

MARCH/APRIL 2024

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A detailed image of an AGM-183A hypersonic missile in flight. The missile is white with a yellow band around its midsection. It features a blue and yellow circular logo on its side and the text "AGM-183A" and "LOCKHEED MARTIN". The missile is angled upwards against a blue sky with wispy clouds. A bright, fiery exhaust plume is visible at the rear.

## HYPERSONICS INDUSTRY UP TO THE CHALLENGE

Ruggedized electronics are ready  
for the challenges of hypersonic flight. PG. 14

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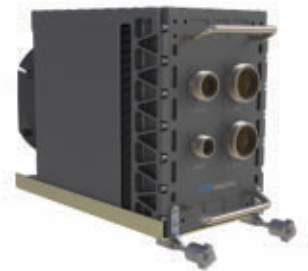
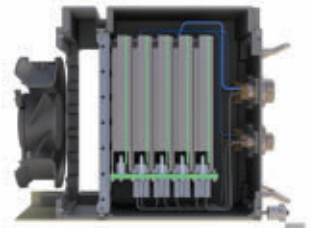
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Military+ Aerospace Electronics®. USPS Permit 5901, ISSN 1046-9079 print, ISSN 2688-366X online, is published 6 times a year in January/February, March/April, May/June, July/August, September/October, November/December by Endeavor Business Media, LLC, 201 N Main St 5th Floor, Fort Atkinson, WI 53538. Periodicals postage paid at Fort Atkinson, WI, and additional mailing offices. POSTMASTER: Send address changes to Military+ Aerospace Electronics, PO Box 3257, Northbrook, IL 60065-3257. SUBSCRIPTIONS: Publisher reserves the right to reject non-qualified subscriptions. SUBSCRIPTION PRICES: U.S. \$171 per year; Canada \$198 per year; All other countries \$224 per year. All subscriptions payable in U.S. funds.

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# Hypersonic technologies are not new, and are ready for the next generations of aircraft and munitions



BY **John Keller**  
EDITOR IN CHIEF

Hypersonic flight for crewed and uncrewed aircraft, as well as smart missiles, is one of the Pentagon's top priorities to keep pace with technological developments in hypersonics in Russia and China. It follows that hypersonics would represent the most cutting-edge enabling technologies, but that would be wrong.

That fact is that U.S. developments in hypersonics — or the ability to fly at speeds in excess of five times the speed of sound — have been in progress now for more than six decades since a U.S. Air Force-NASA North American X-15 rocket-powered aircraft with test pilot Robert White at the controls first took an aircraft hypersonic.

White flew the X-15 experimental aircraft at Mach 5.27, or 4,043.5 miles per hour, on 23 June 1961 after being dropped from a B-52 mothership. It wouldn't be the last manned hypersonic flight in those days. Less than two months later another X-15 flight reached Mach 5.21 on 12 Sept. 1961.

The X-15 would fly hypersonic 110 more times before the program wound-up in 1968, reaching a maximum speed of Mach 6.7, or 5,140.7 miles per hour, on 3 Oct 1967. The speed record set by a manned aircraft that day — more than half a century ago — never has been broken.

Suffice it to say that hypersonic flight isn't new.

The longevity of U.S. research in hypersonic flight is significant because of the many technological lessons learned, ranging from aircraft propulsion, lifting body design, and electronics that can operate through environmental extremes like temperature, shock, and vibration.

The bottom line is nearly all — if not completely all — of the technologies necessary to ruggedize electronic components and subsystems for

hypersonic flight already has been developed and mostly likely perfected.

Microprocessors, general-purpose graphics processing units (GPGPUs), field-programmable gate arrays (FPGAs), power control and conditioning chips, solid-state memory, and many others have been developed that can work through the rigors of hypersonic flight.

Thermal-management techniques, ranging from conduction and convection cooling, to more exotic air-flow-through technologies, and even to liquid-cooling to keep components from exceeding their temperature-design parameters have been developed and deployed.

