes can help warfighters pick out targets peeking out from behind a barrier or tree. A soldier's goggles can display video feeds from the ENVG-B and the Family of Weapon Sights (FWS-I) at once to enable soldiers can see in two directions at the same time if they pointed their FWS-1 behind them or to the side.

Inertial measurement units (IMUs) for unmanned vehicles introduced by KVH

KVH Industries Inc. in Middletown, R.I., is introducing the P-1750 and P-1725 inertial measurement units (IMUs) for unmanned aerial vehicles, unmanned underwater vehicles (UUVs), remotely operated vehicles (ROVs), and platform stabilization. The KVH P-series IMUs come in a proven compact IMU housing, and offer dynamic sensor performance for navigation, and environmental robustness in vibration and shock capability. KVH's PIC technology features an integrated planar optical chip that replaces individual fiber-optic components to simplify production and increase reliability. KVH P-series IMUs are designed to deliver an order of magnitude better drift and noise performance than prior products and offer more than 10 times higher accuracy than less expensive micro electro mechanical systems (MEMS) inertial measurement units. KVH P-series IMUs feature flexible power and communications interfaces, and increased product life for challenging applications on land, sea, and air. The P-1750 IMU offers a choice of 10g or 30g accelerometers for unmanned and manned platforms. The P-1725 IMU is a compact, commercial IMU featuring PIC technology and 10g accelerometers for outstanding performance and serves as an affordable alternative to lower performing MEMS products. For more information contact KVH Industries online at www.kvh.com.

Army upgrading weapon sights with built-in camera and laser rangefinder

The U.S. Army is developing new weapon sights to go on machine guns and grenade launchers called the Family of Weapons Sights-Crew Served (FWS-CS) to enhance battlefield accuracy. Crucial to making the FWS-CS work are a built-in laser rangefinder, networking capability, and a computer that can calculate the ballistics of the shot. All the human operator has to do is align the sight with the target. The sight also includes thermal and infrared imaging to enable its use at night or in dust, smoke, or haze. The sight also is a high-definition camera. What sets the FWS-CS apart is its ability to synchronize with other systems and broadcast live images from the weapon sight to other head-borne systems over battlefield networking. Its built-in camera could connect to the operator's heads-up display to enable firing the weapon without leveling the scope to his own eyes.

Lockheed Martin readies laser weapons and optical dazzlers for Navy surface warships

BY **John Keller**

WASHINGTON — U.S. Navy surface warfare experts are working toward deploying powerful laser weapons aboard front-line Navy warships with a $20.1 million order announced in March to the Lockheed Martin Laser and Sensor Systems segment in Bothell, Wash.

Officials of the Naval Sea Systems Command in Washington are asking Lockheed Martin Laser and Sensor Systems (formerly Lockheed Martin Aculight) for technical engineering services and sustainment for the High Energy Laser With Integrated Optical Dazzler And Surveillance (HELIOS) system.

The HELIOS laser weapon and laser dazzler project is leading to deployment of this weapon aboard the Navy Arleigh Burke-class destroyer USS Preble later this year — possibly to be followed by other late-model Burke-class destroyers.

In 2018 Lockheed Martin won a $150 million contract to design and build two HELIOS test units — one unit for the destroyer USS Preble, and the other for land-based testing. The contract has options that could increase its value to nearly a billion dollars ($942.8 million).

Details of the HELIOS system are classified secret, yet the weapon is expected to have at least 65 kilowatts of power, and will be integrated with a lower-power optical dazzler to disable intelligence, surveillance, and reconnaissance sensors.

The laser's power ultimately could be increased to 100 or 150 kilowatts of power before widespread deployment aboard future Burke-class destroyers.

The HELIOS project is a natural outgrowth of the Navy's 30-Watt AN/SEQ-3 Laser Weapon System (LaWS), which was installed in 2014 aboard the Navy's USS Ponce, an Austin-class amphibious transport dock ship, where it proved itself able to defend the ship from unmanned aerial vehicles, small boats, and other small targets.

Initial versions of HELIOS will have at least twice the laser power of LaWS, and the system's power is likely to be increased in the future to enable destroyers and other front-line surface warships to defend themselves against swarms of fast boats, manned and unmanned aircraft, sophisticated anti-ship missiles, and perhaps even from ballistic missiles.

Late-model Burke destroyers are equipped with long-range missiles that can intercept and destroy ballistic missiles in various phases of flight.

While the HELIOS predecessor LaWS was developed as a prototype to test the feasibility of laser weapons in the ocean environment, HELIOS is being developed from its inception as a full-fledged laser weapon for Navy surface combatants.

On this order, Lockheed Martin will do the work in Bothell, Wash.; Moorestown, N.J.; Owego, N.Y.; Marion, Mass.; Clearwater, Fla.; Manassas, Va.; and other U.S. locations, and should be finished by September 2022.

