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Army moves out on cannon that fires hypersonic projectiles for battlefield air defense



BY **John Keller**
EDITOR IN CHIEF

U.S. Army aerial defense experts are working with industry to develop a hypervelocity gun system able to destroy or disable high-priority targets like incoming missiles or mobile weapons launchers.

The future Hypervelocity Gun Weapon System (HGWS) will have three primary parts — a special 155-millimeter cannon able to withstand the pressures of launching munitions at hypersonic speeds; a hypersonic artillery shell with precision guidance; and a radar system able not only to detect incoming threats, but also to communicate with the hypersonic artillery shell to guide it to its targets.

Army experts got the project started in early July by issuing requests for information for the Hypervelocity Projectile (HVP) and the Multi-Function Precision Radar (MFPR). Industry was asked to respond to these initial requests for information by 24 July 2024.

The HGWS is to be a small, flexible hypervelocity projectile able to shoot from an Army M144 155-millimeter howitzer, as well as and Navy 5-inch deck guns on destroyers. The project is run out of the Army Rapid Capabilities and Critical Technologies Office (RCCTO) at Fort Belvoir, Va.

The HVP prototypes must be compatible with the Multi-Function Precision Radar (MFPR) and Hypervelocity Gun Weapon System (HGWS), to be delivered under separate projects. Delivery of the HPV prototypes must be no later than fall 2027, with demonstrations set for 2028.

The HVP prototypes should fire from rifled and smooth-bore 155-millimeter cannons; interface with Army-provided off-board sensors to intercept the incoming threat; interface with a data transmission device to receive pre-launch mission data; maintain projectile maneuverability through interception; keep flight time to a minimum; be powerful enough to shoot down fixed-wing aircraft and helicopters; UAVs; and

cruise missiles. Army officials also are interested in rapid ammunition resupply.

The Multi-Function Precision Radar (MFPR) should perform not only search, detection, and precision tracking of incoming threats, but also provide Army hypervelocity projectiles with the ability via datalink to navigate, fuze accurately, and possibly even provide battle damage assessment.


The multi-function radar would provide accurate and low-latency detection of hostile threats and help guide future Multi-Domain Artillery Cannon System (MDACS) projectiles at long ranges and in bad weather conditions like heavy rain, snow, wind, and dust. MDACS is to be new development program next year for air and missile defense against cruise missiles and unmanned aircraft.

The MFPR must be accurate enough to help the hypervelocity projectile intercept incoming threats. What's significant is the hypervelocity projectile does not have an onboard seeker. Hypervelocity projectiles fly through the air at speeds of 8 or 9 times the speed of sound. Hypersonic munitions and aircraft travel at least five times the speed of sound.

Developing this kind of multi-function radar technology has the potential to help drive down the costs of air- and missile-defense munitions by enabling these weapons to operate without expensive onboard seekers and guidance systems.

The MFPR should perform in an operational band that is available or could be available for military use worldwide; provide precision radar track data to support projectiles in flight via a communications link; provide long-range high-precision angular coverage for search detection; be able to detect threats and friendly projectiles; operable in high-clutter environments; interface with government-furnished command and control; and demonstrate supportability, safety, and cyber security. ◀

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Military researchers eye translating legacy software automatically from C to Rust

BY John Keller

ARLINGTON, Va. – U.S. military researchers are asking industry to find ways of translating old software written in the C programming language automatically to the Rust programming language in efforts to enhance efficiency and resistance to cyber-attacks.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a program solicitation (DARPA-PS-24-20) for the Translating All C TO Rust (TRACTOR) program.

TRACTOR aims to achieve a high degree of automation towards translating legacy C to Rust, with the same quality and style that a skilled Rust developer would employ, in hopes

▲ **TRACTOR aims to achieve a high degree of automation towards translating legacy C to Rust, with the same quality and style that a skilled Rust developer would employ.**

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of permanently eliminating the entire class of memory safety security vulnerabilities present in C programs. Performers might employ combinations of static analysis, dynamic analysis, and large machine learning language models.

The C programming language has been available since 1972, and many military software applications are written in C and its sister more-advanced programming language called

C++. The C language is showing its age, and is vulnerable to modern cyber-attacks.

Rust, on the other hand, has been available since 2015, and emphasizes performance, type safety, and concurrency. It enforces memory safety by pointing to valid memory without a garbage collector. Rust has far fewer cyber vulnerabilities than the older C language, experts say.

Buffer overflow vulnerabilities and other related memory-safety software flaws enable an attacker to inject messages that hijack control of a computer. These vulnerabilities are possible because programs written in C and C++ don't force their developers to check conditions like array bounds or pointer arithmetic for correctness.

Newer languages like Rust can eliminate these kinds of cyber vulnerabilities completely, while preserving efficiency. Still, significant and expensive manual effort is necessary today to rewrite legacy code into Rust.

Although software experts have applied sophisticated tools in efforts to mitigate memory safety issues in C and C++, the software engineering community largely has concluded that bug-finding tools are not sufficient.

TRACTOR has two technical areas: C to rust translation research; and theoretical translation research.

The core technical challenge of translating C to safe idiomatic Rust revolves around the ability of the C programming language to express concepts that are not allowed in safe idiomatic Rust. C programs can do pointer arithmetic or otherwise treat pointers as if they were integers.

Additionally, Rust has restrictions on how to manage mutable state because C programs cannot simply be transliterated into Rust and be expected to work correctly.

In a multi-threaded context, C programs often will include their own concurrency primitives or may depend on machine-specific memory system semantics, while Rust offers structured concurrency features that are safe and portable.

While the specific multi-threaded challenges have not yet been selected, teams should plan on

supporting POSIX-style threads. Similarly, proposals should assume that "C" means "C as compiled by the current LLVM clang compiler." Support for other C compilers is not required.

Theoretical translation, meanwhile, involves multi-threaded C programs that may depend on machine-specific memory semantics, while translating these programs to safe idiomatic Rust with all of Rust's structured concurrency features.

Translation between C concurrency and Rust will require formal modeling tools that enable software developers to reason about equivalence of the translated code. Even defining equivalence in this context is a significant research challenge.

Companies interested were asked to submit abstracts in September to the DARPA Broad Agency Announcement Tool (BAAT) online at <https://baa.darpa.mil/Public/SecurityAgreement>. Full proposals are due by 6 Nov. 2024 to the DARPA BAAT at <https://baa.darpa.mil/Public/SecurityAgreement>.

Email questions or concerns to DARPA at TRACTORTEAM@darpa.mil. More information is online at <https://sam.gov/opp/7f104d07619542f7bf85b2297deeb6b0/view>. ←



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▲ The Army is asking for fixed-site or vehicle-based laser weapons that follow the Modular Open System Architecture (MOSA) design guidelines.

Army asks industry for counter-UAV laser weapons for fixed sites or armored combat vehicles

BY John Keller

FORT BELVOIR, Va. — U.S. Army air-defense experts are reaching out to industry for quick-turnaround mobile- and fixed-site laser weapons that can defend soldiers and equipment from relatively small unmanned aerial vehicles (UAVs) that weigh as much as 1,320 pounds.

Officials of the Army The Rapid Capabilities and Critical Technologies Office at Fort Belvoir, Va., issued a request for white papers —for the Enduring Directed Energy project, which seeks to develop quick-manufacture high-energy laser weapons for integration into common Army air- and missile-defense networks to defeat Groups 1-3 UAVs.

Army officials want industry to build and test a producible and sustainable laser weapon to counter unmanned aircraft that provide the enemy with intelligence, surveillance, and reconnaissance, and attack with submunitions or one-way Kamikaze attacks.

Group 1-3 UAVs are difficult to detect because they are small and fly at low altitudes, Army officials say. Group 1 UAVs like the RQ-11 weigh zero to 20 pounds and fly lower than 1,200 feet. Group 2 UAVs like the ScanEagle weigh 100 to

21 to 55 pounds and fly lower than 3,500 feet. Group 3 UAVs like the RQ-21 Blackjack weigh less than 1,320 pounds and fly lower than 18,000 feet.

Army experts plan to integrate these counter-UAV laser weapons into common Army air- and missile-defense networks. Suggested laser weapons should follow the Modular Open System Architecture (MOSA) design guidelines.

These laser weapons will be for fixed sites, or for existing Army combat vehicles like the JLTV. Weapons should be ready for testing by this fall, and for field testing this spring. A production contract is expected in fall 2025.

The Army will provide the Forward Area Air Defense Command and Control (FAAD C2) interface-control documents, Army-owned platform interface specifications like JLTV.

Companies interested were asked to email 15-page unclassified white papers by August to Hillary Roy at hillary.s.roy.civ@army.mil and Sydney Horn, Agreements Specialist at sydney.m.horn.civ@army.mil and Sydney Horn at sydney.m.horn.civ@army.mil. More information is online at <https://sam.gov/opp/368be0f48bad4fa2a0f7896b9619da92/view>. ◀

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Navy researchers want uncrewed electronic warfare (EW) to disrupt enemy communications

BY John Keller

CRANE, Ind. – U.S. Navy researchers are asking for industry participation in technology demonstrations of small disposable uncrewed vehicles with electronic warfare (EW) payloads able to destroy or disrupt enemy communications, radar, and surveillance sensors.

Officials of the Naval Surface Warfare Center Crane Division (NSWC Crane) in Crane, Ind., issued a special

notice (N0016424SNC23) for the Silent Swarm 2025 project.

This project focuses on distributed electromagnetic attack, deception and concealment, digital payload delivery, resilient communications, and EW support with geolocation.

Reconfigurable and networked uncrewed vehicles that fly, move along the ground, or travel over the water should be able to target enemy RF communications; S-band, X-band, and navigation radar; and enemy intelligence surveillance and reconnaissance (ISR) systems.

The goal is to design distributed capabilities to create chaos and confusion in the RF spectrum by targeting adversary

▼ **Research want to create chaos and confusion in the RF spectrum by targeting adversary situational awareness, command and control, and decision-making.**



situational awareness, command and control, and decision-making that give friendly forces freedom of maneuver.

Silent Swarm focuses on enabling technologies in the technology readiness level (TRL) 2 to 5 range, which refers to technology concepts to breadboard demonstrations in realistic environments.

Researchers are interested in small unmanned vehicles that can mimic signal of interest; have the ability to overwhelm adversary sensors and decision making; and create an RF congested environment to deny the enemy's ability to maintain an accurate picture of the battlefield.

These uncrewed vehicles and EW payloads should be able to manipulate signals received by target sensors, and deny enemy command and control systems; commercial wireless links; tactical networks; defend and attack resilient tactical communications; and deceive enemy networks.

Uncrewed vehicles and payloads should be anti-jam and low-probability of intercept; multi-channel; involve mesh networks; have adaptive bandwidth control; use adaptive radio control; offer millimeter wave communication networks; use-free space optics; and infrared sensors. Payloads should have narrowband and wideband jammers; and sensing and geolocation capabilities.

Systems should have swarming and intelligent algorithms; alternative position, navigation, and timing; and artificial intelligence and machine learning.

Companies interested were asked to submit unclassified white papers in October to the Vulcan website at <https://www.cylitix.com/homepage/about-us/services/innovation-science/vulcan-page/faq-gov202/>. Register for Vulcan online at <https://vulcan-sof.com/login/ng2/auth/login?requestedUrl=%2Fhome>.

Email questions or concerns to the Navy's Robert Gamberg at robert.d.gamberg.civ@us.navy.mil or Michelle Kitley at michelle.kitley1@navy.smil.mil. More information is online at <https://sam.gov/opp/a5dd0cb585a24748a96a1adc52ef8006/view>. ←

Air Force asks Northrop Grumman for AESA radar systems in F-16 jet fighter aircraft

U.S. Air Force aerial warfare experts are ordering additional modern active electronically scanned array (AESA) radar for F-16 jet fighter aircraft under terms of an \$16.7 million 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 production radars and spare parts. This order brings the total value of this AESA radar contract to \$1.6 billion. 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

Continued on page 14

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NASA selects eight companies as part of its Commercial SmallSat Data Acquisition Program

BY Jamie Whitney

WASHINGTON—The U.S. National Aeronautics and Space Administration (NASA) in Washington has awarded contracts to eight companies to help the agency acquire Earth observation data and provide related services.

NASA has awarded contracts worth as much as \$476 million under the Commercial SmallSat Data Acquisition Program On-Ramp1. The firm-fixed-price, indefinite-delivery/indefinite-quantity contracts will run through 15 Nov. 2028, and involve several companies tasked with providing Earth observation data to support NASA's scientific research.

The selected contractors are BlackSky Geospatial Solutions Inc. in Herndon, Va.; ICEYE US Inc. in Irvine, Calif.; MDA Geospatial Service Inc. in Richmond, British Columbia; Pixxel Space Technologies Inc. in El Segundo, Calif.; Planet Labs Federal Inc. in Arlington, Va.; Satellogic Federal LLC in Davidson, N.C.; Teledyne Brown Engineering Inc. in Huntsville, Ala.; and The Tomorrow Companies Inc. in Boston.

BlackSky will offer data from its Spectra platform, which combines satellite imagery and AI-enabled analytics to provide real-time monitoring and anomaly detection. "Adding BlackSky's space-based intelligence products to NASA's research data repository provides yet another valuable proof point of government demand for real-time,

▲ Contracts will run through November 2028, and involve several companies tasked with providing Earth observation data to support NASA's scientific research.

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dawn-to-dusk monitoring capabilities," said Brian E. O'Toole, BlackSky CEO.

ICEYE will supply synthetic aperture radar (SAR) data, which can capture precise Earth surface measurements regardless of weather or light conditions. "NASA's Earth Science objectives are invaluable for exploring and protecting our planet. We remain grateful for the opportunity to continue supporting NASA's mission with our data," said Eric Jensen, CEO of ICEYE US.

Pixxel, based in California, will provide hyperspectral imaging data, which captures detailed information across numerous wavelengths. "Being selected for this NASA contract is a monumental achievement for Pixxel and further validates that hyperspectral imaging will be integral to the future of space-based Earth observation," said Awais Ahmed, Pixxel CEO.

These contracts will help NASA augment its Earth observation capabilities by leveraging commercial data to support a wide range of research applications. ◀



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NOAA eyes replacing ageing WSR-88D NEXRAD weather radar to warn of tornadoes and thunderstorms

BY John Keller

WASHINGTON – U.S. weather forecasters are beginning the long process of replacing the nation's network of NEXRAD WSR-88D weather radar systems, and are approaching industry for suggestions on the best available enabling technologies to do so.

Officials of the National Oceanic and Atmospheric Administration's National Weather Service (NWS) in Washington

issued a request for information (NOAANWSNEXT) for the Weather Radar Technologies and Concepts of Operations for the National Weather Service project.

NEXRAD — developed in cooperation by the NEW, U.S. Department of Defense (DOD), and Federal Aviation Administration (FAA) — detects, processes, and displays hazardous and routine weather information using Doppler

weather radar systems that detect and produce more than 100 different long-range and high-altitude weather observations on precipitation, winds, and thunderstorms.

NEXRAD, in operation since the early 1990s, helps provides location, time of arrival, and severity of weather conditions to determine the best routing for aircraft, and helps warn the public about approaching severe weather like tornadoes and thunderstorms, as well as damaging winds.

Yet NEXRAD is nearly four decades old, and has exceeded its original 20-year design life. Although the system has been upgraded, NEXRAD still has more than 4,000 components that face obsolescence and supply chain challenges, putting the system at an increasing risk of long or possible permanent failures. NEXRAD is a product of Unisys Corp. in Blue Bell, Pa., which won a government contract to build the system in 1990 after prevailing over Raytheon.

NOAA leaders have decided it's time to replace NEXRAD to prevent disruption in the Nation's weather radars due to aging infrastructure; expand radar coverage; and create a network of radars that are flexible and scalable.

The current national weather radar system is a combination of the NEXRAD radar system and other sensors like the Automated

▼ **NEXRAD — developed in the early 1990s — detects, processes, and displays hazardous and routine weather information using Doppler weather radars.**



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NOAA experts are exploring existing and cutting-edge technologies to advance future weather surveillance Doppler radar capabilities. From industry, NOAA is looking for commercial radars with weather detection capabilities. Experts want to know the radar's maturity level, frequency bands of operation, and future deployment timelines.

Of these weather radar technologies, NOAA would like to know plans for improvement over the current NEXRAD WSR-88D radar network, in terms of software and hardware.

Of particular interest are approaches to reduce the radar's volume scan period to increase lead times and lower false alarm rates for severe weather like flash floods and tornadoes, with no degradation in performance.

