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Enabling technologies gain traction for urban air mobility:
uncrewed aircraft, artificial intelligence (AI), and navigation. PG. 14



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QuartzXM Module
SOSA aligned 3U VPX
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Urban air mobility gaining traction

Industry develops growing number of enabling technologies for urban air mobility, as companies are designing uncrewed aircraft, artificial intelligence (AI), propulsion, navigation, and guidance.

23 TECHNOLOGY FOCUS

The next generation of open-systems embedded computing standards

The Sensor Open System Architecture (SOSA) has support from more than 100 organizations that rely on the new standard to ensure interoperability, technology upgrades, and affordable designs.

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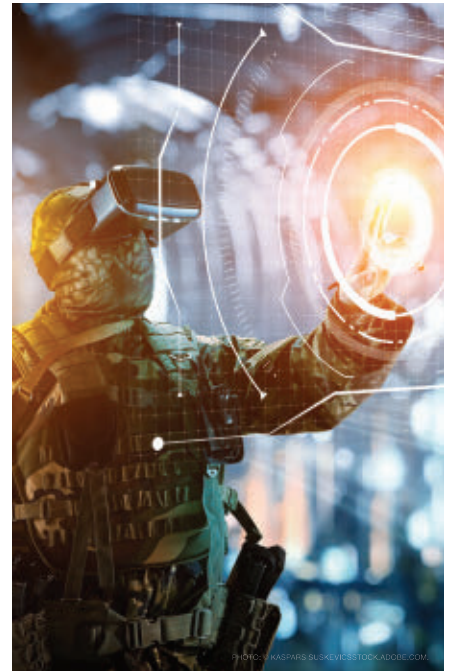
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Will the SOSA era usher-in more liquid cooling in military embedded cooling?



BY **John Keller**
EDITOR IN CHIEF

Electronics cooling and thermal management for high-performance electronics in aerospace and defense applications is as big and as daunting an issue as it's been for years. Not even new generations of open-systems standards like the Sensor Open System Architecture (SOSA) are expected to provide much relief.

Next-generation RF and microwave components, multicore general-purpose central-processing units (CPUs), general-purpose graphics-processing units (GPGPUs), and field-programmable gate arrays (FPGAs) will run hotter than ever before, and will up the ante for electronics systems designers who must deal with the extra heat.

Still, despite SOSA's apparent inability to provide thermal-management relief for current and future generations of embedded computing, don't expect innovations in electronics cooling to slow at all; in fact, the galloping pace of electronic components development is likely to spur new innovations as enabling technologies move forward.

First off, SOSA probably isn't the place to look for encouraging new developments in electronics thermal management. The new standard doesn't aim at creating new design guidelines, but instead seeks to incorporate as many accepted industry standards as possible.

SOSA, for example, has adopted the OpenVPX standard of the VITA Open Standards, Open Markets trade association in Oklahoma City. SOSA has begun adopting the U.S. Army's Vehicle Integration for C4ISR/EW. SOSA adopts standards; it doesn't develop them. That's the job of organizations like VITA, and that's where systems designers should look for innovations in electronics thermal management.

VITA — an organization of experts from the embedded computing industry who share common goals — is where many embedded computing open-systems standards are hammered-out. SOSA has adopted many VITA standards concerning computer boards, backplanes, and high-speed interconnects, and can be expected to adopt thermal-management standards from VITA as they come out. VITA standards also are reviewed and adopted by the American National Standards Institute (ANSI) in Washington.

VITA thermal-management standards are encapsulated in VITA 48, and industry thermal-management best practices guidelines are part of VITA 50. These standards essentially lay out design approaches for air-, conduction-, and liquid cooling, which involve various levels of complexity, reliability, and cost.

ANSI/VITA 48.1, for example, describes mechanical requirements for air-cooled 3U and 6U boards. ANSI/VITA 48.2 describes ways to cool conduction-cooled 3U and 6U boards. ANSI/VITA 48.5 defines air flow-through cooling that uses a compact core heat exchanger inside the central heat sink of the unit. ANSI/VITA 48.7 defines air flow-by cooling that convectively cools boards without exposing electronic components to the cooling air.

Liquid cooling approaches are defined in ANSI/VITA 48.4 concerns liquid flow-through cooling that uses liquid that flows through an integral heat sink of the board to carry away excess heat efficiently. It is the liquid-cooling approach that scares away many designers because of its reputed high costs and questionable reliability. The future should see more liquid cooling by necessity — primarily for the most high-performing and hot-running boards. ◀



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Leidos to design air-breathing hypersonic missile with standardized payload interface

BY John Keller

WRIGHT-PATTERSON AFB, Ohio – U.S. Air Force researchers needed help to develop a large air-breathing hypersonic missile able to carry out several different kinds of missions with a standardized payload interface. They found their solution from Leidos Inc. in Reston, Va.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced a \$334 million six-year contract in December for research and development of the Expendable Hypersonic Multi-Mission ISR and Strike (Mayhem) program.

This project seeks to provide a significant technological advancement and future capability, with a standardized payload interface that would create several different opportunities for payload integration within the same hypersonic missile system.

This program is focused on delivering a large air-breathing hypersonic system capable of executing several different kinds of missions with a standardized payload interface, providing a significant technological advancement and future capability, Air Force officials say.

The Mayhem system will use a scramjet engine to generate thrust, propelling the vehicle across long distances at speeds greater than Mach 5, Leidos officials say. Leidos partners include

▲ **This program is focused on delivering a large air-breathing hypersonic system capable of executing several different kinds of missions with a standardized payload interface.**

Calspan Corp. in Buffalo, N.Y.; The Charles Stark Draper Laboratory Inc. in Cambridge, Mass.; and Kratos Defense & Security Solutions Inc. in San Diego.

It is expected that Mayhem payloads will involve delivering kinetic or explosive weapons, or intelligence and reconnaissance sensor pay-

loads at hypersonic speeds. Hypersonic typically refers to objects traveling faster than Mach 5, or 3,836 miles per hour.

Few additional technical details of the Mayhem project are openly available. Leidos was one of six companies that bid on the Mayhem hypersonic project. The Mayhem solicitation was released in late February, and the six companies bidding were asked to submit their proposals by late May.

The original unclassified solicitation for the Mayhem project is online at <https://sam.gov/opp/4d1797ce5cd04e-b4a9f7e77756031d81/view>. ◀

On this contract Leidos will do the work at Wright-Patterson Air Force Base in Dayton, Ohio, and at other potential testing sites to be determined, and should be finished by October 2028. For more information contact the Air Force Research Laboratory at Wright-Patterson Air Force Base at www.afrl.af.mil, or Leidos at www.leidos.com.

General Dynamics to build Stryker combat vehicles with standard VICTORY vetronics

BY John Keller

WARREN, Mich. — Armored combat vehicles designers at General Dynamics Corp. will build advanced Stryker wheeled vehicles for the U.S. Army under terms of a \$146.7 million contract announced in November.

Officials of the Army Contracting Command-Detroit Arsenal in Warren, Mich., are asking General Dynamics Land Systems in Sterling Heights, Mich., to build flat-bottom-hull Stryker vehicles.

Stryker is a deployable fighting vehicle that is more lethal than light vehicles like Humvees, yet is lighter and more maneuverable than heavyweight combat vehicles like the M1 Abrams main battle tank.

Most Stryker vehicles and vetronics today have the Protector M151 Remote Weapon Station with .50-cal M2 machine gun, 7.62 mm M240 machine gun, or Mk-19 automatic grenade launcher. Some heavily armed versions have a 105-millimeter main gun, similar to a tank.

Compared to earlier versions of the Stryker, the upgraded Stryker A1 has superior engine power, which should result in greater mobility in combat.

The flat-bottom Stryker family has three variants on a common vehicle platform: the M1127 Reconnaissance Vehicle, the M1128 Mobile Gun System, and the M1135 NBC Reconnaissance Vehicle. The Stryker A1 also can be equipped with a scout mission equipment package modification for reconnaissance missions.

The Stryker A1 also establishes the framework for the Vehicular Integration for C4ISR/EW Interoperability (VICTORY) vetronics industry-standard architecture for networking integration and data sharing among the vehicle's common crew stations. The new Stryker version also provides Gigabit Ethernet capability.

The Stryker A1 has a 910-amp alternator to support future electrical power upgrades for future network equipment; an enhanced power distribution unit chassis upgrade; increased chassis payload capacity from 55,000 pounds to 63,000 pounds; and upgrades to its driveline to support an in-vehicle network architecture.

Addition of 30-millimeter cannon turret to the Stryker can boost the vehicle's firepower substantially. A 30-millimeter



The Stryker A1 establishes the framework for the Vehicular Integration for C4ISR/EW Interoperability (VICTORY) vetronics standard architecture for networking integration and data sharing among the vehicle's common crew stations.

cannon bullet is about 10 inches long, while a .50 caliber machine gun bullet is about five inches long, and a 7.62 millimeter machine gun bullet is about three inches long.

While .50 caliber and 7.62 millimeter machine guns primarily shoot anti-personnel bullets for fighting enemy soldiers, the 30-millimeter cannon is an armor-piercing round that is effective against other armored vehicles and fortified bunkers.

The Stryker armored combat vehicle is named for two American servicemen who posthumously received the Medal of Honor: Private First Class Stuart S. Stryker, who died in World War II, and Specialist Four Robert F. Stryker, who died in the Vietnam War. ◀

On this contract General Dynamics will do the work at locations be determined with each order, and should be finished by November 2024. For more information contact General Dynamics Land Systems online at www.gdls.com, or U.S. Army Contracting Command-Detroit Arsenal at <https://acc.army.mil/contractingcenters/acc-dta/>.

Aurora to demonstrate electric aircraft that eliminate traditional control surfaces

BY John Keller

ARLINGTON, Va. — Aerospace designers at Aurora Flight Sciences Corp. in Manassas, Va. are moving to flight demonstration in a project to push the bounds of future electric aircraft by eliminating control surfaces like ailerons, rudders, and flaps.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a \$42.2 million contract to Aurora last week to move to the second and third phases of the Control of Revolutionary Aircraft with Novel Effectors (CRANE) project.

In this phase Aurora Flight Sciences electric aircraft experts will test integrated subsystem components, and then carry out fabrication, assembly, ground test, and flight demonstration of an experimental CRANE electric aircraft.

Last year Aurora won a \$12.4 million order to validate analytical predictions, carry out control loop analyses, and perform CRANE aircraft modeling verification. The company won a \$7.1 million DARPA CRANE contract in June 2020 to craft configuration-agnostic designs, conduct geometric and technology trade studies, and produce process documentation.

Instead of using ailerons, rudders, and flaps for control surfaces on future electric aircraft, the CRANE project seeks to use actuators or effectors to add energy or momentum to the flow of air over the aircraft.

Aurora engineers are trying to inject a disruptive technology early in aircraft design with new flow-control technologies and design tools. The idea is to configure and optimize an aircraft with active flow control to enhance efficiency and effectiveness of new commercial and military aircraft.

Passive control involves geometrical modifications like vortex generators on an aircraft wing for flow separation control, or chevrons on an exhaust nozzle of an aircraft to mitigate noise. Passive control devices always are on, no matter the need or performance penalty.

Active flow control, on the other hand, involves energy or momentum addition to the flow in a regulated manner. It is more desirable than passive control because aircraft pilots can turn it on or off as necessary.

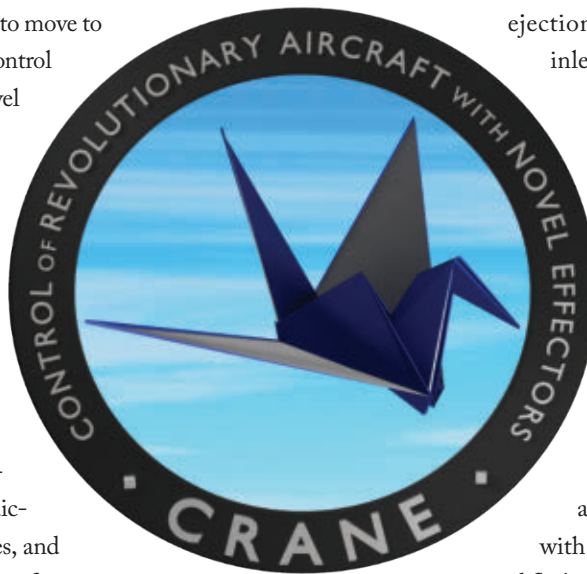
Active flow control alters the aircraft's aerodynamic flow field through mechanical actuators, or by ejection or suction on a wing, fuselage, inlet, or nozzle.

Effectors and actuators typically are the enabling technologies of active flow control, yet have been the weakest link in developing active flow-control technology. Despite their relatively high costs, effectors and actuators typically are light weight, have no moving parts, and are energy-efficient.

Aurora is demonstrating new active flow control on an X-plane, with a focus on the best ways to develop and flight demonstrate their flow-control technologies on a clean-sheet design or modification of an existing aircraft.

The CRANE project excludes large external moving surfaces like ailerons, rudders, flaps, elevators, and trim surfaces; mechanical vectoring of engine jet exhaust, or other traditional moving aerodynamic control devices.

CRANE's goal is to demonstrate in flight that active flow-control actuator technologies can maintain flight safely, and provide quantifiable aircraft capabilities. ◀



▲ **Instead of using ailerons, rudders, and flaps, the CRANE project seeks to use actuators or effectors to add energy or momentum to the aircraft.**

On this contract Aurora will do the work in Manassas, Va.; Cambridge, Mass.; Charleston, S.C.; Bridgeport, Conn.; Huntsville, Miss.; St. Louis; Huntington Beach, Calif.; Mesa, Ariz.; Fort Worth, Texas; National Harbor, Md.; and Salt Lake City, and should be finished in September 2025.

For more information contact Aurora Flight Sciences online at www.aurora.aero, or DARPA at www.darpa.mil/program/control-of-revolutionary-aircraft-with-novel-effectors.



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▲ Companies will compete for orders over the next 10 years for CANES production units; software; software renewals; software maintenance; spares and system components; and lab equipment.

Navy picks eight for \$4.1 billion shipboard computers and networking contract

BY John Keller

SAN DIEGO – U.S. Navy shipboard electronics experts are choosing eight companies to share as much as \$4.1 billion over the next decade for computers and networking equipment for cyber warfare aboard Navy surface warships and submarines.

Officials of the Naval Information Warfare Systems Command (NAVWAR) in San Diego, have announced a \$4.1 billion contract for the Consolidated Afloat Networks and Enterprise Services (CANES) computer hardware, software, spare parts, maintenance, and laboratory equipment.

Companies chosen are:

- BAE Systems Technology Solutions & Services Inc. in Rockville, Md.;
- Leonardo DRS Naval Electronics in Johnstown, Pa.;
- Related: Navy resolves CANES shipboard networking protest with selection of two more equipment vendors
- Global Technical Systems in Virginia Beach, Va.;
- L3Harris Technologies C5 Integrated Systems in Camden, N.J.;
- Leidos in Reston, Va.;

- Peraton in Herndon, Va.;
- Serco in Herndon, Va.; and
- VTG Milcom in Virginia Beach, Va.

These companies will compete for orders over the next 10 years for CANES production units; software; software renewals; software maintenance; spares and system components; and lab equipment.

CANES will consolidate and replace existing afloat networks and networking infrastructure for applications, systems, and services for tactical cyber warfare.

CANES will upgrade cyber security, command and control, communications and intelligence systems afloat, and replace unaffordable and obsolete networks.

The primary goals of the CANES program are to provide a secure afloat network for naval and joint operations; consolidate afloat networks using a common computing system; mature cross-domain computer technologies; reduce the size, training requirements, and logistics for shipboard networking; and increase reliability, security, interoperability, and application hosting.

CANES serves as the bridge to the future of Navy afloat networks, consolidating existing legacy and stand-alone networks, providing infrastructure for tactical applications, systems, and services, Navy officials say. CANES will consolidate and modernize shipboard network systems to improve operational effectiveness and affordability across the fleet.

CANES delivers its capabilities within one system, bringing infrastructure that will enable timely and interoperable information exchange among tactical, support, and administrative users, applications, and computer systems.

NAVWAR awarded a \$2.53 billion shared contract in 2015 to seven companies for CANES-related computers, communications, and networking equipment after a 2014 contractor protest brought the program to a temporary halt.

The seven companies that received CANES contracts nearly eight years ago are BAE Systems; General Dynamics C4 Systems; Global Technical Systems; Northrop Grumman Corp.; Serco Inc.; CGI Federal; and Leonardo DRS.

These seven contractors have manufactured CANES equipment for shipboard networking based on individual Navy orders. The Northrop Grumman Corp. Information Systems segment in San Diego, chosen in early 2012 to be the overall CANES shipboard electronics systems architect as part of a \$37 million contract, and is installing CANES equipment aboard surface warships. With options, the CANES contract to Northrop Grumman could be worth as much as \$638 million.

Resulting from this contract, BAE Systems, Global Technical Systems, Serco Inc., and Leonardo DRS remain CANES computers and networking contractors, while General Dynamics C4 Systems, Northrop Grumman Corp., and CGI Federal drop out. New contractors are L3Harris, Leidos, Peraton, and VTG Milcom.

A contract involving this many companies that is worth more than four billion dollars, is likely to generate protests

could halt work temporarily until protest claims are sorted out — just like the contracts that were awarded originally in 2014. ◀

On this CANES hardware and software contract, the companies will do the work in Huntsville, Ala.; San Diego, Calif.; Largo, Fla.; Ayer, Mass.; Long Beach, Miss.; Camden, N.J.; Johnstown, Pa.; Summerville, S.C.; and Clarksville, Gainesville, Sterling, and Virginia Beach, Va., and should be finished by December 2032.

