SEPTEMBER 2020

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2020 Technology Innovation awards announced

Military & Aerospace Electronics names the year's top technology innovators for leading-edge applications. PAGE 4

High-performance embedded computing

SOSA, HOST, MOSA, VITA, and a host of other new and emerging open-systems industry standards are coming to bear on demanding aerospace and defense applications. PAGE 26

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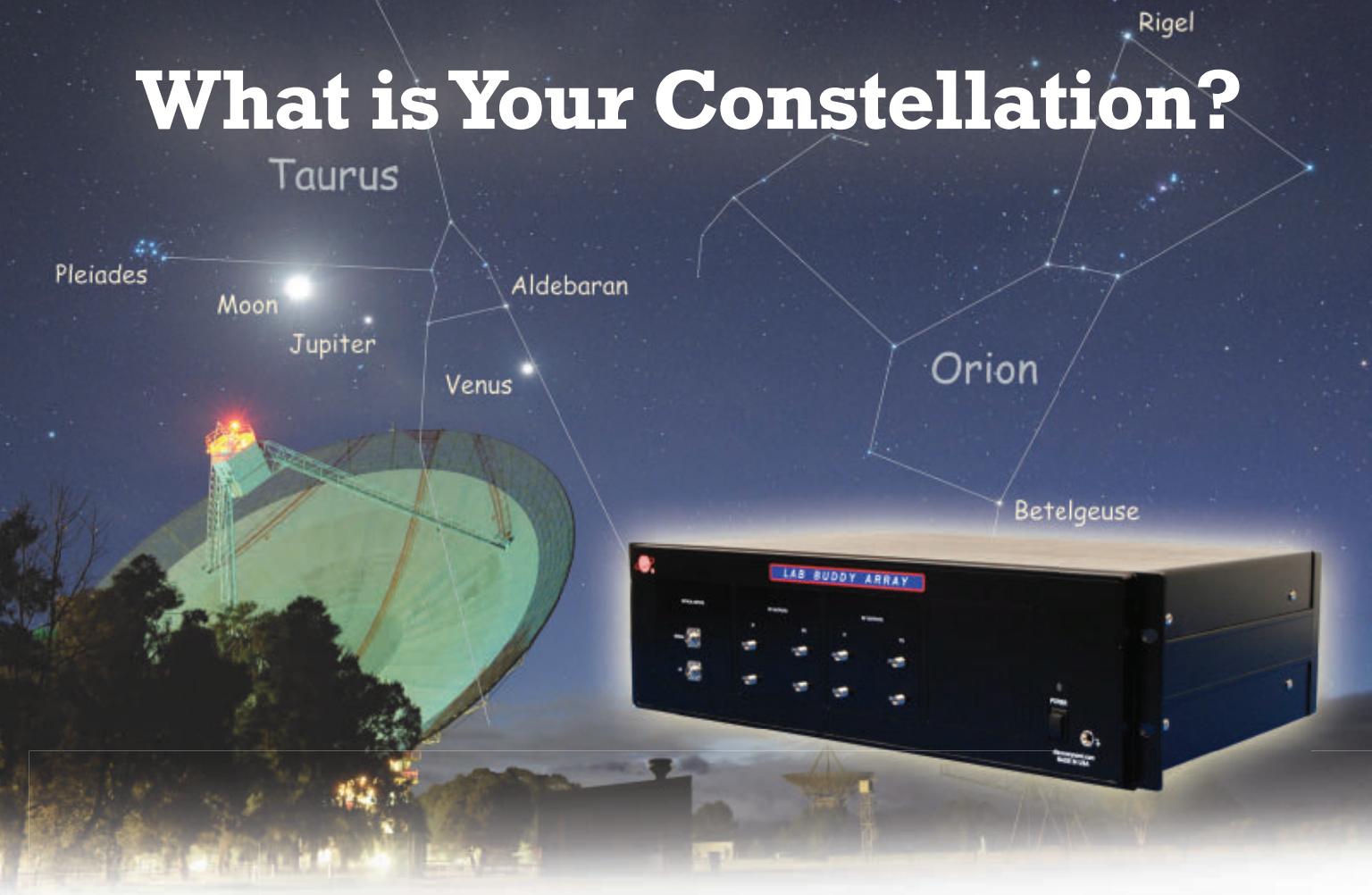
SIMULATION & MISSION REHEARSAL

Artificial intelligence (AI), machine learning, and virtual reality are taking a lead role. PAGE 16

ENDEAVOR BUSINESS MEDIA

What is Your Constellation?



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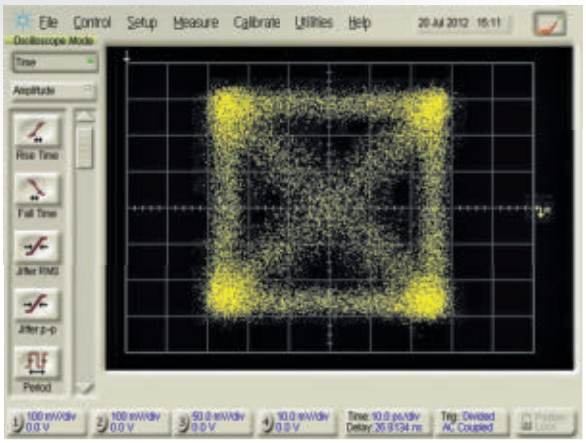

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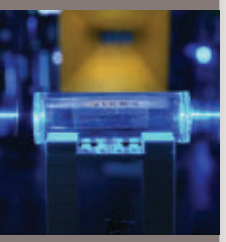
COVER STORY



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BY **JOHN KELLER**, EDITOR IN CHIEF

2020 Military & Aerospace Technology Innovators Awards announced to kick-off the fall season

Military & Aerospace Electronics is recognizing some of the biggest names in the defense electronics industry as innovators in enabling technologies to help U.S. prime contractors and the military services on the cutting-edge of military capabilities.

The 2020 Military & Aerospace Technology Innovators Awards have been announced this month, and the list consists companies with growing reputations as technology innovators. Many of these companies you know, and some you don't.

At the top are companies like Leonardo DRS, Xilinx, Pleora Technologies, North Atlantic Industries, Wind River Systems, Wearin' SA, AdaCore, ZMicro, Mercury Systems, PacStar, Marvin Test Solutions, Wolf Advanced Technology, MilSource, Interface Concept, Annapolis Micro Systems, and Keysight Technologies.

Also with strong showings are companies like W. L. Gore & Associates, Renesas Electronics, Anritsu, Elma Electronic, Advanced Cooling Technologies (ACT), Curtiss-Wright Defense Solutions, Abaco Systems, MPL AG, Vicor Corp., and Pentek Inc.

Not to be outdone, honorable mentions include International Rectifier, Discovery Semiconductors, Milpower Source, and TRM Microwave. Those are some of this year's recognized companies. Next year likely will have many others.

You can see a complete listing of the 2020 Military & Aerospace Technology Innovators Awards winners and their innovations in technology on page 4 of this issue.

So why do we do this? It's a long, difficult process, but well worth it to see who are the go-to companies for technologies in embedded computing; power electronics; sensors; command, control, communications, computers, intelligence, and surveillance (C4ISR); cyber security; electro-optics; high-reliability electronics; interconnect technology; RF and microwave; test and measurement; and other technologies that apply to aerospace and defense applications on land, at sea, in the air, and in space.

These innovators awards aren't just about new products; they are about design solutions to real-world engineering challenges. All those entering are asked about how these devices can help aerospace and electronics engineers overcome some of their most difficult problems.

Preferably these devices have been specified, chosen, and designed into systems, subsystems, and components. Entries include hardware and software, and are from companies with long track records in product application design solutions.

You'll notice that the 2020 Military & Aerospace Technology Innovators Awards were announced much earlier than they were last year. In 2019 we saw award announcements in December. This year they are in September, and likely will stay there for publication just after Labor Day when our industry kicks into high gear after summer vacations and barbecues, and gets ready for one of the most intense periods of the year.

If you don't see your company's name in the list of awardees, it's likely you didn't enter. You can change that starting in 2021 sometime in the spring when next year's awards programs will be announced. You can get more information online at https://militaryawards.secure-platform.com/.

We're asking all defense electronics designers and suppliers interested in innovation to participate. We'll keep you informed about when the 2021 program begins.

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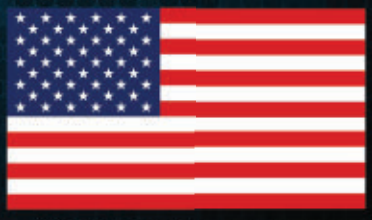

"Server hardware exploits, banned Chinese electronics and a trade war are a wake-up call." *Ben Sharfi, GMS CEO*

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2020 Military & Aerospace Technology Innovators Awards announced for aerospace and defense achievement

NASHUA, N.H. — *Military & Aerospace Electronics and Intelligent Aerospace have announced their 2020 Technology Innovators Awards to recognize companies offering substantial military, aerospace, and avionics design solutions.*

Awards are in three tiers — ranging from platinum, the highest, to the gold awards, and finally to the silver awards — and are based on the recommendations of an independent panel of industry judges.

PLATINUM

The TITAN On Board Vehicle Power (OBVP) system for medium tactical vehicles and heavy trucks from a partnership of Leonardo DRS and Allison Transmission uses a transmission integral generator is able to produce as much power as 125 kilowatts. The retrofit kit encompasses the same volume as the standard transmission, and converts mechanical energy into electrical energy directly from the vehicle's engine. The system is maintenance-free, extends battlefield mobility, and reduces logistical footprint.

The 20-nanometer radiation-tolerant XQRKU060 Kintex UltraScale field-programmable gate array (FPGA) from Xilinx Inc. enables spacecraft designers to get hundreds of gigabits per second of processing capacity in orbit to enable seamless connectivity aboard broadband satellites. The XQRKU060 FPGA enables designers of high-throughput and high-bandwidth satellites to process data on board with a 10X Increase in digital signal processing capability over the prior-generations Xilinx Space FPGA to handle the task of processing raw sensor information and render usable images.

The RuggedCONNECT smart video switcher from Pleora Technologies can help increase intelligence, awareness, and safety while reducing cognitive burden for military vehicle crew members. Manufacturers can design standards-compliant vehicles that are rapidly deployable, mission configurable, and cost-effective. The scalable platform can help implement advanced and future capabilities like machine learning, artificial intelligence, and new sensors to increase mission effectiveness with minimum integration effort. The RuggedCONNECT smart video switcher acquires and processes data from several cameras and sensors into a standardized feed that transmits over a low-latency, multicast Gigabit Ethernet network to processors and displays for vehicle-based local situational awareness and driver vision enhancer applications.

The SIU36 configurable 3U OpenVPX COTS system from North Atlantic Industries (NAI) is a sensor interface unit that focuses on the OpenVPX and COSA architectures to make the most of I/O density. The configurable rugged COTS system is for military, industrial, and commercial applications with the option to use as many as six NAI 3U OpenVPX boards and align with MOSA, OSA, SOSA, and the FACE technical standards. The system makes six card slots available, and offers the option to configure as many as 18 I/O and communication function modules.

The Safety Critical Advanced Compute Solution from CoreAVI and Wind River Systems combines CoreAVI's VkCore SC Vulkan driver, ComputeCore GPGPU compute library, and Wind River's VxWorks 7 real-time operating system. It offers object tracking capabilities through compute; safety critical capabilities; graphics and compute capabilities on one GPU; a real-time operating system for deterministic applications; connectivity and communications; multi-core and multiprocessing support; and a low-risk business model.

The Connected Vest from Wearin' SA is a centralized integrated connectivity system for the infantry warfighter with an integrated distributed data and power bus that can eliminate the need

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The QGen model-based development tool suite from AdaCore includes a qualifiable code generator for the MathWorks Simulink/Stateflow modeling language, which generates C or Ada source code from the model, without human intervention. Developed by AdaCore, the QGen code generator is being qualified by AdaCore and their partner Verocel at tool qualification level one (TQL-1), which is the highest level of qualification recognized by the U.S. Federal Aviation Administration (FAA). The fundamental goal of a qualified code generator is to ensure that the software that is auto-generated has identical semantics to the original model, ensuring that any activities performed at the model level through simulation will produce identical behavior on the final target.

The TranzPak 2 Tracker (TP2 Tracker) from ZMicro Inc. is a removable data storage solution for military applications that enables users to enforce data security policies automatically. The TP2 Tracker is a lightweight rugged removable solid-state device (SSD) that can generate a label dynamically that is written to its built-in e-paper display. The label automatically updates to ensure that it accurately describes user data, security data, and administrative data. This information is stored as metadata in non-volatile memory on the device and enables automatic enforcement of data encryption and access policies.

