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Portable nuclear power plants

Military researchers are considering deployable nuclear power to supply warfighters on the front lines. PAGE 4

Rugged backplanes and embedded computing

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Electronic warfare on the ground

Cyber warfare experts are rediscovering electronic warfare (EW) to help put boots on the ground. PAGE 10

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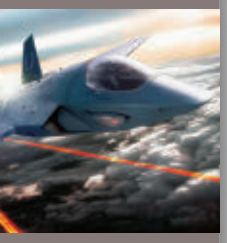

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BY **JOHN KELLER**, EDITOR IN CHIEF

Open-systems standards like SOSA could promote genuine embedded computing interoperability

OpenVPX design standards represent the backbone of today's aerospace and defense embedded computing. This family of open-systems standards offers access to the highest-performing commercially developed processing technologies, promises interoperability, mixes RF and optical interconnects in the same system, and is helping bring the data center into ruggedized deployed applications.

Despite its advantages, however, there's a consistent rap against OpenVPX; critics say it's essentially a collection of proprietary embedded computing technologies masquerading as open-systems standards. The structure of OpenVPX allows a staggeringly wide variety of company-specific technologies, which can make interoperability among products from different suppliers difficult at best, and at worst can lock companies in to long-term supplier agreements — just like the bad old days of proprietary architectures that a quarter-century ago gave rise to commercial off-the-shelf (COTS) designs in the first place.

That all may be changing, however, as an emerging industry standard called Sensor Open Systems Architecture (SOSA) catches on. SOSA, administered by The Open Group in San Francisco, revolves around OpenVPX, and focuses on single-board computers and how they can be integrated into sensor platforms. It involves a standardized approach on how embedded systems interrogate sensor data to distill actionable information.

More to the point, however, experts in the embedded computing industry say SOSA functionally is winnowing-down cumbersome OpenVPX standards into a useful subset for aerospace and defense applications. SOSA's potential to tame the OpenVPX monster could make interoperability of third-party embedded computing modules a reality, which could save costs and enhance competition in the embedded computing industry.

SOSA falls under an umbrella of emerging standards called Modular Open Systems Approach (MOSA). In addition to SOSA includes Future Airborne Capability Environment (FACE); Vehicular Integration for C4ISR/EW Interoperability (VICTORY); and Open Mission Systems/Universal Command and Control Interface (OMS/UCI).

One of the big difference between the MOSA standards and OpenVPX is serious participation of the U.S. military services on the standards committees; it's not just private companies formulating standards in hopes that will adhere to them. Ensuring that embedded computing modules from many different vendors will work and play well together in a variety of backplane databus architectures perhaps offers the biggest payoff of SOSA.

"Before, VPX was so loose that it was difficult to do interoperability," says Steve Gudknecht, product marketing manager at Elma Electronic Inc. in Fremont, Calif. "So then OpenVPX came out, and the user community did address some interoperability. Now, sitting on the standards boards are not just suppliers, but the Army, Navy, and Air Force. SOSA takes that OpenVPX standard and boils it down even further for interoperability and tri-branch convergence."

Military involvement in setting the MOSA and SOSA standards helps keep OpenVPX in a shape that's attractive to the military. "One of the objectives of SOSA and many other standards is to have complete interoperability of as many vendors possible in plug-and-play architectures — to define the standards narrowly enough so that is possible, yet to have advanced functions available," explains Rodger Hosking vice president of Pentek Inc. in Upper Saddle River, N.J. "If the standard is too open, the interoperability suffers."

SOSA may be the best thing in long time to enable the U.S. military to specify embedded computing systems that are economical, powerful, upgradable, and competitive, says Mark Littlefield, defense vertical product manager at Kontron America in San Diego.

The result of the SOSA effort will be "an open-systems architecture for defense that works," Littlefield said last month in a presentation at the 2019 VITA Embedded Tech Trends (ETT) conference in San Diego. ←

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news

Global demand for military wearable computers to grow by 5.85 percent

Global demand for military computers will grow by one-third over the next five years, from $7.9 billion in 2018 to $10.5 billion in 2023, predict analysts at market researcher ASD Media BV in Amsterdam. Militaries around the globe are focusing on deploying more portable and technologically advanced computers in war zones. Ruggedness of military devices such as laptops, handhelds, and wearables is necessary to survive and function properly in extreme conditions such as extreme heat and cold. Military demand for wearable computers, meanwhile, is expected to show healthy growth over the next five years.

Raytheon to build additional radar fire-control systems for Aegis ship electronics

Shipboard electronics experts at the Raytheon Co. are building additional MK 99 fire-control systems for the Aegis weapon system aboard U.S. Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers under terms of a $72.5 million contract. Officials are asking the Raytheon Integrated Defense Systems segment in Marlborough, Mass., to build MK 99 Aegis fire-control systems equipment, and fulfill Aegis modernization production requirements. The MK 99 fire-control system communicates with the missile-control station, notifying it of the air threat, and then illuminates the missile's target. The MK 99 also controls the loading and arming of shipboard missiles aboard Burke-class destroyers and Ticonderoga-class cruisers. The MK 99 launches and provides terminal guidance for the ship's missiles, and controls the continuous-wave illuminating radar to provide a high probability of kill. ←

Pentagon reinforces mandate for open-systems standards like SOSA, FACE, and VICTORY

WASHINGTON — Top U.S. military leaders are reinforcing their commitment to open-systems standards for embedded computing and electronics design, as outlined in a memorandum signed last month by the secretaries of the U.S. Navy, Army, and Air Force.

The memo, directed to the Pentagon's service acquisition executives and program executive officers, calls out existing and emerging open-systems standards that fall under the umbrella of the so-called Modular Open Systems Approach (MOSA) project.

Specifically, the memo mentions the Sensor Open Systems Architecture (SOSA); Future Airborne Capability Environment (FACE); Vehicular Integration for C4ISR/EW Interoperability (VICTORY); and Open Mission Systems/Universal Command and Control Interface (OMS/UCI).

Many of these and similar electronics design industry standards are under supervision of The Open Group in San Francisco.

"MOSA supporting standards should be included in all requirements, programming, and development activities for future weapon system modification and new-start development programs to the maximum extent possible," the memo lays out.

Signing this memo are Navy Secretary Richard Spencer, Army Secretary Mark Esper, and Air Force Secretary Heather Wilson.

SOSA, which revolves around the VITA OpenVPX embedded computing

Military avionics is a big focus for the Pentagon's newly voiced commitment to open-systems electronic design standards.

standard, focuses on single-board computers and how they can be integrated into sensor platforms. It involves a standardized approach on how embedded systems interrogate sensor data to distill actionable information.

The Pentagon-backed FACE open avionics standard is to enable developers to create and deploy applications across military aviation systems through a common operating environment. It seeks to increase capability, security, safety, and agility while also reducing costs.

VICTORY aims at military vehicle electronics (vetronics) components, subsystems, and platforms interoperability. It is for multi-vendor implementation, and is considered a critical enabler for the Assured Position, Navigation and Time (APNT) program; several programs of record require VICTORY standards. VICTORY focuses on

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three core areas: tactical systems capabilities; host and network system capabilities; and vehicle system and logistics capabilities.

The OMS/UCI standard concerns a common message set that enables interoperability across several different manned and unmanned weapon systems. It focuses on interoperable plug-and-play software applications that run on a wide variety of systems, and enable designers to integrate new capabilities quickly in much the same way that smart phone users download applications.

It establishes a common messaging set for machine-to-machine communications in aircraft command and control. It provides an open-systems standard for easy integration of new services and reuse of services among different programs.

"We have reviewed the capabilities of these common standards," the service secretaries' memo states. "We determined the continued implementation of these standards, and further development of MOSA standards in areas where we lack them, is vital to our success."

The service secretaries say the Pentagon's service acquisition executives will publish specific implementation guidance for military acquisition programs, and encourage standardization executives to continue developing open-systems standards where necessary to ensure electronics interoperability, rapid systems development, secure operation, and fast military deployment. ←

For more information contact The Open Group online at www.opengroup.org.

Military eyes mobile nuclear reactor for rapidly deployable atomic power

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are surveying industry to find companies able to develop a small mobile nuclear reactor for forward-deployed fighting forces on land and at sea.

Officials of the Washington Headquarters Services acquisition directorate in Arlington, Va., have issued a request for information (RFI-01182019-RD-WHS019) for the Small Mobile Nuclear Reactor project.

The Washington Headquarters Services is issuing this RFI on behalf of the U.S. Office of the Under Secretary of Defense for Research and Engineering, OUSD(R&E).

This deployable atomic power plant should produce from 1 to 10 megawatts of electricity; weight no more than 40

tons; de deployable by truck, ship, or C-17 cargo aircraft; use passive air cooling; and be inherently safe such that a core meltdown is impossible in power and cooling is lost.

This portable nuclear power plant should take no longer than three days to set up; should operate for more than three years without refueling; and take no longer than seven days to shut down and remove. It should offer semiautonomous operations with no manned control, and run on high-assay low enriched uranium (HALEU) advance gas reactor (AGR) tri-structural isotropic (TRISO) fuel.

Tremendous electrical power demands of the U.S. military are spawning ideas for a portable nuclear power plant for forward-deployed warfighters.

Energy is a critical enabling component of military operations, and demand for it will continue to increase over time, researchers say. Today's military operations has amplified the need for alternative energy sources to enable mobility in forward land-based and maritime military operations.

To meet anticipated power needs, military researchers are asking industry for innovative technologies and approaches to enable a future demonstration of a small mobile nuclear reactor prototype design for a safe, reliable, and nearly unlimited resource in military rapid-response scenarios.

Small mobile nuclear reactors could make the U.S. military domestic infrastructure resilient to an electrical grid attack and fundamentally change the logistics of forward operating bases by making more energy available and by drastically simplifying complex fuel logistical lines, which rely primarily on diesel-powered generators.

Companies like General Atomics in San Diego and NuScale Power LLC in Portland, Ore., already are working on portable nuclear power for industrial and humanitarian efforts.

Comments from industry will help Pentagon officials decide whether to scrap the notion of a portable nuclear power plant, or proceed with a multi-phase prototype project for a small mobile nuclear reactor in support of Project Dilithium.

The Pentagon may fund as many as three different reactor designs during a project's yearlong first phase. The project's second phase would downselect to one design. Pentagon researchers could decide on whether to pursue a deployable nuclear power plan by as early as this spring.