Techniques are in use not only to keep critical electronics cool, but also to detect when systems start to exceed parameters and throttle-back performance to avoid component damage or destruction.

Packaging is available to shield even somewhat fragile advanced commercial-grade electronic components from damage due to shock, vibration, heat, cold, humidity, and thermal shock. Generations of electrical and aeronautical engineers have had plenty of time to develop what they need for navigation, guidance, situational awareness, timing, targeting, and other capabilities for the next generation of hypersonic munitions.

So where do we go from here? How do systems integrators put together today's electronics, packaging, and thermal management technologies for tomorrow's hypersonic munitions and aircraft?

The answer, essentially, is they already have most if not all of the electronic technologies that they need to meet the design challenges of new hypersonic systems. So what does this all mean for the future of hypersonic munitions and aircraft?

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# Researchers ask industry for new ways of controlling quantum materials for computing and sensors

BY John Keller

ARLINGTON, Va. – U.S. military researchers are asking industry to find ways of using engineered light-matter coupling to control or enhance quantum materials for future quantum computing devices that enable quantum enhanced sensing and information processing.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a solicitation last week (DARPA-EA-24-01-03) for the QUAnTum Materials Engineering using eLEctrOmagNetic fields (QUAMELEON) project.

Optical tools such as high-finesse cavities can enhance interactions among quantum materials to control quantum degrees of freedom of individual atoms in cavity quantum electrodynamics, DARPA researchers say.

For example, cavity-enhanced light-matter coupling with cold atoms has been known to control photon transport and induce a new supersolid quantum phase of matter.

Applying precision optical tools to condensed matter systems may help unlock optically enhanced materials for quantum computing, researchers say. Engineered light-matter coupling, moreover, also could create or enhance phases of matter including superconductivity, ferroelectricity, and magnetism. Light matter coupling also could modify semiconductor exciton physics for quantum information device applications.

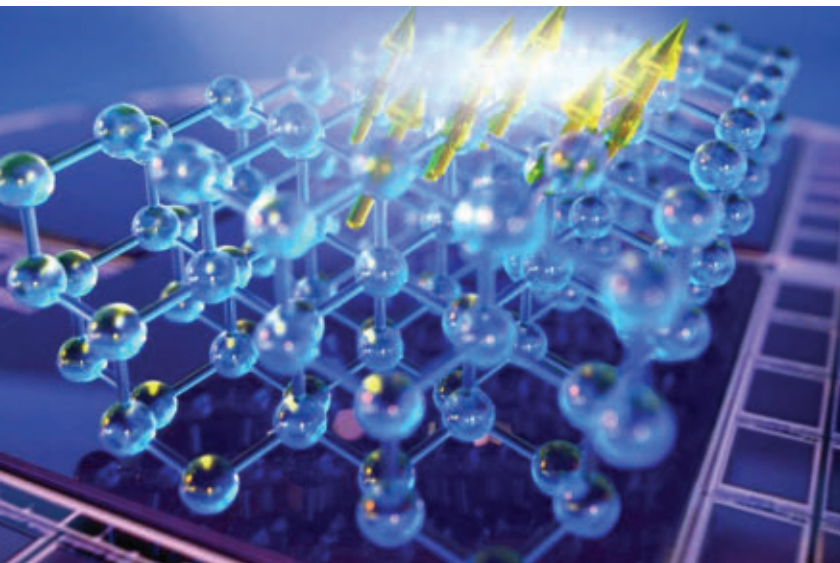
QUAMELEON seeks to push the boundaries of optical control of solid-state materials, and change material properties with electromagnetic fields at the few-photon level.

Of particular interest are systems where engineered light-matter coupling can enhance the inter-particle interactions and correlations in a material, researchers say. The objective is to study condensed matter systems where the coherent interaction between light at the few-photon level and matter results in new physics that could apply to quantum information devices.