The HELIOS laser weapon and laser dazzler project is leading to deployment of this weapon aboard the Navy Arleigh Burke-class destroyer USS Preble later this year.

For more information contact Lockheed Martin Laser and Sensor Systems online at www.lockheedmartin.com/en-us/capabilities/directed-energy.html, or Naval Sea Systems Command at www.navsea.navy.mil.

Industry considers climbing robots to create mesh network for jungle communications

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are asking industry to find ways of using small flying or climbing robots to enhance communications in dense, wet tropical jungles by establishing self-positioning 3D mesh communications for small-unit operations.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has released a Small Business Innovation Research (SBIR) opportunity (HR001121S0007-14) for the SQUad Intelligent Robotic Radio Enhancing Links (SQUIRREL) project.

SQUIRREL seeks to extend the range of wireless mobile communication in triple-canopy tropical rainforest to enable small teams of four to six warfighters to communicate easily not only among themselves, but also with battlefield commanders in other locations.

SQUIRREL anticipates using climbing, flying, or hybrids robots as radio relays to form self-positioning three-dimensional mesh communications networks in support of small unit operations such as reconnaissance.

Good communications for U.S. missions like hostage rescue, scouting, and training allies can be lost in difficult RF environments like jungles and caves, DARPA researchers point out. Small military units operating in triple-canopy jungle face particularly difficult conditions for mobile radio frequency (RF) communication because of attenuation from layers of wet foliage.

Photo (above): A mesh network created by moving robots may key to solving some of the difficulties of military communications in the jungle.

Yet it may be possible to form a dense, low size, weight- and power-consumption (SWaP) 3D mesh of radio communications relays that moves with squads of no more than eight members that helps squad members keep in touch, and keep higher-echelon commanders informed of their status.

These robot-assisted 3D mesh communications networks should be easy to deploy; function on long missions; low noise; low observable; and low probability of detection or intercept.

Small unit movement through a jungle environment means a SQUIRREL mesh must adapt continuously to new settings as it follows and supports the team. To avoid using RF power levels high enough to escape the jungle canopy, SQUIRREL nodes should use low-power RF and free-space optical communications as they move.

SQUIRREL phase-one will develop feasibility studies using reports and white papers based on existing work; test and measurement data; prototype designs; and performance projections. Phase 2 will develop climbing and flying robots with communications relays that weigh less than one pound each.

Some of these robots must include capabilities for locating, self-positioning, and free-space optical means to reach orbiting unmanned aerial vehicles (UAVs) or other overhead assets for reach-back communications.

SQUIRREL also could be useful in public service roles such as search and rescue in densely wooded areas in temperate zones — particularly in its reachback role. SQUIRREL also could provide commercial communications nodes in dense forests for drug formulation and counting endangered species.

Companies interested should submit proposals to the Defense SBIR/SSTR Innovation website no later than 29 June 2021 at https://www.dodsbirsttr.mil/submissions/login. Email questions or concerns to DARPA at HR001119S0035@darpa.mil with BAA number HR001119S0035-20 in the subject line. More information is online at https://beta.sam.gov/opp/4983dfa3040e44978de5fe8627cbef02/view.

Maritime patrol unmanned aircraft with multi-sensor payloads offered by Aeronautics

BY **John Keller**

YAVNE, Israel — Aeronautics Group in Yavne, Israel, is introducing the Orbiter 4 small tactical unmanned aerial vehicle (UAV) for long-range, long-endurance maritime patrol missions.

The Orbiter 4's high-performance EO/IR and maritime patrol radar payloads are for maritime monitoring, gas and oil rigs protection, illegal activity tracking, and search and rescue.

The Orbiter 4's abilities include endurance of more than 24 hours, and the ability to carry and operate several UAV sensor payloads simultaneously.

The UAV offers advanced image processing capabilities, automatic takeoff and recovery system, and the ability to navigate with or without GPS datalink.

Airstrip independent, it the Orbiter 4 is able to take-off and land on any type of vessel. Operated by three personnel, it is easy to use, maintain, and carries a low logistical footprint.

The UAV has a wingspan of 17.7 feet, maximum takeoff weight of 110.2 pounds, payload weight of 26.5 pounds, maximum speed of 70 knots, line-of-sight datalink distance of as far as 94 miles, and service ceiling of 18,000 feet.

For more information contact Aeronautics Group online at www.aeronautics-sys.com.

The Orbiter 4 UAV from Aeronautics Group launches from surface warships for maritime patrol missions, and can carry several UAV sensor payloads simultaneously.

The Knifefish unmanned minehunting submarine will received improved sensors and automated target recognition software to keep pace with advancing mine threats.

General Dynamics plans upgrades to Knifefish unmanned minehunting submarine

BY **John Keller**

WASHINGTON — Unmanned underwater vehicle (UUV) designers at General Dynamics Corp. are upgrading early developmental versions of the Knifefish minehunting UUV under terms of a $72.8 million contract announced in May.

