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2021 Technology innovation awards

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Electronics and
Intelligent Aerospace
recognize 2021's
technology
innovations. **PAGE 4**

SOSA design standard takes hold

Sensor Open Systems
Architecture (SOSA)
seeks to ensure
rapid upgrades
and technology
insertion. **PAGE 22**

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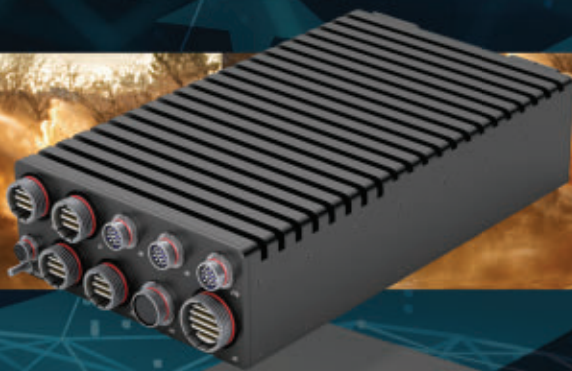
URBAN AIR MOBILITY

*Industry gears-up for
a public transportation
future with unmanned
helicopters. **PAGE 12***

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Innovators awards reveal a list of the military electronics industry's true innovators

There's a lot of conversation about what's new in the aerospace and defense electronics industry, and how it revolves around new products — and that's just fine. New products are part of the bedrock of our industry, and act as somewhat of a barometer that measures technology trends in electronics components for avionics, shipboard electronics, vetronics, wearable computers, radiation-hardened electronics for space, and countless other applications.

Still, we wanted more; we want to highlight true technology innovation that solves design problems and breaks through barriers. That's the reason we started the Military & Aerospace Electronics and Intelligent Aerospace Technology Innovation Awards, which is in its fifth year.

There's more to technology innovation than new products. Most important is how a product can help with technology issues and be a true solution to design challenges. The 2021 Military & Aerospace Electronics and Intelligent Aerospace Technology Innovation Awards were announced last month, and recognize 47 technology solutions submitted by 32 companies.

The Military & Aerospace Electronics and Intelligent Aerospace Technology Innovation Awards recognize developers of the most influential enabling technologies for aerospace and defense applications. Enabling technologies solve problems — sometimes even for which previously there was no known solution before.

Award nominees involve a wide range of military and aerospace electronics technologies, including command, control, communications, computers, intelligence, and surveillance (C4ISR); cyber security; electro-optics; embedded computing; high-reliability electronics; interconnect technology; power electronics, 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.

The awards are going to organizations that demonstrate excellence in the use of a product or system. Designers, integrators, and users of military and aerospace electronic systems may nominate their own projects or applications, or integrators or distributors that supply products or systems can nominate exceptional projects for consideration.

Companies recognized for aerospace and defense electronics technology innovation can use this recognition in promotional materials throughout the establishing them as thought leaders in our industry. These are the aerospace and defense electronics companies making contributions to technological innovations that solve defense and aerospace electronics design challenges with real solutions.

These listings of companies and products are some of the most influential enabling technologies for aerospace and defense applications. Enabling technologies are developed or discovered that actually solve design problems. Often these enabling technology solutions solve problems for which there was no known solution before, or which were particularly difficult.

To make it short and sweet, here is a list of honorees, which will come into broader focus inside this magazine. Advanced Cooling Technologies Inc.; Analog Devices Inc.; Annapolis Micro Systems; Atrenne, a Celestica Company; Concurrent Real-Time; Curtiss-Wright Defense Solutions; Diamond-Roltran; Discovery Semiconductors Inc.; EIZO Rugged Solutions Inc.; Elma Electronic; Green Hills Software; Infineon Technologies; Interface Concept; Klas Government; Kontron America Inc.; LCR Embedded Systems; Leonardo DRS; Logos Technologies; Mercury Systems Inc.; MixComm; MPL AG Switzerland; NAG Marine; Neousys Technology America Inc.; North Atlantic Industries; Pentek; Planar Monolithics Industries, Inc.; Robotic Research; Si Time; Systel Inc.; ViaSat; Vicor; and W. L. Gore & Associates. ←



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2021 Military & Aerospace Technology Innovators Awards announced

NASHUA, N.H. — Military & Aerospace Electronics and Intelligent Aerospace have announced their 2021 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.

2021 **Military & Aerospace** Electronics
Innovators Awards

high-resolution sensor systems, with significant AI-enabling capabilities to help shift the workload from soldier to sensor. Kite-Strike enables the real-time AI inferencing, deep learning, and

machine learning capabilities with centralized sensor ingest and data fusion support for edge AI inferencing for mission-critical applications.

The aluminum 3D-printed air transport rack (ATR) enclosure from Atrenne, a Celestica company in Brockton, Mass., offers substantially reduced lead times when compared to a conventional brazement welding fabrication with negligible tradeoffs in thermal performance. Structural and mechanical characteristics are as good or better when subjected to dynamics testing. While providing a demonstration unit in a matter of weeks after critical design reviews compared to months for a conventionally designed unit, customers are able to take the aluminum 3D printed ATR into the meeting room with a tangible piece of hardware, and the unit can be deployed into the field and perform as a functional piece of deployable equipment and anywhere in between.

The Condor NVP2102AxX computer from EIZO Rugged Solutions Inc. in Altamonte Springs, Fla., is for defense applications such as intelligence and electronic warfare (EW) that exchange video, and metadata



PLATINUM

The MESP-100-2 from the Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is a size, weight, and power (SWaP) optimized solution for encrypting telemetry streams. It provides a PCM encoder interface, Advanced Range Telemetry (ARTM) transmitter interface, and an optional cryptographic key management software package, with supporting ground station hardware. The module set is for use in missile telemetry and test, flight test, and aircraft monitoring applications.

The SEMIL-1748GC from Neousys Technology America Inc. in Northbrook, Ill., is a IP67-rated, waterproof and dust-proof graphics processing unit (GPU) computer with pre-installed NVIDIA Tesla T4 for demanding environments. It is for rugged edge artificial intelligence (AI) solutions, and features a patented system architecture to guarantee fanless operation in temperatures from -25 to 70 degrees

Celsius, and non-throttling GPU performance to 62 C ambient.

The PRX-20-1G18G-850M-SFF-V2 1-18 GHz channelized receiver from Planar Monolithics Industries Inc. in Frederick, Md., is a broadband input, 20 output channelized receiver for surveillance applications with copious transmission signals present in various frequency bands at any given time. The receiver limits the noise to help identify low-power signals without compressing output power for the higher power signals. The channelized receiver offers 20 850 MHz BW outputs up to 4.4 GHz while providing good 50 ohm matches for the broadband input and all outputs.

The Kite-Strike rugged artificial intelligence (AI) edge computing hardware from Systel Inc. in Sugar Land, Texas, offers workstation performance in an embedded size, weight, and power (SWaP)-optimized system. Kite-Strike supports force-protection

Low PIM Rated Sub 6 Ghz 5G Antennas

In-building distributed networks and outdoor wireless networks call for robust antennas that offer wide bandwidth coverage, low PIM ratings as well as MIMO and SISO technology support.

To address these requirements, Fairview Microwave launched a new series of low PIM rated indoor wall mount and ceiling antennas as well as a series of outdoor rated omni-directional antennas. Fairview Microwave is ready to support 5G innovation, testing, and deployments, through an expansive product offering, product support, and a commitment to same-day shipping.

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constantly between sensors and mission systems. The data being analyzed must be captured, processed, encoded/decoded, recorded, and sent to the base station via satellite. Prior to the Condor NVP2102AxX product, program designers had to use external 3G-SDI to DVI converters (for inputs) and DVI to 3G-SDI converters (for outputs) to handle that video format. In the past, systems would need 2-3 graphics cards to get the job done.

The FPGA Workbench from Concurrent Real-Time in Pompano Beach, Fla., is a software tool that provides a complete customizable development environment for its programmable field-programmable gate array (FPGA) processing cards. FPGA Workbench was created from the ground-up for real-time applications. Combine Concurrent's FPGA's with a real-time driver for our RedHawk Linux real-time operating system, and FPGA Workbench becomes a powerful tool to create real-time models. This makes Concurrent's RedHawk RTOS and FPGA Workbench a solution for simulation and testing applications like autonomous driving and flight control, and

ultimately enables industries to bring enhanced products to market quickly and economically.

The Voyager 6 embedded computing chassis from Klas Government in Tampa, Fla., helps to extend artificial intelligence (AI), machine learning, and other cloud-enabled battlefield applications to the tactical edge. The Voyager 6 enables the military to integrate tactical communications systems into military ground vehicles without requiring modifications to the vehicle. It enables users to swap hardware and software to a tactical communications package that meets standardized A-Kit / vehicle envelope certifications for size, weight and power (SWaP).

The Rappid Open Spectrum Processing Platform from Mercury systems in Andover, Mass., helps users load spectrum processing applications quickly into systems that are based on different hardware. Rappid offers openness and modularity by separating the hardware from the techniques and applications, similar to how apps run on a smart phone. It helps reduce development costs with an application-ready framework;

deploy defense capabilities faster than adversaries; and deliver new capabilities to multiple systems by leveraging the open platform. Rappid hardware consists of commercial off-the-shelf devices from industry-trusted vendors. Its abstraction capabilities helps deploy applications from the lab, to the prototype, and on to fielded solutions.

The Endura MEMS oscillators from Si Time Corp. in Santa Clara, Calif., are for aerospace and defense applications, and offer ruggedized performance for applications such as field and satellite communications, precision GNSS, avionics, and space. The oscillators are engineered for tough applications, with timing devices that provide the heartbeat in mission-critical electronic equipment. The ruggedized Endura MEMS timing solutions, offer as much as 50 times faster acceleration sensitivity, and conform to MIL-PRF-55310 specifications and can be up-screened in accordance with standard or custom flows. Raytheon's precision guidance system uses Si Time Endura MEMS oscillators for their precision guidance systems. Si Time devices deliver precise timing, high performance, and reliability in aerospace and defense applications operating in harsh environments.

The WILDSTAR 3XR2 3U OpenVPX FPGA processor from Annapolis Micro Systems in Annapolis, Md., are for embedded computing applications that analog filtering and tuning, as well as digitization and digital processing. Formerly, these capabilities were packaged separately, increasing size, weight, power, and cost (SWaP-C). The 100-gigabit Ethernet RFSoc board combines analog and digital capability in one 3U OpenVPX slot. The WILDSTAR 3XR2 3U OpenVPX FPGA processor incorporates a full-length



The Curtiss-Wright MESP-100-2 SWaP-optimized solution for encrypting telemetry streams is among the top honorees for the 2021 Military & Aerospace Electronics Technology Innovation Awards.

coax-connected analog interface mezzanine site that systems designers can populate in three ways: with a direct RF digitization mezzanine; with simple analog circuitry; and with a third-party or customer-supplied analog tuner to enable digitization of higher frequency signals. This multi-function capability does not negatively affect processing performance. Data moves to two Gen 3 Xilinx UltraScale+ RFSoc FPGAs, which allow for eight channels each of A/D & D/A converting, with an A/D converter sample rate of 0.5—5.0+ gigasamples per second and resolution of 14 bits, and a D/A conversion sample rate of 0.5—10.0+ gigasamples per second and resolution of 14 bits.

The INTEGRITY-178 tuMP real-time operating system (RTOS) software from Green Hills Software in Santa

Barbara, Calif., targets the avionics market by providing the technology and safety certification data to be part of the industry's first two multicore certifications to DO-178C that meet CAST-32A objectives. Certified conformant to the FACE Technical Standard 3.0, INTEGRITY-178 tuMP is a critical part of a system using a Modular Open Systems Approach (MOSA). INTEGRITY-178 tuMP demonstrates that conformance to the FCE Technical Standard and certification to DO-178C can go hand-in-hand. INTEGRITY-178 tuMP provides partitioning in time, space, and resources across a multicore system, which enables verification of a safety-critical application independently from other applications as well as independent measurement of worst-case execution time (WCET).

The ADAR3000 Ka-band beamformer integrated circuit (BFIC) from Analog Devices Inc. in Norwood, Mass., offer a 4 beam/16 channel device that support the K/Ka band satellite communications bands. Each channel contains a programmable step attenuator and programmable time delay for beam steering and draws less than 12 milliwatts per channel. Not only is there a high degree of RF integration in these BFICs, but there is also a sophisticated digital definition that has memory to support quick and efficient beam state selection via program control over the SPI bus. Each device can support beam hopping and raster scanning which are critical for LEO satellites to be able optimize spatial and frequency reuse. The ADAR3000 and ADAR3001 are on a low power process that is also suitable for space missions.



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The process itself is radiation tolerant such that the ADAR3000 and ADAR3001 are suitable for not only LEO missions but also GEO missions.

The ICE-Lok thermal management and cooling wedge lock from Advanced Cooling Technologies (ACT) Inc. in Lancaster, Pa., thermally outperforms standard wedge locks by greater than 30 percent. The ICE-Lok expands in all four directions, allowing it to engage the heat spreader and chassis on all four sidewalls. This not only doubles the contact surface area but also introduces lower thermal resistance paths for the heat to transfer from board to chassis. While existing solutions provided strong mechanical functionality, they are not able to keep up with the trend of increasing processing power the military embedded computing market has been experiencing. In a conduction-cooled system, which is the most desirable structure due to higher reliability, all heat must be transferred through the wedge lock to the chassis and rejected via air or liquid externally. The ICE-Lok is able not only to increase thermal performance and subsequently add reliability and safety for the system, but also is a drop-in replacement in any VITA 48.2 chassis.