Companies interested were asked to email five-page capability statements by 8 Feb. 2019 to SCO_NUCE@sco.mil. Researchers would like to hear from universities, university-affiliated research centers, federally funded research centers, private or public companies, and government research laboratories. ←

Email questions to SCO_NUCE@sco.mil. More information is online at https://www.fbo.gov/spg/ODA/WHS/REF/RFI-01182019-RD-WHS019/listing.html*.*

Navy bulks-up anti-submarine warfare (ASW) capability for surface warships

BY **John Keller**

WASHINGTON — Undersea warfare experts at the Lockheed Martin Corp. Rotary and Mission Systems segment in Manassas, Va., will provide the U.S. Navy with AN/SQQ-89A(V)15 anti-submarine warfare (ASW) systems for surface warships under terms of a $77.8 million order announced in January.

Officials of the Naval Sea Systems Command in Washington are asking Lockheed Martin for production of the Navy's AN/SQQ-89A(V)15 surface ship undersea warfare systems.

The AN/SQQ-89A(V)15 is an undersea combat system that enables surface warships to search, detect, classify, localize, and track underwater contacts, and to attack or avoid enemy

Lockheed Martin is providing the U.S. Navy with AN/SQQ-89A(V)15 anti-submarine warfare (ASW) systems for surface warships like the Arleigh Burke-class destroyer, shown above.

submarines, floating, tethered, or bottom-attacked mines, and torpedoes.

The order is for development, integration, and production of future advanced-capability build and technical-insertion baselines of AN/SQQ-89A(V)15 undersea warfare systems.

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

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

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

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

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

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

On this order Lockheed Martin will do the work in Lemont Furnace, Pa.; Clearwater, Fla.; Syracuse, Hauppauge, and Owego, N.Y.; Manassas, Va.; and Tewksbury, Mass., and should be finished by May 2021. ←

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

Electronic warfare on the ground

U.S. Army cyber warfare experts are rediscovering electronic warfare (EW) for ground operations, as centralized command authorities combine cyber and EW operations into a new discipline known as spectrum warfare. BY **J.R. Wilson**

U.S. Army Pacific Soldiers view video feed from a Phantom 4 Quad Copter during the Pacific Manned Unmanned–Initiative at Marine Corps Training Area Bellows, Hawaii.

The Pentagon defines Electronic Warfare (EW) as military action involving the use of electromagnetic energy and directed energy to control the electromagnetic spectrum or to attack the enemy. EW consists of three divisions: electronic attack, electronic protection, and electronic support; EW is employed to create decisive, stand-alone effects or to support military operations by generating various levels of control, detection, denial, deception, disruption, degradation, exploitation, protection, and destruction.

While its early history is debated, the first known use of an EW capability — the interception of wireless communications — occurred in 1904, during the Russo-Japanese War.

EW sometimes is considered to be interchangeable with cyber warfare, which involves the actions by a nation-state or trans-national organization to attack and attempt to damage another nation's computers or information networks using such methods as computer viruses or denial-of-service attacks.

The U.S. Army is the first American armed force to combine the two, merging EW units and specialists scattered throughout service organizations with its Cyber Command — a 21st Century creation within all military branches and, most recently, recognized as a fifth domain of war (along with air, ground, sea and space) with the creation of the U.S. Cyber Command (USCYBERCOM) as the nation's tenth Unified Combatant Command.

While those elevated cyber to a level never applied to EW, they did not answer the question of where EW and cyber warfare begin, end and overlap.

As of October 2018, Army leaders sought to resolve that by migrating their EW workforce to the cyber branch. They are going through a series of mobile training teams on how to do planning in the cyber domain as part of the Army's new effort to insert cyber and electromagnetic activities cells organically within brigade combat teams to provide EW/cyber warfare domain planning to commanders.

"The way that we're transforming our electronic warfare professionals is they will become cyber operators," says Maj. Gen. John Morrison, commander of the Cyber Center of Excellence. "They will be the face inside our brigade combat teams and our maneuver formations for cyber operational planning. They're complimentary. You cannot look at EW professionals and cyber

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operators in isolation." Morrison made his comments in May 2018 at the AFCEA Defensive Cyber Operations symposium in Baltimore.

This new approach and related technologies and warfighter training mark a significant change in the operations of ground maneuver forces that also is likely to see effects on U.S. Marine Corps and Special Operations concepts of operations (CONOPs) and tactics, techniques, and procedures (TTPs).

Crucial time

It comes at a crucial time for the U.S., as Pentagon planning and emphasis moves away from fighting asymmetric wars in Southwest Asia against less advanced enemy states, insurgents, and terrorist organizations. Now military forces are refocusing their attention on potential conflicts with near-peer and peer adversaries in the Pacific and Europe. It also is the first time in some six decades that the United States has not been the unquestioned military technology leader.

Throughout the history of warfare, "boots on the ground" has been the catch phrase for the successful defeat and conquest of an enemy (the atomic bomb-forced surrender of World War II Japan notwithstanding). In the 21st Century, the value of individual warfighter has increased as they have become nodes in the battlespace network — walking sensors and EW/cyber warfare platforms to combat close proximity enemy electronics like robots, radar installations, communications, and precision-guided munitions. Combined with advanced vehicle-mounted EW capabilities, they will be crucial to dominating the electromagnetic spectrum.

This expansion of EW capabilities across all ground forces also reflects the convergence of offensive and defensive EW and cyber warfare capabilities and the move toward more software-defined systems, which began with the software-defined radio (SDR), where a single piece of hardware can be repurposed in the field in real-time with software changes.

One of the most important EW initiatives today is the C4ISR/EW Modular Open Suite of Standards (CMOSS), which seeks to converge EW in such a way as to leverage a lot more software-defined radio, says David Jedynak, chief technology officer at the Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va.

"That means you're not limited to a specific vehicle for transmit and receive type applications, which gives you a lot more flexibility in terms of what hardware and software can be intermingled on a platform," Jedynak says.

"That includes using one type of sensor to cross-cue or provide a larger picture," Jedynak continues. "For example, using a jammer's power amplifier for broadcast communications or, in reverse, using a communications system as a jammer or comm gear, tuned appropriately, as a poor man's SIGINT [signals intelligence] — maybe more of a COMMINT [communications intelligence] — to add more nodes in terms of spectrum warfare."

Tactical electronic warfare

An example of this is the VMAX and VROD Dismounted Electronic Support/Attack system planned for insertion into tactical forces in Europe. VROD, which stands for Versatile Radio Observation and Direction, detects electronic frequencies and creates a virtual map of the electronic environment. VMAX, which stands for VROD Modular Adaptive Transmit, enables soldiers to conduct focused electronic attacks at certain frequencies in the spectrum.

"In the last couple of years, there has been prototyping of VMAX and VROD handheld systems, so there is a desire to create offensive and defensive effects within the peer and near-peer arena," explains Avetis Ioannisyan, director of the BAE Systems Adaptive Sensors Group in Hudson, N.H. "The idea of having warfighters forward-deployed and having EW capabilities is very valid," Ioannisyan says. "Another, more vehicular, is Sabre Fury. These are designed to inform TTP about the value and capabilities of SIGINT for the warfighter."

Those tools were being delivered in late 2017 to the Army 1st Infantry Division's 2nd Armored Brigade Combat Team at Fort Riley, Kan. At that time Army Lt. Gen. Paul Ostrowski, principal military deputy to the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASAALT), explained their value to the Senate Armed Services Committee.

The Lockheed Martin Symphony system is a radio-controlled improvised explosive device (RCIED) defeat system. Symphony provides global ground EW solutions to U.S. forces and partner nations with the ability to defeat current and emerging IED threats and is interoperable with other jamming devices.e at Marine Corps Training Area Bellows, Hawaii.

"[Commanders now] have the situational understanding of signals of interest in their area," he told the

committee. "They then have the opportunity to do two things: either strike that particular capability with respect to indirect fires or to jam it [with] a limited jamming capability."

Spectrum is central to EW and cyber warfare. Because of this, dealing with them as independent efforts in securing military information networks may create cyberspace or electromagnetic spectrum vulnerabilities, Army leaders believe.

The U.S. Army Cyber and Electronic Warfare Operations Field Manual, released in April 2017, outlines the service's thinking: "Employing cyberspace and EW capabilities under a single planning, integration, and synchronization methodology increases the operational commander's ability to understand the environment, project power, and synchronize multiple operations using the same domain and environment."

That has gained emphasis with growing evidence — from operational doctrine and actual implementation — that China and Russia view information operations and electromagnetic spectrum dominance as critical to any future conflict, especially, but not limited to, peer and near-peer.

Cyber and EW

Maj. Gen. Robert M. Dyes Jr., acting director of the Army Capabilities Integration Center at Fort Eustis, Va., wrote a preface to The U.S. Army Concept for Cyberspace and Electronic Warfare Operations 2025-2040, released in January 2018. "Defeating future enemies that possess advanced capabilities calls for land forces operating as part of integrated joint teams that conduct simultaneous and sequential operations across multiple domains," Dyes wrote. "In multi-domain battle, future Army forces will fight and win across all contested spaces to create windows of advantage across multiple domains that enable Joint Force freedom of action to seize, retain and exploit the initiative.

"The Army will operate in and through cyberspace and the electromagnetic spectrum and will fully integrate cyberspace, EW, and electromagnetic spectrum operations as part of joint combined arms operations to meet future operational environment challenges," Dyes continued. "These operations provide commanders the ability to conduct simultaneous, linked maneuver in and through

multiple domains and to engage adversaries and populations where they live and operate. They also provide commanders a full range of physical and virtual, as well as kinetic and non-kinetic, capabilities tailored into combinations that enhance the combat power of maneuver elements conducting joint combined operations."

This convergence essentially defines the electromagnetic spectrum, rather than cyber warfare alone, as the real fifth domain of war, as the spectrum becomes more crowded with military and civilian transmissions. In an urban conflict, that greatly expands potential targets and vulnerabilities — especially if the rules of engagement call for as little interference with or damage to civilian systems as possible.

"The future operational environment will be more unpredictable, complex, and potentially dangerous than today," the EW/cyber warfare concept document warns. "The physical structure of cyberspace will be extremely vulnerable to attack by an array of destructive weapons, including high-power microwave munitions and laser systems, which are increasingly effective against digitized, miniaturized and integrated circuits. Because these challenges and changes can occur swiftly, the Army must adopt advanced cyberspace operations capabilities at a more rapid rate than current capability development time lines, even while in a constrained fiscal environment.

"State and non-state actors will invest in capabilities to protect their access to cyberspace and disrupt or deny access to others," the document continues. "Use of these capabilities has the potential to negate current Army combat power and technological overmatch. Less capable adversaries will also use a variety of improvised weapons and technologies, such as global positioning system jammers and radio-frequency weapons, that utilize the electromagnetic spectrum to exploit Army reliance on technology."

Army cyber operations specialists from the Expeditionary Cyber Support Detachment, 782nd Military Intelligence Battalion (Cyber), from Fort Gordon, Ga., provided offensive cyber operations as part of the Cyber-Electromagnetic Activities (CEMA) Support to Corps and Below (CSCB) program.

