

SEPTEMBER 2023

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## ELECTRONIC WARFARE TECHNOLOGIES

Trends involve high-performance embedded computing,  
networking, and electronic spoofing. PG. 12



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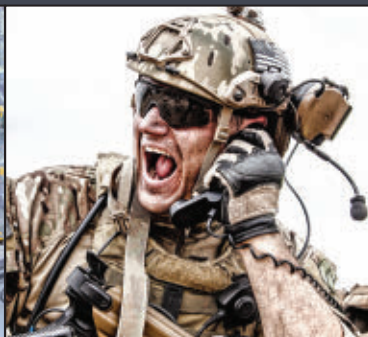
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#### Electronic warfare: all systems go

Staying one step ahead of adversaries in the EW cat-and-mouse game requires state-of-the-art microprocessors, switched-network fabrics, and industry-standard computer hardware and software.

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#### Sticking-it to tough thermal-management challenges

Aerospace and defense specialists are formulating a new generation of electronics adhesives and encapsulants that can stand-up to the heat of hypersonics and space.

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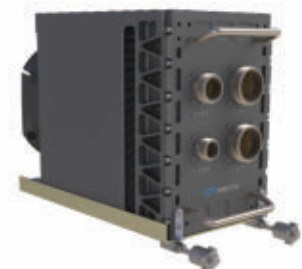
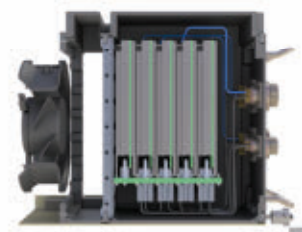
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# Power from the sky: unmanned optical relays may provide on-demand electricity for the battlefield



BY John Keller  
EDITOR IN CHIEF

Imagine a future in which warfighters on the battlefield can access electricity by the kilowatt wirelessly to power weapons, sensors, and recharge batteries via an aerial power network of unmanned aircraft. That's what military researchers are trying to do with Persistent Optical Wireless Energy Relay (POWER) project.

The U.S. Defense Advanced Research Projects Agency is working with RTX Raytheon in McKinney, Texas (formerly Raytheon Intelligence & Space) on the first phase of the POWER project, which seeks to demonstrate optical power-beaming relays on manned and unmanned aircraft operating within line of sight of military operational areas.

This on-demand power network, if it can be made workable on a relatively large scale, potentially could reduce the need for liquid fuels like jet fuel, gasoline, and diesel fuel, as well as for the military infrastructure necessary to transport and store these vulnerable commodities.

DARPA is just getting started with the POWER project, by awarding a \$10 million contract to Raytheon last month for the project's first phase, which seeks to demonstrate optical power-beaming relays as a resilient multipath alternative for expeditionary energy transport.

First, the POWER project seeks to develop optical technologies to create an airborne relay capable of redirection, wavefront correction, and energy harvesting of optical beams. The project's goal is to demonstrate its potential by using three airborne relay nodes hosted on existing aircraft to transmit as much as 10 kilowatts of energy from a ground source laser to 60,000 feet in altitude, and back down to a ground receiver 125 miles away.

Speed-of-light energy transport through a multipath network would enable rapid reconstitution under attack, graceful degradation, and resilience by re-routing energy through the network.

The POWER program seeks to deliver 10 kilowatts of laser energy to the final ground node using a 50-kilowatt source laser, transmitted through three airborne relay nodes using system apertures smaller than one meter diameter.

In POWER's first phase, Raytheon will develop and mature a relay payload design, and design a relay platform. Later, the program will build a low-power demonstration relay, finally to demonstrate three airborne nodes relaying power to a ground receiver at White Sands Missile Range, N.M., using the High Energy Laser Systems Test Facility (HELSTF), and the RQ-4 Global Hawk large unmanned aircraft as an airborne relay.

Will we see it in our lifetimes? Well, that probably depends on how old you are. Beaming power by laser from a ground transmitter via an unmanned aerial vehicle (UAV) to a receiver on the ground would be only the first step toward crafting a wide-area wireless power network.

Might such an on-demand power network rely only on UAV relays, or might such an approach eventually involve orbiting satellites? The short answer is, it's far too early to tell.

The possibilities certainly are intriguing. What might such a power network mean not only for military operations, but also to help power a growing fleet of private and commercial electric cars and trucks? Does it have the power to render gas stations and storage tanks obsolete? Only time will tell. ◀



# RFID Antennas



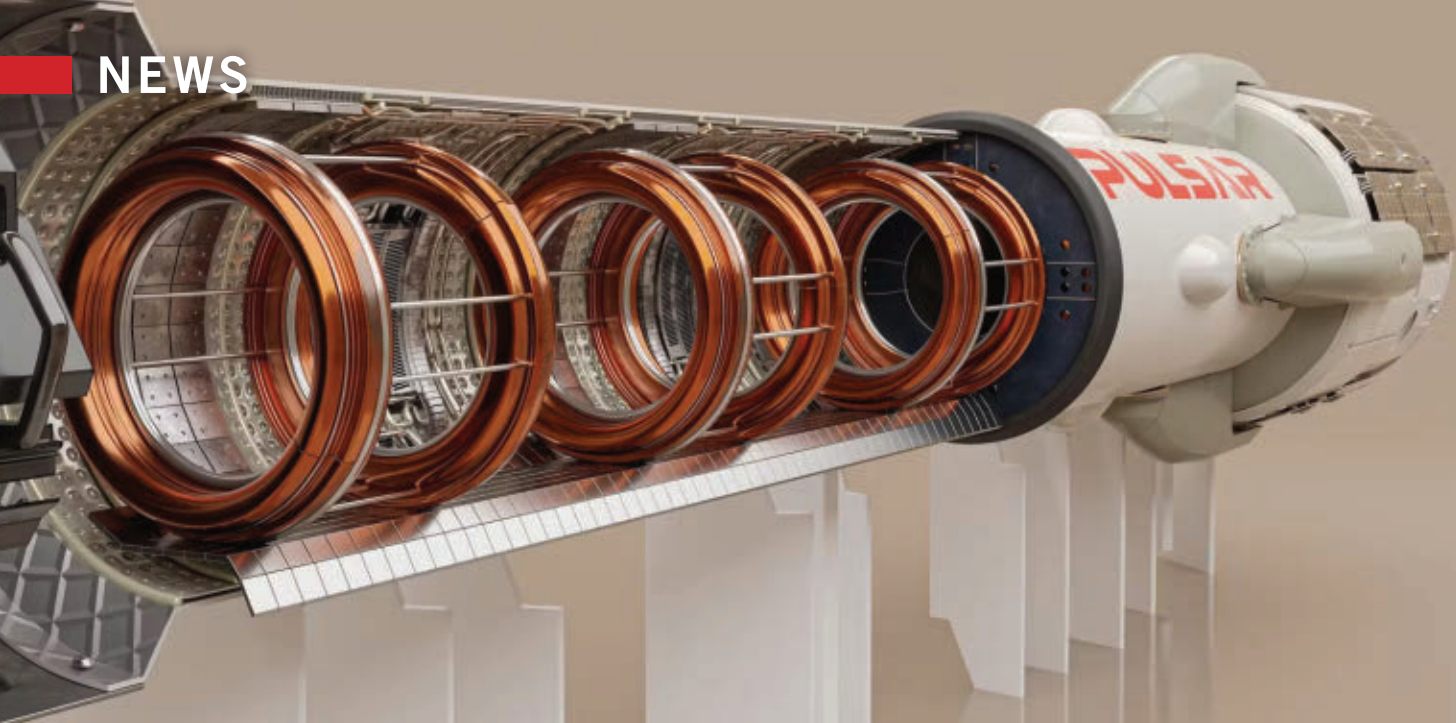
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# Pulsar Fusion begins construction of nuclear fusion rocket engine

BY Jamie Whitney

**BLETCHLEY, England** - Pulsar Fusion in Bletchley, England, has started construction of one of the largest practical nuclear fusion rocket engine ever built. The 8-meter fusion chamber is being assembled in Bletchley and when fired in 2027 will temporarily become the hottest place in the solar system creating exhaust speeds of over 500,000 miles per hour.

Researchers at Pulsar Fusion hope to reach several hundred million degrees when the final plasma shot is fired in the chamber, creating temperatures hotter than the sun.

"The difficulty is learning how to hold and confine the super-hot plasma within an electromagnetic field," says James Lambert, CFO of Pulsar. "The plasma behaves like a weather system in terms of being incredibly hard to predict using conventional techniques."

Scientists have not been able to control the turbulent plasma as it heats to hundreds of millions of degrees and the reaction simply stops. This unpredictability is attributed to the science magneto-hydro

**▲ Researchers at Pulsar Fusion hope to reach several hundred million degrees when the final plasma shot is fired in the chamber, creating temperatures hotter than the sun.**

dynamics (MHD) and Gyrokinetics, the state of the plasma is changing all the time. Scientists can get to fusion temperatures, as recently demonstrated at California's Lawrence Livermore Laboratory, and this will be achieved again more often going forward, but small improvements can dramatically improve the results.

Recent advances in machine learning techniques may have changed the playing field in favor of scientists. Pulsar Fusions is teaming with New Jersey-based Princeton Satellite Systems to take the data from the world record holding PFRC-2 reactor, feed it into supercomputer simulations to better predict how super-hot plasma behaves under electromagnetic confinement and thus, guide and improve the design of the rocket engine prototype.

If the Pulsar rocket test can demonstrate fusion temperatures to aerospace partners in 2027, then the technology has the potential to halve mission times to Mars, reduce flight time to Saturn from 8 years to 2 and ultimately empower humanity to leave Earth's solar system. ◀



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# Companies move ahead on path-agnostic space internet using commercial satellites

BY John Keller

WRIGHT-PATTERSON AFB, Ohio – Military space communications experts at Raytheon Technologies Corp. (RTX) are joining two other U.S. defense systems integrators on a U.S. Air Force research project to find new ways of distributing information among land, sea, and air forces quickly to support high-speed decision-making.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced a \$36.1 million contract to the RTX Raytheon segment in McKinney, Texas, (formerly the Raytheon Intelligence & Space and Raytheon Missiles & Defense segments) last month for the Defense Experimentation Using the Commercial Space Internet (DEUCSI) program.

This project seeks the ability to move and share data seamlessly among a wide variety of fixed and mobile operating locations using constantly available, high-bandwidth, beyond-line-of-sight communications.

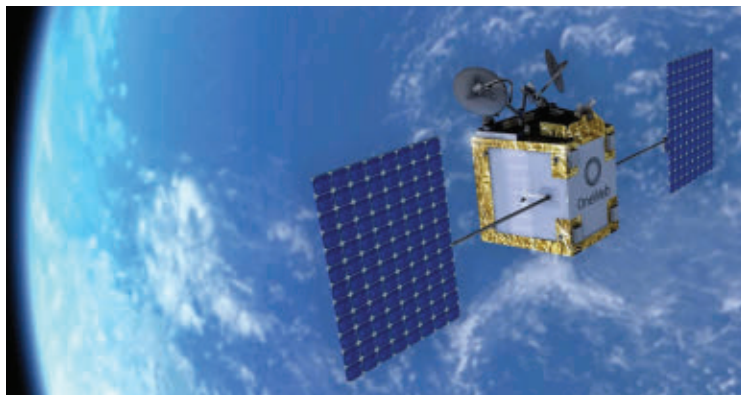
Raytheon joins the L3Harris Technologies C5 Integrated Systems segment in Camden, N.J., and the Northrop Grumman Mission Systems segment in San Diego on the DEUCSI project. Raytheon won its contract on 13 June, L3 Harris won an \$80.8 million DEUCSI contract in May, and Northrop Grumman won an \$80.3 million contract on 2 June.

DEUCSI space-based capability will be called path-agnostic communications because its users will be able to communicate reliably to any location in the world without explicitly specifying which nodes of a communication network to use.

Raytheon, Northrop Grumman, and L3Harris will seek to establish the ability to communicate with Air Force and other military platforms via several different commercial space internet constellations using common user terminal hardware elements.

The vision for path-agnostic communications is becoming possible due to the burgeoning commercial space industry, Air Force officials say. Several commercial companies plan to establish space internet constellations consisting of hundreds to thousands of commercial satellites, each to create global internet services.

The DEUCSI program seeks to establish resilient, high-bandwidth, high-availability Air Force communications



**Raytheon joins the L3Harris Technologies C5 Integrated Systems segment in Camden, N.J., and the Northrop Grumman Mission Systems segment in San Diego on the DEUCSI project.**

and data sharing capabilities by leveraging developing commercial space internet networks.

This approach differs radically from traditional military satellite communications programs in which the government typically specifies and funds every aspect of the program, Air Force researchers point out.

Instead, taking advantage of the commercial space internet will concentrate government efforts on the few areas that are unique to Air Force applications.

The project has three phases: establish connectivity between several Air Force sites using commercial demonstration satellites and terminals; expand connectivity to many Air Force assets by proliferating user terminals to several locations and vehicle types; and special experiments to address military-unique requirements not otherwise met by commercial space internet vendors.

Other DEUCSI contractors include the Lockheed Martin Aeronautics segment in Fort Worth, Texas; and Ball Aerospace & Technologies Corp. in Boulder, Colo. ◀

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Raytheon Technologies Corp. has changed its name to RTX, which consists of three brands: Collins Aerospace, Pratt & Whitney, and Raytheon. For more information contact Raytheon online at [www.rtx.com/raytheon](http://www.rtx.com/raytheon), Northrop Grumman Mission Systems at [www.northropgrumman.com/who-we-are/business-sectors/mission-systems](http://www.northropgrumman.com/who-we-are/business-sectors/mission-systems), L3Harris at [www.l3harris.com](http://www.l3harris.com), or the Air Force Research Laboratory at [www.afrl.af.mil](http://www.afrl.af.mil).





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# Army to give access to precise PNT data down to the most disadvantaged users

BY John Keller

**ABERDEEN PROVING GROUND, Md.** — U.S. Army navigation and guidance experts are asking industry for new ways of proving positioning, navigation, and timing (PNT) information for warfighters operating at the edge of the battlefield who have scant access to PNT data.

Officials of the U.S. Army Combat Capabilities Development Command (DEVCOM) at Aberdeen Proving Ground, Md., issued a request for information (W56KGU23R0103) for the Time Distribution project.

Time Distribution seeks methods and techniques for time transfer that enable accurate timing down to the most disadvantaged users. Experts are interested in wireless enabling technologies that provide nanosecond, picosecond, or sub-picosecond synchronization accuracy and ranging measurement; regional as opposed to global coverage; time referenced to coordinated universal time according to the U.S. Naval Observatory; and size and weight suitable for vehicles, aircraft, or infantry warfighters; that capitalize on existing military systems; and provide a compelling technological capability enhancement.

Traditional Army assets that rely on the Global Position System (GPS) satellite navigation require unique hardware and software to protect PNT capabilities on individual platforms, which reduces the number of protected platforms available.

The primary focus of the Time Distribution project is to evaluate existing or novel technologies in precision time distribution for military

applications that support advanced and distributed assured PNT capability, and tie into existing capabilities in the field.

From industry, the Army wants descriptions of proposed technology solutions; accuracy and antenna information; technical constraints and risks; and maturity level of proposed solutions.

Companies interested were asked to upload 15-page papers by August to DOD SAFE online at <https://safe.apps.mil>, with an email copy to [usarmy.apg.devcom-c5isr.mbx.rti-industry-engagement@army.mil](mailto:usarmy.apg.devcom-c5isr.mbx.rti-industry-engagement@army.mil), with RFI Submission: Time Distribution in the subject line. ←

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Email questions or concerns to the Army at [usarmy.apg.devcom-c5isr.mbx.rti-industry-engagement@army.mil](mailto:usarmy.apg.devcom-c5isr.mbx.rti-industry-engagement@army.mil). More information is online at <https://sam.gov/opp/9e5e717cbc054b5687bb0506d18ccc0a/view>.



**Army leaders want to provide positioning, navigation, and timing (PNT) information to every echelon on the battlefield.**



### NASA's X-59 'Son of Concorde' gearing up for first test flight

Dubbed the "Son of Concorde," NASA's experimental X-59 is almost ready for its first test flights later this year. Formerly called the X-59 Quiet SuperSonic Technology (QueSST) plane, the aircraft could usher-in a new era of supersonic mass transportation. The National Aeronautics and Space Administration (NASA) released images showing NASA's X-59 as it sits on the flight line — the space between the hangar and the runway — at Lockheed Martin Skunk Works in Palmdale, Calif., in June. The move from its construction site to the flight line will prepare the X-59 for its first and subsequent flights. Next up, the team will conduct significant ground tests to ensure the aircraft is safe to fly. The X-59 aircraft—the centerpiece of NASA's QueSST mission—is designed to demonstrate the ability to fly supersonic, or faster than Mach 1, while reducing the loud sonic boom to a quiet sonic thump. NASA will then fly the X-59 over several communities to gather data on human responses to the sound generated during supersonic flight. NASA will deliver that data set to U.S. and international regulators to possibly enable commercial supersonic flight over land. The X-59's engine from

General Electric, packs 22,000 pounds of propulsion energy and will power the X-59 as it flies at speeds up to Mach 1.4 and altitudes around 55,000 feet. The X-59 is designed to fly faster than the speed of sound without producing the typically loud sonic booms that occur when an aircraft flies at supersonic speeds.