Leonardo DRS, A-PNT Converged Computer - Embedded and Scalable (AC²ES); Curtiss-Wright Defense Solutions, NC120A; ViaSat, Dynamic Video Encoding; Elma Electronic, CompacFrame Test & Development Platforms; Curtiss-Wright Defense Solutions, 360SA; MPL AG Switzerland, Rugged MIL/COTS SWaP-C Server Solution; NAG Marine DASPOS Fire Prevention Systems; Pentek, Quartz Model 6350 8-Channel A/D & D/A Zynq UltraScale+ RFSOC Rugged Small Form Factor Enclosure; MixComm, RFSOI Beamformers for 5G and Satellite Communications; W. L. Gore & Associates, GORE High Performance Aerospace Wires; Curtiss-Wright Defense Solutions, HSR10; Elma Electronic, NetSys 5310/11 Rugged Cisco ESR-6300 Platforms; Mercury Systems Inc., RFS1080 Radio Frequency System-in-Package; Robotic Research, Pegasus Mini; Curtiss-Wright Defense Solutions, VPX3-655; Advanced Cooling Technologies Inc., Space Copper-Water Heat Pipes (SCWHPs); Elma Electronic, 3U Conduction-Cooled Load Card Aligned to SOSA; Curtiss-Wright Defense Solutions, Multi-Platform

Mission Management (MPMM) System; and Discovery Semiconductors Inc., Space Qualified, Short Wave Infrared, Extended InGaAs Photodiodes to 2.4 Micron Wavelength.



Diamond-Roltran, Roll-Rings; Mercury Systems Inc., ARES3100 Advanced Radar Environment Simulator; Curtiss-Wright Defense Solutions, Parvus DuraCOR AGX-Xavier; Curtiss-Wright Defense Solutions, PacStar 448; Vicor, BCM4414; Mercury Systems Inc., TAC3290 Microwave Tuner; Elma Electronic, MR50 Rugged Multi-Rotary Selector Switch; Logos Technologies, BlackKite Wide-Area Motion Imagery (WAMI) System; Kontron America Inc., COBALT S1901; LCR Embedded Systems, AoC3U-410 Air over Conduction VPX Chassis; LCR Embedded Systems, DK3 VPX Development System; Interface Concept, ComEth4000e - 6U VME 1/10/40 Gigabit Ethernet Switch; Infineon Technologies, PowerMOS 650V rad hard MOSFET; and North Atlantic Industries, NIU3A SWaP Optimized Processing and Multifunction I/O & Communications System. ←

Pentagon eyes AI to speed flow of actionable intelligence through tactical networks

The U.S. Army's Project Convergence, the Air Force's Advanced Battle Management System and the Navy's Project Overmatch are the names each service gives to an artificial intelligence (AI)- and autonomy-enabled tactical network that seeks to speed information from sensors to shooters. The defining concept for each of these efforts involves clear and fundamental technological

modernization efforts. These efforts rest on the premise that any fighter jet, tank, ground-control station, or surface ship, can operate not only as its own, but also as a node in a tactical network that can gather, process, organize and disseminate time-sensitive data in real time. For example, instead of sending raw imager to one ground-control center, an unmanned aerial vehicle (UAV) could find crucial enemy targets, analyze variables, and send actionable intelligence to several locations in seconds.

Coast Guard updating cyber planning for maritime trusted computing

The U.S. Coast Guard officials updated their service's cyber strategic plans, committing to use best practices to thwart threats and weave cyber planning into its traditional mission preparation. The new cyber strategic outlook is the Coast Guard's response to rapid changes in cyber security in recent years, including an uptick in destabilizing events and evolving security

technology and practices. Coast Guard leaders say they will make its defensive abilities known in cyberspace to help secure the maritime transportation system, a vast commerce network that comprises more than 25,000 miles of water serving 361 ports. Malicious actors have sought to disrupt commerce through cyberspace, leading to billions in losses in recent years. The trusted computing document notes that the Coast Guard, which has unique authorities as a law enforcement entity as well as an armed service, cannot meet its strategic objectives or missions without a robust cyber capability.

Navy eyes new autonomous EW for helicopters to protect ships in the fleet

The U.S. Navy is nearing a decision to approve production for a fleet electronic warfare (EW) system, says the system's manufacturer. The Advanced Off-Board Electronic Warfare sensor pod will be outfitted on MH-60 Sierra and Romeo helicopters to extend ships' line-of-sight limitations in the electromagnetic spectrum. The system can work together with the fleet for extended EW and electronic protection, but also can work in autonomous mode for a denied environment. While it has undergone some flight tests, more testing must be done. While manufacturer Lockheed Martin Corp. worked with the Navy on the program, company experts have learned how the system interacts with the environment and have seen ancillary capabilities not specifically intended during initial design.

U.S. defense industry seeks to share data among military weapon systems networks

Just as consumers like headphones and other audio gear that connects

seamlessly to their streaming data, future militaries will be more interested in weapons that connect to larger networks quickly and intuitively — more so even than high-performing weapons that don't share data well, says Northrop Grumman CTO Scott Stapp. The defense industry — and

particularly, traditional prime contractors — are grappling with the military's new insistence that they share data more freely: among weapons, over the new battle nets, to uniformed maintenance personnel, with Defense acquisition officials, and more. It's the sort of change that will disrupt the way the

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The advertisement features a collage of images. At the top right, several VPT electronic components are displayed, including a large black module labeled 'VPT250-2800S', a yellow module labeled 'DVFL2812D', and several smaller surface-mount components. Below these, three horizontal panels show military-related imagery: a fighter jet in flight against a sunset sky, a main battle tank in a desert environment, and a satellite in orbit above Earth. The VPT logo is prominently displayed in the bottom right corner of the collage area.

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contractors do business. Stapp said defense contractors eventually will stop fretting about opening their data silos and instead offer new software tools to combine and then use that data. "I think it opens a new model for the defense industry, which, in a lot of ways, looks a lot like commercial when it comes to data," he said in an interview. He likened it to Apple, which went from a company that sold computer hardware to a company that sold hardware that seamlessly interlinked to cloud-based data services across devices.

Industry should focus on technology development to compete with China and Russia

Top military commanders are urging defense industry leaders to concentrate on new technology for weapons and ships that the Navy needs to compete with rival nations such as China and Russia. Adm. Mike Gilday, chief of naval operations, requested that the defense industry stop lobbying Congress to build equipment the Navy no longer wants and instead focus on technology development that revolves around new technologies and new platforms. "Lobbying Congress to buy aircraft that we don't need ... it's not helpful," the Navy's top officer said earlier this month at the Navy League's Sea-Air-Space conference in Washington. In the proposed 2022 Navy budget, service leaders call for canceling one of two guided-missile destroyers planned for 2022 and speeding the divestment of F/A-18 Hornet jet fighter-bombers. Congress has been critical of the plans, proposing to save the second guided-missile destroyer, and regularly questioning divestments. ←

Navy asks industry to develop prototype hypersonic weapon for carrier-based aircraft

BY John Keller

ARLINGTON, Va. — U.S. Navy researchers are asking industry to develop a prototype hypersonic munition for the Boeing F/A-18E/F Super Hornet jet fighter-bomber that is hosted aboard U.S. aircraft carriers.

Officials of the U.S. Office of Naval Research (ONR) in Arlington, Va., issued a solicitation last month (N00014-21-S-SN14) asking industry to build and test a hypersonic air-breathing controlled test vehicle called Screaming Arrow.

The goal is for three Screaming Arrow test flights that involve the prototype's captive carriage, air launch separation, controlled flight, booster ignition and operation, separation of the munition's cruiser from its booster, cruiser controlled flight, cruiser engine start, cruiser acceleration to cruise condition, cruiser at cruise condition, cruiser turndown, cruiser terminal-phase flight trajectory, and cruiser flight impact.

Researchers would like to capitalize on previous and current hypersonic developments by government agencies and defense industry contractors ultimately to create a near-term operational hypersonic weapon, which can fly at speeds of at least five times the speed of sound to attack enemy surface warships and other high-priority surface and ground targets.

For storage aboard aircraft carriers, the prototype hypersonic weapon must fit inside storage containers that are 15 feet long, 3.3 feet wide, and 3.75 feet tall. ←

Companies interested were asked to submit full proposals by 20 Sept. 2021 to FedConnect at www.fedconnect.net. Navy researchers say they plan to fund three individual awards. For questions or concerns email Kenneth Heeke at kenneth.heeke@navy.mil or Jerome Kong at jerome.kong@navy.mil. More information is online at <https://sam.gov/opp/b8c56124390d4f2b8e3c8bc6a7bee532/view>.



The U.S. Navy wants industry to develop a hypersonic missile for the F/A-18E/F Super Hornet jet fighter-bomber.



Sierra Nevada and General Dynamics to design updated cryptographic key loaders

BY John Keller

ABERDEEN PROVING GROUND, Md. — U.S. Army trusted computing experts needed upgraded cryptographic key loaders with network connectivity to fill, transfer, issue, and manage cryptographic keys. They found their solution from Sierra Nevada Corp. in Sparks, Nev., and General Dynamics Mission Systems in Dedham, Mass.

Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., have awarded contracts to Sierra Nevada and General Dynamics for the Next Generation Load Device-Medium (NGLD-M) program.

The companies will share \$744.2 million over the next 10 years to develop updated National Security Agency (NSA)-certified cryptographic key load devices, including the simple key loader, to load cryptographic keys into electronic encryption machines.

The Army Contracting Command awarded the NGLD-M contract on behalf of the Army Project Manager Tactical Radios (PM TR) at Aberdeen Proving Ground, Md.

NGLD-Medium (NGLD-M) provides the same functionality as legacy fill devices while adding network connectivity to support over-the-network-key (OTNK) distribution. The NGLD-M will meet NSA certification requirements while providing a reprogrammable crypto subcomponent for future modernization requirements.

Photo (above): Sierra Nevada and General Dynamics will provide needed upgrades to systems that load cryptographic keys into sensitive military communications and computer equipment.

The NGLD-M also will be able to interface with the management client (MGC), NSA's key management infrastructure (KMI), and mission planning management support systems (MPMSS).

The NGLD-M can connect to and receive key material, applications, and other cryptographic products by connecting to U.S. Department of Defense (DOD) networks and will contain standard interfaces to audio fill ports, RJ45 Ethernet ports, and standard Universal Serial Bus (USB).


Users of the NGLD-M, in addition to the Army, will be the U.S. Navy, Air Force, FBI, Department of Homeland Security (DHS), and state and local governments. ←

For more information contact Sierra Nevada Corp. online at www.sncorp.com, General Dynamics Mission Systems at <https://gdmission-systems.com>, the Army Project Manager Tactical Radios (PM TR) at <https://peoc3t.army.mil/tr/>, or the Army Contracting Command at Aberdeen Proving Ground at <https://acc.army.mil/contractingcenters/acc-apg/about-us/>.

Enabling technologies for Urban air

Government regulators and industry designers gearing-up for a public transportation future with unmanned helicopters that rely on machine automation, sensors, and software.

BY Megan Crouse



Automated low-altitude unmanned aerial vehicles (UAVs) within urban and suburban areas: the legendary “flying cars” or passenger drones are always just on the horizon.

Today’s self-driving vehicle technology makes this seem more plausible, even as it has always been a science fiction staple. But industry is taking steps to make it a reality.

What is urban air mobility/advanced air mobility?

The Federal Aviation Administration (FAA) in Washington is taking the notion of urban air mobility (UAM) seriously, too,

or at least beginning to set up laws related to it. The FAA defines UAM separately from advanced air mobility: “UAM will be composed of an ecosystem that considers the evolution and safety of the aircraft, the framework for operation, access to airspace, infrastructure development, and community engagement,” FAA officials say.

Advanced air mobility (AAM), on the other hand, adds some more capabilities on top of these. AAM includes commercial use like inter-city, long-range trips, cargo delivery, public services, and private recreational

mobility



vehicles. All of these would be by the much-sought-after vertical takeoff and landing (VTOL) vehicles. Some military applications fall under this category, such as automated or semi-autonomous aircraft for troop deployment, medical evacuation or scouting and reconnaissance.

Military and commercial applications are being built at roughly the same time, with different teams working to see who will field a practical application, and when. In 2020, Sikorsky, a Lockheed Martin company, tested supervised autonomy, trajectory following, and obstacle avoidance on a UH-60A Black Hawk helicopter. This aircraft, retrofitted as the S-70 optionally piloted vehicle (OPV), sports full-authority, fly-by-wire flight controls. It also has been modified in speed, angle of bank, and the addition of more sensors.

Photo: The S-70 OPV has demonstrated supervised autonomy capabilities.

Sikorsky also will provide this technology to Erickson Inc. in Portland, Ore., for an Erickson S-64 helicopter designed for nighttime fire fighting missions. In addition, Sikorsky also is partnering with the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., on the Aircrew Labor In-Cockpit Automation System (ALIAS) — a tailorable autonomy kit for installation in fixed-wing airplanes and helicopters. Company officials say they plan to keep testing this through 2022.

Jonathan Hartman, strategy lead for Sikorsky Innovations, detailed some of the Matrix project and his experience in UAM. Military and commercial applications “share a common goal, which is safety, reliability, and assured mission execution,” he says. After all, both applications, whether used in today’s Black Hawk or the next generation’s flying car, need some of the same capabilities: sensing and avoiding obstacles, path planning, interpreting mission goals, re-planning and contingency measures.



The Sikorsky Autonomous Research Aircraft, or SARA, is a modified S-76B helicopter using the Matrix Technology autonomy system.

The FAA experts still are working on creating new standards and designs to make this a reality for commercial applications. They plan to use existing helicopter infrastructure services, include routes, helipads, and air traffic control services, wherever possible. Among the new standards will be those for new kinds of airports for vertical takeoff and landing aircraft like helicopters.

So far the FAA has a concept of operations written in June 2020 and a partnership with the U.S. National Aeronautics and Space Administration (NASA) in Washington, which is contributing with their Advanced Air Mobility National Campaign.

For its part, NASA has a campaign to “promote public confidence and accelerate the realization of emerging aviation markets for passenger and cargo transportation in urban, suburban, rural, and regional environments.” That refers to local missions of about 50 miles in rural or urban areas, and intraregional missions of as far as a few hundred miles.”