These kinds of quantum information systems could include quantum computing, quantum-enhanced sensors, light sources or detectors, transducers, and quantum emulators.

Companies interested should submit abstracts no later than 3 June 2024 to the DARPA submission website at <https://baa.darpa.mil>. Email questions or concerns to [QUAMELEON@darpa.mil](mailto:QUAMELEON@darpa.mil). More information is online at <https://sam.gov/opp/448e4bc-8dc154934a114ed7b06342a50/view>. ◀

◀ **QUAMELEON seeks to push the boundaries of optical control of solid-state materials, and change material properties with electromagnetic fields at the few-photon level.**







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# Ozark Integrated Circuits to develop high-temperature electronic components for hypersonics and jet engines

BY John Keller

ARLINGTON, Va. – U.S. military researchers needed electronic components for extremely hot environments for future hypersonics and jet engine applications. They found a solution from Ozark Integrated Circuits Inc. in Fayetteville, Ark.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced a \$10.9 million contract to Ozark Integrated Circuits for the High Operational Temperature Sensors (HOTS) program.

Physical sensors that can operate in the high-temperature environment will enable systems to operate closed-loop with accurate state-of-health monitoring.

Many commercial and defense systems such as hypersonic aircraft and missiles, automotive, jet engine turbine, and oil-and-gas systems experience thermal environments beyond the capability of today's high-performance physical sensors, DARPA researchers explain.

Yet today's state of the art typically cannot operate in temperatures higher than 225 C because of intrinsic limitations to their complementary metal oxide silicon (CMOS) materials.

The HOTS program will develop a technology for high-bandwidth high-dynamic-range sensing that operates at temperatures of 800 C and hotter.



▲ DARPA is supervising a project to develop a technology for high-bandwidth high-dynamic-range sensing that operates at temperatures of 800 degrees Celsius and hotter.

DARPA wants chip designers at Ozark Integrated Circuits to develop a pressure sensor module with an integrated transducer and signal-conditioning microelectronics, as a demonstration of electronic components that could withstand the high temperatures of hypersonic missiles and aircraft, or for internal use in advanced jet engines.

While wide-bandgap materials like silicon carbide (SiC) or gallium nitride (GaN) have potential for use at high temperature due to their significantly lower intrinsic carrier

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### DARPA eyes harvesting electric power from microscopic sea life to power ocean sensors

U.S. military researchers are approaching industry to develop ways to harvest energy from microscopic sea life like dissolved organic matter, phytoplankton, bacteria, and microscopic zooplankton into electric power. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001124S0010) for the BioLogical Undersea Energy (BLUE) program. BLUE seeks to develop self-refueling electric power generation that enable remote ocean sensors like seabed-mounted sensor and profiling systems to operate far longer than possible by batteries alone. BLUE will demonstrate a persistent, sustainable, low-environmental-impact source of electric power that provides ultralong endurance and high payload capacity to remote ocean sensors, which hold great potential for national security, understanding dynamics of marine environments, and monitoring marine climate change. BLUE technologies will self-refuel on input materials, which are readily available in many marine environments; prevent capture of macroscopic living marine

organisms; operate while submerged; will be durable, reliable, deployable; operate in diverse locations; operate independently with consistent electrical power production; and have negligible ecological and environmental impact. BLUE contractors will choose input materials like dissolved organic matter, phytoplankton, and zooplankton as input materials to convert to electrical power. Companies interested in participating in the BLUE program should email abstracts no later than 14 March 2024, and full proposals no later than 30 April 2024 to the DARPA BAA website online at <https://baa.darpa.mil>. Email questions or concerns to Leonard M. Tender, the DARPA BLUE program manager, at [BLUE@darpa.mil](mailto:BLUE@darpa.mil). More information is online at <https://sam.gov/opp/78e3b1374f5b415c82cc2c85d54a8481/view>.