NOAA also is interested in low-elevation scanning, mitigating ground clutter, maintaining low interference between beams, and the ability to incorporate data from other meteorological sensors. Officials also are interested in radar digital signal processing capable enough to filter out complex interference from wind turbine farms.

Companies interested were asked to email responses in September to Kevin Boom at Kevin.J.Boom@noaa.gov; Dan Hoffman at Daniel.T.Hoffman@noaa.gov; and Holly Ferguson at Holly.Ferguson@noaa.gov. More information is online at <https://sam.gov/opp/48f9f8bc90d64d44a885acad343a1bb1/view>. ←

Continued from page 9

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. On this order Northrop Grumman will do the work in Linthicum Heights, Md., and should be finished by May 2031. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com/who-we-are/business-sectors/mission-systems, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Innovative instrument reveals hidden features deep inside the Van Allen radiation belts

A new instrument is using advanced detection techniques and leveraging an orbit with specific characteristics to increase our understanding of the Van Allen belts—regions surrounding Earth that contain energetic particles that can endanger both robotic and human space missions. Recently, the instrument provided a unique view of changes to this region that were brought on by an intense magnetic storm in May 2024. Accurately measuring energetic electrons has long been a challenge, particularly in the inner radiation belt, where protons with energies ranging from MeV to GeV are also present. NASA's Van Allen Probes, which operated from 2012 to 2019 in

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low-inclination, geo-transfer-like orbits, revealed that instruments passing through the core of the inner belt can be affected by highly energetic protons in the region. Despite being heavily shielded, the Relativistic Electron Proton Telescope (REPT) and the Magnetic Electron and Ion Spectrometer (MagEIS) onboard the probes still experienced proton contamination. To address this issue, a team from the University of Colorado Boulder, led by Dr. Xinlin Li, developed the Relativistic Electron Proton Telescope integrated little experiment (REPTile), a simplified, miniaturized version of REPT, for deployment on the Colorado Student Space Weather Experiment (CSSWE). Supported by the National Science Foundation, the CSSWE CubeSat, a 3-Unit CubeSat, operated in a highly inclined low Earth orbit (LEO) from 2012 to 2014. This orbit limited proton exposure to the South Atlantic Anomaly (SAA), where Earth's magnetic field is weaker, significantly reducing proton interference with electron measurements.

Leidos to help Air Force defend military avionics and sensors from enemy cyber-attacks

U.S. Air Force researchers needed new ways to identify and mitigate vulnerabilities to avionics from cyber-attacks. They found a solution from Leidos Inc. in Reston, Va. Officials of the Sensors Directorate of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced a \$6.1 million contract to Leidos for the Radio Frequency (RF) Electronic Warfare (EW) Focused Laboratory Evaluations of Critical Technologies (REFLECT) program. REFLECT also seeks to develop simulation capabilities necessary to develop advanced sensors and avionics technologies, develop agile electronics architecture, and expand emerging open-systems standards for military weapons. The goal is to explore new and emerging technologies related to fending-off cyber-attacks, cyber security, open system architectures, avionics, and sensors. Leidos joins SRC Inc. in North Syracuse, N.Y.; and the BAE Systems Space & Mission Systems segment in Boulder, Colo. on the REFLECT program. SRC won a \$60 million contract in April, and BAE Systems won a \$30 million in June. REFLECT avionics involve manned, unmanned, autonomous, and remotely piloted vehicles; on-board intelligence, surveillance, and reconnaissance (ISR) systems; EW systems, and

munitions. The specific focus is on advanced RF and digital EW simulations, threat models, sensor evaluations, and cutting-edge technology development in the RF domain. For more information contact Leidos online at www.leidos.com; SRC at www.srcinc.com; BAE Systems Space & Mission Systems at www.baesystems.com/en-us/capability/space-systems, or the Air Force Research Laboratory at www.afrl.af.mil.

Northrop Grumman to upgrade E-2D avionics, mission computers, and displays

Aircraft designers at Northrop Grumman Corp. will handle the second phase of a major cockpit avionics upgrade of the U.S. Navy E-2D Advanced Hawkeye carrier-based radar surveillance and early warning aircraft under terms of a \$845.5 million order. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Northrop Grumman Aeronautics segment in Melbourne, Fla., to overhaul the E-2D's integrated navigation and controls, display systems, tactical mission computers, and display systems, as part of the aircraft's cockpit technical refresh and theater combat identification project. Northrop Grumman will replace the current E-2D Integrated Navigation and Controls and Display Systems (INCDS) and tactical mission computer and display systems as part of this avionics upgrade contract. The Navy Northrop Grumman E-2D is a tactical airborne early warning (AEW) aircraft designed to operate from aircraft carriers. The twin-engine turboprop aircraft has a distinctive antenna, and provides the carrier battle group with wide-area radar surveillance for enemy monitoring and combat air traffic control. The E-2D Group 2 Plus aircraft has avionics upgrades that include GPS satellite navigation in the aircraft's weapon system. It also has an upgraded mission computer and engines, compared to earlier models of the E-2D. The plane's large saucer-like radar antenna mounted to the top of the aircraft, as well as other advanced avionics, enables it to detect hostile aircraft and missiles at extremely long ranges and vector Navy aircraft to intercept. For more information contact Northrop Grumman Aeronautics online at <https://www.northropgrumman.com/who-we-are/business-sectors/aeronautics-systems>, or Naval Air Systems Command at www.navair.navy.mil. ◀

Laser, and other

U.S. military forces are well-along with demonstrating the value of directed-energy weapons such as laser weapons, high-power microwaves for tasks like counter-uncrewed systems in the air and at sea.

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microwave, directed-energy weapons ready for the battlefield

BY Jamie Whitney

Perhaps no technology has shaped the 21st-century battlefield as profoundly as the drone. These uncrewed aerial vehicles (UAVs), along with their land and sea counterparts, have redefined the way wars are fought by providing military forces with unprecedented capabilities in surveillance, precision targeting, and intelligence gathering -- all while reducing the risk to their own personnel. Drones have made complex operations more efficient and less costly, enabling militaries to strike with pinpoint accuracy and maintain a persistent presence over the battlefield.

As the century progresses, the influence of drones continues to expand beyond traditional state actors. Non-state groups and non-peer adversaries increasingly have adopted this technology, leveraging it to level the playing field in conflicts around the world. With commercial drones becoming more accessible, these actors can conduct reconnaissance, drop bombs, and challenge conventional military forces in ways that previously were unimaginable.

The influence of drones flows across all domains of warfare. Loitering munitions, or "Kamikaze drones," have disrupted

traditional force structures by providing smaller, more agile units with the ability to strike high-value targets such as tanks, artillery, and command centers.

Meanwhile, underwater drones and ground robots are expanding the reach of unmanned warfare to new environments, further cementing their role in the future of conflict. Now, the U.S. Department of Defense (DOD) and allies are looking once again to gain the upper hand with a relatively low-cost alternative counter-UAS of their own in the form of laser and other directed-energy weapons.

Conflicts that involve drones in areas such as the Red Sea, the Gulf of Aden, and Bab al-Mandeb Strait, are wreaking havoc on U.S. military forces and commercial shipping.

Likewise, Iran and the Lebanese Islamist political and paramilitary group Hezbollah have used drones to attack Israel as part of their support for Hamas in the besieged Gaza Strip following the deadly Hamas attacks on 7 October 2023. The Houthis likewise justified their attacks as a show of solidarity with Palestinians.

In late 2023, the DOD reported that U.S. Navy destroyers shot down nearly 40 drones and several missiles in the Red Sea.



▲ In 2021, the U.S. Army tested 50-kilowatt laser weapons mounted on Stryker combat vehicles.

While the Navy has succeeded in stopping uncrewed air and sea vehicles, they come at a steep financial cost.

It is estimated that Iranian-made drones cost approximately \$2,000 each. While the DOD – citing operational security – has not disclosed what it is using to destroy the Houthi weapons, it is believed to employing the Standard Missile-2, which costs approximately \$2.1 million per shot.

“That quickly becomes a problem because the most benefit, even if we do shoot down their incoming missiles and drones, is in their favor,” says Mick Mulroy, a former DOD official and Central Intelligence Agency (CIA) officer. “We, the U.S., need to start looking at systems that can defeat these that are more in line with the costs they are expending to attack us.”

Speed of light

Lasers -- an acronym for light amplification by stimulated emission of radiation -- have been penciled in by fiction writers as the future weapons in use across galaxies in sci-fi stories. While lasers have been in use in civilian and military applications since the technology was developed in 1960, the deployable “ray gun” remained out of reach until about a decade ago. In 2014, the U.S. Navy outfitted its Austin-class amphibious transport dock USS Ponce with the AN/SEQ-3 Laser Weapon System (LaWS), which was made by Kratos Defense & Security Solutions, Inc. in San Diego.

The AN/SEQ-3 is a 30-kilowatt solid-state ship-mounted laser developed to neutralize a range of low-level threats like small boats and drones. LaWS converts electrical energy from the ship

into a focused beam of light that can be aimed at critical components of a target, such as engines or sensors, to incapacitate or destroy it. LaWS causes structural damage or detonates explosive materials onboard the target by delivering an overwhelming amount of heat. Unlike traditional kinetic weapons that rely on impact and shrapnel, LaWS employs directed energy to burn through parts of the target.

LaWS offers versatility by allowing operators to adjust its power levels. It can operate at lower intensities to dazzle or disable sensors, or at higher intensities to destroy threats. The system tracks targets through optical systems and can engage them over several kilometers with precision, providing a reliable solution for defending against several low-cost threats.

Integrated with the ship’s radar and fire control systems, LaWS operates at the speed of light, enabling rapid response to emerging threats. Its precision targeting minimizes collateral damage, making it well-suited for complex and populated environments.

LaWS was developed as a prototype to test the feasibility of laser weapons in the ocean environment, and the Navy moved forward with the development and deployment of a higher-powered system produced by Lockheed Martin’s Laser and Sensor Systems division in Bothell, Wash.

Dubbed the High Energy Laser with Integrated Optical Dazzler and Surveillance (HELIOS) system, it has at least double the power of its predecessor. The company said HELIOS was rated at more than 60 kilowatts. Although the specifics of HELIOS remain classified, it may see potential increases to 100 or 150 kilowatts for future deployments. The system will also

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▲ The AN/SEQ-3 Laser Weapon System aboard USS Ponce

feature a lower-power optical dazzler for disrupting intelligence and reconnaissance sensors. The system was installed on the USS Preble, an Arleigh Burke-class destroyer, after delivery in 2022.

U.S. Secretary of the Navy, Carlos Del Toro, told Congress at a hearing earlier this year that “We’ve accelerated the development and the testing of the HELIOS laser program ... We also have six other laser projects and high energy projects, some of which are classified. And I can’t talk about openly. But this is a high priority area for us. We obviously well into the future, cannot continue to shoot down drones which simply SM2 and SM6, we need to develop the high energy, high lasers and directed-energy programs to be able to counter these air drones that are being shot at us as well.”

“Lockheed Martin and the U.S. Navy share a common vision and enthusiasm for developing and providing disruptive laser weapon systems,” says Rick Cordaro, vice president of Lockheed Martin Advanced Product Solutions. “HELIOS enhances the overall combat system effectiveness of the ship to deter future threats and provide additional protection for sailors, and we understand we must provide scalable solutions customized to the Navy’s priorities. HELIOS represents a solid foundation for incremental delivery of robust and powerful laser weapon system capabilities.”

Earlier this year, Navy Secretary Del Toro told attendees at the McAleese Defense Programs Conference in Washington that

directed-energy weapons are key to his top goal of strengthening maritime dominance.

“It is an exciting time for new technologies in our Navy and Marine Corps,” Del Toro told attendees. “Our amphibious ships play a crucial role in testing and validating our newest directed-energy weapons technology, including the Laser Weapon System Demonstrator (LWSD). USS Portland (LPD 27) was fitted with LWSD and engaged a marine target in the Gulf of Aden.

He continued, “And while I was in San Diego last month, I visited USS Preble (DDG 88), fitted with the HELIOS laser weapon system. Directed energy weapons, including high-energy lasers, are the future of warfare -- offering a lower cost-per-shot against air and missile defense engagements.”

In the field

The U.S. Army have also deployed a directed-energy system of its own aimed at keeping soldiers safe from UAVs and rockets, artillery, and mortars.

In 2021, the Army tested 50-kilowatt laser weapons mounted on Stryker combat vehicles, conducting additional evaluations. The Army tested the Maneuver-Short Range Air Defense (M-SHORAD) system, developed by Raytheon, which features a vehicle-mounted laser powered by a gasoline generator.

In collaboration with Kord Technologies, a subsidiary of KBR located in Huntsville, Ala., the Army integrated the high-energy laser onto an eight-wheeled Stryker vehicle produced by General

Dynamics Land Systems in Sterling Heights, Mich. During the 2021 trials at White Sands Missile Range in New Mexico, the laser system tracked, targeted, and neutralized 60-millimeter mortar rounds and drones of varying sizes. This achievement is part of an ongoing effort to equip more powerful lasers on smaller, more mobile platforms.

The M-SHORAD system also demonstrated how laser weapons can integrate into broader command and control networks. While it includes its own radar system, it also can connect to the air surveillance data provided by the Terminal High Altitude Area Defense Command and Control system (THAAD C2), enhancing situational awareness and coordinated defense efforts.

“There’s no doubt lasers will be on the future large-scale ground combat battlefield so it’s great to see these initial prototypes to gain understanding of its capabilities and think through where these capabilities will fit into our organizations, the impact on how we fight, and understand how we need to adjust our doctrine,” says Army Maj. General Ken Kamper, commanding general of the Fires Center of Excellence in 2022. “The laser, as part of a necessary layered set of capabilities against threat unmanned aircraft systems, has tremendous potential.”

HEL on wheels

This spring, BlueHalo in Arlington, Va., won a four-year support contract for the Army’s Palletized High Energy Laser (P-HEL) system. The system, which is based on BlueHalo’s LOCUST LaWS, is in use to counter small UAVs. LOCUST is a short-range air defense system designed for quick deployment and mobility.

The self-contained laser is built to handle all aspects of beam control, power management, thermal regulation, and safety. The system transports on standard equipment such as forklifts or pickup trucks and runs on an internal power-management system. The LOCUST LWS features modular components that operators can service or replace in the field. It operates through a single-operator interface using

familiar Xbox-style controls. Setup features an integrated checklist that brings the system to full operational status within 15 minutes of powering up.

The mobility of HEL systems adds a significant tactical advantage, enabling these systems to accompany ground forces and provide a protective shield in dynamic combat environments. Mounted on wheeled or tracked vehicles, these systems can move with troops and deliver air defense against threats



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that would otherwise overwhelm static defenses. By enabling real-time engagement of several threats, P-HEL systems enhance force protection and operational flexibility.

The laser offers scalable output, ranging from two to 20 kilowatts, enabling it to engage a wide range of airborne threats, including drones and projectiles. The system's radar, a pulse-Doppler array, provides full hemispheric coverage and is capable of supporting counter-unmanned aerial systems, air defense, and detection of incoming hostile fire. Even in the event of a laser amplifier failure, the system continues to operate with reduced power.

Target tracking is handled by a specialized camera with zoom optics and a laser rangefinder, allowing for precise engagement of moving threats. The system's sensors provide high-definition imaging for day and night use, and its thermal and power management systems allow for extended operation in various environments. Powered by batteries, generators, or external power sources, BlueHalo says LOCUST is capable of continuous laser firing for extended periods and can operate for up to 24 hours in tracking mode.

"With this contract, BlueHalo is now providing full-scale Directed Energy support to our customers—at home through advanced innovation, in the field through maintenance and training support, and strategically through operational guidance and battlespace management," says Jonathan Moneymaker, BlueHalo Chief Executive Officer.

This spring, Doug Bush, the Army's head of acquisitions, told



▲ The Tactical High-power Operational Responder, or THOR, a high-powered microwave counter drone weapon, stands ready to demonstrate its effectiveness against a swarm of several targets.

Forbes that the Army had used laser weapons in the Middle East to take down hostile drones. Bush, who was nominated and confirmed as the Assistant Secretary of the Army for Acquisition, Logistics and Technology, declined to inform Forbes what laser system earned the kills, though the P-HEL as been in use overseas since November 2022.

Microwave mindset

Beyond lasers, directed-energy technologies also include microwave weapons. These function by emitting concentrated bursts of electromagnetic energy at microwave frequencies.



▼ BlueHalo's LOCUST LaWS is the basis for the U.S. Army's Palletized High Energy Laser (P-HEL) system.