A lot of aerospace companies also are moving in this direction, including Honeywell, Hyundai in partnership with ANRA Technologies, Uber Elevate, and Lockheed Martin and its wholly owned subsidiary Sikorsky.

Real-world experience

Some realistic steps are coming at a broader level. In September 2020 the World Economic Forum and the City of Los Angeles documented principles for adding UAM to existing public transportation offerings. They argued that it would reduce pollution and take strain off of aging ground-level infrastructure. Along with input from a working group of more than 50 manufacturers, service providers, infrastructure developers, academics, community organizations, and government planners, they outlined principles for making urban air mobility a reality. Sikorsky is playing in this same realm with its own UAV efforts to position unmanned aircraft an alternative to lengthy automobile commutes.

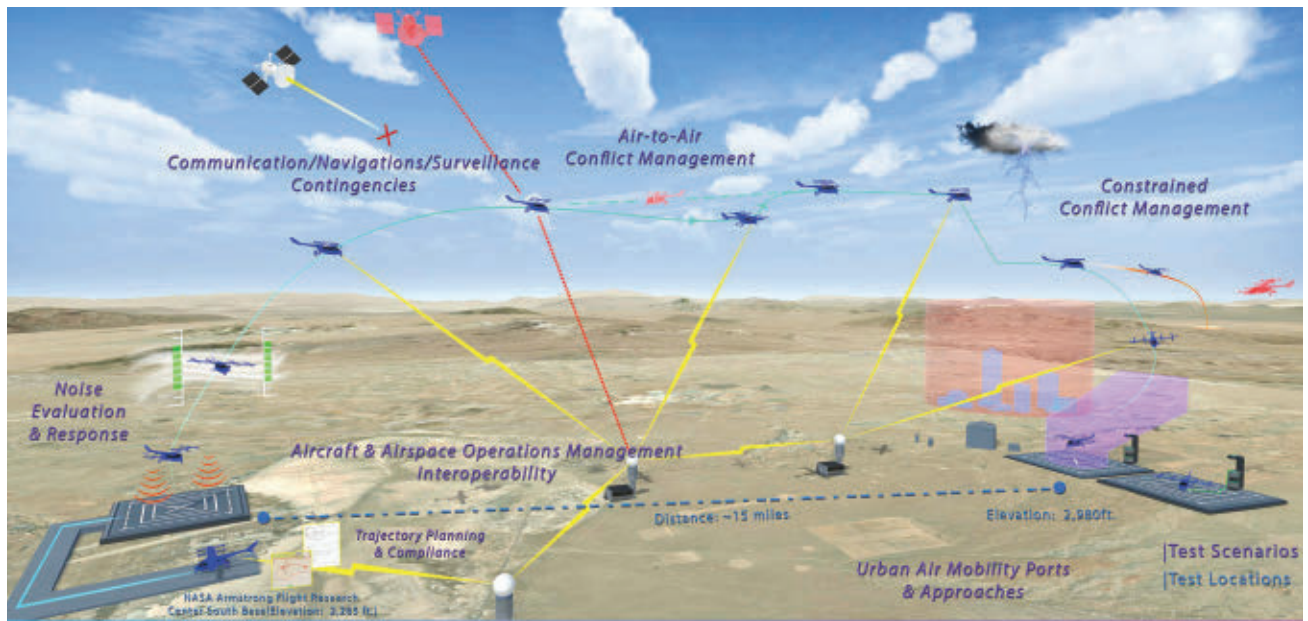
International studies such as the WiNDroVe project in Hamburg, Germany, also have taken off — often with Airbus as a partner. In São Paulo, Brazil, Airbus spinoff venture Voom flew 15,000 people before shutting down due to the COVID-19 pandemic. The project was to provide Airbus with information about the realities of future UAM businesses, by providing a working helicopter booking service. They found that 60 percent of people using the service were first-time helicopter customers, which may or may



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A NASA diagram showing the elements of UAM involved in the Grand Challenge developmental tests.

not indicate broad public interest in the helicopter as an alternative to a passenger car. One thing is clear: Airbus is continuing to invest in this area.

In Dubai, the city has been testing two-person 'flying taxis' run by German company Volocopter. Dubai also put out feelers to share information with the city in Linz, Austria. Market researcher Frost & Sullivan says about 50 cities have some kind of UAM viability project in place, if not the infrastructure and flights.

On the other hand, this potentially revolutionary step in transportation comes with dangers just like any other. In particular, there still is some skepticism as to whether the trend ever will become practical or safe enough for wide-spread public adoption. A Sikorsky S-76 crash leading to the death of retired basketball star Kobe Bryant, his daughter Gianna, and others cast some doubt on personal aircraft safety. Still, crashes never stopped the development of jet airplanes, so this could be seen either as an early warning for more common helicopter-style transportation or simply a tragic and largely independent accident.

Who is working on it?

The other main companies in this area have some interconnection among themselves and with NASA, as it is a relatively small field so far.

One of the first companies to try to make flying cars a reality in the contemporary world was Kitty Hawk in Palo Alto, Calif., backed by Google co-founder Larry Page.

Founded in 2010, it has publicly announced three vehicles, including the 2019 Heaviside, which marks its further strides toward the aerial version of an electric car. The Heaviside has a range of 100 miles on one charge and runs more quietly than a helicopter, Kitty Hawk claims. The company's position as one of the first companies in the field leaves them in an interesting position now, writes Forbes magazine.

At the same time as their name doesn't come up among the larger aircraft companies' partnerships and projects, Kitty Hawk also is trying to leapfrog its competitors by removing the pilot from the equation. A proposed larger version of Heaviside will operate with a pilot on the ground, who will handle several aircraft.

"It's a riskier path than going for a piloted aircraft but we believe the payout is 100X of what any piloted aircraft could be in terms of its business opportunity," Kitty Hawk CEO Sebastian Thrun told Forbes in June 2021.

The U.S. Air Force expressed interest in the commercial Heaviside aircraft for the experimental Agility Prime program in March 2021. Instead of being a combat vehicle, its proposed use would be for medical evacuation missions.

In terms of other commercial aircraft companies, Joby Aviation in Santa Cruz, Calif., and Volocopter in Bruchsal, Germany, "believe they'll win safety approval for their electric air taxis in 2023," writes Forbes. Officials of Beta Technologies in Burlington, Vt., say they plan to provide a



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The modified Black Hawk helicopter S-70 Optionally Piloted Vehicle (OPV) Black Hawk has full-authority, fly-by-wire flight controls.

cargo version of their aircraft to UPS and a passenger version in 2024 to Blade Urban Air Mobility in Denver.

Larger aircraft providers also are feeling out the potential of this new area. Designers at Hyundai Motors in Seoul, South Korea, are working on UAM as one of their future-forward projects, with a goal of commercializing UAM by 2028, officials announced in September 2020. Their project, developed in collaboration with Incheon International Airport Corp. (IIAC), Hyundai Engineering & Construction

Co., and KT Corp., involves using UAM vehicles as airport shuttles.

Hyundai has concept designs for this as well, involving vertiports, or 'UAM-PVB hubs'. The Hubs would be small, airport-like transit centers for personal vehicles in the air and artificial intelligence (AI)-augmented autonomous cars, which would travel in groups and serve as the primary method of ground transportation for the idea. By placing a helipad on top of the hub for the autonomous ground vehicles, the hub ideally would be a

relatively compact staging area for several kinds of autonomous travel.

The air vehicles involved would be five-person electric vertical takeoff and landing planes, with one of those seats intended for a human pilot. Hyundai is working with Uber Elevate in the construction of the vehicles.

"Hyundai is our first vehicle partner with experience of manufacturing passenger cars on a global scale. We believe Hyundai has the potential to build Uber Air vehicles at rates unseen in the current aerospace industry, producing high quality, reliable aircraft at high volumes to drive down passenger costs per trip. Combining Hyundai's manufacturing muscle with Uber's technology platform represents a giant leap forward for launching a vibrant air taxi network in coming years," Eric Allison, Head of Uber Elevate (since sold to Joby Aviation), said in a press release from Hyundai.

Like the Los Angeles project, Hyundai posits this as a solution that would cut down on traffic, as well as the associated 'social costs related to logistics transportation.' They also foresee it becoming more practical and useful as 'mega-urbanization' increases crowds in key high-density areas.

Sikorsky and Lockheed Martin also argue that it would save money, positing an operating cost of \$500,000 to \$2 million per landing spot for helipads compared to \$3 million to \$10 million per mile in U.S. urban areas for surface roads in U.S. urban areas.

"Sikorsky is a decade into its journey of developing the enabling technologies with applications to the urban air mobility market," says Chris Van Buiten, vice president of Sikorsky Innovations. "We were one of the first to quantify the benefits of electric propulsion for vertical lift aircraft. Our MATRIX Technology



Concept art for an autonomous transport hub including ground and air vehicles.

autonomy system, which is installed on a modified S-76B commercial helicopter, is on a path to FAA certification. And our advanced fleet management technologies leverage data intelligence daily to keep hundreds of our aircraft around the world flying safely.”

Enabling technologies

Data intelligence still must be part of the infrastructure around the autonomous aircraft included in most visions of the UAM future. The MATRIX system for autonomous flight runs on systems intelligence with military and commercial applications. It allows for zero, one or two pilots to take control of the aircraft depending on the circumstance and the application of autonomous flight. When it comes to civilian/commuter transport, all a pilot might have to do would be to communicate with air traffic controllers and watch out for unexpected situations.

Some of the considerations facing electric aircraft are not brand new; after all, safety needs to come first. “Remember, they’re operating in a real-world environment,” Sikorsky’s Hartman says. “Wind gusts, micro-weather, lightning, EMF, all of these fundamental facts of a city infrastructure that are going to impede on your vehicle, the vehicle has to be able to handle that and that all falls under the category of safety. While we’re pushing the limits of technology and battery performance, we can’t do that at the expense of safety.”

Electric propulsion offers its own limitations and benefits to UAM. While range may still be an issue, electrical propulsion on aircraft allows for freedom of placement in a way a propeller does not. Instead of running wires to a mechanical gearbox, electric propulsion has more freedom in terms

of where you can place components.

Electric propulsion also takes advances of some new developments in batteries, such as solid state electrodes as opposed to the liquid or polymer electrolytes in lithium-ion batteries.

“Technologies like solid state [have] the potential to remove really

harmful failure modes like thermal runaway and add performance to the aircraft,” Sikorsky’s Hartman says. “From an electric motor standpoint, it’s more about focus and creating electric machines that can adapt to the air vehicles as opposed to something like cars.”



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A Bell OH-58C Kiowa helicopter provided by Flight Research Inc. of Mojave, Calif., sits on a helipad at NASA's Armstrong Flight Research Center in California.

The change from past traditional semiconductor materials like silicon carbide to semiconductor technology that can take higher voltages and higher amps may unlock greater efficiency for vehicles as power-hungry as an electric aircraft.

"Some advancements in carbon nanotubes are starting to yield benefits in terms of reducing wire weight," Sikorsky's Hartman says, "and certainly some of the battery improvements we're seeing also are making their way over to the fuel cell community because batteries and fuel cells share many of the same components."

Traffic management solutions

While the autonomous flight element can be used for commercial and military efforts to deploy large, pilot-optional aircraft, the kind of commercial commuter use that really makes up urban air mobility projects as envisioned in cities requires traffic management for groups of vehicles as well as individual capability. Artificial intelligence can come in here, too, with some crossover with companies offering drone aerospace system management and fleet management.

Air traffic congestion comes with other problems as well. Urban air mobility introduces aesthetic and social complications: Will it ruin the view, or cause excessive noise? Will it be allowed to ruin the view in some neighborhoods and not others, the way the placement of highways caused neighborhoods and towns to boom or bust?

For example, a writer for the Thomas Reuters Foundation pointed out in June 2021 that some urban experts say Delhi's future-city initiative ignores the people who most need help, migrant workers and the poor. Riverside facilities, for example, could deprive farmers who rely on that land of their livelihood.

Sikorsky's Hartman pointed out that urban air mobility efforts are sometimes a matter of good communication between a manufacturer or project leader and an organization like the World Economic Forum and the cities it touches. While some of this conversation is a matter of not disrupting existing infrastructure, Hartman also imagines it as a way in which to offer better infrastructure for more people, over larger areas — as well as under disaster conditions. After all, medical response or disaster relief could use the same infrastructure as a resource.

"I do believe that vertical mobility actually has an opportunity to be more expansive in inclusiveness than other forms of transportation," Sikorsky's Hartman says. "With roads or subways or trains, when you build a mile of infrastructure you connect a mile of geography together. When you put two or three [UAM] landing spots down, you connect a very broad area with limited infrastructure cost. Buses and trains [are] less expensive from an infrastructure standpoint, but you need less infrastructure for the product [with UAM]."

Timelines and the future

The idea of one pilot, perhaps even located at a central hub on the ground, managing multiple mostly autonomous vehicles in case of emergency is the dream goal for some of these projects. But it will be a while until that becomes a reality.

The World Economic Forum reports that NASA predicts UAM is likely to be a commercially viable market for air metro services by 2028 — that is, as long as federal governments put regulations and policies in place to accommodate it.

In some ways, the infrastructure and capabilities for UAM and AAM are already in place. They're simply referred to as helicopters. "If you go to NYC today you will see Sikorsky helicopters moving folks around the city," Sikorsky's Hartman says. "New technology enables the cost to come down, enable those helipads to be closer to people, allows system to be expanded in through-put. But the ability to move people in three dimensions in highly populated areas such as cities today does exist."

The big change to come next might be that more of those helicopters are powered by electric propulsion, but to continue to operate in basically the same areas and roles.

Sikorsky's Hartman casts a bit of a longer timeline than the NASA report, saying that while electrification may become a bigger factor in next five years, it will probably

be a matter of decades before we could get to anything approaching a reliable flying car. However, Hartman proposes that some level of autonomy could “reduce the workload on trained pilots such that they can handle more complex situations and contingencies.”