### NASA tests mobile air traffic kit during wildfire prevention operations

NASA researchers have tested a mobile air traffic management kit for remote ground pilots across forests throughout Tennessee, Mississippi, Georgia, Florida, and South Carolina. During the testing, U.S. Forest Service pilots remotely operated unmanned aircraft systems (UAS) to drop ping-pong-ball-sized plastic spheres that ignited on impact, precisely burning dead brush that acts as fuel to wildfires. The testing was in support of NASA's Wildland Fire Management Initiative, NASA writes. The Aerial Ignition Academy training, hosted by the U.S. Forest Service, in collaboration with the National Interagency Prescribed Fire Training Center, provided pilots with a chance to train using drones for prescribed burns, a wildfire prevention and land management technique that employs *Continued on page 11*



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# STR to develop modeling for HF radio waves to help improve communications and sensing

By John Keller

ARLINGTON, Va. — U.S. military researchers needed a company to develop new ways to model the ionosphere in real time to help predict the propagation of high-frequency (HF) radio waves for improved communications and sensing. They found their solution from Systems & Technology Research LLC (STR) in Woburn, Mass.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a \$6.1 million contract to STR for the Ouija TA-2 project to develop real-time modeling and simulation for assimilative ionospheric and HF radio propagation.

The ionosphere is the ionized part of the upper atmosphere of Earth, from about 30 miles to 600 miles above sea level, which is ionized by solar radiation. It influences radio propagation to distant places on Earth by reflecting HF signals.

HF radio uses signals in relatively long wavelengths of between 10 and 100 meters. HF radio bands lie between the commercial AM and FM broadcast bands, and operate from 3 to 30 MHz. HF radio waves are notable for their ability to propagate signals for long distances by bouncing signals off the ionosphere.

HF radio also is notorious for static from thunderstorms and other radio frequency interference. The ionosphere is changing constantly, and can influence HF radio signals from minute-to-minute, and from season-to-season.

One goal for STR in the Ouija TA-2 project is to develop near-real-time assimilative ionospheric computer models that can mimic ionospheric disturbances at scales of 100 kilometers and below.

These models must assimilate ionospheric measurements taken with the scientific instrumentation packages to be flown on the Ouija TA-1 CubeSats in very low-Earth orbit (VLEO), in addition to standard vertical and oblique sounder data. The scientific instrumentation on the Ouija spacecraft will include Langmuir probes and similar devices to measure electron density and other quantities of interest.

The objective is to predict the characteristics of the ionosphere at unprecedented resolution and fidelity in near-real-time, DARPA researchers say.

▲ **Ouija TA-2 seeks to develop near-real-time assimilative ionospheric computer models that can mimic ionospheric disturbances at scales of 100 kilometers and below.**

The second goal for STR is to develop high-fidelity HF radio propagation models to help predict ground-to-VLEO radio wave propagation, which will be validated using on-orbit measurements taken from the Ouija spacecraft HF payload, which will receive test signals from cooperative terrestrial transmitters.

Researchers expect industry to develop HF radio propagation models by linking ionospheric models using on-orbit measurements to an HF propagation prediction model that will provide high-fidelity predictions of ground-to-space HF radio propagation.

The scientific payload will measure ionospheric characteristics in near-real-time using Langmuir probes, magnetometers, and global navigation satellites system (GNSS) devices to estimate electron density profiles using radio occultation. The HF payload will consist of an HF antenna and receiver to receive test signals from terrestrial transmitters.

One objective is the ability to predict the ionosphere at using high-fidelity models that update at a rate of 10 seconds per update, rather than minutes per update, which should be sufficient to predict HF radio propagation for ground-to-space HF links.

The project's nine-month first phase will begin modeling before data from the Ouija VLEO satellites is available. Instead, it will use sounder measurements from a terrestrial HF radio transmitter to low-Earth orbit (LEO) satellites equipped with an HF receive payload.

The one-year second phase will assimilate data from one VLEO satellite and produce electron density distributions. The 16-month third phase will assimilate on-orbit data from six Ouija satellites. DARPA researchers say they expect to award several contracts. ◀

On this contract, STR should be finished with the first phase by early next year. For more information contact STR online at [www.str.us](http://www.str.us), or DARPA at [www.darpa.mil](http://www.darpa.mil).



*Continued from page 9* the controlled use of fire to burn fuels like dead brush and vegetation. During the training, researchers from NASA's Advanced Capabilities for Emergency Response Operations (ACERO) project shadowed drone pilots as they trained in the field and collected data on the use of NASA's mobile air traffic pilot kit. The kit alerted pilots positioned in forests throughout the five southwestern states to air traffic detected in the surrounding area. This enhanced their ability to avoid conflicts while conducting these prescribed burns.

### SAIC integrates unmanned aircraft technology, seeks partners

As the use of drones continues to grow, so too does the risk of harm from drones to military forces and critical infrastructure globally. SAIC's Billy Jackson, business development director, discusses how SAIC provides counter-UAS (CUAS) services and solutions, to U.S. federal government, state/local, and global commercial markets. Jackson, who spent nearly three decades as an officer in the U.S. Army, flew Black Hawk helicopters and worked as an acquisition officer in army aviation. Now with SAIC, Jackson talks to Zoldi about how the tech integrator works to fight drone attacks against critical infrastructure.

### Boeing and Intel to collaborate on advanced microelectronics for aerospace

In a new strategic collaboration, Boeing and Intel are working together to advance semiconductor technology across the aerospace industry, with the intent to create next-generation microelectronics applications in artificial intelligence, secure computing and advanced flight capabilities for future products. Boeing says this collaboration will focus on technologies that are producible, digital, autonomous, and sustainable. The companies will assess far-ranging microelectronics applications, which will include the

cooperative design, development and manufacturing of foundational semiconductors, and the advancement of advanced flight capabilities and high-performance edge-computing solutions. Boeing will collaborate with Intel to leverage Intel 18A technology, a state-of-the-art Si CMOS (Silicon Complementary Metal-Oxide Semiconductor) fabrication process and other technologies, to create next-generation capabilities relevant to national security. ←



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# ELECT WARFARE





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**Staying one step ahead of adversaries in the EW cat-and-mouse game requires state-of-the-art microprocessors, switched-network fabrics, and industry-standard computer hardware and software.**

BY Jim Romeo

**M**any new technologies, processes, and collaborations all are converging on electronic warfare (EW), providing reason to be optimistic and bullish about its future.

Jonathan Roberts is an engineer at the RAND Corporation in Santa Monica, Calif., whose research focuses on EW, radar, and low-observable technology.

“Since the Electromagnetic Spectrum Superiority Strategy was released in 2020 there has been a lot of work put into harmonizing capabilities between services and partner nations. In terms of general EW technology, cognitive EW is the future,” Roberts says. “Cognitive EW is driving advances in data science and signal processing related to what we field and how we think about data that would have previously been discarded.”

Vitalii Pasichnyk / iStock / Getty Images Plus / Getty Images  
gouvendmir / E+ / Getty Images

## Advancements in autonomy

The U.S. Senate calls for the U.S. Department of Defense (DOD) to address deficiencies in the electronic protection of defense systems. This “ensures that electronic warfare will be a significant topic for years to come,” says Meir Bartur, co-founder and CEO of Optical Zonu Corp. in Van Nuys, Calif., which specializes in RF over optical fiber technology.

“It is no secret that our weaponry and defense systems are becoming increasingly autonomous,” Bartur continues. “As a result, signal transport to manage these systems remotely will require higher frequencies that support more bandwidth and lower latency but also introduces higher attenuation and easier obstruction by natural environments and disruption from EMPs [electromagnetic pulse attacks].”

Bartur points to one signal processing trend that seeks to use RF over fiber for remote antennas as a way to protect electronic signals from detection and interference. This offers a fully analog transport for radio communication over light waves between antennas and the protected areas where sensitive equipment is located.

“Whether it is military radar, cellular and satellite communications, GPS, or GNSS, the fiber used in antenna remoting is completely resistant to electromagnetic interference,” Bartur says. “This technique is also being used in sensitive compartmented information facilities to provide secure Wi-Fi.”

This approach places all access points of the network in an impenetrable area, using fiber to connect to the antennas, and uses a multiple-input and multiple-output (MIMO) architecture for very low signal footprint.

## Spectrum agility and data processing

Mike Lewis is the principal director and leader in Booz Allen’s global defense business. Lewis, along with many other industry professionals are quick to point out the value of electromagnetic spectrum dominance.

“Electromagnetic spectrum dominance is as important as air dominance in the past: vital and scale-tipping,” Lewis says. “Electromagnetic warfare impacts each stage of the existing observe, orient, decide, act loop in a consequential way. As we pivot to more capable potential foes, the impact grows exponentially. As these conflicts grow, such as Ukraine, the overall DOD



▲ The scalable design of the BAE Systems Storm EW spectrum warfare suite provides a trusted hardware baseline that can be customized and integrated into fixed-wing piloted and unmanned, helicopters, and missiles.

focus and importance of EW becomes a cornerstone again.”

Core capabilities involve the ability to sense, make-sense, reason, and effect with lethal and non-lethal effects. “Another aspect of EW desperately needed is the ability to understand, plan, manage, assess, command, and control joint electromagnetic spectrum operations (JEMSO),” Lewis says.

An important part of this is recognizing the coordination and collaboration necessary to avoid fratricide and use assets efficiently. “The ability to plan and orchestrate these across services and domains will need to continue to grow and improve,” Lewis continues. The artificial intelligence (AI) capabilities to integrate and assist in the decision-making process will be an essential component to enable these cross-domain decisions.”

Providing the right information to AI processing engines will play a big part. “It is imperative to ensure information sharing across domains, systems, and services,” Lewis says. This sharing of information will be a key attribute of success as the DOD continues to improve and enhance the existing capability set. Unfortunately, today a significant amount of those EW capabilities is less connected and share less information that is optimal and needed in the future.”

Still, there’s reason to be hopeful. “I’m excited to see the DOD recognize these facts and work towards standards for communications and data sharing,” Lewis says. “It is also imperative to continue to make updates and enhancements to fielded systems.”

Members of the DOD, such as the Army, are taking steps toward future upgrades to fielded systems. “This will help existing



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systems stay current and optimized going forward,” Lewis says. “Another trend that is key to drive adaptability going forward is the ability to rapidly reprogram our sensors and weapon systems. It is vital to quickly understand friend vs foe and react appropriately. The battlefield electromagnetic spectrum will be changing quickly, and our systems will need the ability to be forward-looking and learn using dynamic updating solutions along with AI tools.”

### Ripe for advancement

Electromagnetic spectrum capabilities are building tremendous capability that is ripe for advancement. Lorne Graves is the chief technologist for RF Systems at RF and microwave specialist Spectrum Control in Fairview, Pa.

“The pacific pivot started a few years ago, but the industrial base under the prime manufacturers is starting to see and absorb the new mandates for rapid enhancement of electromagnetic spectrum capabilities. This, coupled with the accelerated commercial deployment of high-speed spectrum services and functions, is generating the perfect storm and an opportunity for the RF defense industry, from the primes to component suppliers,” Graves says.

“To put it more bluntly, there is an initiative to accelerate the commercial use of the spectrum for growth in both government and commercial revenues while securing – and possibly enhancing – defense systems to mitigate and exploit the impact,” Graves says.

In addition to electromagnetic spectrum capabilities, digital technologies, in general, are helping RF architectures that can be beneficial in many ways.

“Second-generation direct-digital technologies are starting to emerge in the marketplace and wideband are enough to merit the first major re-planning of RF architectures for new start programs,” Graves adds. “However, high technology readiness level (TRL) requirements for rapid takeoffs will make for some interesting mixing and matching of old digital and analog architectures with new digital capabilities. At these transitional moments, defense programs may need to take a little more risk to ensure they continue leading-edge technology innovation and not just fund re-engineering efforts of nearly the same capability but with more software.”

This also points to a heightened emphasis on electromagnetic battle management. “One of the key initiatives in EW right now is an emphasis on electromagnetic battle management (EMBM),” says Josh Niedzwiecki, vice president and general manager of electronic combat solutions at BAE Systems in Nashua, N.H.

“Today, each platform has to defeat all of the threats they face. With effective EMBM, strike packages of disparate platforms will be able to collaborate to defeat the network they face,” Niedzwiecki says. “Optimizing all signal processing and spectrum attack resources across the strike package and supporting assets gives teams a much broader arsenal of electromagnetic weapons. In addition, effective use of resources allows tactical data collections to learn from the environment and capability developers to create effective countermeasures and electronic attacks against emerging threat signals.”

Chris Ciufo is the chief commercial officer and chief technology officer at General Micro Systems in Rancho Cucamonga, Calif. He says that an underlying problem with sophisticated EW is related to the ability to move and process data.

“Advanced electronic warfare and the receiving side ISR [intelligence, surveillance, reconnaissance] initiatives from labs haven’t percolated out to programs yet in a big way,” Ciufo says. “In fact, from a ‘sensor’ standpoint, the bottlenecks are more the ability to move the data, process the data, and interpret the results.”

It wasn’t always this way. “Moving the data once relied on proprietary pipes like FPDP (for sonar) or RACE++ for radar, but 1-gigabit-per-second Ethernet moved in. Now, we see that 10-gigabit-per-second Ethernet is the norm for moving data, with 100 gigabits per second being requested for near-term programs.”



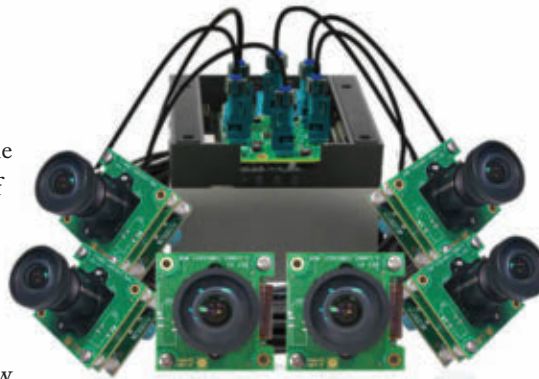
**The BAE Systems state-of-the-art Block 4 EW systems for F-35 Lightning II jet fighter-bombers will accelerate the delivery of advanced EW capabilities to warfighters by combining adaptable hardware and incremental software updates.**



## Value of data

Ciufo says that advancement in the use of sensors can boost the value of the underlying data that such sensors capture.

“Don’t ignore the simplest sensors, since new AI engines can interpolate or interpret data in new ways that bring to light information not previously ‘visible.’ Case in point: EO/IR sensors. A simple optical sensor is a high-resolution camera. With near real-time data fed to an AI engine, that data can yield valuable information that wasn’t visible before. AI algorithms used for manufacturing—such as machine vision or object recognition—are better than ever. They can use UHD (4K) video and bring previous not visible (or not understandable) intelligence to existing, EO/IR sensors. At GMS, we are seeing a huge tidal wave of seemingly “boring” legacy camera-based systems being connected to high-rate pipes and AI engines.”



**This photo from e-con systems that shows six 8-megapixel 4K cameras streaming data to an NVIDIA Jetson Orin general-purpose graphics unit microprocessor. It is the same one used in the General Micro Systems rugged X9-AI small-form-factor-system.**

Others are paying attention to communications networks, and the transference of commercial 5G to defense applications is important and influential to support modern weapon systems. Alexander Wyglinski is the Associate dean of graduate studies and a professor of electrical and computer engineering at Worcester Polytechnic Institute in Worcester, Mass.

“Given how DOD is employing private 5G networks in the field for various types of operations and missions, there exists a wide range of issues associated with commercial technolo-

gies being retrofitted for military applications,” Wyglinski says.

“Many of these issues revolve around the topic of spectrum dominance in challenged environments,” he continues “In addition to spectrally co-existing with commercial 5G networks, various adversaries are developing techniques capable of disrupting DOD private 5G networks by exploiting different adaptive/

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intelligent mechanisms at different layers of the protocol stack, ranging from the radio frequency (RF) characteristics of the individual wireless devices to how these networks access the wireless medium all the way to how networks are formed to generate secure, robust topologies. As a result, there are numerous opportunities for R&D efforts to identify threats against DOD private 5G networks and generate new intelligent cost-effective mechanisms to counter-act these threats.”

Dave Harrold is the vice president and general manager of countermeasure and electromagnetic attack solutions at BAE Systems in Nashua, N.H. He notes the importance of RF and electro-optic/infrared capabilities.