Microwave systems utilize non-ionizing radiation, which doesn't ionize atoms but is effective in disrupting electronic circuits and components. This may prove especially effective at combating swarms of drones.

One microwave weapon garnering attention is the Tactical High-Power Operational Responder (THOR), which is being developed by the U.S. Air Force Research Lab to combat the rising threat of swarming drones. When a swarm of drones is detected, THOR emits a wide-area burst of microwave energy that disables several drones simultaneously, making it highly effective against coordinated, large-scale drone attacks that are designed to overwhelm conventional defenses.

THOR's primary strength lies in its ability to engage several targets at once. While laser systems require precise aiming and can engage one target at a time, THOR's microwave pulses affect all drones within its range, neutralizing swarms efficiently. By disabling drones' electronic systems, THOR avoids the need for physical projectiles, reducing collateral damage and eliminating the need for kinetic engagement.

The system is highly deployable and simple to operate, designed to be mounted on various platforms, including vehicles

or ground-based installations. THOR's microwave emitter is rapidly directed at incoming threats, making it highly responsive in dynamic combat scenarios. With an effectively unlimited magazine, constrained only by its power supply, THOR offers a continuous defense solution without the need for ammunition resupply.

Microwave weapons rely on devices like magnetrons, klystrons, or other microwave generators to convert electrical energy into high-frequency microwave pulses. These devices create intense electromagnetic fields, which are harnessed to produce directed microwave energy. The microwaves are channeled through an antenna or waveguide to create a concentrated beam. Depending on the system's design, this beam can be narrow for precise targeting or wider to impact several targets simultaneously.

In 2023, the AFRL put THOR to the test against a swarm of UAVs at Kirtland Air Force Base in New Mexico, and observers were impressed with what they saw from the demonstration of the microwave weapon.

“The THOR team flew numerous drones at the THOR system to simulate a real-world swarm attack,” says Adrian Lucero, THOR program manager at AFRL’s Directed Energy Directorate. “THOR has never been tested against these types of drones

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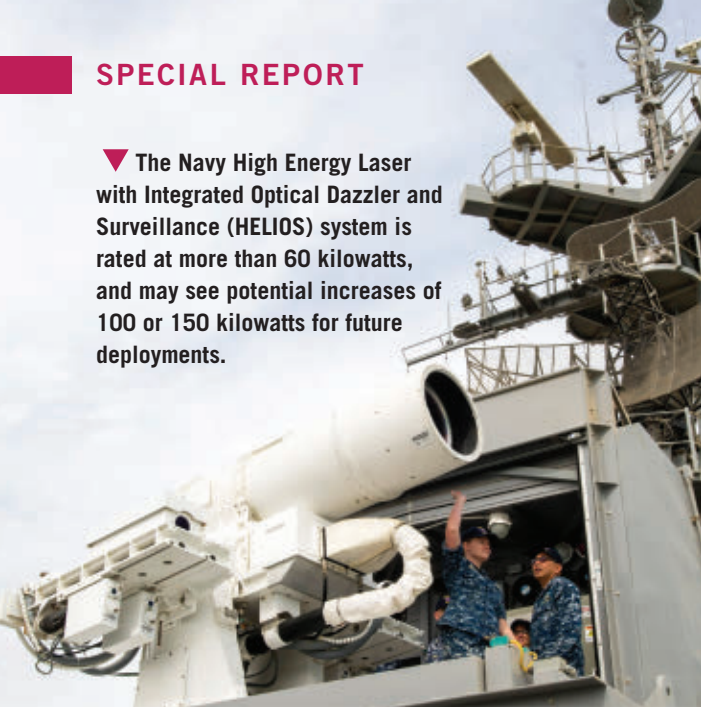
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▼ The Navy High Energy Laser with Integrated Optical Dazzler and Surveillance (HELIOs) system is rated at more than 60 kilowatts, and may see potential increases of 100 or 150 kilowatts for future deployments.



before, but this did not stop the system from dropping the targets out of the sky with its non-kinetic, speed-of-light High-Power Microwave, or HPM pulses,” he says.

“We couldn’t have come this far without the perseverance and professionalism of the entire THOR team,” says Ken Miller, AFRL’s high power electromagnetics division chief. “Our scientists, Airmen and contractors worked early mornings and late nights to make this swarm demo...a great success.”

Work to do

In addition to the DOD wanting to bring down the cost of developing and deploying directed-energy weapons, the military notes that there is a lot to be desired in terms of efficacy if

military branches are looking to utilize lasers where traditional air defenses are currently in use.

Earlier this year at the annual Surface Navy Association symposium, Vice Adm. Brendan McLane remarked that he was in favor of getting more directed-energy systems on more ships in short order.

“I am not content with the pace of directed-energy weapons. We must deliver on this promise that this technology gives us,” McLane told a crowd at earlier this year. “I really want to put a lot of effort into accelerating [directed energy] because that gives us so much when it comes to magazine capacity and in speed and distance.”

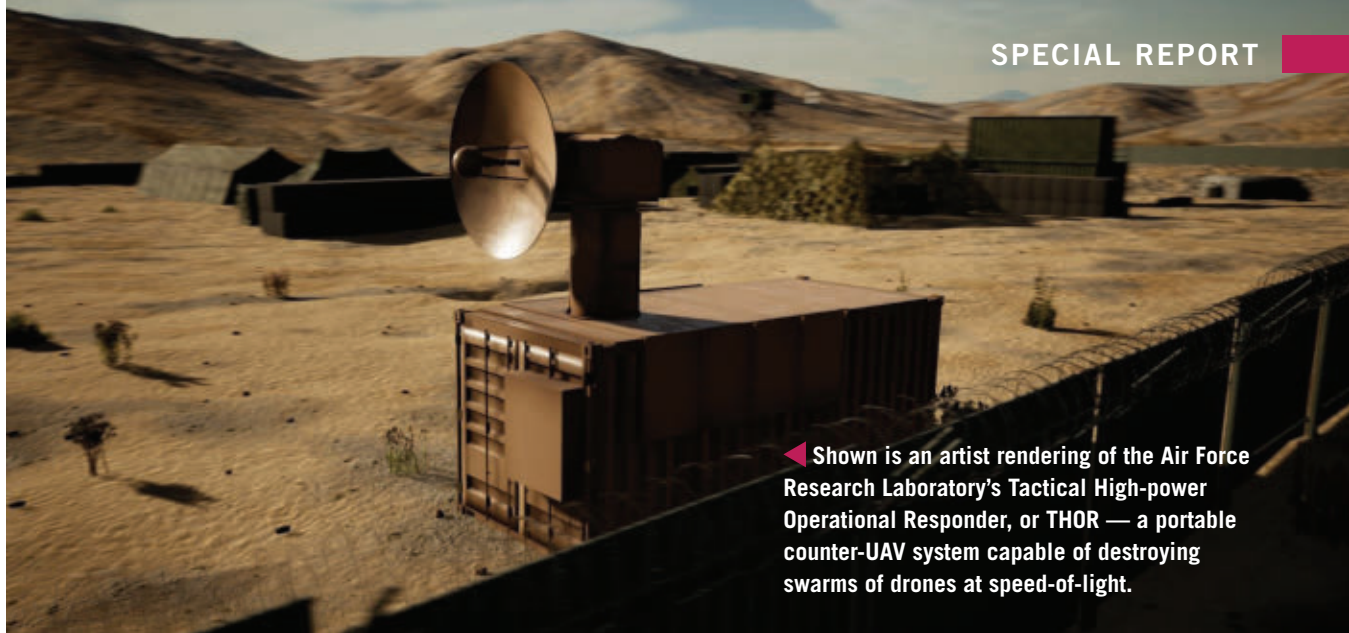
However, like nearly everything in the world of military and aerospace technology, size, weight, power, and cost (SWaP-C) are a major concern with developing and deploying directed-energy weapons systems. These weapons need a continuous power supply, which is often drawn from generators, shipboard systems, or vehicle engines. The need for stable, high-power energy sources makes deploying these systems a challenge, especially in mobile or remote environments.

On ships, laser weapons may rely on integrated power systems with large electrical capacity, while land-based or vehicle-mounted lasers require specialized generators or energy storage systems. And like embedded computer systems, keeping these weapons systems cool is a battle as high-power lasers generate significant heat during operation which necessitate cooling systems that further increase power consumption.

Earlier this year, Rear Adm. Fred Pyle told attendees at the Surface Navy Association’s annual symposium that honesty



◀ This Artist rendering depicts the Lockheed Martin HELIOs directed-energy laser weapon system.



◀ Shown is an artist rendering of the Air Force Research Laboratory's Tactical High-power Operational Responder, or THOR — a portable counter-UAV system capable of destroying swarms of drones at speed-of-light.

about these technologies is necessary when envisioning the near-term future.

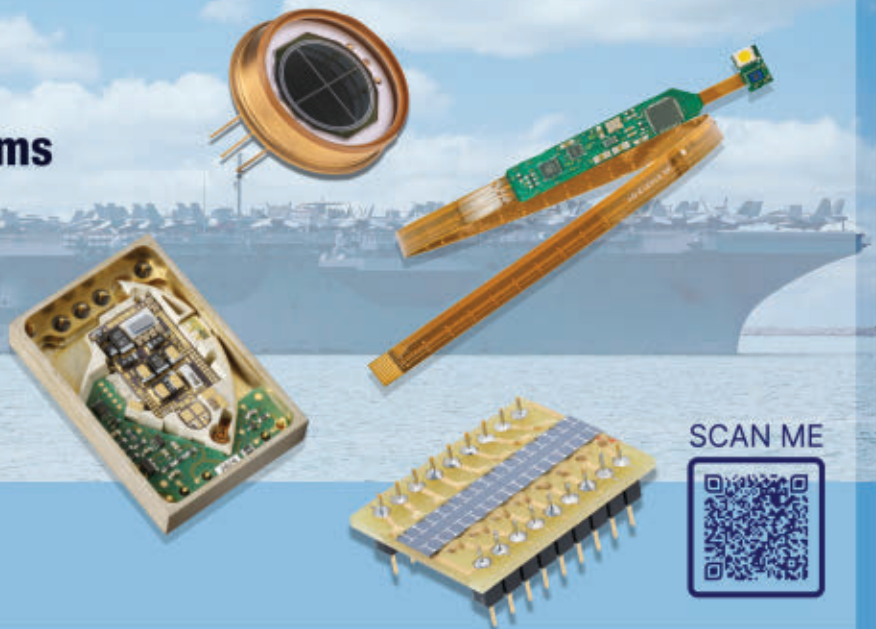
“Sometimes we have a tendency to over promise and under deliver,” Rear Adm. Pyle says. “We need to flip that to where, when we’re intellectually honest, when we’re honest with ourselves from a technology capability, that we have an agreed upon sight picture of what it’s going to look like to deliver that capability.”

While Rear Adm. Pyle urged an “over-delivering” and “under-promising” mindset, he says the Navy was bullish on what directed-energy weapons would offer sailors and Marines. “We’re very focused on delivering directed-energy capability and we’re building it into the future [budget requests] in mind with our frigate and the DDG(X) [the next-generation destroyer],” the officer says at the Surface Navy Association symposium in January. ◀

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SCAN ME



Military embedded computing on the verge of revolutionary new changes

Emerging standards such as VITA 100 and VNX+ will double board and backplane speeds, add a new board size, and help make tiny computers possible for handheld devices and uncrewed vehicles.

BY John Keller

The aerospace and defense embedded computing industry is on the cusp of some of the biggest changes in more than a decade, as board and backplane speeds are increasing, board dimensions are about to expand by including a new size, and small-form-factor embedded computing architectures are poised to move to credit-card-sized modules.

The VITA open-standards organization, which oversees the leading design standards for much of the world's embedded computing industry, is near finishing the most influential change since the VITA 65 OpenVPX standard was ratified in 2010.

Changes revolve around the emerging VITA 100 standard, expected to be ratified in early 2026, which has the potential to double I/O board and backplane connector speeds over OpenVPX, breathe new life into 3U and 6U embedded computing architectures, and add a new 4U standard board size to accommodate the relatively large sizes of state-of-the-art microprocessors, field-programmable gate arrays (FPGAs), general-purpose graphics processing units (GPGPUs), and other high-performance components.

Yet these revolutionary changes to military embedded computing are not only about

VITA 100. Designers of extremely small embedded computing designs for unmanned vehicles, handheld devices, manpack systems, and other lightweight designs are looking ahead to the VITA 74 VNX+ standard to determine how this standard's credit card-sized boards will influence extreme small-form-factor embedded computing.

VITA 100

The VITA 100 suite of standards, in development now, is an evolution to OpenVPX, VPX, and related mechanical standards while embracing a paradigm shift in technology and capability with at least double the pin density, speed, and power for electrical contacts.

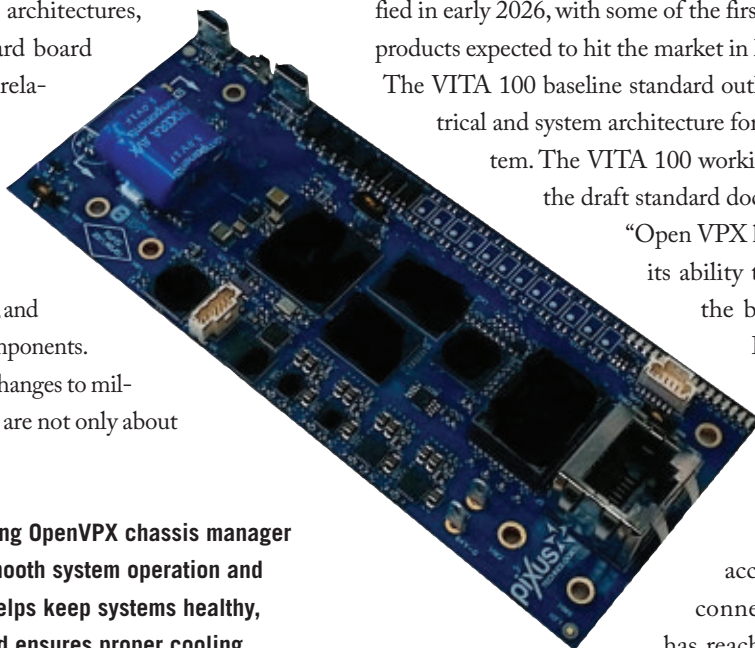
The in-progress VITA 100 standard is expected to be ratified in early 2026, with some of the first VITA 100-compliant products expected to hit the market in late 2026 or early 2027.

The VITA 100 baseline standard outlines the essential electrical and system architecture for the VITA 100 ecosystem. The VITA 100 working group is developing the draft standard document.

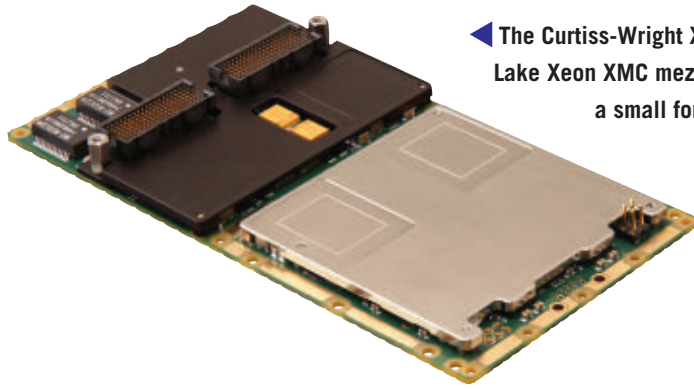
"Open VPX has reached the limit of its ability to pump data through the backplane," says Mark

Littlefield, director of embedded products at Elma Electronic in Fremont, Calif.

"Everybody has accepted that the RT 3 connector of Open VPX has reached its limit." To help



► This embedded computing OpenVPX chassis manager from Pixus helps enable smooth system operation and resource management. It helps keep systems healthy, manages system power, and ensures proper cooling.



▶ The Curtiss-Wright XMC-121 Intel Kaby Lake Xeon XMC mezzanine processor is a small form factor Intel Xeon x86 single board computer with extremely powerful x86 processing with a low power and small footprint.

move embedded computing technology forward, VITA 100 is likely to put in place high-density connectors that roughly will double the throughput of OpenVPX connectors between boards and backplanes. "VITA 100 will double the pins on the backplane over the VITA 46 connector to provide twice as many high-speed connects," explains Aaron Frank, senior product manager at the Curtiss-Wright Corp. Defense Solutions segment in Ashburn, Va.

