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Postage stamp-size computer boards

The latest attempt at extreme small-form-factor embedded computing. PAGE 2

Backplanes and chassis

Databuses focus on 3U and 6U VPX, but VME and CompactPCI still have their applications. PAGE 22

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Adaptive electronic warfare

Enabling technologies for tomorrow's EW in contested environments.

PAGE 12

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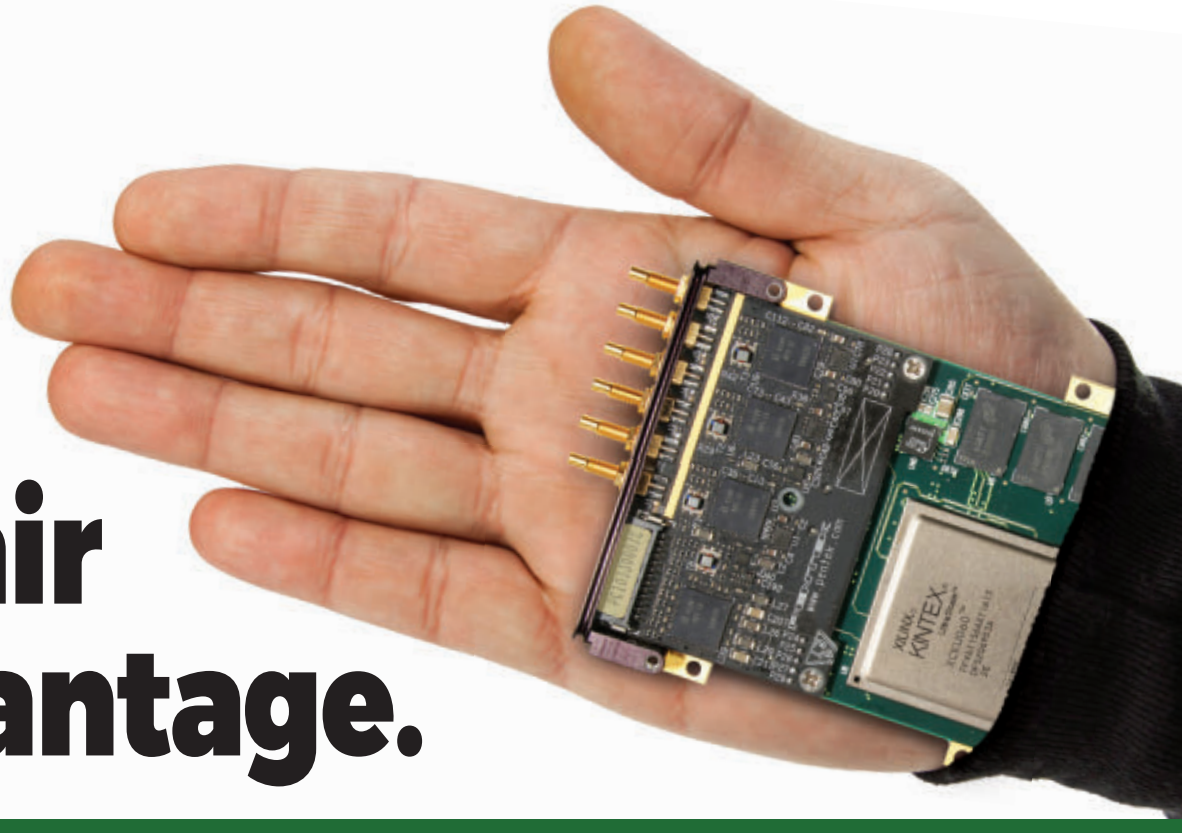

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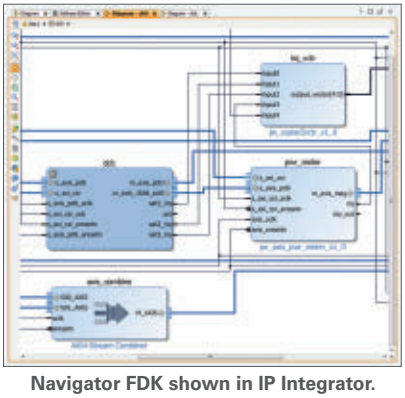

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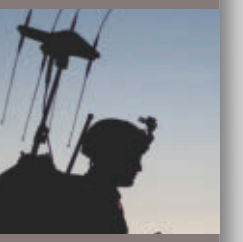

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BY **JOHN KELLER**, EDITOR IN CHIEF

Can embedded computing boards shrink to the size of postage stamps?

Extreme small-form-factor embedded computing has been an elusive goal for the military electronics industry. It's often a tradeoff between performance and adhering to open-systems standards. The best-performing components tend to be proprietary, which the military is trying to avoid.

Still, military systems designers as well as those working on industrial automation and many other embedded computing applications that must operate in tight spaces face a landscape where they must choose between proprietary closed-system components, or pursue standard small-form-factor embedded computing like COM Express, VITA-74 VNX, and 3U VPX.

Although small, these technologies might not be small enough for a wide variety of wearable computing and deeply embedded computing for which tomorrow's aerospace and defense designs will likely call. 3U VPX is powerful, yet might still be too big for the smallest applications. COM Express and VNX still have yet to gain critical mass in aerospace and defense applications that demand small-form-factor embedded computing.

It may be time for another attempt at developing extremely small-form-factor embedded computing that adheres to industry standards, and the PICMG Open Modular Computing Standards organization in Wakefield, Mass., appears ready to take up the challenge.

A new generation of small-form-factor embedded computing may be coming together at PICMG with a computer board no larger than a postage stamp for wearable computing, smart factories, and the Internet of Things (IoT).

This project, just in its infancy, seeks to develop an industry-backed, open-systems standard for a tiny embedded computer with minimal processing and minimal I/O resources for lightweight applications that must operate in extremely tight spaces.

PICMG, formerly known as the PCI Industrial Computer Manufacturers Group, is likely to stand-up a Postage Stamp standards working group sometime this spring, and may have its first-draft standard ready for balloting by 2019, says PICMG President Jessica Isquith.

Postage Stamp likely will describe extremely small embedded computing mezzanine cards ranging in size from a postage stamp to a business card for operating close to assets on a factory floor and similar applications.

Isquith made her comments in January at the Embedded Tech Trends conference in Austin, Texas.

This potential future standard probably won't be for anything like high-performance embedded computing — only for extreme size- and weight-sensitive applications operating near antennas and sensors, in robotic arms, in data analytics uses, and the like. It may operate together on a carrier card for handling several separate tasks.

It's far too early to speculate on specific characteristics for the Postage Stamp embedded computing form factor. PICMG members have shown interest, and developments later this year will be the first indications of the directions this standard will take.

Anyone in the embedded computing industry interested in influencing and working with the future Postage Stamp standard should contact Isquith by e-mail at *jess@picmg.org*.

Orbital ATK to upgrade embedded computing components in AARGM radar-killing missile

PATUXENT RIVER NAS, Md. — Orbital ATK missile experts will upgrade embedded computing components of the AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) that equips carrier-based fighter-bombers and electronic warfare jets. AARGM is a supersonic, medium-range, air-launched tactical missile compatible with U.S. and allied strike aircraft. The AGM-88E AARGM is the latest version of the AGM-88 High Speed Anti-Radiation Missile (HARM).

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $9.5 million order to the Orbital ATK Defense Electronic Systems segment in Northridge, Calif., to design and qualify AARGM sensors embedded computing components.

Orbital ATK experts will build the executive processor circuit card assembly for the AARGM's advanced digital anti-radiation homing (ARH) sensor and its millimeter-wave (MMW) radar terminal seeker under terms of this delivery order.

Orbital ATK upgrades will result in form, fit, and functional replacement of the existing AARGM ARH and millimeter-wave radar in support Naval Air Systems Command's Direct and Time Sensitive Strike program office.

This non-recurring engineering effort will mitigate existing cost and production issues with the AARGM ARH and MMW, as well as incorporate hardware for future expansion.

Orbital ATK is upgrading embedded computing components of the radar-killing Advanced Anti-Radiation Guided Missile (AARGM).

AARGM provides the U.S. Navy, U.S. Marine Corps, and Italian air force with a weapon system for engaging and destroying enemy air defenses and time-critical, mobile targets. The AARGM also has precise global positioning system (GPS)/inertial navigation system (INS) guidance and network-centric connectivity.

The AARGM offers advanced signal processing and improved frequency coverage, detection range, and field of view, compared to earlier versions of the HARM system. It has time-critical standoff strike with supersonic GPS/INS point-to-point or point-to-millimeter-wave-terminal guidance. It also has missile impact zone control to prevent collateral damage through tightly coupled, digital terrain elevation database-aided GPS/INS, as well as counter-emitter shutdown through active millimeter-wave-radar terminal guidance.

FOR MORE INFORMATION visit **Orbital ATK** online at *www.orbitalatk.com*.

IN BRIEF

General Dynamics to upgrade 786 Abrams main battle tanks

Armored combat vehicle experts at General Dynamics Corp. will upgrade as many as 786 M1 Abrams main battle tanks and vetronics to the most advanced M1A2 SEPv3 configuration under terms of a $2.6 billion contract announced in late December. Officials of the U.S. Army Contracting Command in Warren, Mich., are asking General Dynamics Land Systems in Sterling Heights, Mich., to upgrade U.S. Army M1A1 tanks, as well as upgrade legacy M1A1 tanks to advanced versions for the armed forces of Saudi Arabia and Kuwait. The M1A2 SEPv3 main battle tank is the latest version of the M1 Abrams, and has increased power generation and distribution, better communications and networking, new vehicle health management system (VHMS), line replaceable modules (LRMs) for improved maintenance, and an ammunition datalink (ADL) to use airburst rounds. The M1A2 SEPv3 stands for system enhancement package version 3. This latest version of the M1A2 tank also offers an improved counter-improvised

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explosive device (IED) armor package, improved forward-looking infrared (FLIR) sensor using long- and mid-wave infrared, a low-profile Common Remotely Operated Weapon Station (CROWS), and an auxiliary power unit (APU) under armor to run electronics without the engine running.

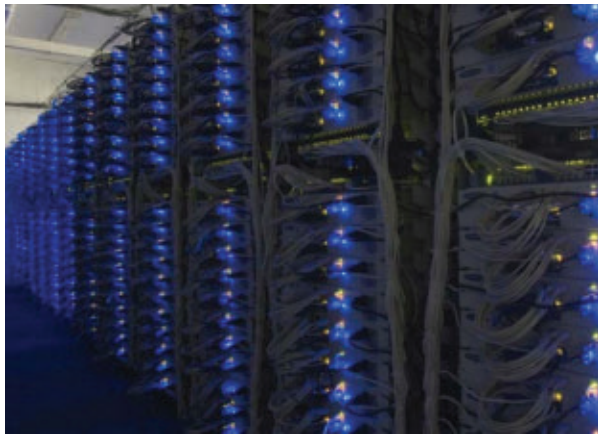
Northrop Grumman to provide counter-IED electronic warfare

Electronic warfare (EW) experts at Northrop Grumman are building additional open-architecture RF jammers for infantry, land vehicles, and fixed sites to protect U.S. and allied warfighters from radio-controlled improvised explosive devices (IEDs). Officials of the U.S. Naval Sea Systems Command in Washington announced a $23.2 million order to the Northrop Grumman Mission Systems segment in Herndon, Va., for Joint Counter-Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) increment one block one (I1B1) systems full-rate production. The JCREW I1B1, formerly known as JCREW 3.3, is the first-generation system that develops a common open architecture across all three capabilities and provides protection for worldwide military operations.

Lockheed Martin continues work on National Cyber Range training for virulent code

BY JOHN KELLER

REDSTONE ARSENAL, Ala. — Cybersecurity experts at the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla., will continue to maintain a key U.S. military training range that tests and validates cyber warfare technologies under terms of a $33.9 million order.



Military cyber warfare experts are trying to study virulent malicious computer code without harm to U.S. computers and networks.

Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., are asking Lockheed Martin for work involving the National Cyber Range (NCR) to allow potentially virulent code to be introduced and studied on the range without compromising the range. The Army Contracting Command is awarding this order on behalf of the Army Program Executive Office for Simulation, Training, and Instrumentation in Orlando, Fla.

The NCR helps with test and measurement of offensive and defensive technologies involving computer malware, viruses, and other cyber warfare aspects.

The range is designed to allow information experts to introduce potentially virulent code and study it without compromising the range itself. Lockheed Martin, which has been working on the NCR for at least the past two years, is considered the only company able to undertake such a task.

The NCR is a self-contained facility for advanced cyber research and testing, using hardware and software automation tools that enable experts to configure the range rapidly to emulate complex, large-scale heterogeneous networks.

The NCR involves software tools and sensors that enable military cyber warfare experts to study cyber threats like worms and viruses so they can understand their behavior and potential defenses, while enabling technicians to sanitize and reconfigure the range quickly after testing.

The NCR can host several independent, simultaneous, multi-security experiments on the same infrastructure, while simplifying the introduction and testing of new code on a cyber range. The NCR seeks to provide ways to test realistic cyber warfare capabilities in a secure and realistic environment.

The range can protect against denial-of-service originating from within the range; malware spillage from test beds; unauthorized access; and data spills across tests boundaries while archived.

The NCR can isolate the test beds to ensure that the range can operate several simultaneous tests at different security and sensitivity levels, as well as prevent test beds from interfering with other test beds by spilling malware code, technology, or characteristics.