The CIOE-1390 from Mercury Systems is a COM Express-based processor module that capitalized the collaboration between Intel and Mercury's design and flight safety certification experts to deliver flight safety-certifiable multicore processing resources. Safety certification is a critically important requirement for commercial aircraft avionics. Complying with the associated standards is time-consuming and expensive, but they must be applied rigorously to ensure the safety of incredibly complex systems. To address the demand for onboard avionics processing, the device has the Intel Atom multicore processors and embedded BuiltSAFE technology capable of flight safety certification. The CIOE-1390 are rugged, small form factor COM Express Type 10 Mini processor modules that are powered with either a dual- or quad-core E3900 Atom Apollo Lake processor, and are available with DO-254 DAL-C flight safety certification evidence for the circuit card assembly and DO-178C DAL-C evidence for custom BIOS and bootloader software.

The Secure Wireless Command Post (SWCP) from PacStar is a small, modular communications package that enables warfighters to transmit classified and unclassified information securely in tactical settings while using their Wi-Fi and LTE-enabled commercial smartphones and tablet computers. PacStar SWCP has proven transformation for military requirements because it marries a modular communications package of hardware and software that reduces the management burden for tactical high-security communications. At the same time, PacStar shrunk the software/hardware package down to where it could be deployed practically in tactical environments. Prior to PacStar SWCP, it simply was not possible for DoD organizations to deploy CSfC in tactical settings.

The MTS-3060A SmartCan Universal O-Level Armament Test Set from Marvin Test Solutions Inc. addresses the challenges of performing flightline test activities with an existing generation of armament test sets that limit

The Leonardo DRS TITAN On Board Vehicle Power (OBVP) system uses a transmission integral generator is able to produce as much vehicle power as 125 kilowatts.

the ability to verify armament system functionality, failures, and readiness. The system can perform flightline test and measurement of all fighter aircraft armament and gun systems. The SmartCan weighs 4.2 pounds, and incorporates more than 30 measurement channels, electronic loads, communications interfaces, a switch matrix, and video/audio signal generators, and cable ID. It is lightweight, cyber secure, battery powered and rugged, and eliminates the need for multiple test sets and cables. Broad measurement capability with more than 30 analog and digital measurement channels enables maintenance testing on armed legacy or 5th generation aircraft. The test set employs smart weapon emulation - enables active versus conventional passive testing.

The VPX3U-XAVIER single-board computer from Wolf Advanced Technology is designed to use an NVIDIA Jetson AGX Xavier in a rugged 3U VPX military and aerospace environments, at the edge, while also adding SDI and CVBS signal conversion capabilities in air- and conduction-cooled versions. Other innovations include the addition of solid-state drive options as large as 1 terabyte. The WOLF VPX3U-XAVIER-SBC is the only product, thus far, that enables the NVIDIA Jetson AGX Xavier to be used at the level of ruggedness required by military and aerospace applications at the edge. The VPX3U-XAVIER-SBC is a single board computer and thus does not require a host to operate, yet it can also work with a PCI Express switch with non-transparent-bridge capability. Multiple WOLF VPX3U-XAVIER-SBC's can be configured to work together in a chassis.

The Data Distribution Unit-Expandable (DDUx) from Leonardo DRS is designed to eliminate the need for several line-replaceable units on a vehicle or weapon system. The multi-purpose design creates the ability to reduce size, weight, power consumption, and cost, and facilitates the integration and convergence of C5ISR, EW, SIGINT and cyber on vehicles and dismounted access to those systems. The DDUx provides an assured edge processing and storage system for platform Cyber including but not limited to protect, defend, identify, isolate/mitigate, restore and report Cyber threats while maintaining the integrity of platform microsystems, subsystems for today and for the next generation of

tactical computers. It enables the integration and use of Artificial Intelligence (AI) on data collected and stored at the edge and is stackable to support multi-domain operations. The DDUx also facilitates multipurpose utilization for multiple ground and air platforms.

The Techaya MILTECH404 from MilSource is an integrated soldier power and data management system (ISPDS) that combines USB, serial, and SMBUS communication along with full smart power management for infantry soldiers. The MILTECH 404 helps create an open architecture and open communication system for field deployable applications. It supplies one port of Fast Ethernet, three USB 2.0 ports, one serial port and one external power source. MIL-STD 810F and IP 68 rated, the MILTECH 404 weighs 300 grams. As the number of soldier-carry technologies continues to expand, each of these technologies requires power. Without the necessary power, the wearable technologies become additional burdens on the battlefield: these technological breakthroughs meant to help soldiers effectively execute a mission can instead put them in harm's way.

The RFM3103s from Mercury Systems is an ultra-wideband dual upconverter, designed to align with the emerging sensor open systems architecture (SOSA) technical standards for demanding electronic warfare (EW) environments. The rugged, compact dual upconverter pioneers system interoperability and upgradeability, supporting an increased and more diverse range of unmanned systems on various platforms including ground, airborne, and subsurface. This SOSA-alignment product contributes to how profoundly more accessible this technology is to aerospace and defense industries. Packages in a low-SWaP 3U module, the RFM3103s is optimized for future upgradeability, and is for electronic attack, ELINT, and beamforming systems.

The IC-ARM-VPX3a from Interface Concept is a3U VPX single-board computer that supports 100-Gigabit Ethernet on the backplane. It has the NXP Arm Cortex-A72 based LX2160A multicore communications processor, and meets the 25 gigabit-per-second Ethernet interfaces on a 3U VPX system backplane specified by the Sensor Open Systems Architecture (SOSA) working group. The NXP Layerscape LX2160A processor combines the low power of FinFET (Fin Field Effect Transistor) process technology, sixteen Arm Cortex-A72 cores up to 2.2 GHz with data path acceleration for L2/3 packet processing, security offload, and traffic management. This board complies with VITA 65.0 standard. It comes with a boot loader and with a Linux or VxWorks BSP. It is available in air-cooled and conduction-cooled versions.

The WILDSTAR 100 Gigabit Ethernet OpenVPX switch from Annapolis Micro Systems Inc. delivers as much as 6.4 terabits per second of switching between backplane slots of multiple channels of 100 Gigabit Ethernet; as many as 26 40 and 100 Gigabit Ethernet ports; seven optional 40 and 100 Gigabit Ethernet optical interfaces to VITA 66; four optional 40 and 100 Gigabit Ethernet optical interfaces to the front panel; air, conduction, or liquid cooling; alignment with the SOSA technical standard; and compliance with VITA 65. These high-performance products are designed for advanced HPC, ISR, and multi-function EW applications, including phased array radar, cyber security network processing, DRFM, beamforming, sensor processing, wireless communication, and radar signal processing.

The PNA/PNA-X network analyzers from Keysight Technologies Inc. provide low phase noise on a network analyzer, enabling users to save time by measuring with a wide IF bandwidth without using averaging. The low phase noise enhances the performance of the wide range of PNA software applications. With a new direct digital synthesis (DDS) source, the PNA and PNA-X provide extremely low phase noise, enhancing applications such as modulation distortion, nonlinear vector network analysis (NVNA), SMC with phase, differential mixer measurements, and I/Q converter measurements.

GOLD

The SCM6010 OpenVPX data storage modules from Mercury Systems feature non-volatile NVMe M.2 memory for high-speed, low-latency performance. Their removable storage canisters are for rapid mission updates, removal of sensitive material and technological refreshes.

The GORE PHASEFLEX RF and microwave test assemblies from W. L. Gore & Associates Inc. have durable construction with inner layers that provide electrical performance and outer-layer protection enable these test assemblies to perform throughout the life of a system.

The ISL70005SEH from Renesas Electronics Corp. is a radiation-hardened dual output point-of-load regulator that combines the high efficiency of a synchronous buck regulator with the low noise of an LDO regulator for systems with 3.3- or 5-volt power buses.

The Field Master Pro MS2090A from Anritsu Co. can measure the amplitude of one spectrum event as short as 2 microseconds and detect an event as short as 5 nanoseconds in a ruggedized, size, weight, and power (SWaP) optimized, field-deployable handheld spectrum analyzer.

The JetSys 5320 Rugged SFF Platform for AI from Elma Electronic is a small, high-performance edge computing platform based on the NVIDIA Jetson module for artificial intelligence (AI) and other image-processing applications.

The Pumped Two-Phase (P2P) Cooling system from Advanced Cooling Technologies Inc. uses vaporization instead of liquid cooling to offer high heat flux capabilities; uniform temperature distribution over large surfaces; and small flexible packaging; and high reliability.

The DuraMAR 6300 rugged Cisco-based Gigabit Ethernet router from Curtiss-Wright Defense Solutions integrates a Cisco ESR-6300 embedded services router card running Cisco IOS-XE software. It is built on trusted Cisco Systems IOS-XE technology for cyber security in a miniature IP67-rated fanless chassis.

The VP430 RFSoC board from Abaco Systems has the 8x8 Xilinx Radio Frequency System On Chip, RFSOC Technology, which combines FPGA processing, multi-processor embedded ARM Cortex-A53, ARM real time processing unit (RPU) and eight A/D and D/A input channels on the 3U VPX standard form factor.

The LAD2150 rugged large-area display from Mercury Systems is a dual-redundant AMLCD display with 1.3 billion colors and 1024 gray shades to enable the viewer to identify objects at extended distances with day and night backlight approaches.

The PIP40 family of rugged embedded computers from MPL AG is based on the Intel 9th Generation CPU. The fanless embedded computer is ruggedized against the effects of shock, vibration, and extended temperatures, and are designed for long-term availability.

The Keysight Z2098B Threat Simulation System from Keysight Technologies Inc. Keysight Technologies Inc. enables users to develop and test sophisticated electronic warfare (EW) systems incrementally based on their needs and budget by combining hardware, software, and services.

The RP24 1,000-Watt power system from Elma Electronic offers protection from electro-magnetic pulse (EMP), overvoltage, shock, and vibration, and is qualified for operation in field deployment, ground vehicles, helicopters and other aircraft.

The VPX3-673 Assured Position, Navi-

gation and Timing (A-PNT) Card from Curtiss-Wright Defense Solutions is a specialized single-board computer and timing card to eliminate the need for multiple in-platform boxes to field new navigational capabilities on ground vehicles.

The DCM5614 isolated regulated 270V-28V DC-DC converter from Vicor Corp. offers a power density of 451 Watts per cubic inch at 178 grams for manned aircraft, ships and submarines, and unmanned aerial vehicles where power density, weight and efficiency are critical.

The VME-1910 single board computer from Curtiss-Wright Defense Solutions brings the latest rugged, high-performance Intel processing technology and enhanced trusted computing to replacing legacy computer boards in existing VME systems.

The model 6001 8-Channel A/D & D/A Zynq UltraScale+ RFSoC Processor from Pentek Inc is a high-performance system-on-module (SoM) based on the Xilinx Zynq UltraScale+ RFSoC FPGA with eight integrated RF-class A/D and D/A converters.

SILVER

The SupIR-SMD Rad Hard MOSFET package technology from International Rectifier HiRel Products Inc. offers a patented multi-layer base design, enabling a gradual CTE change from ceramic to PCB and reducing stress of a large CTE mismatch; and curved wide flat leads, formed to surface mount configuration to give additional stress relief.

The SBC3511 3U VPX single-board computer from Abaco Systems is a SOSA-aligned 3U system that offers high performance, advanced security and leading-edge thermal management, thanks to the long-lived Xeon E3 processor with integrated GPU.

The Space Qualified InGaAs Quad PD + TIA Photoreceivers from Discovery Semiconductors Inc. offers a large active area diameter; small photodiode capacitance; small crosstalk between adjacent quadrants; resilient to radiation for space qualification; and comprehensively tested for radiation background for the space environment.

Military & Aerospace Electronics 2020 Innovators Awards

PLATINUM

3U OpenVPX Sensor Interface Unit – SIU36

The SIU36 is NAI's latest generation of sensor interface units that focuses on the OpenVPX and COSA® architectures to truly maximize I/O density. It is a highly configurable rugged COTS system ideally suited for military, industrial, and commercial applications with the option to use up to six NAI field-proven, 3U OpenVPX boards to maximize flexibility and high density I/O while being aligned with MOSA, OSA, SOSA™ and the FACE™ technical standard.