For more information contact NAVWAR online at www.navwar.navy.mil.



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Lockheed Martin to set up obsolescence-mitigation program for F-35 electronic parts

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy combat aircraft experts are asking Lockheed Martin Corp. to set up a program to mitigate obsolescence of electronic components over the lifetime of the nation's fleet F-35 combat jets.

Officials of the Naval Air Systems Command — the purchase agent for all U.S. F-35 aircraft — has announced a \$25 million order to the Lockheed Martin Aeronautics segment in Fort Worth, Texas, to provide diminishing manufacturing source (DMS) management for the F-35. Lockheed Martin is the primary F-35 designer and manufacturer.

DMS refers to the obsolescence of electronic components such as computer processors, field-programmable gate arrays (FPGAs), power supplies, and databus interface chips. These components go obsolete much more quickly than weapons systems like the F-35, so the military has to plan for supplying integrating modern parts as the obsolete parts that need replacing become difficult to obtain.

This order calls for Lockheed Martin to review and identify actual and potential DMS issues of components, parts, materials, assemblies, subassemblies, and software items, and recommend solutions to mitigate issues in support of the F-35 aircraft.

The Lockheed Martin F-35 joint strike fighter has been in development for more than 27 years, even though the plane is one of the newest combat aircraft in the world. Now consider that the average life spans of commercial electronics spare parts are three years or less.

▲ **Lockheed Martin to review actual and potential obsolescence issues of components, parts, materials, assemblies, subassemblies, and software items, and recommend solutions.**

The most direct way of dealing with DMS electronic parts is to make lifetime buys — essentially buying up every part that manufacturers have on hand before they stop production entirely. Even after

making lifetime buys, systems integrators sometimes eventually must rely on aftermarket parts manufacturers, parts brokers, or the so-called “gray market” to keep spare electronic parts on hand.

It can be a time-consuming and expensive task to ensure that obsolescent parts remain available for military weapons platforms like the F-35, which must remain in top condition for many decades.

Without such a supply of spare electronic parts, systems integrators like Lockheed Martin would be faced with redesigning electronic subsystems with the latest generations of electronic parts. As attractive as that sounds, it's even more expensive and time consuming than keeping obsolescent spare electronic parts on hand.

Redesigning a complex electronic subsystem takes a long time, and an even longer time to certify for safety and performance. Most likely this quarter-billion-dollar investment the Navy is making in F-35 spare parts in the long run will end up being a good deal. ←

On this order Lockheed Martin will do the work in Fort Worth, Texas, and should be finished by July 2023. For more information contact Lockheed Martin Aeronautics online at www.lockheedmartin.com/en-us/who-we-are/business-areas/aeronautics.html, or Naval Air Systems Command at www.navair.navy.mil.

Oshkosh fielding JLTV combat vehicles with VICTORY-based vetronics and open-systems electronics

Armored combat vehicles designers at Oshkosh Defense LLC in Oshkosh, Wis., will support fielding of the U.S. Army Joint Light Tactical Vehicle (JLTV) systems under terms of a \$543.5 million order. Officials of the Army Contracting Command in Warren, Mich., are asking Oshkosh to exercise available options to support the fielding of the JLTV family of vehicles. The U.S. Department of Defense (DOD) wants to buy 54,599 JLTVs — 49,099 for the U.S. Army and 5,500 for the U.S. Marine Corps. The Oshkosh JLTV is light utility and combat multi-role vehicle with open-systems standard electronics. The combat vehicle is expected to deliver a level of protection similar to that of current, but far heavier and less maneuverable, Mine Resistant Ambush Protected (MRAP) class designs, and much better than the latest armored HMMWV combat vehicles. The JLTV features a vetronics architecture that complies with the Army's VICTORY electronics standard. VICTORY stands for Vehicular Integration for C4ISR/EW Interoperability. C4ISR/EW stands for command, control, communications, computers, intelligence, surveillance and reconnaissance/electronic warfare. The JLTV's VICTORY-compliant modular, scalable, open-architecture vetronics is designed to support rapidly evolving C4ISR suites. The U.S. Government Accountability Office (GAO) estimates that the DOD will spend more than \$53.3 billion on the JLTV program — \$1.1 billion for research and at least \$52.3 billion for procurement. On this order Oshkosh will do the work in Oshkosh, Wis., and should be finished by July 2024. For more information contact Oshkosh Defense online at <https://oshkoshdefense.com>, or Army TACOM at www.tacom.army.mil.

How electric air taxis could shake up the airline industry in the next decade

A world with flying vehicles, like the 1960s sitcom *The Jetsons*, might be closer than you think. Companies across the U.S., including several startups, are developing electric air taxis that aim to take cars off the road and put people in the sky. Commercial airlines, specifically, are investing in this type of technology to make trips to and from the airport shorter and faster for consumers. "Initially, eVTOLs are supposed to replace your personal car," Savanthi Syth, managing director of equity research, covering global airlines and mobility at Raymond James, says to CNBC. "But it's going to be different for people, based on where eVTOLs are going to be. We think that you'll see small amounts of [eVTOL] operations starting in the 2025 timeframe, with certifications hopefully happening in 2024," Syth said. "But for you to see a lot of aircraft flying overhead, it's probably going to be more likely into the 2030s."

Final 747 'Queen of the Skies' leaves Boeing's factory

The last Boeing 747 left the company's widebody factory 6 December 2022 in advance of its delivery to Atlas Air in early 2023. The Boeing 747 was the commercial aviation sector's first twin aisle passenger jet. The jumbo jet was designed in just 28 months and took advantage of new methodologies and technologies to pull it off, including fault tree analysis, which showed what would happen if one part in the plane failed and how it would impact others. The principal enabling technology that allowed the massive jet to get off the ground was its high-bypass turbofan engine which produced more thrust and used less fuel than earlier turbojets. The Pratt & Whitney JT9D powered the first 747s as well as Airbus' A300 and A310, plus the McDonnell Douglas DC-10. At 250-feet, two-inches, the 747-8 is the longest commercial aircraft in service. The final airplane is a 747-8 Freighter. This model has a revenue payload of 133.1 tonnes, enough to transport 10,699 solid-gold bars or approximately 19 million ping-pong balls or golf balls. "For more than half a century, tens of thousands of dedicated Boeing employees

Continued on page 13

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Researchers eye quantum computing gear small enough for future military missions

BY John Keller

ARLINGTON, Va. – U.S. military researchers needed new ways of improving high-performance computing performance by at least two orders of magnitude using quantum computing techniques called quantum-inspired solver systems. They found their solution from the University of Rochester in Rochester, N.Y.

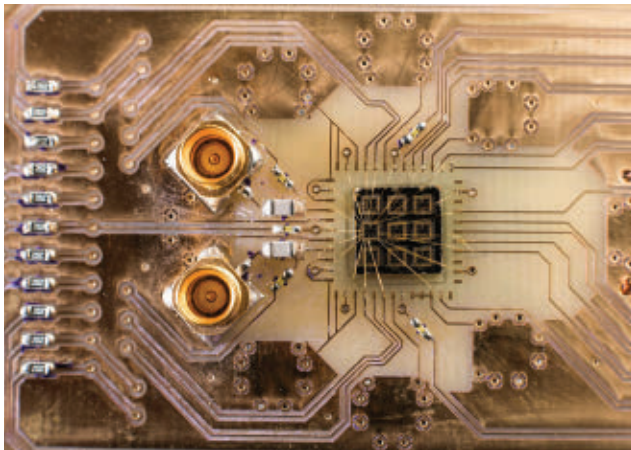
Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced a \$1.6 million contract to University of Rochester for the Quantum-Inspired Classical Computing (QuICC) program.

Quantum computing harnesses the phenomena of quantum mechanics to deliver a huge leap forward in computation to solve certain problems.

University of Rochester experts will develop quantum-inspired solver systems that solve realistic problems for military missions. Quantum-inspired solvers are hybrid: they are classical mixed-signal systems that consist of analog hardware and digital logic.

The analog hardware typically emulates interacting dynamic systems, and the digital logic processes the analog results to obtain quality solutions.

The objective is to deliver system prototype that can improve computational efficiency by at least 50 times for intermediate problem sizes and to show the feasibility of improving efficiency by at least 500 times for mission-scale problems.



Quantum computing harnesses the phenomena of quantum mechanics to deliver a huge leap forward in computation to solve certain problems.

The QuICC program will focus on classical hybrid mixed-signal systems; all-digital solvers or quantum computing are not part of the program.

Many U.S. Department of Defense (DOD) missions are limited by available computing resources. Quantum computing may be a potential solution, yet there is nothing to suggest that quantum computing every will be feasible for military size-, weight-, and power- (SWaP)-constrained environments.

Detailed analysis of quantum computing has led to new algorithms and hardware, while delivering significant advantages over all-digital computing. This is where quantum-inspired solvers may come in.

Quantum-inspired analog hardware typically emulates interacting dynamic systems like magnetic spins, and the digital logic processes the results.

Experts predict that prototype quantum-inspired could outperform conventional and quantum computers by a factor of 10,000, but have been demonstrated on small problems not typical of what the military needs.

A key QuICC metric for University of Rochester experts will be computational efficiency. To overcome scaling challenges, the program seeks solutions with algorithmic and analog hardware co-design, alongside application-scale benchmarking applications like Boolean satisfiability (SAT), maximum likelihood estimation (MLE), maximum-fault minimum-cardinality (MFMC) sampling, and mixed-integer linear programming (MILP).

The program has three technical challenges: scaling analog hardware advantages to mission relevant problems; limiting the growth of digital computations with problem size; and realizing predictive benchmarks at prototype system scales.

The QuICC program is five-year effort with a two year first phase, an 18-month second phase, and an 18-month, and an 18-month optional third phase. The program milestones will advance the scaling of quantum-inspired solver technology progressively toward mission-relevant problems and sizes. ◀

The QuICC project may spend as much as \$58 million over its entire duration, so additional contracts are likely. The program comprises two technical areas: solver co-design and mission relevant benchmarking; and analog hardware prototyping. For more information contact University of Rochester online at www.rochester.edu/research/technology.html, or DARPA at www.darpa.mil.

Continued from page 11

have designed and built this magnificent airplane that has truly changed the world. We are proud that this plane will continue to fly across the globe for years to come,” said Kim Smith, Boeing Vice President and general manager, 747 and 767 programs. For more than 50 years, Boeing updated the 747 as the aerospace and associated industries advanced technologies and as demand changed, including adding a cargo version of the aircraft.

FADEC Alliance to provide electric technologies for sustainable aircraft engine demonstration

The Full Authority Digital Engine Control (FADEC) Alliance, a joint venture of GE, BAE Systems, and Safran Electronics & Defense, will design the electronic control system architecture for the CFM International (CFM) Revolutionary Innovation for Sustainable Engines (RISE) demonstrator engine program. CFM is a joint venture of GE Aviation and Safran Aircraft Engines. As part of the advanced technology program, FADEC Alliance supports the maturation of new technologies for future engines, to reduce fuel consumption and emissions. Technologies matured as part of the RISE demonstrator program will prove concepts and capabilities needed for a potential next-generation CFM engine that is targeted to be available by the mid-2030s. The demonstrator program is focused on advanced technologies like open fan architecture, hybrid electric capability, electrified engine accessories, and hydrogen propulsion. FADEC Alliance will develop the electronic control system architecture and requirements for the demonstrator, along with multiple subsystems through two program phases. Phase one will focus on an expanded control system to accommodate new interfaces associated with an open fan concept. Phase two will address key aspects of

the engine's advanced systems. Development will occur at the BAE Systems site in Endicott, N.Y., and Safran's site in Massy, France. FADEC International is a 50-50 joint venture between a subsidiary of BAE Systems Controls Inc. in Nashua, N.H. and Safran Electronics & Defense in Costa Mesa, Calif., that focuses on the two companies' capabilities to design, produce, and support Full Authority Digital Engine Controls for commercial aircraft engines. ←



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URBAN MOBILITY GAINING TRACTION

Industry develops growing number of enabling technologies for urban air mobility, as companies are designing uncrewed aircraft, artificial intelligence (AI), propulsion, navigation, and guidance.

BY Jamie Whitney

The city soundscape soon may be abuzz with a variety of electric vertical takeoff and landing (eVTOL) aircraft ferrying passengers and cargo across dense urban centers high above the crowded streets below.

As with any nascent technology, there are a glut of designs as the market shakes out which provide the safety, resiliency, comfort, and demand operators need to transform the commuting public into frequent flyers taking short jaunts across cities or metro areas.

The National Aeronautical and Space Administration (NASA) estimates that 130 million passenger trips may be taken by the year 2029. Some market prognosticators estimate the UAM market to grow from \$2.2 billion in 2021 to \$31 billion in 2031.

In the intervening years, the urban air mobility (UAM) sector of eVTOL flying taxis will need to see rapid adoption of regulations, best practices, and infrastructure investment to enable safe air travel in cities dominated by tall buildings, huge radio frequency (RF) transmission traffic, and soon, other aircraft.

While many focus on passengers flying over traffic jams in city centers, the UAM sector is more broad than that. In addition to the promise of a flying taxi, autonomous eVTOL, hybrid, and traditionally fueled aircraft operators say they intend to find customers for air shuttles, personal air vehicles, air cargo, air ambulances/emergency vehicles, last-mile delivery, and similar military applications. These aircraft may be piloted remotely or with a pilot on-board or be fully autonomous in intracity and intercity routes.



AIR CITY

▲ Someday soon, at least for a lucky few, aviation technology will enable the ability to avoid street traffic.

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◀ **Elroy Air in San Francisco's Chaparral uncrewed cargo aircraft is designed for aerial transport of 300-500 pounds of goods over a 300 mile range for commercial, humanitarian, and defense logistics.**

will be utilized by other types of aircraft outside the performance characteristics of this composite aircraft.”

While agencies are establishing standards, engineers are figuring out how to distribute small-takeoff and -landing zones around cities that allow for safe maintenance, as well as for passenger and cargo loading and unloading.

As of 2023, the eVTOL aircraft directory of the Vertical Flight Society in Fairfax, Va., has more than 300 designs registered that feature lift and thrust layouts, including what look like a much larger version of a consumer quadcopter drone; distributed multi-copters; designs that use hybrid concepts where fixed or tilted wings drive forward flight while other fans or propellers are used for liftoff, hovering, and landing; and speedy jet designs. Each, of course, have their own pros and cons.

In addition to UAM's goals of moving people and goods around densely populated environments, the same technology is also anticipated for outside of city centers for civilian and military use and is referred to as advanced air mobility (AAM).

Building for the future

The U.S. Federal Aviation Administration (FAA) in Washington notes that UAM aircraft initially will use a flight ecosystem already in place for traditional helicopters that consists of routes, helipads, and air traffic control (ATC) services. In March 2023, the FAA started to establish standards for UAM-focused vertiports including signage and specifications for concrete.

“The draft [engineering brief] is based on research conducted by the FAA on the performance characteristics of various aircraft designs, currently under development, that will utilize vertiport facilities,” the agency wrote in an announcement last spring. “The draft guidance contains a discussion of a composite aircraft (or reference aircraft), and the recommended safety standards contained in the draft guidance are only applicable to vertiports used by this composite aircraft or by any aircraft within the range of performance characteristics as this composite aircraft. The draft safety standards are not applicable for vertiport facilities that

are established, companies from aviation giants like Airbus in Toulouse, France, and Boeing in Arlington, Va., to automotive and industrial players like Hyundai in Seoul and Toyota in Tokyo, as well as tech-forward start-ups attempt to establish a footprint in the UAM sector.

Major American passenger air carriers like United Airlines in Chicago and others worldwide like Brazil's Azul have made significant investments in UAM. In September, United announced plans to buy 200 four-seat eVTOL aircraft from Brazilian manufacturer Embraer's subsidiary Eve Air Mobility with an option for 200 more.

Eve's design uses conventional fixed wings, rotors, and pushers, giving it a lift-plus-cruise design and has a range of 60 miles and claims to reduce noise levels by 90 percent compared to current conventional aircraft. Eve also is creating air traffic management to enable the UAM industry to scale safely. This software is to perform at the same safety level as Embraer's existing air traffic management software.

Simulations for safety

Last month, Hyundai Motor Group's Supernal announced that it was collaborating with Redmond, Washington's Microsoft to integrate the software giant's Azure cloud platform to run simulations to test and train autonomous aircraft transportation.

Microsoft says it will provide Supernal early access to Project AirSim, an artificial intelligence (AI)-first simulation platform, to build, test, train and validate safe autonomous aircraft transportation through simulation. Project AirSim uses Azure to generate significant amounts of environment and sensory data to train machine learning models that simulate all phases of flight

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and variable weather patterns. Project AirSim provides libraries of pretrained AI models and planet-scale 3D environments representing urban and rural landscapes, as well as a partner ecosystem offering synthetic data generation.

“Air transport is a key pillar in the democratization of mobility, connecting more people, goods and places through safe flight experiences,” says Ulrich Homann, corporate vice president Cloud + AI at Microsoft. “With the Microsoft Cloud, Supernal can unlock the computing power it takes to build, validate, and deploy electric air vehicles at scale, spurring the commercialization of advanced air mobility solutions.”

Real-time software expert Wind River Systems in Alameda, Calif., also offers a cloud-based solution for UAM/AAM and other mission-critical intelligent systems with Wind River Studio.