Officials of the U.S. Naval Sea Systems Command in Washington are asking the General Dynamics Mission Systems segment in Quincy, Mass., to make improvements to five Knifefish Surface Mine Countermeasure Unmanned Undersea Vehicle (SMCM UUV) systems to operate at deeper depths, in more complex target environments, and with more precise localization than the first versions had.

The contract calls for General Dynamics to retrofit five Knifefish SMCM UUV systems to the Block I configuration and provide engineering support services.

General Dynamics began low-rate initial production (LRIP) of Knifefish Block 0 versions in September 2019. Knifefish is being built in blocks to incorporate new technology as it matures. Planned block upgrades will improve the minehunting UUV's sensors and automated target recognition software to keep pace with advancing mine threats.

For nearly the past two years General Dynamics has been building a small number of Knifefish UUVs for initial operational test and evaluation, and started tooling-up for full production sometime next year. Navy officials plan to buy 30 Knifefish systems — 24 for the littoral combat ship (LCS) and six for other Navy vessels.

Knifefish is for deployment from the LCS, other suitable surface vessels, or from shore to detect and classify buried, bottom, and volume mines in high-clutter environments. Volume mines are suspended at shallow depths and are designed to break the keels of ships passing over them.

The Knifefish system has two UUVs and support systems, low-frequency broadband sonar, and

automated target-recognition software to act as an off-board sensor while the host ship stays safely away from the mine field.

The Knifefish minehunting UUV has a common open-systems architecture that offers modularity to enable the undersea vessel to carry out a wide variety of countermine, surveillance, and reconnaissance missions. Planned upgrades will improve its sensors and automated target-recognition software to keep pace with mine threats, Navy officials say.

Navy experts supervised testing in 2019 off the coasts of Massachusetts and Florida against a deployed simulated target field. Sailors during testing performed mission planning, launching and recovering the system, monitoring the sorties, and processing data.

The unmanned undersea vehicles were deployed from a support craft in the vessels of opportunity configuration for all test events in order to provide a characterization of the performance of the entire Knifefish system, including the launch and recovery subsystem.

The Knifefish UUV is based on the Bluefin 21 UUV, which Bluefin Robotics in Quincy, Mass., developed for deep-dive research and counter-mine operations. General Dynamics acquired Bluefin Robotics in 2016.

The Bluefin 21, on which Knifefish is based, is 16.2 feet long, 21 inches in diameter, and weighs 1,650 pounds. The unmanned undersea vehicle can operate to depths to 14,763 feet, and can operate for as long as 25 hours between battery recharges.

The undersea vehicle can store as much as 13.5 kilowatt-hours of energy in nine 1.5-kilowatt-hour battery packs. Powering the Bluefin-21 is a gimbaled ducted thruster, and navigation comes from inertial navigation, remote operation, and Global Positioning System (GPS) satellite navigation.

The UUV has an integrated GPS, radio-frequency, Iridium, and strobe antenna, and communicates with operators via radio frequency links, Iridium satellite communications, and acoustic communications systems.

The Bluefin-21 data capability includes a four-gigabyte flash drive for vehicle data storage. Standard payloads include the EdgeTech 2200-M 120/410 kHz side-scan sonar, EdgeTech DW-216 sub-bottom profiler, and Reson 7125 400 kHz multibeam echosounder

On this contract General Dynamics will do the work in Quincy and Taunton, Mass.; and in Greensboro, N.C., and should be finished by April 2023. For more information contact General Dynamics Mission Systems online at https://gdmissionsystems.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Unmanned floating missile launchers could help Navy gain firepower advantage

The U.S. Navy is about to lose many vertical missile launchers that give a firepower advantage over any potential foe. There's an obvious way to replace them, and Navy officials are beginning to explore the idea. An unmanned surface vessel (USV) could fit this role. Rather than wrapping a billion-dollar manned warship around every cluster of vertical launch system tubes, the Navy could develop a cheap USV that is little more than a floating magazine. Missile barges could motor into a battle zone under their own power. Or auxiliary vessels could tow them. Once on station, they'd plug into a sensor network the fleet is developing. Other vessels would spot targets for the barge. A human operator on a nearby ship or at some base on land then would order the barge to open fire. With the press of a button, scores of missiles could arc toward an enemy fleet. Cheaply.

Air Force investigates high-power microwaves for attacking swarms of enemy UAVs

For military experts tasked with securing bases against assault, preventing damage from a swarm of explosive-laden unmanned aerial vehicles (UAVS) means stopping the entire swarm, not just removing a few moving pieces. That is why the Air Force is testing a new weapon, one that targets the electronics that makes the swarm work, all at once. To defeat swarms like this, the US military is developing THOR, or the Tactical High Power Operational Responder. Built for the Air Force Research Laboratory, THOR is one way that bases or other military installations might defend themselves against aerial robots traveling in groups. Instead of using bullets or explosions to disable robots, THOR attacks their electronics by hitting the gaggle with high-power microwaves. The effect can vary, from temporarily impairing their ability to communicate to frying the electronics and destroying machines in the swarm.