The role of autonomous systems

The document also addresses the evolution of autonomous systems in the battlespace, from unmanned aerial vehicles (UAVs) to robots, with each generation relying on more and more advanced artificial intelligence (AI) capabilities. While such systems will enhance the offensive and defensive capabilities of ground forces, they also comprise new dangers if compromised by enemy EW/cyber warfare attacks, making fail-safe technologies and software crucial to their control and data integrity.

"We've been investing a tremendous amount of money in machine learning and AI to automatically adapt to the environment," BAE Systems's Ioannisyan notes. "Typically, an EW attack begins with a change in jamming modes; some form of AI is required to do that quickly. Future battles will be fought across multiple domains and we must win the first battle, which will be spectrum. We need SDR's that can conform on the fly while under attack."

"The Army plans to continue to acquire EW to support ground-based attack," Ioannisyan continues. "The leverage will come when you have interoperability between all the airborne and ground robotic systems. The Army already has demonstrated having a forward deployed unmanned platform being controlled from an Apache provides a lot of value to the warfighter; a similar progression is likely on the ground."

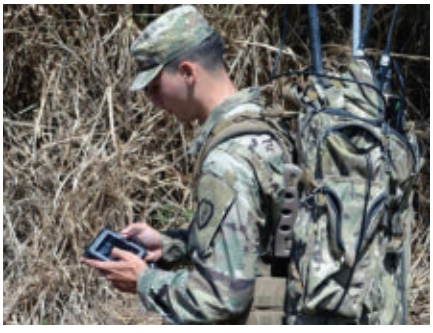
The rapid pace of technology advances — from materiel properties and switching architectures to ever-shrinking components and power requirements — have increased the speed and capacity of operations and the number of ways to attack the electromagnetic spectrum.

"If you want to induce an electronic effect on the enemy, jam them without being detected by using smart, low-power effects. You must use synchronous, smart techniques to be protected from counter-EW," Ioannisyan says.

"One enabler is signal fratricide, being able to maintain friendly C2 networks while disrupting the enemy. If you can do force structure, operate in a high signal-dense environment, adapt to enemy actions, have threat agility and electronic protection and mitigate signal fratricide, you will effectively

win the first battle for the electromagnetic space."

Dramatic reductions in size, weight and power (SWaP), combined with greater sensor range and sensitivity, have enabled EW/cyber warfare capabilities down to the individual warfighter level, revolutionizing the commander's operational options. Employing them as well on remote, robotic and autonomous systems, including artillery and rocket EW munitions, dramatically expands the conduct of electromagnetic spectrum operations with small signature platforms and minimal risk to Army forces and non-combatants.



An electronic warfare specialist trains on the Versatile Radio Observation and Direction system at Schofield Barracks, Hawaii.

Ground-based electronic attack

"Ground-based electronic attack is certainly a critical capability for the future," points out Niraj Srivastava, manager of EW Systems at Raytheon Space and Airborne Systems in Cambridge, Mass. "Tools like EWPMT [Electronic Warfare Planning and Management Tool] Raven Claw will enable operators to manage the entire electromagnetic spectrum. EWPMT Raven Claw can coordinate electronic attack activities across multiple EW assets. It can identify and coordinate a whole host of responses, everything from direction-finding to electronic attack to specific signals of interest."

"A quick reaction capability version of EWPMT, Raven Claw is already deployed in Europe for managing EW systems. It provides electronic warfare officers with a first — the ability to operate in the field without dependency on a host server or external data," Srivastava says. "Now EWOs can be off-network, operating on last-known-data as well as real-time feeds for intelligent, actionable EW. [It] does more than just planning; it remotely controls EW systems [and can] provide RF signal analysis and geolocation capabilities."

While some ground-based EW has been fielded, most advanced prototypes

undergoing real-world evaluations, what the future of individual warfighter and small unit EW will look like remains an open question, with the answer in constant flux."

"It's probably too early to tell how future ground EW capabilities will be incorporated into the battlespace. A lot of ground capabilities are in the experimentation stage. If you look at what the Army is doing with their cross-network teams, they are learning how to do an air-ground, multi-service, integrated framework," says BAE Systems's Ioannisyan.

"I think every component has its own pros and cons," he says. "The real question is how does the battlespace network leverage the best of those capabilities to help the ground maneuver units put kinetic fire on their targets. Can the system itself decide if a specific target is better jammed from the air or hit by Hellfire from the air or by kinetic effects from the ground?"

In the past, EW typically has been segmented. The effort by the Army — which is being closely watched by the other services — to converge EW and cyber warfare is changing that.

"We can't continue to have stovepiped systems and we're seeing requirements for systems to do all those and more demanding in terms of open architecture," says Joe Ottaviano, director of EW at the Lockheed Martin Corp. Rotary and Mission Systems segment in Syracuse, N.Y. "Certainly there has been a lot of advancement in hand-held, carryable EW systems, offensive and defensive. Those have come a long way over the years as technology has improved. And as things become smaller and more compact, they've gotten lighter."

"We're seeing the ability to put more capability into smaller footprints, such as jamming, which is giving everybody added flexibility in how they deal with those," Ottaviano continues. "It is all really handled though the convergence of EW and cyber across multiple access points. And, as we deliver these capabilities, systems we're now deploying, because of the way technology is changing, are being used in ways we never imagined."

Multi-use hardware

As hardware is becoming ubiquitous, smaller, and more capable, the Army is requiring an open architecture set of capabilities with EW/cyber warfare built-in, enabling the warfighter to use the same hardware for different mission-based functions. As the warfighter evolves from the concept of "every shooter is a sensor" to every shooter is an EW/cyber warfare node, the need to bring all that new data back to the commander — from the smallest unit to higher headquarters — as useful information to make real-time tactical decisions also increases.

"There are several communications paths that exist already and others coming online that enable this data to be used across the battlespace," Lockheed Martin's Ottaviano says. "As you open the aperture on EW, we're seeing more and more data, so there is a lot of effort going into data fusion, machine learning, AI and such. As you expand your sensors, the number of capabilities, you have to have a way for the system to narrow all that down, without taking away significant data. And each user has a different view on what that should be. We're seeing a priority for it to be tailorable to the level of data required by each user across the battlespace."

Rapid innovation in the commercial world also leads to rapid innovation in EW and other military applications, with ground EW and associated applications expected to see a lot of innovation on which they can move quickly. Commercial technologies, typically based on industry standards, also make it easier to update existing systems and

COMPANY LIST

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www.baesystems.com

Boeing Defense, Space & Security segment
St. Louis
www.boeing.com/company/about-bds

Comtech PST Corp.
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Lockheed Martin Corp. Rotary and Mission Systems segment
Syracuse, N.Y.
www.lockheedmartin.com

Mercury Defense Systems
Cypress, Calif.
www.mrcy.com/markets/electronic-warfare

Northrop Grumman Corp. Mission Systems segment
Baltimore
www.northropgrumman.com

Raytheon Space and Airborne Systems
El Segundo, Calif.
www.raytheon.com/capabilities/ew

U.S. Army Cyber Center of Excellence
Fort Gordon, Ga.
https://cybercoe.army.mil/home.html

tie all platforms into the battlespace network.

"The overall convergence of assets is the path forward, where ground is not a diverse and separate piece, says Curtiss-Wright's Jedynak. "From a warfare perspective, you're trying to use all your assets together to achieve the goal, so why is EW any different? Ground has a lot of platforms, including individual warfighters, which means a lot of ways to sensibly and intelligently add EW capabilities that are very refreshable because you are leveraging open standards."

"It is critical to understand that EW today may not be the same as EW six months from now, just as the leading cell phone today won't be the leading cell phone in six months," Jedynak says. "EW is shifting into a fast-paced technology area. There may be an advance in a totally different application, such as medicine, that may have applications in EW. You should expect to see developments coming quicker and quicker, especially with the Army Innovation Command saying they want to see new advancements, which is a massive change in government procurement."

Whatever form it may take, it is clear ground-based EW will be a critical part of future military TTPs and CONOPs, not only for U.S. and allied forces, but also for peer and near-peer adversaries, some of whom already may have surpassed the U.S.

"We're seeing EW coming to the forefront," says Lockheed Martin's Ottaviano. "A lot of effort is going into electromagnetic management and it is becoming an extreme priority across the board. Technology is moving extremely quickly and systems must be able to operate in very different environments and produce tactically valuable information." ←

Rugged backplanes take on high-performance embedded computing

Today's rugged chassis designs offer fast throughput, ruggedization, advanced cooling, adherence to emerging industry standards, and options for optical fiber interconnects.

BY **John Keller**

Rugged embedded computing backplanes and chassis for military and aerospace applications are helping lead the aerospace and defense industry into a new era of high-speed data throughput, standard interoperable architectures, and thermal management to tame even the most powerful of today's server-grade microprocessors.

Perhaps at the forefront of these technology trends are backplane data bandwidths that are expected to yield throughput of 100 gigabits per second within the next couple of years, as well as hybrid electronics cooling technologies that blend conduction cooling, convection cooling, and liquid cooling. Traditional copper interconnects are expected to yield their leadership to optical fiber as data speeds increase, and emerging industry standards should offer an attractive balance of performance, cost, and maintainability.

Suffice it to say that today's backplanes and chassis are not your father's embedded computing. Technology has come a long way since the heyday of VME systems, and is evolving rapidly to pave the way to future military and aerospace uses of artificial intelligence (AI) machine learning, sensor fusion, and advanced command and control.

The Aitech rugged 3U VPX C877 single-board computer combines the a 12-core Intel Xeon processor and as much as 1 terabyte of on-board security-protected SATA solid-state drive.

Data throughput

One of the most exciting developments in embedded computing backplanes and chassis is a path towards widespread use of 100 Gigabit Ethernet copper and optical interconnects at the backplane.

"The big sea-change is people in the past were happy to move data at 10 gigabits per second, but today people are pushing the edge of the envelope," says David Pepper, senior product manager at embedded computing specialist Abaco Systems in Huntsville, Ala. "In just a very few years, 40 Gigabit Ethernet came on the scene, and now 100 Gigabit Ethernet is available. For us today it is typical to do 10- and 40-Gigabit Ethernet, but we need to be ready for 100-Gigabit tomorrow."

These faster speeds among embedded computing boards and boxes could lead to new implementations of heterogeneous computing that blends general-purpose processors, field-programmable gate arrays (FPGAs), and general-purpose graphics processing units (GPGPUs) for AI, machine learning, vision systems, cyber security, and smart data storage.

"We're looking at making everything faster with the switch fabrics, and to move at the rate of technology itself," says John Bratton, product and solutions marketing manager at Mercury Systems in Andover, Mass. "The world is moving faster than it ever has before; machine autonomy and AI are moving into edge processing to accommodate more sensors, sensor fusion, and a deluge of sensor information to make intelligent, real-time assessments of the environment."