Wind River Studio is a cloud-native platform for the development, deployment, operations, and servicing of mission-critical intelligent systems, and offers solutions to meet both DO-178C and DO-356A, says Alex Wilson, director of aerospace and defense solutions at real-time software expert Wind River Systems in Alameda, Calif.

“Wind River Studio provides the fundamental building block of future intelligent avionics, based on a modern development environment where the process requirements of safety and security are built into the automated software development process,” Wilson says. “Wind River Studio safety-certified platforms support popular architectures in aviation such as Arm, Intel, and PowerPC. Wind River Studio includes automated validation and verification using digital twins. This allows software developers



Sikorsky demonstrates to the U.S. Army how an optionally piloted Black Hawk helicopter flying in autonomous mode could resupply forward forces. These uninhabited Black Hawk flights at Yuma Proving Ground in Arizona. Sikorsky photo

to not only meet the regulatory requirements, but also to provide innovative capabilities across the fleet using the cloud to scale their operations.”

Safety first

Before United passengers can catch a flight from a Long Island vertiport to LaGuardia airport, designers and engineers need to earn the confidence not only of future flyers, but also of regulators. With many aircraft aiming for totally or partially autonomous flight, experts need to demonstrate flawless systems that do both.

Wind River’s Wilson notes that the highest challenge is ensuring these aircraft operate safely and securely in a challenging environment.

“A dense urban environment means that you cannot have these aircraft causing fatalities due to either airworthiness reasons or to cyber-attacks,” Wilson says. “Regulations must play a part in this challenge. This covers many aspects of the aircraft life cycle, from development to deployment and operations. This is in some ways no different to commercial aircraft, with regulations on how you obtain airworthiness, what conditions your aircraft is built to operate in, and how you maintain that airworthiness through the life cycle. Added to this are regulations on how you are allowed to operate through the airspace, including what communications and sensors you need to comply.”



Hyundai’s Supernal division announced it would be collaborating with Microsoft to use the software giant’s Azure cloud platform to run secure simulations for its urban air mobility projects.



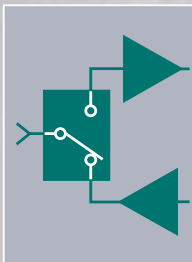
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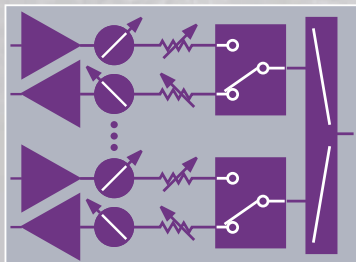
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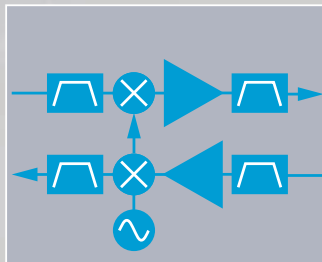
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Wilson says that as manufacturers achieve airworthiness from regulators like the FAA and the European Aviation Safety Agency (EASA), designers must analyze potential failure modes and provide the necessary migrations to make sure there aren't any deadly incidents.

"These mitigations flow down through hardware and software systems, applying safety and security requirements on each subsystem. For software, this would require these components to be safety certified under DO-178C and security certified under DO-356A," Wilson says. "The level of validation and verification would be set by the systems designer as they identify critical sub-systems."

Wilson continues, "This must also align with urban planning around smart mobility, such as who is allowed to operate autonomous services around the city, what services are they allowed to provide, and how they fit into the bigger picture across the city. For example, would they use the 5G infrastructure for navigation and communications, how would passenger services align with ground, rail, and commercial air services, would there be no-fly zones — such as schools or hospitals — for certain types of aircraft?"



This artist's rendering shows how a future United Airlines urban air mobility vehicle might look as it operates around urban areas.

Making connections

With many planned UAM aircraft using autonomous or semi-autonomous systems, constant connectivity is necessary to keep takeoffs and landings spot-on, and routes precise. Like the phone giving you directions, this can be done with RF transmissions and global navigation satellite systems (GNSS). Maintaining connectivity to those systems is critical, says Jia Xu, chief technology officer for the Honeywell Inc. Unmanned Aerial Systems (UAS) business unit in Charlotte, N.C. The offers enabling technologies for UAM/UAS, including detect-and-avoid; actuation; thermal management, and motors, but its anti-GPS jamming solution can help to keep uncrewed systems flying in challenging environments.

Due to the weakness of GNSS signals, UAVs are susceptible to jamming attacks which can be carried out from large distances using cheap jammers bought online. UAV developers and end-users currently try to solve this problem either by creating "safe landing protocols" in GNSS-challenged environments or by adding sensors like lidar or optical LiDAR to their flight controllers.

In late 2021, Honeywell, drone-in-a-box manufacturer and U.S. Air Force supplier Easy Aerial, and Israeli navigation resiliency company infiniDome collaborated to pair GNSS-based UAV-tailored Honeywell Compact Inertial Navigation System (HCINS) with infiniDome's GPS anti-jamming technology, integrated with Honeywell's Radar-based Velocity System (HRVS).

The combined technology demonstration showed that a UAV protected by the Robust Navigation System, under a GPS-challenged environment with a direction of jamming and denied environment with several directions of powerful jamming by military-grade jammers could perform BVLOS and autonomous tasks accurately and safely without taking manual control of the UAV.

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Civilian airspace also can experience nefarious actors attempting to jam GNSS systems as well as more benign — but still potentially dangerous — interference from the cityscape.

“You know in urban environments you have GNSS-availability issues at lower altitude, you have multipath issues with communications with RF navigation aids that you have to manage now,” Honeywell’s Xu says. “The way that we think about it is in the case of autonomous aircraft there’s not a pilot necessarily always in the loop on the aircraft, certainly, to kind of steer you out of that situation. So, you need this higher level of integrity, higher level of assurance. And so having GPS denied capability makes sense and Honeywell has a solution. It’s the GPSDome solution that helps us. It has signal processing and antenna techniques to help us basically reject jamming signals from GPS and gives us that added layer of GPS assurance that we have integrated that in the context of our navigation sensors to basically provide this hybrid approach and navigation that is both resilient and accurate.”

Honeywell’s Xu notes that “our laser ring gyro navigation solution can be used to increase GPS resilience. Because it’s the very low-drift dead-reckoning inertial reference system, you don’t need external aids; you can just sort of track the aircraft’s progress, integrate acceleration into velocity, and velocity to position to get your [navigation] solution. So that’s also a technology that we’re bringing to this market.”

Uncrewed benefits

Achieving autonomous flying systems takes a lot of technological know-how, but it is shaping-up to benefit companies that invest in these systems by potentially reducing payroll costs or allowing professionals to do more with less downtime.

“We at Honeywell think very concretely about the subject because autonomy...it’s super cool, right? And sometimes people think that that’s enough to justify the work,” Xu says. “And certainly, as an engineer I come to you and say, look, that’s kind of great. It’s great. Yeah! Robots! But then we are rather highly motivated by the by the impact that we can have in the way that we fly, in the way that we live as well as the economic benefits and social benefits of autonomous operations.”

He continues, “We also see an opportunity with autonomous aircraft to increase utilization and operating efficiency. So if you have an autonomous flight capability, then you can render the route planning independent of the crew positioning.”

Xu explains that by removing an on-board pilot, hours of training and labor are eliminated. Even with remotely-piloted aircraft, an increased level of flight automation allows people to focus on tasks that are suited to the unique problem solving that can only be achieved with the human brain.



Drones carrying fresh blood products on the front lines may be critical for military medicine in a conflict.

Honeywell’s Xu notes that a lot of time with cargo flights in the military and commercial world, there’s a lot of waiting for the pilot as materiel is taken off of the aircraft. With a pilot that’s able to jump immediately to another remotely-piloted craft, the waiting time is eliminated, and they can get back to what they do best.

Likewise, there is a pilot shortage across numerous industries. “It doesn’t ramp-up where there’s instant demand and instant response,” Xu says of training programs. “So there are

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issues independent of the cost question. There's also a pilot pool constraint question."

In addition, Wind River's Wilson says that software and hardware can help improve a pilot's ability to stay out of trouble in perilous conditions.

"There are also areas which software could improve upon piloted operations, such as using sensors for obstacle detection and avoidance, Wilson says. "This of course assumes these sensors can be developed with a high degree of confidence in detecting all obstacles, always, and in all situations. For example, at night, in foggy conditions, or heavy rain."

Reducing risk

Wind River's Wilson explains that regulators in the U.S. and Europe have different views on automation, and that shows in their recommendations. "From a commercial transport regulatory perspective, this has brought about some differences in approach to automation between the FAA and EASA. European authorities are pushing for more and more automation as it moves to the single pilot concept, whilst the FAA is recommending less automation and improved manual flying skills. Purely from a software perspective, there are benefits to having uncrewed operations. Many of the systems that add complexity to the aircraft are there to support the air crew. Removing the crew from the vehicle means that we can eliminate these systems. For example, cockpit displays, oxygen and life support systems, voice communications. However, the overall functionality of these systems may need to be replaced

by automated systems, which normally implies software systems. However, although displays are not needed in the aircraft, they may be needed as part of the overall system at the remote pilot workstation, and they may also be needed if the vehicle is 'optionally' piloted."

Of course, taking a pilot or pilots out of the cockpit removes a risk factor from flying as Wilson says that uncrewed systems really shine in what would be "D3" domains for people — dull, dirty and dangerous jobs from deep under the sea and up into space.

"In military parlance these translate into certain reconnaissance, strike, and damage-assessment missions where the lack of an on-board operator does not adversely impact the capability of the system while concurrently reducing the risk to the crew," Wilson explains. "In commercial aviation, certain functions and check lists that used to be manually performed by the crew on many jetliners have been automated, and the air cargo industry is advocating for the potential introduction of a one-person cockpit thereby eliminating today's need for a human co-pilot. As the advanced/urban air mobility sector continues to mature, some AAM/UAM industry leaders are pushing the boundaries by conceiving air vehicles that are designed and developed to be 'uncrewed' from the start, with technology leading the way and regulators to eventually follow."

Eyes on the skies

Regardless if small aircraft are autonomous, flown with a pilot on board, or are remotely piloted, UAM/AAM systems not only will need to avoid buildings and people, they'll need to avoid each other, and that is shaping up to be a unique problem and poses questions that have yet to be answered.

"Added to these challenges are those of traffic management," Wind River's Wilson says. "UAS Traffic Management (UTM) would also be on a scale much greater and more complex than current Air Traffic Management (ATM). This is due to both the volume of traffic, but also on the environment it operates in. How would you carve up the airspace in an urban environment for different types of traffic to maintain both safety and operate these systems efficiently? The ad hoc nature of some services would further complicate this, how would you manage services such as door-to-door autonomous air taxis?"

Wilson continues, "Operators will also have to manage fleets of these aircraft, which in some cases could be much larger quantities of aircraft than we are traditionally used to, such as a fleet of delivery aircraft to a large retail supplier. As such they would need to maintain and operate these aircraft at scale, including the ability to test and then update operational software for safety or security concerns." ←

The next generation of open-systems embedded computing standards

The Sensor Open System Architecture (SOSA) is taking the industry by storm, as more than 100 organizations rely on the new standard to ensure interoperability, easy technology upgrades, and affordable systems designs.

BY John Keller

The Sensor Open System Architecture (SOSA) technical standard for embedded computing hardware and software is moving beyond its initial promises of reducing development and integration costs and time to field for military electronics designs, and is beginning to provide tangible benefits for early adopters who are seeing the new standard take hold in a big way.

The Open Group in San Francisco published the Technical Standard for SOSA Reference Architecture, Edition 1.0, in fall 2021, which paves the way for embedded computing companies to prove by documentation that they meet SOSA's guidelines — not merely claim to be in alignment with the spirit of the new standard.

Now the embedded computing industry has a plan to follow, and later this year will have established procedures for certifying computing components as conformant with SOSA guidelines with a conformance test suite that will evolve over time to cover components ranging from chassis and enclosures, to power conditioning and control, and eventually to software components.

The aim of SOSA

“Right now SOSA is probably the most influential standard out there,” says Steve Edwards, director of secure embedded computing solutions for the Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va. “It is the one that is most active, and that has involvement from the government — particularly the Army and Air Force — and SOSA is starting to incorporate some other industry standards.”

For the most part, SOSA doesn't aim at creating a new standard, but instead seeks to incorporate as many accepted industry standards as possible, so as to avoid re-inventing the wheel and to use standards with which industry designers already are familiar. SOSA, for example, has adopted the OpenVPX standard of the VITA Open Standards, Open Markets trade association in Oklahoma City. SOSA has begun adopting the U.S. Army's Vehicle Integration for C4ISR/EW Interoperability (VICTORY) standard, industry experts say, and is expected to adopt additional standards in the future.



▲ The LCR 4-, 6-, and 800-series embedded computing chassis are designed for SOSA-aligned payloads.

“SOSA is a standard of standards,” says Mark Littlefield, senior manager of embedded computing products and solutions at Elma Electronic in Alameda, Calif., and is co-chair of the SOSA small-form-factor subcommittee. “The more standards that collaborate, the better the SOSA ecosystem. It’s also about supporting what is already out there, and having the tie-in to what is already out there will strengthen SOSA as a choice.”

The spirit of SOSA reflects a desire to develop new standards only when necessary, and rely instead on established standards. “The SOSA mandate is to adopt, adapt, and develop,” says Dominic Perez, chief technology officer at Curtiss-Wright Defense Solutions. “If they don’t have to create something new, then don’t, if they can pull in from existing standards. When it doesn’t fit the use case, then they want to adapt and modify those existing standards.”

One example involves the VITA OpenVPX standard. “There are things where SOSA has defined VPX profiles outside of VITA, and then VITA wants to roll those profiles back into OpenVPX,” Perez says. “They are trying to create as little as possible, and adopt as much as they can.”



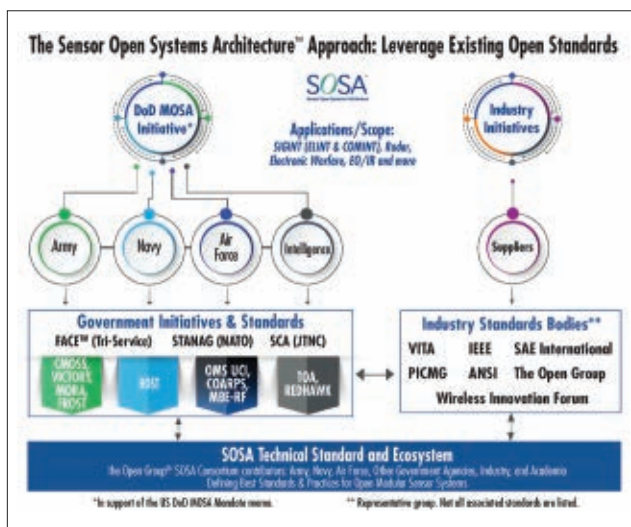
▲ The Pixus Technologies OpenVPX- and SOSA-aligned 10U RiCool embedded computing chassis is for aerospace and defense applications

Ultimately SOSA isn’t intended to be a standard so comprehensive as to cover every conceivable design challenge. “SOSA isn’t a be-all spec; it’s an 80-percent spec., and 20 percent will be application-defined,” says William Pilaud, director of systems architecture at LCR Embedded Systems Inc. in Norristown, Pa. “It makes it easier on the integrators as they try to help people out.”

Overall, SOSA seeks to enable rapid, affordable, cross-platform best practices for systems, software, hardware, electrical, and mechanical engineering. It is intended to reduce development and integration costs for military capabilities and reduce time to field. The standard encapsulates fundamentals of the Modular Open Systems Approach (MOSA)

design approach to develop embedded computing solutions for military applications that involve a unified set of sensor capabilities.

The SOSA Consortium aims to create a common framework for moving electronics and sensor systems to an open-systems architecture based on key interfaces and open standards established by industry and government consensus to support aerospace and defense applications for manned and unmanned surface vessels, submarines, aircraft, land vehicles, and spacecraft. The goal is to reduce development and integration costs and reduce time to field new sensor capabilities.



The SOSA technical standard seeks to capitalize on established standards first, to adapt established standards second, and only create new standards as a last resort.

Demonstrated benefits

Perhaps the best news about SOSA is how the standard is starting to have tangible benefits for the companies that have embraced it. “The prime contractors see that using SOSA will sweeten their offers to the government, because SOSA will make their bids more attractive,” says Rodger Hosking, director of sales at the Mercury Systems facility in Upper Saddle River, N.J.

Early adopters may be seeing some surprises, but overall see SOSA as worth it to help achieve plug-and-play interoperability among products from different vendors, drive down embedded computing costs, and make rapid systems upgrades a reality.

“In some cases SOSA will add some cost because of the backplane RF connectors where all the RF signals must go through the backplane,” Mercury’s Hosking explains. “Those connectors and housings are expensive, and add cost to the system, but you could argue about the savings they offer in reliability and maintenance, compared to front-panel interconnects.”

The benefits can outweigh the drawbacks, Hosking says. “that extra cost really does provide a meaningful benefit that everyone agrees with,” he says. “A lot of what SOSA mandates is based on common sense, and is done for a very deliberate reason. People are making really good arguments about why SOSA should be a military mandate.”

Despite the up-front costs, Mercury customers are buying-in to the long-term benefits of SOSA, Hosking says. “We are selling a lot of this SOSA flavor to our customers, and the trend they see is they want to be ready when and where SOSA is mandated, and might want to provide that backplane analog RF I/O so their customers see that as a benefit. SOSA is good technology, whether it is mandated or not.”