### Seamless Air Alliance works to integrate 3GPP 5G satellite networks into aviation sector

The Seamless Air Alliance (SAA) in Fremont, Calif. announced it will foster the development and integration of 3GPP specified 5G NTN into the aviation sector to enable future connectivity between *Continued on page 13*

concentration, today they do not support sensor microelectronics with high bandwidth and large dynamic range at high operating temperature for useful lifetimes.

At high temperatures these materials can crack because of their coefficients of thermal expansion. They also can leak current because of the increase in thermal carriers. HOTS will be a 36-month program broken into two phases.

To overcome these kinds of thermal limitations, HOTS seeks to overcome three key technical challenges: achieving long lifetime and large bandwidth transistors at high temperature; achieving a high-sensitivity transducer at high temperature; and integrating a high operating temperature sensor without degrading performance. For more information contact Ozark Integrated Circuits online at [www.ozarkic.com](http://www.ozarkic.com), or DARPA at [www.darpa.mil](http://www.darpa.mil). ◀

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# Industry asked to harvest electric power for military battery charging using local CO2 sources

BY John Keller

ARLINGTON, Va. — U.S. military researchers are asking industry to generate fuel from local sources of carbon dioxide to provide electric power and battery charging for military battlefield operations.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001124S0014) for the Expeditionary Carbon Utilization for Energy Resilience and Stabilization (ExCURSion) project.

Batteries and fossil fuels dominate today's technologies for portable energy storage and use by expeditionary forces. While batteries can be recharged from any voltage source, yet most chargers suffer from energy density so low as to make them infeasible for military missions that require low size, weight, and power consumption (SWaP). Although hydrocarbon-based fossil fuels have much higher energy density, they still require regular, costly, and dangerous resupply.

Instead, DARPA researchers seek the ability to generate fuel from local sources of carbon dioxide to combine the high

**▲ DARPA researchers seek the ability to generate fuel from local sources of carbon dioxide to combine the high energy density of fossil fuels with the energy-source-agnostic advantage of electric systems.**

energy density of fossil fuels with the energy-source-agnostic advantage of electric systems to revolutionize expeditionary energy logistics.

Combining carbon dioxide capture and storage with carbon dioxide reduction to energy-storing fuel would enable

a completely closed system able to capture its own combustion stream and recharge its fuel content on energy input, researchers say.

Such a system could take advantage of the high energy density of traditional fossil fuels and the operational flexibility of an electric battery system.

The ExCURSion program seeks to enable carbon dioxide reduction, capture, and storage as key components for a future self-enclosed system to create liquid carbon fuels for storage and use on military missions. This approach could enable safe, field-deployable, high-density, and rechargeable energy storage.

The goals of the ExCURSion proposers day are to introduce the research community to the ExCURSion program vision



and goals; explain the mechanics of a DARPA program and milestones; and encourage teaming among potential bidders.

A carbon fuel cell prototype that is closed, portable, rechargeable, will generate electricity from fuel, and capture its own CO<sub>2</sub> exhaust to regenerate fuel. The program and a potential follow-on prototype effort will enable safe, high-density, and rechargeable energy storage in the field.

ExCURSion confronts two primary challenges: producing liquid fuel from CO<sub>2</sub> is at least 30 times slower than lithium battery recharging; and capturing and storing CO<sub>2</sub> from exhaust is plagued by the tradeoff between the working capacity and the stability of the materials used.

ExCURSion has two technical areas: CO2 reduction to high-energy-density fuel, primarily focusing on the rate of fuel generation; and CO2 capture and storage, primarily focusing on working capacity and stability. DARPA briefed industry on ExCURSion on 1 March 2024. Agency officials say they plan to award several contracts.

Other efforts have focused on carbon dioxide capture and storage. Just last November a researcher at Boston University in Boston won a DARPA Young Faculty Award for chemically developing a new material to capture carbon dioxide in

a targeted and efficient way, according to a story published by the Boston University College of Engineering.