U.S. Army researchers developed a technique that enables robots to remain resilient when faced with intermittent communications losses on the battlefield. The technique, called a-shape, provides an efficient method for resolving goal conflicts between multiple robots that may want to visit the same area during missions like unmanned search and rescue, robotic reconnaissance, perimeter surveillance, and robotic detection of physical phenomena like radiation and underwater concentration of life forms. Researchers from the U.S. Army Combat Capabilities Development Command, known as DEVCOM, Army Research Laboratory and the University of Nebraska, Omaha Computer Science Department collaborated, which led to a paper featured in ScienceDirect's journal Robotics and Autonomous Systems. The robot that remembers a task is based on the topology of their wireless communications network and the geometric layout of the robots, he said. Each robot is assigned a bounding shape representing the area of the environment that they are caching goal locations for, which enables a quick search in the communications network to find the robot that would know if there were any goals requested in that area.

Air Force eyes open architectures upgrades for MQ-9 Reaper UAV

U.S. Air Force unmanned aerial vehicle (UAV) experts have announced plans for upgrades to the service's MQ-9 Reaper to make them more effective against near-peer threats, rather than just for counter-terrorism. Some existing MQ-9 Reaper unmanned aircraft will receive a multi-domain operation configuration — the same that will be on new Reaper UAVs — covered by an order to Reaper manufacturer General Atomics Aeronautical Systems in Poway, Calif. Air Force experts will boost the UAV's electrical power and to develop an open architecture that will accommodate add new features rapidly intended to deal with new threats as they arrive. "The MQ-9 enterprise will add new capabilities to the platform to help ensure the MQ-9 is able to support these missions in the threat environment we envision," says Air Force Lt. Col. Nick Jordan, the material leader for the MQ-9 production and retrofit effort.

British Army looking to robot soldiers to attack enemy forces, and to mini-drones to scout the battlefield

The United Kingdom Ministry of Defence showcased new high-tech equipment this fall, including the Nano Bug mini drone that can fit in the palm of a soldier's hand. The Nano Bug drone can travel at speeds as fast as 50 miles per hour, and provides the troops on the ground with a bird's eye view of the battlefield. The U.K. Chief of Defence, Gen. Sir Nick Carterm suggests that the British Army could fill out its ranks with robot soldiers. The deployment of robots could address the recruitment shortfalls that the U.K. has faced in recent years, but could also give its forces an edge in combating the enemy. The Nano Bug drone can send information to soldiers on the ground, and link to the larger ground-based X3 unmanned autonomous vehicle, which has a speed of 12.4 miles per hour and a range of 1.2 miles. The X3 can be linked with other vehicles and drones, which can share information along a chain up to 15 miles long. This could ensure that infantry as well as armored vehicles avoid entering a battlefield until it has been properly scouted.

AI, information warfare, and machine learning at center of Air Force culture change

Military operations are facing an increasingly disruptive battlefield from information warfare, to malicious cyber activity, and political information subversion. Combating these threats not only requires rapid advancements in data and adoption of transformative technologies such as artificial intelligence (AI) and machine learning, but also a change in the traditional culture of all ranks in the military. Military branches need to be forward thinking to keep up with these adapting environments and threats. In particular, the U.S. Air Force is training personnel by increasing data-use and literacy to improve decisions, readiness, mission operations, and cyber security. In particular, Eileen Vidrine, the Air Force's chief data officer is adopting tools such as advanced data analytics, AI, and machine learning, and is sharing plans for an Air Force culture change to embrace these kinds of tools.

new PRODUCTS

To submit new products for consideration, contact John Keller at jkeller@endeavorb2b.com.

TEST AND MEASUREMENT

Vector network analyzer for aerospace and defense introduced by Rohde & Schwarz

Rohde & Schwarz in Munich is introducing new versions of the ZNA high-end vector network analyzer that features models with 50 GHz and 67 GHz maximum frequencies for signal integrity measurements as well as for aerospace, defense, and 5G component and module characterization. Rohde & Schwarz launched the ZNA touch-operated vector network analyzer two years ago. The new models feature wide dynamic range, low trace noise, and come with a user-friendly touch graphic user interface. It offers as many as four internal phase coherent sources plus a fifth source as a second internal local oscillator or as an additional source for measurements on mixers. In combination with as many as eight parallel measurement receivers, the ZNA hardware architecture is for demanding measurements on components and modules. The ZNA is for high-end research and development in aerospace and defense applications like radar transmitter receiver modules as well as antenna measurements and satellite applications like downconverter characterization. The ZNA is a solution for research on active and passive components such as low-noise amplifiers, filters, antennas. For more information contact Rohde & Schwarz online at www.rohde-schwarz.com.