Interoperability among different companies’ SOSA-aligned products no longer is just a claim; it’s demonstrated reality, says LCR’s Pilaud. “Now that availability of components are getting aligned, at LCR we have the ability to do a lot of mix-and-match between vendors, get standardized, and get the I/O path defined.”

Those factors can help LCR and other embedded computing companies expand their product offerings to customers who no longer have anxiety that these products will be compatible. “We can offer baseline backplanes and systems that can plug and play, and we are almost at that point where I have two customers who had different boards from different vendors, but backplane commonality is almost 100 percent. Then I could offer the same enclosures to two different customers,” Pilaud says. “We will start offering more and more integrated systems that customers can get 80 percent of what they need — and if we get lucky 100 percent of what they need. That’s what I’ve seen in the past two years.”



The Curtiss-Wright VPX3-4936 3U OpenVPX GPGPU processor module for artificial intelligence and machine learning is aligned with the CMOSS and SOSA technical standards.

Pilaud and other embedded experts are not under the illusion that SOSA has the potential to cover all their solutions, but what the standard offers will be enough. “Are we there where every I/O or every program has completely standardized?” Pilaud asks. “No, we are still a ways away, and that is because there are so many types of programs and architectures out there. Radar looks different from communications or electronic warfare. In time we will have a lot of reference architectures. We are standardized at the backplane and the I/O panel. SOSA has enough benefit that having at least some subset of it has extraordinary benefits.”

Not all the measurable benefits of SOSA are technological; there are business advantages, too, says Valerie Andrew, strategic marketing manager for Elma Electronic. “One subset of

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The U-C8500, U-C8501, and U-C8502 3U VPX cyber security-enabled single-board computers from Aitech Systems in Chatsworth, Calif., are aligned to The Open Group Sensor Open Systems Architecture (SOSA) technical standard.

SOSA is focusing on documentation for acquisition,” Andrew says. “We are getting ready to release a document for acquisition people to follow that talks about what kind of language to use in requests for information and requests for quote, and to call out for acquisitions that support developing products in SOSA.”

How SOSA is evolving

SOSA 1.0 was published on 30 Sept. 2021, and the next iteration, SOSA 2.0, should be published sometime this spring, says Ilya Lipkin, chair of the SOSA Steering Committee for the Open Group, and an open-architecture technical expert for the U.S. Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio. “Hopefully we will publish SOSA 2.0 within the next couple of months,” Lipkin says. “Most of the work is completed.”

Since SOSA 1.0 was published, and even before, “we have got an industry adoption,” Lipkin says. As far as organizations that have joined the SOSA consortium since its inception, “we were hoping for 10 to 15 companies.” Today the consortium has 144 companies — and counting. Among the most influential organizations in the consortium are the Air Force Life Cycle Management Center; Boeing; Collins Aerospace; Lockheed Martin; U.S. Naval Air

Systems Command; the U.S. Space Force Space and Missile Systems Center; and U.S. Army PEO Aviation. A list of SOSA Consortium members is online at www.opengroup.org/sosa/members.

As far as the entire SOSA standard is concerned, Lipkin says the consortium is “halfway through technical standard development, and in the next year we could be 80 to 100 percent complete. We are trying to keep solutions as close to the speed of COTS as possible.”

The future of SOSA is somewhat sketchier. “Where we are headed is a moving target,” Lipkin admits. “We need to keep the commercial market as close as possible. We have started small form factors in SOSA recently for smaller than 3U designs. Those are low-cost, large-volume products. For small scale capabilities, this is one of those big game changers.”

Lipkin predicts that SOSA-conformant small-form-factor embedded computing boards should be available on the open market within two or three years. These boards will be smaller than 3U OpenVPX boards.

Among the most pressing technology challenges for SOSA in the future will be countering the effects of heat in high-performance embedded computing systems. “in the future we always will be battling hot components from Intel, NVIDIA, and the FPGAS [field-programmable gate arrays],” says LCR’s Pilaud. “It puts a challenge on the form factor of how to cool effectively. I would say we have a few form factors like liquid and air flow through technologies on the VITA side to help, but I don’t know if we are really there yet.”

Another future challenge of SOSA will involve dealing with extremely high-bandwidth processors for applications like signals intelligence, electronic warfare and radar signal processing, Pilaud adds.

Conformance testing

The next great stage in the evolution of SOSA is setting up and carrying out conformance testing to certify SOSA-conformant products. “There is a whole group within SOSA working on the conformance guide, which will be that go-to thing to tell you what the company has to do to be conformant to SOSA,” says Elma’s Littlefield.

This conformance guide “will help people understand the conformance process,



The Avionics Modular Mission Platform (AMMP) 3U OpenVPX avionics mission computer from Mercury Systems Inc. in Andover, Mass., is SOSA aligned and DAL-certifiable.

with tools of what they need to do, and help guide them through the process,” explains Ken Grob, director of embedded technology at Elma. The conformance guide will help companies “understand how much of this mumbo-jumbo do I have to do, and what is it going to cost me,” Grob says. “There is confusion understanding when and how to achieve conformance.” The first version of the SOSA conformance guide is expected to be available by the end of February 2023.

“Verification isn’t only test,” cautions Elma’s Littlefield. “It involves inspection, analysis, and test. There is a fair amount of analysis required for design materials, and even checking to see if something exists in a product or not. Inspection is does it have the necessary feature. Analysis is looking at the design is does it meet the expectations.”

Early SOSA conformance testing “will be very inspection-heavy because we don’t have an established conformance infrastructure,” Elma’s Littlefield says, adding that the first SOSA conformance testing is expected to happen sometime this fall.

“In a nutshell the conformance program is one of those critical aspects of SOSA to ensure interoperability; we’re all about fast fielding, says the Air Force’s Lipkin. “The initial release of the conformance program will be in the next couple of months, and it will be incrementally released.” Initial SOSA conformance testing most likely will involve hardware components, with the more difficult software aspects coming later.

Many details about SOSA conformance testing have yet to be determined, but Lipkin says the process “needs to be cheap, and we need to automate it to the maximum extent possible. It needs to have cheap enough tooling so vendors can integrate conformance testing as part of their development process.

The Open Group is expected to list companies that receive SOSA product certification on the organization’s website at <https://www.opengroup.org/sosa>. “It will be a short list at first,” points out Elma’s Andrew. ◀

WHO’S WHO IN SOSA-ALIGNED EMBEDDED COMPUTING PRODUCTS

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

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

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

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

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

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

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

General Micro Systems (GMS) Inc.
Rancho Cucamonga, Calif.
www.gms4sbc.com

Kontron America Inc.
San Diego
www.kontron.com

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

Pixus Technologies
Waterloo, Ontario
www.pixustechnologies.com

SMART Modular Technologies
Newark, Calif.
www.smartm.com/

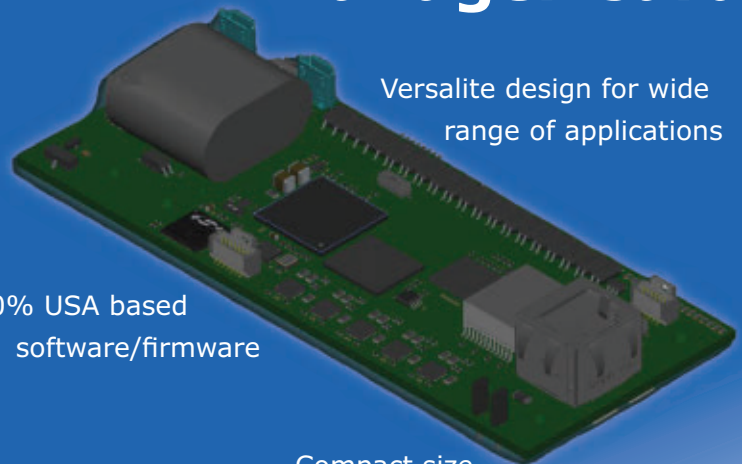
Systel Inc.
Sugar Land, Texas
www.systelusa.com

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

The Open Group
San Francisco
www.opengroup.org/sosa

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Fincantieri Marinette moving forward with shipboard electronics for Constellation-class frigate

BY John Keller

BATH, Maine – U.S. Navy surface warfare experts are asking shipbuilder Fincantieri Marinette Marine Corp. in Marinette, Wis., to plan building a land based engineering site in Philadelphia for the future Constellation-class frigate.


Officials of the Supervisor of Shipbuilding, Conversion, and Repair, Bath, Maine, have announced a \$76.7 million order to Fincantieri Marinette Marine for procurement of long-lead time material for the land based engineering site for the Constellation-class frigate.

Orders for long-lead items are among the first steps in large procurement programs. Long-lead items either are difficult and

time-consuming to obtain, and are funded early in the design process to keep overall production on schedule. Contracts to build the actual engineering center will come later.

The land-based test site in Philadelphia will test the propulsion system and other machinery of the future Constellation-class frigate design, as well as to identify and fix problems before they could cause problems in building the future frigate USS Constellation (FFG 62), which is scheduled for delivery in 2026.

The Constellation-class frigate will replace the Navy's now-retired Oliver Hazard Perry-class frigates — the last of which, the USS Ingraham (FFG 61), was removed from service in 2014.



◀ **This artist's rendering shows the future U.S. Navy Constellation-class frigate, which will replace the service's Perry-class frigates.**

Frigates typically are escort vessels that are lighter than destroyers, and help defend aircraft carrier battle groups or merchant convoys from submarine, aircraft, and cruise missile threats. They are intended to operate in the open ocean, unlike the Navy littoral combat ship, which is designed to operate in coastal waters and harbors.

The Constellation-class frigate will be able to keep up with Navy aircraft carriers and will have sensors networked with the rest of the fleet. It normally will be part of Navy strike groups and large surface combatant-led surface action groups, but also will be able to operate and defend itself in independent operations.

These frigates will have a minimum of 32 Mark 41 Vertical Launch System cells aboard for anti-air warfare. The ship will be designed to destroy surface ships over the horizon; detect enemy submarines; defend convoy ships; employ active and passive electronic warfare systems; and defend against swarming small boat attacks.

Shipboard electronics will include the Lockheed Martin COMBATSS-21 combat management system; AN/SPY-6(V)3 Enterprise Air Surveillance Radar (EASR); AN/SPS-73(V)18 surface search radar; AN/SLQ-61 lightweight towed array sonar; AN/SQS-62 variable-depth sonar; AN/SQQ-89F undersea warfare and anti-submarine warfare combat system; and Cooperative Engagement Capability (CEC).

The Constellation-class frigate will accommodate 32 Vertical Launch System cells that can handle RIM-162 ESSM Block 2 and/or RIM-174 Standard ERAM missiles; RIM-66 Standard SM-2 Block 3C; the Naval Strike Missile; RIM-116 Rolling Airframe Missile; Mk 110 57-millimeter gun; and machine guns. The ship will be able to carry one MH-60R Seahawk helicopter and the MQ-8C Fire Scout unmanned helicopter.

The frigates will use a combined diesel electric and gas hull, mechanical and electrical propulsion system which has never been used in any other U.S. navy ship. The new propulsion system must be tested on land to reduce the risk of engine failure, which has been problematic for the Navy's Littoral Combat Ships.

The Lockheed Martin Rotary and Mission Systems segment in Moorestown, N.J., are designing the combat management system for the Constellation-class frigate. The combat system is based on the company's COMBATSS-21 ship combat management system, which is aboard the Freedom-class littoral combat ships.

COMBATSS-21 is built on an open-architecture scalable framework using non-developmental software, Lockheed Martin officials say. Custom software adapters called boundary components support sensors, communications, and weapon interfaces, and are designed to accommodate future technology insertion and system upgrades with minimal effect on the system's core software.

In addition to developing the combat management system for the Navy's future Constellation-class frigates, Lockheed Martin also builds the Navy's Aegis combat system for Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers at its Moorestown, N.J. facility.

The Lockheed Martin COMBATSS-21 architecture isolates shipboard sensors, communications, and weapons from core components of the command and control system to avoid large system bugs and speed software certification.

COMBATSS-21 can run on computer configurations ranging from one commercial processor running a commercial operating system to more distributed configurations, to enable the COMBATSS-21 system adaptable to vessels ranging from patrol craft to large-deck ships, Lockheed Martin officials say.

The Lockheed Martin COMBATSS-21 combat management system borrows technology from Navy Aegis cruisers and destroyers, as well as the U.S. Coast Guard Deepwater program.

The future USS Constellation will be the lead ship of a class of at least 20 frigates. The hull of the frigate is based on the Italian FREMM-class frigate. The first three ships of the class are under contract to Fincantieri Marinette Marine.

The Constellation and its first two sister ships, the USS Congress (FFG 63) and USS Chesapeake (FFG-64) are named for three of the Navy's six original frigates — USS Chesapeake; USS Constitution; USS President; USS United States; USS Congress; and USS Constellation — built between 1797 and 1800. Of these original ships, the USS Constitution still is a Navy commissioned warship and is based in Boston. ◀

On this order Fincantieri Marinette Marine will do the work in Marinette, Wis., and should be finished by October 2025. For more information contact Fincantieri Marinette Marine online at <https://fincantierimarinegroup.com>, or the Navy Supervisor of Shipbuilding, Conversion, and Repair at www.navsea.navy.mil/Home/SUPSHIP.

Raytheon to upgrade LTAMDS missile-defense radar to handle hypersonic munitions

By John Keller



REDSTONE ARSENAL, Ala. – Missile defense experts at Raytheon Technologies Corp. will carry out upgrades and technology insertion to a new radar system to help defeat quickly evolving missile threats such as hypersonic weapons.

Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., announced a \$122 million three-year contract to the Raytheon Missiles & Defense segment in Andover, Mass., for the Lower Tier Air and Missile Defense Sensor (LTAMDS) pre-planned product improvement Increment III upgrades effort.

Raytheon won a U.S. Army contract in October 2019 to provide the next-generation LTAMDS advanced air and missile defense radar.

LTAMDS is the next generation, 360-degree missile-defense radar that ultimately will replace the current U.S. Army's Patriot missile radars. The radar has gallium nitride components, and is scheduled to reach initial operational capability with the Army in 2022.

LTAMDS consists of a primary antenna array on the front of the radar, and two secondary arrays on the rear. The radar antennas work together to enable operators to detect and engage several threats simultaneously from any direction, ensuring there are no blind spots on the battlefield.

The LTAMDS primary array is roughly the same size as the Patriot radar array, but provides more than twice Patriot's performance. While it is designed for the U.S. Army's Integrated Air and Missile Defense system, LTAMDS will also be able to preserve previous Patriot investments.

▲ **the Lower Tier Air and Missile Defense Sensor (LTAMDS) is a 360-degree missile-defense radar that ultimately will replace the current U.S. Army's Patriot missile radars.**

Raytheon is working with hundreds of suppliers across 42 states, including a core team playing a strategic role in building the LTAMDS solution.

Orolia USA in Rochester, N.Y., for example, is providing the company's rugged SecureSync time and frequency system to supply positioning, navigation, and timing (PNT) capability to the U.S. Lower Tier Air and Missile Defense Sensor

(LTAMDS) radar program.

Crane Aerospace & Electronics in Lynnwood, Wash., is providing defense power systems for power control and conditioning for LTAMDS. Mercury Systems Inc. in Andover, Mass., is providing high-performance digital signal processing and RF solutions for LTAMDS.

On this contract Raytheon will do the work in Huntsville, Ala.; Tucson, Ariz.; Anaheim Hills, El Segundo, and San Diego, Calif.; Fort Walton Beach, Indialantic, and St. Petersburg, Fla.; Fort Wayne and Indianapolis, Ind.; Andover, Burlington, Cambridge, Marlborough, Tewksbury, Waltham, and Woburn, Mass.; Aberdeen Proving Ground and Fulton, Md.; Saginaw, Mich.; Nashua and Pelham, N.H.; White Sands Missile Range, N.M.; Lawton, Okla.; Chambersburg, Pa.; Portsmouth, R.I.; El Paso and San Antonio, Texas; and Arlington and Sterling, Va., and should be finished by October 2025. ◀

For more information contact Raytheon Missiles & Defense online at www.raytheonmissilesanddefense.com, or the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa>.

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Navy orders two Kratos unmanned combat aircraft to work with crewed jet fighters

BY John Keller

PATUXENT RIVER NAS, Md. — U.S. Navy aerial warfare experts are ordering two unmanned combat aircraft from Kratos Defense & Security Solutions Inc. in San Diego as penetrating affordable autonomous collaborative killer aircraft.

Officials of the Naval Air Warfare Aircraft Division at Patuxent River Naval Air Station, Md., announced a \$15.5 million contract to Kratos for two XQ-58A Valkyrie unmanned aerial vehicles (UAVs) with sensor and weapon system payloads.

The XQ-58 is an experimental stealthy unmanned combat aircraft built originally for the U.S. Air Force Low-Cost Attritable Strike Demonstrator program to help break the escalating cost of combat aircraft, and to provide an unmanned escort or wingman aircraft to assist crewed fighter aircraft in combat.

The XQ-58A delivers a combination of long-range, high-speed, and maneuverability that can deploy weapons from its internal bomb bay and wing stations. The XQ-58A demonstrator first flew in March 2019 at Yuma Proving Ground, Ariz.

Air Force Low-Cost Attritable Strike Demonstrator program is part of the Air Force Research Laboratory Low Cost

▲ **The XQ-58A delivers a combination of long-range, high-speed, and maneuverability that can deploy weapons from its internal bomb bay and wing stations.**

Attritable Aircraft Technology (LCAAT) project to design and build unmanned combat aircraft quickly.

The role of the LCAAT is to escort advanced combat aircraft like the U.S. F-22 or F-35 during combat missions, and to deploy weapons or provide surveillance.