And going from one pilot per vehicle to one pilot handling multiple vehicles also is a matter of cost. “If you look at the economics for UAM, part of how that is how do you reduce cost? The human economics of operating an air vehicle, if you reduce that you see a substantial cost reduction. So it’s not unexpected that there’s many companies in the space that say we’re going to [go from] a fully piloted aircraft, to an operated aircraft, to a sort of tended aircraft, getting to a one to many system. I think we have a ways to go, and that’s a trust factor with the certifications and quite frankly with the OEMs [before we can get there].”

In the end, one of the mitigating factors for AAM and UAM might be a basic human need: trust. Customers, manufacturers and government and/or military clients need to be sure the system is, above all, safe and reliable. ←

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SOSA standard taking hold in military embedded computing

The Sensor Open Systems Architecture (SOSA) seeks to ensure rapid upgrades and technology insertion, no vendor lock, and accommodation of existing standards

BY Jamie Whitney

Government and industry partners are working together to ensure that technology is vendor-neutral and easily upgradable thanks the Sensor Open Systems Architecture (SOSA) Consortium.

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

SOSA is heavily influencing the backplane and chassis development in military embedded computing applications, and is driving development of backplanes, chassis, connectors, high-speed switch fabrics, VME, VPX, CompactPCI, PCI Express, and embedded computing computer boards.

The high-level goals of SOSA include openness and being platform- and vendor-agnostic while being aligned with Modular Open Systems Approach (MOSA) using standardized software and hardware. The consortium aims to leverage existing and emerging open standards and align with U.S. Department of Defense (DOD) service objectives. Finally, SOSA aims to keep technology affordable and adaptable.

While the consortium buttons up its rules ahead of the pending "1.0" release, SOSA still is attracting members from the military embedded computing industry.



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Continuing to add companies

In July, officials of Atrenne Computing Solutions, a Celestica company in Brockton, Mass., announced that their company has joined the SOSA Consortium.

"Atrenne fully embraces and looks forward to supporting the development of the SOSA Technical Standard for the defense industry," says Jim Tierney, vice president of defense and aerospace systems at Atrenne. "Our long and strong history of designing and manufacturing technology geared towards the success of the military ecosystem will certainly be center stage in our collaborative efforts within the SOSA community."

Also in July, executives of Pixus Technologies in Waterloo, Ontario, announced the launch of Pixus Technologies USA Corp. in Tonawanda, N.Y., near Buffalo.

"The opening of Pixus USA provides a convenient, U.S.-based pathway for many of our key customers," says Justin Moll, vice president of sales and marketing for Pixus Technologies USA. "The U.S. group positions Pixus as one of the premier providers of backplanes, enclosure platforms, and specialty products in the North American embedded computer market. Our USA team will also be active in the SOSA Consortium and continue to develop SOSA-aligned and OpenVPX innovations."

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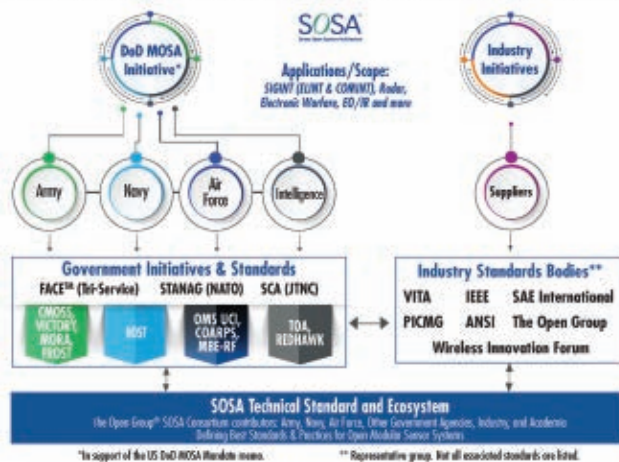


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The Sensor Open Systems Architecture™ Approach: Leverage Existing Open Standards



Graphic courtesy of The Open Group's SOSA Consortium.

Pentagon parameters

In 2019, the DOD issued a directive to the U.S. Army, Navy, and Air Force dubbed the "Tri Services Memo. The use of modular open standards is a "warfighting imperative" according to the DOD.

"After each of the three services had previously developed their own open standard initiatives, with many common elements, they all converged their efforts into the single SOSA initiative," says Rodger Hosking, vice president of Mercury Microelectronics (formerly Pentek) in Upper Saddle River, N.J.

"Due to strong support and participation from all levels of DOD, the MIL-AERO vendor community, defense research facilities, and universities, SOSA will soon release its Technical Standard Rev 1.0," Hosking says. "This will drive DOD procurement requirements going forward, with program awards going to those vendors submitting proposals for products and systems with high SOSA content. When released, the standard is expected to include a limited subset of OpenVPX standards and profiles including boards, backplanes, chassis and switch fabrics, but not those other form factors."

Benefits to open standards

Mark Grovak, the director of the avionics business development segment of Curtiss-Wright Defense Solutions based in Ashburn, Va., notes that the DOD's support of SOSA can enable companies to expedite companies to develop products aligned with the SOSA technical standard.

"This will make adoption easier and faster for the DOD," Grovak says. "By defining common characteristics

for hardware and software, SOSA mitigates vendor lock-in. Integrators are free to choose best-of-breed solutions without feeling bound to a specific vendor for fear of escalating costs and integration burden. This freedom creates more competition between vendors, as they can no longer count on recurring revenue from customers facing vendor lock-in. On the flip side, it also creates new opportunities to seize business where a competitor is the incumbent. Ultimately, it motivates vendors to engineer more innovative products, lower prices, or create new value propositions - such as life cycle management services."

Mercury's Hosking says that the DOD and its suppliers benefit from platform-agnostic hardware.

"The defense community benefits from platform reusability, shorter procurement cycles, easier insertion of new technology, and a stronger, multi-vendor supply chain," explains Hosking. "Defense contractors are able to protect their intellectual property, because SOSA does not require vendors to disclose technology, software, and processes within their SOSA products. Instead, vendors will compete on innovation, performance, capabilities, and price. SOSA will benefit smaller vendors who can develop new technology SOSA products for the larger primes, helping them improve the SOSA content of their proposals to help them win awards, and also speeding delivery."



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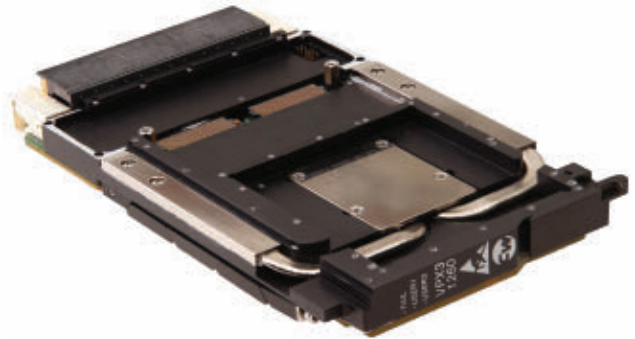
SOSA experts at Elma Electronic in Fremont, Calif., say that SOSA helps solve problems with integrating and upgrading components in embedded military systems. “There are two long-standing problems suffered by the development of high-performance electronic systems in the mil-aero sector,” says Mark Littlefield, senior manager of ECP and systems solutions; Ken Grob, director of embedded computing technologies; and Valerie Andrew, SOSA BWG outreach committee lead, in a joint statement.

“The first is the difficulties of integration, both from components from different suppliers as well as for highly engineered custom backplanes designed specifically for the board complement chosen,” the Elma officials say. “The second is the virtual vendor-lock that the choice of boards triggers, making replacement or future upgrades from other suppliers all but impossible.”

Standards-based platforms and vendor-agnostic components address these problems by reducing development cycle time and costs, while accelerating rapid technology insertion; encouraging interoperability and commonality/reuse across multiple platforms; creating a broader vendor ecosystem for sourcing components and open competition; lowering systems integration costs and risk; and supporting improved capability evolution.

Memory experts at SMART Modular Technologies in Newark, Calif., say that using standardized memory and storage components for MIL-AERO systems can help to reduce costs.

“Common semiconductor components — controllers, NAND Flash, DRAM, etc. — can be leveraged across many



Curtiss-Wright’s the VPX3-1260 family of high-performance single-board computers is made for demanding defense and aerospace applications like mission computing; image and display processing; and intelligence, surveillance, and reconnaissance (ISR) systems.

products,” says SMART’s Michael Guzzo, who serves as the company’s senior manager. “We are seeing this on many fronts. The ability to securely attach industry standard components and to help mitigate heat has helped the mil-aero system designers bridge the gap from proprietary designs to industry standards. There are many devices available from industry including mechanical clips, adhesives and many different heat dissipation techniques.”

The experts at Elma also explain that the SOSA Consortium along with its sister consortium Future Airborne Capability Environment (FACE) are among the first in embedded hardware to be driven jointly by both industry and government.

“Previous open standards have been widely adapted by the defense and government agencies, those standards were primarily driven by industry, with the subsequent

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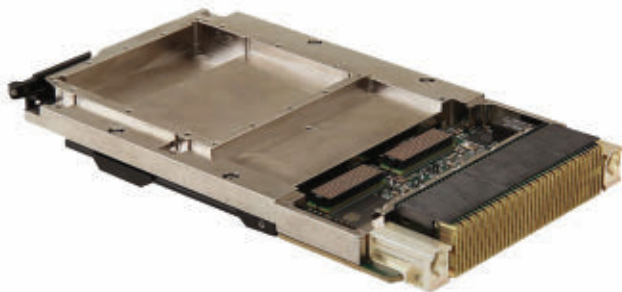
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Curtiss-Wright's The CHAMP-XD1S digital signal processor (DSP) is designed to offer high performance and hardened security for compute-intensive applications, and is aligned to the I/O Intensive Profile.

products being implemented into custom or semi-custom integrated solutions delivered by prime integrators and contractors," Elma officials explain. "It should also be noted that SOSA — and related open systems efforts — are going to have a profound impact on the embedded systems development community worldwide — well beyond the core SOSA community. The ease of system design and integration that SOSA aligned products enable, along with the potential for breaking vendor-lock regarding future technology insertions can be enjoyed by anyone worldwide. We are already seeing activity in both the UK and Europe that shows a real up-tick in interest in the SOSA Technical Standard, and the first real market interest in SOSA aligned products."

Seamless sharing

Curtiss-Wright's Grovak says that a lack of interoperability creates a significant issue with proprietary, non-MOSA solutions to share information between machines.

"These solutions are designed to operate in isolation and, as a result, are difficult and time-consuming to deploy on platforms where systems and people must work together to ensure personnel safety and mission success," Grovak says. "One of the main benefits of leveraging common standards is that it ensures interoperability between sensors and systems. Sensor data and system output can be seamlessly shared between machines on the same platform, providing complete and accurate situational awareness.

"This capability is particularly critical in GPS-degraded or -denied environments, for example, Grovak continues. "When factors such as tall buildings, heavy foliage, underground positions, or adversaries compromise GPS signals, warfighters rely on data from multiple technologies to arrive

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at a positioning, navigation, and timing (PNT) truth. Assured PNT (A-PNT) computing solutions must amalgamate and process data from these sources exceptionally quickly. Once processed, this information must be made available to various systems and clients on the platform.”

Cooling challenges

While SOSA experts agree that the open standard approach benefits both industry and the military, there are still challenges in keeping compact embedded systems cool.

“One of the key challenges of new SOSA configurations is cooling

the chassis,” says Pixus’s Moll. “With plug-in OpenVPX boards that are often more than twice as hot as they were just a few years ago, it is critical to ensure proper thermal management. One such example where this problem is resolved is Pixus’s OpenVPX chassis for 6U boards that leverages a VITA 48.8 airflow approach. Thermal simulation is also increasingly important to utilize in developing SOSA systems and can point to the best cooling strategy.”

In addition to keeping systems cool, Curtiss-Wright’s Grovak explains that industry still needs to meet the DOD’s size, weight, power, and cost (SWaP-C) needs.

“Historically, adding functionality meant equipping a vehicle with a new standalone system — a.k.a., the ‘bolt-on’ approach. Each of these line replaceable units (LRUs) came with its own cabling, power supply, and thermal management equipment — all adding no value to the platform while taking up additional space and costing extra budget. This duplication not only puts a strain on space and power consumption but creates unnecessary integration complexity and hazards for the warfighters occupying the vehicle. What’s more, finding the space to add an LRU comes down to more than just physical volume. The options for placing a new LRU may be limited by mounts and harnesses, and the orientation of an LRU’s connectors can make finding the suitable space to accommodate the system a challenge.”

Grovak says that Curtiss-Wright offers a wide variety of embedded computing aligns with the SOSA technical standard, including the company’s the VPX3-1260 family of high-performance single-board computers for demanding defense and aerospace applications like mission computing; image

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and display processing; and intelligence, surveillance, and reconnaissance (ISR) systems.

Based on Curtiss-Wright's VPX3-1260 core design, the computer boards have the 9th Gen Intel Coffee Lake Refresh Xeon E-2276ME processor, to speed and simplify the integration of the Xeon E processor's cutting-edge capabilities.

The I/O Intensive computer board variant of the VPX3-1260 provides a DisplayPort video interface that supports hardware-accelerated graphics to 4K resolution. It also offers PCI Express expansion, USB and SATA storage interfaces, and external serial and GPIO/DIO connections. An on-board XMC mezzanine site supports expansion options.

Moll highlights the Pixus quick-turn development chassis, which is aligned with the SOSA technical standard.

"The highly versatile open frame enclosure has four VPX slots and four VITA 67.3c slots which are common to SOSA boards," Moll says. "The PSU is modular and the fan speed is adjustable with a dial. "The power and ground only backplane offers SOSA clocking as well as configurable options to accept profiles like the 14.6.11 configuration that have a special grounding row in the connector wafer. Customers can use Meritec cables to route the slots as needed."

Mercury's Hosking says the company's the Quartz RFSoc Model 6003 was made with the SOSA technical standard in mind.