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www.naii.com/3U-OpenVPX-Sensor-Interface-Unit-SIU36/P343

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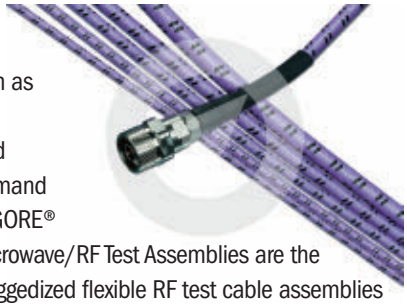

Mission-critical, military aircraft applications such as Radar, Electronic Warfare (EW) and C5ISR Suites demand reliable testing. GORE® PHASEFLEX® Microwave/RF Test Assemblies are the only internally ruggedized flexible RF test cable assemblies on the market that deliver consistent electrical performance with long service life in harsh environments. They provide excellent phase and amplitude stability with flexure while reducing equipment downtime, resulting in lower lifetime costs for testing in laboratory and field test environments.

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The M4054 SOSA Aligned 3U VPX from Milpower Source is a VITA 62-compliant 3U DC-DC power supply that is SOSA aligned for 12-volt DC heavy payload applications. It can be configured to support airborne applications per MIL-STD-704 and ground applications per MIL-STD-1275 & Def Stan 61-5.

The EnsembleSeries DCM3220 3U low latency digital transceiver from Mercury Systems has high spectral processing density, and integrated FPGA processing for system security engineering, and is coherent and spectrally pure for electronic warfare (EW) applications.

The TRM Custom 10-Way Power Divider from TRM Microwave is a high-power device, 140 Watts CW at UHF frequencies with tight amplitude and phase tracking requirements.

The Eurofighter Defensive Aids Sub-System (DASS) End-to-End Test (EETE) Suite (AGERD B1162) from Leonardo DRS is an integrated electronic warfare system (EW), with a significant array of antennae for both ESM and ECM functions, with an active missile warning system and RF towed decoys.

The NETernity GBX25 communications switch from Abaco Systems enables users to free-up slot space, power, and cooling resources in existing chassis by using one switch to replace several switch cards while maintaining a range of communication protocols.

The ADSR-4003 advanced data server and recorder from Curtiss-Wright Defense Solutions can host as many as four host cards for custom data acquisition by integrating three independent solid-state recorders with capacity to 256 gigabytes each into a single unit.

The VITA 48.4 liquid flow-through (LFT) rugged ATR platform from Elma Electronic is designed for data rates as fast as 10 gigabits per second, with eight 6U slots on a 1.2-inch pitch. It is designed to accommodate boards requiring VITA 48.4 LFT liquid flow-through cooling.

The 25G SI Probe Card for OpenVPX Backplane Testing from Elma Electronic exhibits a low-loss launch design using a very low loss dielectric material. A successful low loss launch is very good return loss, meaning the design launches with minimal reflections.

The ComSys 5371 rugged Type 7 COM Express CPU from Elma Electronic features an Intel Xeon server-grade processor with high bandwidth network connectivity via 10 Gigabit Ethernet fiber ports along with increased number of PCI Express ports for added I/O expansion potential.

The M3GB 120-volt input rad hard hybrid DC-DC converter from International Rectifier is a radiation-hardened power supply that uses hybrid technology. It is qualified to MIL-PRF-38534 Class K with DLA Standard Microelectronics Drawing (SMD) for use aboard orbiting spacecraft.

The SFM6126 OpenVPX wideband PCI Express switch from Mercury Systems switches the control and expansion planes with a PCI Express architecture that delivers a performance boost to OpenVPX subsystems for contemporary AI and other big-processing algorithms.

The GVDU ground vehicle display unit from Curtiss-Wright Defense Solutions combines military rugged design in a size-, weight-, and power-optimized display with high performance and GVA programmable bezel buttons and video over Ethernet capability based on the MODUK DEF-STAN 00-82.

Industry eyes microwave photonics components for radar and other RF applications

BY **John Keller**

ARLINGTON, Va. — U.S. military RF and microwave experts are reaching out to the microelectronics industry to develop lithium-niobate field-configurable modulator arrays (FCMAs) for point-to-point RF links, RF signal processing, radar, and RF spectrum management.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) opportunity announcement in late June (HR001120S0019-13) for the Field Controllable Modulator Array (FCMA) project.

Although microwave photonics represents an important technology for military applications, the military microwave photonic systems deployed to date repurpose commercial components for military functions.

The most recent developments in

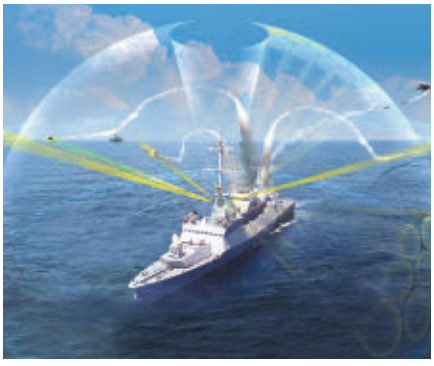
industrial telecommunications have been in specialized application-specific photonic integrated circuits (PICs). Today's military applications cannot use these devices, however, because application-specific PICs cannot be repurposed.

In addition, the volume of military systems is insufficient to support a dedicated PIC infrastructure at a bearable cost. Instead, the FCMA project seeks to solve this problem by developing FCMAs that can be purposed for military and commercial applications.

The FCMA concept is based on electro-optic modulators that can be programmed for different functions. Lithium niobate is considered to be mature, cost-effective, and performs well enough for military applications.

Performers will design, fabricate, and demonstrate an FCMA for electronic protection, signals intelligence, radar beamforming, and communications.

The FCMA must be able to operate from 1 MHz to 18 GHz, and use the nonlinear response of a Mach-Zehnder modulator to suppress a continuous-wave interference signal by 60 decibels to suppress an interference signal with 10 MHz instantaneous bandwidth by 40 decibels — both while reducing the largest intermodulation distortion by 30 decibels.



Future U.S. military RF and microwave applications may use lithium-niobate field-configurable modulator arrays (FCMAs) for point-to-point RF links, RF signal processing, radar, and RF spectrum management.

The signals-intelligence configuration will improve the intrinsic third-order-limited spurious-free dynamic range of a Mach-Zehnder modulator by 10 decibels.

The radar-beamforming application will provide 360 degrees of RF phase shift that can be modulated at 100 kHz. The communications configuration, meanwhile, must support 10 gigabits per second of modulation on each of the in-phase and quadrature components of a lightwave.

Companies selected must demonstrate a complete FCMA design at a lithium-niobate foundry, which the company will identify. If successful, the company will package the FCMA chip in a sealed package. The final prototype will have a permanently attached fiber-optic input and output, with permanently attached RF and control connectors applied to the electrodes.

Companies were asked to submit full proposals by 10 Aug. 2020. More information is online at https://beta.sam.gov/opp/985131830e8f4e96b0efde5eccf82ee4/view.

General Dynamics to procure active-protection sensors and vetronics for Army tanks

BY **John Keller**

WARREN, Mich. — Armored combat vehicle experts at General Dynamics Corp. will integrate active protection sensors to shield the Army's fleet of M1A2 Abrams main battle tanks from rocket-propelled grenades, anti-tank guided missiles, and similar threats.

Officials of the U.S. Army Contracting Command at Detroit Arsenal in Warren, Mich., have announced a $44.4 million order to General Dynamics Land Systems in Sterling Heights, Mich., to procure improved fire control electronics units for the Trophy expedited active protection system aboard M1A2 Abrams tanks.

General Dynamics is working with the Leonardo DRS Land Systems segment in St. Louis to procure the Trophy active-protection system for the Abrams tank. DRS is adapting technology developed by Rafael Advanced Defense Systems Ltd. in Haifa, Israel, to help shield M1A2 Abrams main battle tanks from rocket-propelled grenades and anti-tank guided missiles.

DRS and Rafael are adapting the Rafael Trophy active protection system to the M1A2 Abrams tank. Rafael developed Trophy together with the Elta Group of Israel Aerospace Industries Ltd. in Ashdod, Israel. The Trophy system intercepts and destroys incoming missiles and rockets with a shotgun-like blast.

Trophy vetronics is designed to

locate and destroy incoming enemy fire instantly using a 360-degree radar, processor, and on-board computer. It can locate, track, and destroy approaching anti-tank-guided-missiles, rocket-propelled grenades, or similar anti-armor weapons by launching a countermeasure to detonate the incoming munition away from the vehicle.

The interceptor uses small shaped charges attached to a gimbal on top of the vehicle. The small explosives fire to a point in space to intercept and destroy the approaching round. Trophy locates and identifies incoming threats with radar that scans the tank's perimeter out to a known range. The on-board computer determines the optimal kill point for any incoming threat.

Trophy has been used in combat on Israeli Merkava tanks. In addition to locating and destroying incoming missiles and rocket-propelled grenades, the system also can locate and cue weapons to the positions enemy shooters.

The Trophy vetronics system will protect U.S. main battle tanks from rocket-propelled grenades, anti-tank guided missiles, and similar anti-armor threats.

The DRS-Rafael Trophy system can defeat known anti-armor shaped-charge weapons, like missiles, rockets, and tank-fired high-explosive anti-tank shells before they strike the tank.

The system enables networked threat awareness by pinpointing and reporting shooter location improves platform protection with low risk of collateral injury, and can ensure freedom of movement and maneuver, DRS officials say. On this order General Dynamics will do the work in Tallahassee, Fla., and should be finished by October 2022.

For more information contact General Dynamics Land Systems online at www.gd.com, Leonardo DRS Land Systems at www.leonardodrs.com, Rafael Advanced Defense Systems at www.rafael.co.il, or the Army Contracting Command-Detroit Arsenal at https://acc.army.mil/contractingcenters/acc-dta.

Vricon combines stereophotogrammetry and big data processing to produce its 3D models-like this one of Las Vegas, using real textures and 3-meter absolute accuracy in all dimensions.

Simulation and mission rehearsal relies on state-of-the-art computing

Artificial intelligence (AI), machine learning, and virtual reality are becoming essential parts of today's military simulation and mission rehearsal to keep warfighters on the cutting edge.

BY **J.R. Wilson**

Simulation has been an integral part of military training since the first humans banded together, brandishing rocks and clubs, to defend against or attack other groups, probably between 12,000 and 15,000 years ago. Smaller, lighter sticks helped young warriors-in-training learn the basics before they tried using real weapons. Metal swords saw the introduction of wooden swords, just as wooden rifles helped recruits become familiar with firearms centuries later.

The 20th century's great technological advances in weaponry, like airplanes and tanks, led to the introduction of more advanced, technology-based simulation, along with mission rehearsal exercises using combat radios and other devices, real and simulated, giving warfighters the opportunity to use those technologies, often for the first time, in a combat scenario.

Rapid advances throughout the last century, especially in computing speed and capabilities, improved real-time sensor data, significantly improved and individualized communications, long-range intelligence, and surveillance and reconnaissance (ISR) were matched by equally advanced combat simulation and mission rehearsal. Before deployment to Southwest Asia, U.S. troops spent weeks at simulation-supported training bases in Cali-

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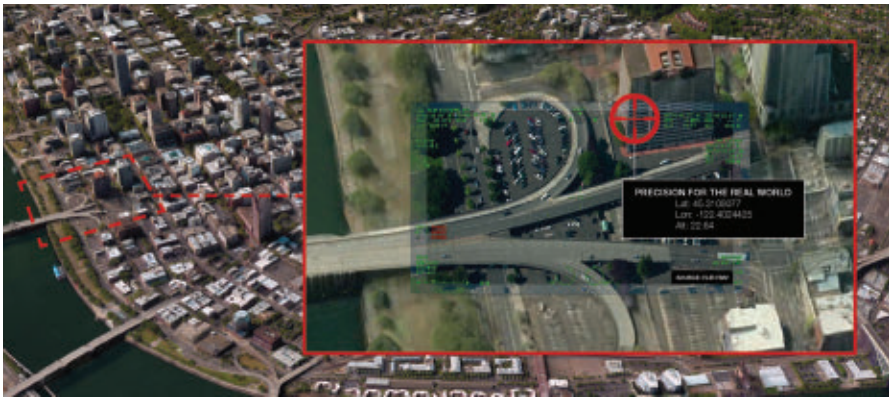
Ocean-going ship bridges are large and complex. To train bridge crews, simulators must equal their size and complexity, as demonstrated by this bridge crew simulator at the Philippines' United Marine Training Center.

fornia, North Carolina, Louisiana, and other states.

For many, simulation reached its zenith with the six-degree of freedom, full-motion dome flight simulator, which gives new and veteran pilots the feel, visuals and real hardware of a combat aircraft in flight. When linked to others — from desktop simulators to actual aircraft flying over a training range — it offered the most intense and comprehensive ground-based training and mission-rehearsal environments.

There are drawbacks, however. The domes are huge, meaning they have to be housed permanently at specific bases. They also are expensive, complex, and require a high level of maintenance oversight and work — sometimes more than the aircraft they simulate.