DARPA recognized Joerg Werner for his work in developing a material to capture carbon dioxide in efforts to isolate and remove this gas from breathable air supplies in enclosed spaces like submarines, underground bunkers, and crewed spacecraft.

“Especially for a space station, you need a very small, lightweight air purification system that uses very little energy,” Werner was quoted in a story headlined Clearing the Air in the Boston University publication (<https://www.bu.edu/eng/2023/11/27/clearing-the-air/>).

Meanwhile, companies like ExxonMobil in Houston and Battelle Memorial Institute in Columbus, Ohio, are recognized leaders in the capture and storage of carbon dioxide.

Companies interested in participating in the ExCURSion effort were asked to submit abstracts by 8 March, and full proposals by 29 April 2024 to the DARPA Broad Agency Announcement Tool (BAAT) online at <https://baa.darpa.mil/Public/SecurityAgreement>. Email questions and concerns to DARPA's Keith Whitener, the ExCURSion program manager, at [ExCURSion@darpa.mil](mailto:ExCURSion@darpa.mil). More information is online at <https://sam.gov/opp/f2d3da78e85447ae922079c05b5194bc/view>. ◀



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# NASA launches new mission to study Earth's climate, ocean, and atmosphere)

BY Jamie Whitney

CAPE CANAVERAL SPACE FORCE STATION, Fla. - The U.S. National Aeronautics and Space Administration (NASA) has launched a satellite mission to study ocean health, air quality, and the effects of a changing climate. The satellite, which is dubbed PACE for plankton, aerosol, climate, and [ocean] ecosystem, launched on 8 February 2024. The PACE mission will study the effects of microscopic life in water and microscopic particles in the air.

The satellite's hyperspectral ocean color instrument will enable researchers to measure oceans and other waterbodies across ultraviolet, visible, and near-infrared light to track the distribution of phytoplankton and — for the first time from space — identify which communities of these organisms are present on daily, global scales. Scientists and coastal resource managers can use the data to help forecast the health of fisheries,

track harmful algal blooms, and identify changes in the marine environment.

The spacecraft also carries two polarimeter instruments, Hyper-Angular Rainbow Polarimeter #2 and Spectro-polarimeter for Planetary Exploration. These will detect how sunlight interacts with particles in the atmosphere, giving researchers new information on atmospheric aerosols and cloud properties, as well as air quality at local, regional, and global scales.

With the combination of the instrument and the polarimeters, PACE will provide insights into the interactions of the ocean and atmosphere, and how a changing climate affects these interactions.

Earth's oceans are responding in many ways to climate change — from sea level rise to marine heat waves to a loss of

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biodiversity. With PACE, researchers will be able to study climate change's effects on phytoplankton, which play a key role in the global carbon cycle by absorbing carbon dioxide from the atmosphere and converting it into their cellular material. These tiny organisms drive larger aquatic and global ecosystems that provide critical resources for food security, recreation, and the economy.

"After 20 years of thinking about this mission, it's exhilarating to watch it finally realized and to witness its launch.

I couldn't be prouder or more appreciative of our PACE team," said Jeremy Werdell, PACE project scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "The opportunities PACE will offer are so exciting, and we're going to be able to use these incredible technologies in ways we haven't yet anticipated. It's truly a mission of discovery."

NASA's Launch Services Program, based at the agency's Kennedy Space Center in Florida, managed the launch



▲ The PACE mission will study the effects of microscopic life in water and microscopic particles in the air.

services for the mission. The PACE mission is managed by NASA Goddard, which also built and tested the spacecraft and the ocean color instrument. The Hyper-Angular Rainbow Polarimeter #2 was designed and built by the University of Maryland, Baltimore County, and the Spectro-polarimeter for Planetary Exploration was developed and built by a Dutch consortium led by Netherlands Institute for Space Research, Airbus Defence, and Space Netherlands. ←

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# Wanted: framework on the ethical use of artificial intelligence (AI) for the military

BY John Keller

**ARLINGTON, Va.** — U.S. military researchers are asking industry to explore the ethics and technical challenges of using artificial intelligence (AI) and machine autonomy in future military operations.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) have released a broad-agency announcement for the Autonomy Standards and Ideals with Military Operational Values (ASIMOV) project.