The cyber range was developed originally by the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. In late 2012 DARPA turned management of the range over to the Pentagon's Test Resource Management Center.

Key benefits of the NCR are the speed with which the range can be re-configured, the diversity of the networks that can be emulated, and the flexibility to handle several activities simultaneously at different classification levels, military experts say.

The NCR provides advanced cyber research and development of new capabilities, analysis of malware, cyber training and exercises, and secure cloud computing and storage architectures.

The NCR is designed to test technologies such as host security systems, and local and wide-area network security tools by integrating, replicating or simulating the technologies. The range provides a large-scale Global Information Grid (GIG) infrastructure, where experts can analyze and test cyber warfare technologies under real-world conditions.

The range's test beds include the ability to test new network protocols, satellite and radio frequency communications, and mobile tactical and maritime communications.

FOR MORE INFORMATION visit **Lockheed Martin Missiles and Fire Control** online at *www.lockheedmartin.com/us/mfc.html*, the **Army Contracting Command-Redstone** at *http://acc.army.mil/contractingcenters/acc-rsa*, and the **Army Program Executive Office for Simulation, Training, and Instrumentation** at *www.peostri.army.mil*.

IN BRIEF

More heavy armor: Army orders 228 155-millimeter self-propelled artillery

The U.S. Army is buying as many as 228 upgraded and fast-moving 155-millimeter, self-propelled howitzer artillery vehicles with digital vetronics and modern power systems, as well as 30 companion ammunition carrier tracked armored combat vehicles. Officials of the Army Contracting Command-Tank and Automotive in Warren, Mich., announced a $227.9 million order late last month to the BAE Systems Platforms & Services segment in York, Pa., for 228 sets of M109A7 self-propelled howitzers and 30 M992A3 ammunition carriers. The M109A7 is the Army's newest M109 version. Formerly known as the M109A6 Paladin Integrated Management (PIM), the M109A7 uses the existing main armament and cab structure of a Paladin M109A6 self-propelled cannon, and replaces the vehicle's chassis components with modem components common to the M2A3 Bradley Fighting Vehicle. The goal of these upgrades is to enable the M109A7 artillery to keep up with the Army's fast-moving armored brigade combat

Three small businesses chosen for DMEA program to fight electronics obsolescence

BY JOHN KELLER

MC CLELLAN, Calif. — U.S. military microelectronics experts are choosing three small-business contractors for a potential $800 million, 10-year program to fight the effects of electronics obsolescence and solve problems of unreliable, unmaintainable, under-performing, or incapable electronics hardware and software.

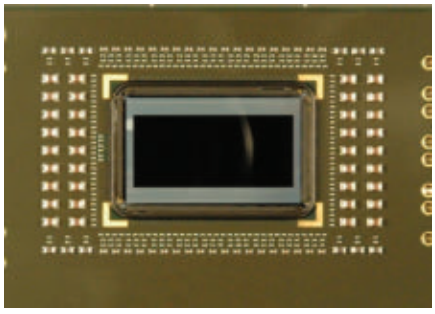
Officials of the Defense Microelectronics Activity (DMEA) in McClellan, Calif., have announced contracts to the three companies for the Advanced Technology Support Program IV (ATSP4) small business (SB) project.

The three ATSP4 SB contractors are RF Integration Inc. in Billerica, Mass.; a team of Alpha Research & Technology, Desert Microelectronics Associates, and MicroNet Solutions Inc. JV in El Dorado Hills, Calif; and Teledevices LLC in Duluth, Ga.

These small-business companies will share as much as $800 million worth of orders over the next 10 years of potential ordering, DMEA officials say. Orders will support U.S. military technology and weapons development, as well as those of foreign militaries.

These contracts are for the smaller of two initiatives under the ATSP4 program. In the larger portion, DMEA chose eight major U.S. defense contractors in March 2016 for the potential $7.2 billion ATSP4 full and open competition.

Those eight contractors are:
— BAE Systems Electronic Systems in Nashua, N.H.;
— The Boeing Co. in Hazelwood, Mo.;



The U.S. Department of Defense is working with a group of small-business contractors to help mitigate the effects of obsolescence on military electronics.

— The Lockheed Martin Corp. Rotary and Mission Systems segment in Owego, N.Y.;
— Cobham Semiconductor Solutions in Colorado Springs, Colo. (formerly Aeroflex);
— General Dynamics Mission Systems in Minneapolis;
— Honeywell Aerospace in Albuquerque, N.M.;
— The Northrop Grumman Corp. Mission Systems segment in Linthicum, Md.; and
— The Raytheon Co. Space and Airborne Systems segment in El Segundo, Calif.

The ATSP4 SB program is designed to resolve problems with obsolete, unreliable, unmaintainable, under-performing, or incapable electronics hardware and software.

Companies involved in this project will develop advanced technologies and applications to meet the requirements of the Department of Defense for a quick reaction capability.

Overall, the ATSP4 seeks to develop a quick-reaction capability

to develop technologies necessary to keep a military system operational, elevate their sophistication levels, and meet new threats.

ATSP4 orders may include developing components to meet the Pentagon's requirements for ultra-low volumes, extending component availability, or ensuring a trusted, assured, and secure supply of microelectronics.

The job also involves the quick application of advanced technologies to upgrade military weapons performance in response to traditional and irregular threats, as well as to the problems of aging weapon systems.

The ATSP4 program seeks to increase warfighter capabilities and solve electronics support problems like reliability, maintainability, and obsolescence by inserting advanced microelectronics into weapon systems.

The ATSP4 program covers hardware and software and includes studies, analysis, design, software, simulation, prototyping, integration, testing, producibility, and limited production.

On the ATSP4 SB program, the contractors will do the work at their own locations.

FOR MORE INFORMATION

visit **RF Integration** online at *www.rfintegration.com*; **Alpha Research & Technology** at *www.artruggedsystems.com*; **Teledevices** at *www.teledevices.com*; or **DMEA** at *www.dmea.osd.mil*.

Air Force to develop tool for military intelligence analysis and decision-making

BY JOHN KELLER

ROME, N.Y. — U.S. Air Force researchers are launching a potential $25 million, five-year project to develop an interactive question-answering software tool to help with military intelligence analysis and decision-making.

Officials of the Air Force Research Laboratory Information Directorate in Rome, N.Y., have issued a solicitation (FA8750-18-S-7005) for the Multi-Source

IN BRIEF

team (ABCT) alongside the M1 Abrams main battle tank and the M2 Bradley armored personnel carrier.

Disposable drone hides inside shell of fake bomb and can be dropped from a fighter jet

Northrop Grumman is working on a drone that can be placed inside the shell of a cluster bomb that will spring into action after being dropped from a fighter jet or bomber. The drone will fly, undetected, behind enemy lines as it collects and transmits information back to its base. It will then crash and destroy itself. Called "Remedy", this U.S. military drone system has been under testing since late October, noted *Defense One* (DO). The first demonstration carried out by Northrop Grumman showed that the drone, which is inside the cluster bomb shell, can communicate and share data with the manned aircraft out of which it will be dropped. The next stage of testing, the report noted, will be to demonstrate Remedy's ability to unfold and take flight mid-air. The drone is expected to be ready for production by 2019, after completing all stages of research and development.

Exploitation Assistant for the Digital Enterprise (MEADE) project.

MEADE seeks to develop a question-answering system that works as a virtual assistant by performing analytical tasks or services for an analyst.

The MEADE objective is to make complex analytics possible for nearly anyone, regardless of their technical ability. This effort is intended not only to support an intelligence function, but also to help with military decision-making in command and control.

Researchers are trying to develop an interactive tool to help military intelligence analysts and battlefield commanders with decision-making.

The intent is to provide analytics that answer questions directly or that will interact with the user to help steer intelligence analysts to an answer rather than simply providing a ranked list of potential information sources to help the analyst answer questions themselves.

Intelligence analysis efficiencies need to be increased to match the complexity, velocity, variety, and volume of intelligence data being collected against increasingly agile and deceptive adversaries, Air Force researchers explain.

While fundamentally similar to chat-bots in virtual assistants like Apple Siri, Google Assistant, Amazon Alexa, and Microsoft Cortana in providing an artificial conversation, MEADE seeks to use the conversation to improve military intelligence analysis.

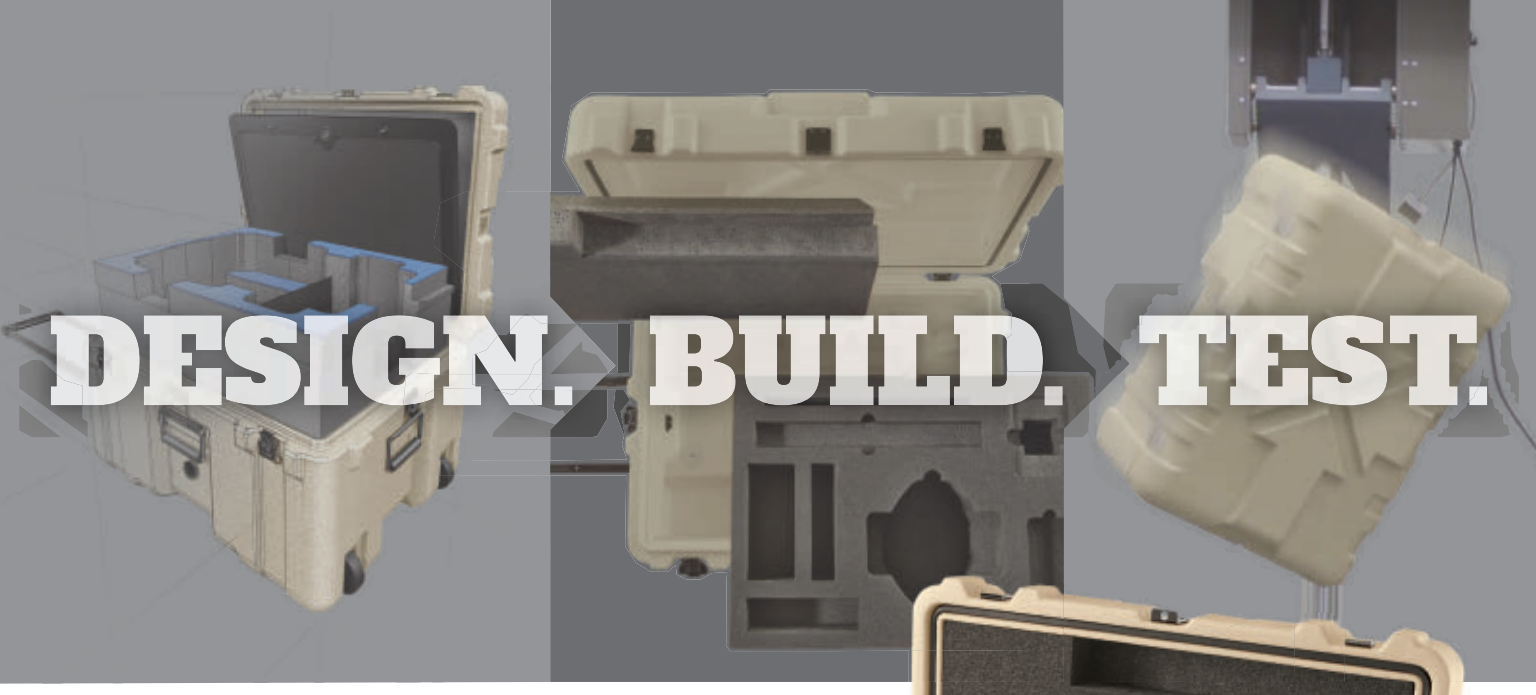
The MEADE project has two focus areas: Real-Time Operator-Driven Gist Exploration and Response (ROGER), and Interactive Analytics and Contextual Fusion (IACF).

ROGER seeks to develop an analyst assistant to provide a convenient interface to enable interactive searches, information retrieval, tasking, and analytics.

The IACF seeks to develop contextual fusion and analytic capabilities for advanced capabilities such as prescriptive analytics, which is dedicated to finding the best course of action for given situations.

Companies interested were to send white papers by post no later than 29 Jan. 2018 to the Air Force's Brian O-Hearn, AFRL/RIEA, 525 Brooks Rd., Rome, N.Y. 13441-4505. E-mail questions or concerns to Brian O-Hearn at *brian.ohern@us.af.mil*.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/USAF/AFMC/AFRLRRS/FA8750-18-S-7005/listing.html*.



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Adaptive and bistatic electronic warfare

Embedded computing, systems-on-chip, artificial intelligence, and advanced algorithms are only a few enabling technologies for EW systems that learn on their own and adapt to the latest conditions.

BY **J.R. Wilson**

The helicopter; cell phone; parachute; computer tablet; battle tank; robotic, flying, and driverless car; artificial intelligence (AI); humans working and living in space; replicators; directed-energy weapons; the Internet; genetic engineering; submarines; hypersonic flight; real-time free global communications; and "Six Million Dollar Man-like" prosthetics.

All of the above share one thing: They were imagined — in diagrams, drawings, models, novels, and film scripts — years, decades, even centuries before the enabling technologies to bring them to reality were developed.