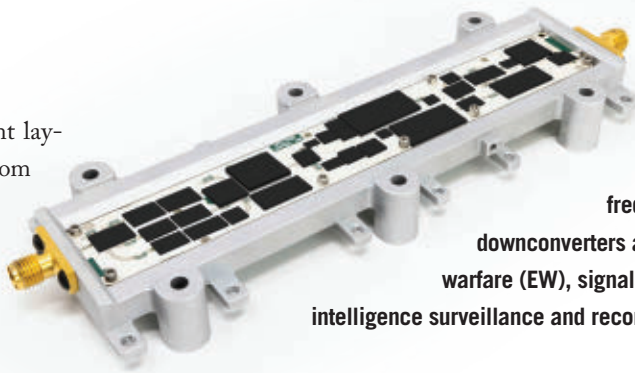
“When platforms need to execute missions in highly contested battle spaces and they will definitely be detected, a full spectrum approach to EW that combines radio frequency electro-optic/infrared capabilities is necessary to counter adversaries’ kill chains, enable freedom of maneuver, and improve warfighters’ survivability and lethality,” Harrold says.

“The layered full spectrum approach includes emerging technologies and capabilities, including next-generation countermeasure dispensers and air-launched effects,” he continues. “The reason full-spectrum EW is so powerful is that different portions of the spectrum offer unique advantages. For instance, weather has much less effect on RF capabilities than EO/IR. EO/IR can offer greater precision and detect features not seen in RF. The first step is to integrate full spectrum capabilities on individual platforms, and then across platforms. Using EMBM, we can enable and coordinate heterogeneous platform capabilities across the physical domains to greatly enhance mission effectiveness.”

## Intelligence gathering

Neil Sampson is the director of aerospace and defense at semiconductor designer GSI Technology Inc. in Sunnyvale, Calif. Like others, Sampson sees improvements in capability of sensor inputs and intelligence gathering among the many things that remain a boon to EW capability.

“EW has always been a central tenet in advanced warfare,” Sampson says. “From listening in the oceans passively for signatures of hostile submarines to watching the skies for unidentified incursions. The modern battlefield utilizes a multitude of sensor inputs and intelligence gathering to guide actions and coordinate timing of attacks for greater effect. With faster processing, and newer methods such as AI and fusion processing,



► **Sci Blocks (“sky blocks”)** are ultra-miniature radio frequency (RF) and microwave downconverters and upconverters for electronic warfare (EW), signals intelligence (SIGINT), and intelligence surveillance and reconnaissance (ISR) applications.

DOD has increased pressure to advance their processing platforms from traditional first principal DSP processing to inference driven assistance to the battlefield decision maker. The successful adopter(s) of this will increase the warfighter’s ability to see all and make highly effective real-time decisions.”

Sampson adds that DOD always has sought to advanced many new and useful technologies and has worked hard at their development and adoption. “Everyone is subject to the fallacy of making good better by doing it faster or with more powerful versions of the same processing,” Sampson says. “As we look at AI we can see similar processing in training and inference because the processor happens to be good at matrix multiplication. If we look at ourselves training and application are not done the same. This opens the path for technologies that may not be suitable for radiation environments, and low power edge applications to be used for training, but different technologies for actual fielding decision making.”

There’s also some developments and advancements aiding the use of collaborative EW and cognitive EW. Mike Paturzo is the vice president of global sales and strategy for electronic systems at Textron Systems. “Key initiatives in Electronic Warfare (EW) include collaborative EW and cognitive EW,” Paturzo says. “Collaborative EW focuses on using multiple cooperating EW platforms to achieve enhanced EW effects. Examples include passive listening from multiple platforms to achieve faster geolocation of the source of an emission and the use of multiple platforms to broaden the effectiveness of Electronic Attack (EA). Cognitive EW seeks to deploy Machine Learning and Artificial Intelligence to the problem of recognizing signals that may comprise an unknown threat and the deployment of countermeasures to defeat the threat.”

It’s clear that the operational importance of EW is increasing. “The world is an increasingly networked environment and the ability to exploit or deny the electromagnetic spectrum is increasingly important to operational success,” Paturzo says. This fact was underscored by the successful Ukrainian attack on the Russian Cruiser Moskva, which was enabled by EW technology.”

Paturzo also highlights trends in signal processing that include the availability of analog-to-digital converters (A/D converters) and digital-to-analog converters (D/A converters) with



ever-increasing sample data rates, and the widespread availability of graphics processing units (GPUs) as key technologies that are assisting EW.

“The availability of faster Sample Data Rates has the effect of moving the D/A conversion closer to the antenna, which generally provides more capability, better accuracy, and reduced RF parasites,” Paturzo says. “The widespread availability of GPUs allows much faster processing of complex algorithms, particularly those that involve large arrays of data.”

## Communications and sensors

As communications and sensors combine with advancements in space operations, there’s an emergent decision superiority for the DOD. Emil Kheyfets director of military and aerospace business development for Aitech Defense Systems Inc. in Chatsworth, Calif.

“Advances in telecommunications, sensors, processing power, and weapons, along with the growing utility of space and cyberspace as operational domains, have fundamentally shifted the character of command and control in warfare,” Kheyfets says. “With this in mind, the DOD is seeking to achieve decision superiority through [Joint All Domain Command and Control] JADC2 “to produce the warfighting capability to sense, make sense, and act at all levels and phases of war, across all domains, and with partners, to deliver information advantage at the speed of relevance.”

Kheyfets says that achieving the JADC2 vision means connecting every current sensor that can support battlespace awareness, making sensor data available to any potential user, at any level of operation. Leveraging AI/ML and advanced algorithmic warfare systems will help in achieving this data-sharing construct.

Kheyfets adds that to make the JADC2 concept a reality, the military services must analyze what each contribution will be in achieving this vision. “While many services are focusing on creating a global targeting system that can enable the find, fix, track, target, engage, and assess functions of the kill chain, some are looking at how JADC2 can assist with achieving decision superiority to maneuver forces to positions of advantage to prevent an adversary from meeting their objectives,” he says.

## The road ahead

Overall, many are upbeat about improvements in EW systems. Bill Conley, chief technology officer Mercury Systems Inc. in Andover, Mass., is bullish on technology advancements that will influence EW.

“We remain excited about the continued need to upgrade and improve EW systems,” Conley says. “Since Russia’s invasion of Ukraine, we’ve seen how software updates to SATCOM systems could mitigate the Russian jammers. We’ve also seen an increasingly contested electromagnetic spectrum as drones are used to support targeting, and long-range precision strike weapons are employed. The U.S. Defense Department is investing to upgrade aircraft and maritime EW capabilities as a part of the current strategy and focus in the INDOPACOM region.”

Simultaneously, Conley says that microelectronics has advanced substantially over the past several years. “The newest A/D converters, D/A converters, field-programmable gate arrays, and novel processors are being blended through chiplets to allow capable, and rapid, component technologies to be formed. Direct RF is a key trend that impacts numerous systems by enabling the development of flexible and compact signal processing solutions, bringing AI-level computer power to smaller platforms,” he says. “Lastly, the analog front end remains critical to ensuring the finite dynamic range of these digital components can be optimized; broadband tunable filters, solid-state power amplifiers and apertures are critical to our future competitiveness.”

Predicting the future can be tricky, yet “it seems likely there will continue be steady advancement in digital signal processing power, sampled data rates, and data memory capabilities,” says Textron’s Paturzo. “There will be continued emphasis on collaborative EW, with an expectation that significant advancements in capability will be obtained as a result. There will also be continued emphasis on cognitive EW, but here the likely outcome is that technical reality will eventually trump the unrealistic expectations. No doubt the hype will be maintained as long as it can be, but at some point, unless there is a significant new breakthrough, the impediments imposed by the technical reality are likely to block an advance to true autonomy.”

When everything adds up, there’s plenty of reason to be optimistic about advancements in EW and its effect on our defense capabilities. And there’s more technological development to come in future years.

“The breakthroughs required for the laboratory and range test equipment will require additional level of complexity and even greater advancement in technology,” Paturzo says. “Machine Learning (ML) and Artificial Intelligence (AI) have the potential to enhance this test community and may unburden human EW test operators.” ◀



## ELECTRONIC WARFARE

For more information on electronic warfare search for “electronic warfare” at [www.militaryaerospace.com](http://www.militaryaerospace.com)



# Sticking-it to tough thermal-management challenges

**Aerospace and defense specialists are formulating a new generation of electronics adhesives and encapsulants that can stand-up to the heat of hypersonics and space.**

BY Jamie Whitney

**W**hile summer is coming to a close, those in the electronics industry experts often have heat at the front of their minds. Engineers have the unenviable task of taking today's ever-more-powerful advanced components like processors and sensors and fit them into shrinking enclosures, all the while keeping everything cool.

Those increasingly diminutive electronics are enabling greater capabilities from all manner of technologies used in the aerospace and defense industries.

"Everything is shrinking in size," says John Santini, chief technology officer of Micross Components Inc. in Melville, N.Y. "Everybody is looking to do point-of-load regulation closer to the ICs — especially ASICs and processors. It gives you much better transient response, and you don't have conductive losses in the traces, and you save board real estate."

While engineers work to reduce wasted energy, the nature of power electronics and physics mean that despite best efforts, everything in an enclosure needs to be ready to stand up to the heat, or total system failure can occur. This extends to non-electric components, like adhesives. In fact, adhesives can aid in the dissipation of heat in critical components, and can help get the engineer out of a sticky situation.

"Thermally conductive adhesives are uniquely qualified to meet the increasingly diverse requirements of advanced electronics systems," says Venkat Nandivada, manager of technical support at Master Bond, a firm specializing in adhesive systems based in Hackensack, N.J.

"From their conventional use as fastening materials, adhesives find wide use in bonding and encapsulation in nearly every application segment, including military/aerospace, medical, automotive, and industrial, among others," Nandivada says. "In computer and communications systems, thermally conductive adhesives have long played a vital role at the chip level for die attach, at the PCB level for heat sink bonding, and at both the chip- and board-levels for all types of thermal management methods."

He continues, "For fast-growing segments ranging from high end electronics to LED lighting and more, engineers need materials to dissipate more heat from advanced electronic devices. In this environment, thermally conductive adhesives not only support a wide range of thermal management requirements but also meet equally challenging requirements for manufacturing assembly and extended product life cycles. Additionally, many of these thermally conductive adhesives are designed to provide resistance to 85 C, [and] 85 percent relative humidity reliability testing."



## Wafer thin

Master Bond's Nandivada notes that adhesives also have to have size, weight, and power consumption (SWaP) in mind when making

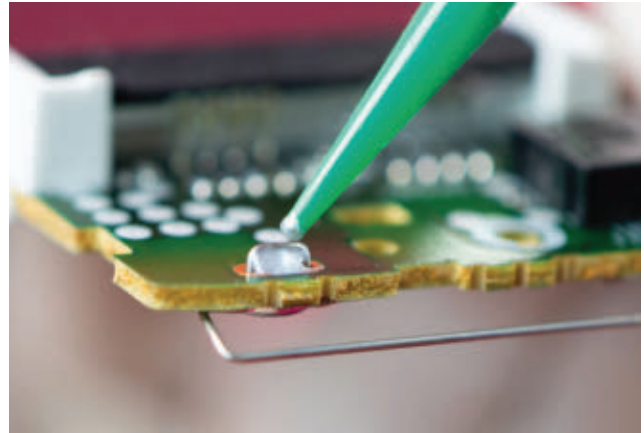
◀ **A U.S. Air Force Global Strike Command unarmed Minuteman III intercontinental ballistic missile launches during a test last year at Vandenberg Space Force Base, Calif.**

ing epoxies, silicones, light curing systems, polysulfides, polyurethanes, and cyanoacrylates for the aerospace and military industries.

"Although thermally conductive adhesives have long played an important role in electronics manufacturing, industry trends are driving a more critical need for these materials," Nandivada says. "As the

semiconductor industry pushes toward smaller, higher density devices, product manufacturers face greater challenges in assembling die, package, and other components into products able to cope with increasing heat loads."

He continues, "One key requirement tends to be the need for thin bond lines to be applied to maximize heat transfer and minimize thermal resistance. Along with heat transfer in many cases there is a critical requirement for electrically non-conductive

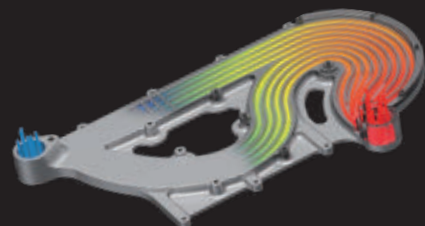


**Master Bond's EP3HTS-TC adhesive has high thermal conductivity, and can solve thermal-management issues in aerospace, electronics, opto-electronic, and specialty applications**

adhesives with low dielectric constant and low dissipation factors at high frequencies. In certain situations, there may even be a need for electrically conductive adhesives which provide low volume resistivity. These adhesives need to not only meet growing thermal requirements, but also meet unique manufacturing

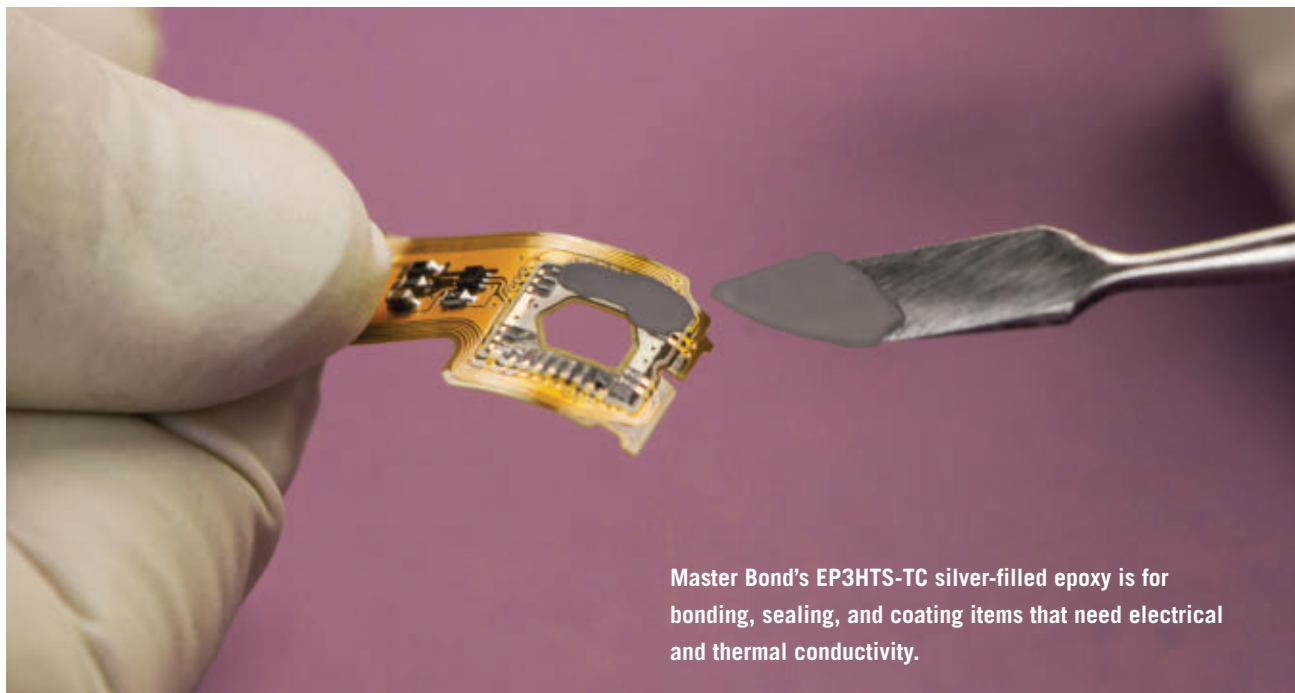


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Master Bond's EP3HTS-TC silver-filled epoxy is for bonding, sealing, and coating items that need electrical and thermal conductivity.

and life cycle requirements dictated by the needs of the application. With advances in epoxies, silicones, and other materials, however, manufacturers can find adhesives able to meet nearly any combination of requirements for thermal, environmental, and structural stability.”

The good news for SWaP-minded engineers is that a thin bond line of is actually preferable to thick as it helps reduce thermal resistance and increase heat dissipation.

“The particle size of the thermally conductive filler in the adhesive can contribute to a trade-off between optimal bond strength and optimal heat transfer,” says Master Bond’s Nandivada. “The bulk thermal conductivity specification addresses only part of the objective of internal heat transfer. In a typical product assembly, a more practical characteristic is the material’s thermal resistance. Thermal resistance describes the ease with which heat can transfer across the interface between the die or component surface and bonding material, across the bonding material, and finally across the interface between the bonding material and package or heat sink.

### Speed and heat

Advances in semiconductor process technologies boost not only speed, but also heat in today’s military and aerospace systems. That problem may grow — literally — as the U.S. Department of Defense (DOD) eyes development future electronics architectures that involve 3D heterogeneous integration (3DHI) chip stacks.

Earlier in the year, Military + Aerospace Electronics reported on the U.S. Defense Advanced Research Projects Agency (DARPA) releasing an announcement (HR001123S0019) for the Miniature Integrated Thermal Management Systems for 3D Heterogeneous Integration (Minitherms3D) project as the government looks for a way to keep the 3DHI chip stacks cool.

In a 3D stack, hot spot thermal management must rely on in-tier heat spreading, since interior tiers do not have direct access to top or bottom cooling. In a Si tier of 100-micron thickness, thermal conduction limits heat spreading to hot spot of 1-by-1 millimeter to 200 Watts per square centimeter with a temperature rise below 10 degrees Celsius over the rest of the tier.