In its first two decades, the 21st century already has seen more technological advances — and glimpses of even greater leaps still in development — than any other period in history. Imperatives for rapid development and deployment is moving those from lab to battlefield seemingly overnight. Training has required cutting edge technologies to ensure warfighters not only receive training on new weapons and technologies in the continental U.S., but also training that is mobile enough to accompany them on deployment.



The Vricon P3DR can georegister full-motion video, providing accurate coordinates, even on the sides of buildings.

"The first headsets came out eight years ago, but in the past year have reached a level of resolution where they can seriously replace the visual system on many trainers," says Phil Perey, head of technology at CAE Defence & Security in Saint-Laurent, Quebec. "That makes them much more compact and enables training in the field you couldn't do with a big trainer on six motion jacks. Another advance has been data analytics and machine learning, which are revolutionizing much deeper insights into how students improve their training performance. By analyzing hundreds of maneuvers, it can help instructors identify underlying weaknesses that may not have been identified before.

Cloud computing

Cloud computing also plays a role in today's simulation and mission rehearsal. "Cloud computing has really come of age now where the infrastructure the tech giants are providing means you can migrate an entire environment in the cloud," Perey continues. "Cloud computing enables us to scale the number of entities and interactions, which could not have been done before for a single training device. It also gives you a direct access. Passive and real-time simulation can create an environment for commanders and a 'what if' scenario, giving them access to make the best and most informed decisions."

Fortunately, as many older officers and senior enlisted military personnel have noted, today's young warfighters grew up surrounded by constantly

changing and advancing technologies, making them far more adaptable to and acceptable of new systems than might otherwise be the case. Nonetheless, they still must be trained with simulators and exercise their new skills with cutting-edge mission rehearsal.

Even for a tech-savvy generation, however, rapid advances in simulation and mission rehearsal can overwhelm student warfighters, leading to another set of requirements and cutting-edge developments, part high-tech, part advanced medical understanding of the human brain and sensory organs.

The next five years will see major advances in simulation and mission rehearsal, just short of "plugging a cord right into your brain," says Peter Fedak, contractor of flying training and support site manager for KF Aerospace in Kelowna, British Columbia.

"The visuals and processing power of the equipment is reaching the point where the human eye and brain can't absorb a lot more," Fedak says. "How do you process terabytes of data being generated by each student and compare that to the global database, then model the DNA? The training tools are more than adequate to do that, but now it is about adapting that, aligning it to make sure each student is getting back the information they need when they need it," he says.

"Whether it is 4k or 8k visuals, the eye can't pick it all up, anyway, so the real question is how you work with the tools you have now," Fedak continues. "We're looking at eye-tracking and emotional tracking, where the cameras watch your face and determine when you are stressed and use analytics to determine what is causing that stress. It's more looking at the human aspect, how the human interfaces with all the technology."

Advanced weapons, especially semi- or fully autonomous, are likely to have two major influences on humans in uniform — fewer people will be necessary, especially in the battlespace, and those who remain will have to receive intense training unprecedented in military history. As the military becomes more and more reliant on AI-driven simulations, with increasingly realistic sounds and visuals, systems designers must take care to ensure that these devices do not give trainees a false impression of reality.

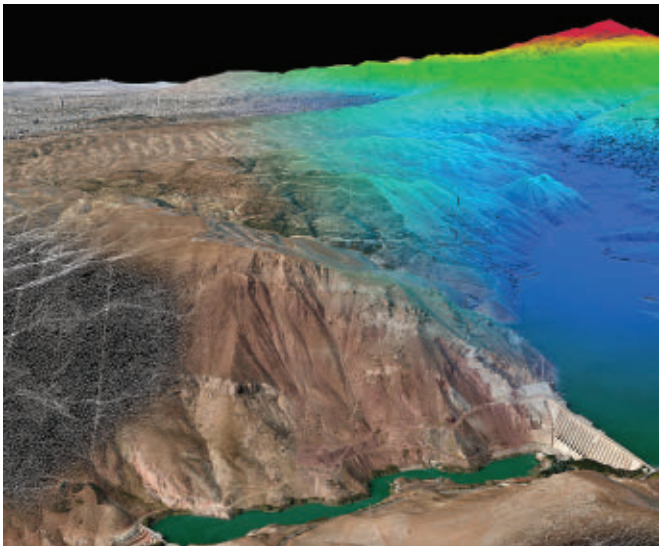
Simulation across the military

Simulation and mission rehearsal are not limited to weapons and platforms, but cover the entire spectrum of military activities — communications, logistics, tactical data links, and battlefield medicine — all of which must be part of any realistic training environment. Those at the heart of bringing emerging technologies out of the lab and onto the battlefield often disagree.

"AI is not ready for this field yet; it still has a long way to go before it becomes intelligent. There's no room for guesswork when talking about tactical data links," says Brian Bass, director of operational support at the Curtiss-Wright Corp. Tactical Communications Group segment in Tewksbury, Mass. Nonetheless, he says he sees a need and a future for AI as the technology matures. "In many of the scenarios in which we participate, our adversaries are cuffed — held to what we know about them. But they could do something different in reality.

"In simulation and mission rehearsal, it would be better to train our troops to face the unexpected," Bass continues. "Advanced systems could come up with new possibilities in a shorter period of time — and hopefully at lower cost. AI will multiply the speed at which those things happen, creating a lot of scenarios we might not think of so quickly."

Military radios most likely will play a big role in future simulation and mission rehearsal. "The primary goal of tactical data links is giving anybody with a tactical radio the ability to receive the information they need, in the format they expect, in near-real time," Bass says. "We would schedule advances in simulations in closer proximity instead of spacing them out. If we need to stress a system or operator, we can transmit a future event at a different time. We currently do not have any AI tool to assist the operator in making those decisions."



This image shows a 3D model of the area outside Tehran, Iran. The image fades to the Vricon 3D Surface Model, the core output.

Growing importance

Cutting-edge simulation and mission rehearsal are of growing importance to all of the nation's military services, including its joint commands, such as the Special Operations Command (SOCOM). SOCOM representatives highlighted the application of emerging technologies to unique SOF mission training sets at the annual Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) in Orlando, Fla., in December 2019.

"SOCOM is focused on addressing defense and security threats and challenges from emerging great power competitors as well as terrorists and violent extremist organizations, as has been identified in the 2018 National Defense Strategy," Army Maj. Gen. Robert Karmazin, Director, J-7/9, Directorate of Training, Doctrine and Capability Development, told a presentation of the SOF Simulation Technologies Capability Assessment Event.

"To help enable our objectives, SOCOM needs to expand the use of transformative technologies. For mission preparedness, virtual reality, augmented reality, mixed reality, AI machine learning capabilities are absolutely paramount."

Randy Jackson, chief of mission preparation, J3 Training and Education, explained the extent of emerging technologies on SOCOM's overall training, mission rehearsal and operational future.

"The use of advanced technologies should help prepare SOF for what lies ahead. They will increase cognition, optimize human materiel performance, reduce operational risk and better enable SOF adaptation for a variety of situations," he said. "We must harness these ideas, leverage capability, share information, capture the good, smell the bad, navigate data, transfer knowledge, fuse networks, bolster cyber security and increase interoperability — again to reduce risk, save time, increase cognitive learning and truly change the way we do business."

Throughout most of the 20th century, cutting-edge and transformative technologies were driven by the government, which had specific requirements needed to keep the United States in the global technology lead, a position it assumed at the end of World War II. But increasingly higher research costs to meet increasingly small, military-specific

needs made it more and more difficult for industry to recover costs from the Pentagon alone.

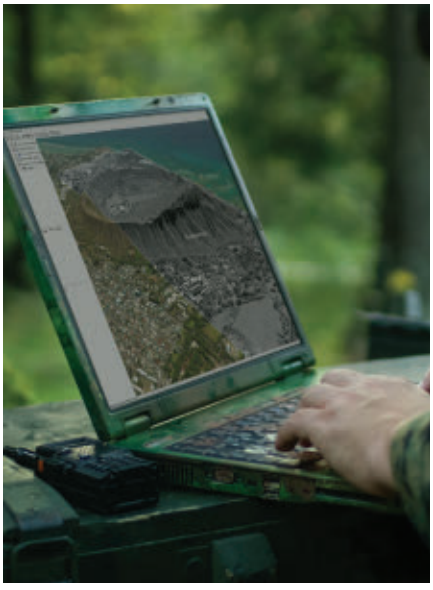
Commercial technology

Commercial developers brought in more academic researchers to provide new ideas and speed the development process, leading to new generations of technology evolving far faster than traditional U.S. Department of Defense (DOD) acquisition processes could follow. By 2020, cutting-edge and emerging technologies aimed at simulation and mission rehearsal had even larger customer bases in the gaming, automotive, communications, and other civilian areas than DOD could muster.

"In different ways, all three [government, industry, academia] are driving portions of this transformation, almost a renaissance," says Isaac Zaworski, CEO of 3D graphics specialist Vricon in McLean, Va. "The government side has some of the very large service models looking at how training and mission rehearsal are conducted, focusing on leveraging commercial technologies to provide timelines that allow soldiers to train more frequently and connect the dots between synthetic environments and simulation to train like they fight. That has traditionally been cost prohibitive or the tech just wasn't there.

"With advances in commercial technology and remote sensing in the geospatial community, you can achieve that mission today. You have a confluence of advances with what is coming out of the computing world — large scale processing, cloud computing, gaming world 3D rendering, on top of the image generators," Zaworski says. "That combination is driving a massive amount of innovation in a very short time. On the academic side, you have organizations such as the University of Southern California bridging the gap between government and industry on technologies being developed for mission rehearsal, for example. Those require real-world accuracy unique to that community."

Vricon is working with the Army on elements of the Synthetic Training Environment (STE), a 3D training and mission-rehearsal tool combining live, virtual, constructive, and gaming environments for soldier and unit readiness. Vricon's focus is on STE's One World Terrain (OWT) component, an accessible 3D representation of the global operating environment.



The Vricon VP3DR 3D model has 3-meter absolute accuracy in all dimensions.

The Vricon Precision 3D Registration (P3DR) georegisters sensor data with a 3D model in real time to measure coordinates without the need for ground-control points.

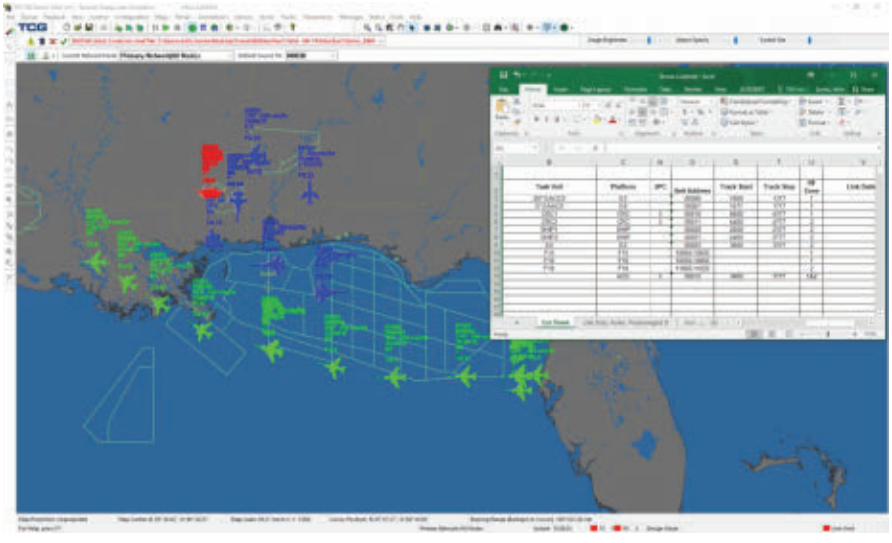
In its winning proposal, Vricon officials said rather than trying to bring together incomplete and misaligned data sets from different sources, their company would create a foundation built from high-resolution 3D data already collected and establish a single data standard as the interface for OWT. The goal, Zaworski says, is to make it through a successful operational test at STE initial operating capability, scheduled for September 2021.

Tough definitions

Many experts have a hard time defining the current state of the art in simulation and mission rehearsal or forecasting what will be emerging from research labs in the near-term, much less in 10 or 20 years. They point to programs such as the Army's Integrated Visual Augmentation System (IVAS) as driving the bleeding edge of commercial augmented reality and the military's synthetic training environment into military modeling and simulation problem sets.

"That's where you're really starting to see true demonstrations of using these technologies in an organized way to accomplish mission rehearsal objectives," says Vricon's Zaworski. "When it comes to simulation and mission rehearsal, it's all about being able to bring, in a very agile way, these different segments together at program levels to implement capabilities that can be scaled largely across very large, service-level problem sets.