EMBEDDED COMPUTING

3U VPX board for AI and electronic warfare (EW) offered by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the VPX3-4935 3U OpenVPX general-purpose graphics processing unit (GPGPU) module for compute-intensive intelligence, surveillance, reconnaissance (ISR), and electronic warfare (EW) applications. The module is designed in compliance with the U.S. Army CCDC C5ISR Center's C4ISR/EW Modular Open Suite of Standards (CMOSS) and aligned with standards being defined by The Open Group Sensor Open Systems Architecture (SOSA) Consortium. This rugged SOSA-aligned variant of the VPX3-4935 — an NVIDIA Quadro Turing based GPGPU processor card — is for accelerating tensor/matrix computation used for deep learning neural network inference used in deployed artificial intelligence (AI) and machine learning applications requiring teraFLOPS of accelerated processing. These applications include high-performance radar, signals intelligence (SIGINT), electro-optical and infrared sensor processing, data fusion ingest, processing and display, and autonomous vehicles. For more information contact Curtiss-Wright Defense Solutions online at www.curtiss-wrightds.com.

RACKMOUNT COMPUTERS

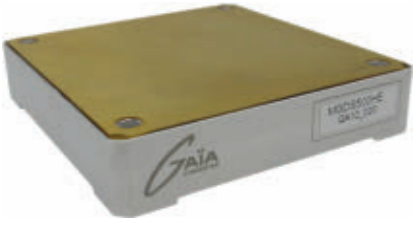
Configurable rugged computer servers for artificial intelligence (AI) introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing the RES XR7 line of high-performance, configurable, rugged rackmount computer servers for to accelerate applications such as artificial intelligence (AI), sensor fusion and communications. These rugged servers feature 3rd Gen Intel Xeon Scalable processors (formerly code-named Ice Lake) and are optimized with the latest PCI Express Gen4 processing, storage, and networking technologies. Mercury's RES XR7 rugged servers are certified to several military and industrial standards for resilience to shock, vibration, dust, sand, and temperature extremes. The servers are protected by Mercury's cybersecure IT infrastructure and are screened, assembled, manufactured, and tested in AS9100-, AS5553-, and ISO9001-certified facilities. For more information contact Mercury Systems online at www.mrcy.com.

POWER ELECTRONICS

500-Watt DC-DC converter for aerospace and defense introduced by Gaïa Converter

Gaïa Converter in Le Haillan, France, is introducing the MGDM-500 series 500-Watt DC-DC converter for high-reliability aerospace and defense applications. The MGDM-500 enables



power supply engineers to develop power architectures in an agile way for demanding applications were MIL-STD-461/704/1275 and DO-160 compliance is necessary. The MGDM-500 series allows 500-Watt power output over the permanent input voltage range from 9 to 36 volts DC. Benefits of the MGDM-500 DC-DC converter include high power density and efficiency in a half-brick format; input range of 9 to 36 volts DC with 40 volts DC at 100 microseconds transient input voltage; galvanic isolation 1 500 volts DC; output voltage trim from 90 to 110 percent; and no derating in temperatures from -40 to 105 degrees Celsius. For more information contact Gaïa Converter online at https://gaia-converter.com.

SAFETY-CRITICAL COMPUTING

Rugged computing boards for safety-critical avionics applications introduced by Abaco

Abaco Systems Inc. in Huntsville, Ala., is introducing two embedded computing board products: the SBC314C single-board computer and RAR15XC avionics data bus communications XMC mezzanine board, for embedded flight-certifiable applications. The two are available as separate boards. The SBC314C 3U VPX single board computer, based on the NXP QorIQ T2081 Multicore Communications Power architecture processor, is built to DO-254 DAL-A and features a Switched Mezzanine Card (XMC) site. It is pin-compatible with the SBC314, providing a pathway to flight certification. The SBC314C supports I/O that includes Gigabit Ethernet, serial communication ports, USB 2.0, SATA, and GPIO. The SBC314C has Power-on Built-In Test (PBIT) and Bootloader, both built to DO-178C DAL-A, and supports ARINC 653 operating systems including VxWorks 653, Deos, INTEGRITY-178 tuMP, and LynxOS-178 for integrators designing modular avionics. The RAR15XC XMC board delivers MIL-STD-1553 and ARINC 429 data bus communications as well as avionics discrete I/O. The RAR15XC is pin-compatible with the RAR15X and is for aircraft systems. It is engineered for safety-critical avionics applications. For more information contact Abaco Systems online at www.abaco.com.