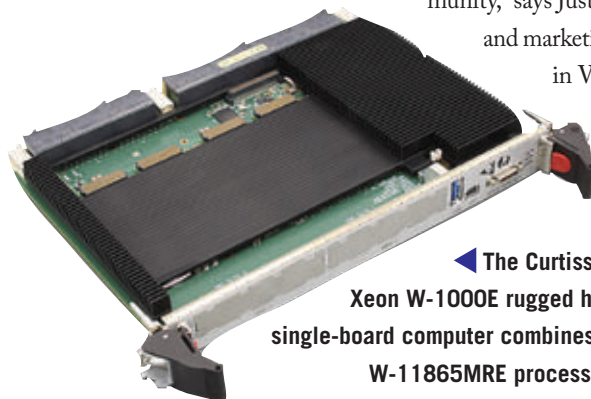
The improvements that VITA 100 promises are "getting the backplane to catch up," Frank says. What used to be processing power-limited, now becomes I/O-limited. This will help get more data to and from the modules. This is the biggest area where we customers struggle with," Frank continues. "As we move to data center applications like artificial intelligence into embedded computing, they are hitting the bottlenecks of where OpenVPX is today." The I/O-doubling capabilities of the VITA 100 connectors will apply to all VITA-based embedded computing modules.

"VITA 100 will be a worthwhile next-generation platform," says Elma's Littlefield. "The schedule is aggressive; they want it done and approved by ANSII by the end of next year. They could do it if they can keep the momentum up, but it is a lot of work for everyone involved."

New form factor

While VITA embedded computing standards typically call either for 3U- and 6U-size circuit boards — with 3U the most prevalent — the future VITA 100 standard also may accommodate a 4U-size card to fit modern high-performance processors.

"VITA 100 will use the typical 3U and 6U size board formats, but a 4U size may be implemented, as well, which is new for the VITA and even the PICMG community," says Justin Moll, vice president of sales and marketing at Pixus Technologies Corp. in Waterloo, Ontario. "Driving to 4U mainly are concerns with the newer chipsets



▶ The Curtiss-Wright VPX6-1961 VPX Intel Xeon W-1000E rugged high-performance 6U OpenVPX single-board computer combines the Intel 11th Gen Intel Xeon W-11865MRE processor with VPX high-speed fabric interconnects.



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coming out for applications that you may not have the space and I/O that you need to achieve in a 3U card,” Moll says, adding that some future high-performance applications that won’t fit on a 3U, may find a solution in 4U, and not need to move all the way up to 6U.

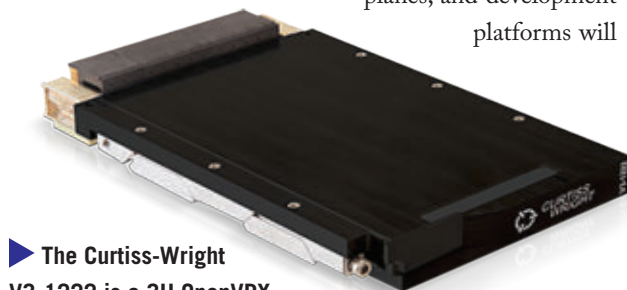
If the future VITA 100 standard does accommodate 4U card size — no guarantee of that yet — “it will be the customer’s performance demands will require it,” Moll says. “They will want to have as compact an enclosure as possible, but want this higher-level performance that only can be achieved in that 4U size. There will be enough volumes in key programs that will drive that market.”

It’s unlikely that a standards body like VITA would embrace a whole new board form factor like 4U — unless the market unequivocally was demanding it. “Today’s electronics are getting more powerful, and chips are becoming larger,” says Curtiss-Wright’s Frank.

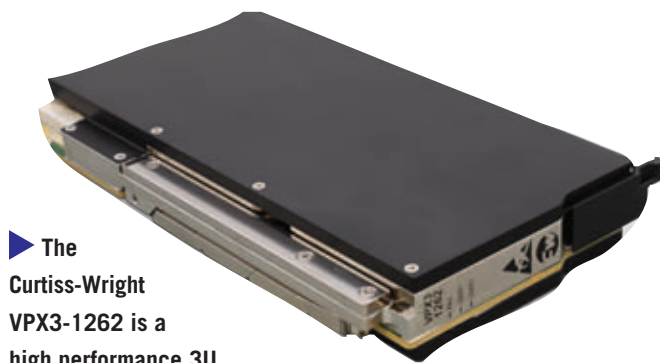
“Components and FPGAs, GPUs, and processors are getting really big,” points out Elma’s Littlefield. “The Ice Lake processor supports four banks of memory, but there isn’t enough space for that on a 3U card. Then 4U is attractive to buy space for these big components.”

Power consumption and thermal management also play into the equation. “There also is a big desire for high-power densities,” Littlefield says. “with 4U we can get to 150 Watts per slot with air-flow-through cooling; conduction cooling is limited to 100 Watts. GPUs and FPGAs are big power-hungry components, and developers eventually want to see 200 Watts per slot, and there’s no way we can do that on 3U.”

Any move to a 4U board form factor would involve growing pains, experts say. “When you look at VITA 100, because the connector gets bigger with more pins, and the data throughput is 4 times what the Open VPX connector offers, the form factor changes to 4U,” says Ken Grob, director of embedded technologies at Elma Electronic. “Then we need to go back and change all the reference backplanes, and development platforms will



► The Curtiss-Wright V3-1222 is a 3U OpenVPX single-board computer is for avionics that require Design Assurance Level A reliability.



► The Curtiss-Wright VPX3-1262 is a high performance 3U OpenVPX single board computer for next-generation SOSA-aligned processing systems.

have to be updated.”

So if implemented, how would the new 4U form factor influence the long-term viability of 3U and 6U cards? “I think 3U will be around for many decades; not every project is going to need the special requirements that a 4U board would facilitate,” says Pixus’s Moll. “I would expect it will be several years before 4U really will take off, and 3U will be the predominant size for a long time to come.”

As for the 4U’s influence on 6U embedded computing cards, 6U will certainly have its place as a subset of applications, but its use will remain smaller than 3U,” Moll continues. Simply from a board real estate option, there are still a lot of applications where that 6U size is a must, such as applications that have a lot of RF or optical interfaces, or a combination of chip set options that require the real estate, like radar applications and C4ISR.”

VNX+ standard

Another recent standard of note in the aerospace and defense embedded computing industry is VITA 90 VNX+, a credit card-size board that is designed to meet the growing needs for improved size, weight, and power consumption (SWaP) VNX+ uses a rugged, low cost, and fast serial fabric interconnect based plug-in module.

VNX+, while not offering the performance of VITA 100 3U, 4U, or 6U modules, primarily is for extremely small applications like smart missiles and uncrewed vehicles, in which 3U cards simply are too large. “I wouldn’t call VNX+ a big impact yet, but it’s coming really soon,” says Elma’s Littlefield.

How might the smaller VNX+ bode for 3U module demand? “I don’t think the impact of VNX+ will be significant on dampening the 3U market, says Pixus’s Moll. “If VNX+ takes off, it will be for applications that absolutely demand very small size, such as smaller UAVs, robotics, etc. The performance you get out of 3U OpenVPX is indispensable.”

Adds Curtiss-Wright’s Frank, “VNX+ has size and power limits that restrict its use to smaller entry-level processing

systems. We are finding that consolidation of SWaP, they want to do more in less space, rather than less in less space. VNX+ has a place in the market, but not in high-performance high-density applications.”

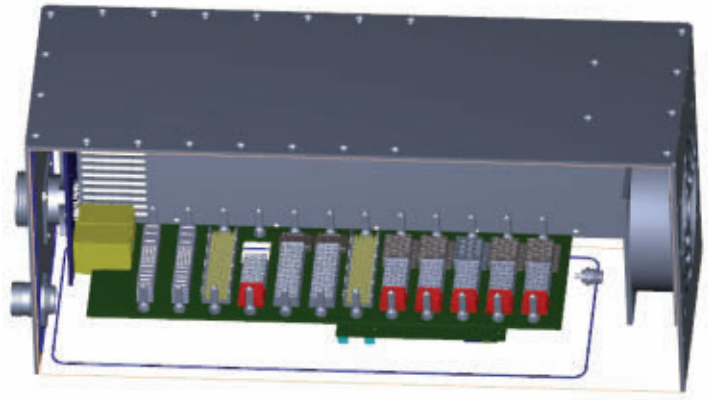
SOSA

The big topic in the military embedded computing industry of the past few years has been the Sensor Open Systems Architecture (SOSA), which seeks to enable rapid, affordable, cross-platform best practices for systems, software, hardware, electrical, and mechanical engineering. SOSA is intended to reduce development and integration costs for military capabilities and reduce time to field, and encapsulates fundamentals of the Modular Open Systems Approach (MOSA) design approach to develop embedded computing solutions for military applications that involve a unified set of sensor capabilities.

The Open Group in San Francisco, which administers the SOSA standard, published the Technical Standard for SOSA Reference Architecture, Edition 1.0, in fall 2021, and published the Technical Standard for SOSA Reference Architecture,

Edition 2.0, Version 2 (Snapshot 2) in March 2024.

The latest SOSA snapshot includes features to expand support for electronic attack, signals intelligence, synthetic aperture radar, and infrared sensors applications like security services. SOSA 2.0 also includes standards such as Modular Open Radio Frequency Architecture (MORA) V2.5 and Vehicle Integration for C4ISR/EW Interoperability (VICTORY) V1.10 to refine guidelines for SOSA module and interface functions to help enable interchangeable components for sensing.



▲ The Pixus 3U OpenVPX backplane one shows dual VITA 91 slots for speeds as fast as 56 gigabits per second.

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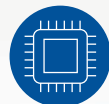
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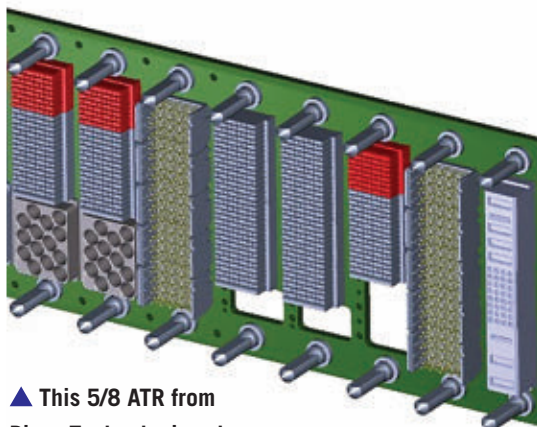
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▲ This 5/8 ATR from **Pixus Technologies** shows a larger variation with 10 SOSA-aligned slots, with two high-speed VITA 91 connector interfaces. Beneath the ackplane is the Pixus compact SOSA-aligned chassis manager mezzanine

The latest snapshot also addresses additional chassis connectors and the use of high-speed Ethernet and high-density fiber connectivity; software and hardware; electrical-mechanical interfaces; and business use-cases.

The snapshot provides guidance of what will become the technical standard for SOSA Reference Architecture, Edition 2.0, and was published to make public the direction of how SOSA is evolving.

A copy of the Technical Standard for SOSA Reference Architecture, Edition 2.0, Version 2 (Snapshot 2) is available online at <https://publications.opengroup.org/standards/sosa/s241>.

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

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

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

"We are seeing continued adoption of SOSA in the market place, as part of MOSA adoption, flowing from the platform integrator through the primes, board suppliers, and systems suppliers," says Curtiss-Wright's Frank.

It's difficult to talk about military embedded computing these days without discussing SOSA. "A very significant portion of VITA-based opportunities have SOSA-aligned requirements," says Pixus's Moll. "That means that typically the speeds are 100 Gigabit Ethernet or faster, and they are supposed to have a SOSA-aligned chassis manager." ◀



Boeing and BAE Systems to provide EW avionics for F-15 aircrew situational awareness

BY John Keller

WRIGHT-PATTERSON AFB, Ohio – U.S. Air Force airborne electronic warfare (EW) experts are asking the Boeing Co. and BAE Systems to provide EW systems for the U.S. F-15E jet fighter-bomber under terms of a \$19.1 million order announced.

Officials of the Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, are asking the Boeing Defense, Space & Security segment in St. Louis to install the F-15 Eagle Passive/Active Warning and Survivability System (EPAWSS) on F-15E aircraft.

The BAE Systems Electronic Systems segment in Nashua, N.H., is the primary designer and manufacturer of the F-15 EPAWSS airborne EW avionics.

The F-15 EPAWSS replaces an analog federated avionics system with a next-generation, digital, integrated EW suite that enables the F-15 to operate in the presence of modern EW threats with dense radio-frequency backgrounds.

The updated EW avionics improves pilot situational awareness with the capability to autonomously detect, identify, and

locate threat systems, and then deny, degrade, and disrupt those threats.

Boeing manufactures the F-15 and serves as the integrator for the program, and BAE Systems is producing the advanced EW hardware. This contract modification brings the total cumulative face value of the contract to \$824.7 million.

EPAWSS increases the aircrew's situational awareness, helps them understand when they are being targeted by radar, and it provides them with advanced techniques to counter modern integrated air defense systems. This order brings the total value of this EPAWSS contract to Boeing and BAE Systems to \$805.5 million.

On this order Boeing and BAE Systems will do the work in Nashua, N.H., and should be finished by December 2026. For more information contact BAE Systems Electronic Systems online at www.baesystems.com/en-us/product/eagle-passive-active-warning-survivability-system-epawss, Boeing Defense, Space & Security at www.boeing.com, or the Air Force Life Cycle Management Center www.afcmc.af.mil. ◀

Navy asks industry for EW, RF surveillance, and artificial intelligence (AI) technologies

BY John Keller

ARLINGTON, Va. – U.S. Navy electronic warfare (EW) experts are approaching industry for enabling technologies in EW and RF surveillance.

Officials of the Office of Naval Research in Arlington, Va., issued a broad agency announcement last week (N0001424SBC10) for the Enabling Technologies for Electronic Warfare and RF Surveillance project.

Technical areas of interest are signal processing algorithms for radars; EW against modern emitters; artificial intelligence (AI) to create complex modeling and simulations; repairing and restoring signals after frequency-selective limiters; counter-electro-optical sensors; rapid insertion of emerging counter-intelligence, surveillance, and reconnaissance (ISR) and EW technologies; and technologies for EW and ISR applications.

Signal processing algorithms for radars seeks to achieve real-time processing by diminishing hardware and software latencies using efficient algorithms and effective hardware implementation.

The Navy is seeking signal processing algorithms with high efficiency and low-latency, including synthetic aperture radar (SAR) with or without maritime ground moving target indication, interferometric SAR, polarimetric SAR, or tomographic SAR.

Although real-time radar signal and image processing still is costly, Navy researchers say software-defined radio and edge processing technologies have the potential to help develop affordable small lightweight radar systems for applications like unmanned aircraft.



▲ Navy researchers are asking industry for RF and microwave technologies related to electronic warfare (EW), RF surveillance, and artificial intelligence (AI).

Technologies for EW techniques against modern emitters seeks to enable a distributed network of EW systems to respond adaptively to modern complex emitter threats.

Generative artificial intelligence to create complex modeling and simulation scenarios at scale seeks to create algorithms to model the movement and timing of military platforms to help them detect and classify RF transmissions.

Methods for repairing and restoring signals after frequency-selective limiters seeks to develop a receiver module that adaptively can correct and repair signals distorted by free space loss.

CountER-electro-optic/infrared (EO/IR) concepts seeks to counter emerging EO/IR imaging sensor threats using non-traditional solutions to the problem of deceiving and denying imaging sensors without resorting to such brute force techniques.

Dynamic, composable architecture for rapid insertion of emerging counter-ISR and EW technologies seeks to develop a flexible architecture that can integrate new EW and counter-ISR capabilities for Navy EW uses.

Technologies for truly innovative EW/ISR applications seeks to explore to explore additional EW and ISR concepts for the fundamental transformation of the Navy's current capabilities.

Companies interested were asked to submit white papers by September 2024, and full proposals via FEDCONNECT no later than 20 Dec. 2024 online at <https://www.fedconnect.net/FedConnect/Default.htm>. Email questions or concerns to the Navy's Kevin Leonard at ONR.NCR.312.list.ISR-Admin@us.navy.mil. More information is online at <https://sam.gov/opp/8aaadf9896754873800eaddae36553b5/view>. ◀

Dual-LRU airborne SATCOM with high data rates introduced by Astronics

Astronics Corp. in East Aurora, N.Y., is introducing the Typhon T-400 series satellite communications (SATCOM) system to operate on GEO-based Ku Satellite networks to address the high cost of equipping an aircraft with SATCOM connectivity. The Typhon T-400 series combines advanced satellite technology combined and a modem manager in the streamlined dual-LRU system that incorporates commonly sourced connectors with low-cost cabling to help reduce total life cycle costs. The Typhon T-400 series integrates the iQ800 modem technology from iDirect in Herndon, Va., for connectivity and data transmission at high data rates in demanding airborne environments. For more information contact Astronics online at www.astronics.com.