"Even five years ago, the mission-rehearsal world was largely relegated to the very tip of the spear, with tightly integrated, often heavily proprietary systems supporting that use case," Zaworski continues. "Now there is a recognition that to scale these technologies, government needs to partner with industry for structure and implementation."



This screenshot represents a TCG BOSS/GTS scenario from the Curtiss-Wright Corp. Tactical Communications Group.

Advancing technologies have changed the nature of simulation for training and mission rehearsal significantly, moving from large platforms and projection screens to virtual reality and augmented reality headsets. The key, however, is creating ever-more realistic visuals — without the nausea and disorientation of earlier efforts. Gone forever are displays where green cones represented trees, although Star Trek-like holograms, while perhaps the ultimate desirable goal, remain unlikely.

Advanced image generators

A high-fidelity, immersive simulated environment happens by using advanced image generator systems and high-density databases to create the appearance of a live-action picture in the trainee's helmet-mounted display. Adding 3D sound, haptic feedback, and full-body sensation via combat training suits make the virtual world more realistic, but emerging technologies are expected to advance training and mission rehearsal through the next decade well beyond the state of the art of the last decade.

"Users continue to look for better image quality and more realism," says Andrew Fernie, senior technical fellow at CAE Defence & Security. "Each person evaluating a visual system makes a comparison, consciously or unconsciously, against what they see with their own eyes in the real world. And no matter how far industry has come, we still have work to do to satisfy that test of making the synthetic environment more like the real world."

"Improvements in resolution, density of the content and the fidelity of special effects will contribute to meeting expectations — and will require work on all aspects of the visual system: database content, image generator and display system. At the same time, however, we are expected to reduce the life cycle costs associated with the visual system," Fernie says.

Data collection has grown dramatically in the past five years, from military unmanned aerial vehicles (UAVs) to civilian self-driving cars equipped with cameras and other sensors. In the next five years, a lot of effort will go into developing ways to link that raw data, in near-real time, into a reference frame of the 3D world in which we live,

organizing it to power the simulation component of simulation training and mission rehearsal.

"Simulation requires a whole lot of knowledge about the digital world, very early constructions of transportation systems, the interiors of buildings and how we as people interact with those structures," says Vricon's Zaworski. "How do you use modern computer technology and machine learning to take satellite and drone imagery and rapidly and accurately correlate all that in near-real time? In the next five years, we will see a greater ability to build out the interior and underground elements.

"There also will be massive progress on the end user hardware side — integrating visual systems to allow people to interact with this data in ways we've never been able to before," Zaworski continues. "You will see a host of other applications start to emerge, where we take the incredible investment in the commercial market into virtual reality and mixed reality headsets and impact the modeling and simulation world to leverage the latest and greatest of hardware tech with the core data underneath that is a living, breathing version of the planet, at human scale, to support mission rehearsal."

Cyber security

As new and more advanced commercial technologies adapt to military use — especially making deployed simulation and mission rehearsal more aligned to the real world in near-real time — equally significant advances in hacking and code-breaking technologies raise cyber security issues to new highs. AI and quantum computing for simulation training and mission rehearsal close to or within a battlespace would provide an enemy with invaluable up-to-date information of U.S. capabilities, and logistics.

"The closer you push for mission rehearsal and high fidelity, the higher the need for protection. To practice team training, you need to share classified information over a network, so it is important the construction, the cyber security access, is very high so you don't compromise the technology or the system," says Lenny Genna, president of the military training sector at L-3 Harris Technologies in Arlington, Texas.

"Whether someone is stealing it or hacking into it to try to change it, the security is the same," Genna says. "You build in anti-tamper plans so they can't be messed with. The fidelity you want and access to the cloud requires working through the ability to have it secure no matter where it is. I think we now have worked it out so the students have a device that is not classified but connects to classified data once hooked up to the cloud."

With the quality and affordability of virtual, augmented and mixed reality technologies essential to military readiness, Lockheed Martin Corp. has identified three current and evolving technologies for simulation training and mission rehearsal. According to the company:

Evolving technologies

1 — augmented reality and on-demand training

Warfighters need mission rehearsal tech at their fingertips. Simulation combined with augmented reality glasses provide a new tool to conduct maintenance on critical warfighting platforms at the point of need.

2 — virtual reality and multi-domain training

In the multi-domain battlespace, systems are connected and integrated. F-35 Lightning II simulators network with other systems to provide a train-as-you-fight virtual environment. The vision is to integrate simulators on the ground with aircraft flying and virtual friendly or foe forces to make the training environment realistic to the max.

This photo shows a simulation and mission rehearsal system for the Bell CH-146 Griffon multi-role utility helicopter, a variant of the Bell 412EP for the Canadian Armed Forces.

3 — mixed reality and turn-key training

Military training is about people, not just tech. Traditional approaches focus on delivering training tools and devices, but today's militaries are taking a more innovative approach to provide the shortest path to learning. Turn-key training programs provide every element needed to prepare military personnel in one integrated system, including simulators and aircraft, resulting in increased skill sets, shorter training times and lower training costs.

Simulation training and deployable mission rehearsal are becoming increasingly important and valuable parts of military readiness, enabling effective training on difficult and complex scenarios, especially when using new and advanced equipment.

"The flexibility of procedural training systems allows students to become proficient in a wider range of emergency and hazardous scenarios that would be impractical or dangerous to train under real conditions. We believe the use of simulation training will become more and more central to the training of military personnel and, as technology continues to evolve, the gap in fidelity between the simulation and reality will continue to close," predicts Ian Cox, head of training and simulation at Systems Engineering & Assessment Ltd. (SEA) in Beckington, England.

WHO'S WHO IN SIMULATION AND MISSION REHEARSAL

CAE Defence & Security
Saint-Laurent, Quebec
https://www.cae.com

Curtiss-Wright Corp. Tactical Communications Group
Tewksbury, Mass.
http://www.g2tcg.com

L3Harris Technologies Military Training sector
Arlington, Texas
https://www.l3t.com/link

KF Aerospace
Kelowna, British Columbia
https://www.kfaero.ca

Systems Engineering & Assessment Ltd. (SEA)
Beckington, England
https://www.sea.co.uk

U.S. Special Operations Command (SOCOM)
MacDill Air Force Base, Fla.
https://www.socom.mil

Vricon
McLean, Va.
https://www.vricon.com

When high-performance embedded computing meets open-systems standards

SOSA, HOST, MOSA, VITA, and a host of other new and emerging open-systems industry standards are coming to bear on the most performance-demanding aerospace and defense applications.

BY **Jamie Whitney**

When it comes to aerospace and defense embedded computing systems, open standards continue to hold a firm place in development and deployment. These include Sensor Open Systems Architecture (SOSA), VITA, Hardware Open Systems Technologies (HOST), and Modular Open Systems Approach (MOSA).

The emerging SOSA standard, overseen by The Open Group in San Francisco, aims to enable military embedded designers to create new systems and make significant upgrades to existing systems much quicker than today's technologies allow.

MOSA, as the name implies, focuses on modular approaches between systems, components, and platforms, and, like SOSA, aims to lower costs and allow the rapid deployment of new technology.

HOST uses commercial off-the-shelf (COTS) components in a small form factor, like VITA's OpenVPX standard.

Justin Moll, vice president of sales and marketing at Pixus Technologies Inc. in Waterloo, Ontario, says that he is seeing a pair of trends in enclosed, embedded systems - the first is that the sector is being driven by SOSA and HOST.

"The backplanes for these systems typically require VITA 66 (optical) and VITA 67 (radio frequency) housings on the backplane PCB," Moll says. "There is also a timing slot with routing implementations supporting the clocks and system management across the OpenVPX backplane. The speeds of the backplanes are also increasing to offer 40 Gigabit Ethernet speeds and even PCI Express Gen4 (16 gigabits per second) and 100 Gigabit Ethernet requirements. With higher power demands, advanced thermal management solutions are often required. The PSUs in the SOSA-based enclosures have shifted to 12-volt heavy versions. These enclosure systems also typically require a VPX Chassis manager.

"The second trend is the adoption of SpaceVPX and larger form factor OpenVPX boards," Moll continues. "The VITA 78 spec provides the option for 6U x 220 millimeters versus the standard 160 millimeters deep OpenVPX boards. The spec also provides for redundancy of the PSUs. Aside from SpaceVPX, many customers are using larger-form-factor boards to support their components and devices. Therefore, providing a deeper enclosure than the typical 160 millimeters is not uncommon as well as a wider than usual slot pitch."

SpaceVPX aims to address interoperability like OpenVPX does, except its focus is, as its name suggests, space applications. SpaceVPX defines payload, switch, controller, and backplane module profiles.

Mercury's EnsembleSeries HDS6605 6U OpenVPX blade server offers hardware-enabled support for artificial intelligence (AI) applications.

This summer, Pixus announced the release of a development chassis that supports board depths of 160 millimeters for OpenVPX and 220 millimeters for SpaceVPX.

The open-frame chassis features as many as four slots at 1-inch pitch for each board depth type. The modular enclosure allows various board pitches to be used at 0.2-inch increments. Card guides to support air- and conduction-cooled boards are standard. There also are 220-millimeter-deep card guides that are wide enough to support extra-thick SpaceVPX conduction-cooled boards per the VITA 78 open-systems industry standard.

The Mercury Systems GSC6204 OpenVPX 6U NVIDIA Turing architecture-based GPU co-processing engine provides accelerated high-performance computing capabilities to commercial aerospace and defense applications.

Beyond open

In addition to open standards like VITA and MOSA, experts at Curtiss-Wright Defense Solutions in Ashburn, Va., say that 2017's "Third Offset" strategy introduced by then-Secretary of Defense Ashton Carter continues to drive trends in embedded systems.

The Third Offset strategy aims to use technology to win and deter military conflicts while acknowledging that other world powers are catching up to American technical superiority. Open standards are key to update embedded systems used by the American military quickly and affordably.

"A big part of that strategy is very much the go get it to field, and get it the field quickly," says David Jedynak, Curtiss-Wright's chief technology officer of technological improvements. "We're really enforcing the open standards. The lines are cleaner. Build it such a way that you don't have

Curtiss-Wright's rugged VPX3-4925, VPX3-4935 (pictured above), and VPX6-4955 modules are designed to support compute-intensive ISR and EW systems.

to tear it apart to upgrade it. With those top-level trends, we're seeing faster data communication - the speed of the Ethernet is going up to 100 gigabits."

Jedynak says that because new and better components can slot in and slot out, the lifespan of embedded technologies is longer than in years previous.

"Some of the old way of doing things is sometimes akin to tearing down an office building and rebuilding it with all new everything, just because you need to upgrade the printer," Jedynak jokes. "That's not the right way to do it. It would be better if you knew that I've got an infrastructure in the building that allows me to yank that printer off with another one on another and take it away."

Automated systems

Jedynak says that the holistic view of capabilities brought on by the Third Offset strategy enables systems to power smart, autonomous, or remotely piloted technologies, and is also helping to drive development in embedded systems.

"Autonomy is very hot — optionally-manned or automated systems," Jedynak says. "Intelligently finding ways to take systems ... and turn it into something that is autonomous or at least remote controlled. What sensors do we need, what processors do we need? Machine learning — how do you make a platform smarter? At the end of the day, they're applications that will make things better. How do we use the 'smarts' on the platform in a way that reduces warfighter burden? Think like Iron Man and "JARVIS" where there's a lot of data coming in and it is triaged and the right information is at your fingertips."

While SOSA and similar open standards allow for manufacturer-agnostic embedded systems for the military, Jedynak says that those standards are not hampering innovation in the industry.

"It's not just a good idea; now it is what they're supposed to be doing," Jedynak says of open standards. "It's a good thing for everybody around. You have to think a little harder when it comes to proprietary (designs), unique advantages. I used the metaphor that every automobile manufacturer doesn't have their own custom roads out there, right? There's a lot of room for automobile manufacturers to innovate. There's something that makes sense to do completely on your own — you don't need to have proprietary form factors and pin outs if your job is really about adding compute capability, right? For the most part, we need to focus on innovating on the performance."

Eyes on performance

Experts at Mercury Systems in Andover, Mass., say they have spent more than a year powering-up their company's approach to OpenVPX bus-and-board embedded systems by focusing on performance.

"What we've done over the past 12 to 18 months at Mercury is take a somewhat new approach to the whole world of OpenVPX," says Shaun McQuaid, Mercury's product manager of embedded computing. "And really what it comes down to is leveraging from data center architectures, doing it in a way that's still fully compatible with the kind of OpenVPX so it is an open architecture approach.