All control and data paths are accessible by the RFSoc's programmable logic and processing system. The Xilinx Zynq UltraScale+ RFSoc

Gen 3 integrates eight RF-class A/D converters and D/A converters into the Zynq FPGA fabric along with quad ARM Cortex-A53 and dual ARM Cortex-R5 processors, creating a multichannel data conversion and processing solution on a single chip.

The QuartzXM Model 6003 is pre-loaded with a suite of IP modules to provide data capture and processing solutions for many common applications. Modules include DMA engines, DDR4 memory controller, test signal and metadata generators, data packing and flow control. The board comes pre-installed with IP for triggered waveform and radar chirp generation, triggered radar range gate engine, wideband real-time transient capture, flexible multi-mode data acquisition and extended decimation. ←

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Navy researchers clear Logos persistent-surveillance sensors for further development

BY John Keller

ARLINGTON, Va. — U.S. Navy researchers have cleared Logos Technologies LLC in Fairfax, Va., to continue development of the Spectral and Reconnaissance Imaging for Tactical Exploitation (SPRITE) wide-area motion imagery (WAMI) sensor pod.

Officials of the Office of Naval Research (ONR) in Arlington, Va., say Logos has met all the goals of its five-year contract with ONR for the SPRITE system.

ONR experts supervised a test flight of the U.S. military version of the company's platform-agnostic Multi-Modal Sensor sensor pod (MMSP) aboard a manned Cessna 337 Super Skymaster general aviation aircraft.

The Logos MMSP houses WAMI, hyperspectral, and inspection sensors, and processes the data onboard manned or unmanned aircraft in real time.

The MMSP persistent-surveillance sensor pod can cover an area the size of a city; offers cross-sensor cueing; can stream video on as many as 10 windows, depending on datalink bandwidth; and offers user-defined watchboxes and alerts; offers multiplexed motion videos for several user-defined locations; provides transmission to mobile devices over an internal datalink; and archives data every four to eight hours.

"We had SPRITE flying between four and five hours a day for a whole week," says Chris Stellman, lead principal scientist and program manager for Logos Technologies. "We were able to use SPRITE's sensor modalities to detect signatures of interest, process that data on the fly, and stream it down in real time to users on the ground."

The SPRITE sensor pod houses an ultra-light Logos Technologies RedKite

Photo (above): The SPRITE wide-area motion imagery (WAMI) sensor pod from Logos Technologies has received military okay for further development.

WAMI sensor, a high-definition spotter camera, and commercial shortwave infrared hyperspectral sensor.

In addition, SPRITE contained a Logos palm-sized multi-modal edge processor (MMEP) to process the raw data being produced by all three sensors, in real time, and cross cue between the sensors.

The MMEP is the brains of the SPRITE sensor pod," Stellman says. "It's what makes data actionable to the warfighter and searchable to the analyst." ◀

For more information contact Logos Technologies online at www.logotech.net, or the Office of Naval Research at www.onr.navy.mil.

Microwave electromagnetic weapons may prevail in the battle to defeat unmanned swarms

The U.S. military is racing to deploy new weapons to tackle the threat from small unmanned aerial vehicles (UAVs). That means countering several attackers simultaneously, and microwave-based electromagnetic weapons are considered the obvious choice. From China's 48-cell barrage launcher to Israel's successful deployment of a combat swarm in Gaza, swarming drones are becoming a battlefield reality. Swarm attacks easily can overwhelm existing missile and gun systems. Laser weapons may look like a solution: precise, speed-of-light-operation, and an infinite magazine, but they have a problem with dwell time. This is the amount of time necessary to hold the laser on target to bring it down. A typical tactical laser can take as long as five seconds. If a laser weapon only can acquire small drones from two kilometers away, then a few dozen cheap drones will overrun the million-dollar laser. Microwaves work differently. A burst of high-intensity microwaves will overload electronics, causing many failures and knocking a drone out of the sky instantly. The microwave weapon also can swat whole unmanned swarms at once.

Lockheed Martin to build JAGM air-to-ground missile with multimode seeker

Missile experts at Lockheed Martin Corp. will build advanced air-to-ground missiles for unmanned aerial vehicles (UAVs) and manned attack helicopters under terms of a \$13.5 million order. Officials of the Army Contracting Command at Redstone Arsenal, Ala., are asking the Lockheed

Martin Missiles and Fire Control segment in Orlando, Fla., to build Joint-Air-to-Ground Missile (JAGM) systems, which will replace U.S. Army and Navy inventories of Airborne TOW, Maverick, and Hellfire air-to-ground missiles. Lockheed Martin is developing the JAGM for launch from the Army AH-64 Apache attack helicopter, the Army MQ-1C Gray Eagle unmanned aerial vehicle (UAV), the Navy MH-60R helicopter, and the Marine Corps AH-1Z Viper attack helicopter. The Lockheed Martin JAGM has a multi-mode guidance section with semi-active laser (SAL) sensor for precision-strike and a fire-and-forget millimeter wave (MMW) radar for moving targets in all-weather conditions. The small missile is nearly six feet long, seven inches in diameter, and

weighs 108 pounds. JAGM can engage several different stationary and moving targets in the bad weather, smoke and dust, and advanced countermeasures. Laser and radar guided engagement modes enable JAGM to strike accurately and reduce collateral damage, Lockheed Martin officials say. JAGM's targets include moving and stationary armored combat vehicles; air defense units; patrol craft; artillery; missile launchers; radar sites; command-and-control nodes; bunkers; and other structures in urban and complex terrain. On this order Lockheed Martin will do the work in Orlando, Fla., and should be finished by September 2024. For more information contact Lockheed Martin Missiles and Fire

Continued on page 33



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DARPA eyes nanocrystalline materials-based X-ray imaging for non-destructive testing

BY John Keller

ARLINGTON, Va. — U.S. military researchers are asking industry determine the feasibility of a new generation of X-ray imaging technology for applications like non-destructive test and evaluation, elemental analysis, parts qualification, and high-contrast medical imaging.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a small business innovative research (SBIR) opportunity for the Extreme Photon Imaging Capability- Hard X-ray (EPIC-HXR) project.

The EPIC-HXR seeks to develop uncooled hard X-ray imagers based on advanced nanocrystalline materials with high spatial and energy resolution at a Technology Readiness Level (TRL) of 5, which means that components can be validated in simulated or real-space environment.

Nanocrystalline materials include quantum dot and perovskite material systems, which have generated interest because of their properties such as tunable bandgap energies, quantum confinement, multi-exciton generation, and phonon quenching.

Such materials hold promise as high-performance photon absorbers able to operate at room temperature and can be tailored to the hard X-ray region of the electromagnetic spectrum for applications like non-destructive testing and high-contrast medical imaging.

In addition, these materials often are amenable to solution processing to enable production of low-cost imagers with small pixel sizes by avoiding hybridization with complementary metal oxide semiconductor (CMOS) or emerging indium gallium zinc oxide (IGZO) readout circuitry.

Still, challenges like poor charge transport, limited scalability of assembly processes, limited lifetimes or poor stability remain before such materials can help produce practical devices, DARPA researchers point out.

From room-temperature nanocrystalline hard X-ray imagers, researchers want energy resolution of less than 2 percent; spatial resolution of less than 55 microns; energy range of 5 to 300 kilo-electron volts (keV); area larger than 30 by 30 centimeters; and absorption equivalence of less than 50 percent stopping power.

Phase-one of the EPIC-HXR project a feasibility study that should demonstrate the scientific, technical, and commercial merit and feasibility of a basic device design and credible process flow.

Activities could include device modeling, materials modeling, basic material synthesis, assembly experiments, characterization, and identification of Key requirements for materials and interfaces. The project also should identify the technical challenges of scaling the absorbing material to size and thickness. ←

Companies interested were asked to submit proposals by 28 Sept. 2021 online at www.sbir.gov/content/submission-proposals. Email questions or concerns to HR001121S0007@darpa.mil, with BAA HR001121S0007-21 in the subject line. More information is online at <https://sam.gov/opp/d1816a9e-3b4a476aa07247c02f899411/view>.



Could new X-ray imaging technologies help improve non-destructive test and evaluation and parts qualification? Military researchers want to find out.

Continued from page 31

Control online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at www.acc.army.mil/contractingcenters/acc-rsa.

Nokia offers military-grade rugged smartphone for defense applications

The maker of Nokia-branded phones introduced its latest line of three new devices on last month, including a military-grade smartphone that's equipped with 5G capabilities. HMD Global, which was created by former Nokia executives in 2016 and bought Nokia's ailing mobile phone unit back from Microsoft in a \$350 million deal, say the new Nokia XR20 smartphone will be the most durable phone its ever created. "Built to survive anything life can throw at you, the Nokia XR20 can withstand much more than you'll ever demand of it," Nokia officials say. The tough XR20 phone comes with a 6.67-inch Gorilla Glass Victus display and can resist damage from scratches and drops from as high up as about 6 feet, according to the company. On

top of its toughness, the rugged XR20 comes with ultra-fast 5G internet capabilities and has a 48-megapixel and 13-megapixel dual-lens main camera. It's available in black and blue.

Army explores enabling technologies for the future battle tank

Though the current main battle tank, the M1 Abrams, is expected to hum along in the center of the armored formation for decades to come, some kind replacement is on its way. Rather than swapping a tank for a tank, most experts in the field are looking to a family of vehicles and vetronics architectures that will take tank-like capabilities and spread them across manned and unmanned platforms for better survivability. The Army is doing more than simply upgrading existing vehicles and fueling the next steps in ground fighting over the coming decade. Scientists at the U.S. Army Research Laboratory at Aberdeen Proving Ground, Md., such as Zabinski and Dr. Scott Schoenfeld, senior scientist for terminal ballistics,

are envisioning how to do the work of armor without armor. The key to that is distributing the functions of a tank, such as sensors, vetronics, firepower, protection. Some of that still involves heavy metal moving around the battlefield — sometimes with a crew; sometimes without. But protection can also mean not being seen, or even being seen as something else.

Electronic protection (EP) takes high priority vs. top adversaries

The U.S. Department of Defense (DOD) risks failing to achieving electromagnetic superiority against top adversaries because military leaders silo different aspects of electronic warfare (EW) across various portfolios. Dave Tremper, director of electronic warfare for the Office of the Secretary of Defense, was referring to electronic protection (EP), which involves shielding systems from spoofing or jamming. He has made electronic protection one of his top priorities since getting into the job — even though he does not have responsibility for protecting systems from EW of top adversaries. ◀



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Northrop Grumman to build radar-hunting AARGM missiles for combat jets

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy air warfare experts are ordering another batch of the AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) to equip the service's carrier-based fighter-bombers, electronic warfare (EW) jets, and allied combat jets.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a \$94.9 million contract to the Northrop Grumman Corp. Innovation Systems segment (formerly Orbital ATK) in Northridge, Calif., for lot 10 full-rate-production of the AARGM anti-radar missiles.

The contract includes conversion of 87 U.S.-provided AGM-88B High Speed Anti-Radiation Missiles (HARMs); and 40 Germany Air Force-provided AGM-88B HARMs into 127 AGM-88E AARGM all-up-rounds for the F/A-18C/D and

F/A-18E/F jet fighter-bombers, and EA-18G electronic warfare (EW) jet for the Navy and U.S. allies.

The AARGM radar-hunting missile is the newest version of the AGM-88 missile, and is compatible with U.S. and allied strike aircraft, including the F/A-18 fighter bomber, EA-18G electronic warfare jet, F-16, and F-35.

The AARGM features an advanced digital anti-radiation homing sensor, millimeter wave radar terminal seeker, global positioning system/inertial navigation system (GPS/INS) guidance, net-centric connectivity, and weapon-impact-assessment transmit (WIA).

The AGM-88E enables the U.S. Navy, U.S. Marine Corps, and allied combat jets to attack and destroy enemy air defenses and time-critical mobile targets.

The AARGM features new software and enhanced capabilities to counter radar shutdown and passive radar using an additional active millimeter wave seeker. Previous versions of the missile could be spoofed by turning off radar before the weapon could lock on to their signals. ←

On this contract, Northrop Grumman will do the work in Northridge, Calif., and Ridgecrest, Calif., and should be finished by March 2024. For more information contact Northrop Grumman Corp. online at www.northropgrumman.com, or Naval Air Systems Command at www.navair.navy.mil.

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The AARGM radar-hunting missile is the newest version of the AGM-88 missile, and is compatible with the F/A-18 fighter bomber, EA-18G electronic warfare jet, F-16, and F-35.



Kratos to build target drones to help pilots launch air-to-air missiles

BY John Keller

EGLIN AIR FORCE BASE, Fla. — Kratos Unmanned Aerial Systems Inc., Sacramento, Calif., will build BQM-167A Air Force Subscale Aerial Target (AFSAT) drones under terms of a potential \$338.1 million U.S. Air Force contract.

Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., are asking Kratos to build lots 17 to 21 of the BQM-167A aerial target drones. The contract includes out-of-warranty-repairs and contractor logistics support.

The BQM-167A provides Air Force combat aircraft pilots to practice launching air-to-air missiles. The drone carries 115 gallons of fuel to enable the unmanned aircraft to operate for long periods, which increases the number of presentations per launch, Kratos officials say.

The BQM-167A supports missions with a several different internal and external payloads, including scoring, identification friend or foe (IFF), passive and active radar augmentation, electronic countermeasures, infrared plume pods, and internally stored chaff and flares.

The BQM-167A AFSAT is a high-performance, remotely controlled subscale aerial target drone that helps combat aircraft pilots prove the value of advanced air-to-air weapons. Kratos builds the BQM-167A of carbon fiber and epoxy-based

The Kratos BQM-167A Air Force Subscale Aerial Target (AFSAT) drones will help U.S. combat pilots practice their skills in launching air-to-air missiles.

materials that help increase performance and endurance compared to previous targets, which were built mainly of aluminum, Air Force officials say.

The BQM-167A can reach speeds from 230 to 600 knots true airspeed at sea level, and can perform G-turns to 9Gs, and other aerial acrobatic turns that emulate high-performance jet fighter aircraft.