ASIMOV aims to develop benchmarks to measure the ethical use of future military machine autonomy, and the readiness of autonomous systems to perform in military operations.

The rapid development of machine autonomy and artificial intelligence (AI) technologies needs ways to measure and evaluate the technical and ethical performance of autonomous systems. ASIMOV will develop and demonstrate autonomy benchmarks, and is not developing autonomous systems or algorithms for autonomous systems.

The ASIMOV program intends to create the ethical autonomy language to enable the test community to evaluate the ethical difficulty of specific military scenarios and the ability of autonomous systems to perform ethically within those scenarios.

ASIMOV performers will develop prototype modeling environments to explore military scenarios for machine automation and its ethical difficulties. If successful, ASIMOV

will build some of the standards against which future autonomous systems may be judged.

ASIMOV will autonomy benchmarks — not autonomous systems or algorithms for autonomous systems — will include an ethical, legal, and societal implications group to advise the performers and provide guidance throughout the program.

ASIMOV contractors will develop prototype generative modeling environments to explore scenario iterations and variability across increasing ethical difficulties. If successful, ASIMOV will build the foundation for defining the benchmark with which future autonomous systems may be gauged.

ASIMOV will use the Responsible AI (RAI) Strategy and Implementation (S&I) Pathway published in June 2022 as a guideline for developing benchmarks for responsible military AI technology. This document lays out the five U.S. military responsible AI ethical principles: responsible, equitable, traceable, reliable, and governable.

A measurement and benchmarking framework of military machine autonomy will help inform military leaders as they develop and scale autonomous systems — much like Technology Readiness Levels (TRLs) developed in the 1970s that today are used widely.

Companies were asked to submit proposals by March. Email questions or concerns to DARPA at [HR001124S0011@darpa.mil](mailto:HR001124S0011@darpa.mil). More information is online at <https://sam.gov/opp/bebfb61ed56e4d78bdefde9575b2d256/view>. ◀



*Continued from page 7* terrestrial and non-terrestrial satellite networks. In mobile satellite services, historical reliance on proprietary technologies has impeded seamless integration with terrestrial networks. Airlines have faced substantial challenges due to the lack of interoperability among various satellite providers' In-Flight Connectivity (IFC) offerings, attributed to differences in modems, antennas, and frequencies. The Seamless Air Alliance (SAA) established a dedicated Non-Terrestrial Network (NTN) Working Group to tackle these issues. This group is focused on ensuring that 5G NTN addresses the distinct challenges of the aviation industry and has unveiled its inaugural white paper. The document delineates crucial factors and considerations for implementing 5G NTN in IFC, emphasizing the potential for a substantial evolution towards a fully interoperable aviation connectivity solution. The SAA was founded by Airbus, Delta, OneWeb, Sprint, and Airtel to work to provide seamless in-flight technology connectivity and now has dozens of airline and technology partners. It comprises seven specialized working groups chaired by experts in telecommunications, aeronautics, and connectivity technologies.

### **Woods Hole to develop sensors and automation for unmanned underwater vehicles(UUVs)**

U.S. Navy researchers needed new sensor technologies for next-generation unmanned underwater vehicles (UUVs). They found their solution from the Woods Hole Oceanographic Institution in Woods Hole, Mass. Officials of the Office of Naval Research in Arlington, Va., announced a \$13.6 million contract to Woods Hole for the 'Development, Integration, Test, and Demonstration of Next-Generation Autonomous Underwater Vehicle Sensors and Capabilities' effort. Woods Hole experts will advance the capabilities of autonomous underwater vehicles by focusing on improving or increasing vehicle endurance, speed, sensors, and autonomous performance in different environmental conditions. Woods Hole engineers will explore and evaluate new vehicle designs, and autonomous teaming scenarios for unmanned vehicle innovation. On this contract Woods Hole will do the work in Woods Hole, Mass., and should be finished by March 2027. For more information contact Woods Hole Oceanographic Institution online at [www.whoi.edu](http://www.whoi.edu), or the Office of Naval Research at [www.nre.navy.mil](http://www.nre.navy.mil). ←