The project highlights a growing need by the military and aerospace industry to use every bit of available space in increasingly tight confines to solve heat issues.

“The ability of thermally conductive adhesives to help dissipate heat has motivated their use as the preferred fastening approach in applications requiring careful thermal management,” says Master Bond’s Nandivada.

### Playing defense

Although adhesives play a crucial role in mission success outside of embedded computer systems, researchers in China are using epoxy not just to protect separate internal components, but in an entire weapons system. Study lead Gao Lihong noted in the peer-reviewed Chinese-language journal Ordnance Material Science and Engineering publication on 17 May 2023 that using



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**A 2.5-millimeter coating made primarily of boron phenolic resin for high-heat and high-stress environments, plus additives stopped a high-energy laser from melting aerospace aluminum alloys.**

a cheap solution to protect reported success in using a resin that has shown efficacy as an anti-high-energy laser protective coating on ballistic missiles.

The Alibaba Group-owned South China Morning Post reported on the discovery in a story titled “Could this 1-dollar Chinese adhesive defeat a billion-dollar US laser weapon?”

SCMP journalist Stephen Chen reported that the researchers applied a 2.5-millimeter coating made primarily of boron phenolic resin (BPR), which is used in high heat and high stress environments. “This solution uses low-cost raw materials, a simple manufacturing process and has very high performance,” says Gao and her colleagues in the paper.



**Commercial and defense applications in hypersonic aircraft and missiles, automotive, jet engine turbine, and oil-and-gas experience thermal environments beyond the capability of today's enabling technologies.**

In fact, the adhesive costs approximately \$1 per kilogram (2.2 pounds). Chen's reporting notes that a high-energy laser could burn a whole through the thin BPR coating in seconds, but the team added readily available inorganic compounds like silicon carbide, zirconium dioxide and carbon black nanopowder to protect the aerospace aluminum alloys.

The coating withstood energy from a high-powered laser for 15 seconds and reached a surface temperature of 445 degrees Fahrenheit. Aerospace alloys generally have a minimum melting temperature of around 750 degrees Fahrenheit.

“BPR-1 and other recent advancements in protective technology are pushing

the directed energy weapons arms race between the United States and China to a new stage, according to a Beijing-based laser scientist,” Chen writes in the SCMP piece.

“Welcome to Star Wars 2.0,” said the researcher, who Chen said requested not to be named due to the sensitivity of the technology.

## Sticky situations

Practical applications for military and aerospace-grade adhesives is as varied as the industry itself. Snipers are known to seal threads on their clothing with silicone to protect it while in the field and on mission, while aerospace engineers need adhesives that stand up to the rigors of supersonic flight and the conditions of space.

Master Bond's EP3TS-TC fast curing, silver filled, one-part epoxy meets National Aeronautics and Space Administration (NASA) requirements for low outgassing in outer space, high vacuum conditions in optical and electro-optical applications, among others. Master Bond's EP3HTS-TC cures rapidly at 250 to 300 F with minimal flow and low shrinkage upon curing.

Its main use is as an adhesive for die attach and general bonding purposes. EP3HTS-TC bonds well to a wide variety of substrates including metals, composites, ceramics, and many plastics. It is well suited for automatic dispensing equipment and can be applied without any tailing.



For other types of bonding, it combines remarkable thermal and electrical conductivity. In fact, the thermal conductivity exceeds  $16 \text{ W}/(\text{m}\cdot\text{k})$ . Along with this, the maximum particle size is about 20 microns, and when these numbers are combined, the thermal resistance is a  $1\text{-}5 \times 10^{-6} \text{ K}\cdot\text{m}^2/\text{W}$ .

Other desirable attributes include resistance to thermal cycling, and a low coefficient of thermal expansion. The temperature range is  $-80^\circ\text{F}$  to  $+400^\circ\text{F}$ . Two scenarios in which EP3HTS-TC would be a top candidate include in applications where the lowest possible volume resistivity is required. Another is when pre-eminent thermal conductivity is necessary and the need for electrical conductivity is not a pertinent issue.

Master Bond also offers its EP5TC-80 epoxy for use in bonding, sealing and small encapsulation applications. EP5TC-80 is a special system. Master Bond says that a typical, unfilled epoxy is highly electrically and thermally insulative with a thermal conductivity value of about  $0.25 \text{ W}/(\text{m}\cdot\text{K})$ . Adding filler materials that conduct heat and not electricity, generally increases thermal conductivity. EP5TC-80 is able to achieve up to  $3.3\text{-}3.7 \text{ W}/(\text{m}\cdot\text{K})$ .

According to Master Bond, this system bonds well to a wide variety of substrates such as metals, composites, ceramics and



### THERMAL MANAGEMENT

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many plastics. The filler material has ultra fine particles, with the largest being 10 to 15 microns, which designers can use in very thin sections. The end result is very low thermal resistance. The combination of fine bond lines and thermal conductivity lowers the thermal resistance to  $6\text{-}10 \times 10^{-6} \text{ K}\cdot\text{m}^2/\text{W}$ .

EP5TC-80 resists water, oils and fuels. It is gray in color. The service temperature range is  $-50$  to  $150^\circ\text{C}$ . With its robust thermal conductivity, it can solve thermal management issues in aerospace, electronics, opto-electronic, and specialty OEM applications. EP5TC-80 is a versatile system which can be used for bonding heat sinks to circuit boards, coils and motors, die attaching in optics, bonding SMDs, potting power modules and encapsulation of very small coils. ←

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# Northrop Grumman eyes path-agnostic military communications using space internet

By John Keller

**WRIGHT-PATTERSON AFB, Ohio** – Military space communications experts at Northrop Grumman Corp. are moving forward with a U.S. Air Force research project to find new ways to distribute information among land, sea, and air forces quickly to support high-speed decision-making.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced a \$80.3 million contract to the Northrop Grumman Mission Systems segment in San Diego for the Defense Experimentation Using the Commercial Space Internet (DEUCSI) program.

This project seeks the ability to move and share data seamlessly among a wide variety of fixed and mobile operating locations using constantly available, high-bandwidth, beyond-line-of-sight communications.

DEUCSI space-based capability will be called path-agnostic communications because its users will be able to communicate reliably to any location in the world without explicitly specifying which nodes of a communication network to use.

Northrop Grumman will seek to establish the ability to communicate with Air Force and other military platforms via several different commercial space internet constellations using common user terminal hardware elements.

The vision for path-agnostic communications is becoming possible due to the burgeoning commercial space internet, Air Force officials say. Several commercial companies plan to establish space internet constellations consisting of hundreds to thousands of satellites, each to create global internet services.

The DEUCSI program seeks to establish resilient, high-bandwidth, high-availability Air Force communications

▲ **Project seeks to move and share data among fixed and mobile operating locations using constantly available, high-bandwidth, beyond-line-of-sight communications.**

and data sharing capabilities by leveraging developing commercial space internet networks.

This approach differs radically from traditional military satellite communications programs in which the government typically specifies and funds every aspect of the program, Air Force researchers point out.

Instead, taking advantage of the commercial space internet will concentrate government efforts on the few areas that are unique to Air Force applications.

The project has three phases: establish connectivity between several Air Force sites using commercial demonstration satellites and terminals; expand connectivity to many Air Force assets by proliferating user terminals to several locations and vehicle types; and special experiments to address military-unique requirements not otherwise met by commercial space internet vendors.

Other DEUCSI contractors include the Lockheed Martin Aeronautics segment in Fort Worth, Texas; Ball Aerospace & Technologies Corp. in Boulder, Colo.; and the Raytheon Technologies Corp. Intelligence & Space segment in McKinney, Texas. The L3Harris Technologies C5 Integrated Systems segment in Camden, N.J., won a \$80.8 million DEUCSI contract last month. ◀

For more information contact Northrop Grumman Mission Systems online at [www.northropgrumman.com](http://www.northropgrumman.com), or the Air Force Research Laboratory at [www.afrl.af.mil](http://www.afrl.af.mil).



### Northrop Grumman to build 48 airborne radar systems for F-16 jet fighters

U.S. Air Force aerial warfare experts are ordering additional modern active electronically scanned array (AESA) radar for F-16 jet fighters under terms of an \$128.5 million eight-year order. Officials of the Air Force Life Cycle Management Center, Fighter Bomber Directorate, F-16 Division, at Wright Patterson Air Force Base, Ohio, are asking the Northrop Grumman Corp. Mission Systems segment in Linthicum Heights, Md., for 48 production radars and spare parts. The APG-83 AESA fire-control scalable agile-beam radar (SABR) integrates within the F-16's structural, power, and cooling constraints without Group A aircraft modification, Northrop Grumman officials say. The company leverages technology developed for the APG-77 and APG-81 radar systems on the U.S. F-22 and F-35 combat aircraft. In a 2013 competition, Lockheed Martin Corp., the F-16 manufacturer, selected the APG-83 as the AESA radar avionics for the F-16 modernization and update programs of the U.S. Air Force and Taiwan air force. The bandwidth, speed, and agility of AESA radars enable legacy fighter aircraft like the F-16 to detect, track, and identify many targets quickly and at long ranges, and to operate in hostile electronic warfare (EW) environments. Northrop Grumman is building APG-83 radar systems for global F-16 upgrades and new aircraft production, as well as for the U.S. Air National Guard. Northrop Grumman also has installed a production APG-83 SABR on a U.S. Marine Corps F/A-18C Hornet jet fighter-bomber, company officials say. On this order Northrop Grumman will

do the work in Linthicum Heights, Md., and should be finished by May 2032. For more information contact Northrop Grumman Mission Systems online at [www.northropgrumman.com](http://www.northropgrumman.com), or the Air Force Life Cycle Management Center at [www.afllcmc.af.mil](http://www.afllcmc.af.mil).

### GaN RF and microwave communications amplifier for introduced by Empower RF

Empower RF Systems Inc. in Inglewood, Calif., is introducing the model 2245 gallium nitride (GaN) on silicon RF and microwave amplifier for defense commercial and avionics, space and deep space, electronic warfare (EW), naval applications, mobile internet, satellite communications, and wireless communications. This liquid-cooled amplifier delivers a minimum of 4100 Watts continuous wave from 2 to 4 GHz with 5-kilowatt mid band performance. With no single point of RF failure, the 2245 offers extreme effective mean time between failures (EMTBF). The modular architecture enables hot or muted swapping of the integrated amplifier drawers or cold swap of the 3U system controller in less than 15 minutes. Repair of this RF and microwave amplifier is modular, fast, and easy, and specialized technician training is not required. There are no dangerous high-voltage power supplies to contend with. Only fractional system spares are necessary for a complete backup system; users only need to spare one amplifier drawer and one controller. The 2245 is the smart choice for those seeking exceptional reliability and lowest lifetime cost of ownership. For more information contact Empower RF Systems online at [www.empowerrf.com](http://www.empowerrf.com). ←

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# Raytheon to upgrade software on radar that bounces HF radio waves off the ionosphere

BY John Keller

**PHILADELPHIA** – Long-range radar experts at Raytheon Technologies Corp. will upgrade and maintain software for a U.S. Navy surveillance system designed to detect and track aircraft and surface ships all over the Caribbean from the Florida Coast to South America.

Officials of the Naval Supply Systems Command Fleet Logistics Center, Norfolk, Contracting Department, Philadelphia Office in Philadelphia announced a four-year \$87.5 million contract to the Raytheon Intelligence & Space segment in Woburn, Mass., to upgrade the Relocatable Over-The-Horizon Radar (ROTHR) at the Forces Surveillance Support Center in Chesapeake, Va.

The ROTHR over-the-horizon radar uses high-frequency (HF) radar waves that bounce off a layer of the atmosphere called the ionosphere to provide long-range over-the-horizon radar

coverage. It achieves long ranges by skipping waves off the ionosphere, just like shortwave radio.

ROTHR uses HF radio waves, which are particularly susceptible to interference from lightning almost anywhere in the world. HF signal reception also changes throughout the course of the day and the seasons, as well as at night, so ROTHR poses a particularly difficult digital signal processing (DSP) problem.

ROTHR is designed to provide early warning of strikes against aircraft carrier task forces, and is suited especially for long-range surveillance of large open-water areas out to ranges as far as 2,500 nautical miles.

The U.S. Navy operates two ROTHR systems, one in Chesapeake, Va., and the other in Corpus Christi, Texas. Together, these radar systems cover most of the Caribbean, and extend into the Pacific coast of Central America and South America as far south as the Galapagos Islands.

As their name implies, the ROTHR systems can be moved, and have been redeployed for detection and monitoring of air



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► ROTHR over-the-horizon radar uses high-frequency (HF) radar waves that bounce off the ionosphere to provide long-range radar coverage.





traffic in the U.S. government's war against drugs, Raytheon officials say.

The ROTHr system has been operational with the U.S. government for more than 25 years, supporting the counter drug mission in the Caribbean and South America, and early warning detection for Navy vessels at sea.

ROTHr originally was developed to keep long-range watch for cruise missiles and other low-flying threats to the U.S. mainland well offshore. Eventually ROTHr took over monitoring drug smuggling in the Caribbean.

The radar provides more than 2.5 million square miles of coverage and detects more than 350,000 targets per year. It is currently the U.S. government's primary surveillance system for the counter-drug mission, Raytheon officials say.

Raytheon has been upgrading the radars since the initial installations to improve performance and reliability. Performance improvements included state of the art computers and displays and enhanced software for more accurate tracking of small aircraft and boats.

On this contract Raytheon will do the work in Chesapeake, New Kent, and

Arlington, Va.; Marlboro, Mass.; Corpus Christi, Texas; San Juan, Puerto Rico; Adelaide, Australia; Dayton, Ohio; Colorado Springs, Colo.; Washington, D.C.; and Key West, Fla., and should be finished by August 2027. ◀

For more information contact Raytheon Intelligence & Space online at [www.raytheonintelligenceandspace.com](http://www.raytheonintelligenceandspace.com), or the Naval Supply Systems Command Fleet Logistics Center at [www.navsup.navy.mil](http://www.navsup.navy.mil).



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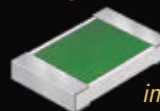
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# Raytheon to design networked swarming unmanned aircraft for reconnaissance and strike

BY John Keller

ARLINGTON, Va. — U.S. Navy anti-air warfare experts needed an advanced unmanned aircraft for reconnaissance and strike that can be launched from unmanned submarines and surface vessels. They found their solution from Raytheon Technologies Corp.

Officials of the Office of Naval Research in Arlington, Va., announced a \$146.7 contract to the Raytheon Missiles & Defense segment in Tucson, Ariz., for the Future Advanced Strike (FAST) project — essentially a modernized version of the Raytheon tube-launched Coyote block 3 unmanned aerial vehicle (UAV).

FAST is to provide intelligence, surveillance, reconnaissance, and precision strike capability by completing design modifications to the Coyote block 3.

Raytheon will complete configurations and develop technical data, manufacturing test, for an enhanced payload air system, a new launch module, a fire control system, and ancillary support.

The Coyote is a small, expendable, and tube-launched UAV that can be deployed from the ground, air, or surface warships. It can operate individually or can be networked with other Coyote UAVs in swarming operations for surveillance, electronic warfare (EW), and strike missions.

The system will operate for as long as one hour, and can carry out surveillance imagery, enhanced targeting, near real-time damage assessment, and reduced threat to manned aircraft missions.

The U.S. Army has selected the Coyote for near-term counter-unmanned systems with an advanced seeker and warhead. In 2016 demonstrations on land and at sea, more than two dozen Coyote systems launched in a swarm and moved in formation, demonstrating the effectiveness of autonomous networking.

The block 3 Coyote is being designed to provide intelligence and strike capability when launched from unmanned surface vehicles (USVs) and unmanned underwater vehicles (UUVs).

Raytheon announced in August 2021 that a demonstration of the Block 3 in an air intercept test had used a non-kinetic warhead to defeat a swarm of 10 drones. The Block 3 Coyote has a traditional UAV design with wings and an electric motor similar to the original Coyote Block 1, but is bigger in size. ←

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On this contract, Raytheon will do the work in Tucson, Ariz., and San Luis Obispo, Calif., and should be finished by December 2024. For more information contact Raytheon Missiles & Defense online at [www.raytheonmissilesanddefense.com](http://www.raytheonmissilesanddefense.com), or the Office of Naval Research at [www.nre.navy.mil](http://www.nre.navy.mil).



**FAST is to provide intelligence, surveillance, reconnaissance, and precision strike capability by completing design modifications to the Coyote block 3 UAV.**



# Companies to build test prototypes of next-gen optionally manned combat vehicles

BY John Keller

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

Officials of the Army Contracting Command at Detroit Arsenal in Warren, Mich., announced two separate contracts — collectively worth nearly \$1.6 billion — to American Rheinmetall Vehicles LLC in Sterling Heights, Mich.; and to General Dynamics Land Systems in Sterling Heights, Mich., to build prototypes of the Optionally Manned Fighting Vehicle (OMFV).