SOLID-STATE MEMORY

High-reliability nvSRAM memories that meet MIL-PRF-38535 introduced by Infineon

Infineon Technologies LLC in Munich is introducing the rugged 256-kilobit STK14C88C and 1-megabit STK14CA8C second-generation non-volatile static random-access memory (nvSRAM) devices for high-reliability military and industrial applications. These 32-pin 300-mil dual-in-line ceramic packaged memory devices meet MIL-PRF-38535 QML-Q specifications to operate in temperatures from -55 to 125 degrees Celsius, and are for demanding non-volatile code storage and data-logging applications in harsh environments. The 256-kilobit STK14C88C and 1-megabit STK14CA8C nvSRAMs come in 5-volt and 3-volt versions, and support boot code, data logging, and calibration data storage for aerospace, communications, and navigation systems. These devices also are for industrial furnaces and railroad-control systems. Infineon's nvSRAM technology combines SRAM with SONOS non-volatile technology. Under normal operating conditions, nvSRAM acts similarly to a conventional asynchronous SRAM. In the event of a power failure, a nvSRAM automatically saves a copy of the SRAM data into non-volatile memory, where the data is protected for more than 20 years. For more information contact Infineon Technologies online at www.cypress.com/products/aerospace-defense.

RF AND MICROWAVE

Waveguide components for SATCOM, radar, and test introduced by Pasternack

Pasternack, an Infinite Electronics brand in Irvine, Calif., is introducing a new series of double-ridge waveguide components for satellite communications (SATCOM), radar, wireless communications, and test and instrumentation. This series consists of 28 models that include WRD-180, WRD-650, and WRD-750 sizes. Products include straight sections, bends, and twist configurations. These transmission line components deliver RF performance, cover wide frequency bands and offer low cut-off frequencies compared to conventional rectangular waveguide components. These RF and microwave components are available that feature WRD-180, WRD-650, and WRD-750 waveguide sizes, SMA, N-type and 2.92-millimeter connectors, UG-style square cover flanges, and typical voltage standing wave ratio (VSWR) performance as low as 1.5:1. For more information contact Pasternack online at www.pasternack.com.

RUGGED COMPUTING

Server with encryption for edge computing introduced by Trenton Systems

Trenton Systems Inc. in Lawrenceville, Ga., is introducing the 3U BAM rugged server for military edge computing that can secure sensitive information with a holistic hardware, firmware, and software trusted computing methodology. The 3U BAM server is designed, manufactured, assembled, tested, and supported in the USA by security-savvy engineers who put a priority on supply chain security, counterfeit electronics prevention, and layer-specific cyber security protections. The rugged computer is equipped with Intel cyber security technologies like PFR, SGX, and TME, as well as the Star Lab Titanium Security Suite and FIPS 140-2 encryption to protect the BAM's hardware, firmware, and software to resist unauthorized access to and compromise of sensitive information. The 3U BAM server has two next-generation Intel Xeon SP general-purpose processors, 11 PCI Express Gen 4 slots, and 24 ECC RDIMM slots arranged in a lightweight ruggedized aluminum chassis. It also offers platform-wide cyber security protections and offers a Counterfeit Protection Program (CPP); and adherence to CSfC, ITAR, and ISO9001. For more information contact Trenton Systems online at www.trentonsystems.com.

POWER ELECTRONICS

High-reliability power buffer modules for communications introduced by TDK-Lambda

TDK-Lambda Americas Inc. in San Diego is introducing the ZBM20 12-, 15-, and 24-volt 20-amp rated open-frame buffer power electronics modules for robotics, test, communications, semiconductor fabrication equipment,

and industrial automation. The ZBM20 series provides an extended 380-millisecond hold-up time to power supplies to prevent data loss during brief power interruptions or enabling equipment to shut down safely. These power electronics devices store energy in electrolytic capacitors, replacing the need for batteries. Users can activate a remote on/off function to avoid an unsafe discharge of stored energy. Users can monitor the charge and discharge status locally or remotely via a DC OK relay, an LED indicator, and photo-coupled signals. Designers can connect modules in parallel for longer hold-up times. The 24-volt model has a switch that can select either fixed- or variable-voltage power buffer levels. In fixed mode, it will provide power when the input voltage drops to 22.4 volts; in variable mode when the input decreases by one volt. The power module measures 175 by 85 by 57 millimeters and will operate without derating in ambient temperatures of -25 to 70 degrees Celsius. For more information contact TDK-Lambda online at www.us.lambda.tdk.com.

MEDIA SERVERS

Media server for simulation and training introduced by RGB Spectrum

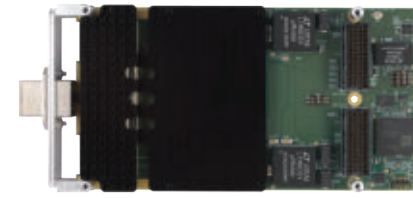
RGB Spectrum Inc. in Alameda, Calif., is introducing the Zio media server for mission-critical applications including simulation, training, command and control, missile testing and telemetry, surveillance, reconnaissance, and mission analysis. The Zio simultaneously can record, store, and distribute streams of high-resolution, real-time imagery using the H.264 compression standard. It can record streams while outputting

other streams. The media server offers RGB Spectrum's Zio codecs for multicast encoding and decoding at origination and destination, and comes in several hardware configurations depending on the number of simultaneous streams required. In a simulation and training application the instructor can view pilot data seen by the pilot while the same recording information on the Zio media server. Observers in remote locations can view the same visuals, real-time or afterwards. For more information contact RGB Spectrum online at www.rgb.com.