The XQ-58A is controlled by a crewed aircraft on missions like scouting, defensive fire, or absorbing enemy fire if attacked. Its stealthy trapezoidal fuselage, chined edge, V-tail, and S-shaped air intake help veil the aircraft from enemy sensors.

The plane can deploy as part of a swarm of unmanned aircraft, with or without direct pilot control. The XQ-58 can take off and land from conventional runways, from land launchers, or from surface ships at sea.

The XQ-58A weighs 2,500 pounds, and can carry 600 pounds of fuel, weapons, and sensors. It is 30 feet long, has a wingspan of 27 feet, can fly as fast as 476 knots, has a range of 3,000 nautical miles, and can fly as high as 45,000 feet. ◀

For more information contact Kratos online at www.kratosdefense.com/about/divisions/unmanned-systems, or the Naval Air Warfare Aircraft Division-Patuxent River at www.navair.navy.mil/nawcad.

Marine Corps chooses Silvus MANET radios for battlefield vehicle communications

BY John Keller

QUANTICO, Va. – U.S. Marine Corps battlefield communications experts needed mobile ad hoc network (MANET) radios for Networking On-the-Move (NOTM) communications system for the Joint Light Tactical Vehicle (JLTV) and Amphibious Combat Vehicle (ACV). They found their solution from Silvus Technologies Inc. in Los Angeles.

Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., are choosing the Silvus StreamCaster 4400 MANET radios under terms of a \$5 million contract for the NOTM communications system on the JLTV and ACV armored combat vehicles.

This is the same kind of networked communications system that enables unmanned ground vehicles to communicate with their operators in congested areas where RF interference is a frequent problem.

Marine Corps officials chose StreamCaster MANET radios because of the communications system's ability to create a self-organizing mesh network across several spectrum bands at high data rates, Silvus officials say. The Marine Corps order for StreamCaster 4400 is the first MANET radio added into the NOTM mobile communication system.

The Silvus StreamCaster 4400 MANET radio offers 20 Watts of transmit power, and can establish air-to-air and air-to-ground datalinks at distances beyond 100 miles.

The StreamCaster 4400 MANET radio will enable the Marine Air-Ground Task Force to access satellite communications, as well as to connect and network dispersed vehicles, aircraft, and infantry units.

This will enable Marine Corps warfighters to employ NOTM to transmit important information to commanders and increase situational awareness in hostile environments.

In addition, all StreamCaster radios for the Marines will include the Silvus proprietary Mobile Networked MIMO (MN-MIMO) waveform with spectrum-dominance features to enable operations in congested and contested spectrum environments.

The radio uses DES56, AES256, and FIPS 140-2 Level 2 (Suite B) encryption; offers a data rate as fast as 100 megabits per second; has spatial multiplexing, space-time coding and transmit-receive Eigen beamforming MIMO techniques; output



The Silvus StreamCaster 4400 MANET radio offers 20 Watts of transmit power, and can establish air-to-air and air-to-ground datalinks at distances beyond 100 miles.

power of 1 milliwatt to 20 Watts; operates on frequencies from 300 MHz to 6 GHz; and has 64 gigabytes of onboard data storage.

The radio operates in temperatures from -40 to 65 degrees Celsius, is submersible in water to 20 meters for as long as 30 minutes; measures 133.35 by 114.3 by 45.72 millimeters without connectors; weighs 1,134 grams; and comes in black anodized aluminum.

“As the Department of Defense increases integration of MANET radios into the Joint All-Domain Command & Control Communications architecture, enabling Marine Corps NOTM communications system is a significant milestone for Silvus,” says Chris Nigon, senior director of Navy, Marine, and Air Force Programs at Silvus. ◀

For more information contact Silvus online at <https://silvustechnologies.com>, or Marine Corps Systems Command at www.marcorsyscom.marines.mil.

Boeing making progress on Navy long-endurance unmanned underwater vehicle

BY John Keller

WASHINGTON – Undersea warfare experts at the Boeing Co. will continue supporting extra-large unmanned underwater vehicles (UUVs), which will be expected to undertake long-endurance missions to deploy sensors or other UUVs.

Officials of the U.S. Naval Sea Systems Command in Washington has announced an \$11.6 million order to the Boeing Defense, Space & Security segment in Huntington Beach, Calif., for engineering support services in support of the Extra Large Unmanned Undersea Vehicle (XLUUV) program.

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

The modular-construction Boeing Orca XLUUV will be an open-architecture reconfigurable unmanned underwater vehicle (UUV) with the core vehicle providing guidance and control, navigation, autonomy, situational awareness, core communications, power distribution, energy and power, propulsion and maneuvering, and mission sensors, Navy officials say.

The Orca XLUUV will have well-defined interfaces for cost-effective future upgrades to capitalize on advances in technology and respond to threat changes. The Orca XLUUV will have a modular payload bay, with defined interfaces to support current and future UUV payloads.

XLUUVs, which are among the largest unmanned submersibles ever conceived, will be for long-endurance surveillance missions or undersea cargo vessels to deliver other sensor payloads and other UUVs.

These large unmanned undersea vehicles eventually could be used as mother-ships to deploy and recover smaller surveillance UUVs on far-flung reconnaissance, surveillance, or special warfare missions in the open ocean or along coastlines and inside harbors.

The Navy and the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have involved Lockheed Martin and Boeing on a variety of large UUV projects such as the Large-Displacement Unmanned Underwater Vehicle (LDUUV) project.

An LDUUV typically is described as an autonomous submarine no larger than 80 inches in diameter. Future XLUUVs likely will be larger. Experience with the LDUUV will help inform concepts for using XLUUV.

DARPA also is sponsoring the Hunter program to develop a payload-delivery system from an extra-large UUV. The Hunter program, however, involves only the payload delivery system and not the extra-large UUV itself.

Hunter payloads could involve persistent-surveillance sensors, weapons, or other unmanned underwater vehicles (UUVs) and



The Boeing Orca XLUUV is an open-architecture reconfigurable unmanned underwater vehicle (UUV) with guidance and control, navigation, autonomy, communications, power distribution, propulsion, and mission sensors.

unmanned aerial vehicles (UAVs). They could involve persistent-surveillance sensors, weapons, or other UUVs and perhaps even unmanned aerial vehicles (UAVs).

The Navy's XLUUV project is moving enabling technologies forward that were developed originally in other projects such as the DARPA Hydra program to develop an unmanned submersible large enough to transport and deploy UAVs and UUVs stealthily in enemy territory to respond quickly to situations around the world.

Boeing also has developed the Echo Voyager, a 51-foot large UUV that can reach depths of 11,000 feet and can operate independently for months underwater. Boeing unveiled the Echo Voyager in early 2016 and began sea trials of the unmanned undersea craft in summer 2017.

Boeing and Lockheed Martin both were involved in a DARPA project in 2015 ago called Blue Wolf, which focused on revolutionary underwater propulsion and drag-reduction technologies to enable manned and unmanned military undersea vehicles to move through the water faster and more energy-efficiently than ever before.

Related: Navy asks Boeing to build four long-endurance extra-large UUVs for long-range surveillance missions

The Blue Wolf program demonstrated integrated underwater vehicle prototypes able to operate at speed and range combinations previously unachievable in fixed-size platforms, while retaining traditional volume and weight fractions for payloads and electronics. ◀

On this order Boeing will do the work in Huntington Beach, Calif.; East Greenwich, R.I.; Herndon, Va.; Cockeysville, Md.; and Joplin, Mo., and should be finished by September 2023. For more information contact Boeing Defense, Space & Security online at www.boeing.com, or Naval Sea Systems Command at www.navsea.navy.mil.

SRCTec to build counter-fire radar to protect Ukraine from rockets and UAVs

U.S. Army air-defense experts are asking engineers at SRCTec LLC in Syracuse, N.Y., to build lightweight counter-mortar radar (LCMR) systems for Ukraine to help defend Ukrainian warfighters from rocket, artillery, and mortar (RAM) attacks. Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., have announced a \$12.1 million order to SRCTec for UKR/TPQ-50 radar systems as part of the Ukraine Security Assistance Initiative. The LCMR family of counter-fire radars from SRCTec provides 360-degree surveillance and 3D rocket, artillery, and mortar location using a non-rotating, electronically steered antenna. The SRCTec LCMR family consists of the AN/TPQ-49 and AN/TPQ-50. The TPQ-50 is the official Army program of record, while the TPQ-49 is designed for expeditionary forces, company officials say. The radar systems detect and track several different rounds fired from separate locations, and send early warning messages indicating a round is incoming. The radar also pinpoints the location of the incoming round's launcher for counter-fire from friendly artillery, mortars, or aircraft. For more information contact SRCTec online at www.srcinc.com/about/companies/srctec.html, or the Army Contracting Command-Aberdeen at <https://acc.army.mil/contractingcenters/acc-apg/>.

LCI selects Elroy Air's Chaparral autonomous VTOL cargo aircraft

DUBLIN - LCI, an aviation company and a subsidiary of Libra Group based in Dublin, needed advanced autonomous cargo aircraft systems. They found their solution from has signed an agreement with Elroy Air in San Francisco. LCI inked a deal to acquire up to 40 of the

Elroy's Chaparral vertical take-off and landing (VTOL) aircraft.

Under the terms of the agreement, LCI will initially acquire 20 aircraft with an option for a total of up to 40 units. The VTOL aircraft are currently under development at Elroy Air's facility in South San Francisco, California.

The Chaparral is an end-to-end autonomous VTOL cargo delivery system. It is designed for aerial transport of up to 500 lbs of goods over a 300 nautical mile range. This is enabled initially by a turbine-based hybrid-electric powertrain with distributed electrical propulsion, and specially designed aerodynamic modular cargo pods.

The Chaparral is a transitioning "lift and cruise" VTOL aircraft with a full carbon composite airframe, and a turbine-based hybrid-electric powertrain for long-range mission capabilities. It was also designed to fit in a 40-foot shipping container or C-130 cargo aircraft.

The Chaparral system features eight vertical lift fans, four distributed electric propulsors for forward flight, a high-wing airframe configuration, as well as improved ground autonomy and cargo-handling systems.

Elroy Air has developed lightweight, aerodynamic modular cargo pods that can be pre-loaded by ground personnel and picked up by the aircraft before takeoff. At the delivery location, the cargo pod is lowered to the ground and released after the system has landed. The Chaparral system can retrieve another pre-packed pod and transport the pod to its next destination.

The new VTOL aircraft will complement LCI's existing fleet of modern helicopters and fixed wing aircraft. In addition, LCI and its parent company, Libra Group, whose subsidiaries own and operate assets in approximately 60 countries. ◀



Lockheed Martin to refurbish M-TADS/PNVs electro-optical sensors on AH-64 helicopters

BY John Keller

REDSTONE ARSENAL, Ala. — U.S. Army aviation experts needed a company to refurbish electro-optical assemblies in the Modernized Target Acquisition Designation Sight/Pilot Night Vision Sensor (M-TADS/PNVs) system, also known as Arrowhead. They found their solution from Lockheed Martin Corp.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., announced a \$13.1 million order to the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla.,

▲ The new day sensor structure assembly offers fields of view that match the Arrowhead FLIR fields of view to accommodate image blending.

for a M-TADS/PNVs for a refurbishment support effort on the AH-64 Apache attack helicopter.

The lower M-TADS turret contains the targeting system, which has day and night electro-optical sensors. The Arrowhead targeting sensor suite has forward looking infrared (FLIR) elements of the TADS and the PNVs to provide modern technological and precision engagement, and ensure the Army's Apache helicopter remains an effective attack helicopter well into the future.

The system's laser rangefinder designator includes an eye-safe rangefinder and day sensor electronics unit, which replace the laser transceiver unit and related electronics in the Apache's legacy day sensor assembly.

The new day sensor structure assembly offers fields of view that match the Arrowhead FLIR fields of view to accommodate image blending. The modernized TV sensor incorporates color and low-light sensitivity. A modern inertial measurement unit replaces three spinning-mass gyros, and the new laser spot tracker uses a four-quadrant detector and improved processing. A laser pointer marker helps enhance coordination with ground and air units.

These targeting components enable Apache helicopters to identify targets at long ranges through an additional field-of-view and extended-range picture-in-picture capability, as well as provide the ability to view high-resolution, near-infrared and color imagery on cockpit displays.

The system provides a new laser pointer marker that improves coordination with ground troops, and an updated multimode laser with eye-safe lasing capability that supports flight in urban environments and home-station training.

M-TADS/PNVIS provides Apache helicopter pilots with long-range, precision engagement and pilotage capabilities for mission success and flight safety during day and night and in adverse weather conditions. ◀

On this order Lockheed Martin will do the work in Orlando, Fla., and should be finished by August 2025. For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com/en-us/who-we-are/business-areas/missiles-and-fire-control.html, or the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa>.

LWIR sensor core for military and security uses introduced by Xenics

Xenics nv in Leuven, Belgium, is introducing the Dione 1024 long-wave infrared (LWIR) core for safety, security, and industrial applications. The device is for cost optimized hand-held thermal imagers; 360-degree situation awareness systems; drone observation; and cost-optimized industrial application. The Dione 1024 is an extended electro-optical graphics array (XGA) with resolution of 1024 by 768 pixels. The LWIR camera core optimized for small size and low weight, power, and cost (SWaP-C), and is for embedded systems that require SWaP-C. The Dione 1024 electro-optical sensor offers high-resolution at an affordable price. It offers sensitivity of 50 mK, comes without a shutter, or with a shutter for rapid adaptation to the environment. The SAMTEC ST5 connector supports the 16-bit digital output, command and control, and the power supply. For more information contact Xenics online at www.xenics.com

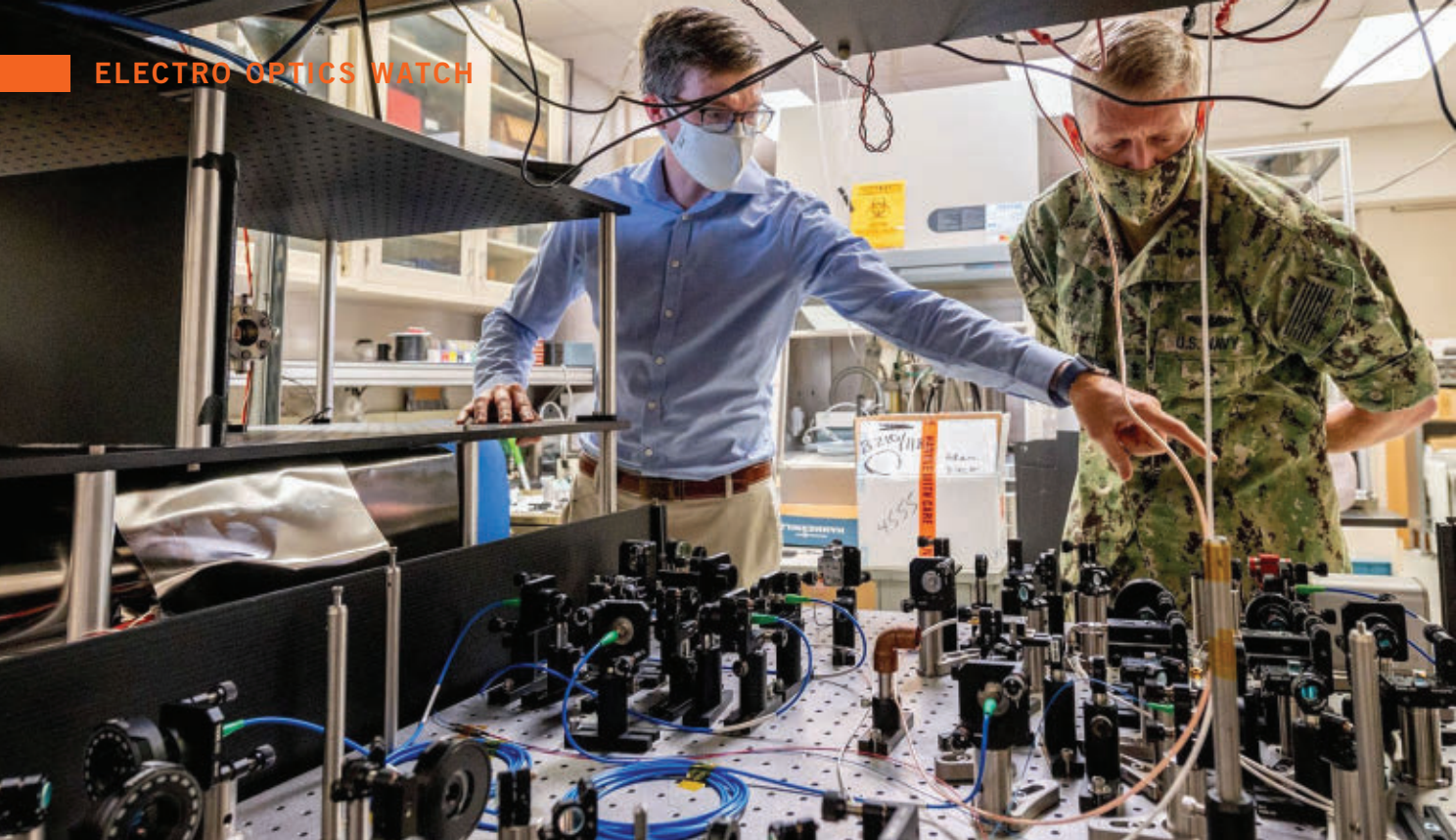
InGaAs photodiodes for high-speed communications offered by OSI

OSI Optoelectronics, an OSI Systems company in Hawthorne, Calif. is introducing infrared-sensitive pigtail-packaged high-speed indium gallium arsenide (InGaAs) photodiodes for high-speed optical communications and medical applications. These photodiodes offer active areas of 75 microns and 120 microns, with single- and multi-mode fiber aligned optically either to a hermetically sealed InGaAs diode in a TO-46 cap package or can be connected to the InGaAs diode mounted on a ceramic substrate. With high responsivity from 900 1700 nanometers, low capacitance, and low back reflection, the OSI family of pigtail photodiodes are available in a variety of configurations with different

terminations and different fibers. The electro-optical components are for high-bit-rate communications receivers used in LAN, MAN, and WAN, as well as for laser-assisted surgeries for ophthalmology. Other uses include optical power monitoring and instrumentation, GPS gyroscopes. The devices are available with angle polished connectors and custom packages. Operating temperatures range from 0 75 degrees Celsius. For more information contact OSI Optoelectronics online at www.osioptoelectronics.com.