Today new concepts and rapidly evolving technologies can mean even what once would have been considered virtually no delay may

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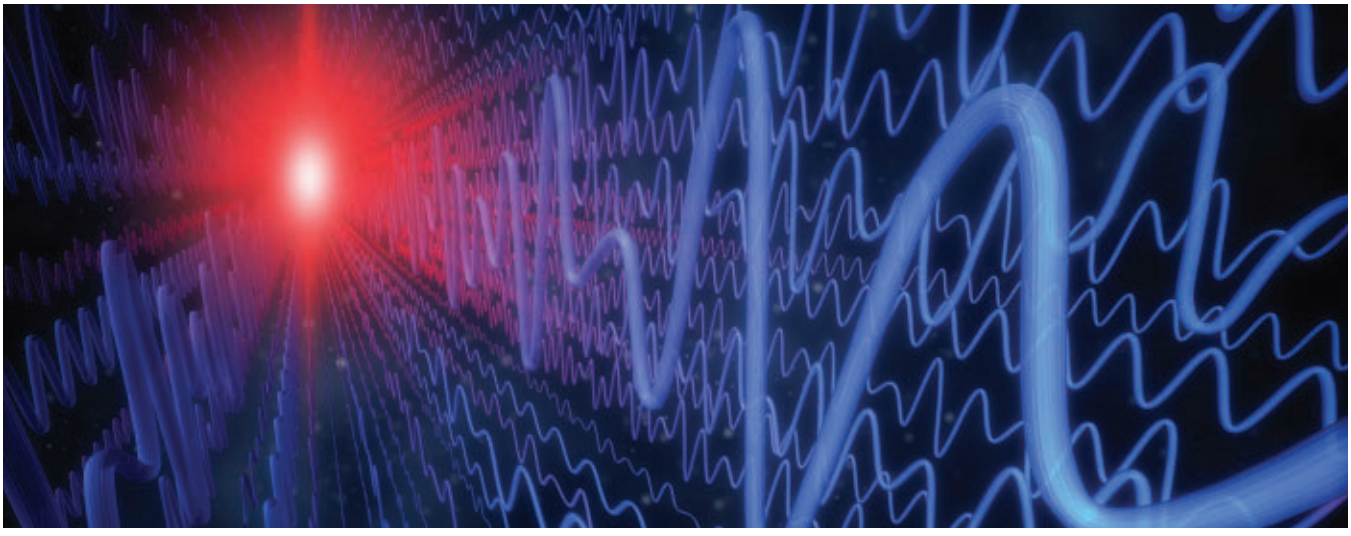


place a nation's defense or economic well-being in jeopardy. With changes in critical military systems and applications on the battlefield in the midst of combat, the response to them must be equally fast, in-place, and real-time. In other words, adaptive.

Nowhere is this more important than in electronic warfare (EW), sometimes seen as a too-long neglected subset of cyber warfare — the military's latest domain of war.

In June 2017, Bill Conley, deputy director of the Pentagon's new Office of Electronic Warfare, told the Air Force Association that the U.S. has done little to address a quarter century of adversary advances in EW capabilities. It has led the U.S. Department of Defense (DOD) to develop a new EW strategy acknowledging domain superiority — be it land, air, sea, space, cyberspace — is predicated on the ability to control the electromagnetic spectrum.

This new strategy focuses on a crucial central goal: "agile, adaptive, and integrated electronic warfare to offensively achieve electromagnetic spectrum superiority across the range of military operations."

Although the U.S. historically has been the largest market for EW technologies, Dutch market researcher ASD Reports predicts a 36.1 percent worldwide growth in EW over the next decade, from $14.4 billion in 2016 to $19.6 billion in 2026, at which time the total global investment in EW will reach $184.1 billion.

Enabling technologies

That growth is being driven by rapidly advancing enabling technologies — such as cognitive radar and radio communications. Also driving EW demand are open commitments from China and Russia to achieve EW superiority.

As with those earlier technologies moving, often slowly, from concept to deployment, the key to EW superiority is technology finally catching up with human imagination.

"EW is on the verge of a sea-change," says John Tranquilli, technical director of signals & communications processing at the BAE Systems Electronic Systems segment in Nashua, N.H. "The days of big, expensive, database-driven, and slow-to-upgrade platforms, with big radars that are static, are pretty much over. "Adaptive means the EW system can change its operations or response based on some feedback signal it observes from its environment, such as mode changes in a radar. That doesn't mean you aren't relying on a database.

"A system that's cognitive is capable of two things: First, its operations are not reliant on a predefined threat database," Tranquilli continues. "It can determine the meaning of the signals it receives and reason over the potential responses it can make. It's also adaptive, observing changes in its environment. Second, it makes use of learned knowledge so it can respond quicker and more effectively in subsequent engagements."

Bistatic, on the other hand, has been part of the military lexicon for more than 75 years; most early radars in World War II featured a transmitter in one location and the receiver in another.

"That can break some traditional assumptions on how an EW system might respond," Tranquilli continues. "It is the simplest form

of multistatic, which is possible for any system using the RF spectrum. It's not a new concept in terms of bistatic operations, but the application and the extension to multistatic are new."

Embedded computing

"As we move toward bringing things such as the broad term of machine learning, statistical methods and more physics-based modeling into our processing, they take more resources than just looking something up in a database, so HPEC [high-performance embedded computing] comes into play. We are looking to leverage developments in the commercial embedded computing space for adaptive, bistatic, and multistatic. Technology will never be over and done with in terms of what can be achieved, so we will continue to work to further adaptive, cognitive and multistatic EW."

Bistatic and multistatic radars offer several improvements over traditional radar, including a heightened potential for detecting stealth aircraft.

"Bistatic or specially distributed systems provide simultaneous looks at the same signal, which gives you spacial diversity and may provide some elements you couldn't get from a single system. But it is technologically difficult — coordinating across separated receivers, how to share information — and other levels of complexity that still need to be solved," says Anthony Nigara, director of EW mission solutions at the Harris Corp. Electronic Systems segment in Rochester, N.Y.

Sharing information among bistatic or multistatic radars moves into a new level when combined with adaptive or cognitive capabilities.

"The main benefits of adaptive are resilience to change over previously unseen threats. Not being hemmed in by preconceived or predefined databases allows for that resilience against a potentially very broad set of threats. And once you've seen something, you can respond more quickly in the future," Tranquilli adds.

"That ties into multistatic, because what is learned by one can be learned across the multistatic distribution. That gives you

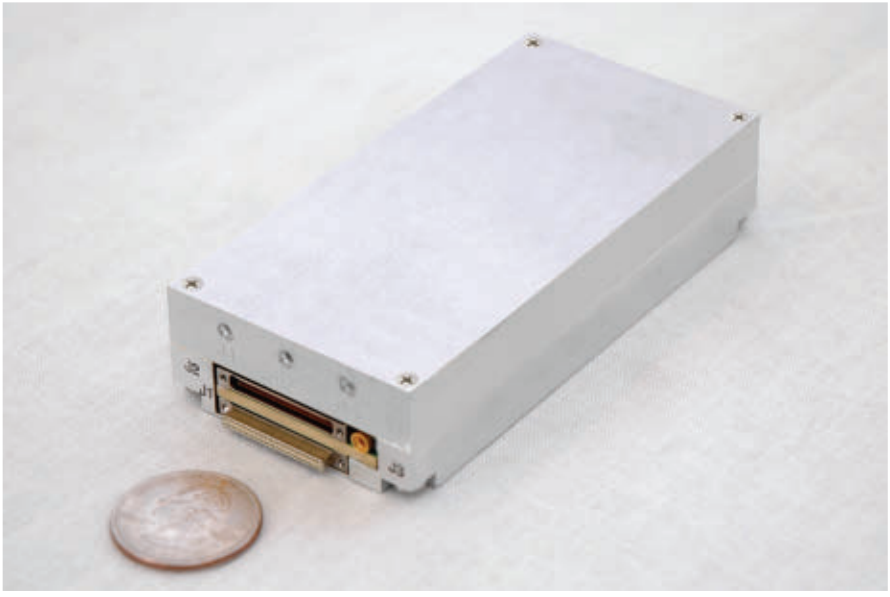
an instantly larger baseline and multiple perspectives. With multiple platforms, you also can distribute processing to save battery life. And in a multistatic environment, if one element is lost, the system can survive and continue, which is a big advantage."

Detecting stealth

Frequency-hopping, software-defined radios and radars have been in use for some time, but advances in the sophistication of potential adversarial systems have significantly reduced the battlespace edge the U.S. has enjoyed since the 1980s. As radar and signal processing become increasingly more complex, radar and other systems must not only detect targets with ever-shrinking radar cross-sections, but identify them, provide size and range information, even target images, operate in all environments (including high sea states) and not only sense but quickly adapt to EW weapons and countermeasures.

This is further complicated by the use of adaptive and cognitive EW systems by adversaries at levels equal to, or potentially more advanced than, U.S. systems and countermeasures. If an enemy fields such capabilities, their systems will be adapting to U.S. countermeasures even as U.S. systems are adapting to them. It is the old paradigm of armor/anti-armor, where each advance in one was countered — weeks or months later — by an advance in the other, reduced instead to seconds, if not nanoseconds.

The speed of technology evolution in the commercial market — primary source of new components for the military — has overwhelmed the Pentagon's traditional research and acquisition rates, wrote Nydia De Nova, principal systems engineer at Raytheon Space & Airborne Systems, in the 26 June 2017 issue of *Electronic Component News*.



Disruptor SRx is an electronic warfare (EW) system that performs several different functions and represents the next generation of EW technology.

"The biggest challenge that exists today is the short timeline for countermeasure advances versus the long development and upgrade cycle time of EW systems. The unprecedented acceleration of new technology development has allowed the adversary to field new threats at increased rates. The U.S. is losing its military superiority over the EMS domain," De Nova warned. "The EW paradigm has shifted, creating the need for rapid development and fielding of systems capable of transforming post-deployment. As enemy threats become more sophisticated, EW designers need to create systems that can adapt and respond to changes in real-time. Such systems have to conform to unseen changes with minimal addition of components/subsystems to support many cycles of countermeasures."

The role of artificial intelligence

To hold a lead in EW, the military must identify new technologies and capabilities designed for commercial use that, with no or minimal modification, can be applied quickly to military needs. That is especially true of revolutionary advances, such as cognitive EW's use of AI to provide adaptive decisions about and actions against new threats in real-time, typically at speeds that preclude human control.

"In pursuing the vision, DOD systems must become more spectrally efficient, flexible, and adaptable, and DOD spectrum operations must become more agile in their ability to access the spectrum in order to increase the opportunities available to mission planners," according to De Nova.

"This includes increasing the operating frequency range of systems, increasing the ability to share

spectrum with other systems, amending DOD processes pertaining to spectrum use, increasing the speed of system adaptation, avoiding potential interference with commercial networks, and developing near-real-time spectrum operations that integrate spectrum management, network operations, EW, cyberspace, and intelligence operations."

In 2016, the U.S. Air Force Scientific Advisory Board (AFSAB) initiated the yearlong study "Responding to Uncertain or Adaptive Threats in Electronic Warfare." The original abstract cited challenges to the Air Force's ability to identify the source and intent of RF signals due to "increasing signal density and highly variable or real-time adaptive waveforms and modalities... software-defined architectures and advanced digital signal processing in adversary systems," especially in an Anti-Access/Area Denial (A2/AD) environment.

"To conduct electronic protection, attack and support, blue systems will need to adaptively probe, sense and respond in real-time, utilizing machine-learning algorithms in what has been described as Cognitive EW," according to the abstract. "However, it is unclear to what extent the current state-of-the-art [SOTA] in machine learning and adaptive decision-making algorithms is suitably mature to fully enable this approach.

"Potential red countermeasures and the likelihood of blue fratricide are also poorly understood," the abstract continues. "There is a need to clarify what is realistically possible to support probe-sense-respond in the near-term and over the foreseeable future, what the performance of such adaptive approaches will likely be and what offers the most promise for developing cognitive EW capabilities."

To that end, the study was commissioned to:

- define current and likely further threat system characteristics that complicate or prevent traditional a priori development of effective electronic countermeasures;
- survey the current SOTA in machine learning and adaptive decision-making algorithms and assess the likely rate of progress in key areas over the foreseeable future;
- determine the performance that will be realistically achievable in the near, mid-, and far-term from various technical approaches to the probe-sense-respond paradigm;
- identify the most promising avenues along which development of cognitive EW should be focused and provide realistic timelines and milestones for each;
- determine key R&D efforts that should be undertaken to accelerate progress in essential technical areas for enabling probe-sense-respond approaches; and
- recommend integrated demonstrations and transition opportunities for near-, mid- and far-term implementation of cognitive EW.

At the time the study was announced, AFSAB Vice Chairman James Chow told reporters the A2/AD threats also are becoming much more adaptive, forcing the Air Force to find new ways to significantly reduce response cycle time. One solution is raising the level of AI in adaptive EW systems.

A U.S. Air Force airman provides training using a simulated satellite constellation at Langley Air Force Base, Va.

Deep learning

"Deep learning and artificial intelligence are industry-driving trends in the data-center market, which will be directly beneficial to the military

Advanced electronic warfare long has been part of shipboard and airborne military applications, and also is becoming an important part of land-based infantry operations for Army and Marine Corps warfighters.

EW market," says Denis Smetana, FPGA senior product manager at the Curtiss-Wright Corp. Defense Solutions segment in Ashburn, Va. "FPGA [field-programmable gate array] vendors, who are competing against GPGPU [general-purpose graphics processing unit] suppliers, continue to optimize their tools to improve the productivity of customers using FPGAs for these types of applications. They are also optimizing their devices to improve the processing capacity of deep learning algorithms."