DARPA eyes HF radio waves ionospheric test instruments for over-the-horizon radar

U.S. military researchers have briefed industry on an upcoming project to create test instruments suitable for high-frequency (HF) surface-wave and sky-wave over-the-horizon radar (OTHR). Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has launched the Transponders for Ionospheric Measurement (TIM) program. TIM seeks to create distributable channel sounding and test instrumentation that will measure and respond to HF radio waves. The goal is to capitalize on commercial communications devices to create test instruments suitable for HF surface-wave and sky-wave over-the-horizon radar (OTHR) using small, lightweight, and power-efficient transponders. Instrumentation nodes will have three functions: receive, modulate, and retransmit radar signals; measure the propagation channel response using a chirp-sounding receive function; and capture and relay portions of the HF

radio band for analysis. The vision for TIM is to coordinate several test instrumentation nodes to help improve understanding of HF radio propagation across a wide geographic area and to perform as test signal sources for improving HF radar performance. Small-size instrumentation will help procure quantities necessary for cost-effective wide-area deployments. Email questions or concerns to DARPA's Frank Robey at DARPA-PS-24-07@darpa.mil. More information is online at <https://sam.gov/opp/5aac901d6a3746ecab6914e5e2a12331/view>. ←

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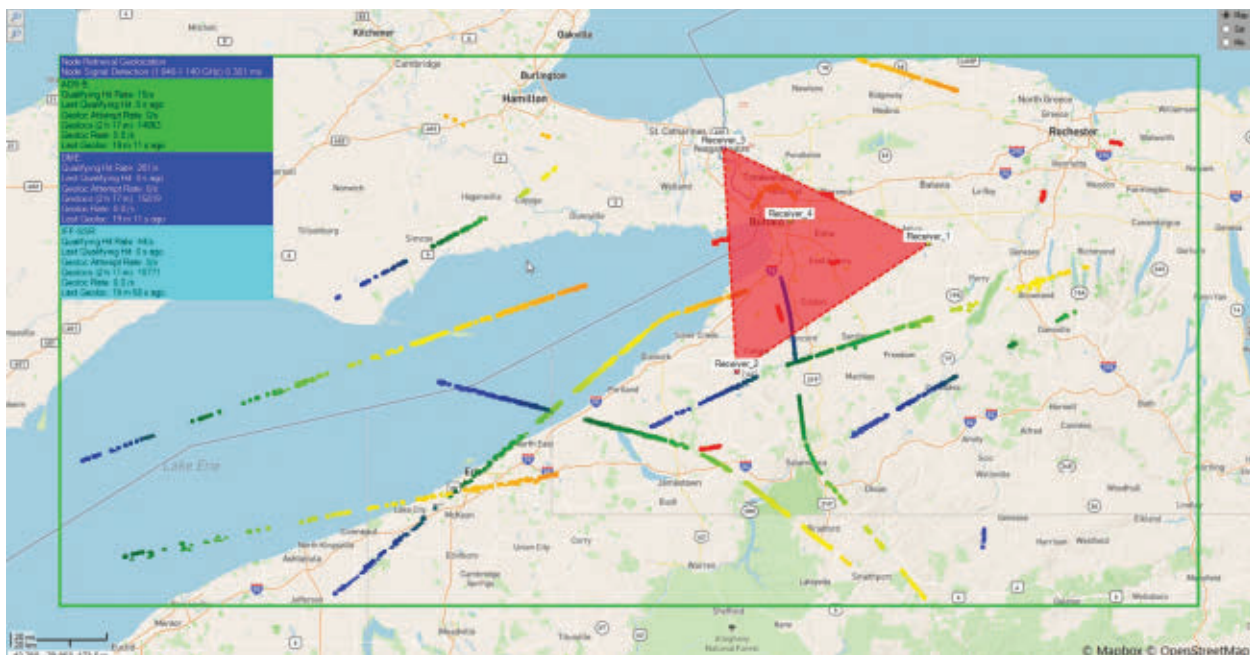
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Army seeks autonomous unmanned passive geolocation technology to pinpoint RF emitters

BY John Keller



ADELPHI, Md. – U.S. Army researchers are approaching industry for autonomous unmanned passive geolocation technology to detect and pinpoint RF emitters such as integrated air-defense radars, unmanned aerial vehicle (UAV) communications links, electronic warfare (EW) jammers, and control stations.

Officials of the Army Contracting Command Aberdeen Proving Ground annex in Adelphia, Md., have issued a request for information (W911QX24Q0112) for one autonomous unmanned passive geolocation system.

Army researchers want to acquire an autonomous unmanned RF-based passive geolocation system that can operate in all-visibility conditions.

The geolocation system also should have an RF multi-band payload weight of less than 7.7 pounds, offer low size, weight, and power consumption (SWaP); robust localization capability;

▲ **Army researchers want to acquire an autonomous unmanned RF-based passive geolocation system that can operate in all-visibility conditions.**

wide area RF surveillance; an open-architecture design; and control one or many unmanned aircraft.

Scientists in the past, for example, have used autonomous unmanned passive geolocation systems to control swarms of UAVs that are trying to detect, locate, and classify enemy fire-control and air-defense radar systems.

Companies interested were asked to email capability statements in April to the Army's Swati Jain at swati.jain2.civ@mail.mil. Email questions or concerns to the Army's Swati Jain at swati.jain2.civ@mail.mil. More information is online at <https://sam.gov/opp/186375531815433aa74d74a960604e01/view>. ◀

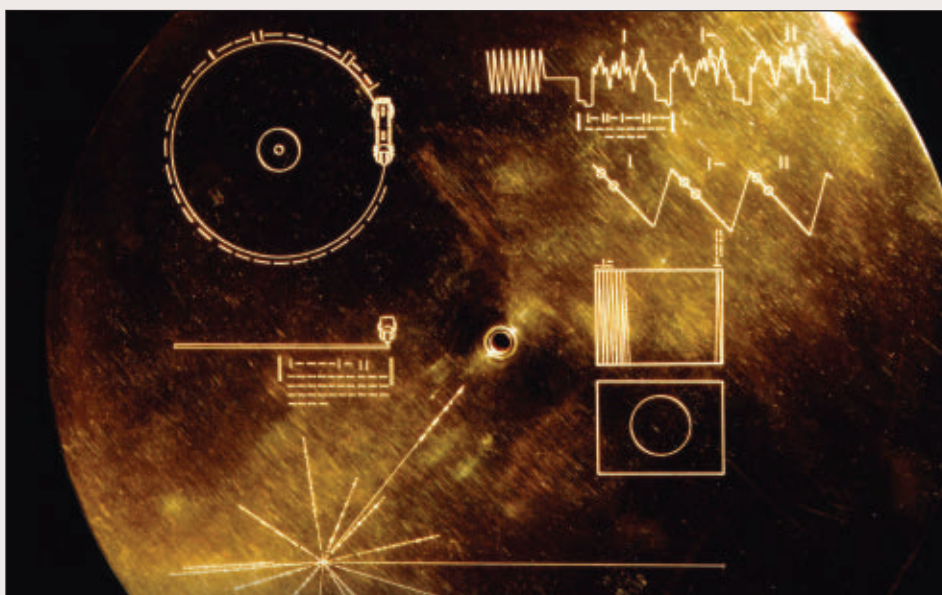
Subsea power-distribution for charging unmanned underwater vehicles introduced by Diversified Technologies

Diversified Technologies Inc. in Bedford, Mass., is introducing the PowerMod Subsea MVDC Power Distribution System for subsea power distribution applications. The power-distribution system features pressurized power conversion modules that measure 18 inches in diameter and operate at depths to 3,500 meters to enable transmission of as much power as one megawatt at medium voltages over thousands of kilometers. This bi-directional system converts 10 kilovolts DC to 375 volts DC at the seafloor to permit grid or loop configurations with multiple power sources. The PowerMod Subsea MVDC Power Distribution System is for charging unmanned undersea vehicles and other applications. It can be powered from high voltage onshore generators or from undersea sources such as hydro-thermal or wave power generators at 375 volts, with their voltage up-converted to 10 kilovolts. Modules provide a 90 percent probability of operation for 25 years. For more information contact Diversified Technologies online at www.divtecs.com. ←

AeroVironment to build Switchblade unmanned smart mortar with video feeds

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 Simi Valley, Calif. Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., announced a \$32.1 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, 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 anti-personnel 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. For more information contact AeroVironment online at www.avinc.com/lms, or the Army Contracting Command at www.army.mil/acc. ←



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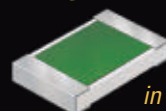
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▲ MOSA-compliant tethered UAV should extend line of sight reconnaissance, and lengthen communications ranges in contested airspace.

Army wants tethered UAV to handle reconnaissance and communications in contested airspace

BY John Keller

REDSTONE ARSENAL, Ala. – U.S. Army researchers are surveying industry to find companies able to develop covert and stealthy tethered unmanned aircraft for reconnaissance and communications relays inside of enemy integrated air defenses.

Officials of the Army Rapid Capabilities and Critical Technologies Office at Redstone Arsenal, Ala., has issued a request for white papers for the Human-Machine Integrated Formations (H-MIF) Tethered-UAS project.

Researchers want a tethered unmanned aerial vehicle (UAV) designed to modular open systems approach (MOSA) guidelines to extend line of sight for intelligence, surveillance, and reconnaissance, as well as to lengthen communications ranges in contested airspace.

This tethered UAV should be integrated with crewed or uncrewed land vehicles; be able to carry one or more sensor

and communications payloads; have a secure base station that interfaces with the host vehicle; remote-control software. The host vehicle also will protect the tethered UAV while not in use.

Modular payloads aboard the tethered UAV should include a stabilized gimbal, daylight cameras, infrared cameras, laser pointers, laser designators, elevated antennas, and radios mounted to a common rail interface. The system's modular control software must be able to run on the computers aboard the host vehicle or within the robotic controller.

When operating within an enemy's integrated air defense systems bubble, the ability of manned and unmanned aircraft to identify targets may be impaired, researchers explain. In conditions when high-altitude and satellite reconnaissance penetrate enemy air defenses because of terrain, vegetation, and structures, ground units may be vulnerable.

To overcome this capability gap, the Army needs tethered UAVs and host land vehicles to extend line of sight for intelligence, surveillance, and reconnaissance (ISR) as well as extending communications ranges. Such systems must offer reduced signatures, enhanced concealment, and extended endurance.

The UAV's tether must provide a continuous high-capacity and high-bit rate data and power interface between UAV and base station; the tether must not be a significant RF radiator or be susceptible to RF interference. The base station will draw power from the host vehicle, and its software will control the tethered UAV from inside the host vehicle.

The tethered UAV must be able to carry at least five pounds of payloads; be compatible with a range of sensor and communications payloads; have open-systems control and power links; operate in a GPS-denied environment; operate in bad weather and rough terrain; and have lights that the controller can turn off and on.

The tether will carry power, control, payload data, and RF over fiber links to the base station; must be able to transmit data at rates of between 100 and 1,000 megabits per second; have minimized RF emissions and susceptibility from the tether; and allow operations at distances of between 200 and 300 feet.

The base station must connect to existing host vehicle power and data buses via configurable networking; interface with existing vehicle connections; meet environmental and EMI standards to include rough terrain; allow under-armor and remote launch; offer expandable computing; and interface with the host vehicle's tactical radios.

The controller must have software that runs on a stand-alone tablet computer wired to the base station for maintenance and debugging; and operate as a standalone unit.

Modular payloads must be able to operate with host controller software; use the same physical, data, and power interface on the tethered UAV; include a laser range finder; offer target identification, recognition, and localization; must enable artificial intelligence (AI) and machine learning to assist in detection, target recognition, and tracking; and have radios for signals intelligence (SIGINT), mesh radio, and backhaul using the tethered UAV antenna.

Companies interested were asked to email unclassified white papers in April to the Army's Simone Brightmon at simone.l.brightmon.civ@army.mil, Tessa Jones at tessa.a.jones.civ@army.mil. Email questions or concerns to Brightmon and Jones. More information is online at <https://sam.gov/opp/1484619ff8894164b10d599b8112b486/view>. ←



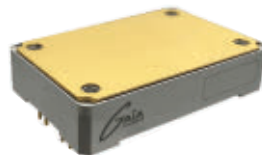
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Military researchers seek to use laser beams to provide on-demand power for the battlefield

BY John Keller

ARLINGTON, Va. — U.S. military researchers are asking for industry's help in demonstrating electro-optical laser power beaming technology as part of a project to design a high-altitude optical relay to create scalable on-demand power networks able to distribute about 10 kilowatts of electricity to military users as far away as 125 miles.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a program solicitation (DARPA-PS-24-25) for the POWER Receiver Array Demonstration (PRAD).



▲ POWER optical technologies are expected to create an airborne relay capable of redirection, wavefront correction, and energy harvesting of optical beams.

PRAD seeks to demonstrate enabling technologies in power beaming, as part of the DARPA Persistent Optical Wireless Energy Relay (POWER) project. POWER seeks to demonstrate optical power-beaming relays not only as a resilient multipath alternative for expeditionary energy transport, but also to enable small-yet-persistent manned and unmanned aircraft to provide on-demand power for a wide range of military missions.

POWER optical technologies are expected to create an airborne relay capable of redirection, wavefront correction, and energy harvesting of optical beams. The ultimate goal is to use three airborne relay nodes hosted on existing aircraft to transmit energy from a ground source laser to 60,000 feet in altitude, and back down to a ground receiver 125 miles away.

The PRAD program seeks to develop and demonstrate a laser power beaming receiver for a future energy web that consists of three major component types: transmitters, relays, and receivers.

Optical laser power beaming delivers energy over long distances via transmission by laser beam that is then directed towards a receiving station. The receiving station is equipped with photovoltaic cells or similar devices that capture the laser energy and convert it back into electrical power.

A ground-to-ground demonstration is crucial for proving the feasibility and effectiveness of optical laser power beaming technology — particularly in validating the photovoltaic receiver array and its efficiency, DARPA researchers explain.

The RTX Raytheon segment won a \$10 million contract in August 2023 for the DARPA POWER project. The next step is to develop and demonstrate a laser power beaming receiver for the POWER program.

POWER seeks balance energy generation, storage, and distribution for military missions by capitalizing on power beaming for near-instantaneous energy transport.

Military power today relies primarily on liquid fuels like jet fuel, gasoline, and diesel fuel, which are vulnerable to enemy attack and require significant infrastructure. Instead, POWER seeks to reduce the military's dependence on liquid fossil fuels, their delivery, and storage capacity.

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 in a matter of seconds or minutes, and restoring full capability by replacing nodes in minutes or hours.

For the POWER program, Raytheon 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 is developing a relay payload design and relay platform. The PRAD part of the POWER program seeks to build a low-power demonstration relay.

Eventually DARPA would like 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.

Companies interested in demonstrating a POWER laser power beaming receiver as part of the PRAD program were asked to email 3-page abstracts in September to DARPA-PS-24-25@darpa.mil.

Companies submitting promising abstracts may be invited to give oral presentations. Email questions or concerns to DARPA at DARPA-PS-24-25@darpa.mil. More information is online at <https://sam.gov/opp/51e880f298304099a8b-2f62352617a2f/view>. ←

Elbit to build light-amplification night vision monocular for dark and degraded-visibility

U.S. Army night vision experts are asking Elbit Systems of America to build monocular night vision devices for nighttime and degraded-visibility conditions. Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., announced a \$27.8 million order to the Elbit Systems of America Night Vision segment in Roanoke, Va., for AN/PVS-14 monocular night vision devices. The legacy AN/PVS-14 night-vision

Continued on page 41

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Wanted: optical interconnects in 3D chips for signal processing, free-space communications, remote sensing

BY John Keller

ARLINGTON, Va. – U.S. military researchers are approaching industry for project to develop 3D chip-to-chip and intra-chip optical interconnects to speed information throughput and reduce vulnerability to electromagnetic interference.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001124S0038) for the Heterogenous Adaptively Produced Photonic Interfaces (HAPPI) program.