The drone is 10 feet long, has a 10.5-foot wingspan, can fly nearly at the speed of sound, and operates at altitudes from 50 feet to 50,000 feet above sea level.

Experts from the Air Force 53rd Weapons Evaluation Group at Tyndall Air Force Base, Fla., will use the BQM-167A target drones to test and evaluate air-to-air weapon systems and for evaluation and training exercises on the Gulf Range Complex and other authorized U.S. military test ranges. ←

For more information contact Kratos Unmanned Aerial Systems online at www.kratosdefense.com, or the Air Force Life Cycle Management Center at www.afcmc.af.mil.



Northrop Grumman develops UUV payload delivery system for sensors and weapons

BY John Keller

ARLINGTON, Va. — Undersea warfare experts at Northrop Grumman Corp. are moving forward with a project to build and test an advanced undersea payload delivery system for future extra-large unmanned underwater vehicles (XLUUVs) under terms of a \$3.4 million order.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., are asking the Northrop Grumman Mission Systems segment in Annapolis, Md., to support the second phase of the Hunter program to develop a payload-delivery system for a large unmanned underwater vehicle (UUV). The Hunter program involves only the payload delivery system and not the extra-large UUV itself.

DARPA Hunter for unmanned submarines payloads is a 45-month program in three phases: the first to design and build the payload delivery device to fit inside a government-provided payload module; and the second and third phases to support integration of the payload delivery device into the big UUV for testing. Technical details of the Hunter program are classified.

Northrop Grumman won a \$9.9 million DARPA Hunter phase-two order in June 2019. Two years before that, the company won a \$5.8 million Hunter phase-one contract.

This is a competitively awarded contract to support phase-two of the DARPA Hunter program to support integration of the payload delivery device into the XLUUV and perform testing. Northrop Grumman is integrating the XLUUV

Photo: Northrop Grumman is developing a payload-delivery system for a future large unmanned underwater vehicle (UUV).

payload delivery system for persistent-surveillance sensors, weapons, other UUVs, and unmanned aerial vehicles (UAVs).

The Boeing Co. Defense, Space & Security segment in Huntington Beach, Calif., won a \$43 million order in February 2019 from U.S. Naval Sea Systems Command in Washington to build four Orca XLUUVs that could undertake long-endurance missions to deploy sensors or other UUVs.

Extra-large UUVs and their weapons and sensors typically are autonomous mini-submarines that measure about seven feet in diameter — sometimes larger. They are designed for launch from shore, from large military ships with well decks, or from large civil vessels with moon pools.

Now Northrop Grumman will continue integrating Hunter payload-delivery systems for large unmanned submarines like the Boeing Orca.

One of the U.S. military research projects that have led to the Boeing Orca XLUUV and the Northrop Grumman Hunter XLUUV payload-delivery system has been the Large Displacement Unmanned Undersea Vehicle (LDUUV) of the U.S. Office of Naval Research (ONR) in Arlington, Va. ←

For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, Boeing Defense, Space & Security at www.boeing.com, or DARPA at www.darpa.mil.

Russia employing mile-long sonar on UUVs to hunt U.S. submarines

Russia is working on a new trick to track American submarines: sonar-equipped unmanned underwater vehicles (UUVs). Russia is testing UUVs equipped with sonar towed arrays, according to the newspaper Izvestia. Attached to long, flexible tethers more than a mile long, towed sonar transmitters and receivers are far enough from the noise of the towing surface ship that they suffer less interference. The downside is that like a car towing a U-Haul trailer, the towing ship moves more slowly and has to maneuver more carefully to avoid snapping the tether. So why not attach the sonar and tether to a remote-controlled underwater robot that can operate detached from the mother ship, which can enjoy the advantages of a towed array without being hampered by it? Externally, the towing robot resembles a small submarine with a keel and several depth rudders, Russian Navy officials told Izvestia. It is located at the end of the antenna and adjusts the depth of its immersion, as well as if necessary, taxiing during the maneuvers of the ship.

Researchers take a new approach to machine autonomy for unmanned combat vehicles

The U.S. Army Research Laboratory (ARL) in Adelphi, Md., has begun using its own new autonomy stack to speed development of its unmanned ground vehicles (UGV) program during a one-year sprint. By owning its autonomy tech stack — all the layers of technology that support applications and development — rather than depending on a contractor for it, ARL has more control over its Scalable, Adaptive and Resilient Autonomy (SARA) program to improve how autonomous combat vehicles drive themselves. Namely, it gave the lab more flexibility to assign research roles to partners to be more deliberate about what groups do and how they use the tech stack to fuse their efforts. The SARA program kicked off its one-year sprint last year, working with eight collaborators from across the country that each was given a specific part of the complex world of machine autonomy to engineer new solutions to, instead of putting out broad requests for proposals.

Continued on page 39

Dual Channel mini PCIe Reference Design for MIL-STD-1553



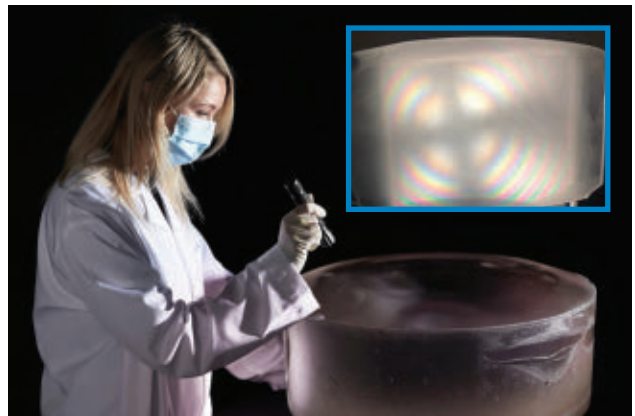
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Five companies to design future armored combat vehicles with vetronics and machine autonomy

BY John Keller

WARREN, Mich. — U.S. Army land warfare experts are choosing five defense contractors to design next-generation fast armored combat vehicles and vetronics architecture to replace the Army M2 Bradley Fighting Vehicle.

Officials of the Army Contracting Command at Detroit Arsenal in Warren, Mich., announced five separate contracts — each worth \$26.6 million — on 23 July for the Optionally Manned Fighting Vehicle (OMFV) phase-two concept design.

The OMFV will be able to operate with or without a human crew, and will emphasize advanced electronics, machine autonomy for operating in unmanned mode, a 30-millimeter cannon, and a second-generation forward looking infrared (FLIR) sensor system for fighting at night, in bad weather, or in smoke and haze.

Contractors chosen to design competing OMFV versions are American Rheinmetall Vehicles LLC in Sterling Heights, Mich.; the BAE Systems Platforms & Services segment in Sterling Heights, Mich.; General Dynamics Land Systems in Sterling Heights, Mich.; Oshkosh Defense LLC in Oshkosh, Wis.; and Point Blank Enterprises Inc. in Miami Lakes, Fla.



The Army is asking five companies to start initial design of the Optionally Manned Fighting Vehicle (OMFV) phase-two concept design.

The OMFV is part of a future family of Army combat vehicles encapsulated in the Next-Generation Combat Vehicle (NGCV) program to design several armored vehicles and vetronics to add new capabilities to Army units and replace existing platforms that are nearing the end of their service lives.

The NGCV program contains the OMFV to replace the Bradley Fighting Vehicle; the Armored Multi-Purpose Vehicle (AMPV) to replace the M113 armored personnel carrier; the Mobile Protected Firepower (MPF) light tank for Infantry Brigade Combat Teams (IBCTs); the Robotic Combat Vehicle (RCV) of three unmanned ground vehicles in light, medium, and heavy configurations; and the Decisive Lethality Platform (DLP), the replacement for the M1 Abrams main battle tank.

The M-2 Bradley, which the OMFV is to replace, has been in service since 1981. It moves infantry on the battlefield and provides fire support and attacks enemy armored fighting vehicles. The Bradley is reaching the technological limits of its capacity to accommodate new electronics, armor, and defense systems.

Army leaders say the OMFV should be optionally manned, in that it must be able to conduct remotely controlled operations while the crew is not aboard. The future vehicle should have no more than two crewmen, and be able to carry as many as six infantry soldiers.

The C-17 cargo jet should be able to carry two OMFVs and have them ready for combat within 15 minutes of landing. The new vehicle should be able to fight in urban terrain, super-elevate weapons, and simultaneously engage threats using main gun and an independent weapons system.

The OMFV also should have sufficient protect to survive on today's and tomorrow's battlefields, and be able to carry extended-range medium-caliber, directed-energy, and missiles, and should be able to hand-off targets to infantry soldiers on foot, in vehicles, and to unmanned systems. ←

The OMFV also should have onboard embedded training systems, advanced power systems, reactive armor, active protection, artificial intelligence (AI), directed-energy weapons, and advanced target sensors.

Unmanned tracked vehicle could evacuate wounded, recharge batteries, or carry cargo

At first glance, the Expeditionary Modular Autonomous Vehicle (EMAV) looks like the bottom half of a tank. It is a tracked vehicle, but one small enough to fit inside the hold of a V-22 Osprey aircraft. The vehicle, which the Marine Corps tested in North Carolina in June, is a literal platform for the future. As the Marines plan towards not just mechanized but wars of the 2030s, the EMAV will be there, a sometimes autonomous unmanned truck carrying wounded Marines on stretchers, or whatever else it needs to. The EMAV is powered by a diesel-electric hybrid engine that enables it to run parts of its missions silently. It also can, with fuel on hand, provide electrical power for the Marines using it in the field. Its body weighs 7,000 pounds baseline, with capacity for as much as 7,000 more pounds of attachments, sensors, weapons, or cargo. Fitting the robot inside a V-22 is crucial to the entire Marine Corps conception of future warfare. The vertical-takeoff and landing Osprey can transport 24 people in seats (or 12 on stretchers) in and out of small clearings zones, allowing it to get right into the action.

Multi-intelligence sensors fly for first time on MQ-4C long-range reconnaissance UAV

A Northrop Grumman MQ-4C Triton drone equipped with an upgraded multi-intelligence sensors package called Integrated Functional Capability Four (IFC-4), has taken to the air for the first time. The turbofan-powered robotic aircraft in its new configuration is being developed by the Northrop Grumman Corp. Aeronautics Systems sector in San Diego for the U.S. Navy and the Royal Australian Air Force (RAAF) for advanced long-endurance maritime intelligence, surveillance, and reconnaissance. Since its first test flight in 2013, the subsonic Triton unmanned aerial vehicle (UAV) has grown in capabilities that have transformed it from a maritime-patrol remotely operated unmanned aircraft to a semi-autonomous UAV that could revolutionize how the Navy and the RAAF carry out maritime patrol and reconnaissance. In its latest configuration, the MQ-4C Triton combines its High-Altitude, Long-Endurance (HALE) capabilities with multi-intelligence systems that bring to bear state-of-the-art radar and other sensors as well as very high-bandwidth multiple data feeds. This provides for much greater situational awareness. ◀

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Experts from Northrop Grumman and CACI will develop supercontinuum fiber laser technology for electro-optical sensors in military applications.

Northrop Grumman and CACI to develop technologies for multispectral laser sensors

BY John Keller

WRIGHT-PATTERSON AFB, Ohio — U.S. Air Force researchers are asking two defense companies to develop relatively high-power multispectral laser technologies for precise sensors that not only can detect small objects, but also determine what those objects are made of.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, have awarded two contracts — one to the Northrop Grumman Corp. Aeronautics segment in Redondo Beach, Calif.; and the other to CACI Inc. in Florham Park, N.J. — for the Multi-Spectral Laser Development project.

Experts from Northrop Grumman and CACI will develop and refine supercontinuum fiber laser technology for electro-optical sensors in a variety of military applications.

Laser sensors can detect small objects or precise positions, while multispectral lasers can help determine the materials from which these small detected objects are made. These kinds of sensors have the potential to help military forces find small objects of interest and quickly determine what they are.

Northrop Grumman won a \$4.9 million Air Force contract on 12 Aug. 2021, and CACI won a \$4.9 million contract on 23 July 2021.

While supercontinuum lasers are available commercially today with 10 to 20 Watts of power, Air Force researchers are asking Northrop Grumman and CACI to develop enabling

technologies that could lead to supercontinuum lasers of about 280 Watts.

The goal is discover and develop electro-optics and photonics supporting technologies that enable increased performance and affordability, and prepare these technologies for potential deployment in Air Force sensing systems.

Supercontinuum fiber laser technology has a continuous optical spectrum that spans a wide range of wavelengths, typically a factor of five or more in wavelength between the lower and upper bounds of the generated spectrum, researchers explain. These lasers often are called white light if the spectrum covers visible wavelengths.

Supercontinuum generation most frequently is created using a broad range of concurrent nonlinear optical interactions between high peak power mode-locked laser pulses and a suitable optical material, very often in a fiber-optic form.

Air Force researchers want Northrop and CACI to develop a high-power laser emitting broadly in the spectral range 350 to 1750 nanometers, with a power spectral density of 200 milliwatts per nanometer for 280 Watts total power, with a beam quality M2 value of less than 1.5. ←

For more information contact Northrop Grumman Aeronautics online at www.northropgrumman.com, CACI at <https://www.caci.com>, or the Air Force Research Laboratory at www.afrl.af.mil.

MZA Associates to develop portable laser weapons for counter-UAV operations

BY John Keller

ARLINGTON, Va. — Laser weapons experts at MZA Associates Corp. in Albuquerque, N.M., are adding their expertise to U.S. military efforts to develop portable high-energy lasers to damage or destroy unmanned aerial vehicles (UAVs) that are violating the airspace of military bases or other sensitive installations.

Officials of the U.S. Office of Naval Research (ONR) in Arlington, Va., have announced an \$18.7 million contract to MZA Associates to develop the counter unmanned aerial vehicle (C-UAS) High Energy Laser Weapon System (HELWS).

MZA engineers will design, develop, deliver, integrate, test, and demonstrate a compact, portable, low-cost and reliable C-UAS HELWS using the latest available commercial components.