The U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has been working the defensive side of dealing with evolving enemy adaptive technologies through two primary programs: Adaptive Radar Countermeasures (ARC) with the U.S. Naval Air Systems Command and the Air Force and Behavioral Learning for ADaptive EW (BLADE) with the Army's Communications-Electronics Research, Development and Engineering Center (CERDEC). Both are investigating how machine learning — a form of AI — can be employed in real time to identify and jam enemy signals, especially those not yet cataloged.

"U.S. military aircraft lack countermeasures against new radar frequencies and waveforms not in their on-board jamming profile library and it can take months to develop and deploy new profiles and countermeasures," notes the agency's 2017 document, "Changing How We Win."

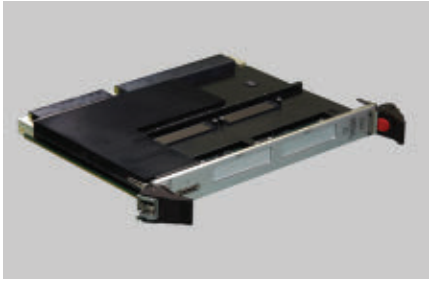
"DARPA has developed a completely new way to address this threat: Cognitive electronic warfare, in which the on-board system senses across the radio spectrum, uses artificial intelligence to learn in real-time what the adversary's radar is doing, and then immediately generates a specific jamming profile to counter it."

Six companies are completing the final year of their individual five-year contracts with DARPA to develop and employ technologies supporting ARC: BAE Electronic Systems, Helios Remote Sensing Systems, Michigan Tech

Research Institute (MTRI), Science Applications International Corp. (SAIC), Systems & Technology Research (STR), and Vadum.

They have been focusing on how to isolate hostile, friendly, and neutral signals to determine the specific threat and jam the signal. Primary threats under study include multifunction ground-to-air and air-to-air phased array radars using agile beam-steering, waveform coding, and pulse-repetition intervals.

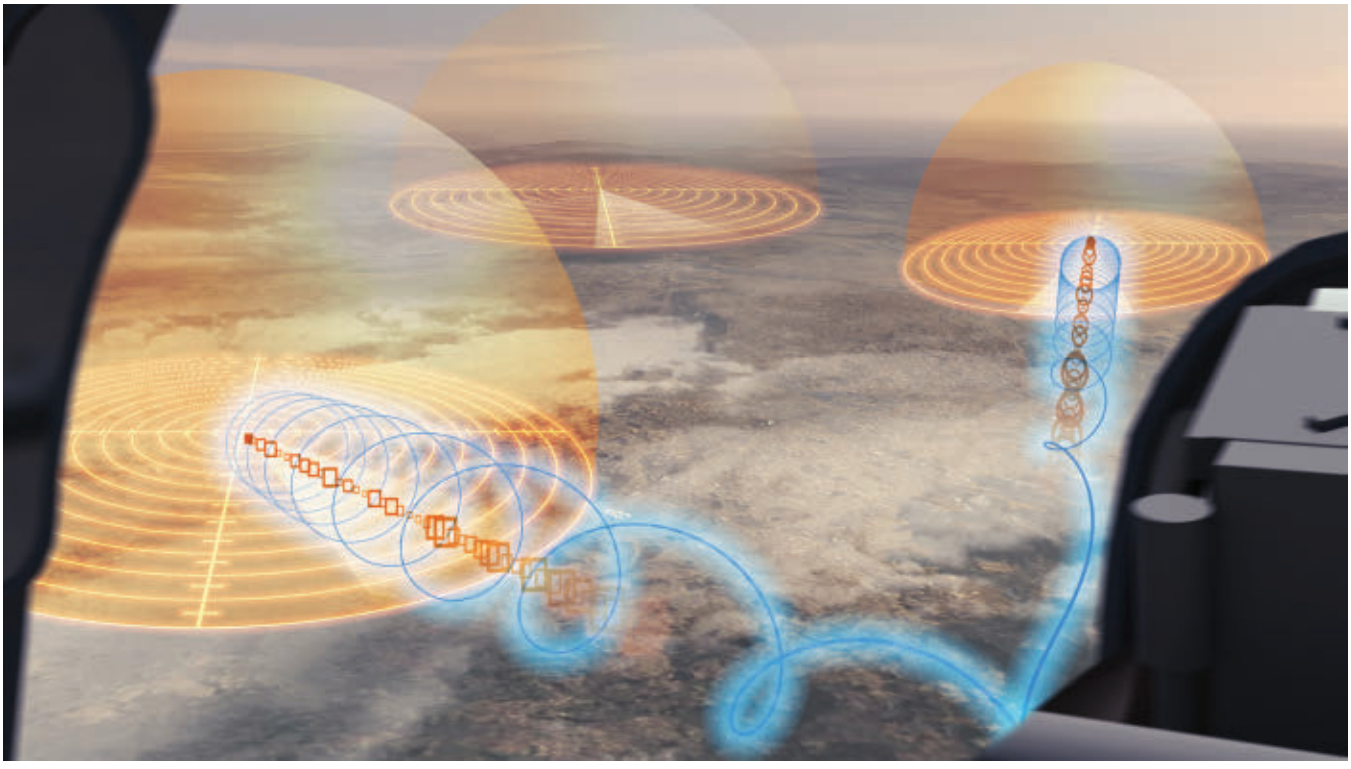
The BLADE program is developing ways to counter new and dynamic wireless communications threats in tactical environments by enabling a shift from today's manual-intensive, lab-based countermeasures to an adaptive, in-the-field systems approach. DARPA says that involves developing "novel machine learning algorithms and techniques to rapidly detect and characterize new radio threats, dynamically synthesize new countermeasures and provide accurate battle damage assessment based on over-the-air observable changes in the threat."



Curtiss-Wright's 4th generation 6U FPGA card, the CHAMP-FX4, combines the dense processing resources of three large Xilinx Virtex-7 FPGAs with more than 12 gigabytes of memory, all on a rugged 6U OpenVPX form factor module.

"Traditional EW systems have relied on preprogrammed data; adaptive systems make some of those determinations without the need of those databases. So they learn in real-time to adapt to their missions as they go along," Harris' Nigara says.

"A lot of the fundamental technologies being explored for adaptive EW have been around in papers for 15 years or longer," Nigara says. "What has caught up is we now have EW systems that operate over a broad enough bandwidth and can take in and process enough information about those resources and sufficiently fast-acting computing to use these algorithms. Our ability to implement and substantiate these



This image from BAE Systems illustrates the company's work on DARPA's Adaptive Radar Countermeasures (ARC) project to enable airborne electronic warfare (EW) systems to counter new, unknown, and adaptive radars in real time.

is due to the hardware catching up to a lot of the theory."

Research and development

Adaptive EW developers have identified a number of enabling technologies and areas of continued R&D that make systems truly adaptive, including:

- smart FPGAs with embedded processors;
- real-time capabilities of leading-edge FPGAs to provide on-the-fly flexibility and reconfigurability with improved size, weight, and power (SWaP) savings;
- RF and microwave components;
- pushing the state of the art (less noise, more bandwidth, etc.) to sense more of the spectrum at any given time without constantly tuning around it to pick up different signals; and
- high-performance embedded computing (HPEC) that provides in-module processing close to the RF signal, with software running alongside the FPGAs to translate signals in-place, reducing latency;
- algorithms;
- machine learning to find breakthrough algorithms that can be modified for EW;
- databases for efficient remote storage and retrieval of the extreme volume of information already pouring out of the battle theater and growing exponentially;
- system-on-chip developments without commercial market applications; and
- extremely fast analog-to-digital (A/D) and digital-to-analog D/A converters.

A/D and D/A converters can be located between the transceiver antennas and digital signal processing that bypass the FPGA to reduce signal passes by tens of nanoseconds for such high-performance, high-bandwidth applications as EW, digital RF modulator (DRFM), signals intelligence (SIGINT), electronic countermeasures (ECM), and ground-penetrating radar (GPR).

"As electronic warfare moves from adaptive (able to adapt responses to different stimuli) to cognitive (able to generate new responses to previously unseen stimuli), the amount of processing continues to increase and the intelligence required to make those decisions has to move closer to the sensors," says Curtiss-Wright's Smetana. "FPGAs, which have always been at the front-end of

the sensor processing chain, continue to evolve to incorporate new enabling capability which directly relates to this trend.

"First, the level of integration of cores inside an FPGA is increasing to include more powerful processors, embedded SDRAM and even A/D and D/A converter cores," Smetana says. "The embedded processor cores provide a tight coupling between software and the front-end sensor data. The embedded SDRAM will aid in the application of deep-learning algorithms inside the FPGA which require a low-latency, high-bandwidth memory interface. And, lastly, the embedding of A/D and D/A converters directly inside the FPGA specifically helps low-latency sense-and-response EW applications by removing the external FPGA-A/D-D/A interface, which is increasingly impacting latency."

U.S. Marines use advanced radio to communicate voice, data, and imagery. Cognitive radio capability could help keep communications channels open despite enemy attempts to jam them.

Looking to the future

As to the future, adaptive EW is seen as a subset of cognitive EW, both part of a continuum that will enable warfighters to do more, faster, with greater reliability and confidence, but also with significant reductions in SWaP, as well as the number of devices and systems required.

"Generically, we're seeing a convergence into multifunction systems," Harris' Nigara says. "An EW system today may be built for a specific role, such as sensing and detecting radars, but we're trying to move toward systems that can move from a specific EW mission to a SIGINT or communications mission without being reprogrammed. So instead of a [dedicated] EW system in the future, you'll really have a spectrum management system. I see that starting to move into the spotlight in the next one to five years.

"The systems we are trying to detect and counter within the spectrum are becoming more and more software-defined, which is spurring the need for adaptive and cognitive systems," Nigara continues. "I think you'll see a natural progression; a lot of pieces are starting to come together and will begin to be seen in fielded systems as they are required. However, a full adaptive or cognitive system doesn't mean we throw away decades of proven EW technologies. The new will exist within traditional EW systems or operate very closely alongside them."

According to Harris, as adaptive EW systems get fielded and their capabilities are fully explored in operation and become a trusted technology by the EW community, "adaptive EW has the potential to fundamentally alter how EW is conducted, from development to logistics to operational employment." However, not even radically streamlined DOD acquisition procedures in the future will match the speed of commercial development o nor should they, in the view of some observers.

"If you look at any conflict, there will always be a mix of capabilities," Nigara predicts. "History has shown it is slow to phase out older technologies, especially in the military, because in certain areas they still work. So it will be a long road before we have only adaptive and cognitive systems out there, at least through the 2020s.

"Sometimes having that diversity out there is a good thing," Nigara says. "There is still work to be done on how they are used in the field. For example, do we need an additional command-and-control level to arbitrate between legacy and adaptive systems that don't agree. And while AI is here to stay, it's a matter of how much additional effort is needed to implement it and how complex a thought process will it be using." ←

Backplanes and chassis for military electronics

Databuses today revolve around 3U and 6U VPX, but many applications still rely on VME and 3U CompactPCI, while demanding performance is giving rise to a variety of innovative air- and liquid-cooling approaches.

BY **John Keller**

The 9U RiCool chassis platform from Pixus Technologies offers 392 cubic feet per minute of airflow. It offers 32 OpenVPX backplane slots in the 3U size and up to 16 slots accommodating 6U cards.

Here are a few things you can count on from those who specify defense electronics: They want it small; they want it powerful; they want it interoperable; and they want it to be cost-effective. These needs drive aerospace and defense electronics designers to reduce size, weight, and power consumption (SWaP); provide increased processing power; and increase their reliance on open-systems standards.

How this shakes out for the embedded computing industry is the increasing popularity of databus and backplane designs that adhere to 3U and 6U VITA VPX architectures. VPX, as it encompasses its many different versions, is perhaps today's biggest trend when it comes to backplanes and databuses in military and aerospace electronics.

Design trends leading to VPX architectures also require innovative cooling and thermal management to accommodate current and future powerful digital processors and analog RF and microwave components; government- and industry-backed open-systems standards initiatives to enhance popularity and drive down costs; new approaches to squeezing the most capability possible into small electronics enclosures; and overall industry consensus on the best paths to the future.

At the same time, there's still a lot of interest in legacy backplane and databus architectures like VME and 3U CompactPCI for technology insertion and systems upgrades in existing applications, as well as for new applications with relatively modest demands on processing power.

These trends are requiring from systems designers and component suppliers a mix of technology innovation, good sense, and a willingness to work together in standards organizations to level the playing field and create broad opportunities for design wins for new platforms and legacy systems.

The rise of VPX

"Everything is pushing toward OpenVPX, and that could be much bigger than the first wave," says Ivan Straznicky, chief technology officer of advanced packaging at the Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va.

"We are seeing growth in our demand for VPX," says Ken Grob, director of embedded technologies at Elma Electronic Inc., an international company based in Wetzikon, Switzerland. "That takes us to the types of VPX backplanes being requested. We are seeing more

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demand for 3U than we are for 6U VPX. The applications requiring VPX are high-performance embedded computing (HPEC) products."