"So just as an example, if you think about the way that data centers operate, they're dealing with big data problems," McQuaid continues. "They have large data sets they have to manage. They have significant context switches. They're doing different tasks at different times. They're dealing with different programs and different processes over time and of course, their security concerns that come along with all of that. What we've tried to do...is take that data center architecture and deploy it."

McQuaid says the shift to data center-powered embedded systems results in a "big data problem."

"So what we're talking about doing is leveraging that big data architecture out of the commercial world, out of the data center and building all of those same building blocks into OpenVPX and then building subsystems where we

tie those together and are in an architecture that's identical to the way the data center does business," McQuaid says, noting that security and infrastructure make it impossible for forward-deployed warfighters to leverage commercial data processing centers like Amazon Web Services or Microsoft's Azure. "And so what we're doing is bringing that data center processing to the platform itself and doing it in an open-architecture friendly manner so that it can be easily refreshed over time."

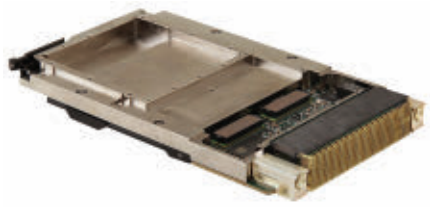
This summer, Mercury Systems announced the GSC6204 OpenVPX 6U NVIDIA Turing architecture-based GPU co-processing engine which aims at tackling compute-intensive tasks like artificial intelligence (AI), radar, electro-optical and infrared imagery, cognitive electronic warfare (EW), and sensor fusion applications that require high-performance computing capabilities closer to the sensor for effectiveness.

The module is powered by dual NVIDIA Quadro TU104 processors and incorporates NVIDIA's NVLink high-speed direct GPU-to-GPU interconnect technology, and Mercury says it brings high-level parallel processing capability out of the data center.

The Curtiss-Wright VME-1910 features Intel's 6-core hyper-threading Intel 8th Gen "Coffee Lake" E-2176M Xeon processor with integrated graphics and supports today's latest software and security advances.

Deployable AI

Curtiss-Wright Defense Solutions announced reseller agreement with Wolf Advanced Technology in Stouffville, Ontario last December to



The Curtiss-Wright CHAMP-XD1S high-performance 3U OpenVPX digital signal processor (DSP) engine is a multi-core High Performance Embedded Computing (HPEC) module with advanced security features.

WHO'S WHO IN BUS AND BOARD EMBEDDED COMPUTING

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

Elma Electronic Inc.
Fremont, Calif.
www.elma.com

ECS Case
Grants Pass, Ore.
www.ecscase.com

Extreme Engineering Solutions (X-ES)
Verona, Wis.
www.xes-inc.com

FiberQA
Old Lyme, Conn.
https://www.fiberqa.com

Finisar Corp.
Sunnyvale, Calif.
www.finisar.com

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

Pentek Inc.
Upper Saddle River, N.J.
www.pentek.com

Pixus Technologies
Waterloo, Ontario
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

Wolf Advanced Technology
Stouffville, Ontario
https://wolfadvancedtechnology.com

Pixus Technologies has released an OpenVPX chassis platform that supports both 160 millimeters deep (standard OpenVPX) and 220 millimeters deep (SpaceVPX) boards.

expand open-architecture high-performance embedded computing (HPEC) processors designed for demanding intelligence, surveillance, and reconnaissance (ISR) applications with the addition of three NVIDIA Quadro Turing (TU104/6) GPU/inference engine-based OpenVPX module with its VPX3-4925, VPX3-4935, and VPX6-4955 modules.

The VPX3-4925 module is a 3U OpenVPX GPGPU processor and features a NVIDIA Quadro Turing TU106 GPU that delivers 6.4 TFLOPS/TIPS performance. It provides 2304 CUDA cores, 288 Tensor Cores and 36 ray-tracing (RT) cores. For higher performance in size, weight, and power (SWaP)-constrained applications, the 3U VPX3-4935 module features a NVIDIA Quadro Turing TU104 GPU that delivers 11.2 TFLOPS/TIPS. The VPX3-4935's higher core count includes 3072 CUDA Cores, 384 Tensor Cores, and 48 RT Cores. For more demanding applications, the 6U form factor VPX6-4955 (6144 CUDA cores, 768 Tensor Cores, 96 RT Cores) hosts dual TU104 GPUs for 22 TFLOPS/TIPS performance.

Mercury Systems also has its eyes on AI with its EnsembleSeries HDS6605 general-purpose processing 6U OpenVPX blade server with hardware-enabled support for artificial intelligence applications.

"With the new second generation Intel Xeon Scalable processors, Mercury's OpenVPX blade servers deliver a huge boost to the industry's ability to embed the big data processing capability required for new, smarter and autonomous military missions," says Joe Plunkett, Mercury's senior director and general manager for sensor processing solutions. "This next-generation compute capability delivers enhanced performance and power optimized for modern AI applications which enable our customers to take data center processing capability all the way to the tactical edge."

The Intel second-generation Xeon scalable processors feature Intel Deep Learning Boost, which extends Intel Advanced Vector Extensions-512 to accelerate inference applications like speech recognition, image recognition, language translation, and object detection. Its new set of embedded accelerators — Vector Neural Network Instructions speed up dense computations characteristic of convolutional neural networks (CNNs) and deep neural networks (DNNs), delivering up to a 14-times improvement in inference performance compared to the first-generation Intel Xeon Scalable processor. Along with increased scalability via ultrapath interconnect (UPI), each blade provides up to 22 cores from a single 1.9GHz device, delivering 2.6 TFLOPS of general-purpose processing power.

Military researchers are considering enhancements to the performance of atomic vapors for electric field sensing for electronic warfare and anti-submarine warfare.

Researchers eye new enabling technologies for electric field sensing

BY **John Keller**

ARLINGTON, Va. — U.S. military scientists are reaching out to industry for enabling technologies to advance the performance of atomic vapors for electric field sensing for applications ranging from airborne electronic warfare (EW) to naval anti-submarine warfare (ASW).

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a broad agency announcement in August (HR001120S0062) for the Science of Atomic Vapors for New Technologies (SAVaNT) project.

DARPA researchers are looking for high-performance atomic vapors for electric field sensing and imaging, magnetic field sensing, and quantum information science (QIS).

Atoms are constants of nature; they are not subject to manufacturing variabilities, defects, impurities, or aging, which makes them suitable for precision measurements, DARPA researchers explain.

One example involves atomic clocks, which are accurate to a fraction of a second over the age of the universe. Still, such high-precision quantum devices typically require laser-cooled and trapped atoms kept at microKelvin temperatures to mitigate thermal noise effects. This means laboratory-scale expansive setups.

Yet vapor-based technologies operate at or near room temperature without complex laser cooling and trapping, but still offer the advantages of the pristine nature of atoms.

The ability to manipulate atoms with light has advanced tremendously over the past couple of decades, and includes powerful quantum methods like electromagnetically induced transparency and spin exchange relaxation-free (SERF) magnetometry.

Scientists have used atomic vapors like Rydberg electrometry and SERF magnetometry for quantum information systems, and it may be possible to achieve additional significant breakthroughs in vapor-based devices.

The DARPA SAVaNT program aims to develop techniques to mitigate main

decoherence mechanisms to realize the full potential of atomic vapor based technologies. The program has three technical areas based on applications where atomic vapors should have the biggest benefit: Rydberg electrometry; vector magnetometry; and vapor quantum electrodynamics (VQED).

SAVaNT seeks new technologies for important military needs like low size, weight and power (SWaP), high-sensitivity electric and magnetic field measurements, and application that require scalable room-temperature quantum memories and interfaces. A common scientific challenge will be to improve atomic coherence in vapors, and will depend on dominant decoherence mechanisms.

SAVaNT will be a four-year program in two phases and three technical areas. The first phase focuses on demonstrating the physics of Rydberg electrometry; vector magnetometry; and vapor quantum electrodynamics.

The second phase will demonstrate an integrated benchtop physics package, and characterize technology tradeoffs of Rydberg electrometry; vector magnetometry; and vapor quantum electrodynamics.

Rydberg electrometry uses atoms to sense electric fields, and has notable advantages over antennas, such as extremely large operational bandwidth accessible with one device; potential for high sensitivity; and self-calibration. The focus is on improving sensitivity and instantaneous bandwidth of Rydberg electrometry.

Vapor magnetometers demonstrate one of the highest scalar magnetic field sensitivities of any device, yet it requires expansive magnetic shielding and complex active cancellation of ambient magnetic fields. The focus is on achieving vapor-based vector magnetometry of quasi-DC fields ranging from 100 Hz to 1 MHz with high sensitivity and accuracy in a small package.

Vapor quantum electrodynamics, meanwhile, seeks to demonstrate a room-temperature, vapor-based quantum electrodynamics platform in the strong-coupling regime.

Companies interested were asked to upload abstracts by 11 Sept. 2020, and full proposals no later than 27 Oct. 2020 to the DARPA BAA website at https://baa.darpa.mil. Email questions or concerns to Tatjana Curcic, the DARPA SAVaNT program manager, at SAVaNT@darpa.mil. More information is online at https://beta.sam.gov/opp/f66cc4e7b5cf4d28b5ec9977d87448a4/view.

Looking to Earth's magnetic fields for reliable navigation in GPS-denied environments

Military leaders have been warning of the fragility of the satellite-based Global Positioning System (GPS) for years and researchers have been working on ranging from quantum clocks to inertial navigation. The U.S. Air Force is adding a new one, using the Earth's magnetic fields as a secure way to detect location for aircraft and possibly other vehicles. Magnetic fields emanating from the earth's surface vary in intensity, just like topography, and so-called magnetic anomaly maps of those fields have existed for years. Back in 2017, Aaron Canciani, an assistant professor of electrical engineering at the Air Force Institute of Technology at Wright-Patterson Air Force Base, Ohio, set out to see if magnetic sensors (magnetometers) affixed to aircraft could measure the intensity of those magnetic fields and, thus, locate the plane based on where it was in relation to those landmarks. His paper shows how to outfit a Cessna light general-aviation aircraft with magnetometers in the rear and the front. Forty flight-hours worth of navigation data and a lot of work reducing noise from the readings proved the idea viable.

Lockheed Martin eyes military 5G networking and reimbursements for company research

The new CEO of Lockheed Martin Corp. wants to help build 5G networking that the Pentagon can use to connect all its weapons and retain military advantage over China. Jim Taiclet doesn't unveil many details, but the former telecommunications executive says he wants the firm to adopt "tech industry practices and maybe some new partnerships in technologies," a shift for a company with revenues that turn largely on weapon sales. "I've got an idea called 5G.mil that we're going to try to figure out how to create and really bring that technology ... into our space and drive performance at this company as a result of that," Taiclet says. Taiclet, who spent most of the past two decades as CEO of American Tower, which specializes in wireless communications infrastructure, says the Pentagon needs to incentivize companies to invest in areas like 5G by reimbursing firms for their research and development.

This image depicts the conceptual design for the Skyborg low-cost attritable unmanned combat aerial vehicle.

Four U.S. contractors to build AI-equipped unmanned combat aircraft

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — Four U.S prime defense contractors will share as much as $400 million to develop a prototype low-cost unmanned combat aircraft with artificial intelligence (AI) and modular payloads for a wide variety of fighter and ground-attack capabilities.

Officials of the U.S. Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio in July named the Boeing Co. Defense, Space & Security segment in St. Louis; General Atomics Aeronautical Systems Inc. in Poway, Calif.; the Kratos Defense & Security Solutions Inc. Unmanned Systems segment in Oklahoma City, Okla.; and the Northrop Grumman Corp. Aeronautics segment in Palmdale, Calif., for the Skyborg Vanguard program.

Skyborg will be an unmanned autonomous attritable aircraft to generate massed combat power, and fight and win against enemies with capabilities similar to those of the U.S. It will have modular hardware and software, as well as the future Skyborg autonomy core system that will enable teaming among manned and unmanned aircraft.

The Skyborg project will develop a prototype inexpensive, quick-turnaround, autonomous unmanned fighter-like aircraft that will be able to accommodate increasingly complex electronic and aeronautical technologies.

Advanced autonomy and AI are poised to change the character of the international battlefield substantially in the near future, Air Force researchers explain. Researchers want to field an autonomous combat aircraft that meets an immediate operational need, as well as that can jump-start complex AI development, prototyping, experimentation, and fielding.

Skyborg will be attritable, meaning it will have a low-enough cost to sacrifice in combat to attack high-value targets. It also will be reusable after flying routine missions. It also has autonomy necessary to compose and select independently among different courses of action.