The OMFV will be able to operate with or without a human crew, and will emphasize advanced electronics, machine autonomy for operating in unmanned mode, a 30-millimeter

▲ **The future Optionally Manned Fighting Vehicle (OMFV) will be able to operate with or without a human crew, and will emphasize advanced electronics and machine autonomy.**

cannon, and a second-generation forward looking infrared (FLIR) sensor system for fighting at night, in bad weather, or in smoke and haze.

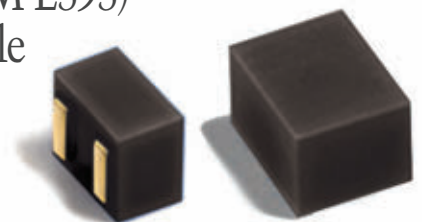
The Army awarded five OMFV development contracts in August 2021 for the second phase of OMFV concept design. These contracts are for the third and fourth phases of OMFV detailed design and prototype build and testing.

Phase-two OMFV contractors not named this week to move to the program's third and fourth design phases are the BAE

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Systems Platforms & Services segment in Sterling Heights, Mich.; Oshkosh Defense LLC in Oshkosh, Wis.; and Point Blank Enterprises Inc. in Miami Lakes, Fla.

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

The NGCV program contains the OMFV to replace the Bradley Fighting Vehicle; the Armored Multi-Purpose Vehicle (AMPV) to replace the M113 armored personnel carrier; the Mobile Protected Firepower (MPF) light tank for Infantry

Brigade Combat Teams (IBCTs); the Robotic Combat Vehicle (RCV) of three unmanned ground vehicles in light, medium, and heavy configurations; and the Decisive Lethality Platform (DLP), the replacement for the M1 Abrams main battle tank.

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

Army leaders say the OMFV should be optionally manned, in that it must be able to conduct remotely controlled operations while the crew is not aboard. The future vehicle should

### Companies form partnership for urban air mobility operations in India

FlyBlade India in Gurgaon, India, a joint venture between Hunch Ventures and Blade Air Mobility Inc. and Jaunt Air Mobility LLC, an AIRO Group company, announced a strategic partnership aimed at launching electric vertical take-off and landing (eVTOL) aircraft operations in India and the

subcontinent region by 2027. The partnership includes BLADE India's intended acquisition of 150 Jaunt Journey aircraft, with an option to order another 100 aircraft to meet the projected demand over the next decade. The companies expect to collaborate in specific areas to support future short-haul mobility operations. Their plans include, in particular, BLADE India working with Dallas, Texas' Jaunt and its partners to explore development of key infrastructure capabilities in aircraft charging and energy distribution technologies. In turn, Jaunt intends to use BLADE India's existing short haul operations to support the development of the Jaunt Journey aircraft and its integration into the Indian airspace.

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### Airbus and STMicroelectronics eye power electronics for unmanned electric aircraft

Airbus in Blagnac, France, and STMicroelectronics in Geneva are working together to develop light and efficient power electronics for future manned and unmanned hybrid-powered aircraft and full-electric urban air mobility vehicles. The collaboration focuses on wide-bandgap semiconductor materials like silicon carbide (SiC) and gallium nitride (GaN) for aircraft. These materials could enable applications that require high-power, high-frequency, or high-temperature operations. The co-operation revolves around developing semiconductor materials for Airbus aerospace applications. The companies will demonstrate these components for e-motor control units, high- and low-voltage power converters, and wireless power transfer systems.

### Honeywell introduces new SATCOM system for advanced air mobility

Honeywell Aerospace in Phoenix has unveiled the VersaWave small satellite communications (SATCOM) system with



have no more than two crewmen, and be able to carry as many as six infantry soldiers.

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

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

5G for advanced air mobility and unmanned aerial systems. VersaWave combines SATCOM; 5G, 4G, and 3G cellular; Wi-Fi, and Bluetooth connectivity in a small lightweight package for beyond-visual-line-of-sight (BVLOS) communication for unmanned aircraft. It weighs 2.2 pounds, and switches between cellular and SATCOM automatically to provide Inmarsat SATCOM connectivity when outside cellular coverage to enable vehicle command and control as well as data transfer and video streaming. The system also is Wi-Fi- and Bluetooth-enabled for remote configuration. VersaWave with 5G is undergoing qualification and certification and is planned to be commercially available this fall. Users of the current small SATCOM system can upgrade with minimal downtime. For more information contact Honeywell online at <https://aerospace.honeywell.com/us/en/pages/sff-uav-satcom>.

### **Safety-critical software for Arm Armv8-A microprocessor introduced by Wind River**

Wind River Systems in Alameda, Calif., is offering support DO-178C DAL A safety-critical software for the Wind River Helix virtualization platform for the Arm Armv8-A microprocessor architecture. The latest version of VxWorks 653 provides updated DO-178C DAL A certification evidence for PowerPC. DO-178C DAL A evidence is a safety-certifiable multi-core multi-tenant processor design with support for several independent levels of criticality. The Wind River software is designed for a variety of mission-critical applications like commercial and military avionics by enabling users to run unsafe software alongside software certified to the highest level in avionics (DO-178C), automotive (ISO 26262), industrial (IEC 61508), and other similar standards. Helix Platform also is ARINC 653-conformant and provides

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

On these contracts American Rheinmetall and General Dynamics Land Systems will do the work in Sterling Heights, Mich., and should be finished by December 2027. For more information contact American Rheinmetall Vehicles LLC online at [www.rheinmetall.com/en/company/subsidiaries/american-rheinmetall-vehicles](http://www.rheinmetall.com/en/company/subsidiaries/american-rheinmetall-vehicles), General Dynamics Land Systems at [www.gdls.com](http://www.gdls.com), or the Army Contracting Command at Detroit Arsenal at <https://acc.army.mil/contractingcenters/acc-dta/>.

robust time and space partitioning on modern microprocessors to contain faults and enable upgrades with minimal test and integration. VxWorks 653, with DO-178C DAL A evidence, is safe, secure, and reliable, and is available for PowerPC processors. VxWorks 653 also is ARINC 653-conformant. For more information contact Wind River online at [www.windriver.com](http://www.windriver.com). ◀

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# NASA to develop orbiting hyperspectral space sensors to measure ocean ecosystems

BY John Keller

**GREENBELT, Md.** – U.S. space agency researchers are making plans to ask industry to develop a space-based hyperspectral ultraviolet-through-infrared passive imaging radiometer to measure ocean biology, chemistry, and ecology to assess ocean productivity, ecosystem change, coast and inland water quality, and hazards like harmful algae blooms.

Officials of the U.S. National Aeronautics and Space Administration (NASA) Goddard Space Flight Center announced plans to issue a request for proposals (RFP) for the GeoXO Atmospheric Composition (ACX) instrument to fly on the Geostationary Extended Observations (GeoXO) series of geostationary three-axis Earth-observation satellites.

This is a new orbiting space instrument for the GeoXO program will provide data for ecological forecasters, marine resource managers, fisheries, health departments, water treatment managers, and the commerce, recreation, and tourism industries.

ACX will track and help respond to climate-driven ocean and coastal ecosystem changes. High spatial and temporal resolution ACX observations will be an improvement over contemporary

▲ **Orbiting hyperspectral ultraviolet-through-infrared passive imaging radiometer will measure ocean biology, chemistry, and ecology.**

low-earth orbiting ocean color sensors, NASA officials say.

From its position in geostationary orbit, ACX will view ocean and coastal conditions in real time and improve the chance of cloud-free observations of areas of interest. A draft RFP is expected

in July, and a final RFP is expected in September.

Hyperspectral imaging involves slicing an image into many different spectral bands to uncover details that otherwise might be hidden. This presents a formidable digital signal processing challenge, which is compounded when the dimension of time is added.

The upcoming RFP will be for hardware for an ACX engineering development model and four flight models to launch between 2032 and 2042. ←

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Companies interested should email their intentions to do so, as well as any technical and contractual questions, to NASA's Darlene Harkins at [darlene.harkins@nasa.gov](mailto:darlene.harkins@nasa.gov). More information is online at <https://sam.gov/opp/2e9a3adc17c44ff9b20bbd5d3ab7d831/view>.



# Kord Technologies to build air-defense laser weapons for armored combat vehicles

BY John Keller

REDSTONE ARSENAL, Ala. – U.S. Army laser weapons experts needed a company to build and sustain an air-defense laser for the Stryker armored combat vehicle. They found their solution from Kord Technologies Inc. in Huntsville, Ala.

Officials of the Army Rapid Capabilities and Critical Technologies Office (RCCTO) at Redstone Arsenal, Ala., announced a potential \$158.1 million contract to Kord Technologies for the Directed Energy Maneuver Short Range Air Defense (DE M-SHORAD).

The DE M-SHORAD is a 50-kilowatt mobile air defense laser weapon able to shoot down manned and unmanned fixed-wing aircraft, helicopters, and missiles from the Stryker vehicle.

It consists of an onboard thermal and power system that dissipates heat, recharges the system's batteries, and fires its laser off the batteries. The beam emits from a roof-mounted beam director on the Stryker vehicle.

Kord will build as many as four DE M-SHORAD prototypes for delivery in 2023, and as many as four more system prototypes in 2024. Company engineers will make design changes to DE M-SHORAD prototypes to reduce overall weight and increase maintainability.

The Army chose Kord Technologies in November 2021 to build as many as eight DE M-SHORAD prototypes for delivery this year and in 2024. In September 2021 the Army chose Kord Technologies and the Raytheon Technologies Corp. Missiles & Defense segment in McKinney, Texas, to supply three 50-kilowatt high-energy laser weapons for three Stryker A1 armored combat vehicles as part of the DE M-SHORAD project.



**DE M-SHORAD 50-kilowatt mobile air defense laser weapon can shoot down manned and unmanned fixed-wing aircraft, helicopters, and missiles.**

Kord and Raytheon participated in a laser weapons combat shoot-off in July 2021 to demonstrate the capabilities of their systems at Fort Sill, Okla. Kord engineers are designing DE M-SHORAD to reduce overall weight and enhance maintainability. ←

On this contract Kord Technologies will do the work in Huntsville, Ala., and should be finished by January 2026. For more information contact Kord Technologies online at <https://kordtechnologies.com>, or the Army Rapid Capabilities and Critical Technologies Office (RCCTO) at <https://rapidcapabilitiesoffice.army.mil>.

### CMOS image sensor that works in all light conditions introduced by Teledyne e2v

Teledyne e2v, a Teledyne Technologies company in Grenoble, France, is introducing the Hydra3D+ time-of-flight CMOS image sensor for pick and place, logistics, factory automation, and factory safety. The sensor incorporates 832-by-600-pixel resolution, is tailored for 3D detection and measurement, and works in all light conditions. Designed with Teledyne e2v's proprietary CMOS technology, Hydra3D+ features a 10-micron three-tap pixel that provides fast transfer times starting from 10 nanoseconds, and displays high sensitivity in the near-infrared wavelength, and demodulation contrast. The sensitivity of Hydra3D+ enables it to manage lighting power and handle a wide range of reflectivity. Its high resolution, with

powerful on-chip HDR enables a tradeoff between distance range, object reflectivity, and frame rate. This makes it suitable for mid, long-range distances and/or outdoor applications such as automated guided vehicles, surveillance, ITS and building construction. The sensor offers large field-of-view scenes captured in 2D and 3D by a compact sensor that makes the system cost effective. For more information contact Teledyne e2v online at [www.teledyne-e2v.com](http://www.teledyne-e2v.com).

### Electro-optical sensors with artificial intelligence (AI) introduced by Raytheon

The Raytheon Technologies Intelligence & Space segment in Arlington, Va., is introducing the RAVEN electro-optical intelligent-sensing capability, which will enable pilots to identify threats more

quickly and precisely than they can today. RAVEN can identify objects optically and spectrally simultaneously in real-time; just one infrared system never has been able to do this before, company experts say. RAVEN's intelligent-sensing capability uses artificial intelligence (AI), hyperspectral imaging, and light detection and ranging (lidar) to enable operators to see as much as five times farther and clearer than traditional optical imaging. RAVEN synthesizes reams of data into a detailed picture of the battlespace and the threats within it. The first version of RAVEN, RT-1000, can support a wide array of missions, including the U.S. Army's Future Vertical Lift modernization effort, with the first flight test being conducted in 2024. For more information contact Raytheon Intelligence & Space online at [www.raytheonintelligenceandspace.com](http://www.raytheonintelligenceandspace.com). ←

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## AD-HOC NETWORKING

### ► Royal Marines choose networking radios from Persistent Systems for unmanned surveillance

The United Kingdom Royal Marines, the commando and amphibious arm of the Royal Navy, needed handheld networking radios for the Future Commando Force program. They found their solution from Persistent Systems LLC in New York.

Persistent Systems will supply more than 1,000 of the company's MPU5 handheld networking radios to the Royal Marines for the Future Commando Force program.

The Android-loaded MPU5 runs the Wave Relay mobile ad-hoc networking (MANET) algorithm for peer-to-peer sharing of voice, video, text, GPS location, and sensor data without the use of vulnerable base stations or external communications infrastructure.

The Royal Marines Future Commando Force program seeks to enable Royal Marines warfighters to serve in two new littoral response groups, and the new radio equipment to reflect that role.

This gear includes new helmet cameras, hand-thrown unmanned aircraft and ground systems, rotary-wing drones for intelligence, surveillance, reconnaissance (ISR), and resupply, and MPU5s to provide the MANET that connects the troops, equipment, and command.

The Royal Marines have used MPU5s during the Green Dagger exercise in California's the Mojave Desert, where Royal Marines were part of a U.S. Marine Corps force in multi-national wargames.

Last December, the Royal Marines likewise used MPU5s during Musandam Fort in Oman to test new communications equipment designed to create powerful, secure networks anywhere in the world, Royal Navy officials say.

Delivery, training, and customer support to the Royal Marines will come from Steatite Ltd. in Redditch, England, the prime contractor on this Royal Marines procurement. Deliveries will continue throughout 2023.

"The network is the foundation on which future technologies will be deployed," says Eve Shapiro, director of international business development at Persistent Systems. "Our MPU5's will transport data from sensors and unmanned systems enabling small agile commando teams to exert a disproportionately large effect on the battlefield."

For more information contact Persistent Systems



online at [www.persistentsystems.com](http://www.persistentsystems.com), Steatite Ltd. at <https://steatite-embedded.co.uk>, or the Royal Marines at <https://www.royalnavy.mod.uk/our-organisation/the-fighting-arms/royal-marines>.

## TEST AND MEASUREMENT

### ▼ RDA to build test and measurement system for ASW digital signal processing

U.S. Navy anti-submarine warfare (ASW) experts needed an affordable sonobuoy test, development, and evaluation system for airborne submarine hunting. They found their solution from the RDA Inc. segment of Sentient Digital Inc. in Doylestown, Pa.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced their intention last Wednesday to ask RDA to build the Low-Cost Acoustic Processor (LCAP) engineering tool, and support ASW engineering development and test.

The LCAP is a roll-on/roll-off ASW acoustic test and measurement system that operates aboard the Navy P-8A Poseidon ASW and maritime patrol aircraft. The value of



the upcoming contract to RDI has yet to be negotiated.

The LCAP helps Navy and industry ASW experts test design approaches to multi-static active coherent systems and enhancements; multiple input/multiple output (MIMO) ASW signal processing; acoustic communications; investigate new capabilities for the AN/SSQ-101 and the AN/SSQ-125 sonobuoys; concurrent processing of active and passive sonobuoys; new operator machine interface designs; undersea source and receiver sonobuoy array modifications; and related digital signal processing.

RDI will upgrade LCAP hardware, software, and firmware; update software-defined sonobuoy receivers; and install LCAP onto P-8 aircraft. The LCAP engineering tool also will support airborne ASW testing and development.

LCAP is a sonobuoy test system that records command, control, and acoustic processing of legacy and developmental sonobuoys, and helps with at-sea and in-flight ASW research and development by enabling engineers and operators to interpret results, identify problems, and adjust test plans.

The system has provided test and evaluation of the Navy's AN/SSQ-101 and AN/SSQ-77C air deployed active receiver (ADAR) sonobuoys; and the SSQ-53 high-gain array and extended-range passive directional low frequency analyze and record (DIFAR).

LCAP is a PC-based architecture for rapid development, low cost, and easy upgrades, and can command, record, and process current and experimental sonobuoys in the Navy's inventory. For more information contact RDA Inc. online at <https://sdi.ai/our-companies/>, or Naval Air Systems Command at [www.navair.navy.mil](http://www.navair.navy.mil).

### TACTICAL NETWORKING

#### ▲ Navy orders fiber-optic shipboard networking for communications and navigation

Military communications experts at the Boeing Co. will continue their support for high-speed fiber-optic shipboard networking for the navies of Japan, Korea, Australia, and Canada under terms of a \$16.8 million contract.

Officials of the U.S. Naval Sea Systems Command in Washington are asking the Boeing Defense, Space & Security



segment in Huntington Beach, Calif., to continue support of the shipboard AN/USQ-82(V) family of shipboard networking systems for the four navies allied with the U.S.