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# Advanced hypersonic munitions and

## Industry shows it's up to the challenge

Military systems designers are applying technological lessons learned over the past six decades to perfect hypersonics enabling technologies in materials, thermal management, and electronics ruggedization.

▲ The U.S. Air Force's Air-launched Rapid Response Weapon (ARRW) combines critical high-speed flight technologies and accelerates the weaponization of air-to-ground hypersonic strike capabilities. All photos courtesy Lockheed Martin



# eed ersonics itions d aircraft



BY John Keller

**D**eveloping enabling technologies for hypersonic flight — or the ability to move at speeds of Mach 5 or faster — is one of the highest research priorities at the U.S. Department of Defense (DOD). The pressing need for hypersonics comes from a perception that the U.S. military may be behind Russia and China in developing hypersonic technologies, so defense officials are all-in on research and development to bring this about.

There's good reason for the attention. Hypersonic munitions are unlike any other weapon, in that they can move at Mach 5, or even faster. The central issue is warning time; a

missile traveling at five times the speed of sound is going about 3,800 miles per hour.

That's more than a mile per second. Target a ship at sea from 100 miles away with such a hypersonic missile, and that ship's crew has less than two minutes to detect, identify, and track the incoming missile, and then bring defensive weapons to bear and fire. Count to 105, and that's all the time that ship has to defend itself — only if it has sufficient sensors and weaponry, and only if everything works right.

A hypersonic missile traveling at Mach 5 could reach a target 20 miles away in about 21 seconds. It would take a



▲ Hypersonic munitions can travel in excess of five times the speed of sound, which gives adversaries very little time to detect, classify, and deploy countermeasures.

subsonic anti-ship missile more than four minutes to land an attack from 20 miles away. Viewed in these terms, hypersonic munitions are the weapons of the future.

### Hypersonic development

There are a wide variety of high-visibility DOD projects to develop hypersonic technologies. Some of these projects involve propulsion to accelerate munitions and aircraft to speeds approach Mach 25, or 19,181.7 miles per hour. Some involve lifting bodies able to sustain those kinds of speeds without disintegrating, and some involve ruggedizing electronic and electro-optical components and subsystems to operate through the extremes in shock, vibration, and heat of hypersonic flight.

The Hypersonic Air-breathing Weapon Concept (HAWC) of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., is developing technologies for a scramjet-powered hypersonic air-launched cruise missile project. In tests, the scramjet propelled the missile faster than Mach 5, or about 3,300 miles per hour.

HAWC technologies are expected to go into future hypersonic production missiles to be carried aboard aircraft like the B-1 strategic bomber, the F-25 joint strike fighter, and perhaps even the F/A-18 jet fighter-bomber. Successful HAWC test flights happened in 2021, 2022, and 2023.

Lockheed Martin Corp. in Bethesda, Md., is leading several hypersonics research and development projects. Programs under contract include:

- the U.S. Air Force's Air-launched Rapid Response Weapon (ARRW), which combines critical high-speed flight technologies and accelerates the weaponization of air-to-ground hypersonic strike capabilities;

- the U.S. Navy's Conventional Prompt Strike (CPS) weapon system and the U.S. Army's Long Range Hypersonic Weapon (LRHW), which use a common hypersonic all up round; and

- the U.S. Navy's Hypersonic Air-Launched Offensive Anti-Surface Warfare (HALO) system.

CPS is a hypersonic boost-glide missile development and test program that provides longer range, shorter flight times, and high survivability against enemy defenses.