Sealed position-sensing detector (PSD) introduced by Advanced Photonix

Advanced Photonix Inc. in Camarillo, Calif., is introducing the APX-PSD-XVInG-3.1 sensitive 2-millimeter diameter position-sensing detector (PSD) for position-sensing applications in communication and defense for alignment, nulling, centering, targeting, and guidance systems. The APX-PSD-XVInG-3.1 offers spectral response from the visible out to the near- and shortwave-infrared (NIR-SWIR) wavelengths. The APX-PSD-XVInG-3.1 is a low-noise position-sensing device with sensitivity from 400 to 1700 nanometers and position-detection accuracy. APX's 400-1700 nanometers PSD features 2 kilohms inter-electrode resistance, high shunt resistance, low capacitance, and 20 micron position detection error. The sensitive PSD is housed in a hermetically sealed TO-5 package or a 5 by 3.6 millimeters surface-mount ceramic package with an anti-reflective window. Advanced Photonix's PSD is specially designed for extended visible indium gallium arsenide position-sensing applications. For more information contact Advanced Photonix online at www.advancedphotonix.com. ◀



DCS Corp. to investigate new ultraviolet and infrared sensors for reconnaissance

BY John Keller

WASHINGTON – U.S. Navy researchers needed a company to carry out research that could lead to development of new kinds of electro-optical sensors for reconnaissance, surveillance, and situational awareness. They found their solution from DCS Corp. in Alexandria, Va.

Officials of the U.S. Naval Research Laboratory in Washington announced a \$9.6 million contract to DCS to investigate the use of radiation in the wavelength region between near-ultraviolet and far-infrared wavelengths.

These electro-optical technologies could lead to a variety of advanced sensors for applications like missile defense, counter-terrorism, anti-camouflage, and target acquisition.

DCS experts will conduct research and development in the generation, propagation, detection, and use of radiation in wavelengths between near-ultraviolet and far-infrared.

The Naval Research Laboratory's Optical Sciences Division carries out theoretical and experimental research in these optical wavelengths, with an eye to understanding physical principles involved in optical devices, materials, and phenomena. DCS

▲ **DCS experts will conduct research and development in the generation, propagation, detection, and use of radiation in wavelengths between near-ultraviolet and far-infrared.**

engineers will focus on extending this understanding in the direction of device engineering and advanced operational techniques.

Among the jobs DCS will do under this contract are systems analysis, prototype system development, research in opti-

cally related military problems.

This electro-optical work will involve quantum optics, laser physics, optical waveguide technologies, laser-matter interactions, atmospheric propagation, holography, optical data processing, fiber-optic sensor systems, optical systems, optical materials, radiation damage studies, infrared surveillance and missile seeker technologies, infrared signature measurements, and optical diagnostic techniques. ←

Part of the effort will involve developing, analyzing, and using special optical materials. On this contract DCS will do the work in Washington and should be finished by October 2023. For more information contact DCS Corp. online at www.dccorp.com, or the Naval Research Laboratory Optical Sciences Division at www.nrl.navy.mil/Our-Work/Areas-of-Research/Optical-Sciences.

POWER AMPLIFIERS

► DARPA taps CPI for amplifiers for future applications of electromagnetic warfare

U.S. military researchers needed a company to develop high-power RF and microwave amplifiers able to generate sufficient electromagnetic radiation to damage or kill enemy electronics. They found their solution from Communications and Power Industries (CPI) International Inc. in Palo Alto, Calif.

Officials of the U.S. Defense Advanced Research Projects Agency announced a \$9 million order to CPI for the second phase of the Waveform Agile Radio-frequency Directed ENergy (WARDEN) project to develop electronic amplifiers for future electromagnetic warfare applications.

WARDEN seeks to develop high-power microwave amplifiers that generate enough electromagnetic radiation to disrupt, disable, or damage targeted electronic components and circuits. CPI won a potential \$12.1 million contract in September 2021 for the initial phases of the WARDEN project.

The WARDEN initiative also seeks to develop theory and computational models to describe the coupling of electromagnetic radiation into complex enclosures via unintentional paths like seams, apertures, and cable entry points, and to develop agile waveform techniques that can cause damage to enemy electronics.

Agile waveforms refer to time-dependent signals that combine frequency, amplitude, and pulse-width modulations to make the most of coupling into a complex enclosure, and are optimized to produce disruptive effects on internal electronic components and subsystems.

The WARDEN program has three technical areas: high-power microwaves traveling-wave amplifier; rapid assessment and numerical generation of electromagnetic response (RANGER); and agile waveform development. The high-power microwave traveling-wave amplifier and agile waveform portions are classified, and the Ranger portion is not.

High-power microwave systems for electromagnetic warfare are radio-frequency directed-energy weapons that use electromagnetic radiation to disrupt, disable, or damage targeted electronic components and circuits.

The advantages of high-power microwave systems include non-kinetic, wide-area effects at long stand-off distances; deep magazines; operation in adverse environmental conditions; and speed-of-light engagement, DARPA researchers explain.

Electromagnetic radiation can couple into targets in band via intentional ports such as antennas. This is called



a front-door electromagnetic attack. These systems also can couple into targets in band via unintentional coupling paths such as seams, apertures, and cable-entry points. This is called a back-door attack.

Today's high-power microwave systems typically use oscillators as their RF source, operate at a fixed frequency, are not easily tunable, and lack the phase coherence necessary for power combining.

Front-door systems have the longest range, but their effectiveness is limited to specific classes of targets. Back-door systems are effective against a wider variety of targets, but their range is limited by electromagnetic coupling inefficiencies due to their lack of frequency tunability.

Agile waveforms, combined with broadband high-power amplifiers, can make enemy electronics more susceptible to back-door attacks, and significantly can extend the range and effectiveness of high-power microwave weapon system.

WARDEN seeks to develop flexible technology that can be useful against a wide variety of target types by developing high-peak-power amplifiers for back-door attacks. Unlike oscillators, a broadband amplifier is agile enough to make the most of electromagnetic coupling into targeted electronics by improving coupling frequencies even with modest tuning.

Broadband amplifiers also support waveform modulations that can make enemy electronics more vulnerable to disruption by electromagnetic radiation. Combined, these effects can increase the range of back-door high-power microwave directed-energy weapons.

Yet high-power broadband amplifiers have proven extremely difficult to build because their gain and frequency capabilities are unstable and prone to oscillation. Input/output couplers and high-power vacuum windows also can be a problem.



SOFTWARE

◀ IBS Software and IATA partner for CASSLink air cargo initiative

IBS Software in Thiruvananthapuram, India, announced that it has been selected by the International Air Transport Association (IATA), as a technology partner for IATA's new CASSLink project.

The modernized CASSLink has been deployed in the U.S. air cargo market, in collaboration with IATA's wholly owned subsidiary Cargo Network Services (CNS).

CASSLink is IATA's internet-based data processing and customer man-

agement system that enables companies to meet the evolving billing and payment requirements for the entire air cargo value chain.

It facilitates the interaction and exchange of information between airlines and freight forwarders participating in IATA's Cargo Accounts Settlement System (CASS), simplifying the customer experience and driving operational efficiencies.

Working with IATA, IBS Software is focused on digitally transforming the CASS platform to develop a platform that can meet payment innovations and customer demands.

Focused on customer experience, the CASS platform features improvements in real time analytics, self-service capabilities, additional payment options, global accessibility and a fresh modern multi-lingual user interface. The new CASSLink will be rolled out to all other CASS markets through 2023.

"Air cargo played an outsized role during the pandemic, delivering life-saving vaccines and medical supplies and keeping global supply chains running," says Muhammad Albakri, IATA's senior vice president of financial settlement and distribution services.

"Moving forward, it is vital that industry continues to digitally transform to allow payments between parties to be handled quickly, efficiently and with total trust," Albakri says. "Our CASSLink platform has already changed the way airlines and third parties interact. We're delighted to have found an excellent partner in IBS Software to power the new CASSLink, ensuring that it continues to be fit for purpose as we head into a new era for air cargo."

Understanding the physics of electromagnetic wave coupling into a complex enclosure, and the interaction with internal electronics is critical to improving the effectiveness of back-door high-power microwave attacks, researchers explain.

The big challenge here is developing computationally efficient time-domain models that can simulate electromagnetic wave interaction with large structures containing features of widely varying sizes and material properties.

The main challenges for developing agile waveforms are developing physics-based computational tools to predict high-power microwave effects on electronics; creating agile waveform techniques to produce the most damaging effects on enemy electronics.

WARDEN will be a four-year, three-phase program that will develop and demonstrate the first broadband high-power microwave amplifier using high-peak and average-power handling; broadband input and output coupler design; broadband vacuum window design; and thermal management.

The project also will develop physics-based models to enable the rapid prediction of agile electromagnetic waveforms coupling into complex enclosures and the spatial distribution of the internal electric fields. It also will extend testing and modeling to broad classes of target systems to create a physics-based computational framework to predict high-power microwave effects.

On this order CPI will do the work in Bethesda, Md.; and Palo Alto, Calif., and should be finished by September 2026. For more information contact CPI online at www.cpii.com, or DARPA at www.darpa.mil.



BATTLE PLANNING

▲ BAE Systems to tackle computer-generated battle planning that works at machine speed

U.S. military researchers needed a company to develop enabling technologies for computer-aided battle planning systems, which perform as well as humans but work at machine speed. They found their solutions from BAE Systems.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced an \$8.3 million contract to the BAE Systems Electronic Systems segment in Nashua, N.H., for the Strategic Chaos Engine for Planning, Tactics, Experimentation and Resiliency (SCEPTER) program. The Air Force Research Lab awarded the contract on behalf of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

The SCEPTER computer-generated campaign-scale planning and analytics project is asking BAE Systems experts to develop analytic engines that will produce machine-generated strategies that can compete with humans in the planning of real warfare as evaluated within trusted simulation environments.

SCEPTER seeks to help BAE Systems discover new courses of action by exploring complex military engagements at machine speed. Enabling high speed will come from tailorable abstraction of trusted expert-informed models. Researchers will validate a few of the best performing solutions in high-fidelity trusted simulators and with thorough human review.

The SCEPTER program's first phase will address two key technical focus areas: developing unscripted goal-oriented agents able to discover relevant and interpretable solutions; and managing growth of threats to achieve fast exploration of large-scale military scenarios.

SCEPTER is planned as a two-phase three-year battle planning program. BAE Systems is working only on the 18-month first phase. The Phase 2 program will be classified. DARPA researchers say they plan to spend \$39 million on the SCEPTER program over the next three years.

On this contract BAE Systems will do the work in Nashua, N.H., and should be finished by May 2024. For more information contact BAE Systems Electronic Systems online at www.baesystems.com, the Air Force Research Laboratory at www.afrl.af.mil, or DARPA at www.darpa.mil.

TRUSTED COMPUTING

▼ Georgia Tech to investigate cutting-edge cyber security software

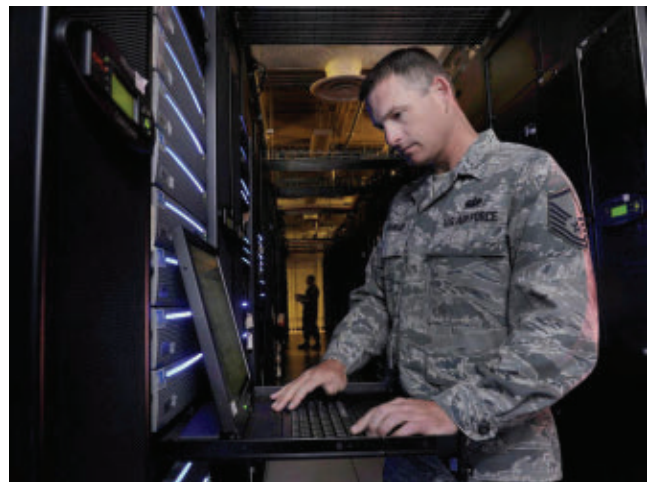
ARLINGTON, Va. – U.S. military researchers are asking Georgia Tech Research Corp. in Atlanta to develop ways to detect, manage, and defeat cyber hackers and help build-in cyber security as part of the computer design process.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a \$22.7 million contract to Georgia Tech for the Signature Management Using Operational Knowledge and Environments (SMOKE) project.

SMOKE seeks also to measure the risk of cyber threats in real-time; and find new ways for red-team ethical hackers to maintain their evasiveness as they help train cyber security experts root-out malicious cyber behavior.

Georgia Tech cyber security experts will develop data-driven tools to automate the planning and execution of threat-emulated cyber infrastructure necessary for military network security assessments.

Military computer networks are under persistent threat from malicious cyber hackers, so network security





experts must be able to assess their cyber vulnerabilities and defenses by using red team ethical hackers and blue team cyber defenders.

Red team exercises are designed to exceed simple penetration testing, and emulate cyber attacker behaviors as realistically as possible, to form a picture of network defense readiness.

Towards the aim of realism, red teams use tactics that mimic advanced cyber threats to evade network defenders and assess how critical networks fare against a determined cyber attack.

A core aspect of red team security assessments are procedures to build domain names, IP addresses, virtual servers, and other components to control red team tools. This infrastructure must exist openly on the public Internet and emits signals that, if detected too easily, can end the assessment quickly without much gain.

Signatures are patterns of the way an organization performs cyber operations. Attribution is the ability to link a cyber attack to a likely hacker. Red team members don't want the blue team to attribute attacks to likely perpetrators too quickly, which can weaken a cyber security assessment.

The ability to emulate sophisticated threats, evade detection, and reduce signatures requires a significant amount of time and expertise. Today, furthermore, the demand for network security assessments is greater than the supply.

SMOKE seeks to develop tools to automate the deployment of automated cyber threats that will enable red teams to increase the effectiveness of cyber security assessments. These tools also could provide red teams with longer cyber security assessments.

DARPA researchers want industry to develop tools that enable automated and scalable emulated cyber threats. SMOKE will prototype components that enable red teams to plan, build, and deploy cyber infrastructure that is informed by machine-readable signatures of sophisticated cyber threats.

To ensure realism, DARPA experts will evaluate SMOKE components on real-world networks controlled by SMOKE performers and government partners — first on emulated environments, and perhaps later on live networks.

The SMOKE program seeks breakthrough approaches in abstracting away complexities of diverse network environments; operating in partially denied environments, reasoning under uncertainty, and reacting to unforeseen detection and/or attribution events; measuring tradeoffs among efficiency and effectiveness of plans in terms of speed and evasion; overcoming state space explosion of typical models for cyber infrastructure planning; developing mechanisms to acquire, manage, and maintain infrastructure elements that conform to signature management policies; executing infrastructure changes in accordance with real-time attribution assessments and plan contingencies; discovering latent associations between infrastructure artifacts; automating expert judgments used to build and traverse infrastructure associations; and expanding knowledge of adversary infrastructure.

SMOKE is a four-year effort divided into two: developing, demonstrating, and evaluating individual components; and comparative evaluations formed by integrating program components. The contract includes one option that could increase its value to \$24.7 million.

SMOKE has two technical areas: automated planning and execution of attribution-aware cyber infrastructure; and generating infrastructure signatures.

On this contract Georgia Tech will do the work in Atlanta and Athens, Ga., and should be finished by October 2026. For more information contact Georgia Tech Research online at <https://gtrc.gatech.edu>, or DARPA at www.darpa.mil/program/signature-management-using-operational-knowledge-and-environments.

ARTIFICIAL INTELLIGENCE

◀ NOAA taps Orion Space Solutions to develop observation processing system

The U.S. National Oceanic and Atmospheric Administration (NOAA) has awarded Orion Space Solutions (OSS) in Louisville, Colo., a grant to build a platform to process, analyze, and visualize Earth observations using advanced artificial intelligence (AI) and digital technologies.

The resulting system will further human understanding of environmental change on Earth, considering current and past environments to provide important insights on rapidly changing environments.

Digital twin technology acts as a real-time digital counterpart of a physical object or process, for example digitally replicating how an ecosystem looks before and after wildfire. It seamlessly “connects the dots” across data sources, bringing Earth observation data to one place for processing, analysis, and visualization.

In doing this, the platform provides unprecedented visibility and insight into the data and, in the example, a view on current or future ecosystem impacts.

The idea is to help broaden environmental knowledge. “The team brings a depth of AI, data science, and digital twin expertise to bear, developing new ways to support NOAA in better understanding and addressing pressing environmental challenges,” says Rachel Hauser, the Orion Space Solutions senior director of business development.