Its AI embedded computing will have modular components and protocols that conform to open-systems standards, which integrate easily with third-party products. Open systems

mitigate risks of technology obsolescence, vender-unique technology, and single sources of supply and maintenance, Air Force researchers explain.

Skyborg must have an open AI software architecture and toolkits that enable timely modifications and upgrades of complex autonomous behaviors; have modular open-systems mission hardware; and meet military certification and acquisition requirements.

From Skyborg, Air Force researchers also the ability to avoid other aircraft, terrain, obstacles, and hazardous weather without human intervention; conduct autonomous takeoffs and returns; have separate sensor payloads and flight computers that allow for modular adjustments and adaptability; and have mission-planning software that integrates with next-generation Air Force mission planning tools that emphasize modularity and openness.

Researchers also want an autonomous aircraft that can operate with personnel who have limited engineering or pilot experience. On these contracts Boeing, General Atomics, Kratos, and Northrop Grumman will do the work at locations to be determined at the order level, and should be finished by July 2026.

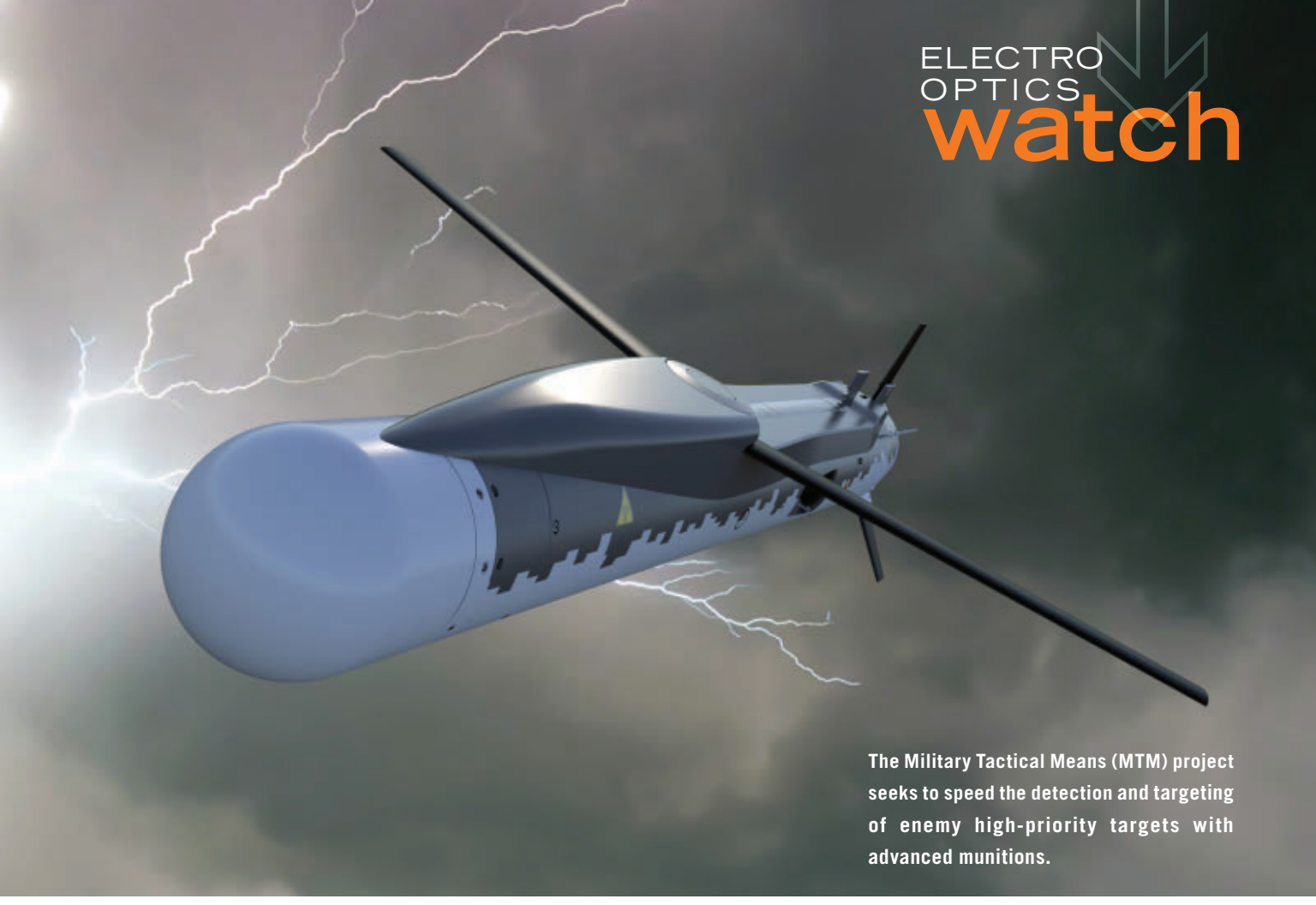
For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds; General Atomics Aeronautical Systems at www.ga-asi.com; Kratos Unmanned Systems at www.kratosdefense.com, Northrop Grumman Aeronautics at www.northropgrumman.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Sierra Nevada Corp. to build unmanned orbiting space station

The U.S. Defense Innovation Unit in Cambridge, Mass., the Pentagon's advocate for fast use of emerging commercial technologies, has awarded Sierra Nevada Corp. in Sparks, Nev., a contract to build an unmanned orbiting space station. The unmanned orbital outpost will be placed in low-Earth orbit (LEO) for experiments and demonstrations. The Shooting Star vehicle is a 16-foot attachment to the company's Dream Chaser space plane. While the outpost will operate in low-Earth orbit (LEO), future orbits could be placed in other orbits, including cislunar.

Small, power-efficient inertial navigation for unmanned vehicles introduced by VectorNav

VectorNav Technologies LLC in Dallas is introducing the VectorNav Tactical Embedded line of inertial products for autonomous pointing and geo-referencing applications like gimballed intelligence, surveillance and reconnaissance (ISR); satellite communications (SATCOM) systems; laser detection and ranging (LiDAR) mapping; and photogrammetry. VectorNav's Tactical Embedded line features support for an external selective availability anti-spoofing module (SAASM) GPS for defense applications in ISR, electronic warfare (EW), munitions, and unmanned aerial vehicle (UAV) navigation. For more information contact VectorNav Technologies online at www.vectornav.com.



The Military Tactical Means (MTM) project seeks to speed the detection and targeting of enemy high-priority targets with advanced munitions.

Leidos eyes networked sensors to detect and attack high-value targets

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — U.S. military researchers are working with Leidos Inc. in Reston, Va., on a secretive networked sensors and signal-processing project to speed the detection and targeting of enemy high-priority targets.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, have announced a $3 million contract to Leidos for the Military Tactical Means (MTM) project.

Details and specifications of the MTM project are classified, but it seeks to design advanced sensing and automated signal processing of remotely sensed data for detection, classification, and geolocation of adversary military equipment on the battlefield.

The MTM program aims to develop sensors and exploitation techniques capable of performing wide-area searches to detect high-value targets. Program design will provide the ability to identify high-value adversary targets and to maintain positive chain-of-custody hand-offs. In addition, MTM will have the potential to be used in highly proliferated systems, such as small platforms.

The Air Force Research Laboratory awarded the contract on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

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

Mosaic warfare involves military forces that move quickly, adapt to changing circumstances, and continue

to function efficiently even though some segments may disappear or be called away to higher-priority missions.

The MTM project seeks to develop multi-mode electro-optics, sensors, and exploitation techniques for wide-area searches to detect high-value targets and destroy or disable these targets quickly using networked weapon systems.

The MTM project will consist of two 24-month phases. The first phase consists of two technical areas to be completed in parallel over two years. The second phase will have only one technical area.

The MTM project is one example of programs that are part of the DARPA Mosaic Warfare vision. Another example is the DARPA Timely Information for Maritime Engagements (TIMEly) project, which kicked-off last June. TIMEly mosaic warfare into the maritime realm, and involves assets like manned submarines and unmanned underwater vehicles (UUVs) to provide options on the fly for carrying out different missions.

TIMEly seeks to develop a heterogeneous maritime communications architecture, and the demonstrate a prototype during sample missions at sea. The project emphasizes undersea communications, as well as communications among manned and unmanned submarines, surface vessels, aircraft, and satellites.

TIMEly networks must be able to work together with established military networks to be effective, DARPA researchers say. The undersea domain imposes well-known limits on communications and on the ability to transfer the right information to warfighters.

For more information contact Leidos online at www.leidos.com, the Air Force Research Laboratory at www.wpafb.af.mil/afrl, or DARPA at www.darpa.mil/program/military-tactical-means.

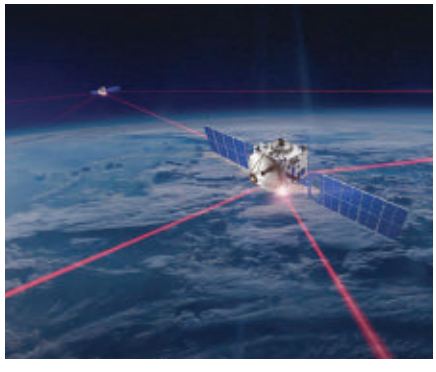
Air Force chooses ATA for free-space optical communications on spacecraft

BY **John Keller**

KIRTLAND AIR FORCE BASE, N.M. — U.S. Air Force researchers needed a communications system with two-way time transfer operating within W- and V-bands with free-space optical links. They found their solution from ATA Applied Technology Associates in Albuquerque, N.M.

Officials of the Air Force Research Laboratory Space Vehicles Directorate at Kirtland Air Force Base, N.M., have announced a $16.9 million contract to ATA (also-known as A-Tech Corp.) to develop a communication system with two-way time transfer operating within W- and V-bands and incorporating free space optical links.

This contract is part of the Air Force Space Technology Advanced Research (STAR) project to develop enabling technologies for space flight, on-orbit servicing, debris management, controlled reentry, ground systems, communications links, command and control, advanced spacecraft manufacturing technologies, and space system user equipment.



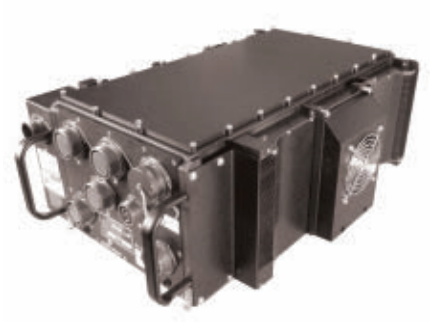
ATA Applied Technology Associates is developing a communications system with two-way time transfer operating within W- and V-bands with free-space optical links.

ATA experts will model heterogeneous optical W- and V-band optical communications, develop its components, and demonstrate its potential for national defense applications in space.

This contract is part of the STAR program's initiative in space battle management, command, and control, which seeks to enable uninterrupted delivery of tactical, operational, and strategic space services within a contested environment.

The initiative seeks to achieve unprecedented domain awareness; accurate and timely battle management tools; and robust command and control options. It focuses on integration of allied, commercial, and non-traditional capabilities, data fusion, machine learning, artificial intelligence, and related methods for rapid threat assessment and response; network-centric command and control concepts for air, sea, land, and space; and autonomy and on-board threat assessment algorithms to enhance satellite resiliency.

On this contract ATA will do the work in Albuquerque, N.M., and should be finished by October 2023. For more information contact ATA Applied Technology Associates online at www.atacorp.com, or the Air Force Research Laboratory Space Vehicles Directorate at www.kirtland.af.mil/Units/AFRL-Space-Vehicles-Directorate.



AVIONICS

Curtiss-Wright to provide avionics computer for Navy MQ-4C unmanned patrol plane

Avionics computer experts at Curtiss-Wright Corp. will provide the U.S. Navy with an onboard advanced mission management system for the MQ-4C maritime patrol unmanned aerial vehicle (UAV) under terms of a $7.5 million sole-source contract.

Officials of the U.S. Defense Logistics Agency's Aviation activity in Philadelphia are asking the Curtiss-Wright Defense Solutions division in Santa Clarita, Calif., to provide the mission management system for the Navy Northrop Grumman MQ-4C broad-area maritime surveillance (BAMS) UAV.

The Curtiss-Wright advanced mission management system (AMMS) provides the MQ-4C surveillance UAV with network-centric mission computer, data collection, and data correlation while incorporating support for Red/Black separation information security.

The AMMS has a new and improved high-speed interface embedded computing suite for high processing requirements, and a modular and scalable network-centric architecture, Curtiss-Wright officials say.