The AN/USQ-82(V) family consists of the Data Multiplex System (DMS), the Fiber Optic Data Multiplex System (FODMS), and Gigabit Ethernet Data Multiplex System (GEDMS).

The AN/USQ-82(V) family of shipboard networking equipment transfers inputs and outputs for a surface warship's machinery control systems, damage-control system, steering control system, Aegis combat system, navigation displays, and interior communications alarms and indicators.

Boeing designed this shipboard network equipment to replace the mile of point-to-point cabling, signal converters, junction boxes, and switchboards that make up a conventional ship's cabling, Navy officials say.

As the AN/USQ-82(V) design agent, Boeing will provide advanced and specialized system sustainment technical engineering; cyber security enhancement; configuration management; systems development, qualification, and integration; testing; and technical support to manufacturing and repair vendors.

The AN/USQ-82(V) is being installed on U.S. Navy Burke-class destroyers, as well as in upgrades to flight I/II Burke-class destroyers and to flight IIA Burke-class destroyers.

Surface warships with similar capabilities and data-throughput requirements to the Burke-class destroyer are Japan's Kongo-class guided-missile destroyers; Korea's Sejong the Great-class destroyers; Australia's Hobart-class air-warfare destroyers; and Canada's future Surface Combatant.



The AN/USQ-82(V) is designed to transfer data via a reliable, redundant, mission-critical network backbone aboard Navy surface warships. It is the most recent upgrade to the Navy's Data Multiplex System (DMS) networks, and offers enhanced network communication capabilities by providing an IP-based backbone that supports multimedia services such as video and data.

AN/USQ-82(V) offers manpower reduction and increased crew safety by using video and sensors for monitoring remote or confined shipboard spaces, Boeing officials say.

In September 1989, Boeing delivered the first DMS system to the Navy for installation aboard the USS Arleigh Burke, the namesake for the DDG 51 class destroyer. As the DDG new ship construction continued, the DMS was upgraded to the Fiber Optic Data Multiplex System (FODMS) to support evolving needs.

In August 2010, the Navy replaced the copper-based DMS systems installed on the Arleigh Burke and the USS John Paul Jones (DDG 53) with the high-performance fiber-optic AN/USQ-82(V), the latest variant in the DMS family of networks.

The manufacturer of the AN/USQ-82(V) fiber-optic shipboard network is Argon ST in Fairfax, Va., a wholly owned subsidiary of Boeing, which acquired Argon ST in 2010 to expand capabilities in C4ISR, cyber security, and intelligence.

This contract includes options that could bring its value to \$100 million. Boeing will do the work in Huntington Beach, Calif.; Arlington, Va.; remote Navy and foreign military shipyards and laboratories; Annapolis Junction, Md.; Colorado Springs, Colo.; and Tukwila, Wash., and should be finished by May 2028. For more information contact Boeing Defense, Space & Security online at [www.boeing.com/company/about-bds](http://www.boeing.com/company/about-bds), Argon ST at [www.argonst.com](http://www.argonst.com), or Naval Sea Systems Command at [www.navsea.navy.mil](http://www.navsea.navy.mil).

#### GUIDANCE

#### ► **Army orders Switchblade unmanned smart mortar to attack light armored vehicles**

U.S. Army fire support experts needed manpackable armed unmanned aircraft that have become notable for their use in Ukraine against invading Russian military forces. They found their solution from AeroVironment Inc. in Arlington, Va.

Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., announced an \$18.9 million order to AeroVironment to build the Switchblade armed loitering unmanned aerial vehicle (UAV) that launches from a small tube that can be carried in a warfighter's backpack.

The Switchblade attack drone system, which essentially functions as a smart mortar round, transmits live color and infrared video wirelessly after launch for display on a small ground-control unit. The operator confirms the target using the live video feed, commands the air vehicle to arm its payload and lock its trajectory onto the target.

The Switchblade UAV weapon reportedly has been successful in Ukraine against Russian light combat vehicles and other valuable targets of opportunity. Ukraine officially uses the Switchblade 300 attack drone.

Controllers can manipulate the Switchblade loitering munition from as far away as 6.2 miles, and the missile can operate for as long as 10 minutes. It can engage long-range targets and help to relieve warfighters who are pinned down by enemy fire.

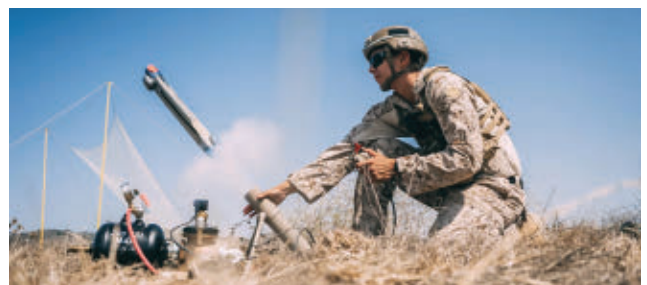
The Switchblade 300 uses compressed air to shoot out of its launch tube, and has an electric engine for propulsion. The loitering munition uses a fly-by-radio frequency signal, and daylight and infrared cameras to lock on to stationary and moving targets.

The warhead has a forward-firing shotgun-blast effect that throws pellets forward of the missile. The missile weighs six pounds, and is for use against beyond-line-of-site targets. It can provide real-time GPS coordinates and video for information gathering, targeting, or target recognition.

The Switchblade warhead has an explosive charge equivalent to a 40-millimeter grenade that is able to destroy light armored vehicles, enemy infantry, and supplies.

The Switchblade killer drone operates with a common ground-control station; has a 6.2-mile range; flies at speeds of 55 to 85 knots, at altitudes below 500 feet; and can launch from the ground, from aircraft, from ground vehicles, and from surface vessels.

On this order AeroVironment will do the work in Simi Valley, Calif., and should be finished by November 2023. For more information contact AeroVironment online at [www.avinc.com](http://www.avinc.com), the Army Contracting Command-Redstone at <https://acc.army.mil/contractingcenters/acc-rsa>.





### COMMUNICATIONS

#### ▲ Navy picks SyQwest for undersea sonar communications for ships and submarines

U.S. Navy undersea warfare experts needed a new sonar communications system to replace the AN/WQC-2A underwater communications system. They found their solution from SyQwest Inc. in Cranston, R.I.

Officials of the Naval Undersea Warfare Center Division Keyport in Keyport, Wash., announced a \$16.6 million contract to SyQwest to build the first Next Generation Gertrude (NGG) underwater communication device. The NGG will replace the Navy's AN/WQC-2A underwater communications system.

The NGG will be for new-construction surface ships, as well as for back-fits to Navy Arleigh Burke-class destroyers and future Constellation-class frigates.

The AN/WQC-2A sonar communications set is a single sideband, general-purpose voice and continuous-wave communication set that functions as an underwater communications system to link surface ships, submarines, and shore stations.

The AN/WQC-2A sonar communications set has been in service for more than 35 years and is one of the Navy's in-service sonar underwater communication system for surface ships, submarines, and coastal based shore installations.

Navy officials are requiring its replacement with a commercially available or purpose built product capable of providing Navy surface combatants with underwater communications between surface ships and submarines.

The NGG underwater communicator will use existing Navy transducers and established electronic interfaces necessary to transmit and receive single-sideband modulated voice, audio, and continuous-wave signals acoustically through the water. NGG will be a STANAG 1074-compliant system.

Test range sites and other coastal installations also use the AN/WQC-2A to communicate with nearby vessels. This system is installed on most U.S. Navy surface ships and submarines, and transmits and receives voice, audio, and low-speed telegraphy for short- and long-distance underwater communications.

The AN/WQC-2A also can amplify and transmit signals from external sources. Ultra Electronics Ocean Systems in Braintree, Mass., is a longtime supplier of the AN/WQC-2A, with more than 300 sonar sets produced for the U.S. Navy and foreign customers, company officials say.

The AN/WQC-2A consists of a control station, a remote control station, a receiver-transmitter, as well as low- and high-frequency transducers.

On this NGG contract SyQwest will do the work in Cranston, R.I., and should be finished by June 2028. For more information contact SyQwest online at [www.syqwest-inc.com](http://www.syqwest-inc.com), or the Naval Undersea Warfare Center Division Keyport at [www.navsea.navy.mil/Home/Warfare-Centers/NUWC-Keyport](http://www.navsea.navy.mil/Home/Warfare-Centers/NUWC-Keyport).

### RF AND MICROWAVE

#### ▼ Southwest Research to help measure HF radio waves to boost situational awareness

U.S. military researchers needed a company to measure HF radio waves to improve warfighter radio spectrum situational awareness. They found their solution from Southwest Research Institute in San Antonio, Texas.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a \$38.9 million contract to Southwest Research for the Cancun program, which seeks to create distributable nodes to measure high-frequency radio waves for improved warfighter situational awareness.





The low size, weight, power, and cost (SWaP-C) of these nodes will enable cost-effective wide-area deployments. The Cancun nodes will measure the state of the ionosphere using a sounding function, as well as record and relay portions of the HF radio band for analysis.

The primary challenge in Cancun is coordinating many Cancun units deployed over distances farther than 620 miles. Cancun will provide a command and control (C2) network and planning tools to address this challenge.

The C2 hardware solution may involve existing wired or wireless infrastructure. Communications latency will be an important parameter for this network. The mission planning tool will be developed with warfighter input to optimize functionality.

Technologies developed under the Cancun program will move over to the U.S. military services. For more information contact Southwest Research Institute online at [www.swri.org](http://www.swri.org), or DARPA at [www.darpa.mil](http://www.darpa.mil).

#### SOFTWARE

##### ► **Navy chooses Peraton for ocean-forecasting software to predict conditions at sea**

U.S. Navy researchers needed help developing software to predict conditions over, on, and under the ocean's surface for anti-submarine warfare (ASW), search and rescue, amphibious landings, mine warfare, and mission planning. They found their solution from Peraton Inc. in Herndon, Va.

Officials of the Naval Research Laboratory (NRL) in Washington awarded a potential \$45.7 million contract to Peraton for the Ocean Dynamics and Prediction Engineering and Software Development project. The initial contract is worth \$8.9 million.

The ocean forecasting software contract calls for Peraton to develop software to process and analyze data from ocean and atmospheric sensors to determine and predict conditions over the ocean, at the ocean's surface, and under the ocean from the surface to the sea floor.

The company also will handle data collection from near-real time underwater sensors and via remote sensing at high resolution, and assimilate data into 3-D models and multi-horizon extended forecasts.

From Peraton, NRL researchers want an improved understanding of the seabed geologic processes, and geospatial enablement of meteorology and oceanography (METOC) processes that lend themselves to new environmental models for nowcast and forecast systems.

These systems will cover deep ocean basins, marginal and semi-enclosed seas, and coastal regions, including



ocean tide and wave modeling and upper ocean processes, coupled air-ocean wave processes, coupled ocean/acoustic processes, geology, and seabed processes.

The Ocean Dynamics and Prediction Engineering and Software Development project seeks to use this advanced information for Navy missions such as anti-submarine warfare, search and rescue, amphibious landings, mine and special warfare, sea bottom warfare, and mission planning.

Ocean dynamics modeling will incorporate computational numerical techniques and data assimilation approaches, and encompasses data collection from near-real time in-situ underwater sensors or via remote sensing at high resolution to assimilate this data into 3-D models and multi-horizon or extended forecasts.

Peraton will provide NRL researchers with oceanography software and modeling support in remote sensing exploitation; sea surface temperature; ocean and atmosphere coupling and processes; regional ocean circulation; arctic sea ice; ocean acoustics; environmental impacts on sensors; marine geology, geophysics and geodetics with emphasis on understanding seabed geologic processes; geospatial analysis and visualization; and program management.

The company also will develop high-quality data; generate numerical models, algorithms, test cases, and software. Companies chosen will use remote sensing data to determine sea surface temperatures; forecast arctic sea ice; model ocean acoustics throughout the water column; predict environmental impacts on sensors; conduct network-centric sensor analysis for mine warfare; understand seabed geologic processes; perform geospatial analysis and visualization; conduct geospatial environmental analysis and visualization.

On this contract Peraton will do the work at the NRL detachment at John C. Stennis Space Center, Miss., and should be finished by June 2024. For more information contact Peraton Inc. online at [www.peraton.com](http://www.peraton.com), or the Naval Research Laboratory at [www.nrl.navy.mil](http://www.nrl.navy.mil).

### AVIONICS

#### ▼ Collins to demonstrate enhanced vision and image processing for aerial firefighting

U.S. Air Force cockpit avionics experts needed a digital heads-up display (digital HUD) to demonstrate the ability of the C-130J utility aircraft to fight forest fires and fly in close formation in smoke, bad weather, and at night. They found their solution from Raytheon Collins Aerospace.

Officials of the Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, announced a \$5.8 million contract to the Raytheon Technologies Corp. Collins Aerospace segment in Cedar Rapids, Iowa, to demonstrate the Collins EVS-3600 digital HUD aboard an Air Force C-130J aircraft equipped with the Modular Airborne Fire Fighting System (MAFFS).

These aircraft routinely fly low-visibility missions into smoke-obscured mountainous terrain below 1,000 feet closely behind a lead aircraft to drop fire-retardant chemicals that help extinguish forest fires.

MAFFS aircraft also fly operations after sunset, which makes crews susceptible to visual illusions created by the loss of daylight, combined with reduced visibility conditions due to smoke.

MAFFS units fit inside C-130 airplanes without requiring structural modification, and can be loaded on short notice. It takes about two hours to load a MAFFS unit onto the C-130, which then drops fire retardant from an altitude of about 150 feet.

A MAFFS unit can discharge about 3,000 gallons in less than five seconds to cover an area one-quarter of a mile long and 60 feet wide. Today, one Air Force Reserve Command and three Air National Guard locations participate in the MAFFS program.

The 302nd Airlift Wing in Colorado Springs, Colo., is the only Reserve unit. The Guard units include the 145th AW in Charlotte, N.C.; the 146th AW in Channel Islands, Calif., and the 153rd AW in Cheyenne, Wyo. The 302nd AW has two of the MAFFS units and the Guard has two units each for a total of eight systems nationwide.

An enhanced vision system helps air crews see through fog, smoke, dust, blowing sand, and other obscurants, and can improve aircrew situational awareness and safety significantly in these conditions. The Collins EVS-3600 enhanced vision system will improve MAFFS and mobility mission success rates and increase safety margins, Air Force officials say.

The enhanced vision system not only can augment aerial firefighting, but it also can help with military operations such as formation flying, low-level situational awareness, obstacle avoidance, and objective area acquisition in particle-obscured environments.

Collins will create software to display an enhanced vision system on a digital HUD aboard the demonstrate C-130J, permanently replace the analog HUD with the improved digital HUD on the test aircraft, and demonstrate the technology on the aircraft during low-visibility weather conditions like fog, smoke, and heavy rain during the fire-fighting season.

Collins avionics experts will demonstrate formation flying at 1,000 and 1,500 feet while following a lead aircraft similar in size to those used by the U.S. Forest Service.

The Collins enhanced vision system software must be able to verify enhanced visibility in fog or smoke during the day, and during recovery to austere tanker bases with limited-approach lighting systems.

The enhanced vision system software will provide primary flight reference information to the copilot as primary flight

display. Collins experts also will demonstrate three different kinds of sensors — visual, short-wave infrared, and long-wave infrared in video format on the digital HUD, and image processing and data fusion for automatic adjustment of gains.

As the designer, developer, and sole manufacturer of the certified and fielded C-130J digital HUD and compatible enhanced vision system, Collins is the only business with enough detailed knowledge of the design to adequately produce and support this demonstration, Air Force officials say.

For more information contact Raytheon Collins Aerospace online at [www.rtx.com/who-we-are/our-businesses#ca](http://www.rtx.com/who-we-are/our-businesses#ca), or the Air Force Life Cycle Management Center at [www.afclmc.af.mil](http://www.afclmc.af.mil). ◀





## BOARD PRODUCTS

### ► SOSA-aligned data conversion card for embedded computing introduced by Annapolis

Annapolis Micro Systems Inc. in Annapolis, Md., is introducing the WILD FMC+ DME1 data conversion card for demanding embedded computing applications that require direct sampling frequency coverage anywhere from 0.1 to 36 GHz (VHF through Ka-band), and wide instantaneous bandwidths. The WILD FMC+ DME1 card features the Jarjet Technologies Electra-MA chip with 64 gigasamples-per-second 10-bit A/D converter and D/A converter capability. The card aligns to the Sensor Open Systems Architecture (SOSA) open-systems standard. The direct sampling Jarjet transceiver performs frequency conversion and filtering in the digital domain, eliminating the need for costly analog frequency conversion. The embedded computing card has usable analog bandwidth of 36 GHz and a maximum instantaneous bandwidth of 6.4 GHz on both channels simultaneously. All transceiver channels feature onboard digital downconverters and digital upconverters, including sub-band channelizers for dynamic frequency selection. The DME1 is available for use with the Annapolis WILDSTAR 3U OpenVPX baseboards with one WFCM+ mezzanine site, or 6U OpenVPX baseboards with two WFCM+ mezzanine sites. In development are two additional products that also deliver sample rates of 64 gigasamples per second at 10-bit resolution: the WILDSTAR 3AE1 3U OpenVPX baseboard; and the WILDSTAR SAF1 standalone small-form-factor module. For more information contact Annapolis Micro Systems online at [www.annapmicro.com](http://www.annapmicro.com).



of RF signal processing capabilities and expedite the integration of existing applications aligned with the Modular Open Radio Frequency Architecture (MORA) open-systems standard. The design and development platform

uses the hardware-agnostic helux Core from Sciens Innovations in York, Pa., which is a combination of software libraries and firmware modules. Elma's MORA-Ready Development Platform integrates an I/O-intensive processor card, a high-speed Ethernet switch, and a high-performing RF transceiver payload plug-in card to provide interfaces aligned to MORA for the VICTORY Data Bus (VBD) and MORA Low Latency Bus (ML2B). The demonstration platform uses a standard Elma CompacFrame with an 8-slot backplane aligned to SOSA as well as power and chassis management with a range of payload, Ethernet switch, power supply, I/O, and other plug-in cards from a large ecosystem of embedded computing manufacturers. For more information contact Elma Electronic online at [www.elma.com](http://www.elma.com).