Several companies already have announced embedded computing

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products that involve 100-Gigabit Ethernet interconnects — among them the Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va. "Pushing VPX to higher and higher transmission speeds to get more capability is a clear backplane trend," says Ivan Straznicky, chief technology officer at Curtiss-Wright. "We announced a 100-gigabit VPX product in January 2018."

Enhanced data throughput especially is crucial for leading-edge aerospace and defense applications like radar and electronic warfare signal processing, Straznicky says. "We have a clear demand from customers for those applications and those speeds. With more processing comes memory bandwidth and communications among the processors, and switching between the systems."

Today the majority of high-performance embedded computing (HPEC) applications are using interconnects that run at 10 to 40 gigabits per second, "but in the next two or three years you will see products coming out at 100 gigabits, and that technology could become mainstream in the next five years," Straznicky.

The VITA 48.4 Chassis from Elma Electronic offers liquid flow through cooling and has four 6U OpenVPX (VITA 65) slots.

Not every embedded computing application will need 100-gigabit throughput, Straznicky cautions. "Mission and flight computers, for example, really don't need it yet," he says. Only the most demanding applications, like signal processing for radar, EW, and signals intelligence will be the pioneering applications for 100-Gigabit Ethernet."

Signal integrity

Increasing signal throughput in today's high-performance embedded computing systems comes at a price, however. Perhaps chief among these design tradeoffs is compromised signal integrity; as speeds increase, the problem becomes worse.

"Signals get faster all the time," says Chris Ciufo, chief technology officer at General Micro Systems (GMS) in Rancho Cucamonga, Calif. "It's very difficult to design these systems, because we have to talk about signal integrity." Anything running in the gigahertz range over copper interconnects transmits electronic noise, for which systems designers must compensate, Ciufo explains.

"Every time there is a discontinuity in the system — from a connector, cable, circuit card via — it is like an antenna stub," Ciufo says. "It affects and can degrade the signal. You have to worry about crosstalk and jitter; add up all those discontinuities, and it is very difficult to design these systems that run a really fast speeds."

Interconnect companies like TE Connectivity in Harrisburg, Va., are keeping pace with technology by providing leading-edge connectors to minimize noise, crosstalk, and jitter in high-performance embedded computing. "The

TE connector can run at 40 GHz, and they are talking about running it up to 100 GHz," Ciufo says.

The problem, however, isn't just the responsibility of the interconnect suppliers; it's up to every systems designer to minimize signal integrity issues throughout their systems. "It's really incumbent on the designers of all the bits and pieces of these systems to safeguard signal integrity issues," Ciufo says. "With each jump in speed it gets more difficult. They also have to worry about the power supply signals; it isn't easy. With each new generation of technology, the dial is turned up just a little bit more, so we have to keep upping our game."

Thermal management and ruggedization

It's a rule of thumb in embedded computing that higher performance and faster speeds mean increased waste heat. Fortunately, systems designers today have a wide and growing set of open-systems standards to choose from to help keep their systems cool and operating at peak efficiency.

"On the chassis we are seeing two effects: one, a lot of people want to put a lot of these circuit cards that are getting hotter and hotter inside an ATR [air transport rack standard chassis]," says Justin Moll, vice president of U.S. market development at rugged embedded chassis provider Pixus Technologies in Waterloo, Ontario. "In the past you might see six slots as the average size. Now people want to put in as many as 12 OpenVPX cards, and get 800 Watts into an ATR. People are trying to put more and more power on cards in less space, and that also means hotter cards."

It can be difficult to do this while reducing system size, weight, and power consumption (SWaP). "It's a challenge

The Pixus ATR with heat exchange is designed for 3U OpenVPX boards, and can cool as much as 800 Watts. The inner chamber is sealed, with an outer shell to pull supplemental cooling air over the enclosure fins.

for us chassis guys to prevent all the enclosures from getting bigger and bigger because of the cooling they need," Moll says.

Pixus is designing rugged OpenVPX embedded computing chassis with heat exchangers on the outside to cool by pulling outside air across the outside edges. "The outer shell pulls air from the outside for extra cooling, while inside it is sealed and protected from the environment," Moll says.

This kind of cooling approach that involves blown air can be a necessity, and not a luxury, in today's powerful embedded computing designs. "People are more willing to use some of the air-cooled systems, and in rugged rack-mount applications there are a lot more of those," Moll says. "The overall trend is keeping the air-cooled approach because they are getting beyond the limits of what traditional conduction cooling can do."

Curtiss-Wright's Straznicky says systems designers are making broader use of industry standards like VITA 48.8 air-flow-through and VITA 48.4 liquid-flow-through to help tackle heat in high-performance systems.

VITA 48.8 permits air inlets at both card edges, as well as on the top circuit card edge opposite the VPX connectors. It also can promote use of polymer or composite materials to reduce chassis size and weight.

VITA 48.8 seeks to improve the efficiency of the thermal path to cool high-performance processors, FPGAs, general-purpose graphics processing units (GPGPUs), and other hot components. Specifications for ANSI/VITA 48.8 use gasketing to prevent particulate contamination from the moving air.

When designers need even more cooling capacity, they can turn to VITA 48.3 liquid flow by and 48.4 liquid flow through technology to keep cards sealed from outside contaminants, while capitalizing on the strong cooling properties of liquid to cool embedded electronics that is generating even 800 or 900 Watts per slot.

Curtiss-Wright also is offering hybrid thermal management solutions that blend air flow through and liquid flow through technologies to cool embedded computing systems with widely ranging waste heat. "We have a hybrid approach that allows the designer to use conduction-cooled modules to optimize," Straznicky says.

The Pentek plenum has an exposed wall that helps control the cooling airflow in Pentek high-performance data recorders.

Copper vs. optical fiber interconnects

Most embedded computing industry experts are waiting for as long as they can before making the transition from copper to optical fiber interconnects — although few deny that an eventual move to optical fiber is a virtual certainty.

Many industry old timers are amazed that copper interconnects today are capable of speeds as fast as 100 gigabits per second, whereas only a few years ago few thought that copper could carry signals much faster than 1 gigabit per second.

Fortunately, however, industry standards are evolving such that designers probably won't be forced into making a choice anytime soon. Standard architectures are allowing hybrid approaches that can mix and match copper RF signals and optical signals over fiber on the same OpenVPX backplane.

Optical fiber interconnects offer obvious advantages over copper — faster speeds, lower system noise, better signal integrity, and enhanced security. Still, the transition can be difficult because of the expense, new technologies necessary, and the difficulty of keeping fiber interconnects clean enough for maximum signal throughput. "Fiber weighs less than copper, you can't eavesdrop on it, and it can go long distances," points out Mercury's Bratton. "It also requires precision alignment, and cleanliness is an issue."

FiberQA in Old Lyme, Conn., offers AVIT-DT technology that uses a system of robotics and automated software to inspect and clean dozens of optical fiber ferrules in a matter of minutes, rather than hours or days. While the AVIT-DT is big enough to take polishing plates, several military-standard circular connectors, or dozens of MPO ferrules, it is compact enough to fit on a workstation. It can help inspect individual ferrules or different sized military and aerospace shell connectors at the same time.

Optical-to-electronic-conversion, and electronic-to-optical-conversion, also is an issue for today's embedded computing designs. "Optical-to-electronic and electronic-to-optical converters are crucial enabling technologies," says Curtiss-Wright's Straznicky. "In rugged transceivers, I don't know if there are any on the market now, but once there is a clear need, then companies will go ahead and innovate."

Companies to watch on future Optical-to-electronic-conversion, and electronic-to-optical-conversion chips include Finisar Corp. in Sunnyvale, Calif.;

Reflex Photonics in Kirkland, Quebec; and Ultra Communications Inc. in Vista, Calif.

Optical fiber offers more advantages than just signal throughput; it also helps data storage systems keep up with today's fast microprocessors. Non-Volatile Memory Express (NVMe) solid-state drives can communicate with the CPUs at PCI Express Gen3 speeds, which alleviates the need for drive controllers that slow data throughput and add unnecessary controller latency.

NVMe over fiber is a trend," says GMS's Ciufo. "To scale-up to more storage, we are looking for ways to connect more boxes with fiber with new protocols. Fiber is very light weight, immune to EMI [electromagnetic interference], is inherently not tapable, and gives you tremendous speeds with low SWaP."

The Apex rugged computer server for military and aerospace applications from General Micro Systems is designed to evolve and upgrade as system needs change over several years.

Despite its advantages, many companies still are reluctant to move to optical fiber. "No one will do optical until they have to," says Abaco's Pepper. "But when you get beyond 100-gigabit interconnects, we'll have to get serious about these optical standards coming on." Echoes Michael Munroe, backplane product specialist at Elma Electronic, "People will go to fiber when the have to, but there will be an awful lot of copper for RF and power. There always will be a mix."

Emerging industry standards

One of today's most talked-about emerging industry standards influencing embedded computing backplanes and chassis is the Sensor Open Systems Architecture (SOSA) standard, administered by The Open Group in San Francisco.

It revolves around OpenVPX, and focuses on single-board computers and how to integrate them into sensor platforms. Embedded computing experts also say SOSA functionally is boiling-down cumbersome OpenVPX standards into a useful subset for aerospace and defense applications. SOSA's potential to streamline OpenVPX could

bolster interoperability of third-party modules in military and aerospace systems, and help save costs and enhance competition.

SOSA falls under an umbrella of emerging standards called Modular Open Systems Approach (MOSA). In addition to SOSA includes Future Airborne Capability Environment (FACE); Vehicular Integration for C4ISR/EW Interoperability (VICTORY); and Open Mission Systems/Universal Command and Control Interface (OMS/UCI).

Military involvement in MOSA and SOSA standards is helping keep OpenVPX attractive to the military. Although SOSA is not yet a final standard, it eventually may help forge consensus among suppliers and users.

"SOSA is a big deal," says Mercury's Bratton. "It's really got traction, and we are seeing a lot of technology re-use, upgradeability, removing vendor-lock, and scalability."

Kontron America Inc. in San Diego has introduced the VX305C-40G 3U OpenVPX single-board computer that uses an open-systems architecture that aligns with SOSA. The embedded computer for battlefield server-class computing and digital signal processing (DSP uses a defined OpenVPX single-board computer profile that marries a 40 Gigabit Ethernet port and user I/O to the 12-core version of the Intel Xeon D processor.