Such a system potentially could enable U.S. Marines on the ground or sailors aboard surface warships to destroy, disable, or discourage potentially hostile UAVs flying too closely to Marine ground units, ships, or forward-deployed bases.

MZA Associates specializes in modeling, analysis, design, development, integration, and testing of high-energy laser and advanced optical systems in support of advanced beam-control systems, atmospheric characterization, and optical systems engineering.

MZA provides expertise in wave-optics modeling; adaptive optics; and scientific data acquisition, analysis, and management. The company developed the WaveTrain wave-optics analysis tool for the analysis of optical atmospheric propagation and adaptive optics systems.



MZA engineers will design and demonstrate a portable low-cost counter-drone laser weapon using commercially available components.

MZA joins the Raytheon Technologies Corp. Intelligence & Space segment in McKinney, Texas, in efforts to develop portable and mobile laser weapons for anti-UAV warfare.

Raytheon is providing the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, with counter-UAV high-energy laser weapons for counter-drone operations. The company won a \$13.1 million order in late 2019 to build a HELWS for six months of in-field evaluation against enemy UAVs.

The Raytheon prototype HELWS combines a solid-state laser weapon with a Raytheon multi-spectral targeting system. The unit mounts to a military RZR all-terrain vehicle from Polaris Inc. in Medina, Minn. This results in an advanced, lightweight, and adaptable weapons system that enables military mobile light forces to defend against enemy UAVs in a wide variety of conditions and terrain.

The Office of Naval Research is supporting development of directed-energy weapons that cause physical damage that degrades, neutralizes, defeats, or destroys enemy capabilities such as UAVs.

ONR is supporting research potentially leading to naval laser subsystems, beam directors, and fire-control architectures, including advanced design power architectures for low-duty cycle and continuous-wave laser applications with reduced size, weight, and power consumption, and cooling (SWAP-C).

ONR researchers particularly are interested in laser components that offer high brightness, high power-beam-combining technologies, and controlled micro-channel optical component cooling methods that reduce thermal distortions for enhanced beam quality.

ONR also is sponsoring research in directed-energy weapons system tracking sensors, target illuminators, and automated target recognition components — especially those that offer tracking through intermittent or partially obscured maritime viewing conditions. ◀

On this contract MZA Associates will do the work in Albuquerque, N.M., and Dayton, Ohio, and should be finished by August 2023. With options, the project could continue through August 2025. For more information contact MZA Associates online at www.mza.com, or the Office of Naval Research at www.onr.navy.mil.

PRODUCT applications

SENSORS

BAE Systems to build seekers for Lockheed Martin LRASM anti-ship missile



Munitions guidance experts at the BAE Systems Electronic Systems segment in Nashua, N.H., will provide next-generation missile seekers for the Long Range Anti-Ship Missile (LRASM) under terms of a \$117 million contract from Lockheed Martin Corp.

The seeker comprises long-range sensors and targeting technology that help the stealthy missile find and engage protected enemy ships amid attempts to jam or spoof the missile, BAE Systems officials say.

LRASM is for use against high-priority enemy targets like aircraft carriers, troop transport ships, and guided-missile cruisers. BAE Systems has delivered more than 50 LRASM seekers to date that have demonstrated technical performance over several tests.

Following design improvements conducted under a Diminishing Sources/Affordability contract, BAE Systems is producing next-generation seekers for LRASM lots four and five that are more capable and easier to produce, with less-complicated manufacturing processes. The next-generation seekers have replaced obsolescent and limited-availability parts to reduce system cost.

The LRASM anti-ship missile contract will support missiles for the U.S. Navy, Air Force, and allies. The BAE Systems LRASM seeker uses sensor fusion to blend information from the missile's on-board radar, semi-autonomous guidance, Global Positioning System (GPS) satellite navigation, high-speed secure tactical networking links, and nearby sensors to strike high-value targets from long range while avoiding shipboard missile counter-fire.

The missile guidance sensor uses semi-autonomous guidance and target cueing data to locate and attack targets precisely and reduce reliance on airborne intelligence, surveillance, and reconnaissance (ISR) aircraft, networking links, and GPS navigation.

BAE Systems designers also are working to make the seeker system smaller, more capable, and more efficient to produce. Building LRASM

is the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla. Lockheed Martin is in charge of LRASM overall development, and the BAE Systems is developing the LRASM onboard sensor systems.

LRASM is a joint project of the U.S. Defense Advanced Projects Agency (DARPA) in Arlington, Va., the Navy, and the Air Force to design an advanced anti-ship missile that can launch from the Navy F/A-18E/F Super Hornet jet fighter bomber, as well as from the Air Force B-1B Lancer long-range strategic bomber.

In the future LRASM also will launch from the F-35 Lighting II joint strike fighter, as well as from the Navy Mark 41 shipboard Vertical Launch System. The missile travels at high subsonic speeds, and likely will give way in the future to expected new generations of hypersonic missiles. Submarine-launched versions are under consideration.

LRASM is designed to detect and destroy high-priority targets within groups of ships from extended ranges in electronic warfare jamming environments. It is a precision-guided, anti-ship standoff missile based on the Lockheed Martin Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER).

Lockheed Martin has been designing LRASM for the last 11 years, primarily under DARPA supervision. The advanced anti-ship missile is intended to replace the ageing Harpoon anti-ship missile. It has a multi-mode radio frequency sensor, a new weapon data-link and altimeter, and an uprated power system.

The LRASM can be guided toward enemy ships from as far away as 200 nautical miles by its launch aircraft, can receive updates via its datalink, or can use onboard sensors to find its target. LRASM will fly towards its target at medium altitude then drop to low altitude for a sea skimming approach to counter shipboard anti-missile defenses.

The LRASM uses on-board targeting systems to acquire the target independently without the presence of intelligence or supporting services like Global Positioning System (GPS) satellite navigation and data links. Lockheed Martin is designing the missile with advanced counter-countermeasures to evade hostile active defense systems.

The Lockheed Martin LRASM has a 1,000-pound penetrator and blast-fragmentation warhead, multi-mode sensor, weapon data link, and enhanced digital anti-jam global positioning system to detect and destroy selected surface targets within groups of ships.

On this contract BAE Systems will do the work in Wayne, N.J.; Greenlawn, N.Y.; and Nashua, N.H. For more information contact BAE Systems online at www.baesystems.com, or Lockheed Martin Missiles and Fire Control at www.lockheedmartin.com.

NAVIGATION AND GUIDANCE

Lockheed Martin to upgrade navigation and guidance on ATACMS battlefield munitions



U.S. Army fire-support experts are asking Lockheed Martin Corp. to convert ground-launched munitions with single explosive charges to versions with airburst mode and area effects capability by adding proximity fuses.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., announced a \$98.1 million order to the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, for the Army Tactical Missile Systems Guided Missile (ATACMS) and Launching Assembly Service Life Extension (SLEP) program.

The Lockheed Martin ATACMS is a surface-to-surface missile with a top range of about 100 miles. It can fire from multiple rocket launchers, including the M270 Multiple Launch Rocket System (MLRS), and M142 High Mobility Artillery Rocket System (HIMARS).

The ATACMS SLEP project seeks to convert M39/M39A1 ATACMS rockets, which have anti-personnel and anti-materiel (APAM) bomblet payloads. The job is to convert the M57 ATACMS single-explosive rocket using the same single warhead used in the Navy's Harpoon missile.

Moreover, the ATACMS SLEP project seeks to provide the upgraded ATACMS munition with a proximity fuse to provide the blast effects, anti-personnel capability, and the ability to destroy or damage soft targets over large areas. The new missile is designated M57E1 ATACMS Unitary.

Other aspects of ATACMS SLEP involve re-graining the M39/M39A1 motor, updating obsolete navigation and guidance software and hardware, and replacing the M39/M39A1 APAM bomblets with the WDU-18/B warhead that is used in the Navy's Harpoon anti-ship missile.

Army leaders say the warhead change will meet the unexploded ordnance rate requirement defined in the 2008 Pentagon Policy on Cluster Munitions and Unintended Harm to Civilians.

The ATACMS SLEP missile uses inertial measurement unit and GPS guidance to attack point and area targets out to a range of about 186 miles. It will engage long-range point or area-located targets including air defense, command posts, assembly areas, and high-value targets without the hazard of unexploded submunitions.

On this order Lockheed Martin will do the work in St. Louis; Lufkin, Texas; Williston, Vt.; Boulder, Colo.; Camden, Ariz.; Grand Prairie, Texas; Clearwater, Fla.; and Windsor Locks, Conn., and should be finished by 30 Sept. 2024.

For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa/>.

MISSILE ILLUMINATORS

Saab to design missile tracker illuminator in upgrade of MK 57 surface-to-air missile



U.S. Navy shipboard electronics experts needed a tracker-illuminator to upgrade the Raytheon MK 57 NATO Seasparrow surface-to-air missile system aboard aircraft carriers and amphibious assault ships. They found their solution from Saab Inc. in East Syracuse, N.Y.

Officials of the Naval Sea Systems Command in Washington announced a potential \$104.8 million contract to Saab for the MK 9 Tracker Illuminator System (TIS) Replacement Continuous Wave Tracking Illuminator (CWTI) development and production effort.

The contract is for engineering and manufacturing development (EMD), production, and integration of the tracker illuminator replacement for big-deck U.S. Navy amphibious- and helicopter-assault surface warships.

The MK 57 NATO Seasparrow is a medium-range, rapid-reaction missile that uses a semi-active radar-guidance, which uses reflected memory local area network fiber optic cable. It consists of the tracking illuminator and the MK 29 guided missile launching system (GMLS).

The tracking illuminator is a computer-operated fire-control system that provides automatic acquisition and tracking of a designated target, generates launcher and missile orders, and in the automatic mode initiates the firing command when the target comes into range.

Saab engineers will capitalize on an existing qualified design, develop the MK 9 TIS interface modifications, produce the MK 9 TIS replacement CWTI, and deploy it as part of the MK 57 MOD 14/15 surface-to-air missile system.

The MK 57 system fires the RIM-7 Seasparrow radar-guided missile, which helps protect big-deck naval surface warships from enemy aircraft, helicopters, anti-ship cruise missiles, and similar threats.

The initial contract is for \$32.3 million, and has options that could extend its duration through 2030, and increase its value to \$104.8

million. On this contract Saab will do the work in East Syracuse, N.Y., and should be finished by August 2023.

For more information contact Saab Inc. online at www.saab.com/markets/united-states, or Naval Sea Systems Command at www.navsea.navy.mil.

OPTICAL GYROS

KVH chosen to provide fiber-optic-gyro (FOG) to stabilize vehicle turret

Weapons-control experts at Spanish defense systems integrator Escribano Mechanical & Engineering in Madrid needed a fiber-optic gyro (FOG) for the company's new Guardian 30 remotely controlled turret. They found their solution from KVH Industries Inc. in Middletown, R.I.

KVH officials have received a \$7.9 million order from Escribano to provide the KVH DSP-1750 FOG for the Escribano Guardian 30 remotely controlled turret. The Guardian 30 turret recently was chosen by the Spanish Ministry of Defense for the Spanish army's VCR 8x8 Dragon wheeled combat vehicle.

The Guardian 30 turret has a 30- or 40-millimeter cannon, platform stabilization, and electro-optical sensors to fire the weapon from long ranges. KVH's DSP-1750 FOG will provide stabilization for the Guardian 30 turret.

"Escribano relies on the precision of KVH fiber optic gyros to ensure our remote weapons systems have the stabilization they need to perform in challenging defense environments," says Angel Escribano, CEO of Escribano Mechanical & Engineering.

The DSP-1750 integrates into platforms where space and payload weight are at a premium, including long-range optical and sensor systems, gimbals, autonomous vehicle navigation, and the stabilization of defense and commercial platforms.

KVH's shipment of FOGs to Escribano is expected to continue through 2025. Shipments increase annually over the term of the order, with a small portion scheduled for delivery in 2021 and the substantial majority of shipments scheduled for delivery after 2022.

For more information contact KVH Industries online at www.kvh.com, or Escribano Mechanical & Engineering at www.eme-es.com.



INFRARED DETECTORS

Lockheed Martin to build components for electro-optics infrared search and track sensors



U.S. Navy air combat experts are asking electro-optics engineers at Lockheed Martin Corp. to build 12 infrared receivers and 11 control processors for the infrared search and track (IRST) system aboard F/A-18E/F Super Hornet jet fighter-bomber.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a \$48.8 million order to the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., to provide these IRST components. The IRST enables the F/A-18E/F to detect, track, and attack enemy aircraft in a stealthy way without making its presence known.

The Super Hornet combat aircraft IRST is a long-wave infrared detection sensors system that targets enemy aircraft in conditions where the Super Hornet cannot use its radar.

The system, which Boeing Co. Defense, Space & Security segment in St. Louis is buying from Lockheed Martin, uses infrared search and track technology to detect and provide weapons-quality track solutions on potentially hostile aircraft.

The Navy and Boeing first flew the IRST Block II pod on an F/A-18E/F Super Hornet in late 2019. IRST is a passive, long-range sensor incorporating infrared and other sensor technologies for accurate targeting.

The IRST Block II gives the F/A-18 improved optics and processing power, significantly improving pilot situational awareness, Boeing officials say. The Block II variant will be delivered to the U.S. Navy in 2021, reaching initial operational capability shortly thereafter.

The IRST Block II is part of the Super Hornet Block III upgrades to keep the F/A-18 in active service for decades to come. Block III upgrades also include enhanced network capability, longer range with conformal fuel tanks, an advanced cockpit system, signature improvements, and an enhanced communications system.

The IRST sensors fit on the front of the Super Hornet's centerline fuel tank. Three years ago Navy leaders approved a restructured program that foregoes full-rate production of Block I sensors and proceeds directly to the Block II system.

The IRST passive search system consists of a passive longwave infrared receiver, a processor, inertial measurement unit, and environmental control unit. The infrared receiver, processor, and inertial measurement

unit fit inside the sensor, which attaches to the front of the fuel tank mounted to the aircraft on the BRU-32 bomb rack.