## SENSORS

### ► Light-detection sensors for laboratories, factory floors introduced by L-Com

L-com Inc. in North Andover, Mass., is introducing internet of things (IoT) light-detection environmental sensors that gauge either ambient or ultraviolet light. The sensors assist in IoT data collection to streamline process control lower building and process costs.

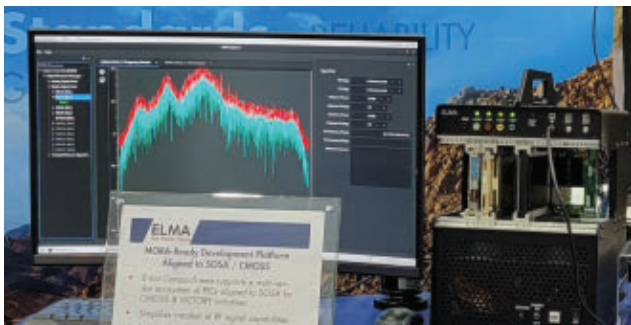
Applications for the light-detection sensors include environmental monitoring, laboratories, factory floors, manufacturing, solar farms, agriculture, and greenhouses. L-com's light sensors measure either ambient light or UV light. The wall-mount ambient light models measure light intensity either to 65,000 Lux or 200,000 Lux. They have a waterproof housing and are well suited for outdoors as well as demanding indoor environments such as factory floors. The UV light model mounts to a DIN rail or a panel and is useful with UV testers, UV index meters, germicidal lamps, flame detection, UV monitoring equipment and other applications. It is sensitive to UV light in the wavelengths of 200 nanometers to 370 nanometers. It has a 4-20 milliamps output and screw-type terminals for easy field termination. The 3-in-1 environmental integrated transmitter measures illuminance as well as temperature and humidity



## DESIGN TOOLS

### ▼ Design and development platform for RF processing offered by Elma

Elma Electronic Inc. in Fremont, Calif., is introducing the MORA-Ready Development Platform to simplify design

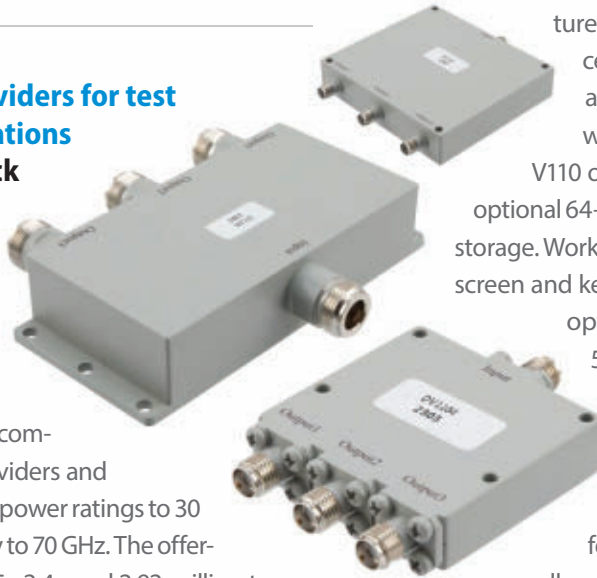


for outdoors and for demanding indoor environments such as solar farms and industrial automation. The IoT light-detection environmental sensors are contained in a weatherproof, wall-mount housing, and its output is via the popular Modbus protocol. For more information contact L-com online at [www.l-com.com](http://www.l-com.com).

### RF AND MICROWAVE

#### ► RF couplers, power dividers for test and satellite communications introduced by Pasternack

Pasternack, an Infinite Electronics brand in Irvine, Calif., is introducing RF power dividers and RF couplers for test and instrumentation, telecommunications, satellite communications, and wireless communications. The RF power dividers and RF couplers feature maximum power ratings to 30 Watts and operating frequency to 70 GHz. The offering provides SMA, N-type, 1.85-, 2.4-, and 2.92-millimeter connectorized options as well as 3-way, 4-way, and 8-way configurations. Pasternack's RF power dividers are designed to break an input signal into two or more output signals with a specific phase and amplitude. The RF couplers sample high-frequency signals by taking one signal as the input while providing two outputs — one being the regular output and the other being the coupled output. For more information contact Pasternack online at [www.pasternack.com](http://www.pasternack.com).



UX10 rugged laptop offers 8 gigabytes of DDR4 RAM, with an option of 32 gigabytes, and a 256-gigabyte PCI Express NVMe solid-state drive, with an option of as much as 1 terabyte. Connectivity features include Bluetooth 5.3, Intel Wi-Fi 6E AX211, Thunderbolt 4 Type-C, and optional 4G LTE or 5G

Sub-6 support. The V110 rugged laptop features a 12th Generation Intel Core processor and Intel Iris Xe graphics, with an 11.6-inch LumiBond touchscreen with 1,000 nits of brightness. The V110 offers dual hot-swappable batteries, optional 64-gigabyte DDR4 + 2 terabytes of data storage. Users can switch quickly between touchscreen and keyboard-based inputs. Connectivity options include Wi-Fi 6E, Bluetooth 5.3, optional 4G LTE/5G Sub-6 and GPS, while Thunderbolt 4 Type-C enables fast data transfer and connection with other devices. Users can switch between two different carrier networks without physically swapping SIM cards. The mil-spec V110 meets MIL-STD-810H, MIL-STD-461G, and IP65 certifications, and protect the machine from knocks, drops, spills, and vibrations, while optional ANSI/UL 12.12.01 and salt fog resistance also are available. Both models offer security features like the Microsoft suite of authentication tools, TPM2.0, smart card reader, and optional Intel vPro, fingerprint reader, RFID, and Windows Hello Webcam. For more information contact Getac online at [www.getac.com/us/products/laptops](http://www.getac.com/us/products/laptops).

### RUGGED COMPUTERS

#### ► Rugged mil-spec tablet and laptop computers introduced by Getac

Getac Technology Corp. in Irvine, Calif., is introducing the UX10 rugged tablet and V110 rugged laptop computers for challenging work environments like the military, public safety, and public utilities. The UX10 and V110 offer 12th Generation Intel Core processors, expanded memory and increased storage options, as well as I/O and connectivity options like 5G. The 10.1-inch UX10 rugged tablet offers a choice between 12th Generation Intel Core processors and Intel Pentium Gold processors, to suit different applications, and a LumiBond touchscreen with 1,000 nits of brightness. Additionally the





## SOFTWARE

### ▲ Curtiss-Wright IQ-Core enhancements include visibility of endpoints in secure environments

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is adding enhanced network configuration and management capabilities, device support, better visibility of endpoints in secure environments, and security auditing and management features to the company's PacStar IQ-Core Software unified communications network management solutions. IQ-Core Software v5.1.15 design and development tools offer configuration plan support for selected devices to send plans to a system, compare them against actual device configurations, and then activate a plan for the new configuration. The software also has enhancements to profile templates to enable scriptable configuration of an entire management environment. This version of IQ-Core Software includes updates to expose more critical operating information about industry standard satellite modems and radios to help operators stay within one interface to manage the network. Additional features such as viewing, exporting, alerting for interface and throughput data, and integrated access to a device console help manage any network devices that IQ-Core Software does not support natively. IQ-Core Software has extensive support for the certificate and VPN management needs of Commercial Solutions for Classified (CSfC) secure environments. Enhancements help users accomplish complex tasks that range from infrastructure gateway configuration to secure endpoint management. Updates include enhanced support for continuous monitoring, bulk provisioning, and secure endpoint rekeying. A new audit logging system helps audit and store actions in a secure military-approved manner, and user session control helps terminate inactive sessions are terminated reauthenticate when roles change. IQ-Core Software has support Microsoft Windows Server 2022 and Microsoft Windows 11, in addition to previous versions of Microsoft Windows. For more information contact Curtiss-Wright Defense Solutions online at [www.curtisswrightds.com](http://www.curtisswrightds.com).



## CABLE AND CONNECTORS

### ▼ Micro-coaxial cable for high-frequency applications introduced by Times Microwave

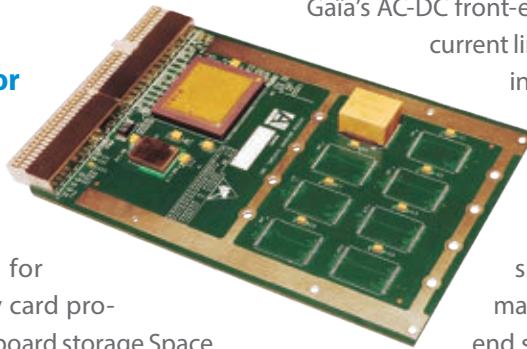
Times Microwave Systems, an Amphenol company in Wallingford, Conn., is introducing the TF-047 micro-coaxial cable for high-density and high-frequency applications that require small size, such as quantum computing, semiconductor test, and mobile devices. The TF-047 is for easy routing in space-constrained areas, with an overall diameter of 0.055 inches and can support tight bends of as much as 0.2 inches. TF-047 is optimized to perform from DC to 50 GHz. The lightweight TF-047 micro-coaxial cable weighs a maximum of 3.77 pounds per 1000 feet, and is available with push-on and threaded connectors. It is for board-to-board, backplane and crossover box-box/inside-the-box connectivity, bench/production tests, troubleshooting setup, signal fanout and ATE in semiconductor manufacturing. The TF-047 will also be useful in quantum computing for external and internal RF lines, and in laptop computers, tablet computers, and audio/video products. For more information contact Times Microwave online at <https://timesmicrowave.com/cables/tf-047-coax-cable/>.



### SPACE ELECTRONICS

#### ► **Radiation-tolerant 3U CompactPCI memory card for space introduced by Aitech**

Aitech Defense Systems Inc. in Chatsworth, Calif., is introducing the S993 radiation-tolerant 3U CompactPCI memory card for space applications. The memory card provides as much as 1 terabyte of on-board storage Space NAND flash with all 8 NAND modules installed. It provides high-capacity non-volatile Flash memory for data storage for in-orbit spaceflight and downlink communications to Earth-bound base stations. The space-rated memory card includes built-in hardware error detection and correction (EDAC) to correct single-bit errors and detect double-bit errors, and offers a low single event upset (SEU)-rate and high latch up immunity. The radiation-tolerant memory board offers Aitech's Flash File Driver (FFD) technology, a POSIX-compliant file system with wear leveling, and semaphore protection. Systems can access the board as a file system from any CompactPCI single-board computer with a Flash File System implemented. The S993 also includes a Flash Translation Layer (FTL) to handle writes and wear leveling, bad block management and garbage collection, offloading this function from the host processors. Future planned interfaces for the S993 includes Space VPX Lite (VITA 78.1) and TSN/TTE Ethernet to extend the number of space applications with access to high-capacity memory storage. For more information contact Aitech online at <https://aitechsystems.com/product/s993-3u-compactpci-non-volatile-memory-board/>.



Gaia's AC-DC front-end modules have a soft-start, active current limitation, short circuit protection, and inhibit function. The soft-start/active current limitation prevents inrush current during start-up. The short circuit protection safeguards the module against short circuits by shutting down and restoring to normal when the overload is removed. Front end series of less than 50 Watts offer two isolated low-voltage outputs. Series stronger than 150 Watts provide non-isolated high voltage output. For more information Gaia Converter online at [www.gaia-converter.com](http://www.gaia-converter.com).

### POWER SUPPLIES

#### ▼ **Harsh-environment DC-DC converters for robotics and industrial power introduced by TDK**

TDK-Lambda Americas Inc. in San Diego is introducing the 300-Watt TDK-Lambda RGC series of ruggedized non-isolated DC-DC converters for use in harsh-environment applications such as robotics, communications, industrial, and portable battery-powered equipment. Operating from an input voltage of 9 to 53 volts, the step-up/step down converters deliver output voltages that can be adjustable from 9.6 to 48 volts or 5 to 28 volts with output currents of as much as 12.5 amps. With a 1/16th brick pinout and measuring 38.1 by 39.4 by 13 millimeters, the DC-DC converters are encapsulated to provide shock and vibration performance to MIL-STD-810G. The five-sided aluminum case reduces radiated electromagnetic interference and enables

### POWER ELECTRONICS

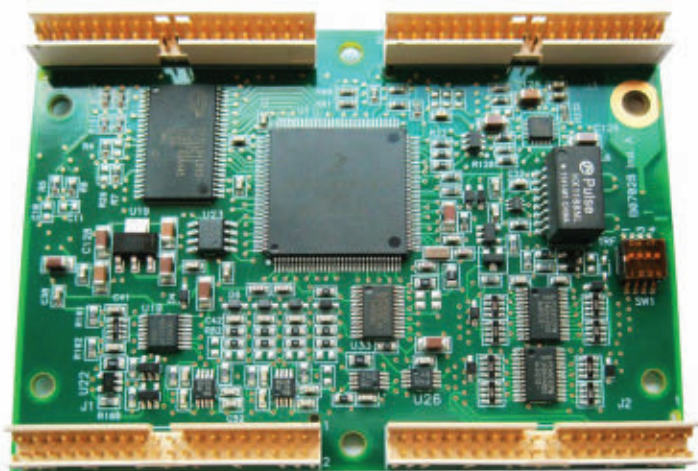
#### ◀ **AC-DC power-factor-corrected front-end converters for airborne power introduced by Gaia**

Gaia Converter in Le Haillan, France, is introducing AC-DC power-factor corrected front-end modules that are compatible with common airborne AC input bus voltages and variable frequencies. These power electronics

devices particularly are suited for use in centralized power architectures with point-of-load or isolated DC modules. In addition, all of the modules meet the stringent requirements of DO-160, ABD-100, and Mil-Std-704 specifications.







conduction cooling to a cold-plate for fanless operation. The RGC series of power supplies comprises of two voltage and current combinations to support operation from 12-, 18-, 24-, 36-, and 48-volt power sources. These devices have efficiencies to 97 percent, and operate in temperatures from -40 to 115 degrees Celsius. The basic-feature models include an output voltage adjustment pin, negative logic remote on-off, remote sense, input under-voltage, over-current and thermal protection. The full-feature models have a power good signal, current monitoring, and the ability to synchronize the operating frequency to minimize system noise. For more information contact TDK Lambda online at [www.us.lambda.tdk.com](http://www.us.lambda.tdk.com).

#### EMBEDDED COMPUTING

##### ▲ Heat-sensing 3U and 6U SOSA-aligned chassis manager offered by Elma

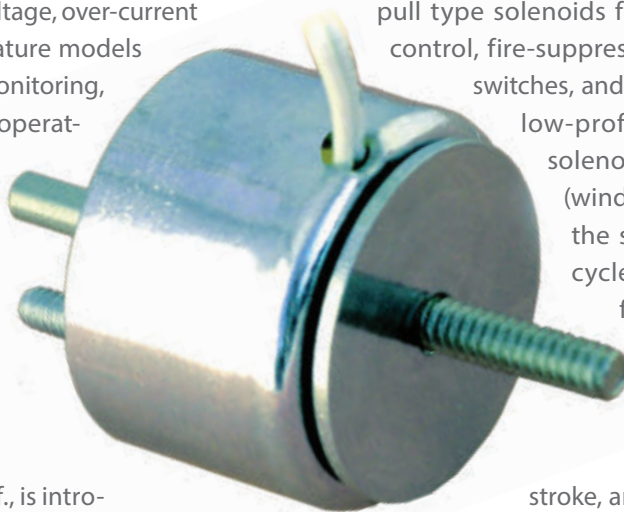
Elma Electronic Inc. in Fremont, Calif., is introducing a VPX chassis manager that aligns with The Open Group Sensor Open Systems Architecture (SOSA) technical standard 1.0 and supports the Modular Open Systems Approach (MOSA) standardization initiative from the U.S. Department of Defense. The VITA 46.11 Tier 3 chassis manager comes as a standalone unit or can be mounted on a carrier card. 3U and 6U conduction-cooled plug-in versions and an air-cooled 3U version also are available. The card offers firewall support and SOSA out-of-band command support as well as 16 digital inputs and 16 configurable digital outputs that provide a high degree of system management function.