Close behind Kontron in introducing SOSA products is Pentek Inc. in Upper Saddle River, N.J., with the model 71813 SOSA-aligned LVDS XMC module with optical I/O. It is based on the Xilinx Kintex Ultrascale field-programmable gate array (FPGA) and features 28 pairs of LVDS digital I/O to align with the emerging SOSA standard. The model 71813 also implements an optional front panel optical interface supporting four 12-gigabit-per-second lanes to the FPGA.

COMPANY LIST

Abaco Systems Inc.
Huntsville, Ala.
www.abaco.com

Aitech Defense Systems Inc.
Chatsworth, Calif.
www.rugged.com

Atrenne Integrated Solutions Inc.
Littleton, Mass.
www.atrenne.com

Crystal Group Inc.
Hiawatha, Iowa
www.crystalrugged.com

Curtiss-Wright Defense Solutions
Ashburn, Va.
www.curtisswrightds.com

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Extreme Engineering Solutions (X-ES)
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Finisar Corp.
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General Micro Systems (GMS) Inc.
Rancho Cucamonga, Calif.
www.gms4sbc.com

Kontron America Inc.
San Diego
www.kontron.com

Mercury Systems Inc.
Andover, Mass.
www.mrcy.com

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www.pentek.com

Pixus Technologies
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www.pixustechnologies.com

Reflex Photonics
Kirkland, Quebec
https://reflexphotonics.com

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

TE Connectivity
Harrisburg, Va.
www.te.com/usa-en/home.html

Ultra Communications Inc.
Vista, Calif.
www.ultracomm-inc.com

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

ZMicro
San Diego
https://zmicro.com

Distributed architectures

A growing number of military embedded computing applications are dispensing entirely with the traditional circuit-card-and-backplane architecture in favor of distributing networked stand-alone computer boxes throughout their systems.

"There is a migration in the customer base toward small-form-factor computer systems," says Doug Patterson, vice president of global marketing at Aitech Defense Systems Inc. in Chatsworth, Calif. "They want distributed intelligence and a way to communicate that back to the main mission computer, which is backplane-and-chassis-based.

Distributed systems move signal processing and data conversion as closely to sensors and antennas as possible, and perform as much processing and data-reduction as possible. Then it flows back to a centralized computer system. "It's taking a lot of intelligence and pushing that out to the sensor," Patterson says. "Instead of flowing the data through a harness, it goes out to the edge to the sensors."

Driving the move to distributed architectures are SWaP and price, Patterson says. "It's moving smaller compute clusters out closer to the sensors, and passing that data along to the main mission processors."

Will distributed architectures replace traditional bus-and-board boxes? Probably not in the foreseeable future, Patterson says. "All that data has to go somewhere," he says. "Payloads typically form a ring of boxes around the vehicle, which are booster controllers, GPS, and navigation systems. All that data has to reside in a box of some form. It may change in the future, but for now you will have a main mission computer." ←

Northrop Grumman to operate BACN voice and data gateway for airborne communications

BY **John Keller**

HANSCOM AIR FORCE BASE, Mass. — Military communications experts at Northrop Grumman Corp. will continue operating and maintaining for a major battlefield airborne communications system involving manned and unmanned aircraft under terms of a $149.6 million contract announced Tuesday.

Officials of the U.S. Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., are asking the Northrop Grumman Corp. Aerospace Systems segment in San Diego to provide option year one for Battlefield Airborne Communications Node (BACN) payload operations and sustainment.

The BACN is an electronic payload aboard the E-11A and Air Force RQ-4 Global Hawk large unmanned aerial vehicle (UAV). The E-11A is based on the Bombardier Global Express business jet.

The Northrop Grumman Technology Services segment in Herndon, Va., also won a $44.4 million contract for logistics support on four E-11A aircraft, as well as subsystems and support equipment in support of military operations in Afghanistan.

The BACN uses the Airborne Executive Processor (AEP) to enable a persistent voice and data gateway in the sky that receives, bridges, and distributes communications among all participants in a battle.

The Battlefield Airborne Communications Node (BACN) goes aboard the RQ-4 Global Hawk large unmanned aerial vehicle (UAV), shown above, and on the E-11A modified Bombardier Global Express business jet.

Last fall the Northrop Grumman Corp. Mission Systems segment in Middle River, Md., won an $80.2 million order for military Global Positioning System (GPS) capability for BACN nodes aboard the E-11A jet, as well as to enhance the system's positioning, navigation, and timing (PNT).

The BACN payload aboard the E-11A and Global Hawk helps enable diverse battlefield weapon systems to communicate with each other during in-theater operations where mountainous

Thales to provide RF sensors for advanced Rafale F4 multirole jet fighter

France's defense ministry has awarded Thales a contract to develop onboard RF and electro-optical sensors and communication systems for Rafale F-4 multirole jet fighter aircraft. France's government has signed a $2.3 billion contract for 28 updated Rafale F4 fighter jets from French-headquartered Dassault Aviation. The F4 standard is to improve the Rafale avionics and sensors in line with technological progress and operating experience. Thales will prepare for the introduction of the CONTACT radio; secure, intelligent communications server technology; and a Syracuse IV satellite communications capability. To ensure high survivability, new threat detection and jamming capabilities will be developed for the aircraft's SPECTRA electronic warfare system. Further improvements to the air-to-ground mode of the RBE2 active electronic scanning array (AESA) radar are also planned. In addition, the TALIOS electro-optical sensor pod will incorporate artificial intelligence to analyse tactical data almost instantaneously in flight and extract and identify targets. The enhancements will enable aircrews to locate, identify, classify, and engage threats.

Designing naval surface warships for modern ASW with networked sensors

The Australian government is weighing up its options when it comes to the anti-submarine warfare (ASW) capability requirements for the forthcoming decision on Project SEA 5000—the multi-billion-dollar future frigate project. The proliferation of submarines in the Indo-Pacific certainly warrants close attention being paid to this decision. For starters, we need a clear understanding *[PAGE 27]*

terrain, large buildings, or other obstructions inhibit line-of-sight communications.

Military leaders found that such obstructions could limit operating units to see only a limited set of the complete picture of the battlefield. The BACN command and control network is designed to provide situational awareness from small ground units in contact up to the highest command levels, Northrop Grumman officials say.

BACN's AEP provides translator and gateway interfaces among all supported communications systems, and forwards intelligence information to the Global Information Grid. By controlling the AEP via a ground station, BACN is radio- and platform-agnostic, Northrop Grumman officials say.

On these deals Northrop Grumman will do the work in San Diego; Middle River, Md.; Kandahar, Afghanistan; and at several international sites, and should be finished by January 2020.

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

Army looking for COTS dumb terminals to upgrade obsolescent rugged displays in Stryker vetronics

BY **John Keller**

WARREN, Mich. — U.S. Army vetronics experts are looking for rugged dumb terminals — video displays without internal processors — to replace obsolescent displays in the Army's fleet of Stryker Double V-Hull A1 (DVH A1) armored combat vehicles.

Officials of the Army Contracting Command in Warren, Mich., have issued a request for information (W56HZV-19-Vehicle-Electronics-and-Architecture-Request-for-Information) to find commercial off-the-shelf (COTS) solutions for DVH A1 in-vehicle network-2 (IVN-2) mission display.

The Army is looking for rugged displays without processors to replace obsolescent displays in the Stryker armored combat vehicle.

The Army Contracting Command is issuing this RFI on behalf of the Vehicle Electronics and Architecture office of the Army Tank and Automotive Research, Development, and Engineering Center (TARDEC) in Warren, Mich.

Army vetronics designers are looking for stand-alone dumb displays to replace the Stryker DVH A1 video display terminal (VDT) and its replacement video display electronic terminal (VDET), which rapidly are approaching obsolescence, Army officials say.

The new display's USB touchscreen and USB bezel may be provided to the keyboard, video, mouse (KVM) through one interface, and the displays should be able to accommodate secure classification separation. The new

display's performance should be equal to or better than the current VDET specification.

The rugged displays must have active touchscreen areas of at least 10 inches. The complete display and bezel must not be larger than 12.25 by 11 by 4.25 inches, and weigh no more than 24 pounds. Its bezel buttons must use the USB human interface device (HID) keyboard protocol, and use either the USB HID touchscreen; USB HID touchpad; or USB HID mouse protocol.

If companies would like to suggest a smart display, its processor must be physically removable from the unit at its point of manufacture to help the Army avoid removing the processor later on.

Army officials want to know the availability and cost of providing a display without an internal processor in a production quantity of 300 units per year; and to understand risk areas that could inhibit product development.

The Army only wants display hardware that meets the Stryker Mission Display (SMD) performance specification, which is available for download as a Microsoft Word document at https://www.fbo.gov/utils/view?id=cb6f4457b2ddb812eafe28dae2bee0ea.

Companies interested were asked to email responses to the Army's Jenelle Vickberg at Jenelle.L.Vickberg.civ@mail.mil no later than 18 Feb. 2019. Email questions or concerns to Vickberg at Jenelle.L.Vickberg.civ@mail.mil.

More information is online at https://www.fbo.gov/notices/ab233684b4f2e814712e1a15cf738afb.

[FROM PAGE 25] that ASW is about much more than just what can be expected from only one of many surface warships, no matter how sophisticated the fit-out. But who understands this esoteric field? The one-on-one hunter–killer scenario we sometimes think of from World War II or early in the Cold War is no longer what can be expected. Now, submarines are even harder to detect and, as a result, the World War II concept of a single ship hunting a submarine is of limited utility. With only on-board sensors available to conduct detection work, the submarine would always have an advantage. Building on evolved capabilities, ASW today involves coordinating a suite of networked sensors that involve sonar and electromagnetic sensors aloft, on the surface, and underwater to detect, track, deter, and potentially attack hostile submarines.

DARPA eyes tiny insects as models for artificial intelligence (AI) computing

BY **John Keller**

ARLINGTON, Va. — U.S. military researchers are drawing on the evolution of very small flying insects to improve artificial intelligence (AI) computing with reduced training times, improved computational efficiency, and low power consumption.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a solicitation (DARPA-PA-18-02-03) for the for the Microscale Biomimetic Robust Artificial Intelligence Networks (Micro-BRAIN) project.

DARPA scientists seek to develop new computational frameworks and strategies by drawing from the impressive computational capabilities of very small flying insects, which nature has forced to reduce their scale, size, and energy consumption without any loss of performance.

The past decade has seen explosive growth in development of AI systems, DARPA researchers explain. Nevertheless, the amount of computation necessary to train the largest AI systems has been increasing ten-fold each year as AI has taken on progressively more complex problems.

Experts predict, moreover, that tradeoffs between computational capability, resources, and size, weight, and power consumption (SWaP) is becoming increasingly critical.

Although computer research in this area is going in the right direction, much more needs to be done, DARPA researchers say. Today's neuromorphic and neural architectures rely on digital computing that attempt to mimic the way nature computes, yet not the way nature functions.