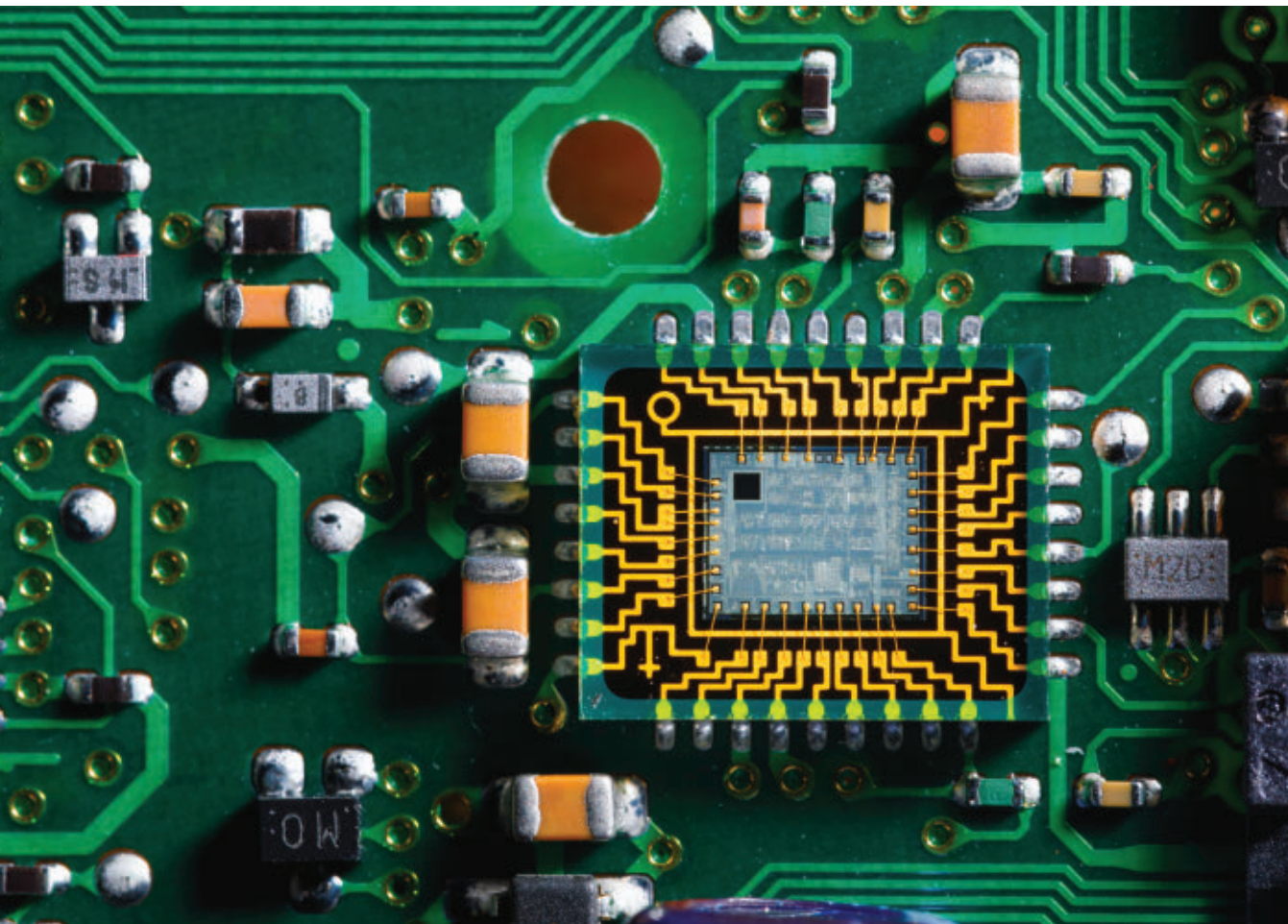
HAPPI will seek hardware demonstrations of low-loss, high-density optical interconnects for 3D chips using a

scalable manufacturing process that is compatible with microelectronics. DARPA briefed industry on the program on 9 Sept.

The HAPPI program focuses on high-density 3D chip optical links and the ability to provide several routing planes within a photonic integrated circuit or photonic interposer.

▼ **The HAPPI program focuses on high-density 3D chip optical links and the ability to provide several routing planes within a photonic integrated circuit or photonic interposer.**

219960382 © Nikkytok | Dreamstime.com



The project also will emphasize vertical connections between routing layers that can traverse substrate thickness, and surface methods for coupling light from one photonic chip to another. Chip-to-fiber coupling and chip-to-chip edge coupling are not part of the program.

A major thrust of the program is to create optical interfaces that are robust to typical microsystem misalignments due to fabrication and assembly variability, especially for large link arrays that span reticle-or wafer-scale systems.

The program also will seek robust-by-design or adaptive interfaces capable of environmentally and mechanically stable optical performance, with compatibility with standard microelectronics manufacturing and assembly flows.

Approaches should include coupling to a photonic integrated circuit with demonstrated optoelectronic sources, amplifiers, modulators, multiplexers, filters, detectors, and other electro-optical components. The operating wavelengths may be within the visible or near infrared optical bands.

The HAPPI program aims to create a 1000x increase microsystem information transmission density by exploiting photonic signaling. The ability to move and process information efficiently throughout a microsystem requires signal routing technology with high data rates and dense access points.

Photonic links are sparse within the microsystem due to planar optical routing geometries. Increasing the density of photonic links requires moving to 3D optical routing within the chip and between chips, and will enable information delivery when and where it is needed in applications such as signal processing, free-space communications, remote sensing, digital compute, and atomic sensing.

A major thrust of the program involves creating robust optical interfaces — especially for large link arrays that span reticle-or wafer-scale systems.

The HAPPI program is a 36-month, two-phase program, with a base and an option period. The 18-month first phase will prove the feasibility of 3D routing in integrated photonics, while the 18-month second phase will scale the density and prove the manufacturability of the 3D routing platform.

Companies interested were asked to submit abstracts in early October 2024, and full proposals by 29 Oct. 2024 to the DARPA Broad Agency Announcement Tool (BAAT) online at <https://baa.darpa.mil/Public/SecurityAgreement>. Email questions or concerns to HR001124S0038@darpa.mil. More information is online at <https://sam.gov/pp/5e053d585aed466e9bbf7d2d5d36f247/view>. ←

Continued from page 39

monocular is in widespread use by the U.S. military and NATO allies. It uses a third-generation image intensifier tube, and often is used hands-free using a head harness or attached to a combat helmet. The AN/PVS-14 can double as a weapons night sight. On this order, Elbit will do the work in Roanoke, Va., and should be finished by March 2025. For more information contact Elbit Systems of America Night Vision online at www.elbitamerica.com/night-vision, or the Army Contracting Command-Aberdeen Proving Ground at <https://acc.army.mil/contractingcenters/acc-apg/>.

Air Force picks Georgia Tech for infrared sensors for persistent surveillance

U.S. Air Force researchers needed help in developing infrared sensors to enable combat aircraft to search wide areas covertly. They found a solution from the Georgia Tech Applied Research Corp. in Atlanta. Officials of the Multispectral Sensing & Detection Division of the

Air Force Research Laboratory Sensors Directorate at Wright-Patterson Air Force Base, Ohio, announced a \$3.6 million contract to Georgia Tech as part of the Multi-Spectral Sensing Technologies R&D (MuSTeR) program. This contract is to develop infrared (IR) sensor technology for enhanced electro optical and infrared sensors for airborne search and track applications. Georgia Tech joins other MuSTeR contractors, which include the Northrop Grumman Corp. Mission Systems segment in Linthicum, Md.; Sensing Strategies Inc. (SSi) in Pennington N.J.; BlackHorse Solutions Inc. in Herndon, Va.; and Senseker Engineering Inc. in Santa Barbara, Calif. Other focus areas of the MuSTeR program are multiband multifunction radio frequency sensing; laser radar technology; passive radio frequency sensing; and distributed radio frequency sensing. For more information, contact Georgia Tech Applied Research online at <https://gtarc.gatech.edu/gtarc/>, or the Multispectral Sensing & Detection Division of the Air Force Research Laboratory Sensors Directorate at www.afrl.af.mil. ←



ELECTRONIC WARFARE

▲ Navy asks Northrop Grumman for electronic warfare (EW) and radar warning receivers for MV-22B tiltrotor

U.S. Navy avionics experts are asking engineers at Northrop Grumman Corp. to build eight electronic warfare (EW) avionics sets for the Navy MV-22B medium-lift tiltrotor aircraft under terms of a \$9.1 million order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Northrop Grumman Mission Systems segment in Rolling Meadows, Ill., for eight AN/APR-39 D(V)2 radar warning receiver/electronic warfare management systems, and eight D(V)2 battery handle assemblies for the MV-22B tiltrotor.

The AN/APR-39 family of radar warning receivers is for a variety of Navy aircraft and ships. It detects radar threats to aircraft, such as radar ground sites and particularly radar-guided missiles, and provides 360-degree coverage around the aircraft. When the system detects radar threats, it alerts the aircraft crew to each threat with a graphic symbol on the cockpit display.

Northrop Grumman also won a \$106.6 million U.S. Army order last December for AN/APR-39 avionics, and an \$18.1 million Navy contract last September for AN/APR-39D(V)2 EW and radar warning receiver avionics equipment.

The AN/APR-39D(V)2 is the latest upgrade to the AN/APR-39 radar warning receiver that corrects deficiencies and enhances capability in the same weight and dimensions as the previous system. The upgrade calls for a new digital receiver for the AN/APR-39D(V)2.

The APR-39 provides the pilot and air crew with information on threat types, bearing, and the severity of

the threat. The system also gives the aircrew synthetic speech audio threat warnings.

The APR-39 also functions as an electronic warfare management system, and serves as the heart of Northrop Grumman's suite of integrated sensors and countermeasures that integrates and displays data from onboard sensors radio frequency and electro-optical sensors.

The Bell-Boeing V-22 Osprey uses tiltrotor technology to combine the vertical performance of a helicopter with the speed and range of a fixed-wing aircraft. It features vertical take-off and landing (VTOL) and short take-off and landing (STOL) capabilities, and is designed long-range high-speed missions.

In addition to the AN/APR-39D(V)2, aircraft's avionics has a weather radar, a forward firing ALE-47 airborne countermeasures dispenser system, improved hover coupled features, and an improved environmental conditioning system, compared to earlier versions of the tiltrotor.

The V-22 has a glass cockpit with four multi-function displays that are compatible with night-vision goggles, and one shared central display unit to display various images including: digital maps, imagery from the turreted forward-looking infrared system, primary flight instruments, navigation, and system status.

The V-22B is a joint service, multirole combat aircraft that uses tiltrotor technology to combine the speed and range of a fixed-wing airplane with the vertical performance of a helicopter. The tiltrotor aircraft has triple-redundant fly-by-wire flight control with computerized damage control to isolate damaged areas automatically.

With its nacelles and rotors in vertical position, it can take off, land, and hover like a helicopter. Once airborne, its nacelles rotate forward to transform the aircraft into a turboprop airplane capable of high-speed and high-altitude flight.

The Marine Corps MV-22B transports warfighters, equipment, and supplies from ships and land bases for combat assault and assault support.

The aircraft also supports naval missions like combat search and rescue, fleet logistics support, special warfare support, amphibious assault, ship-to-objective maneuvers, and sustained operations ashore. The MV-22B can transport 24 combat troops and 20,000 pounds of internal cargo, or 15,000 pounds of external cargo.

On this contract Northrop Grumman will do the work in Rolling Meadows, Ill.; Woburn, Mass.; Lansdale, Pa.; San Leandro, Calif.; Lewisburg, Tenn.; Longmont, Colo.; Verona, Wis.; Salt Lake City; Newark, Del.; Melbourne, Fla.; Baltimore, and should be finished by May 2027. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com/who-we-are/business-sectors/mission-systems, or Naval Air Systems Command at www.navair.navy.mil.

ELECTRONIC MATERIALS

► Air Force asks ARCTOS and UES for new electro-optical and electronic materials for electronic warfare (EW)

U.S. Air Force researchers needed new electronic, photonic, electro-optical, and quantum materials for intelligence, surveillance, and reconnaissance (ISR), as well as for electronic warfare (EW).

They found their solution from ARCTOS Technology Solutions LLC in Beavercreek, Ohio, and from UES Inc. in Dayton, Ohio.

Officials of the Electronic Materials Branch of the Air Force Research Laboratory's Materials and Manufacturing Directorate at Wright-Patterson Air Force Base, Ohio, has announced separate \$12 million contracts to ARCTOS and UES for the Materials for Integrated Nano-electronic

and Optoelectronic Structures (MINOS) project.

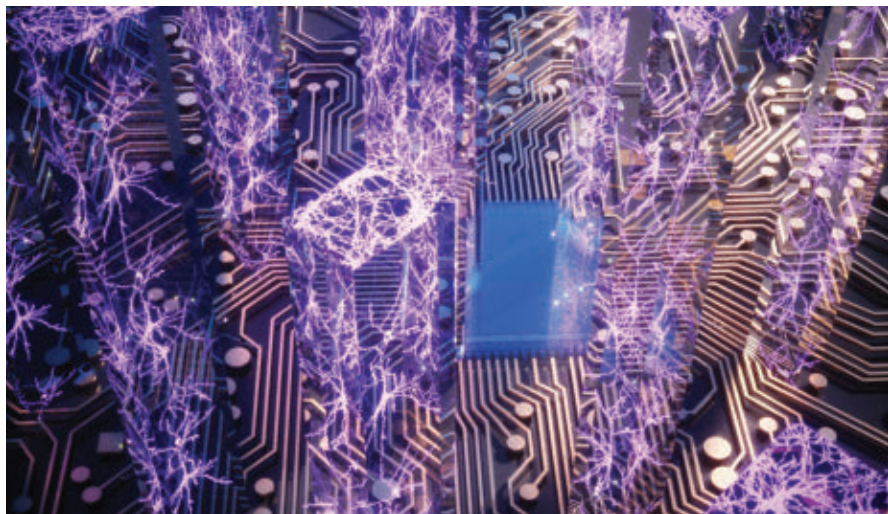
MINOS seeks to enhance electronic, electro-optical, photonic, magnetic, ferroic, and quantum materials; wide-bandgap and ultra-wide-bandgap semiconductors; digital and analog switching materials; electronic materials integration; and hybrid systems to enable next-generation ISR and EW systems for Air Force applications.

Air Force missions require sustained operations in extremely harsh environmental conditions, researchers explain. ARCTOS and UES scientists will pursue material advances for electronic, photonic, electro-optical, and quantum materials.

ARCTOS and UES will conduct research in photonic, electro-optical, and quantum materials for ISR and EW applications. This includes solid-state qubits; optical, RF, and hybrid material technologies; modulator materials, RF magnetic materials and materials for integrated photonics; and electro-optical sensing.

Company researchers seek to develop and demonstrate electronic, photonic, electro-optical and quantum materials, including prototypes, models, and computational tools. Researchers want industry to develop new materials through physical vapor and chemical vapor deposition processes to grow magnetic, electronic, optoelectronic, and optical thin films for pulsed laser deposition, sputtering, molecular beam epitaxy, atomic layer deposition, and molecular layer deposition.

ARCTOS and UES will fabricate materials into different shapes and sizes, and create areas that are conducting (like metals), semiconducting (like dichalcogenides) or insulating (like oxides and nitrides) using focused ion beam, ultra violet lithography, nano lithography,



e-beam lithography, reactive ion etching, wet chemical treatment involving acids and solvents, metal vaporation and sputtering, ion implantation, and mechanical and electronic fixture arrangements.

For more information contact ARCTOS online at <https://arctos-us.com>, UES at www.ues.com, or the Air Force Research Laboratory at www.afrl.af.mil.



FLIGHT DISPLAYS

▲ Phoenix Rising Aviation and Global Jet Partners pick flight displays

Phoenix Rising Aviation in Bartlesville, Okla., and Global Jet Partners in Scottsdale, Ariz. sought to upgrade flight displays for the company's Dassault Falcon aircraft. They found their solution from Universal Avionics in Tucson, Ariz.

Universal Avionics InSight Flight Display System was selected to replace the existing technology in a Falcon 900B. Phoenix Rising Aviation performed the installation together with major "C" check maintenance. The InSight installation in a Falcon 900B is based on the Supplemental Type Certificate certified by Chicago Jet Group.

InSight replaces outdated avionics with an integrated flight deck solution including four high-resolution displays and two touchscreen-enabled control displays while increasing available payload and improving reliability. Its 3D synthetic vision system and associated digital maps, combined with advanced safety

features for traffic, weather, and terrain, enhance situational awareness.