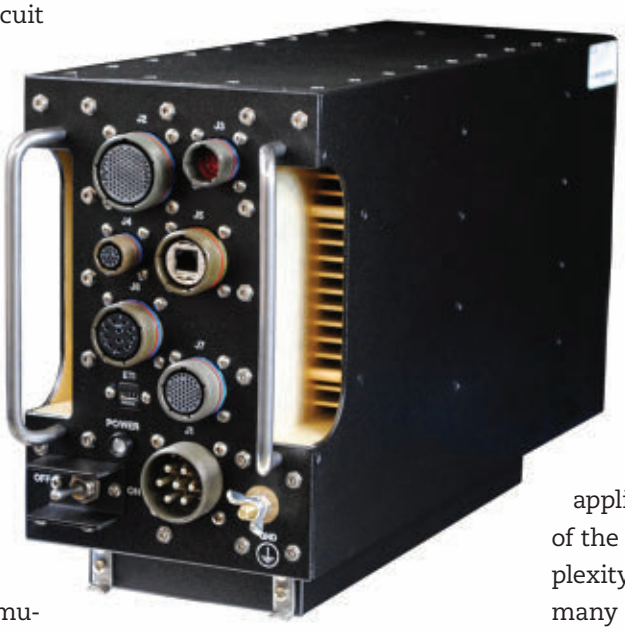
Where it breaks down between 6U and 3U VPX depends on the application, says Grob, who is based in Horsham, Pa. The 6U VPX circuit board is roughly twice the size of the 3U board, and typically is packaged in a system in an air transport rack (ATR)-type enclosure. Elma is seeing demand for 6U VPX at roughly 30 or 40 percent of the company's demand for 3U VPX, Grob says.

"We also are doing 6U VPX designs, and it is significant," Grob says. "6U is more than niche; it needs to be conduction-cooled, or needs to be in an ATR. But if the computing needs to be in a pod, or in communications and radios, those things fit well on 3U VPX. A variety of sensor-based platforms are leveraging the 3U VPX architecture."

Typically, the most demanding applications, in which small size isn't necessarily a top priority, are opting for 6U VPX. "If it is sensor-related, and you need a lot of I/O, the I/O requirement drives you out of a 3U board," Grob says. "Or if you need the processing requirements for high-performance FPGAs [field-programmable gate arrays], some duality that requires dual-FMCs for A/D converters, or high-performance Xeon processors that might not fit on 3U."

This year Elma got requests for 6U backplanes with power densities as high as 3,000 watts for redundant systems or symmetrical architectures, Grob says. That level of thermal management simply would not be possible in a 3U system.

One attractive element of 6U and 3U VPX is its ability to accommodate safety-certifiable systems for commercial and military avionics, says Curtiss-Wright's Straznicky. "Safety certification is a trend in aerospace and defense, and because of this trend we are seeing some influence from commercial avionics, in particular on the small-form-factor VPX side."



This rugged 3U VPX air conduction-cooled chassis from Elma is for avionics, land vehicles, and other military SWaP-constrained applications.

Ease of design and the potential for interoperability also are benefits of using VPX, says R.J. McLaren, systems product manager at Kontron America in Mira Mesa, Calif. "A lot of customers in pure defense want to have plug-in cards in a backplane, and everybody is going with the VPX style."

The stronger the need for computer power, the more likely the systems integrator will specify VPX, McLaren says. "Where you might want to move to VPX is if you want more real-time processing capability. You could upgrade your low-speed card to a mezzanine card and keep the same enclosure size."

Yet one of the most compelling reasons to choose VPX is its capacity for growth. "You can add analytical capability," McLaren says. "People are looking at VPX for its growth potential and to increase processing and analytical capability inside existing platforms."

Industry experts admit, however, that not all military embedded computing applications call for VPX because of the technology's relative complexity. The VPX standard offers many different profiles, and the process of sifting through them in search of just the right design approach can be a big challenge.

"There are so many different designs in VPX; every backplane is custom," says Doug Patterson, vice president of marketing and business development at Aitech Defense Systems Inc. in Chatsworth, Calif. "There are three or four backplane configurations with how the main PCIbus works. There are code numbers associated with every single backplane configuration of a card. You have to decipher the standard, and it is a pain for the customer base to get interoperability because there are so many variables in the standard."

It is for these and similar reasons that some systems designers are taking a second look at legacy embedded computing backplane

technologies like VME and CompactPCI — especially when it comes to ease of use.

The enduring legacy of VME

With the growing popularity of VPX, there are plenty of embedded computing engineers who are surprised that VME survives as a viable option.

"We thought VPX would be the death knell for VME, but that has not been the case," says Curtiss-Wright's Straznicky. "VME is still alive and kicking. If a prime or end-user has a requirement to upgrade functionality, and they can still get by with VME, then you just take out the computing blade and put in another VME blade. Those applications continue to pop up with a high number of programs. We and others continue to introduce new VME products, and that is testimony that our customers still want to use it."

When — and if — there will be an end of VME in military and aerospace electronics designs is anyone's guess.

"VME has not gone away by any means, even though more programs are asking for VPX," says Kontron's McLaren. "If it isn't broke, then don't fix it. If you have a single-processor and low-speed signaling I/O cards, and your design is for a use case, then there is not a compelling reason to go with VPX. There are plenty of systems out there where VME still makes sense."

Ease of use remains one of the most attractive features of VME. While VPX requires systems designers to navigate through many different profiles and technologies, "the big question in VME is how many slots do you want," says Aitech's Patterson. "At the high end, with high speed FPGAs in vision systems is where VME falls short."

While VME may fall short in complex digital signal processing, "not every application requires gigabits per lane on a backplane," Patterson continues. "If you are controlling a mirror in a targeting platform, you don't need VPX. If it is a simple control system, then VME works fine, and so does Compact PCI."

Patterson says Aitech is still getting VME design wins at the rate of a couple a month. "Machine control and process control is the sweet

spot for VME and 3U Compact PCI. Fire control for missile systems? VME works just fine."

Patterson says he sees the military embedded computing market broken out to about 50 percent VPX, and 50 percent VME and 3U CompactPCI. "We have introduced the fastest Intel processors and Freescale PowerPC on VME, and they are doing fine. Why would Aitech make another VME card if the market is dead? The answer is people want to buy it; it is much easier to work with, and is less complex."

As with many legacy technologies, however, users VME and 3U CompactPCI must contend with obsolescence issues. If there will be an end to VME in the future, it may be due to the lack of VME interface chips, which are rarely manufactured today.

"VMEBus interface chips, they are gone," Patterson says. "We found them, we bought them, and they're gone. We made a huge investment and bought the parts. CompactPCI chips have the same problem."

Kontron's McLaren, however, says finding VME interface chips can be a challenge, but one he can deal with. "There are bridge chips we use for legacy devices," he says. "It's not as easy as it used to be to find them, but we stay on top of that."

Cooling and thermal management

For high-performance embedded computing involving 6U or 3U VPX, cooling and thermal management almost always is an issue. To get the heat out, companies are using industry-standard cooling techniques that involve high-performance air cooling, liquid cooling, or a hybrid of both.

Curtiss-Wright is using VITA 48.8-standard air flow through cooling to remove heat from 6U VPX systems running as much as 250 watts. Air-flow-through retains sealing of on-board components to reduce the threat of contamination, while using high-velocity blown air to remove heat individually from each board.

The Elma 3U OpenVPX 12-slot CMOSS backplane supports the defense industry's hardware and software convergence initiatives for modular architecture. It is an integration platform for modules addressing the military's C4ISR Modular Open Suite of Standards (CMOSS).

Air-flow-through cooling is an alternative to traditional conduction cooling that removes heat from boards through board wedge locks and out to the edge of the electronics enclosure. It can provide adequate cooling to high-performance systems that only a short time ago would require liquid cooling.

Moreover, liquid flow through cooling opens up new possibilities in using non-metallic chassis materials to save on size and weight. "It gives us the ability to use materials other than metals, like composites and polymeric materials," says Curtiss-Wright's Straznicky. "That is an interesting change from what we've seen in the past."

Air-flow-through doesn't solve all thermal-management problems, however. "Once you get into 300 watts or more on a 6U blade, you really need to consider liquid-flow-through cooling," Straznicky says.

Engineers at Mercury Systems are using a hybrid approach that blends air and liquid flow through cooling for applications that may not have continual access to air or liquid on a platform. This approach, which Mercury calls air flow by, "offers the same cooling as with liquid-flow-through, but also has baked-in air-flow-through," says John Bratton, product and solutions marketing manager at Mercury Systems in Andover, Mass.

For many implementations of VPX, "cooling really drives the architecture," Bratton says. Mercury's air-flow-through thermal-management approach is creating "a redundant and more-robust cooling capability," Bratton says. "It can air cool or liquid cool, from hot on the ground to operating at altitude; it can cool with the fuel running or not."

With its ability to cool with liquid or air, Mercury's air-flow-through offers more cooling in a smaller

space “so you can put more cards in a system,” Bratton says. This design “is flying today,” although he declines to name the specific application.

Not only can this approach cool high-performance digital electronics, but also has the potential to cool much-hotter RF and microwave components, which is a particular benefit to Mercury, which is blending digital and RF and microwave processing in a variety of electronic warfare and radar systems. “It offers a solution across the sensor-processing chain, and cab become very small, rugged, and application-specific like the electronics at the front of a missile,” Bratton says.

Military standards initiatives

One of the most-watched military standards initiatives where embedded computing is concerned is the C4ISR/EW Modular Open Suite of Standards (CMOSS), which is part of the U.S. Army Communications-Electronics Research, Development and Engineering Center (CERDEC) C4ISR/EW Hardware/Software Convergence project.

Mercury Systems uses liquid-flow-by technology in this VPX embedded computing board, which uses a hybrid approach using air and liquid for cooling.

It seeks to create a converged architecture that provides open interfaces to enable rapid insertion of new capabilities, interoperability, and a reduced SWaP footprint. It seeks to enable sharing of hardware and software among communications, surveillance, and electronic warfare capabilities, and allow technology refresh to keep pace with threats. The CMOSS project seeks to create a layered approach in which industry standards play a part individually or in concert.

CMOSS relies on OpenVPX at the hardware layer, and on the Future Airborne Compatibility Environment (FACE) at the software layer. It includes the Modular Open RF Architecture (MORA) standard for defining components within an electronics architecture, and defines messaging and protocols among components. CMOSS, furthermore, uses the Vehicular Integration for C4ISR/EW Interoperability (VICTORY) standard at the network layer for connectivity within the platform.

The VME-690 24-Port 6U VMEBus Gigabit Ethernet switch module from Curtiss-Wright provides a 35-watt, pin-compatible replacement for earlier designs while adding advanced data security features.

"When we look at what's new, for the past few years we have seen trends in hardware convergence initiatives, driven out of the Army, and driven down by DOD [U.S. Department of Defense] activities," says Elma's Grob.

"Lately we have produced the CMOSS Backplane — a 12-slot hardware-convergence backplane. Now we are seeing demand from other government consortia for the convergence architecture," Grob says, adding that broad industry standards like CMOSS could be a win-win for everyone in the embedded computing industry.

"They are working to get the community to make interoperable modules, and they are starting to prove that," Grob says. "It is healthy for everyone. If the playing field is level, then volumes can go up. It gives the users a better solution, and is more of a common backplane structure."

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Systel Inc.
Sugar Land, Texas
www.systelusa.com

Themis Computer
Fremont, Calif.
www.themis.com

United Electronic Industries (UEI)
Walpole, Mass.
www.ueidaq.com

Vadatech Inc.
Henderson, Nev.
www.vadatech.com

Army upgrading ground-penetrating radar system for detecting IEDs

Counter-land mine experts at Chemring Sensors and Electronics Systems (CSES) in Dulles, Va., will upgrade a ground-penetrating radar system to detect improvised explosive devices (IEDs) buried in roadways. Officials of the Army Contracting Command-Aberdeen Proving Ground in Alexandria, Va., announced plans to ask CSES, formerly Non-Intrusive Technology Inc. (NIITEK), to make engineering changes to the CSES Husky Mounted Detection System (HMDS), a counter-IED system able to detect underbelly IEDs and anti-tank land mines buried in primary and secondary roads. The system is a combination of the CSES VISOR 2500 ground-penetrating radar and Husky vehicle from Critical Solutions International in Carrollton, Texas. The HMDS helps the Army quickly clear roadways of anti-tank mines, roadside bombs, and other IEDs. The CSES VISOR 2500 ground-penetrating radar detects metallic and non-metallic explosive hazards, pressure plates, and antitank mines. It combines advanced, real-time automatic-target-recognition algorithms, integrated metallic and non-metallic threat detection, automatic precision marking, and software in a ruggedized, supportable package.

Navy researchers need help to upgrade software-defined radar for wide-area search

BY **John Keller**

STENNIS SPACE CENTER, Miss. — U.S. Navy researchers are asking for industry's help to upgrade an advanced software-defined radar system designed for wide-area search and obscured target detection.

Naval Research Laboratory (NRL) officials at Stennis Space Center, Miss., have issued a sources-sought notice (NRL-18-WR03) for the Synthetic Aperture Radar Development–Resources project to enhance the capabilities of the Northrop Grumman multi-band synthetic-aperture radar (MB-SAR).

Northrop Grumman developed the MB-SAR and delivered it to the NRL in 2010. The Navy has used the system for a variety of advanced-detection projects such as Arctic sea ice mapping, counter-IED operations, downed World War II aircraft location in the Pacific and in Greenland, and special target imaging.

NRL researchers want to develop new capabilities in the MB-SAR's radar and optical data acquisition, processing, and analysis, and integrate these technologies aboard Navy aircraft for use in the field. On NRL's agenda is developing and improving SAR data acquisition, signal-processing and -exploitation algorithms, data screening and compression techniques, and ways to disseminate this information to military users. This requires developing hardware, software, and algorithms

The MP-SAR radar has been tested aboard a Navy NP-3D four-engine turboprop research aircraft to detect potential IEDs and other threats over swaths nearly eight miles wide.

to exploit active and passive signals to detect, track, image, and identify targets within permissive and contested areas using either a single or distributed RF architecture.