For the Micro-BRAIN project, DARPA is asking for new ways of understanding integrated sensory and nervous systems in miniature insects and developing prototype computational models that could map onto computer hardware to emulate their functions.

Nature has forced on these small insects drastic miniaturization and energy efficiency, some having only a few hundred neurons in a compact form factor, while maintaining basic functionality, researchers explain.

Tiny bugs, moreover, may be able to display increased subjectivity of experience, which extends simple look-up table responses potentially to AI-based problem solving. This research could lead to new capabilities in inference, prediction, generalization, and abstraction of problems.

Ultimately, the goal is to understand the computational principles, architectures, and neuronal details of small bio-systems driven by extreme SWaP needs in nature. Doing could help identify new computing paradigms that will enable improved AI with considerably reduced training times and power consumption.

Researchers may be able to draw on several factors related to miniaturized insects, such as sensing, memory, processing, and actuations integrated into a system that can be smaller than a few human neurons.

Evidence suggests that even small insects have subjective experiences that could be the first steps towards consciousness. This could imply some ability to infer, generalize, and abstract.

What's the next wave of artificial intelligence technology for unmanned aerial vehicles? Perhaps the insect world has the answer.

The six-month first phase of the DARPA Micro-BRAIN program will map input/output channels of a model insect's central intelligence system to understand physical interactions involved in signaling. The yearlong second phase will involve new AI computational hardware.

Proposers should understand not only computer science, signal processing, and computing architectures, but also the physiology of insects and their neural-sensory systems. Teams need to be able to identify the chemical and electromagnetic interactions involved in signaling in miniaturized distributed neural systems.

Companies and organizations interested were asked to submit 8-page proposals by 4 Feb. 2019 to the DARPA BAA Website at https://baa.darpa.mil. The program may begin as early as 3 April. 2019. Email questions or concerns the DARPA Micro-BRAIN program manager, Michael Fiddy, at MicroBrain@darpa.mil. ←

More information is online at https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-PA-18-02-03/listing.html.

Air Force moves forward on increasing power of laser weapons for tactical aircraft

BY **John Keller**

KIRTLAND AIR FORCE BASE, N.M. — U.S. Air Force aerial warfare experts are launching a new effort to increase the power and efficiency of laser weapons to make them suitable for next-generation tactical aircraft.

Air Force researchers are moving closer to developing enabling technologies for laser weapons aboard jet fighters and other combat aircraft.

Officials of the Air Force Research Laboratory Directed Energy Directorate at Kirtland Air Force Base, N.M., issued a broad agency announcement in January (FA9451-19-S-0001) for the Compact High Energy Laser Subsystem Engineering Assessment (CHELSEA) project.

CHELSEA seeks to identify the most promising technologies for significant increases in power over previous efforts to develop an airborne laser weapon for tactical aircraft.

Specifically, CHELSEA seeks to identify technologies that offer significant increases in power of prototypes developed in the Air Force Self-protect High Energy Laser Demonstrator (SHiELD) project and its laser subsystem called Laser Advancements for Next Generation Compact Environments (LANCE).

Air Force researchers say they will use CHELSEA data to help design and build by 2024 a Technology Readiness Level-5 laser prototype of a compact, ruggedized, high-energy laser subsystem suitable for tactical aircraft able to fly at near the speed of sound.

Now the CHELSEA project seeks to bring SHiELD and LANCE to a whole new level. It seeks to scale laser power by 2024 as a possible drop-in replacement for the SHiELD LANCE laser subsystem, or as part of a new prototype laser system for airborne applications. CHELSEA data also may help guide government technology investment decisions beyond 2024.

Companies interested should send responses by post or courier no later than 26 Feb. 2019 to AFRL Det 8/RVKDL, ATTN: Ms. Kim Armstrong, 3550 Aberdeen Avenue, Kirtland AFB, NM 87117-5773.

For technical questions or concerns contact Kevin Hewlett by email at kevin.hewett@us.af.mil, or by phone at 505-853-2684. For contracting questions or concerns contact Kim Armstrong by email at kim.armstrong.3@us.af.mil. ←

More information is online at https://www.fbo.gov/spg/USAF/AFMC/AFRLPLDED/FA9451-19-S-0001/listing.html.

Pentagon to study anti-missile laser weapons in space

The U.S. Department of Defense (DOD) will study the possibility of space weapons — perhaps particle beams, ray guns, space laser weapons, or orbiting missiles — that could intercept enemy missiles coming off the launch pad. The Pentagon will forgo actually developing them, for now. It's part of the Trump administration's effort to expand the scope of what we're postured to defend against. Much has changed since the Pentagon's last attempt to publicly frame the state of missile defense and the way forward: 2010's Ballistic Missile Defense Review. The review will also discuss prospects for using SM3 IIA missiles, of the sort on Arleigh Burke-class Aegis destroyers, as ICBM interceptors, with testing to occur in 2020. New weapons would be partially cued by a planned constellation of sensor satellites in low Earth orbit that will keep tabs on Russian, North Korean, or Chinese mobile missiles — part of the "space-based sensor layer" that is to be in place by 2023.

Air Force schedules tests of laser- and microwave-based directed-energy weapons

The U.S. Air Force officials say they plan future experiments involving laser- and microwave-based directed-energy weapons after recent successes in testing sessions. Future experiments in microwaves and lasers in the Directed Energy Experimentation Campaign are planned at the White Sands Missile Range in New Mexico, the Air Force said in a statement. The tests essentially use microwaves or lasers to bring down aerial targets. The experiments offer better understanding of the capabilities of off-the-shelf high-power microwaves and high-energy lasers, Air Force officials say. ←

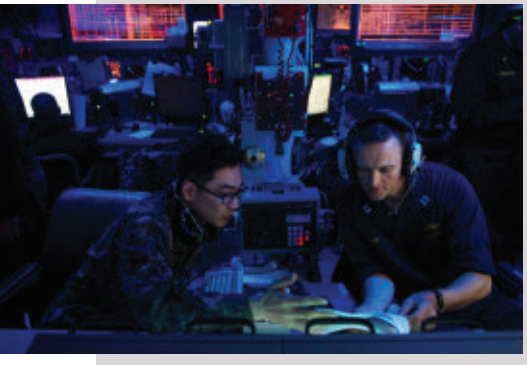
PRODUCT applications

RUGGED COMPUTERS

Navy chooses water-cooled shipboard computers from GTS for SEWIP and self-defense systems

Shipboard electronics designers at Global Technical Systems (GTS) in Virginia Beach, Va., will provide the U.S. Navy with additional rugged air- and water-cooled open-architecture shipboard computers under terms of an $8.5 million order.

Officials of the Naval Sea Systems Command in Washington are asking GTS to build 15 Common Processing System (CPS) technical instruction-12 hybrid (TI-12H) water-cooled computers for the Navy Surface Electronic Warfare Improvement Program (SEWIP) and two CPS TI-12H air-cooled computers for ship self-defense systems. The CPS is a rugged shipboard computer processing system based on an open-architecture design.



The CPS provides a common computing infrastructure for ship combat systems, including processing and memory, data storage and extraction, and I/O interfaces for shipboard combat systems. The GTS team building the open-architecture CPS consists of Northrop Grumman, DRS Technologies, IBM, and Oracle Corp.

GTS engineers build the CPS using commercial off-the-shelf (COTS) hardware and software such as BladeCenter technology that supplies common infrastructure for processing and network fabric. Plug-in components are accessible, hot-swappable, and battle-ready protected by the GTS Advanced COTS Enclosure (ACE).

The CPS consists of a rugged enclosure and three subsystems: the processing subsystem, the storage and extraction subsystem, and the I/O subsystem.

The storage and extraction subsystem provides data storage for CPS operating system (OS) image storage, program storage, data extraction, and database management. The I/O subsystem, meanwhile, interfaces the processing and storage hardware to various external elements.

Oracle provides for the Common Processing System open-standard middleware, designated SAFfire, for the CPS to support high-availability management of mission-critical combat system. SAF stands for Standards Availability Forum, an industry consortium of companies that develop open standards-based products. The new-generation Open-SAFfire middleware uses open-source technology based on SAF standards.

The overall CPS is designed with a shock-isolating enclosure that protects unhardened COTS components from the intense shock and vibration that can occur on Navy surface ships.

On this order GTS will do the work in Virginia Beach, Va., and should be finished by this October. For more information contact **Global Technical Systems** online at *http://gts.us.com*, or **Naval Sea Systems Command** at *www.navsea.navy.mil*.

AVIONICS

Air Force chooses cockpit management unit from Avalex for F-16 jet fighter avionics upgrade

U.S. Air Force jet fighter avionics experts needed a cockpit management unit as part of the F-16 communications suite modernization program. They found their solution from Avalex Technologies in Gulf Breeze, Fla.

Representatives of Avalex Technologies have announced that the Air Force has awarded the company a contract to provide the new-generation ACM9454V cockpit management unit as part of the F-16 cockpit avionics upgrade.

The Avalex ACM9454V is part of the Air Force Mobile User Objective System (MUOS) program, which will deliver a tenfold increase in the real-time, global digital SATCOM throughput capabilities for all blocks of F-16 jet fighter avionics, Avalex officials say.

MUOS is a is a UHF narrowband military satellite communications (SATCOM) system that provides increased communications capabilities to newer, smaller terminals while still supporting interoperability with legacy terminals. MUOS is designed to support users who require greater mobility, higher bit rates, and improved operational availability.

"Once implemented, the number of available SATCOM channels will increase by 10-fold, giving our pilots much greater connectivity in tomorrow's battlespace," says Tony Hatten, vice president of business development at Avalex.

Hatten explained that along with being a key part of the F-16 MUOS upgrade, the ACM9454V offers other key advantages including acting as

a single-point controller for any type of radio system, which eliminates the need for pilots to receive training on multiple voice and data communications systems.

"Another advantage of the Avalex Technologies cockpit management unit is that it is a commercial off the shelf (COTS) solution," Hatten says. "That means there is no added development cost or development cycle time required for the implementation program.

The Avalex ACM9454V cockpit management unit is a drop-in replacement for current ARC-210 full-size cockpit controllers; is software-upgradable for control of MUOS digital networking radios; offers a full-color sunlight-readable NVIS-A compatible display; offers a common radio user interface with standby and active tuning; and provides an interface to 10 common ARC-210 and other military radios, as well as IFF transponders, TACAN, and SAR direction finders, company officials say.

The Avalex ACM9454 cockpit management unit measures 5.75 by 4.88 inches; weighs 2.4 pounds, has a display area of 5 inches. It operates in temperatures from -40 to 55 degrees Celsius, has a 28-volt DC input, offers 640-by-640-pixel resolution, has two Ethernet ports, and one CAN bus port. For more information contact **Avalex Technologies** online at *https://avalex.com*.