EMBEDDED COMPUTING

Rugged embedded computing XMC Ethernet interface for radar introduced by New Wave DV

New Wave DV in Minneapolis is introducing the V1160 dual-port 100G rugged Ethernet switched mezzanine card (XMC) for radar, signals intelligence (SIGINT), embedded communications, video, storage, and medical imaging systems. The card is for high-bandwidth and low-latency interface applications that require 10-, 25-, 40-, and 100-Gigabit Ethernet. The rugged design of the V1160 turns a VPX single-board computer into a single-slot sensor processor. Featuring the NVIDIA Mellanox ConnectX-5 network interface, the V1160 offers hardware offloads for UDP, TCP, RoCE v2, DPDK, and other protocol offloads. Options are available to select optical or electrical Ethernet interfaces, as well as for front panel I/O or backplane I/O. Backplane electrical interfaces come via Pn6, and backplane optical interfaces come via VITA 66 connectors. The V1160 is built from the ground-up for rugged



and harsh environments. This XMC is designed and tested to VITA 47 environmental standards and provides VITA 20-compliant conduction cooling. For more information contact New Wave DV online at https://newwavedv.com.

RADIATION-HARDENED ELECTRONICS

Radiation-hardened DC-DC converters for weather satellites introduced by Microchip

Microchip Technology Inc. in Chandler, Ariz., is introducing nine new members of the company's SA50-120 radiation-hardened power converter family for communications and weather satellites. The radiation-hardened DC-DC converters are based on commercial off-the-shelf (COTS) technology that provides developers with space-qualified power converters that help to minimize risk and lower development costs. The SA50-120 power electronics components are standard non-hybrid space-grade power converters use surface-mount component construction are qualified to Mil-Std-461, Mil-Std-883 and Mil-Std-202, and enable designers to scale-up development. SA50-120 power converters use 120-volt inputs and offer as much as 56 Watts of output in a small low profile package. These EMI-compliant designs offer single and triple outputs. The power electronics units use switching regulators that use peak current mode controlled single-ended forward converter topology with inherent single-event immunity. They offer eight million hours mean time between failures and as much as 87 percent efficiency. The units are qualified to resist as much as 100 kilorads of total ionization dose (TID), and single-event effects (SEE) greater than 80 MeV cm2/mg. For more information contact Microchip Technology online at www.microchip.com.

ETHERNET SWITCHING

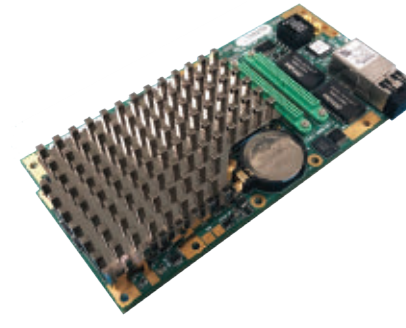
10-Gigabit Ethernet switch for tactical networking introduced by Curtiss-Wright

Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the PacStar 448 10-Gigabit Ethernet switch module for military, intelligence, and commercial applications. The Ethernet switch delivers a 10x increase in networking speed to its PacStar Modular Data Center (MDC) 2.0. The PacStar 448 module, based on Cisco ESS 9300 technology, supports high-speed switching for the MDC's servers and storage devices. It enables PacStar MDC to perform compute and network tasks in tactical and expeditionary settings. The module features ten 10 Gigabit Ethernet SFP+ enhanced small form-factor pluggable transceiver ports that deliver speed and density. The enhanced network interconnect performance provided by PacStar 448 supports command and control, Internet of Things, cloud, storage replication, artificial intelligence (AI) and machine learning. The module also is a drop-in replacement for previous Ethernet switch modules. Curtiss-Wright acquired PacStar last fall. PacStar MDC is based on the PacStar 400-series commercial off-the-shelf (COTS) small-form-factor modules. It is a tactical and expeditionary rugged data center capable of hosting mission command, cloud storage, sensor fusion, AI, and analytics applications. More information about the Curtiss-Wright PacStar brand is online at https://pacstar.com.