ANTI-SUBMARINE WARFARE

► Navy to boost ASW capabilities of multistatic, active, and passive sonobuoys

U.S. Navy anti-submarine warfare (ASW) experts are boosting the capabilities of naval air-launched sub-hunting sonobuoys to counter advanced nuclear-powered and air-independent propulsion enemy submarines.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a collective \$5.1 billion order to three sonobuoy manufacturers for improved bathythermograph, passive, active/passive combo, multistatic source, multistatic receiver, and special mission sonobuoy capabilities.

This order involves the Lockheed Martin Corp. Rotary and Mission Systems segment in Manassas, Va.; Ultra Sonobuoy Systems in Columbia City, Ind.; and Sparton, an Elbit Systems of America company, in De Leon Springs, Fla.

Bathythermograph capability, such as that of the SSQ-36 sonobuoy, provides vertical temperature profiles of the ocean layer for ASW and research, and is used widely in ASW operations to evaluate local effects of seawater temperature on sonar propagation and acoustic range prediction.

Passive capability, such as that of the SSQ-53 passive directional low frequency analyze and record (DIFAR) sonobuoy, uses multichannel directional piezoelectric ceramic transducer hydrophones that operate at depths of 90, 200, 400, and 1,000 feet to listen for potentially hostile submerged enemy submarines.

Aircraft can drop a pattern of sonobuoys that relay information back to the aircraft by radio link, to determine the exact locations of enemy submarines.



Active capability, such as that of the SSQ-62 directional command active sonobuoy system (DICASS) sonobuoy, uses active sonar pings for detecting and localizing submarines in preparation for attack. It can provide range and bearing to the target to fix position.

Multistatic source capabilities, such as that of the AN/SSQ-125 multistatic sonobuoys, helps sonobuoys work together with other Navy sonobuoys. The AN/SSQ-125 sonobuoy is a source in a multistatic field, and can generate a variety of waveforms, and is designed to work with the AN/SSQ-53F, AN/SSQ-77C, and AN/SSQ-101 (ADAR) sonobuoys.

A multistatic sonar system contains several spatially diverse monostatic or bistatic sonar components with a shared area of coverage, and enables Navy ASW operators to use sensor fusion to combine the power of the separate sonobuoys.

The AN/SSQ-125's RF channel can be programmed to any of the standard sonobuoy operating channels. At any time after deployment, the AN/SSQ-125 can be commanded to change its operating parameters or depth (deeper only), generate a ping, or scuttle.

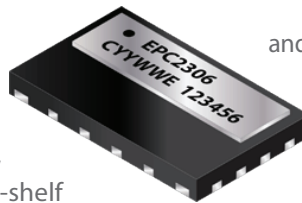
The three companies will compete for individual orders. Lockheed Martin will do the work in Manassas, Va.; Undersea Sensor Systems will do the work in Columbia City, Ind.; and Sparton will do the work in De Leon Springs, Fla. Work will be finished in September 2027.

For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com; Ultra Sonobuoy Systems at www.ultra.group/our-business-units/maritime/sonobuoy-systems; Sparton at www.sparton.com/products/sonobuoys, or Naval Air Systems Command at www.navair.navy.mil. ◀

DC-DC CONVERTERS

► 100-volt GaN FETs for robotics and computing introduced by Efficient Power

Efficient Power Conversion Corp. (EPC) in El Segundo, Calif., is introducing the 100-volt EPC2306 off-the-shelf gallium nitride (GaN) field-effect transistors (FETs) in thermally enhanced QFN packages for high-density computing applications. The 100-volt EPC2306 is for 48-volt DC-DC conversion, also is for 48-volt brushless DC motor drives for e-mobility and robotics in solar optimizers and microinverters, and in Class D audio. The EPC2306 GaN FET offers a RDS(on) of 3.8 milliohms, together with small QG, QGD, and QOSS parameters for low conduction and switching losses. The device features a thermally enhanced QFN package with exposed top and footprint of 3 by 5 millimeters for high-power-density applications. The EPC2306 is footprint-compatible with the previously released 100-volt, 1.8 milliohms EPC2302. The two footprint-compatible devices enable designers to trade off RDS(on) vs. price to optimize solutions for efficiency or cost by dropping in a different part number in the same footprint on a printed circuit card. For more information contact EPC online at <https://epc-co.com/epc>.



and reduce energy consumption. The Pulsiv OSMIUM microcontroller family and supporting components can combine with commodity flyback DC-DC converters to displace LLC solutions.

Pulsiv has demonstrated a universal-input single-switch 150-Watt flyback power supply design that delivers 97.5 percent average front-end efficiency while maintaining 90 percent at 2 Watts. A 240-Watt interleaved flyback is being developed. The PSV-AD-150 and PSV-AD-250 OSMIUM microcontrollers do not determine output power directly and can be used for applications that require 1 Watt to 10,000 Watts, by adjusting three system components and connecting a suitable DC-DC converter. Critical components in a Pulsiv OSMIUM circuit operate at low temperatures to extend their expected operating life, even under convection cooling. By regulating the flow of mains through a charging capacitor, Pulsiv has completely eliminated inrush current, meaning that manufacturers of industrial power supplies and LED lighting products can simplify their designs and reduce the cost of system installation. Pulsiv OSMIUM technology supports active bridge control, configurable hold-up, X-cap discharge, HVDC output selection, a power consumption indicator and grid failure detection. For more information contact Pulsiv online at <https://pulsiv.co.uk>.

POWER MICROCONTROLLERS

▼ Microcontroller family to boost power efficiency introduced by Pulsiv

Pulsiv Limited in Cambridge, England, is introducing the OSMIUM Pulsiv OSMIUM microcontroller family for converting AC to DC that involves charging and discharging a small storage capacitor without the need for a power factor correction (PFC) inductor. This solution delivers high power and efficiency in an compact system design that can help improve overall system efficiency, optimize cost,



EMBEDDED COMPUTING

► SOSA-aligned 3U OpenVPX board with Versal processor introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing the model 5560 next-generation 3U OpenVPX SOSA aligned co-processing board for electronic warfare (EW) and spectrum processing applications. The model 5560, which aligns to the Sensor Open Systems Architecture (SOSA) open-systems standard, is powered by the AMD Xilinx Versal HBM series processor with integrated high-bandwidth memory. The model 5560 offers 16 gigabytes of Versal high-bandwidth memory, which delivers memory bandwidth as quickly as 820 gigabytes per second. This is eight times the bandwidth of DDR5 memory at 63 percent lower power consumption. The embedded computing board also offers four 100 Gigabit Ethernet high-speed optical data





pipes for an aggregate data throughput rate of 50 gigabytes per second. It uses the Navigator field-programmable gate array (FPGA) design kit (FDK) and board support package (BSP) for operational control and IP development. Mercury's model 5560 is integrated with the on-chip HBM via the Versal Programmable Network-On-Chip, which can increase the overall amount of data that can be pushed through the system. For more information contact Mercury Systems online at www.mrcy.com.

POWER SUPPLIES

▲ High-reliability DC-DC converters for robotics and trains offered by TDK

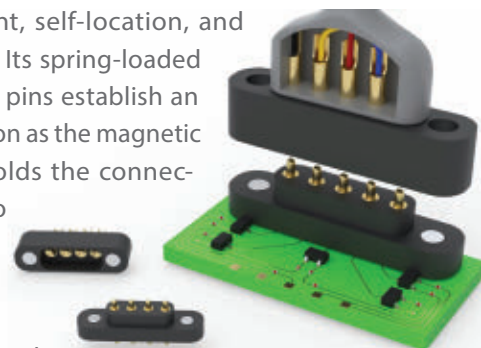
TDK-Lambda Americas Inc. in San Diego is introducing the 200- and 300-Watt TDK-Lambda CN-B110 series of half brick DC-DC converters for robotics, automated vehicles, scientific research, and railway applications. Capable of operating from an input voltage of 43 to 160 volts DC, the converters are compatible with 72- or 110-volt DC nominal railway systems. These second-generation converters are available with 12-, 13.8, 15-, and 24-volt outputs. Using the trim function, users can adjust them for using a resistor or an external voltage to compensate for voltage drops, or to accommodate non-standard system voltages. The standard models have non-latching self-recovering over current and overvoltage protection, with an option for latching with manual reset. The CN-B110 has 11.8-millimeter spacing between the primary input and baseplate for a 2,500-volt AC isolation voltage. Input to output isolation is 3,000 volts AC and output to ground 500 volts AC. With efficiencies to 91 percent, the power electronics device can operate at baseplate temperatures of -40 to 100 degrees Celsius, with minimal derating at high temperatures. Cooling comes from the optional heat sinks or to a cold plate via the module's aluminum baseplate. Parallel operation using the current share function with as many as 11 modules is

possible to support redundant applications. The CN-B110 has a DC good signal and remote on/off as standard, with an optional 12-volt 10-milliamp auxiliary output. Overall dimensions are 12.7 millimeters high, 61 millimeters wide, and 57.9 millimeters long. For more information contact TDK Lambda online at www.us.lambda.tdk.com.

CONNECTORS

▼ Magnetic connectors for power or signal transmission offered by Mill-Max

Mill-Max Manufacturing Corp. Inc. in Oyster Bay, N.Y., is introducing the Maxnetic magnetic-mating spring-loaded connectors for applications that require quick and easy connections like portable medical device docking and charging stations that need repeated mating and un-mating of cables. The connectors can be used for power or signal transmission and may be mounted in vertical or horizontal orientations. Optimal electrical and mechanical reliability is ensured using high-quality Mill-Max spring-loaded pins. This series of magnetic connectors feature self-alignment, self-location, and zero force mating. Its spring-loaded and mating target pins establish an electrical connection as the magnetic force pulls and holds the connectors together. No aligning or plugging is required to mate the connectors, and no hardware is needed to keep them mated. The connectors offer quick connections, blind mating, and the ability to break away for emergency release without damage to the components. The Maxnetic product line comes with a connector pair consisting of a through-hole circuit board mount spring-loaded connector (P/N: 878-22-00X-10-011101) and a shrouded target connector with solder-cup terminations (P/N: 878-20-00X-00-011000). The connectors are single-row, 2-6 positions, with a pin to pin spacing of 4 millimeters. The spring-loaded connector has an above-board height of 9.6 millimeters and contains spring-loaded pins featuring 2.3-millimeters maximum stroke, a cycle life to one million cycles, 25 milliohms contact resistance, 7.2 amps per pin current rating, and gold plating on all components. For more information contact Mill-Max online at www.mill-max.com.



TEST AND MEASUREMENT

► **Test system to move SOSA embedded computing to the field introduced by LCR**

LCR Embedded Systems Inc. in Norristown, Pa., is introducing the RTS-210 dual-slot rugged test and measurement system for VPX and SOSA-aligned payloads. The RTS-210 enables performance demonstration and testing in harsh environments when development activities move from the lab to the field. Designed for in-vehicle use, the RTS-210 enables functional testing at, or near, application-level environments. A front expansion module provides access to the development backplane and discrete I/O panel connectors, allowing for signal connectivity and backplane profile layout using Meritec cabling. The RTS-210 test system for SOSA-aligned embedded computing is for high power, high speed command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) systems that operate on land, air, and sea. The RTS-210's design enables users to switch from development to deployment when they replace the expansion module with the custom I/O front panel and backplane containing the application-specific profile. The chassis offers backplane versions that support the latest module profiles for four different VPX/SOSA aligned payload modules in as many as three, 2-slot combinations (plus VITA 62 PSU slot). Slot options include VITA 67 fill and half-width apertures. The VITA 48.2 conduction-cooled base chassis design and the final custom I/O panel meets military shock, vibration, thermal, and ingress requirements. For more information contact LCR Embedded Systems online at www.lcrembeddedsystems.com. ◀



electrical signal to an optical signal, then change it back to an electrical signal at the receiving device. The CWDM transceivers come in eight different wavelengths:

1470 through 1610 nanome-

ters, in 20-nanometer increments. The DWDM transceivers come in 40 different channels, from channels 20 through 59 at 1530.33 nanometers through 1561.41 nanometers, in 0.8-nanometer increments. More than 30 of the fiber optic transceivers models support fiber optic lines as long as 120 kilometers at Gigabit Ethernet and SONET OC-48 data rates. These products also features grey 1G and 10G optics for multimode and single-mode fiber deployments. This expansion of L-com's line includes more than 100 offerings in the SFP, SFP+, and XFP form factors.

In addition, the models broaden 29 of the 38 OEM platforms with which L-com's line is compatible, in addition to the standard MSA-compliant versions.

The most significant additions are to Ciena, Alcatel 7x50, Alcatel OMNI, Brocade/Foundry, Cisco, Cyan, Huawei, Juniper, and MRV. The CWDM transceivers and DWDM transceivers handle standard operating temperatures, yet integrators can request custom versions for industrial-temperature versions. For more information contact L-com online at www.l-com.com.



COMMUNICATIONS

▲ **Rugged fiber optic transceivers for government networks introduced by L-com**

L-com, an Infinite Electronics brand in North Andover, Mass. is introducing more than 300 new coarse wavelength division multiplexing (CWDM) and dense wavelength division multiplexing (DWDM) fiber optic transceivers for government networks, telecommunications, cable TV, data communications, and enterprise networks. Fiber optic transceivers convert a switch's or router's



CONNECTORS

▼ **Harsh-environment connector for ships, tanks, and planes offered by Amphenol Socapex**

Amphenol Socapex in Thyez, France, is introducing the MPO Field TV connector for harsh-environment applications like high-speed embedded network backbones aboard surface warships, armored combat vehicles, aircraft, and trains. The MPO Field TV connector enables users to transform a standard MPO patchcord into a high-reliability connector designed to resist the harshest environments. The MPO

patchcord is integrated into a metallic plug based on MIL-STD-38999 Series III shell size 13 military connector that protects sensitive electronics from shock, dust, and fluids. MPO Field TV connector combines

high-speed and high-density MPO/MTP fiber-optic connectors using MT ferules with the high resistance of MIL-DTL-38999 Series III military shells. These harsh-environment connectors offer high density and speed; 12 or 24 fiber channels integrated into 28-millimeter diameter 38999 metal shells with tri thread coupling; and no tool or field cabling required.



battery pack offers hot-swappable internal battery; primary and secondary voltage and current protection circuits; automatic cell-to-cell balancing circuitry; over and under temperature protection; sealed, shock-proof, and weather-proof construction; and a weight 11.8 pounds. For more information contact SynQor online at www.synqor.com.

BATTERIES

▲ Extended-temperature battery pack for standard UPS introduced by SynQor

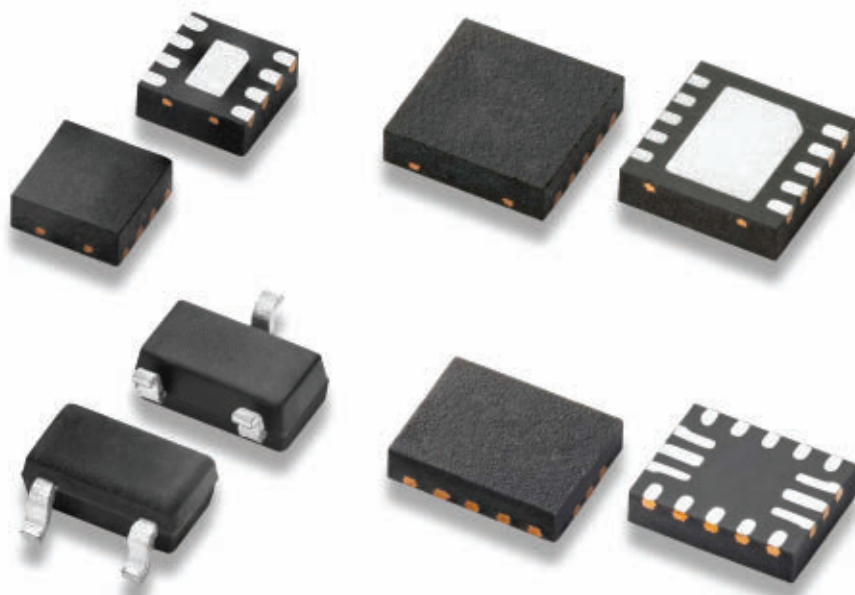
SynQor Inc. in Boxborough, Mass., is introducing the BAT-0400-M-1U-000 battery pack for use with the company's military-grade uninterruptible power supplies (UPS) for military and aerospace applications. The military-grade battery pack is an efficient, low-weight, compact, sealed lithium polymer battery self-contained unit, with energy capacity of 400 Watt hours to increase the runtime of a standard UPS to 16 minutes at full load. The battery also expands the operating temperature range of standard or shallow-rack UPS units. The battery has internal heaters to warm the battery from -40 to 0 degrees Celsius to enable standard UPS to charge or discharge the battery at ambient temperature as cold as -40 C. The battery includes automatic cell-to-cell balancing and over- and under-temperature protection. The extended-temperature

POWER ELECTRONICS

▼ Circuit-protection ICs for wearable devices introduced by Littelfuse

Littelfuse Inc. in Chicago is introducing the eFuse Protection series of four circuit-protection devices to protect against overvoltage, overcurrent, short circuits, inrush currents, reverse currents, and overtemperature, all in one chip. The eFuse Protection integrated circuits provide power input ranging from 3.3 to 28 volts, and are for wearable devices; charging cables; battery devices; data communications power systems; fan power controls; and data storage drives. The eFuse Protection integrated circuits offer current limiter, with fast response time, and integrated protection features; adjustable overvoltage threshold, current limiting, and inrush current; a reduction in the design-in phase; improved reliability; increased battery life; and long overall product lifetime. The LS0504EVT23 is a 5-volt, 4-amp, overvoltage, overcurrent protection in a SOT23-3 package; the

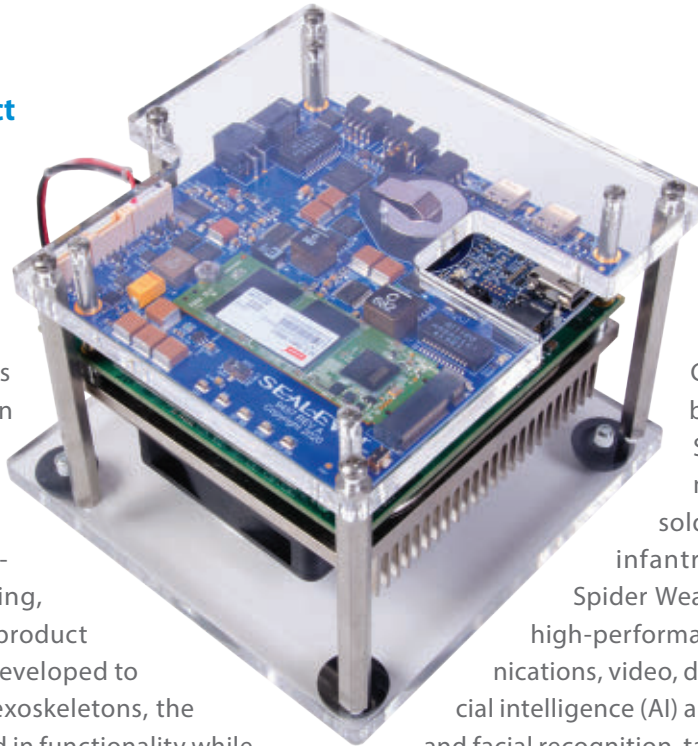
LS0505EVD22 is a 5-volt, 5-amp, overvoltage, overcurrent protection in a DFN2x2 package; the LS1205ExD33 is an 18-volt, 5-amp, programmable current limit, output voltage clamp in a DFN3x3 package; and the LS2406ERQ23 is a 28-volt, 6-amp, true reverse blocking, fast role swap in a QFN2.5x3.2 package. The eFuse Protection power integrated circuits are available in tape and reel format in quantities of 3,000 (LS0504EVT23, LS0505EVD22) or 5,000 (LS1205ExD33, LS2406ERQ23). For more information contact Littelfuse online at www.littelfuse.com.