The InSight flight display system integrates with existing aircraft systems and includes the latest Universal flight management systems (FMS) and UniLink data communications management, enabling FANS 1/A+, CPDLC, and ATN B1 capabilities. Operational efficiency is improved with CPDLC Departure Clearances, saving 15 minutes or more on a typical flight, while WAAS/LPV and RNP approaches down to 0.3nm expand the range of airports where precision approaches can be performed.

"We chose the cutting-edge Universal InSight avionics cockpit retrofit upgrade to bring this beautiful, older Falcon 900B up to the latest 21st Century standards and enhance its market and resale value," Michael D. Long, CEO at Global Jet Partners says. "After a 5-month, complete upgrade, this aircraft is actively for sale and represents a high-value, turn-key market proposition."

"This one-of-a-kind jet is a compelling example of the transformative potential of the InSight system," said Warren Peck, President at Phoenix Rising Aviation. "With InSight, Falcon 900B owners have a sustainable and cost-effective path to modernization, regardless of its original avionics configuration, ensuring that their aircraft remain competitive and valuable within the market."

DESIGN AND DEVELOPMENT TOOLS

▼ Air Force looks to dSPACE for design and development tools for testing wind turbulence

U.S. Air Force and university researchers needed design and development tools to help build a gust generator to simulate the effects of turbulence on a wide variety





of military and civil aircraft. They found their solution from dSPACE Inc. in Wixom, Mich.

Officials of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, and University of Dayton in Dayton, Ohio, have chosen dSPACE to provide the company's MicroLabBox for test and measurement, and aircraft turbulence research.

MicroLabBox is an all-in-one development system for the laboratory that combines compact size and low system costs with high performance and versatility. The Air Force and the University of Dayton are using the MicroLabBox to develop and validate control systems to mitigate wind gusts.

Research could lead to no noticeable wind turbulence on commercial aircraft flights and to reliable unmanned aerial vehicle (UAV) delivery through nearly any weather. Measuring the effect of wind gust dynamics on an aircraft wing or rotary propeller is critical, experts say.

Michael Mongin, an engineer at the Air Force Research Lab is working with graduate students from the University of Dayton to conduct experiments using the dSPACE MicroLabBox to uncover the secret of calmer flight.

Research aims to understand the physics of the flow field surrounding a wing undergoing gusts. The Air Force Research Lab and University of Dayton want to understand the changes in the flow field so they can unpack the direct physics of why certain movements are present as gusts interact with the wings.

Once understood, that information can help engineers design controllers for flying through gusty winds with no adverse effects. "We are understanding the dynamics on a deeper level and unraveling how we might use this in the future," the Air Force's Mongin

says. "We are getting closer to having a controller able to demonstrate some pretty high vortex gust rejection and high mitigation rates on the gusts."

Air Force and University of Dayton researchers built a gust generator using the dSPACE MicroLabBox. "I needed to look at the flow fields and study the physics, and the MicroLabBox has been a good means to an end for us because it allows us, through a very familiar programming architecture, Simulink, to write and develop these controllers and control structures for our lab that we can just drop in, plug them in, and run the experiments," Mongin says.

"Before the MicroLabBox was in the lab, researchers would have to come up with open-loop profiles for the wing pitch," Mongin explains. "They had to have perfect models and run prescribed profiles then analyze in post to see how well it did at mitigating. Now we say, 'target this amount of lift', and the controller can make corrections in the loop to get us to the mitigation we want."

For more information contact dSPACE online at www.dspace.com/en/inc/home/products/hw/microlabbox.cfm, the Air Force Research Lab at www.afrl.af.mil, or University of Dayton at https://udayton.edu/engineering/departments/mechanical_and_aerospace/grad_ae/index.php.

PROPULSION

▲ Angola's TAAG Airlines selects Pratt & Whitney Fleet Management program for PW150A engines (art:)

TAAG Angola Airlines E.P., Angola's state-owned airline headquartered in the nation's capital Luanda, needed a company to oversee engine maintenance on its PW150A

turboprop engines. They found their solution from Pratt & Whitney Canada in Longueuil, Quebec.

TAAG signed a six-year Fleet Management Program (FMP) agreement. The engine maintenance services cover the airline's PW150A engines which power their fleet of Dash 8-400 regional turboprops. Pratt & Whitney is an RTX business.

The agreement also includes Pratt & Whitney's proprietary oil-analysis technology and its FAST diagnostic and prognostic solution which captures, analyzes and wirelessly sends full-flight data intelligence to the customer within minutes of engine shutdown.

"With a roughly 75-passenger capacity, optimal fuel efficiency, and overall reliability, the PW150A-powered Dash 8-400 fits our needs," said Nelson de Oliveira, CEO, TAAG Airlines. "P&WC's FMP program is ideal for us as we can rely on the proven expertise of the engine original equipment manufacturer to ensure we gain maximum productivity and efficiency from our PW150A engines."

The PW100/PW150 engine family powers 90 percent of 30- to 90-passenger regional turboprop aircraft operating today. These turboprop engines consume 25 to 40 percent less fuel and produce 50 percent fewer CO2 emissions than similar-sized regional jets.

"Airlines that provide regional connectivity such as TAAG play a vital role in helping customers travel to major urban centers, often for connections to international destinations," says Irene Makris, vice president, Customer Service, Pratt & Whitney Canada. "Consequently, the dispatch reliability of regional aircraft plays a critical role in keeping the entire ecosystem operating efficiently and economically. By maintaining TAAG's PW150A engines we are helping to ensure optimal aircraft availability and engine asset management."

TEST AND MEASUREMENT

► Navy chooses multimeter calibrators from FLUKE for checking power electronics devices

U.S. Navy test and measurement experts needed multimeter calibrators for the Naval Air Systems Command Metrology and Calibration Program. They found their solution from FLUKE Electronic Corp. in Everett, Wash.

Officials of the Naval Surface Warfare Center Corona Division in Norco, Calif., announced a \$33.8 million contract to FLUKE for the company's 5730A/03/AN multimeter calibrators.

The multimeter power electronics calibrators measure AC/DC voltage, AC/DC current, wideband frequency, as well as four-wire and two-wire electrical resistance.

The Navy's Metrology and Calibration (METCAL) program seeks the periodic calibration for equipment used in military electronic systems test and measurement to ensure that test and measurement is as accurate as possible.

The Fluke Calibration 5730A high performance multifunction test system calibrates a wide range of digital multimeters, up to long-scale 8.5 digit digital multimeters, as well as RF voltmeters when equipped with the wideband option.

The 5730A offers improved specifications to help test and measurement experts increase test uncertainty ratios and increase test confidence, company officials say.

These test and measurement units help reduce the need to guardband. The 5730A helps improve performance specifications for AC voltage, AC current, and resistance; offer a 6.5-inch VGA capacitive touchscreen with color graphical user interface; offer visual connection management output terminals to guide connections; have graphical user interfaces in nine languages; are compatible with the FLUKE 52120A and 5725A amplifiers; and offer artifact calibration using 10-volt, 1-Ohm, and 10-kilo-ohm external standards.

On this contract FLUKE will do the work in Everett, Wash., and should be finished by April 2029. For more information contact FLUKE Corp. online at <https://us.flukecal.com>, or the Naval Surface Warfare Center Corona Division at www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Corona. ◀



CONNECTORS

► Rugged 38999 circular connectors for military optical interconnects introduced by TE Connectivity

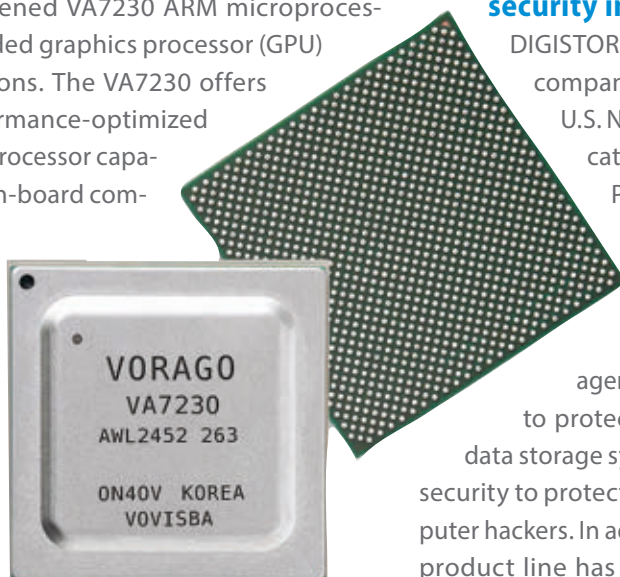
TE Connectivity in Harrisburg, Pa., is introducing VITA 87 high-density circular MT connectors high-density applications. These rugged connectors feature 12 to 24 optical fiber options that house as many as 96 fibers within a compact size 15 shell with 4 MTs. TE's VITA 87 standard connectors helps enable next-generation systems to meet size, weight and power (SWaP) requirements while supporting the high bandwidth needs of emerging data-intensive capabilities. The circular connectors meet the VITA 87 and the Sensor Open Systems Architecture (SOSA) technical standards, and are available in physical contact and lensed versions. These rugged products offer MIL fiber optics cable assemblies to optical add-on and option cards, and to ruggedized uses that involve the MIL-STD 38999 interface. VITA 87 is in process as a new standard for high density MT-based optical interconnects in an M38999 package. For more information contact TE Connectivity online at <https://www.te.com/usa-en/home.html>.



MICROELECTRONICS

▼ Rad-hard ARM microprocessor with embedded graphics for space applications offered by VORAGO

VORAGO Technologies in Austin, Texas, is introducing the radiation-hardened VA7230 ARM microprocessor with an embedded graphics processor (GPU) for space applications. The VA7230 offers a power and performance-optimized applications microprocessor capable of supporting on-board computing, payload processing, and satellite imagery compression and processing. The VA7230 offers two ARM Cortex-A72 cores running as fast as 1.5 GHz. The



embedded graphics processor enables more than 10 billion floating-point operations per second of power-efficient performance to address challenging use cases. The VA7230 is adapted to meet the reliability requirements of space applications by testing and screening to MIL-PRF-38535 Class B, and radiation testing to MIL-STD-883-1. Advanced security features include ARM TrustZone, secure boot, and cryptographic acceleration, the VA7230 provides a tamper proof system to protect your mission critical data. Additionally, deploying an ARM microprocessor provides the ability to leverage the vast ARM software ecosystem. For more information contact VORAGO Technologies online at www.voragotech.com..

SECURE DATA STORAGE

► CSfC-certified data storage for aerospace and defense information security introduced by DIGISTOR

DIGISTOR, a CRU Data Security Group (CDSG) company in Vancouver, Wash., has received U.S. National Security Agency (NSA) certification for the DIGISTOR Citadel C Series Pre-Boot Authentication (PBA) to the Commercial Solutions for Classified (CSfC) storage component list for information security. CSfC listing ensures military and government agencies seeking high data security levels to protect sensitive data. The CSfC-certified data storage system provides pre-boot single-layer security to protect sensitive data from would-be computer hackers. In addition to the CSfC listing, the Citadel product line has been streamlined to focus on the



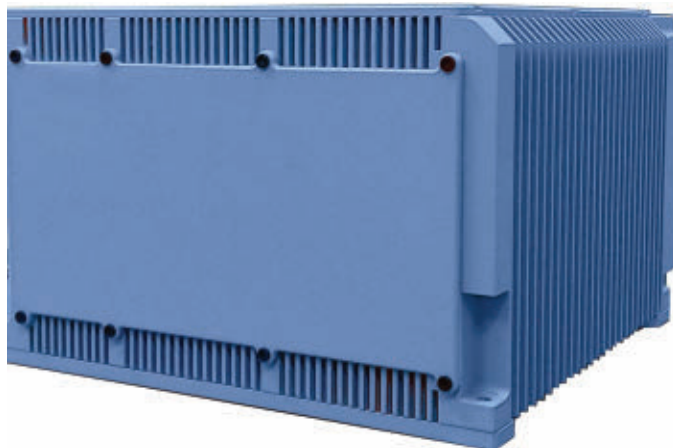
C Series offerings while discontinuing the Citadel K Series products. The company will continue support for Citadel K Series customers and installations. A new Citadel C Series drive, the Citadel C Series PBA, has been added to the C Series Select and the C Series Advanced. The C Series Select and C Series Advanced have several post-boot cyber security features in addition to the core PBA feature while the C Series PBA only contains the PBA feature on a CSfC-listed SSD. For more information contact DIGISTOR online at <https://digistor.com/products/citadel/c-series>.

CHASSIS AND ENCLOSURES

▼ Military-rugged chassis for SOSA-aligned 3U OpenVPX boards introduced by Pixus

Pixus Technologies USA Corp. in Tonawanda, N.Y., is introducing the rugged ATR058F series of electronics chassis in the ATR form factor for aerospace and defense embedded computing applications. The ATR058F series aligns to the Sensor Open Systems Architecture (SOSA)

open-systems standard, and offers supplemental airflow through the chassis sidewalls and a front-loaded configuration. The front-loaded ATR has six slots for VITA 48.2-compliant 3U OpenVPX boards and one slot for a VITA 62 power supply. The backplane options include SOSA-aligned slot profiles and interfaces for optical and RF interfaces through the backplane. The chassis also offers space behind the backplane to mount the Pixus SlotSaver mezzanine-based SOSA-aligned chassis hardware manager. The ATR058F series features optional fans or air ducting for airflow over the fins in the sidewalls of the enclosure for improved cooling of the system, while keeping the plug-in boards sealed. The chassis uses has options for SOSA-aligned power supplies use 12 volts primarily along with some 3.3-volt AUX. A slot for an external quick-access solid state drive (SSD) also is available. For more information contact Pixus Technologies USA online at www.pixus-technologies.com.



EMBEDDED COMPUTING

▲ FPGA mezzanine card (FMC) for radar and electronic warfare (EW) offered by Abaco

AMETEK Abaco Systems in Huntsville, Ala., is introducing the FMC300 wideband low latency FMC module for software defined radio (SDR), electronic warfare (EW), digital radar, and test and measurement applications. The FMC300 integrates high-performance A/D and D/A conversion capabilities into a compact VITA

57.4-standard form factor. The FMC uses the Analog Devices AD9082 and AD9081 software-defined direct RF sampling transceivers. The FPGA mezzanine card (FMC) handles several channels, and offers performance to 12-bit 6-gigasample-per-second RF A/D converter and to 16-bit 12-gigasample-per-second RF D/A converter through a JESD204B/C interface. This module is for low-latency, high-rate sampling operations in SDR, EW, and digital RF memory (DRFM) systems, and offers 7 GHz usable analog bandwidth. When paired with Abaco's field-programmable gate array (FPGA) carrier cards, the FMC300 helps solve difficult challenges when designing modern digital signal processing (DSP) embedded computing systems. The FMC300 offers flexible control options for clock source, sampling frequency, and calibration, as well as individual calibration circuits for gain fine-tuning, offset, phase, and advanced monitoring and power-down modes. For more information contact AMETEK Abaco Systems online at www.abaco.com. ←

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 **AirBorn**
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Boeing predicts China's commercial air fleet to double in next two decades

BY Jamie Whitney

BEIJING—Market analysts at The Boeing Company in Arlington, Va. project that China's commercial airplane fleet will more than double by 2043, driven by the country's growing demand for passenger and cargo air travel.

This is according to Boeing's 2024 Commercial Market Outlook (CMO) for China. The report provides a long-term forecast for the demand for commercial airplanes and related services in the region. Boeing's CMO is available online at <https://www.boeing.com/commercial/market/commercial-market-outlook>.

"China's commercial aviation market for passengers and cargo continues to expand, driven by economic growth and airlines building their in-country networks," says Darren Hulst, Boeing's vice president of commercial marketing. "As this forecast shows, China's airlines will see strong demand, requiring further growth of their modern fuel-efficient fleets."

Boeing predicts that China's commercial fleet will grow by 4.1% annually, increasing from 4,345 to 9,740 airplanes by 2043. The forecast also expects an annual passenger traffic growth rate of 5.9%, exceeding the global average of 4.7%. This growth in passenger volume will be supported by airlines expanding their networks, and connecting large hubs to smaller cities.

▲ **Demand for 8,830 new planes over the next 20 years; about 60% for growth and 40% for replacing older jets with more fuel-efficient models.** 161210688 © Boarding1now | Dreamstime.com

Air travel within China is expected to become the world's largest traffic flow, contributing significantly to the growth of the single-aisle fleet, which will account for more than three-quarters of all new airplane deliveries.

Additionally, China is projected to have the largest wide-body fleet in the world, with demand for 1,575 new widebody airplanes. The country's freighter fleet, which includes both dedicated and converted models, is expected to nearly triple, driven by the rapid expansion of e-commerce.