AMMS is an open-systems VPX-based system with internal volatile data storage, new DIO subsystem and discipline rubidium oscillator module, VPX-based embedded computing modules, and Gigabit Ethernet switches.

The MQ-4C Triton unmanned aircraft flies maritime surveillance missions as long as 24 hours at altitudes of more than 10 miles to enable coverage out to 2,000 nautical miles. The UAV's suite of sensors can detect and classify different types of ships automatically.

Curtiss-Wright won a $25 million contract from Northrop Grumman a decade ago to provide AMNS mission-management systems for the MQ-4C, and have been providing these kinds of avionics subsystems for the Triton UAV ever since.

The Triton is a crucial component of the Navy's 21st century strategy for conducting surveillance of surface ship and submarine traffic in the vast Pacific and other oceans around the globe. The Triton UAV will work together with the Navy's P-8A Poseidon manned maritime patrol aircraft.

The Triton's maritime search radar is called the Multi-Function Active Sensor (MFAS), and will provide the UAV and its operators with a 360-degree view of a large geographic area while providing all-weather coverage for detecting, classifying, tracking, and identifying points of interest. MFAS is separate from the Triton's air-to-air radar. The MFAS radar first flew on the Triton during testing in April 2015.

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

The MQ-4C Triton is provides combat information to military authorities like the expeditionary strike group, carrier strike group, and the joint forces maritime component commander. The Triton air vehicle is based on the U.S. Air Force RQ-4B Global Hawk, while its sensors are based on components and systems already fielded in the U.S. military.

The large unmanned aircraft provides intelligence for large ocean areas to maintain the common operational and tactical picture of the maritime battle space. The Triton feeds intelligence, surveillance, and reconnaissance (ISR) data to the Global Information Grid (GIG), and can work alone or together with other aircraft and surface ships.

The MQ-4C Triton's ability to perform persistent ISR within a practical range of 2,000 nautical miles enables the P-8A aircraft to focus on anti-surface ship warfare, anti-submarine warfare (ASW), and multi-intelligence. The Triton can fly as far as 8,200 nautical miles without refueling.

On this contract Curtiss-Wright will do the work in Santa Clarita, Calif., and should be finished by February 2022. For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com, or the Defense Logistics Agency-Aviation at www.dla.mil.

SENSORS

Ultra Electronics to develop sonobuoy prototype to detect quiet enemy submarines

U.S. Navy researchers needed a company to develop enabling technologies for a new advanced air-deployed passive sonobuoy able to detect, identify, and track new generations of extremely quiet enemy submarines. They found their solution from Ultra Electronics Ltd. in Columbia City, Ind.

Officials of the Office of Naval Research in

Arlington, Va., have announced a $28.3 million contract to the Ultra Electronics UnderSea Signal Systems segment to develop a sonobuoy, known as Extended Range Directional Frequency Analysis and Recording (ER-DIFAR).

This system will be a replacement A-size sonobuoy that measures 36 inches long, 5.25 inches in diameter, and weighs 39 pounds. This new sonobuoy should offer passive detection at tactically significant ranges to detect and identify extremely quiet submarine targets.

A government conceptual hydrophone array design will serve as the basis for maturing the sonobuoy design, as well as for developing and demonstrating a prototype.

Ultra Electronics engineers will seek to deploy the prototype from an A-size package; develop automatic precise localization of hydrophone elements on the hydrophone array; and build an in-buoy signal-processing for beam-forming and communicating data to a receiving system.

Included will be an upper float, communications and GPS receiver, and surface suspension for motion isolation of the upper assembly from the array. A lower electronics section will have power for the sonar hydrophone array, telemetry, beamforming, and signal processing hardware with sufficient processing power to run software developed and provided by the Navy.

Ultra Electronics will integrate components into an A-size sonobuoy and demonstrate the ability to achieve air launch certification, water entry, and array deployment in an at-sea demonstration.

For more information contact Ultra Electronics Undersea Signal Systems online at www.ultra-electronics.com, or the Office of Naval Research at www.onr.navy.mil.

COMMUNICATIONS

Leonardo DRS to provide tactical networking terminals for E-2D aircraft

U.S. Navy anti-air warfare experts needed an electronics manufacturer to build sensors and weapons tactical networking terminals for the carrier-based E-2C and E-2D airborne early warning aircraft. They found their solution from the DRS Laurel Technologies segment of Leonardo DRS in Johnstown, Pa.

Officials of the Naval Sea Systems Command in Washington announced an $10 million order to DRS Laurel to build AN/USG-3B Cooperative Engagement Capability (CEC) equipment sets and installation and checkout replacement components.

The CEC is a tactical sensor and weapons network for anti-air warfare that combines information from sensors operating over broadly distributed geographic areas in a common tactical picture for battle groups at sea. CEC avionics improves overall situational awareness, and enables fleet commanders to work closely together to attack enemy forces from long ranges.

CEC blends sensors and weapons into an integrated real-time network that expands the battlespace; enhances situational awareness; increases depth of fire; enables long intercept ranges; and improves decision and reaction times.

On this order DRS Laurel will do the work in Largo, Fla.; Johnstown, Pa.; and Menlo Park, Calif., and should be finished by January 2022. For more information contact DRS Laurel Technologies online at www.leonardodrs.com/locations/naval-electronics-laurel-technologies-johnstown-pa, or Naval Sea Systems Command at www.navsea.navy.mil.

PERSISTENT SURVEILLANCE

Logos Technologies to provide wide-area motion imagery (WAMI) sensor for RQ-21A UAV

U.S. Navy aerial surveillance experts needed a wide-area motion imagery (WAMI) sensor for the Boeing Insitu RQ-21 Blackjack small tactical unmanned aerial vehicle (UAV). They found their solution from Logos Technologies LLC in Fairfax, Va.

Officials of Naval Air Systems Command at Patuxent River Naval Air Station, Md., have awarded Logos a $6.7 million contract to develop, deliver, and perform proof-of-concept flight tests on a WAMI sensor called Cardcounter for the Navy and Marine Corps RQ-21A Blackjack UAV.

Cardcounter will be derived from Logos BlackKite sensor — an ultra-lightweight WAMI sensor prototype with infrared sensing capability.

BlackKite, on which Cardcounter is to be based, weighs less than 28 pounds, yet is powerful enough to image an area of more than about five square miles to detect and track all land vehicles in real time.

The Cardcounter WAMI sensor will capitalize on BlackKite's high-performance, multi-modal edge processor, which can store six or more hours of mission data.

With this technology, users can analyze the recorded imagery forensically to determine what is unfolding in the real-time imagery, drawing connections between people, places, and events.

The initial $6.7 million Navy contract covers development of two Cardcounter prototypes, with delivery and flight testing by September 2020 aboard the RQ-21A Blackjack.

Designed to provide battlefield reconnaissance capability for Navy and Marine Corps field commanders, the RQ-21 is a twin-boom, single-engine, monoplane UAV.

For more information contact Logos Technologies online at www.logostech.net, Boeing Insitu at www.insitu.com, or Naval Air Systems Command at www.navair.navy.mil.

POWER ELECTRONICS

Rugged voltage suppressor to protect electronics introduced by Microchip

Microchip Technology Inc. in Chandler, Ariz., is introducing the MDA3KP transient voltage suppressor TVS diode array family for aerospace and defense applications that must operate in harsh environments. These devices are for engine-control units, environmental controls, instruments, actuators, data centers, 5G infrastructure, and communications systems. These devices also have military system circuit protection for ruggedized handheld radios, Global Positioning Systems (GPS), communication test equipment, automotive, industrial logging equipment, power supplies, and marine systems. The TVS diode arrays meet aircraft lightning protection requirements set forth in RTCA DO-160E, the standard for environmental testing of avionics for lightening-induced transient susceptibility. The 3-kilowatt diode family has more than 25 products with different screening levels, polarities, and qualification standards. Microchip's MDA3KP TVS diode array family offers a voltage range tested and qualified to the MIL-PRF-19500 JANTX level equivalence standard. The integrated multi-diode solution is a voltage-clamping device that provides fast-reacting avalanche breakdown diode (ABD) features that divert excess current around sensitive components to provide protection from electrical overstress. For more information contact Microchip Technology online at www.microchip.com.

DATA ACQUISITION

Rugged data recorder for helicopters and UAVs offered by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va., is introducing the SSR/CHS/001 Ethernet multi-role data recorder for standalone data acquisition in helicopters, unmanned aerial vehicles (UAVs), and electric vertical takeoff and landing (eVTOL) aircraft. This data recorder, optimized for small size, weight, and power consumption (SWaP) is for complementing a KAM-500 chassis for data logging and muxing. The enhanced compact chassis combines field-configurable data acquisition modules and CompactFlash based data recording. The rugged SSR/CHS/001 Ethernet multi-role recorder supports as many as four user-configurable KAM-500 data acquisition module slots. The system for SWaP-constrained uses provides flight test engineers with the flexibility to leverage their existing library of KAM-500 plug-in modules to integrate a data acquisition system solution with built-in recording capability. The SSR/CHS/001 supports removable industrial-grade CompactFlash cards that can be read by standard commercial-off-the-shelf (COTS) readers to eliminate the need for dedicated software or docks. For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com.

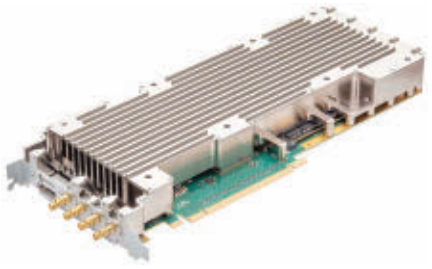


IMAGE PROCESSING

PCI Express video-capture board for military surveillance offered by EIZO

EIZO Rugged Solutions Inc. in Altamonte Springs, Fla., is introducing the Condor GR4 PCI Express card for airborne and naval surveillance applications, as well as for use in rugged rackmount servers and workstations. The Condor GR4 video-capture board has four 3G-SDI inputs and outputs. The Condor GR4 PCI Express card is to capture, process, encode, decode, display, and stream video data simultaneously in manned and unmanned rugged intelligence, surveillance, and reconnaissance (ISR) applications. The embedded computing card can host Nvidia Pascal and Turing-based MXM graphics processing units (GPUs), and supports PCI Express Gen 3.0 in four, eight, or 16 lanes. The product currently has two variants, based on the NVIDIA GPUs — Quadro P5000 or Quadro P3000 — but also offers an upgrade path to the latest Nvidia Quadro RTX Turing GPUs. The maximum power consumption ranges from 85 to 110 Watts depending on the variant. For more information contact EIZO Rugged Solutions online at www.eizorugged.com.

INTERCONNECT PRODUCTS

Optical connectors for radar and communications introduced by TE Connectivity

TE Connectivity in Harrisburg, Pa., is introducing the EB16 expanded beam optical pin-and-socket termini in single-mode and multimode variations for a variety of military, commercial aerospace, harsh-environment industrial, and space applications. Both variations are based on an updated

design that includes springless mating and crimpless cable retention. Applications include radar and sensor systems; rugged communications networks; fixed wing and rotary aircraft; unmanned aerial vehicles; commercial avionics and sensing; military avionics, sensing and ordnance; and military ground vehicles. EB16 optical single-mode and multimode pin-and-socket termini are drop-in replacements for the MIL-PRF-29504 /4 and /5 physical contact termini used in many ruggedized circular connector systems. EB16 termini fit standard D38999 size 16 cavities and are compliant with MIL-DTL-38999 Series I and Series III connectors, as well as the MIL-STD-1760 connector. Crimp eyelets and the need for a crimp tool have been eliminated; therefore, reducing overall termination time and labor. For more information contact TE Connectivity online at www.te.com.

BOARD PRODUCTS

SOSA-aligned 3U VPX single-board computer introduced by Interface Concept

Interface Concept in Quimper, France, is introducing the LX2160A 3U VPX single-board computer with the NXP Arm Cortex-A72-based LX2160A Multicore Communications Processor for high-performance aerospace and defense applications. The LX2160A is the highest-performing member of the NXP Layerscape processor family. This design meets requirements for 25-gigabit-per-second Ethernet interfaces on a 3U VPX system backplane specified by the Sensor Open Systems Architecture (SOSA) working group. The SOSA-aligned IC-ARM-VPX3a features 32 gigabytes of DDR4 memory, local storage options (eMMC and M.2 slot), PCI Express Gen 3.0, SATA3, USB, UART, and several 10/40 Gigabit and 25/100 Gigabit Ethernet interfaces available on the backplane. This board complies with VITA 65.0 standard. It comes with a boot loader and with a Linux or VxWorks BSP. It is available in air-cooled and conduction-cooled versions. For more information contact Interface Concept online at www.interfaceconcept.com.

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