EMBEDDED COMPUTING

► **COM Express Compact embedded computing evaluation board introduced by Sealevel Systems**

Sealevel Systems Inc. in Liberty, S.C., is introducing the 12009 COM Express Compact Type 6 evaluation board to enable accelerated development of embedded computing prototypes, expedite electrical hardware engineering, and reduce costs for new product introductions. Originally developed to control wearable robotic exoskeletons, the board design has expanded in functionality while maintaining a mandated extremely small footprint. At 95 millimeters square, the 12009 is identical in size to a Compact Type 6 COM Express module, and is for a wide variety of applications. Standard I/O includes Gigabit Ethernet, USB 3.0, USB 2.0, GPIO, RS-232, and Mini DisplayPort. The carrier board is designed for the Congatec conga-TC370 COM Express family, with support for 8th generation Intel Core processors. The board offers as much as 64 GB DDR4 RAM, and TPM 2.0 support. The 12009 operates in temperatures from 0 to 70 degrees Celsius, and is powered via a locking four-position Molex Micro-Fit connector. The complete evaluation kit (Part #12009-001-KT) includes a Type 6 module with Intel Core i3-8145UE CPU and 8 gigabytes DDR4 RAM, and includes a 128-gigabyte M.2 SATA SSD module that supports Windows and Linux operating systems. The evaluation board kit has a desktop power supply and cables to facilitate connections to serial and Ethernet ports and optional fans. A power button and power-indicating LED are also included. For more information contact Sealevel Systems online at www.sealevel.com.



WEARABLE COMPUTING

▼ **High-reliability wearable computer introduced by General Micro Systems**

General Micro Systems Inc. in Rancho Cucamonga, Calif., is introducing the battery-powered X9 Spider Wearable S1502-MP mobile computer for U.S. soldiers, Marines, and other infantry warfighters. The X9 Spider Wearable is for on-the-move high-performance processing, communications, video, database access, and artificial intelligence (AI) applications such as image and facial recognition, target tracking, and sensor fusion. Designed to offer compute power and I/O in a small lightweight package, X9 Spider Wearable can drive as many as four on-body displays; connect to wireless local-area and personal-area networks; uplink to vehicles or command posts; store as much as 20 terabytes of onboard data, and connect to body sensors. The wearable computer is based on Intel's latest 11th-generation Core i7 Xeon W eight-core (8C Tiger Lake-H) laptop processor. It has quad Thunderbolt 4 and USB 4 40-giga-bit-per-second I/O. LightBolt ports connectable to body sensors. An optional on-board NVIDIA RTX5000 general-purpose graphics processing unit (GPGPU) co-processor couples to the processor for AI-intensive tasks. Together, the two embedded processors and eight I/O legs in the X9 Spider Wearable represent server-class cloud processing in a battery-powered wearable computer that weighs less than three pounds. For more information contact General Micro Systems online at www.gms4sbc.com. ◀



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NASA selects concepts for experimental space tech study

BY Jamie Whitney

WASHINGTON - The National Aeronautics and Space Administration (NASA) has announced grants to 14 people as part of the NASA Innovative Advanced Concepts (NIAC) program.

NASA officials say the NIAC program “fosters innovation by funding early-stage studies to evaluate technologies that could support future missions.” The latest round of awards will provide the 14 people selected with a \$175,000 grants.

“NASA dares to make the impossible possible. That’s only achievable because of the innovators, thinkers, and doers who are helping us imagine and prepare for the future of space exploration,” said NASA Administrator Bill Nelson. “The NIAC program helps give these forward-thinking scientists and engineers the tools and support they need to spur technology that will enable future NASA missions.”

The new Phase I projects include innovative sensors and instruments, manufacturing techniques, power systems, and more.

“These initial Phase I NIAC studies help NASA determine whether these futuristic ideas could set the stage for future space exploration capabilities and enable amazing new missions,” said Michael LaPointe, program executive for NIAC at NASA Headquarters.

All NIAC studies are in the very early stages of conceptual development and are not considered official NASA missions. The researchers selected to receive NIAC Phase I grants in 2023, their institutions, and the titles of their proposals are:

- Edward Balaban, NASA’s Ames Research Center in California’s Silicon Valley: Fluidic Telescope: Enabling the Next Generation of Large Space Observatories;
- Igor Bargatin, University of Pennsylvania in Philadelphia: Photophoretic Propulsion Enabling Mesosphere Exploration;
- Theresa Benyo, NASA’s Glenn Research Center in Cleveland: Accessing Icy World Oceans Using Lattice Confinement Fusion Fast Fission;

▲ **NASA has named 14 winners of as part of the NASA Innovative Advanced Concepts (NIAC) program.**

- Zachary Cordero, MIT: Bend-Forming of Large Electrostatically Actuated Space Structures;
- Peter Curreri, Lunar Resources, Inc. in Houston: Lunar South Pole Oxygen Pipeline;
- Artur Davoyan, University of California, Los Angeles: Pellet-Beam Propulsion for Breakthrough Space Exploration;
- Ryan Gosse, University of Florida, Gainesville: New Class of Bimodal Nuclear Thermal/Electric Propulsion with a Wave Rotor Topping Cycle Enabling Fast Transit to Mars;
- Congrui Jin, University of Nebraska, Lincoln: Biomineralization-Enabled Self-Growing Building Blocks for Habitat Outfitting on Mars;
- Mary Knapp, MIT: Great Observatory for Long Wavelengths;
- Quinn Morley, Planet Enterprises in Gig Harbor, Washington: TitanAir: Leading-Edge Liquid Collection to Enable Cutting-Edge Science;
- Christopher Morrison, Ultra Safe Nuclear Corporation – Space, in Seattle: EmberCore Flashlight: Long Distance Lunar Characterization with Intense Passive X- and Gamma ray Source;
- Heidi Newberg, Rensselaer Polytechnic Institute in Troy, New York: Diffractive Interfero Coronagraph Exoplanet Resolver: Detecting and Characterizing all Earth-like Exoplanets Orbiting Sun-like Stars within 10 Parsecs;
- Stephen Polly, Rochester Institute of Technology in Rochester, New York: Radioisotope Thermoradiative Cell Power Generator; and
- Ryan Weed, Positron Dynamics in Seattle: Aerogel Core Fission Fragment Rocket Engine. ◀



LCI selects Elroy Air's Chaparral autonomous VTOL cargo aircraft

BY Jamie Whitney

DUBLIN - LCI, an aviation company and a subsidiary of Libra Group based in Dublin, needed advanced autonomous cargo aircraft systems. They found their solution from has signed an agreement with Elroy Air in San Francisco. LCI inked a deal to acquire up to 40 of the Elroy Chaparral vertical take-off and landing (VTOL) aircraft.

Under the terms of the agreement, LCI will initially acquire 20 aircraft with an option for a total of up to 40 units. The VTOL aircraft are currently under development at Elroy Air's facility in South San Francisco, California.

The Chaparral is an end-to-end autonomous VTOL cargo delivery system. It is designed for aerial transport of as much as 500 pounds of goods over a 300 nautical-mile range. This is enabled initially by a turbine-based hybrid-electric powertrain with distributed electrical propulsion, and specially designed aerodynamic modular cargo pods.

The Chaparral is a transitioning "lift and cruise" VTOL aircraft with a full carbon composite airframe, and a turbine-based

▲ **The Elroy Chaparral vertical take-off and landing (VTOL) aircraft will become advanced autonomous cargo aircraft systems for LCI.**

hybrid-electric powertrain for long-range mission capabilities. It was also designed to fit in a 40-foot shipping container or C-130 cargo aircraft, enabling it to be quickly shipped and deployed worldwide.

The Chaparral system features eight vertical lift fans, four distributed electric propulsors for forward flight, a high-wing airframe configuration, as well as improved ground autonomy and cargo-handling systems.

Elroy Air has developed lightweight, aerodynamic modular cargo pods that can be pre-loaded by ground personnel and picked up by the aircraft before takeoff. At the delivery location, the cargo pod is lowered to the ground and released after the system has landed. The Chaparral system can retrieve another pre-packed pod and transport the pod to its next destination, creating a bi-directional conveyor belt through the sky.

The new VTOL aircraft will complement LCI's existing fleet of modern helicopters and fixed wing aircraft. In addition, LCI and its parent company, Libra Group, whose subsidiaries own and operate assets in approximately 60 countries. ◀

Trio of European NewSpace companies demo orbital demonstration collision avoidance system

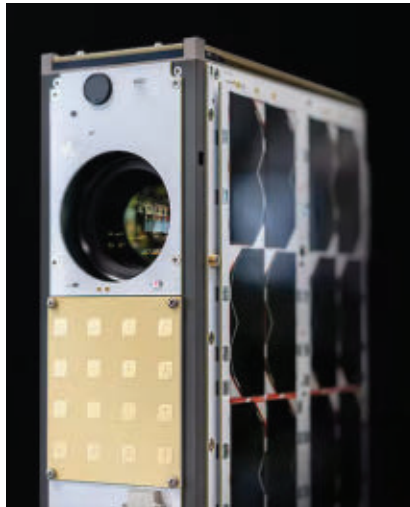
BY Jamie Whitney

MADRID - Three European NewSpace companies have partnered for Europe's first orbital demonstration of a collision avoidance system based on artificial intelligence (AI). The companies are Neuraspace in Coimbra, Portugal; Ienai Space in Madrid; and EnduroSat in Sofia, Bulgaria. The companies say their aim is to make space-traffic-management a reality.

Neuraspace is a Portuguese space traffic management company based in Coimbra, Ienai Space a Spanish in-space mobility company in Madrid, and EnduroSat is a Bulgarian satellite manufacturer, operator, and 990turnkey provider of space-as-a-service (SPaaS) -Bulgaria's capital, Sofia.

The mission will serve as a precursor for an end-to-end space traffic management (STM) solution for increased spacecraft safety. The STM will provide spacecraft operators with better space traffic data, collision detection algorithms and more efficient propulsion systems.

Ienai and Neuraspace also signed a memorandum of understanding (MOU) to collaborate on tackling the growing issue of space debris through joint traffic management products. Both companies



Three European NewSpace companies are involved in Europe's first orbital demonstration of a collision avoidance system based on artificial intelligence (AI).

are looking to reduce the risk of collisions in space by lowering decision times for customers. They will provide operators with more effective decision-making and execution options for collision avoidance maneuvers for their spacecraft.

In collaboration with EnduroSat, the companies plan to demonstrate their joint collision avoidance capabilities with a mission in 2023.

The satellite, built by EnduroSat, will be launched aboard an Isar Aerospace rocket (ISAR 2). Once in orbit, it will be maneuvered by Ienai's 'Athena' thrusters. The thrusters will respond to both simulated and real collision warnings and maneuvering suggestions. The warnings and suggestions will be generated by Neuraspace's AI/ML (machine learning) driven STM solution.

With this mission, EnduroSat also plans to further expand its sustainability capabilities. EnduroSat, and Neuraspace are both early adopters of the Space Sustainability Rating which encourages, recognizes, and rewards, space actors who enforce sustainable space missions with a rating system. ←

Boom Supersonic selects FlightSafety International as flight training provider

Boom Supersonic in Denver needed a partner for flight training and education for its flagship Overture supersonic passenger airliner. They found their solution from FlightSafety International (FSI) in New York City. FSI will develop a training program and curriculum for Overture pilots, mechanics, and cabin crew, specifically tailored for supersonic flight and operations. The comprehensive training program will leverage the expertise of professional FAA-and EASA-qualified instructors, and include flight simulators and training environments. To support Boom's commercial airline customers who conduct their own internal training, FSI

will provide full-flight simulators. FSI will provide flight deck simulators for The Iron Bird, Boom's integration test facility in Colorado. They will also provide full-flight simulators and training curriculum for advanced flight training. Developed to support the Overture flight test program, including regulatory certification, the flight simulators will incorporate technologies for safety, fidelity, and reliability. Recently, Boom announced Symphony, the new propulsion system designed and optimized for Overture. Boom also announced that it will be teaming with three industry leaders to develop Symphony including Florida Turbine Technologies (FTT) for engine design, GE Additive for additive technology design consulting, and StandardAero for maintenance.

The Airbus EGNOS V3 satellite-based augmentation system achieves system critical design review

BY Jamie Whitney

TAUFGIRCHEN, Germany – Airbus has achieved the System critical design review (CDR) on the European Geostationary Navigation Overlay Service (EGNOS) V3 satellite-based augmentation system.

The EGNOS V3 is designed to add security features for the most safety-critical applications such as aircraft navigation and landing, and will provide entirely new services for maritime and land users. EGNOS V3 is the second generation of the overlay system and will improve the performance of GPS and Galileo.

The new V3 generation of EGNOS being developed by Airbus will introduce new services based on multiple frequencies of multiple constellations (GPS, Galileo), and will embed sophisticated security protection against cyber-attacks. The System CDR covers the functional design, external interfaces, operations, security, integration verification, qualification and deployment.

EGNOS V3 relies on three operations centers and 44 monitoring stations across Europe and elsewhere. It monitors the signals from satellite navigation systems and generates augmentation



Development is moving forward for the European Geostationary Navigation Overlay Service (EGNOS) V3 satellite-based augmentation system.

messages, broadcast to all users using transponders on geostationary satellites. In early 2018 Airbus was awarded the prime contract for the EGNOS V3 Implementation Phase by ESA on behalf of the European Union Agency for the Space Program.

Airbus is currently building the next generation of Galileo satellites which will improve the accuracy of the system as well as resilience of its signal, which will be key for the upcoming digital decade. They will provide new capabilities such as digitally

configurable antennas, inter-satellite links, new atomic clock technologies and fully electric propulsion systems. The new spacecraft will also be more flexible and reconfigurable in orbit to satisfy the expected evolution in end-user needs.

EGNOS is a component of the European Union Space Program and is managed in the frame of the partnership agreement established between the European Commission's Directorate-General for Defense, Industry and Space (DG-DEFIS), the European Union Agency for the Space Program (EUSPA) and the European Space Agency (ESA). ◀

Airbus and CERN to partner on superconducting technologies for aviation decarbonization

Airbus UpNext, a wholly owned subsidiary of Airbus, and the European Organization for Nuclear Research (CERN) have announced that they are launching a project to evaluate how superconductivity can contribute to the decarbonization of future aircraft systems. The Super-Conductor for Aviation with Low Emissions (SCALE) demonstrator aims to promote the adaptation and adoption of superconducting technologies in airborne electrical distribution systems. The SCALE demonstrator combines CERN's experience in superconducting technologies with Airbus UpNext's capabilities in innovative aircraft design and manufacturing. First results are expected at the end of 2023. The initiative seeks to develop and test in laboratory conditions, an

optimized generic superconductor cryogenic (about 500 kilowatts) powertrain by end 2025. SCALE will be designed, constructed and tested by CERN using Airbus UpNext specifications and CERN technology. The demonstrator consists of a DC link (cable and cryostat) with two current leads. The cooling system is based on gaseous helium. "In its research, CERN pushes the limits of science and engineering, and partners with industry to enable innovation, with positive environmental impact," said Raphael Bello, CERN's Director of Finance and Human Resources. "Our technologies have the potential to be adapted to the needs of future clean transportation and mobility solutions, as demonstrated by this agreement with Airbus. This partnership is only a first step in our journey with the European leader in aviation, and shows how much we value the excellence of our Member States' industry." ◀