AIRBORNE NETWORKING

Navy chooses sensor datalink from L-3 Communications-West for helicopters and warships

U.S. Navy shipboard communications experts needed a digital datalink to enable the MH-60R multi-mission naval helicopter to share its sensor information in real time with surface warships. They found their solution from L-3 Communications-West in Salt Lake City.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $12.6 million order to L-3 to build and support the common datalink Hawklink AN/SRQ-4 systems for the MH-60R helicopter.

The L-3 rugged AN/SRQ-4 Hawklink shipboard terminal is aboard Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers, and provides command and control, sensor data transfer, datalink operation, and built-in test, L-3 officials say.

It enables surface ships and the MH-60R helicopter to share information from radar, video, network, and acoustic data interfaces, and enables naval personnel to exploit aircraft sensor data in real time to extend situational awareness over the horizon. It has a range of about 100 nautical miles.

The Ku-band communications system runs on an open-systems architecture with touch-screen interfaces. Its 43-inch directional antenna offers auto-switching between open-loop pointing and closed-loop tracking, depending on the range between the helicopter and the ship.

The terminal is interoperable with the AN/SQQ-89 warship undersea warfare combat system and shipboard navigation sensors. It is software-configurable with Common Data Link (CDL) waveforms, and is compatible with SAU7000 digital messaging interfaces.

In addition to the MH-60R helicopter, the system also can work with the Fire Scout unmanned aerial vehicle (UAV), the P-8 Poseidon reconnaissance aircraft, and the P-3 Orion maritime patrol aircraft.

On this order L-3 will do the work in Salt Lake City; Atlanta; Mountain View, El Cajon, Sunnyvale, Oxnard, and Salinas, Calif.; Exeter and Dover, N.H.; Derby, Kan.; Boise, Idaho; York Haven, Pa.; Bohemia, N.Y.; Littleton and Stow, Mass.; Providence, R.I.; Cedar Park and Fort Worth, Texas; Minnetonka, Minn.; Phoenix; Skokie, Ill.; and Toronto, and should be finished by December 2020.

For more information contact **L-3 Communications-West** online at *www2.l3t.com/csw,* or **Naval Air Systems Command** at *www.navair.navy.mil*.

MISSION COMPUTERS

Tactical Air Support chooses mission computers from Curtiss-Wright for F-5E/F jet fighters

Military avionics experts at Tactical Air Support Inc. (TacAir) in Reno, Nev., needed cockpit-accessible rugged data recorders and mission computers to upgrade the company's fleet of F-5 E/F Tiger II supersonic jet fighters. They found their solution from the Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va.

TacAir awarded a contract worth more than $1 million to Curtiss-Wright to provide a commercial off-the-shelf (COTS) Parvus DuraCOR 8042 processor and Data Transport System three-slot (DTS3) network attached storage (NAS) file server for Tactical Air Support F-5E/F jet fighters.

TacAir owns and operates a fleet of 26 Northrop Grumman F-5 fighter aircraft and military avionics, largely consisting of an improved, lower flight-time version of the current adversary platform of the U.S. Navy and Marine Corps.

TacAir has operated F-5 aircraft since 2013. The F-5 is operational with 19 international air forces. The company is upgrading its F-5 fleet into advanced tactical aircraft with sensor and systems capabilities on-par with current U.S. military fourth-generation fighter aircraft, TacAir officials say.

Since its inception in 2005, TacAir has provided government and the aviation industry with

consulting and training services modeled after a weapons school with weapons school instructors, graduates, adversaries, and test pilots.

The company's F-5s are upgraded with head-up display (HUD) and hands-on-throttle-and-stick (HOTAS) systems, open-architecture mission computers, and tailored operational flight programs that enable integration of advanced radar and radar warning receivers, infrared search-and-track, electronic attack systems, datalinks, and high off-boresight simulated weapons.

The Curtiss-Wright DTS3 file server supports FIPS 140-2 hardware encrypted solid-state data storage that communicates via Ethernet to a modified version of Curtiss-Wright's DuraCOR 80-42 modular mission computer.

The DTS3 NAS file server is for aircraft, as well as for mobile vehicles and field ground stations. The rugged unit integrates into network-centric systems to provide a network file server. The system hosts three removable memory cartridges — each of which supports as much as two terabytes of stored data. Users can remove the unit from one DTS3 and install it into another DTS3.

The Parvus DuraCOR 8042 rugged modular mission computer subsystem is based on a quad-core, eight-thread, fifth-generation Intel Core i7 Broadwell microprocessor. The small-form-factor mission computer is qualified to MIL-STD environmental and EMI testing.

Its PCI Express Mini Card slots and a PCI Express/104 bus architecture supports rapid add-on I/O module integration for size, weight, and power (SWaP)-sensitive applications. It combines graphics and multi-core processing in a fanless IP67 design.

On this contract Curtiss-Wright will do the work in Dayton, Ohio, and Salt Lake City, and should be finished by this summer. Curtiss-Wright will ship products to the TacAir facility in St. Augustine, Fla.

For more information contact **Curtiss-Wright Defense Solutions** online at *www.curtisswrightds.com* or **Tactical Air Support** at *https://tacticalairsupport.com*.

NETWORKED RADIO

Mobile ad-hoc networking radio from Persistent Systems chosen for Resolute Eagle UAV

Unmanned aerial vehicle (UAV) experts at PAE ISR in Sterling, Va., needed mobile ad-hoc networking (MANET) capability for the company's Resolute Eagle UAV. They found their solution from Persistent Systems LLC in New York City.

Persistent Systems will provide the company's MPU5 Wave Relay networking radio for Resolute Eagle communications and navigation.

The MPU5 rugged digital radio has an onboard Android operating system, and the Wave Relay MANET, integrated GPS, native video encoding and decoding, and push-to-talk audio. It helps form secure networks, unites critical data sources in real time, and handles data, video, voice.

The system can run live voice-over-internet-protocols, video, and other high-demand applications, and uses existing infrastructure to augment the capacity of a wireless network. The radio's algorithm enables users to incorporate meshed devices into the network in which the devices themselves form the communication infrastructure.

The MPU5 then enables that critical information to quickly be disseminated to mobile teams on the ground and positively impact their mission. Keeping our soldiers safe while simultaneously making them more effective is the overall goal."

"The ability to deliver real-time intelligence data from an aircraft to teams of dismounted users is a force multiplier," Rubens says. "The aircraft's small operational footprint and extremely large payload capacity enables it to carry the most advanced sensor systems available and can be operated just about anywhere."

The Resolute Eagle UAV uses line-of-sight, beyond-line-of-sight, and beyond-visual-line-of sight RF communications for law enforcement, homeland security, humanitarian, and commercial UAV missions.

"The aircraft's small operational footprint and extremely large payload capacity enables it to carry the most advanced sensor systems available and can be operated just about anywhere," says Herb Rubens, Persistent Systems chief executive officer.

The UAV offers landing and recovery without a runway and offers a vertical takeoff and landing (VTOL) option for takeoff and landing for rough terrain and maritime operations. The aircraft is 9.5 feet long, with an 18.2-foot wing span.

It can operate unrefueled for 18 hours, cruises at 50 knots at altitudes to 17,000 feet. It has an empty weight of 120 pounds, and can carry 100 pounds of fuel, communications, and sensor payloads. It takes off by catapult and lands on its belly.

"This smart platform frees up valuable space and weight and in doing so, increases the endurance and payload carrying capability of the Resolute Eagle," says Joe Sartiano, PAE ISR chief operating officer, says of the Persistent Systems MPU5 radio.

"The MPU5's unique ability to rapidly change C, L, and S bands by swapping the interchangeable frequency modules paired with the Resolute Eagle's large multi-intelligence payload capacity makes this a game-changing capability," says Jake Jacobs, PAE ISR chief technology officer. "The MPU5 and its Wave Relay MANET technology allow the Resolute Eagle to achieve higher data-rates and deliver actionable intelligence from its multi-int sensors in near real-time."

For more information contact **Persistent Systems** online at *www.persistentsystems.com*, or **PAE ISR** at *www.paeisr.com*. ←

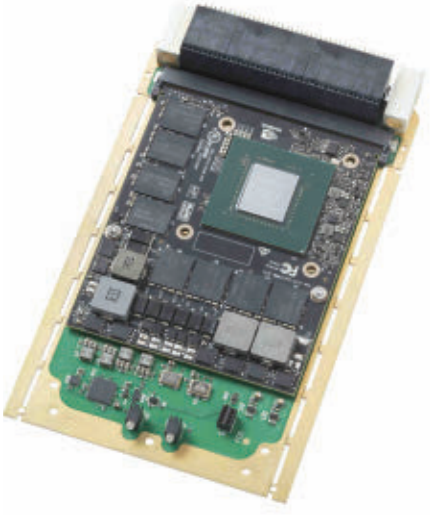
new PRODUCTS

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

VIDEO PROCESSING

Abaco and EIZO to bring GPGPU and video processing to high-performance embedded computing (HPEC)

Abaco Systems in Huntsville, Ala., is collaborating with EIZO Rugged Solutions Inc. in Altamonte Springs, Fla., on military and aerospace video processing and general-purpose graphics processing unit (GPGPU) technology for high-performance embedded computing (HPEC) systems. This collaboration is enabling Abaco to expand its NVIDIA-based GPGPU board and system family. Typical compute-intensive applications will include intelligence, surveillance and reconnaissance (ISR), electronic warfare (EW), radar and sonar and remote sensing and analysis, as well as



video capture and processing. EIZO Rugged Solutions' product line capitalizes on NVIDIA Pascal GPU technology to deliver as much as 6.4 TeraFLOPS of floating-point performance for video processing from one 3U OpenVPX chassis slot. As well as 3U OpenVPX platforms, Abaco will offer XMC solutions with NVIDIA GPUs. For more information contact **Abaco Systems** online at *www.abaco.com*, or **EIZO Rugged Solutions** at *www.eizorugged.com*.

RUGGED CABLING

High-temperature Ethernet cables for avionics and other extreme environments introduced by MilesTek

MilesTek Corp. in Lewisville, Texas, is introducing a series of high-temperature Ethernet cables for

aerospace and extreme high-temperature environment applications. The cable assemblies feature FEP jackets that are rated to a temperature range of -55 to 150 degrees Celsius, and a double shielded cable with 100 percent foil and 85 percent braid shields that provide maximum EMI and RFI protection. These Ethernet cables come off-the-shelf in Cat6a, Cat5e and Cat5e slim construction versions and comply with all RoHS directives. Furthermore, the fire properties of these Ethernet cables meet FAR (Federal Aviation Regulation), Airbus and Boeing requirements. "Our high temp cables are perfect for in-flight systems, cabin management applications, ground vehicle trunks, backbone avionics, high-temp testing and for general military, avionics or aerospace use," says MilesTek Product Manager Mark Hearn. For more information contact **MilesTek** online at *www.milestek.com*.