Beyond airplane deliveries, the growth of China's aviation industry also will create a substantial need for aviation services. Boeing estimates that Chinese carriers will require services worth \$780 billion, including digital solutions, maintenance, and modifications. Furthermore, the industry will need nearly 430,000 new personnel, including pilots, maintenance technicians, and cabin crew, to support the expanding fleet.

Boeing projects that new airplane deliveries in China from 2024 to 2043 will include 365 regional jets, 6,720 single-aisle airplanes, 1,575 widebody aircraft, and 170 freighters, for a total of 8,830 new airplanes. ◀

NASA gauges industry interest in using VIPER lunar rover for moon missions

BY Jamie Whitney

WASHINGTON—The National Aeronautics and Space Administration (NASA) in Washington is looking for industry partners to use the agency's Volatiles Investigating Polar Exploration Rover (VIPER) on the moon.

NASA's VIPER mission is to provide observations and insights into the composition, distribution, and quantity of volatiles in the moon's south polar region. The mission is planned to last 100 Earth days on the lunar surface, with the rover capable of enduring up to 50 hours of darkness on a full charge and conducting approximately nine hours of operations in Permanently Shadowed Regions (PSRs), which are highly likely to contain water ice and other volatiles.

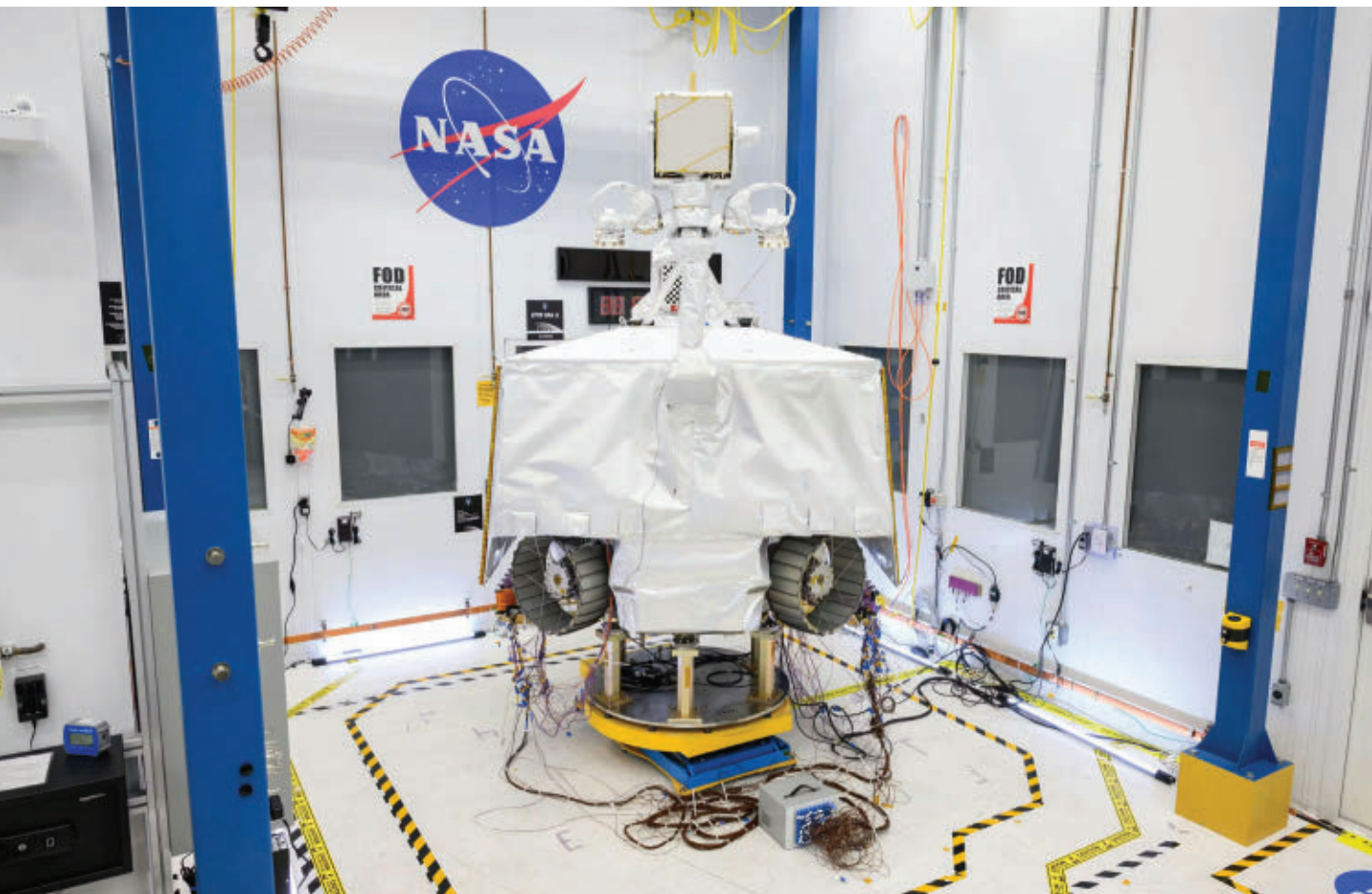
The rover weighs 1,102 pounds, measures 1.5 by 1.5 by 2 meters, and has battery capacity sufficient to survive

several lunar day-night cycles by using strategic hibernation spots.

VIPER is equipped with instruments like a neutron spectrometer, a near-infrared spectrometer, a mass spectrometer, and a drill. A list of technologies and capabilities is online at <https://science.nasa.gov/wp-content/uploads/2024/08/viper-pip-final.pdf>.

Any partners would begin with the existing VIPER rover and be responsible for completing any remaining systems-level testing, coordinating the integration and successful landing on the moon, conducting a science and exploration campaign,

▼ The NASA VIPER robotic moon rover shown in a clean room at NASA Johnson Space Center in Houston.



and openly sharing the science data.

U.S.-based partners also would need to provide the resources to complete the mission from the hardware's current state and reimburse NASA for the use of any NASA capabilities, which includes additional testing, anomaly resolution activities, payload preparation, and processing support, or support from science/instrument/operations teams.

The goal for any partnership is to incur minimal or no additional costs to NASA. If NASA decides to proceed with

this approach, partners would not be allowed to disassemble and use VIPER's instruments or parts separately from a VIPER mission.

Interested parties were asked to submit required documents by September. This request for information's primary point of contact is Brad Bailey, assistant deputy associate administrator for exploration, and can be reached at HQ-VIPER-RFI@nasa.gov. More information is available at <https://sam.gov/opp/31284effc2ba4da4978a6dde931b6250/view>. ◀

FAA lays out 'roadmap' for AI safety in aircraft

The U.S. Federal Aviation Administration (FAA) has released a document to assure safety in the use of artificial intelligence (AI) in airborne and ground systems. The roadmap was developed following two years of meetings with industry. The aircraft and avionics industry has its eyes on AI image processing tasks, among others, but because AI falls outside normal operations it must take a new approach. The FAA established seven guiding principles to provide safety assurance in AI systems in aircraft and ground operations, including the need to use existing civil aviation processes and methods. The agency noted the focus of AI technology needs to be on safety assurances and what safety enhancements can be made. In addition, the FAA cautions against anthropomorphizing the technology. The FAA says it is necessary to differentiate between learned AI and learning AI. The FAA makes the distinction by categorizing learned AI systems as static in their operating environment while learning models continually incorporate adaptations into their reasoning. Finally, the FAA's guidelines include the need to use industry consensus standards. The FAA's Roadmap for AI Safety Assurance document is online at https://www.faa.gov/aircraft/air_cert/step/roadmap_for_AI_safety_assurance.

NASA's 'ultra-cool' quantum sensor demonstrated aboard International Space Station

The National Aeronautics and Space Administration's (NASA) Cold Atom Lab aboard the International Space Station (ISS), is pushing the boundaries of quantum science in space. Recently, the lab's research team achieved a significant milestone by measuring subtle vibrations of the space station using ultra-cold atoms. This marks the first instance where such atoms have been utilized to detect environmental changes in space. A study published on 13 August in *Nature Communications* highlights this breakthrough and reports

the longest demonstration of atoms displaying wave-like behavior during freefall in space. This achievement underscores the potential of the Cold Atom Lab to further quantum science in ways that were previously thought to be impossible in the space environment. The team conducted these measurements using an atom interferometer, a quantum device that can accurately detect forces such as gravity and magnetic fields. On Earth, atom interferometry is employed to explore fundamental forces like gravity and has practical uses in technologies for navigation. While quantum science has already been pivotal in the development of technologies like cell phones and GPS, atom interferometry remains a largely untapped field with considerable promise.

Embraer eyes electric future with Energia aircraft concepts

Aircraft manufacturer Embraer in São José dos Campos, Brazil announced advancements in its Energia sustainable aircraft project, broadening its research focus from 30-seat to 50-seat aircraft. The company also revealed it is now exploring hydrogen gas turbine/dual fuel (GT/DF) technologies, in addition to its existing research into hybrid electric and fuel cell propulsion systems. These developments stem from insights provided by Embraer's Energia Advisory Group, which includes airlines, lessors, suppliers, and other aviation experts. The group advises Embraer on sustainable aircraft development, focusing on propulsion technologies, aerodynamics, structural design, systems integration, and passenger comfort. The goal is to create sustainable and commercially viable aircraft for the future. The updated Energia concepts include advanced airframe designs, improved aerodynamics, enhanced cabin comfort, and reduced noise levels, thanks to rear propulsion configurations. For Hybrid-Electric concepts, Embraer is developing a parallel hybrid electric powerplant, integrating next-generation *Continued on page D5*

FCC announces new rules for dedicated radio frequencies for UAS operators

BY Jamie Whitney

WASHINGTON—U.S. The Federal Communications Commission (FCC) in Washington has adopted new rules for operating drones within the 5 GHz RF and microwave spectrum band, facilitating wireless communications for safe control of uncrewed aircraft systems (UAS).

The UAS market in the U.S. is projected to triple over the next decade and expand into a multi-billion dollar industry, and

these systems are playing a growing role in search and rescue, infrastructure inspection, agriculture, and more.

FCC officials say this establishes rules for operators to obtain frequency assignments in a portion of the 5030-5091 MHz band for non-networked operations.

These new rules rely on dynamic frequency management to coordinate access to approved UAS radio frequencies and enable their safe and efficient use to provide operators with

▼ **Frequency management systems will provide requesting operators with temporary frequency assignments to support UAS control link communications.**

114578120 © Dmitry Kalinovsky | Dreamstime.com



temporary frequency assignments to support UAS control link communications in controlled airspace and other safety-critical circumstances.

"I am pleased that UAS operators will have access to spectrum for exclusive and protected use through dynamic frequency management systems," says FCC commissioner Geoffrey Starks. "Through an automated process, these dynamic frequency management systems will assign a requesting operator the temporary use of certain frequencies for a particular geographic area and time period tailored to the operator's submitted UAS flight plan."

FCC Chairwoman Jessica Rosenworcel emphasized the importance of addressing the spectrum needs of UAS operations

as the technology enables operations from firefighting and news gathering to national security.

"Over the last decade, drones and other unmanned or uncrewed aircraft systems have migrated from novelties in our skies to routine use in modern life," Rosenworcel says. "In 2021 there were 2 million drones in operation in the United States. By 2030, we expect that number to more than triple to 6.5 million."

This action aligns with the FCC's National Spectrum Strategy, previewed in November 2023 to promote growth of UAS operations in the 5 GHz band. The FCC will collaborate with the National Telecommunications and Information Administration (NTIA) and the FAA on future spectrum needs for evolving UAS applications. ◀

Continued from page D3

thermal engines with small electric motors to improve efficiency during takeoff and idle phases. The propulsion system is paired with more electric aircraft systems and a small, cost-efficient battery.

NOAA taps Lockheed Martin to provide next-gen lightning mapping instruments

The National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) needed a company to design and build the next-generation GeoXO Lightning Mapper (LMX) instruments. They found their solution from Lockheed Martin in Denver. The baseline contract is valued at approximately \$297 million for two instruments with options for two additional instruments. LMX, a near-infrared optical instrument designed to detect, locate, and measure lightning flashes in near-real-time. The single-channel instrument will be deployed on NOAA's upcoming GeoXO weather satellites, providing crucial data for severe weather monitoring across the Western Hemisphere. By tracking lightning activity, the system will enhance storm analysis and forecasting, as well as aid in identifying tornado-producing storms. The instrument will also improve hurricane intensity assessments, detect lightning hazards, help identify wildfires, and assist with aviation safety. LMX is an evolution of the Geostationary Lightning Mapper (GLM), the first operational lightning tracker flown in geostationary orbit. The new instrument will offer higher spatial resolution, faster lightning detection, and a broader field of view, including coverage of Alaska. Lockheed Martin will develop and build the LMX instruments at its Sunnyvale,

California facility. The GeoXO satellites represent NOAA's next-generation weather system, following the Geostationary Operational Environmental Satellites (GOES) series. The final satellite in the GOES series, GOES-U, launched on June 25, 2024, and has since been renamed GOES-19 after reaching its geostationary orbit. 1

Boeing's commercial Starliner spacecraft returns to Earth after rocky first mission

The National Aeronautics and Space Administration (NASA) and The Boeing Company in Arlington County, Va., announced that the aerospace giant's Starliner spacecraft safely touched down—uncrewed—at White Sands Space Harbor in N.M. NASA astronauts Butch Wilmore and Suni Williams embarked on their mission aboard the Starliner spacecraft on 5 June, which launched from Cape Canaveral Space Force Station in Fla. as part of the Boeing Crewed Flight Test. The following day, as Starliner neared the International Space Station (ISS), both NASA and Boeing detected helium leaks and encountered problems with the spacecraft's reaction control thrusters. After weeks of in-space and ground-based testing, along with technical discussions and agency assessments, NASA ultimately decided to prioritize crew safety and return the Starliner to Earth without its crew. Wilmore and Williams will remain aboard the space station as part of the Expedition 71/72 mission, with plans to return in February 2025 via NASA's SpaceX Crew-9 mission. NASA's Commercial Crew Program requires a spacecraft to fly a crewed test flight to prove the system is ready for regular flights to and from the orbiting laboratory. Following Starliner's return, the agency will review all mission-related data. ◀

► Proposed changes would introduce type certification and airworthiness requirements to safeguard transport category airplanes, engines, and propellers. 139681595 © Alexandersikov | Dreamstime.com

FAA looks to add cyber security considerations to airworthiness

BY Jamie Whitney

WASHINGTON—The U.S. Federal Aviation Administration (FAA) in Washington is looking to standardize cyber security as part of the agency's airworthiness certification process.

The FAA outlined the agency's reasoning and goals and is seeking comments from the public. The document is available online at <https://www.federalregister.gov/documents/2024/08/21/2024-17916/equipment-systems-and-network-information-security-protection>. Industry comments were due in October 2024.

The proposed changes would introduce type certification and airworthiness requirements to safeguard transport category airplanes, engines, and propellers from intentional unauthorized electronic interactions (IUEI) that could pose safety risks. Applicants for design approval would need to mitigate these hazards and develop Instructions for Continued Airworthiness (ICA) to maintain protections throughout the product's service life.

The trends in airplane design involve a growing integration of systems between airplanes, engines, and propellers, along with increased connectivity to internal and external data networks and services. As a result, regulators and the industry must continuously monitor the cybersecurity landscape to identify and address emerging threats.

One potential vulnerability comes from field loadable software, which can be used to update or modify onboard systems but may also open the door to unauthorized access.

Maintenance laptops, often connected to aircraft systems for diagnostics and repairs, represent another point of entry for cyber threats.

Additionally, airport or airline gate link networks, used for communications between the aircraft and ground systems, can introduce risks, particularly if they are not properly secured. Public networks, such as the internet, also pose a threat, as increased connectivity could allow external attackers to exploit security gaps.

Wireless aircraft sensors and sensor networks, designed to enhance data collection and system performance, may also create vulnerabilities if they are not adequately protected. Similarly, cellular networks, often used for communication and data transmission, can be a target for cyber-attacks if they are not properly managed.

Universal Serial Bus (USB) devices, commonly used to transfer data or install updates, are another potential entry point for malicious software. Satellite communications, which provide critical links for navigation and communication, can also be susceptible to cybersecurity threats.

Portable electronic devices and portable electronic flight bags (EFBs), used by pilots and crew for operational tasks, add another layer of risk due to their connectivity and reliance on digital systems. Lastly, GPS and satellite-based augmentation system digital data can be vulnerable to spoofing or other cyber-attacks that could disrupt operations. ◀