The MB-SAR system has benefits to the military. Legacy radar systems typically have been designed with specific applications in mind which limited the information from the sensor data.

The software-defined MB-SAR, however, offers more flexible RF sensing and multiple exploitation layers over a wide area from one sensor stream. In contested environments, moreover, the system may present opportunities to exploit passive sensing using signals of opportunity.

This upgrade project will involve improving the MB-SAR radar antenna subsystem to extend its range and cover additional portions of the frequency spectrum. NRL researchers also want to reduce the MB-SAR's size, weight, and power (SWaP)

requirements for use in unpressurized aircraft compartments or pods.

NRL also wants to develop and test new detection algorithms for single-look, coherent, and non-coherent change detection. Researchers are interested in geolocation, and tracking moving targets such as move-stop-move, low-velocity movers, and low-radar-cross-section objects.

NRL also is interested in new algorithms for advanced SAR imaging for targeting, classification, interferometric SAR, video SAR, ultra-fine resolution imagery, and 3D volumetric imagery — particularly in congested and contested environments. Also of interest is new software for compression, data integration, and visualization to preserve SAR change detection and target identification quality. NRL wants deep-learning and neural network capability for the MB-SAR to automate different system functions.

NRL officials plan a five-year project to upgrade MB-SAR capabilities.

MORE INFORMATION IS online at *http://bit.ly/2BOwAM9*.

DARPA seeks to ensure radio networking reliability in jamming and interference

BY **John Keller**

ARLINGTON, Va. — Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a presolicitation (HR001118S0012) for the Network Universal Persistence (Network UP) project to develop and demonstrate radio technology that maintains network reliability through periods of frequent signal degradation that routinely occur during military operations.

The project seeks to maintain network reliability by separating control information and communications data in separate wireless links to create a protected control channel that can maintain network reliability even when the data channel is lost. A significant problem with many of today's military wireless networks involves periodic network outages due to brief losses of wireless links outages. This loss of network connectivity that can take more than two minutes to recover once the wireless link is re-established. Moreover, networks in dynamic wireless environments can end up mostly attempting to establish the network rather than sending data.

Today's military radios send the network control information and the data using the same wireless link, which causes a network failure when that wireless link degrades. Separating the control and data information across two different wireless links should enable developers to use the relatively low bit rate of the control information and match the control link frequency to the environment to create a robust control link that can withstand degradation of tens of decibels, researchers say.

Maintaining the network via a robust control channel should enable the network to send data over the network immediate as soon as the link is available.

The three-year Network UP program seeks to develop prototypes that enable military wireless networks to send data over unstable wireless links. The program's first phase has two parts: developing a radio architecture that separates control and data channels; and developing a bursty link network that exploits burst or transient links.

Radio architectures and waveforms should be able to operate the control channel through deep and periodic data channel degradation, with an eye toward developing an applique to improve the performance of legacy radios.

The DARPA Network UP project is trying to maintain military radio communications and networking amid enemy jamming and interference.

The project's second part will develop a scalable control plane that resides in a separate RF band from the data plane, and develop an ability for the control to send essential mission information when the data channel is not available.

Demonstrations in the project's second phase will integrate the Network Up control radio with a legacy radio as the data radio; evaluate performance in urban, dense-foliage, and jamming conditions; and integrate a Network UP control radio applique with a legacy radio with significant performance improvement.

MORE INFORMATION IS online at *http://bit.ly/2s2FnKG*.

L-3 to provide naval shipboard electro-optical gun sights

BY **John Keller**

WASHINGTON — Military electro-optics experts at L-3 KEO in Northampton, Mass., will provide shipboard sights to enable U.S. Navy and Coast Guard warships to hit enemy ships and aircraft with naval gun fire under terms of a $30.8 million order.

L-3 will provide MK20 shipboard electro-optical sights to help keep naval gunfire on target.

Officials of the Naval Sea Systems Command in Washington are asking L-3 KEO to produce additional MK 20 electro-optical sensor systems (EOSS), radar cross sections kits, shock ring kits, engineering support services, and spares for the Navy and Coast Guard.

The MK 20 EOSS is a check sight and targeting sensor for anti-surface and anti-air warfare and naval gun fire support missions, Navy officials say. L-3 KEO has been building the system since 2005. That year L3-KEO won a Navy contract to provide the EOSS for the Ticonderoga-class Cruiser Modernization Program.

Company electro-optical engineers built on the MK46 Optical Sight System to blend new technologies into the MK20 MOD 0 EOSS, as well as integrate the system into the MK34 5-inch deck guns aboard Ticonderoga-class cruisers.

The MK20 EOSS has digital stabilization with fiber-optic gyros, a separate eye-safe laser rangefinder with diode-pumped laser, enhanced built-in test, and improved sensor-to-sensor boresight alignment. The EOSS meets MIL-S-901D heavyweight and large-displacement shock tests.

The MK20 MOD 0 incorporates several technology improvements over the MK46, and new features that support integration with the MK34 Gun Weapons System (GWS).

To integrate with the MK34 deck gun, the EOSS has a new interface electronics unit (IEU) that interfaces with as many as two deck gun computers and three deck gun consoles to provide video, target bearing and range, and system status data to all three, while taking commands from any one.

On this contract modification L-3 will do the work in Northampton, Mass., and Brattleboro, Vt., and should be finished by July 2019. ←

FOR MORE INFORMATION visit **L-3 KEO** online at *www2.l3t.com/keo*, and **Naval Sea Systems Command** at *www.navsea.navy.mil*.

Rugged displays for ground vehicles and helicopters introduced by Esterline

Esterline Technologies Corp. in Bellevue, Wash., is introducing a new version of the company's Thin eXtreme displays for harsh-environment applications in ground vehicles and helicopters. The TX series/2 display is available in two sizes: the TX-126/2 10-inch diagonal 4:3 aspect ratio, and the TX-340 15-inch diagonal 16:9 aspect ratio. The avionics and vetronics displays come with full HD sensors interface and display. The Esterline products feature high-brightness performance, touchscreens, and GVA/NGVA keypad layout. The displays interface to several different video formats for driver display, commander display, and gunner position displays.

China deems blasting space junk with a laser station feasible

NASA estimates that millions of fragments of man-made debris are zipping in Earth's orbit at more than 17,500 miles per hour. At such velocities, even a tiny piece of junk like a nut or bolt can wreak havoc on satellite infrastructure as well as threaten the lives of astronauts. Scientists at the Air Force Engineering University in China completed a computer simulation that found it feasible to blast orbiting space junk with space-based lasers. The simulation confirms this concept can work by calculating how long they would have to target debris and the best angles to do so. ←

Navy orders 10 P-8A Poseidon surveillance and patrol aircraft

BY **John Keller**

PATUXENT RIVER NAS, Md. — Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Boeing Defense, Space & Security segment in Seattle to build 10 more P-8A Poseidon maritime patrol and surveillance aircraft — seven for the U.S. Navy and three for the United Kingdom — under terms of a $1.2 billion order that includes mitigating unknown component and subsystem obsolescence issues, as well as class I change assessment, and obsolescence monitoring.

The Navy plans to buy 108 P-8A aircraft from Boeing, which is building the Poseidon in Renton, Wash. The 737 fuselage and tail sections will be built by Spirit AeroSystems in Wichita, Kan. The flight management system and the stores management system have been developed by GE Aviation Systems in Grand Rapids, Mich. The cabin has as many as seven operator consoles.

The P-8A surveillance aircraft has an electro-optical sensor turret that can accommodate infrared, CCDTV, image intensifier, laser rangefinder, and laser illuminator sensors.

The Poseidon's MX-20HD digital electro-optical and infrared (EO/IR) multi-spectral sensor turrets come from L-3 Communications Wescam in Burlington, Ontario. The MX-20HD is gyro-stabilized and can have as many as seven sensors, including infrared, CCDTV, image intensifier, laser rangefinder, and laser illuminator.

The aircraft has the upgraded APS-137D(V)5 maritime surveillance radar and signals intelligence (SIGINT) system from the Raytheon Co. Space and Airborne Systems (SAS) segment in McKinney, Texas.

The P-8A will have the CAE Inc. advanced integrated magnetic anomaly detection (MAD) system, and eventually may use air-deployable unmanned aerial vehicles (UAVs) to handle magnetic anomaly detection. The Navy plans to arm the P-8A with the MK 54 torpedo.

Work on the contract should be finished by December 2020.

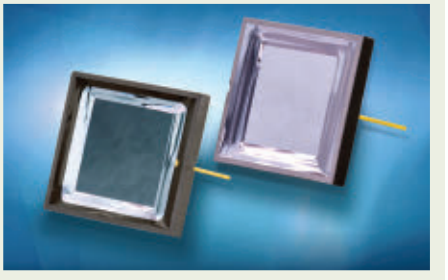
FOR MORE INFORMATION visit **Boeing** online at *www.boeing.com*.

Photodiodes for laser power monitoring and metrology introduced by Opto Diode

CAMARILLO, Calif. — Opto Diode Corp. in Camarillo, Calif., is introducing the SXUV100TF135 and SXUV100TF135B photodiodes with integrated thin-film filters for electro-optical applications such as laser power monitoring, semiconductor photolithography, and metrology systems that use extreme ultraviolet light.

The detectors have a 100-square-millimeter active area and a directly deposited thin-film filter for detection between 12 and 18 nanometers. Both detectors have typical responsivity of 0.09 A/W at 13.5 nanometers.

The SXUV100TF135 model is optimized for high-speed reverse bias voltage operation. The device has low capacitance, typically 260 picofarads, with a reverse bias voltage of 12 volts. The SXUV100TF135B is optimized for zero bias voltage operation where low dark current is of paramount importance. The detector has a high shunt resistance greater than 10 micro-ohms.



Laser power monitoring, semiconductor photolithography, and metrology are potential applications for Opto Diode photodiodes.

Opto Diode's photodiodes with integrated thin-film filters offer stability and a design for extreme ultraviolet environments. Operating and storage temperatures range from -10 to 40 degrees Celsius in ambient environments and from -20 to 80 degrees C in nitrogen or vacuum environments. The devices are shipped with protective covers.

FOR MORE INFORMATION visit Opto Diode online at *http://optodiode.com*.

Coast Guard wants small unmanned aircraft for national security cutters

The U.S. Coast Guard intends to release a request for proposals for small unmanned aerial vehicles (UAVs) for national security cutters and other Coast Guard vessels. The future Coast Guard UAV award, for which requirements are not yet finalized, will be worth no more than $300 million. The Coast Guard wants economically priced UAVs able to remain airborne for at least 12 hours a day. The drone should have the size, weight, and power to operate an electro-optical infrared sensor, aeronautical transponder, VHF/UHF communications relay, and a non-visible infrared marker. The service wants a UAV capable of swapping out those payloads with others, including government-provided systems, in less than a couple of hours.

Pentagon confirms Russia building nuclear UUV

An internal Pentagon nuclear study confirms Russia is developing an intercontinental-range, nuclear-armed unmanned underwater vehicle (UUV). It is among new strategic weapons being developed as part of a nuclear modernization underway over the past decade. Russian nuclear modernization includes upgrades for older missiles, launchers, bombers, and submarines, according to an internal draft of the *Nuclear Posture Review*.

Hydronalix developing buoy for unmanned underwater vehicle control and communications

BY **John Keller**

The U.S. Navy is developing special buoys to house, control, and distribute information from unmanned submersibles exploring rivers and streams.

LAKEHURST, N.J. — U.S. Navy unmanned underwater vehicle (UUV) experts needed a special buoy to house and control surveillance UUVs designed to determine the depth and underwater topography of rivers and inland waters. They found their solution from Hydronalix Inc. in Green Valley, Ariz.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., have announced plans to award an advanced research contract to Hydronalix to develop prototype mobile gateway buoys with integrated communications and control software. The amount of the upcoming contract was not disclosed.

These gateway buoys will be part of a Navy research project called Autonomous Underwater Vehicle (AUV) for Sustained Riverine and Littoral Assessments, which is developing covert UUVs to explore rivers, harbors, and coastal waters for military surveillance. A gateway buoy works together with a UUV operator to track, monitor, command, and interact with the UUV remotely while the unmanned submersible is underway. It helps maintain communications with the UUV, and share information with military forces who need it.

Hydronalix engineers will build an improved gateway buoy hull with hybrid electric and heavy-fuel propulsion, integrated with MK 18 gateway buoy communications equipment, and controlled by Neptune control software. The company will build two gateway buoy prototypes, and integrate them with control software and acoustic communication systems. Engineers will design the buoy to accept new communications technologies as they become available into a common modular buoy payload bay.

The AUV for Sustained Riverine and Littoral Assessments project is developing covert UUVs able to conduct surveys along rivers and streams while navigating under the vegetation canopy, causing the UUV's onboard global positioning system (GPS) to operate only intermittently.

Since 2010, this project has involved Hydronalix, as well as Ocean Server Technology Inc. in Fall River, Mass.; SeaLandAire Technologies Inc. in Jackson, Mich.; and FarCo Technologies Inc. in Brooklyn, N.Y.

The project's first phase focused on developing UUV sensors, navigation, propulsion, control, hull, algorithms, and integrated system design. The second phase developed a demonstration prototype UUV, and the third phase is developing an acquisition-ready river surveillance UUV.