BOARD PRODUCTS

Digital signal processing boards for VPX SIGINT embedded computing introduced by VadaTech

VadaTech Inc. in Henderson, Nev., is introducing the AMC598 and VPX598 digital signal processing boards for communications intelligence

(COMINT), signals intelligence (SIGINT), radar, research, and instrumentation. These boards provide quad A/D conversion with sample rates as fast as 3 giga-samples per second (AD9208) at 14-bits and a quad D/A converter (Analog Devices AD9162 or AD9164) with update rates as fast as 12 giga-samples per second and direct RF synthesis at 6 giga-samples per second. The boards have an on-board, re-configurable UltraScale XCKU115 field-programmable gate array (FPGA) which interfaces to the A/D converter and D/A converter. The FPGA interfaces to three banks of DDR4 memory channels to store large buffer sizes during embedded computing as well as for queuing the data to the host. The AMC598 comes with an 8HP panel size; it will occupy two mid-size slots in a chassis. The VPX598 routes x8 high-speed serializer/deserializer (SerDes) to the P1 that could be configured as PCI express and Serial RapidIO and 10 Gigabit Ethernet and Aurora etc. and x8 high speed SerDes to P2 that could be configured for SRIO and 10 Gigabit Ethernet and Aurora. For more information contact **VadaTech** online at *www.vadatech.com*.

POWER ELECTRONICS

Rugged power supplies with high operating efficiencies for industrial uses introduced by TDK Lambda

TDK-Lambda Americas Inc. in San Diego is introducing the 1500-Watt CUS1500M series of

AC-DC power supplies for industrial, medical, cosmetic laser treatment and analysis equipment requiring less than 300 microamps earth leakage current, low audible noise, and class B EMI. The announcement extends the CUS-M family of products, which cover 30 to 1500 Watts. The CUS1500M has medical and Information Technology Equipment (ITE) certifications. The 1500-Watt additions are available with 12, 15, 24, 36, and 48-volt outputs, adjustable from -15/+20 percent (+15 percent for the 48-volt) of nominal. All models accept an 85 to 265-volt AC input and can operate at full load in ambient temperatures from -20 to 50 degrees Celsius, derating linearly to 60 percent load from 50 to 60 C. High operating efficiencies to 88 percent reduce internal waste heat and component temperatures, resulting in electrolytic capacitor service life predictions of at least 10 years. For more information contact **TDK-Lambda Americas** online at *www.us.tdk-lambda.com*.

SPECTRUM ANALYZERS

Spectrum analyzer for aerospace and defense test and measurement introduced by Rohde & Schwarz

Rohde & Schwarz in Munich is expanding the company's Spectrum Rider FPH family of handheld spectrum analyzers with three new base models providing frequency ranges from 5 kHz to 6 GHz, 13.6 GHz, and 26.5 GHz for everyday measurement tasks in aerospace and defense, mobile network testing and broadcasting. These test and measurement devices offer a capacitive touchscreen and a unique frequency upgrade concept via keycodes.

Since upgrades require neither downtime nor recalibration, users can upgrade their base models. The Spectrum Rider FPH is a tool for verifying signal transmission over 5G, broadcast, radar and satellite communications links. Higher-frequency models enable the rugged Spectrum Rider FPH to perform measurement tasks in the field and lab. Weighing

PRODUCT & LITERATURE SHOWCASE

5.5 pounds, the Spectrum Rider FPH spectrum analyzers have a battery that lasts more than six hours. The analyzer can be controlled remotely via USB or LAN. Its MobileView app for iOS and Android provides wireless remote control of the Spectrum Rider FPH from a mobile device. For more information contact **Rohde & Schwarz** online at *www.rohde-schwarz.com*.

MOTION CONTROL

Differential measurement for space and airborne night vision and image stabilization introduced by Kaman

The Measuring Division of Kaman Precision Products Inc. in Middletown, Conn., is introducing the KD-5100 differential measurement system for night vision systems, precision telescope positioning, fast steering mirrors (FSM) for space-based and airborne applications, and image stabilization systems. The measurement system provides resolution to a nanometer of positional change. With its stable design, small size, and low power consumption, the KD-5100 has a package size of 2 by 2.12 by 0.75 inches thick for applications where space is a limiting factor. It is manufactured to MIL-H-38534, with

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BPA WORLDWIDE Connectiv

MIL-SPEC components used throughout the electronics module wherever possible. The KD-5100 features rugged construction, with a mean time between failures of better than 238,000 hours in a space flight environment and 55,000 hours in a tactical environment. For more information contact **Kaman Precision Products** online at *www.kamansensors.com*.

EMBEDDED COMPUTING

3U VPX development device for rugged systems introduced by Concurrent Technologies

Concurrent Technologies Inc. in Woburn, Mass., is introducing the SY TR2/525 3U VPX development system for applications that require a computer board closely coupled to field-programmable gate array (FPGA) or graphics processing unit (GPU) boards with dedicated communication pipes capable of 3.9-gigabit-per-second bandwidth. Concurrent Technologies can supply a range of M.2 modules for use in rugged and extended-temperature operating environments. M.2 modules with encryption capability for more secure applications also are available. The system comes with an 8- or 12-core computing board with a PCI Express link to four slots for additional peripheral boards. Alternatively, SY TR2/525 is for applications that require a computer board and as many as four I/O boards, as it removes the need for a PCI Express fabric switch board. A rear transition module with two 10 Gigabit Ethernet uplinks comes with the embedded computing board to communicate with external systems. The system also has an AC power supply and cooling fans. For more information contact **Concurrent Technologies** online at *www.gocct.com*.

POWER SUPPLIES

Rugged 120-Watt AC-DC power supplies for mission-critical applications introduced by Power Partners

Power Partners Inc. in Hudson, Mass., is introducing the PDAM120 series of 120-Watt AC-DC power supplies for life- and mission-critical applications such as medical and public transportation. The power electronics devices feature either Class I or Class II input configurations, and come in industry-standard 2-by-3-inch packages. They are available in three design options;

open-frame; u-channel; and enclosed. The power supplies offer efficiency of 15.27 Watts per cubic inch. Available in three single output models: 12-, 24-, and 48 volts DC, each unit features 90 to 264-volt-AC input voltage ranges; no-load power consumption of less than 300 milliwatts, operating temperature ranges of -30 to 70 degrees Celsius (with derating); mean time between failures of more than 250,000 hours per MIL-HDBK-217F at full load, and at 25 C ambient and weight of 6.4 ounces. All models of these rugged power electronics devices are designed to meet Level VI requirements and suitable for BF applied part applications. This series is certified to UL/cUL/EN60601-1, UL/cUL/EN60950-1, EMC Class B radiated and conducted EN55011, and Class A susceptibility EN55011. For more information contact **Power Partners** online at *http://powerpartners-inc.com*.

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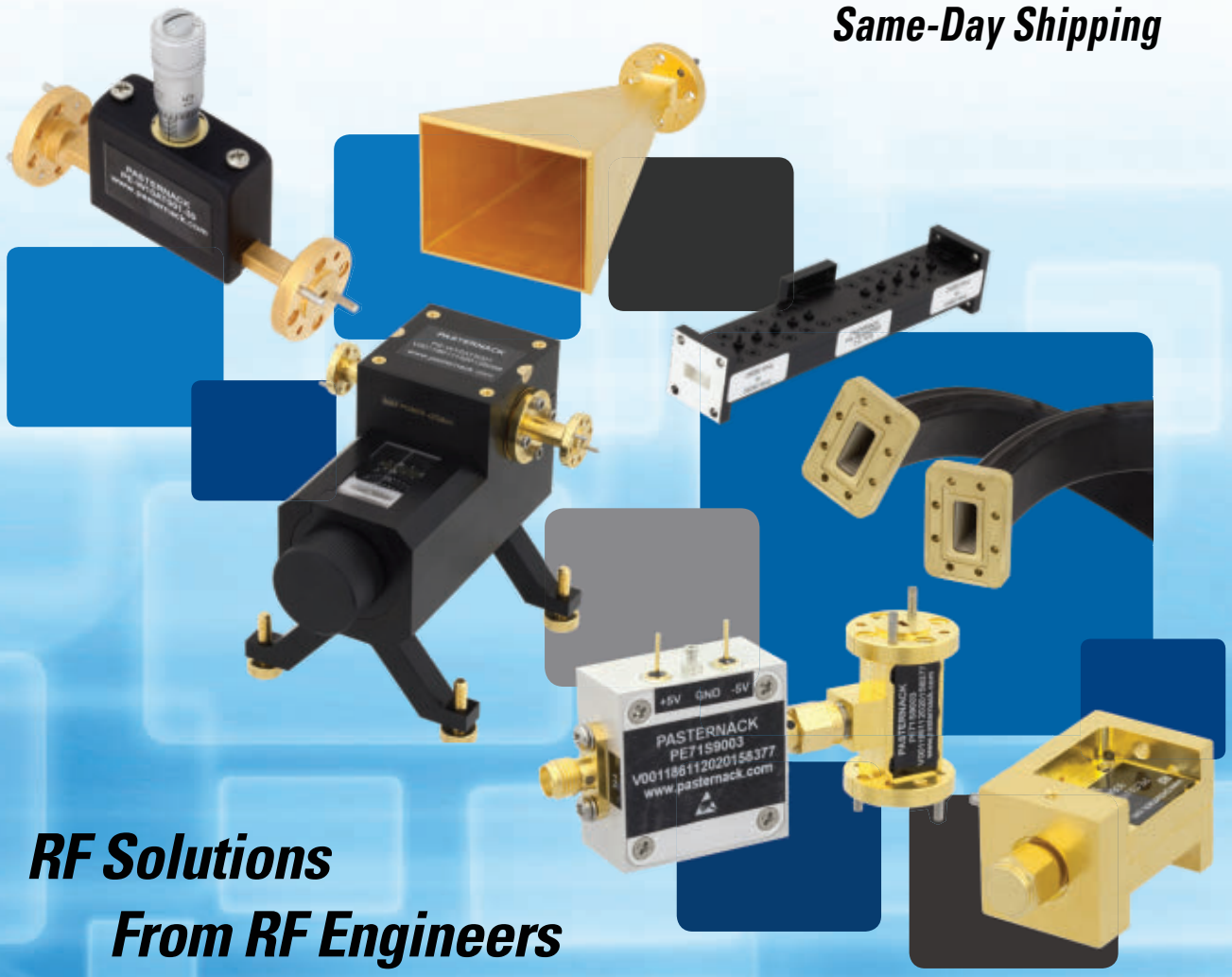

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