The Navy developed the IRST Block I using components from the F-15K/SG aircraft's infrared receiver, which is based on the IRST design of the now-retired Navy F-14 Tomcat jet fighter. IRST Block II includes improvements to the infrared receiver and updated processors. The Navy intends to produce 170 IRST systems.

Even amid electronic attack or heavy RF and infrared countermeasures, IRST provides autonomous, tracking data that increases pilot reaction time, and enhances survivability by enabling first-look, first-shoot capability, Lockheed Martin officials say.

Infrared sensors like the IRST detect the heat from an aircraft's engine exhaust or even the heat generated by the friction of an aircraft as it passes through the atmosphere. Unlike radar, infrared sensors do not emit electronic signals, and do not give away their presence to adversaries.

This ability can enable Super Hornet pilots to identify enemy aircraft at long ranges, and enable them to fire their air-to-air missiles at their maximum ranges.

Data from the IRST system can stand alone or fuse with the Super Hornet's other on-board sensor data situational awareness. Lockheed Martin also is developing an IRST pod that can be fitted to the F-15C and F-16 jet fighters.

On this order Lockheed Martin will do the work in Orlando and Ocala, Fla.; and Santa Barbara, Calif., and should be finished by February 2023. For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com, Boeing Defense, Space & Security at www.boeing.com/company/about-bds, or Naval Air Systems Command at www.navair.navy.mil.

HIGH-PERFORMANCE COMPUTING

Georgia Tech develops high-performance computing to simulate RF and microwave testing

U.S. Navy researchers needed a new kind of high-performance computing (HPC) system to help simulate a high-fidelity RF environment for a large-scale virtual RF test range. They found their solution from Georgia Tech Research Corp. in Atlanta.



Officials of the Naval Information Warfare Center Pacific in San Diego announced an \$11.5 million order to Georgia Tech to move forward with a project to develop a new breed of high performance computer (HPC) called Real-Time HPC.

This new high-performance computer architecture seeks to balance computational throughput with extreme low latency to create a large-scale virtual RF and microwave test range. This order increases the Real-Time HPC contract value to \$13.9 million.

This project builds on work by the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., called Digital RF Battlespace Emulator (DRBE), which seeks to deliver the scale, fidelity and complexity necessary to match how complex sensor systems are employed today, and provide a valuable military development and testing environment.

Testing, evaluation, and training of future military systems increasingly will happen in virtual environments because of rising costs, system complexity, and the limited availability of military ranges, DARPA researchers explain.

Virtual simulators already are used to augment real-world training for modern fighter aircraft pilots, and they hold significant promise for addressing the demands of testing and training artificial intelligence (AI)-enabled technologies.

Today's simulated test range environments, however, rely on conventional computing that are unable to generate the computational throughput and speed to replicate real-world interactions, model the scale of physical test ranges, or meet the technical requirements of more complex systems, experts say.

To address those computing limitations, Georgia Tech researchers helped DARPA create the DRBE, which Georgia Tech now is extending and refining under supervision of the Naval Information Warfare Center Pacific.

Georgia Tech researchers will design computing architectures and domain-specific hardware accelerators for future simulations of complex RF environments.

Existing high-performance computers rely on general-purpose computing devices like general-purpose graphics processing units (GPGPUs) or field-programmable gate arrays (FPGAs), which put a priority on high computational throughput at the expense of latency, or have very low latency and low computational throughput.

Georgia Tech researchers will try to overcome those limitations by creating a new breed of high-performance computing hardware that combines the best traits of GPGPUs and FPGAs.

Georgia Tech also will develop tools, specifications, and interfaces to integrate a real-time high-performance computing system, and create a virtual RF test range.

On this order Georgia Tech will do the work in Atlanta, New York, and Aurora, Colo., and should be finished by July 2024. For more information contact Georgia Tech Research Corp. online at <https://gtrc.gatech.edu>, the Naval Information Warfare Center Pacific at www.niwc.pacific.navy.mil, or DARPA at www.darpa.mil. ◀



DATA DESTRUCTION

Granulator for destroying solid-state data storage media offered by Intimus



Intimus North America in Wabash, Ind., is introducing a compact granulator for the destruction of solid-state data storage devices, optical media, and small magnetic media. Intimus engineers designed the granulator to be adaptable to future destruction requirements because digital media storage technology is ever changing. Total destruction of data storage media comes from two industrial solid-steel cutting heads that rotate in opposition to one another to rip and tear items into tiny shreds until they are small enough to pass through a user selectable waste sizing screen. Users can change screens quickly depending on the level of destruction and security required. The granulator can reduce data storage media to particle sizes as small as 2 by 3 millimeters with a 3-millimeter screen. This small particle translates to DIN levels E-5, F-4, O-6, T-7. Destruction feed rates vary based on size and type of items and waste sizing screen used. However, throughputs of about 60 to 600 standard solid-state drives per hour and 200 to 2000 USB sticks per hour are typical. Automatic overload protection with auto reverse protects the cutting head and motor from damage due to overfeeding. All items feed into the destruction chamber via a mailbox-style safety chute. All operational

controls mount on the front of the granulator and include start, stop, and emergency stop buttons. A digital hour meter is included. A 23-gallon collection bin mounts on casters for easy removal and replacement, monitored by an ultrasonic sensor to prevent overfilling. The unit is small enough to fit through standard office doors and is mounted on casters for easy relocation if necessary. For more information contact Intimus online at www.intimus.com.

COMPUTER BOARDS

Rugged 6U OpenVPX data storage module for C5ISR applications offered by Curtiss-Wright



The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the VPX6-SBM data storage blade module for increasing an OpenVPX system's data storage capability for demanding C5ISR applications deployed in harsh environments. This rugged 6U OpenVPX (VITA 65) data storage module expands the memory capacity and data rates that can be integrated into one slot. The VPX6-SBM enables system designers to integrate 32 or 64 terabytes of high-speed low-latency 6.25-gigabits-per-second NVMe data storage into deployed OpenVPX systems. The data storage module is for direct-attached storage (DAS) for embedded computers, high-speed data offload, video recording, mission data and map storage, and database and data logging. The modules extends Curtiss-Wright's support for modular open system approach (MOSA).

Curtiss-Wright is an active contributor to the definition and advancement of open standards in support of MOSA. For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com.

SENSORS

Miniature rad-hard inertial sensors for space introduced by Honeywell



Honeywell Aerospace in Phoenix is introducing the HG4934 rate sensors to help small satellites navigate increasingly crowded orbits above the Earth's surface. The micro-electromechanical system (MEMS)-based product can reduce cost and power consumption in a smaller size, all while maintaining high levels of performance - an ideal fit for customers building smaller and lower-cost satellites. At 145 grams, Honeywell's HG4934 space rate sensor is roughly the same size and weight as a baseball. It consumes about one-fifth the amount of electric power, and it is more than 32 times lighter and 60 times smaller than Honeywell's current offerings. It also is more tolerant of radiation -- a key attribute in space, and uses Honeywell's sensor technology. A space rate sensor, also known as an inertial reference unit or IRU, is composed of three gyroscopes that work together to sense rotation rates. They determine an aircraft or spacecraft's change in rotational attitude over time and enable it to move from one location to another without using any external information. It also can serve as a backup to provide extra redundancy in case other navigation systems fail. Celestial navigation options like star

trackers are a popular method of obtaining pointing directions for satellites and spacecraft. This form of navigation uses angular measurements between objects in space like stars and planets, and the horizon to calculate location. For more information contact Honeywell Aerospace online at <https://aerospace.honeywell.com>.

RUGGED COMPUTERS

Rugged laptop computer with 5G wireless networking offered by Getac



Getac Technology Corp. in Irvine, Calif., is introducing the B360 rugged laptop computer that is certified for 5G high-speed wireless networking for aerospace and defense, public service, and industrial applications. The high-speed 5G capability joins the B360s existing communications options that consist of 4G, Intel Wi-Fi 6 AX200, 802.11ax, Bluetooth 5.2, and optional dedicated GPS. Sub-6 5G major advantages over current 4G LTE technology include increased throughput, reduced latency, more simultaneous connections, improved consistency in dense areas, high-user capacity per tower, enhanced spectral efficiencies for reliable network connections and a solid platform for future development. Available in two variants, a regular version for public service, heavy industry, and other vertical markets and a Pro model with rugged enhancements specific to military needs, the B360 has the Intel 10th Generation CPUs, massive amounts of optional RAM and SSD storage space, shock protection, an IP66 rating for resistance to the effects of dust ingress and high-speed water spray from any direction, proprietary salt water

spray protection, and extreme temperatures. Both models feature 5G wireless networking, a 13.3-inch IPS TFT LCD FHD LumiBond 2.0 screen offering a maximum brightness of 1400 nits at 1920 by 1080 pixels, Getac's proprietary sunlight-readability and anti-glare solution, and ability to accept input from industrial-weight gloves. An optional power-efficient NVIDIA GeForce 10 series GTX portable computing graphics engine that combines NVIDIA Pascal GPU architecture, ultra-fast FinFET, and DirectX 12 support also is available. For more information contact Getac online at www.getac.com.

EMBEDDED COMPUTING

Rugged embedded computing chassis for electronic warfare (EW) offered by LCR

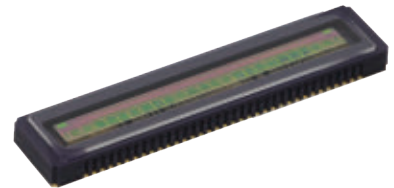


LCR Embedded Systems Inc. in Norristown, Pa., is introducing the AoC3U-100 rugged single-slot packaging solution for 3U VPX and Sensor Open Systems Architecture (SOSA)-aligned payload embedded computing cards that support high-speed connectivity with RF, Gigabit Ethernet, 10 Gigabit Ethernet, and optical interfaces. The AoC3U-100 is part of LCR's air over conduction cooled (AoC) chassis line, and addresses electronic warfare (EW), radar, and intelligence, surveillance, and reconnaissance (ISR) air and ground applications where size constraints and functional performance are key. The system is for counter-ISR systems, multi-mission EW, navigational systems, air and ground surveillance radar, fire-control radar, on-the-move radar, multi-mission radar systems, and enables deployment in demanding environments. Designed to maintain safe operating temperatures for high-power VITA 48.2 conduction cooled payloads, the chassis combines forced air with conduction cooling

to increase cooling, while using VITA 48.2 plug in modules. A small-form-factor 28-volt power supply provides MIL-STD-461 protection for 12-volt 3U VPX and SOSA-aligned modules. Custom I/O boards and front panels may include 38999, Mighty Mouse, and SMA connectors. Internal cabling and board layout ensures high signal integrity. The AoC3U-100 also can be configured for fanless passive cooling for lower-power payloads. For more information contact LCR Embedded Systems online at www.lcrembeddedsystems.com.

SENSORS

CMOS multispectral imaging sensors for machine vision introduced by Teledyne e2v



Teledyne e2v, a Teledyne Technologies company in Grenoble, France, is introducing the Tetra low-cost, high-performance quad linear complementary metal-oxide-semiconductor (CMOS) sensor family for machine vision applications with multispectral imaging. Tetra sensors are available in a 2k resolution with a 14-by-14-micron pixel size, or 4k resolution with a 7-by-7-micron pixel size at a maximum line rate of 128 kHz aggregate. The mono models can be configured to output one, two, or four rows and the color models provide red-green-blue (RGB) and mono outputs. Using wafer level coated dichroic filters, the sensor also provides spectrally independent RGB and near-infrared (NIR) outputs for multispectral imaging. Based on a synchronized shutter design, Tetra sensors provide low read noise and high dynamic range with true correlated double sampling (CDS). Each channel has its own exposure control and are easy to perform white balancing. The ceramic LCC package also offers high performance and

new PRODUCTS

high reliability over a wide range of operating temperatures. The sensor data ports have high signal integrity and simple interfacing for quick system integration. For more information contact Teledyne e2v online at <https://imaging.teledyne-e2v.com>.

POWER SUPPLIES

High-reliability industrial power supplies introduced by TDK Lambda

TDK-Lambda Americas Inc. in San Diego is introducing the CUS350MP-1000 AC-DC medical- and industrial-certified power supplies for low audible noise applications that require occasional high peak power demands, such as medical equipment with DC motors and industrial printers. Capable of providing 500 Watts with external airflow (1,000 Watts peak), the series is rated at 350 Watts when convection cooled and can deliver peaks of 800 Watts for as long as five seconds. The high-reliability series is available with 24-, 30-, 36-, and 48-volt outputs, a 5-volt isolated standby and a remote on/off function.



The CUS350MP-1000 has an 85-to-265-volt AC input range and a leakage current of less than 300 microamps. With efficiencies to 94 percent, operation in ambient temperatures of -20 to 70 degrees Celsius is possible, derating linearly above 50 C to 30 percent load. Open-frame models measure 88 by 183 by 44 millimeters with a weight of 27.2 ounces. Options include a perforated cover, double-sided board coat-

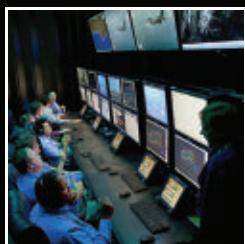
ing, single-input fuse, and screw terminations. The industrial-grade CUS350MP-1000 has an input-to-output isolation of 4,000 volts AC, input to ground of 1,500 volts AC, and 1,500 volts AC output to ground for suitability in B and BF rated medical equipment. Safety certifications include IEC/UL/CSA/EN 62368-1, IEC/EN/ES 60601-1, EN 62477-1 (OVC III), with CE marking to the Low Voltage, EMC and RoHS Directives. The units also comply with EN 55011-B and EN 55032-B conducted and radiated emissions, EN 61000-3-2 harmonics, IEC60601-1-2 Edition 4 and IEC 61000-4 immunity standards. For more information contact TDK-Lambda Americas online at <https://product.tdk.com/en/power/cus350mp>. ←

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