For use in military embedded computing applications, the chassis manager helps ensure overall system health and proper operation. This includes maintaining a components and sensor inventory and receiving reports and notices from installed intelligent field replaceable units. The SOSA-aligned chassis manager also can adjust the fan speed for over- and under-temperature conditions and report or shut down the system due to over or under voltage and current conditions. Additional features include power management and cooling control, event sensor logging, electronic keying, and card hot-swap monitoring. The chassis manager offers a redundant Intelligent Platform Management Bus (IPMB), and operates in temperatures from -40 to 85 degrees Celsius. For more information contact Elma Electronic online at [www.elma.com](http://www.elma.com).

#### POWER ELECTRONICS

##### ▼ Clapper push/pull type solenoids introduced by Magnetic Sensor Systems

Magnetic Sensor Systems (MSS) in Van Nuys, Calif., is introducing the S-66-100 series of 18 low-profile clapper push/pull type solenoids for door controls, valve control, fire-suppression systems, clutches, switches, and mixing equipment. The low-profile push/pull clapper solenoids offer ampere turns (windings) adjusted to meet the specific force and duty cycle requirements of different applications. The S-66-100 series solenoids are one inch in diameter, 0.66 inches deep, have a 0.4-inch stroke, and can operate at a variety of voltage-dependent duty cycles.

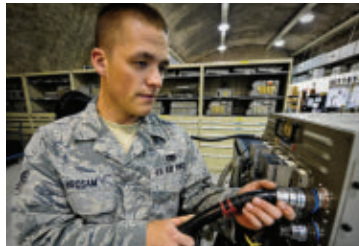


Supplied with four-inch leads, mounting is via two 4-40 UNC or M3 x 0.5 threaded studs 0.25 inches long on a 0.656-inch in-bolt circle. The pull end of the shaft features a 6-32 thread 0.50 inches long. The push end is 0.125 inches in diameter. The device is for short strokes, pull force versus stroke between 0.10 inches and zero stroke range from 75 to 190 ounces at 10-percent duty cycle and from 8 ounces to 118 ounces at 100-percent duty cycle. A low friction brass guide and stainless steel shaft assures long life. For more information contact Magnetic Sensor Systems online at [www.magneticsensorsystems.com](http://www.magneticsensorsystems.com).

### SAFETY-CRITICAL AVIONICS

#### ► Embedded computing companies offer MOSA and FACE safety-critical avionics

DDC-I in Phoenix is working together with North Atlantic Industries (NAI) in Bohemia, N.Y., and Real-Time Innovations (RTI) in Sunnyvale, Calif., to offer a MOSA-aligned SWaP-optimized design system for avionics that seek to adhere to the Future Airborne Capability Environment (FACE) open-systems standards. The multicore design and development tools combine NAI's PowerPC and ARM-based Configurable Open Systems Architecture (COSA) single-board computers and multifunction I/O with DDC-I's Deos' FACE Technical Standard, Edition 3.1-aligned Operating System Segment (OSS) software and RTI's ConnexT software connectivity framework. DDC-I, NAI, and RTI share an approach to building safety-critical avionics that align to the Modular Open Systems Approach (MOSA) open-systems design



guidelines, and that emphasizes modular, scalable, portable DO-178C DAL A certification evidence. Deos uses a DAL A linking loader that enables OS binary components and their artifacts to travel separately. NAI's COSA uses modular, portable components that can be added, removed, and reapplied to other system configurations with maximum reuse of DAL-A artifacts. RTI ConnexT TSS employs an open modular framework with DAL A evidence that provides real-time messaging and information sharing for seamless, safety-critical communications, data exchange and interoperability between FACE applications and Deos. Deos is a safety-critical embedded software real-time operating system (RTOS) that employs cache partitioning, memory pools, and safe scheduling to deliver high CPU utilization on multi-core processors. For more information contact DDC-I online at [www.ddci.com](http://www.ddci.com), North Atlantic Industries at [www.naii.com](http://www.naii.com), or Real Time Innovations at [www.rti.com](http://www.rti.com). ◀

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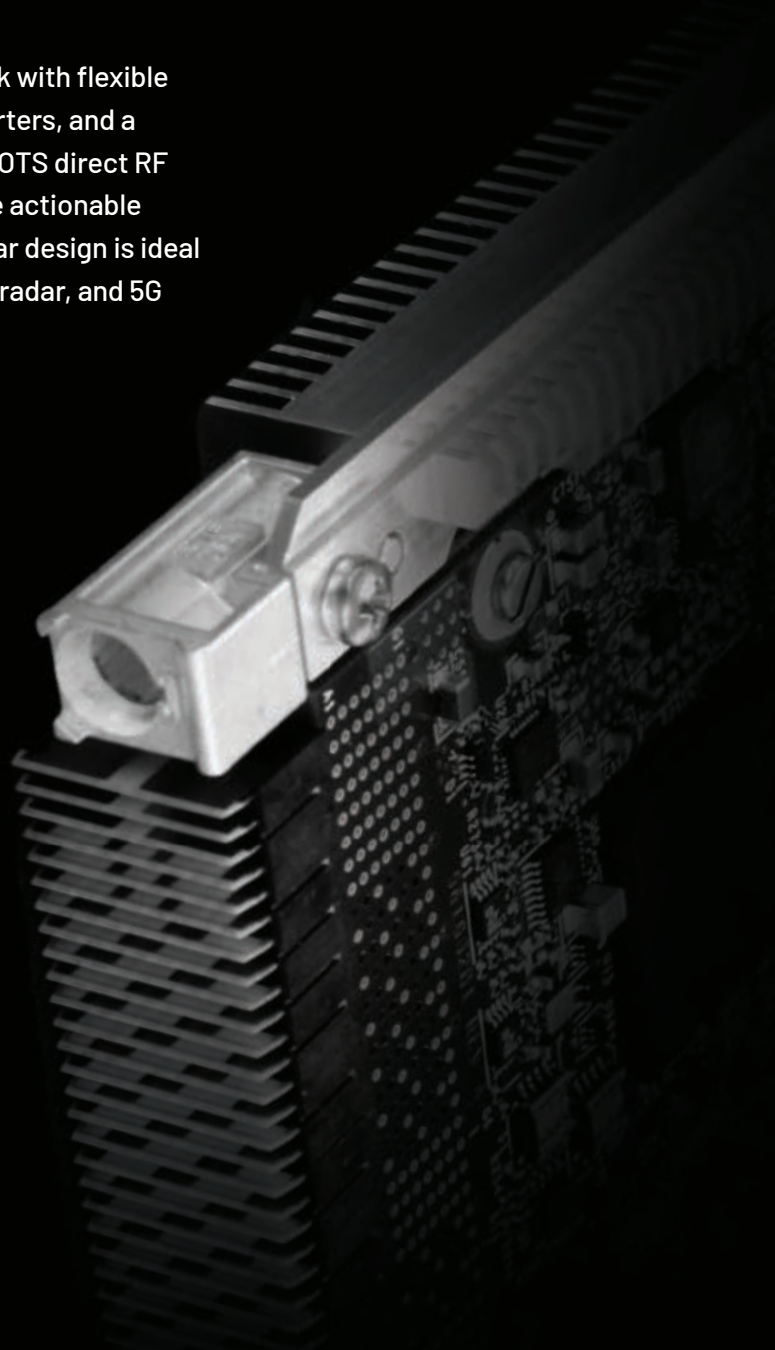
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# FAA asks for industry insights as it looks to link automated systems

BY Jamie Whitney

**WASHINGTON** - The U.S. Federal Aviation Administration (FAA) in Washington is asking industry for information on the agency's Automation Evolution Strategy (AES), which focuses on automation to increase the speed of moving enabling technologies to operational use.

Many FAA automation systems independently maintain hardware, operating systems, and data management tools that generally do not take advantage of shared, infrastructure to optimize costs, scale to meet user demands, and use common data flows to improve air traffic management (ATM) services.

The FAA is seeking input on industry experience with designing, operating, and sustaining software, with a focus on solutions for enterprise scale across multi-vendor industry and government teams.

▲ **These systems generally do not take advantage of infrastructure elements and methodologies that could optimize operating costs or scale to meet dynamic user demands.**

The FAA wants to know about industry approaches to enable software components from different vendors to interoperate and share data and computation services.

The FAA is also interested in industry experience with modern software methodologies and architecture approaches like Agile, DevSecOps, Service Mesh, Cloud Native/Well-Architected Framework.

Inputs on recommended approaches for moving legacy systems to the envisioned Service-Based Architecture Mission Layer is also of interest. In particular, approaches must adopt to agile acquisition. Recommendations for deprecating legacy software and reducing technical debt while continuing service delivery.

The FAA wants to know about enterprise data management for a Service-Based Architecture that includes the following areas of interest:

- **data access:** how best to provide layered, flexible, efficient, simultaneous data access to external and internal end users and services;
- **data consistency:** optimal solutions to maintain data consistency across different operating environments;
- **performance:** ensure scalable performance to handle concurrent requests and high volumes of data;
- **disaster recovery:** ensure data is not lost in the event of a failure;
- **data security:** support for securing data of various levels including ensuring data integrity and protecting sensitive data from unauthorized access while maintaining privacy; and
- **integration:** integration of the data management capabilities with other technologies including enablement of a unified data integration architecture that accounts for metadata to integrate and govern data across different environments.

The FAA is interested in industry experience with providing enterprise platform solutions that can be used for development, integration, testing, and production operations. The platform should support the Mission Layer and Data Management functions described above, including tools to

support modern software methodologies and should insulate application and services in the mission layer from the underlying enterprise-wide compute environments. The FAA also seeks industry experience in deploying a Platform as a Service (PaaS) approach.

The FAA is also seeking industry experience with architecting, providing, and operating the underlying compute solutions, to include hybrid off-premise (e.g., commercial and Gov cloud) and on premise compute environments. In addition, information on industry experience with government systems that have been deployed and are operating in GovCloud is also of interest. The FAA is especially interested in industry experience with technical and business requirements analogous to those of the NAS that includes the need to provide high availability, low latency, high throughput, secure computing with data sources and FAA personnel performing critical functions at locations widely distributed across United States Controlled Airspace. ←

More information can be found at <https://sam.gov/opp/3158fdd42ea54662bb-89f24a70340c12/view>. The contact for this inquiry is David Reynolds, who can be reached via phone at 202-267-0795, or [David.L.Reynolds@faa.gov](mailto:David.L.Reynolds@faa.gov).

## Airbus to trial in-flight auxiliary power entirely generated by hydrogen

**PARIS** - Airbus UpNext in Toulouse, France, is launching a demonstrator program to explore generating non-propulsive energy using hydrogen for power needs aboard commercial aircraft on the ground and in flight.

On conventional airliners, the auxiliary power unit (APU) is a small additional engine that runs on traditional jet fuel to provide energy to power functions like air conditioning, and avionics.

With this new technology demonstrator, Airbus will replace the actual APU of an A330 passenger jet with a hydrogen fuel cell system not only to power onboard electronics, but also to reduce emissions of CO<sub>2</sub>, nitrogen oxides (NO<sub>x</sub>), and noise levels.

New design features and integration techniques also will contribute to maturing the safety and operations of future hydrogen-powered aircraft and will demonstrate the stable operation of a fuel cell in-flight, including its restart.

The flight test campaign will use a modified Airbus A330 and a ground test bed of the system. Airbus UpNext will procure a production unit for renewable hydrogen to fulfill the entire need for the test campaign. ←



**Airbus will demonstrate hydrogen power cell technology to generate onboard electric power on an A330 passenger jet.**





# Voyager Space and Airbus announce joint project to build and operate Starlab

BY Jamie Whitney

DENVER – Voyager Space in Denver and Airbus Defense and Space in Taufkirchen, Germany, announced an agreement to develop, build, and operate Starlab, a commercial space station planned to succeed the International Space Station.

Voyager was awarded a \$160 million Space Act Agreement (SAA) from the U.S. National Aeronautics and Space Administration (NASA) in December 2021 via Nanoracks, part of Voyager's exploration segment.

Part of NASA's Commercial Low Earth Orbit Development Program, this SAA sets the foundation to create Starlab, a continuously crewed, free-flying space station to serve NASA and a global customer base of space agencies and researchers.

The program's mission is to maintain continued human presence and American leadership in low Earth orbit (LEO). The announcement builds on an agreement made public in January

▲ **Starlab will serve as a commercial successor for the International Space Station.**

2023, where Voyager selected Airbus to provide technical design support and expertise for Starlab.

"We are establishing this joint venture to reliably meet the known demand from global space agencies while opening new opportunities for commercial users," says Matthew Kuta, president at Voyager Space.

In addition to the U.S. entity, Starlab will have a European joint venture subsidiary to directly serve the European Space Agency (ESA) and its member state space agencies.

This announcement follows a major design milestone in Starlab's development, the Systems Requirements Review (SRR), which baselines the major space systems, technical readiness, and ability to meet NASA's mission and safety requirements. The Starlab SRR was completed in June 2023 in coordination with NASA's Commercial LEO Development Program team. ←

# Boeing forecasts need for 2.3 million new commercial pilots, cabin crew, and techs in the next 20 years

BY Jamie Whitney

OSHKOSH, Wis. - With the global commercial airplane fleet expected to double by 2042, Boeing in Arlington, Va. announced at the AAA AirVenture show in Oshkosh, Wis., that the company forecasts industrywide demand for 2.3 million new aviation personnel over the next 20 years to support the commercial fleet and meet long-term growth in air travel.

The company's 2023 Pilot and Technician Outlook (PTO) projects that commercial carriers will need significant personnel through 2042 to support the global commercial fleet, including 649,000 pilots, 690,000 maintenance technicians, and 938,000 cabin crew members.

"The demand for training and related services has shown signs of faster recovery, but the industry still faces lingering challenges in meeting the demand. Among them are insufficient training capacity to support significant personnel shortage and the lag time required to bring personnel online while continuing to prioritize safety," the report states.

"To support the recovery and growth driven by expansion of global fleets, the aviation industry will need a long-term strategy that addresses upcoming labor challenges," Boeing writes

in its PTO. "Investment in early career development programs and outreach efforts that spark excitement among future aviators will be essential to a healthy aviation market for years to come."

In the next 20 years, Boeing projects that China, Eurasia and North America drive demand for more than half of new industry personnel, with requirements in China surpassing North America.

The fastest-growing regions for personnel are Africa, Southeast Asia and South Asia, with their regional demand expected to nearly double. After omitting demand for Russia in last year's PTO due to uncertainty in the region, this year's forecast includes Russia in the Eurasia region, and it comprises 3 percent of global demand for personnel. ←

More information is online at <https://www.boeing.com/commercial/market/pilot-technician-outlook/>.

▼ **The 2023 Pilot and Technician Outlook forecasts China, Eurasia and North America representing more than half of demand for aviation staffing through 2042**







# Boeing takes delivery of MD-90 jet to be modified into NASA X-66A experimental aircraft

**PALMDALE, Calif.** - The Boeing Co. in Arlington, Va., has moved an MD-90 single-aisle airliner from Victorville to Palmdale - both in California - where the company intends to develop the aircraft into the National Aeronautics and Space Administration (NASA) newest "X-plane."

The X-66A is NASA's first experimental plane focused on helping the U.S. achieve its goal of net-zero aviation greenhouse gas emissions. Modification will begin soon and ground and flight testing is expected to begin in 2028. The X-66A will test the Transonic Truss-Braced Wing (TTBW) configuration as part of NASA's Sustainable Flight Demonstrator project.

With thin wings braced by struts with larger spans and higher-aspect ratios, the TTBW design and other expected technological advances could lead to reductions in fuel use and emissions by up to 30 percent. Boeing and NASA have collaborated for more than a decade on the concept through the Subsonic Ultra Green Aircraft Research (SUGAR) Program.

"This marks an important step in the Sustainable Flight Demonstrator project, advances Boeing's commitment to sustainability and brings us closer to testing and validating the

▲ **The X-66A is NASA's first experimental plane focused on helping the U.S. achieve its goal of net-zero aviation greenhouse gas emissions.**

TTBW design," says Boeing Chief Technology Officer Todd Citron.

Due to their heavy usage, single-aisle aircraft today account for nearly half of worldwide aviation emissions. Creating designs and technologies for a more sustainable version of this type

of aircraft has the potential for profound impact on emissions.

NASA's history with the X-plane designation dates to the 1940s, when its predecessor agency, the National Advisory Committee for Aeronautics (NACA) jointly created an experimental aircraft program with the Air Force and the U.S. Navy. The X-66A is the latest in a long line of NASA X-planes. Additionally, NASA's Armstrong Flight Research Center in Edwards, California, has provided technical expertise and support for several additional X-planes.

For the Sustainable Flight Demonstrator, NASA has a Funded Space Act Agreement with Boeing through which the agency will invest \$425 million over seven years, while the company and its partners will contribute the remainder of the funding, estimated at about \$725 million. NASA also will contribute technical expertise and facilities. ◀