SOSA COMPUTING

SOSA-aligned embedded computing chassis manager introduced by Annapolis

Annapolis Micro Systems Inc. in Annapolis, Md., is introducing the WABGM0 VITA 46.11-aligned WILD VPX chassis manager to enable critical chassis control, maintenance, and security functions in embedded computing systems. Annapolis Micro developed the WABGM0 in alignment with the Sensor Open Systems Architecture (SOSA) open-systems standard, and offers commercial-off-the-shelf (COTS) availability. For security, the chassis manager implements security signal interfaces and a Xilinx UltraScale+ Zynq ZU5EG MPSoC and latest Microsemi PolarFire FPGA. Other chassis manager features include MIL-STD-1553 support and an additional storage flash. The chassis manager plugs directly into a backplane or into a 3U or 6U OpenVPX carrier that plugs into a backplane as a payload card. It supports VITA 66/67 by avoiding optical/RF backplane openings. The chassis manager supports the SOSA management interface for all the cards in the chassis, allowing for controlled power-on/off of VPX cards and controlling main 12-volt power to the chassis with local Ethernet control. The management interface also allows out-of-band monitoring of board health and statistics like board temperature and power. The system allows for access to as many as four slots in parallel so the user can access maintenance ports over Ethernet without opening the chassis. It also allows access to JTAG for as many as four slots at a time, which allows board maintenance and recovery without removing boards from the chassis. For more information contact Annapolis Micro Systems online at www.annapmicro.com.



SIMULATION AND TRAINING

Radar simulator for laboratory production testing introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing the ARES3100 Advanced Radar Environment Simulator (ARES) for testing demanding radar applications ranging from anechoic chamber and open-air range (OAR) to laboratory production testing and radar performance evaluation. ARES includes a high-performance open-architecture configurable with hardware and software options to provide the ability to model several targets, jamming threats, and atmospheric effects. The graphical user interface offers an out-of-the-box experience with minimal system setup. The ARES3100 includes a library of waveforms to simulate real-world environments to replicate field testing within a safe controlled environment. "New radar technologies, such as synthetic aperture radar (SAR) imaging, as well as increased agility and a wide spectral range — coupled with the introduction of cognitive electronic warfare (EW) jamming techniques — have dramatically increased the complexity of radar testing," says Mark Bruington, vice president and general manager of Mercury Spectrum Systems. For more information contact Mercury Systems online at www.mrcy.com.

PRODUCT & LITERATURE SHOWCASE

ADVERTISERS INDEX

Military & Aerospace Electronics

SUBSCRIPTION INQUIRIES
Phone: 1-877-382-9187 / International Callers: +1-847-559-7598
E-mail: MAEM@omeda.com
Web: www.mae-subscribe.com

VICE PRESIDENT/GROUP PUBLISHER Paul Andrews
203 423-3963 / pandrews@endeavorb2b.com

EDITOR-IN-CHIEF John Keller
603 891-9117 / jkeller@endeavorb2b.com

ASSOCIATE EDITOR Jamie Whitney
603 891-9135 / jwhitney@endeavorb2b.com

CHIEF CONTRIBUTOR Megan Crouse

EDITORIAL ART DIRECTOR Kermit Mulkins

PRODUCTION MANAGER Sheila Ward

AUDIENCE DEVELOPMENT MANAGER Debbie Bouley
603 891-9372 / dbouley@endeavorb2b.com

MARKETING DIRECTOR Adrienne Adler
603 891-9420 / aadler@endeavorb2b.com

ENDEAVOR BUSINESS MEDIA
www.endeavorbusinessmedia.com

EDITORIAL OFFICES
Endeavor Business Media, LLC
Military & Aerospace Electronics
61 Spit Brook Road, Suite 501, Nashua, NH 03060
603 891-0123 / www.milaero.com

SALES OFFICES

EASTERN US & EASTERN CANADA & UK
Keith Gregory, Sales Manager
508 1/2 Ocean Park Ave., Bradley Beach, NJ 07720
732 897-9550 / Cell 917 993-3741
kgregory@endeavorb2b.com

WESTERN CANADA & WEST OF MISSISSIPPI
Maureen Elmaleh, Sales Manager
7475 Miller Street, Arvada, CO 80005
303 975-6381 / Cell 212 920-5051
melmaleh@endeavorb2b.com

REPRINTS Jessica Stremmel
717 505-9701 x2205 / Jessica.stremmel@theygsgroup.com

DIRECTOR LIST RENTAL Kelli Berry
918 831-9782 / kberry@endeavorb2b.com

For assistance with marketing strategy or ad creation, please contact Marketing Solutions
Kaci Wheeler
918 832-9377 / kwheeler@endeavorb2b.com

ENDEAVOR BUSINESS MEDIA, LLC
CHIEF EXECUTIVE OFFICER Chris Ferrell
CHIEF REVENUE OFFICER, CHIEF MARKETING OFFICER June Griffin
CHIEF FINANCIAL OFFICER William Nurthen
CHIEF OPERATING OFFICER Patrick Rains
CHIEF ADMINISTRATIVE AND LEGAL OFFICER Tracy Kane
CHIEF TECHNOLOGY OFFICER Eric Kammerzelt
EVP, TECHNOLOGY GROUP Lester Craft

BPA WORLDWIDE Connectiv

GENERAL MICRO SYSTEMS, INC.

ADVANCED SERVERS

ONE COMPANY FOR ALL YOUR SERVER NEEDS

RUGGED SERVERS

INDUSTRIAL SERVERS

COMMERCIAL SERVERS

MADE IN U.S.A.

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.