Now Hydronalix will develop a gateway buoy to house and control the UUV, as well as distribute UUV information. Future contract options may involve situational awareness sensor integration; vertical acoustic communication system integration; expendable data exfiltration embedded relay radio integration; and high-frequency ground wave radio integration.

FOR MORE INFORMATION visit **Hydronalix** online at *https://hydronalix.com*, and the **Naval Air Warfare Center Aircraft Division-Lakehurst** at *www.navair.navy.mil*.

Navy beefs-up wide-area ocean surveillance with orders for more Triton UAVs

BY **John Keller**

PATUXENT RIVER NAS, Md. — Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $255.3 million order to the Northrop Grumman Aerospace Systems sector in San Diego for three MQ-4C Triton long-range and long-endurance unmanned aerial vehicles (UAVs) for real-time intelligence, surveillance, and reconnaissance (ISR) over vast ocean and coastal regions. The three low-rate initial production UAVs are part of the third lot of Triton production.

Northrop Grumman is building the Triton, also called Broad Area Maritime Surveillance (BAMS), to fly maritime surveillance missions lasting 24 hours at altitudes of more than 10 miles to enable coverage out to 2,000 nautical miles. The UAV's suite of sensors can detect and classify different types of surface ships automatically. The Triton will be a crucial component of the Navy's 21st century strategy for conducting surveillance of surface ship and submarine traffic in oceans around the globe.

The Triton's maritime search radar, the Northrop Grumman AN/ZPY-3 Multi-Function Active Sensor (MFAS), will provide a 360-degree view of a large maritime area while providing all-weather coverage for detecting, classifying, tracking, and identifying surface ships and other targets of interest. MFAS is separate from the Triton's air-to-air radar. The MFAS radar first flew on the Triton during testing in April 2015.

Along with the air-to-air and MFAS radar systems, the MQ-4C will carry an electro-optical/infrared (EO/IR) sensor that will provide still imagery and full-motion video of potential threats; an electronic support measures package to identify and geolocate radar threat signals; and an automatic identification system (AIS) that will detect and track vessels equipped with AIS responders.

The Navy took delivery of the first operational MQ-4C unmanned aircraft last November at Point Mugu Naval Air Station, Calif. The MQ-4C Triton is designed to provide combat information to military authorities like the expeditionary strike group, carrier strike group, and the joint forces maritime component commander. The Triton is based on the U.S. Air Force RQ-4B Global Hawk. The Triton feeds intelligence, surveillance, and reconnaissance (ISR) data to the Global Information Grid (GIG), and can work alone or together with other aircraft and surface ships.

The U.S. Navy is using large long-endurance unmanned aircraft for maritime patrol and surveillance missions.

Triton aircraft and support facilities are based domestically at Point Mugu Naval Air Station near Ventura, Calif., and at Mayport Naval Station near Jacksonville, Fla. Triton UAVs also will be forward-deployed to Andersen Air Force Base, Guam; Sigonella Naval Air Station, Italy; and with the Navy's Fifth Fleet based in Bahrain in the Middle East.

FOR MORE INFORMATION visit **Northrop Grumman** online at *www.northropgrumman.com*.

PRODUCT applications

ANTENNAS

Raytheon to provide high-speed SATCOM antennas for nuclear submarines

Satellite communications (SATCOM) experts at the Raytheon Co. will provide the U.S., United Kingdom, and Australian navies with high-speed SATCOM antennas for submarines under terms of a $25.8 million order.

Officials of the Space and Naval Warfare Systems Command (SPAWAR) in San Diego are asking the Raytheon Integrated Defense Systems segment in Marlborough, Mass., to provide six Submarine High Data Rate (Sub HDR) antenna systems.

The Sub HDR antennas provide submarines with high-capacity communications in the extremely high frequency (EHF) and super high frequency (SHF) SATCOM bands and enable reception of Global Broadcast Service messages.

The Sub HDR connects submariners to the above-sea world by giving them high-data-rate, multi-band SATCOM capability. Submariners deploy Sub HDR by raising a mast-mounted antenna above the ocean's surface, while the submarine remains submerged at periscope depth where the boat is difficult to detect.

The system can send and receive mission-critical information such as secure wideband multimedia, voice and data traffic, imagery, and video teleconferencing. Sub HDR enables underwater forces to participate in coordinated fleet battle group operations.

This order is a modification to an April 2015 $89.1 million contract for 25 Sub HDR antenna systems. This contract has options that could bring its value to an estimated $114.7 million. The order is 62 percent for the U.S. Navy, 16 percent for the United Kingdom Royal Navy, and 22 percent for the Royal Australian Navy.

On this order, Raytheon will do the work in Largo, Fla.; Marlborough, South Deerfield, and Stow, Mass.; Fairfield, N.J.; Portsmouth, N.H.; Woodland Hills, Torrance, and Carlsbad, Calif.; and Lititz, Pa., and should be finished by November 2019.

FOR MORE INFORMATION visit **Raytheon Integrated Defense Systems** online at *www.raytheon.com*.

ANTENNAS

Navy chooses shipboard SATCOM antennas from Trivec-Avant Corp.

U.S. Navy shipboard communications experts needed satellite communications (SATCOM) antennas to support the Mobile User Objective System (MUOS) military narrowband SATCOM system. They found their RF and microwave solution from Trivec-Avant Corp., a Cobham company in Huntington Beach, Calif.

Officials of the Space and Naval Warfare Systems Command (SPAWAR) in San Diego announced a $45.5 million contract to Trivec-Avant to build, test, and upgrade the UHF SATCOM Antenna System. The contract includes the antenna's small-ship variants (SSV) of the MUOS deck box backfit kits, spare parts, and engineering and training services.

The MUOS SATCOM system supports a worldwide, multi-service population of users in the ultra high-frequency (UHF) band. MUOS is designed to support users who require mobility, high bit rates, and improved operational availability over existing SATCOM systems.

The Trivec-Avant AV2099 dual-antenna, dual-RF path, azimuth-stabilized UHF SATCOM antenna system computes satellite pointing angles and maintains

azimuth pointing despite changes in ship heading. It offers MUOS compatibility and remote Ethernet control.

The U.S. Navy today uses the OE-82/OE-570/OE-570A/WSC antenna system and SSV for UHF SATCOM on various Navy surface warships. The SSV provides a UHF SATCOM antenna to coastal patrol craft, littoral combat ships, joint high-speed vessels, and other users that cannot accommodate the size and topside weight of the full-size OE-570A antenna system.

MUOS provides increased communications capabilities to relatively small terminal users while still supporting interoperability to legacy terminals.

Trivec-Avant will do the work in Huntington Beach, Calif., and should be finished by July 2018.

FOR MORE INFORMATION visit **Trivec-Avant** online at *https://trivec.com*.

AIRBORNE TELEMETRY

Raytheon to provide telemetry and transmitters for Navy G550 test range aircraft

U.S. Navy flight test experts needed a tri-band telemetry system and command transmitter avionics for a modified Gulfstream G550 business jet to enable the aircraft to act as the Navy's new Telemetry Range Support Aircraft (TRSA). They found their solution from The Raytheon Co. Missile Systems segment in Albuquerque, N.M.

Officials of the Naval Air Warfare Center Weapons Division at China Lake Naval Air Weapons Station in Ridgecrest, Calif., announced a $79.7 million contract to Raytheon Missile Systems to build and install the telemetry system and transmitter on a modified Gulfstream G550.

The segment of Raytheon Missile Systems handling the work formerly was Ktech Corp., which Raytheon acquired in 2011. For the G550 aircraft Raytheon will build and install the Commercial Aircraft Based Instrumentation Telemetry System (CBITS) and the Airborne Command Transmitter System (ACTS) on the modified G550 TRSA aircraft.

This new aircraft will replace the Navy's NP-3D Orion aircraft primarily for operations on the Navy's 36,000-square-mile ocean test range northwest of Los Angeles for missile test support, such as radar and visual safety surveillance; telemetry data collection and retransmission; time, space, and position information; high-resolution optical collections; and general fleet support. The aircraft also could be deployed for testing worldwide.

The NP-3D aircraft needs to be replaced because of significant service life, sustainment challenges, and obsolescence of the telemetry system, Navy officials say.

Today the Navy operates five NP-3Ds, which are based at Point Mugu Naval Air Station, Calif. The G550 TRSA aircraft will replace the NP-3D in Air Test and Evaluation Squadron 30 at Point Mugu NAS, which the Navy uses for telemetry range support.

This contract to Raytheon is part of a two-phase project to create the G550 TRSA aircraft to replace the NP-3D. In March 2016, the Navy bought a G550 from Gulfstream Aerospace in Savannah, Ga., which came with airborne early warning structural mold line modifications,

mission systems provisions, and a Federal Aviation Administration Type Certificate.

The commercial variant of the Gulfstream G550 can seat as many as nine passengers, flies as fast as 590 knots at altitudes as high as 51,000 feet, and can fly as far as 6,750 miles without refueling.

The Navy's G550 TRSA version is modified with an enlarged nose, tail and side fairings; cable conduits and channels; interior layout; and a liquid cooling system.

Now Raytheon will develop and build the CBITS and ACTS, and install them aboard the modified G550 TRSA aircraft for airborne data retrieval functions, officials say.

During a typical telemetry mission, the aircraft flies near missiles, aircraft, or other systems under test and collects data through the telemetry antennas. The systems record the data and relay it back to ground test ranges for further analysis. The aircraft itself will have six crew stations in the cabin with consoles for mission system operators.

The CBITS will require two or three antennas covering about 100 square feet mounted to the side of the G550 TRSA fuselage. Additional line of sight radios and satellite communications will also be added for voice and data transmission.

FOR MORE INFORMATION visit the **Raytheon Missile Systems Ktech division** online at *www.raytheon.com*.

new PRODUCTS

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

MEZZANINE BOARDS

X-ES adds NXP QorIQ LS1046A and LS1026A embedded computing processors to XPedite6401 mezzanine module

Extreme Engineering Solutions (X-ES) in Middleton, Wis., is offering the NXP QorIQ LS1046A and LS1026A embedded computing processors to the company's XPedite6401 XMC/PMC mezzanine module for small-form-factor

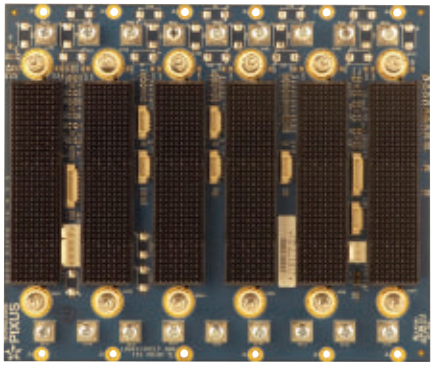
networking and rugged industrial embedded computing applications. The introduction of the NXP Arm A72 core processors brings as many as four 64-bit ARM Cortex-A72 cores to the XPedite6401, extending the available processor range and enabling support for a scalable, low-power, high-performance embedded computing solution in one product. The XPedite6401 is a switched mezzanine card (XMC) and processor PCI mezzanine card (PrPMC), and supports an NXP QorIQ LS10xxA processor with four 64-bit Arm Cortex-A53 or A72 cores. The LS10xxA processor family delivers networking performance and flexible I/O options in one system-on-chip (SoC) design. The XPedite6401 supports as much as eight gigabytes of DDR4-1600 ECC SDRAM memory in its default configuration with the LS1043A processor. For increased bandwidth and storage, the XPedite6401 supports as much as 16 gigabytes of DDR4-2100 ECC SDRAM when configured with the LS1088A or LS1046A processor.

FOR MORE INFORMATION visit **X-ES** online at *www.xes-inc.com*.

BACKPLANES

3U OpenVPX six-slot high-speed backplane introduced by Pixus

Pixus Technologies in Waterloo, Ontario, is introducing a 3U OpenVPX high-speed backplane in the six-slot size. The 3U OpenVPX backplane meets the BKP-DIS06-15.2.14 profile per VITA 65. The PCI Express Gen3-capable backplane features a high-grade laminate material and back-drilling of vias. Rear Transition Module (RTM)



connectors are optional for rear I/O access. Conformal coating and customized versions of the backplane are also available. The slot pitch of the 3U OpenVPX backplane is 1 inch, with 0.8-inch versions available. Pixus also offers 3U 6-slot backplanes in other VITA 65 backplane profile and speed options. Pixus provides OpenVPX enclosures, backplanes, components, and accessories. The company also offers mounting rails and subrack components for CompactPCI Serial, CompactPCI, VME64x, and other architectures.

FOR MORE INFORMATION visit **Pixus Technologies** online at *www.pixustechnologies.com*.

TEST AND MEASUREMENT

VITA 57.4 loopback card products for FPGA transceiver design and test introduced by Samtec

Samtec in New Albany, Ind., is introducing the VITA 57.4 FMC+ HSPC loopback card and the VITA 57.4 FMC+ HSPC/HSPCe loopback card to provide field-programmable gate array (FPGA) embedded computing designers easy-to-use loopback options for testing low-speed and high-speed multi-gigabit transceivers on any FPGA development board or FPGA carrier card. The VITA 57.4-compliant FMC+ loopback cards come in VITA 57.4-compliant form factors, and feature optimized SI performance via Samtec Final Inch break-our region (BOR)

PCB trace routing for the VITA 57.4 FMC+ connectors included in the cards. The VITA 57.4 FMC+ HSPC loopback card includes one HSPC VITA 57.4 FMC+ connector (Samtec P/N ASP-184330-01). It supports 24 high-speed multi-gigabit transceivers operating at data rates to 28 gigabits per second per channel. The VITA 57.4 FMC+ HSPC/HSPCe loopback card includes one HSPC VITA 57.4 FMC+ connector (Samtec P/N ASP-184330-01) and HSPCe VITA 57.4 FMC+ connector (Samtec P/N ASP-186900-01). It supports as many as 32 high-speed, multi-gigabit transceivers operating at data rates to 28 gigabits per second per channel.

FOR MORE INFORMATION visit **Samtec** online at *www.samtec.com*.

EMBEDDED COMPUTING

Rugged Cisco-enabled embedded computing system for unmanned vehicles introduced by Elma

Elma Electronic Inc. in Fremont, Calif., is introducing the ComSys-5301 rugged version of its Cisco-enabled embedded computing system for ground vehicles, unmanned vehicles, command centers, and other mission-critical applications. Based on the industry-standard COM Express and mini PCI Express form factors, the modular computer is configured and upgraded with application-targeted I/O, CPU, and storage. The ComSys-5301 endures tough environmental conditions to provide reliable long-term performance. With special attention paid to size, weight, and power consumption (SWaP), the system is lightweight and energy-efficient, while still offering high-performance processing. The fanless ComSys-5301 uses passive conduction cooling and features a 4th Gen Intel Celeron CPU, solid-state storage, dual Gigabit Ethernet ports, and flexible I/O configurations. Robust MIL-38999 connectors ensure that the I/O interfaces can withstand severe environmental conditions such as intense shock, vibration, and humidity, typically found in rugged, mobile applications. Approximate weight is six pounds and the system can be wall- or table-mounted, per VITA 75.

FOR MORE INFORMATION visit **Elma Electronic** online at *www.elma.com*.

AVIONICS POWER

280-watt power converter for commercial aviation introduced by DDC

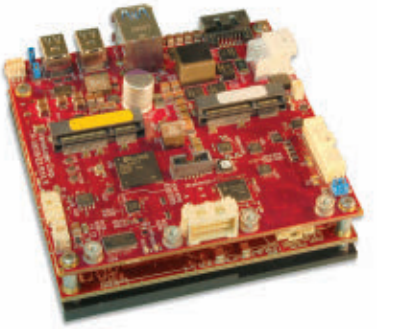
Data Device Corp. (DDC) in Bohemia, N.Y., is introducing a 280-watt power converter to supply 28-volt commercial aviation power for in-flight entertainment and communications (IFEC) electronics. The power converter also is for USB charging ports for portable electronic devices to as many as 18 aircraft seats. The 1-14683-R converter's space-saving design enables more comfort and space for passengers by eliminating the need for below-seat boxes, brackets, or shrouds. This compact unit can be mounted within the cabin wall or ceiling, out of the way of aircraft passengers. The power converter offers power efficiency of more than 92 percent at a 115-volt DC 400 Hz and maximum load; offers over-current protection; thermal shut-down; short-circuit protection; and an MRO package that includes sidewall mounting, seat loom, and USB sockets. The power unit "affords aircraft integrators a cost-effective means to shorten installation time, while freeing up valuable cabin space for passenger comfort and safety," says Graham Jefferies, managing director for DDC Electronics Limited.

FOR MORE INFORMATION visit **DDC** online at *www.ddc-web.com*.

COMPUTER BOARDS

Rugged COM Express Skylake Core-based embedded computer offered by VersaLogic

VersaLogic Corp. in Tualatin, Ore., is introducing the rugged COM Express VL-EPU-4460 Condor high-performance embedded



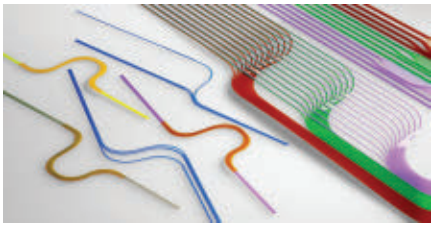
computer with trusted computing features and the Intel 6th generation Skylake Core processor for military and industrial applications. The Condor's on-board TPM security chip trusted computing feature can lock out unauthorized hardware and software access. It provides a secure root of trust. Additional security is through built-in Advanced Encryption Standard (AES) instructions. The Condor measures 95 by 95 by 37 millimeters and provides as much as six times the processing power of Intel's Bay Trail processors, while keeping power consumption as low as 15 watts. The Condor is designed and tested to operate in industrial temperatures of -40 to 85 degrees Celsius, and meets MIL-STD-202G specifications to withstand high impact and vibration. Condor is designed around COM Express form factors, but are board-level computers. They provide separate CPU and I/O modules, and are delivered as assembled and tested units. It comes with a heat plate, and is ready to bolt into a system.

FOR MORE INFORMATION visit **VersaLogic** online at *www.versalogic.com*.

INTERCONNECT PRODUCTS

Optical flex circuit cable assemblies for aircraft introduced by TE

TE Connectivity in Harrisburg, Pa., is introducing optical flex circuit cable assemblies for high-speed electronic packaging in the harsh environments of aerospace, commercial and military aircraft, and defense systems. These compact, robust fiber optic circuits are customizable for card-to-card and



backplane applications. They are made up of thousands of individual fibers positioned on a rugged substrate that employs crossovers to minimize stress while maximizing opportunities for complex routing arrangements. A thin film encapsulating each fiber helps provide enhanced protection from harsh environments and allows for high-density packaging that saves valuable space. Added durability and low insertion loss are achieved through controlled optical circuit routing using a computer numerical control (CNC) machine. Optical flex circuits manage high fiber counts in small spaces to simplify routing. They can accommodate as many as 12 layers stacked and six fiber crossings.

FOR MORE INFORMATION visit **TE Connectivity** online at *www.te.com/optical-flex*.

RUGGED COMPUTERS

Military portable rugged computers introduced by Chassis Plans

Chassis Plans LLC in San Diego is introducing the MTP Rugged Portable family of rugged computers for use in challenging military, industrial, and commercial applications. This system is configurable and customizable, and offers a variety of motherboards, processors, expansion slots, I/O, network communications, and power. The MTP ruggedized trifold computer offers three 18.5-inch (1920 x 1080 resolution) LCD displays in a small-form-factor, rugged-portable configuration. The total viewing area of all three displays together is 5,760 by 1,080 pixels. It includes support for Intel Core and Xeon CPUs with as much as 32 gigabytes of ECC system memory. Motherboard options include a COM Express embedded main board as a sealed conduction-cooled unit, or a more traditional ATX motherboard with

larger expansion capabilities. System expansion includes two MINI-PCI Express 3.0 slot, one and two PCI Express 3.0 slots, and eight XMC expansion slots. Four removable 2/5-inch drive bays provide for JBOD or RAID hard drive array configurations that can support solid-state drive and rotating hard drives.

FOR MORE INFORMATION visit **Chassis Plans** online at *www.chassis-plans.com*.

EMBEDDED POWER

500-watt 3U VITA 62 power supply for military embedded computing introduced by Aitech

Aitech Defense Systems Inc. in Chatsworth, Calif., is introducing the P233 power supply units for VME, VPX, and CompactPCI embedded computing systems. The 3U VITA 62-compliant power supply offers an output capacity to 500 Watts as well as a voltage input range of 18 to 32 volts DC. Systems

designers can connect two P233 power supplies in parallel with a load sharing option to provide 1,000 watts of total output power. Or, for added system reliability and redundancy, the connected units can function as two parallel redundant 500-watt supplies with auto-failover. The MIL-STD-704-compliant P233 features six supply outputs, each with independent current limiting as well as protection mechanisms to ensure the power supply will not be damaged, even if connected to an incorrect or malfunctioning power source. It has internal built-in test (BIT) and input line filters that protect from input power overvoltage, surges, and reverse polarity. Input-to-output isolation eliminates ground loops, and the main high output supplies of 3.3, 12, and 5 volts offer remote sense lines for voltage stability in high current loads.

FOR MORE INFORMATION visit **Aitech** online at *www.rugged.com*.

ADVERTISERS INDEX

Military & Aerospace Electronics

GROUP PUBLISHER **Alan Bergstein**
603 891-9447 / alanb@pennwell.com

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

EXECUTIVE EDITOR **Courtney E. Howard**
courtney@pennwell.com

CONTRIBUTING EDITOR WESTERN BUREAU **J. R. Wilson**
702 434-3903 / jrwilson@pennwell.com

ART DIRECTOR **Meg Fuschetti**

PRODUCTION MANAGER **Sheila Ward**

SENIOR ILLUSTRATOR **Chris Hipp**

AUDIENCE DEVELOPMENT MANAGER **Debbie Bouley**
603 891-9372 / debbieb@pennwell.com

AD SERVICES MANAGER **Glenda Van Duyne**
918 831-9473 / glendav@pennwell.com

MARKETING MANAGER **Gillian Hinkle**
603 891-9126 / gillianh@pennwell.com

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EDITORIAL OFFICES
PennWell Corporation,
Military & Aerospace Electronics
61 Spit Brook Road, Suite 401, Nashua, NH 03060
603 891-0123 • FAX 603 891-0514 • www.milaero.com

SALES OFFICES

EASTERN US & EASTERN CANADA & UK
Bob Collopy, Sales Manager
603 891-9398 / Cell 603 233-7698
FAX 603 686-7580 / bobc@pennwell.com

WESTERN CANADA & WEST OF MISSISSIPPI
Jay Mendelson, Sales Manager
4957 Chiles Drive, San Jose, CA 95136
408 221-2828 / jaym@pennwell.com

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

DIRECTOR LIST RENTAL **Kelli Berry**
918 831-9782 / kellib@pennwell.com

For assistance with marketing strategy or ad creation, please contact PennWell Marketing Solutions
Paul Andrews, Vice President
240 595-2352 / pandrews@pennwell.com

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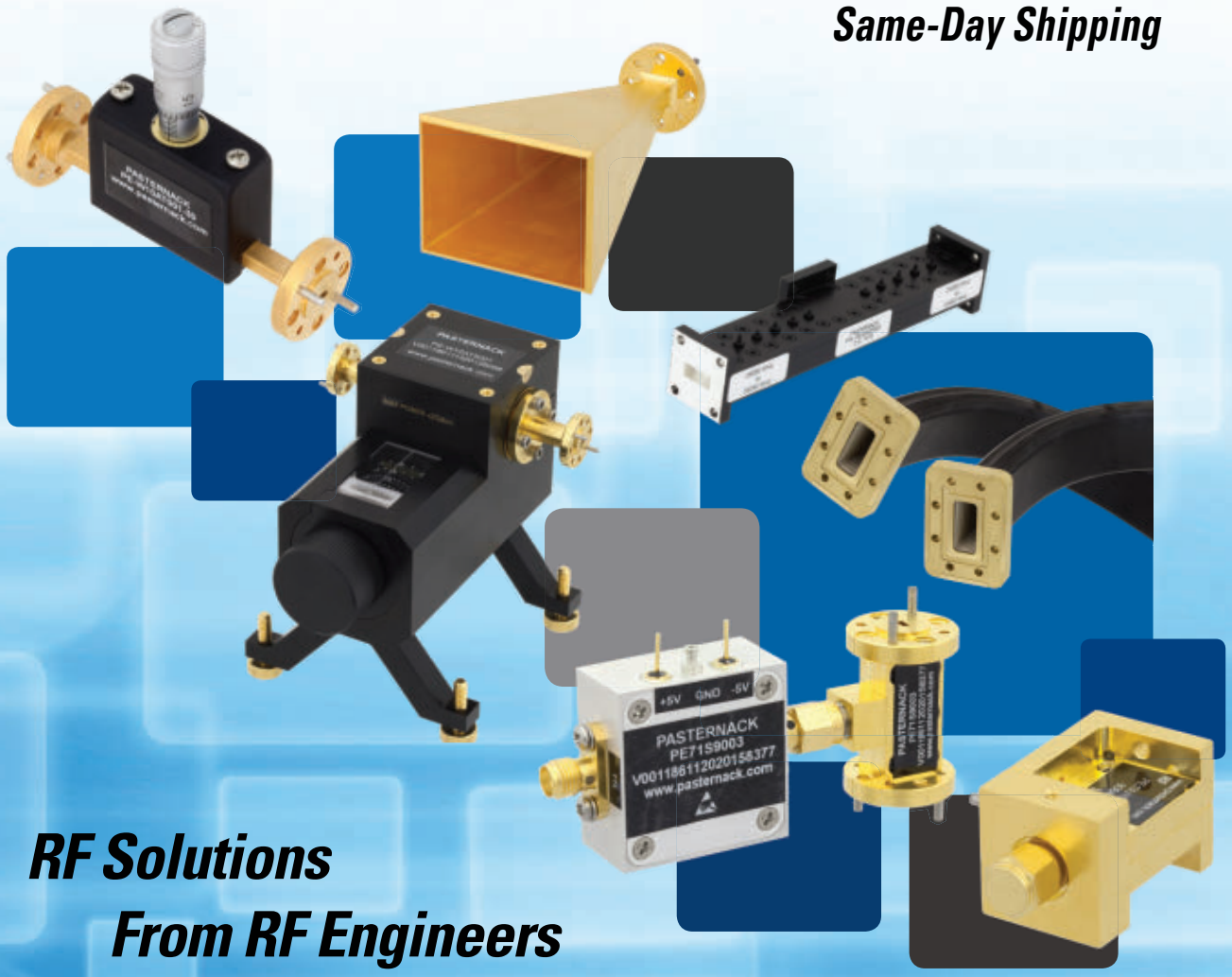

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