The ARRW program seeks to mature critical technologies to high speed flight, and accelerate the weaponization of hypersonic strike capabilities. The hypersonic weapon is being designed to travel at 3,800 miles per hour.

### LRHW project

LRHW, meanwhile, will leverage the common hypersonic boost glide all up round and, in partnership with the US Navy's CPS program, introduce a new class of ultrafast and maneuverable long-range missiles with the ability to launch from ground mobile platforms.

Just last summer the U.S. Army awarded a \$428.3 million four-year order to Leidos Dynetics Technical Solutions (DTS) in Huntsville, Ala., to develop prototype glide bodies for hypersonic weapons that could see applications across all





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▲ U.S. Army's Long Range Hypersonic Weapon (LRHW) uses a common hypersonic all-up round, which it shares with the U.S. Navy's Conventional Prompt Strike (CPS) weapon system.

U.S. military services. The Common-Hypersonic Glide Body (C-HGB) prototypes. DTS is a wholly owned subsidiary of Leidos Dynetics.

The Army three years ago awarded a \$352 million contract to DTS to produce the first commercially manufactured set of C-HGB systems. DTS is working with Lockheed Martin Corp.

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to support integration and prototyping of the new C-HGB, which is expected to be available across military services to provide commonality to air, land, and sea hypersonic weapons.

Lockheed Martin Corp. is working with the Army on multi-year hypersonic weapons development in support of the Army's focus on long-range precision-strike missiles.

Lockheed Martin is prime contractor for the Long-Range Hypersonic Weapon (LRHW) systems integration project. The Lockheed Martin-team will develop and integrate a land-based hypersonic strike missile prototype in partnership with the Army Hypersonic Project Office.

The Lockheed Martin LRHW team includes DTS; Integration Innovation Inc. (i3) in Huntsville, Ala.; Verity Integrated Systems in Huntsville, Ala.; Martinez & Turek Inc. in Rialto, Calif.; and Penta Research Inc. in Huntsville, Ala.

The LRHW prototype will capitalize on the C-HGB and introduce a new class of ultrafast and maneuverable long-range missiles with the ability to fire from mobile ground launchers. Hypersonic munitions travel at speeds at least as fast as Mach 5, or five times the speed of sound.

Hypersonic strike weapons are a key aspect of the Army's Long Range Precision Fires (LRPF) effort to develop long-range artillery-delivered munitions able to fire as far as 187 miles, as well as the national security strategy to compete with and outpace potential enemies in hypersonics.

### HALO project

HALO enables carrier-based aircraft to conduct stand-off strikes against high-value surface threats. It penetrates near-peer air-defense systems to defeat high-value surface threats, so the Navy can operate in and control contested battles paces.

The Navy is ready to approach industry to develop a new hypersonic munition that can be launched from carrier-based

aircraft for attacking enemy surface ships and shore installations. The Hypersonic Air-Launched Offensive Anti-Surface Warfare (OASuW) (HALO) Weapon System, if successful, may replace or augment a variety of today's anti-ship missiles.

Preliminary development of HALO has been handled by Lockheed Martin Corp. and by Raytheon Technologies Corp. (RTX) in Tucson, Ariz. HALO likely will augment or replace current carrier-based anti-ship missile systems like the Long

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▲ **The U.S. Navy's Hypersonic Air-Launched Offensive Anti-Surface Warfare (HALO) system enables carrier-based aircraft to conduct stand-off strikes against high-value surface threats.**

Range Anti-Ship Missile (LRASM), Harpoon, and Penguin missiles. Hypersonic missiles typically will be for attacking high-value targets like enemy capital ships, command posts, or forward-staging areas.

The HALO hypersonic weapon should have early fielding by 2029, and first operational capability by 2031. Only eligible prime contractors who have experience with carrier-based hypersonic weapons development — like Raytheon and Lockheed Martin — will have access to the upcoming HALO solicitations.

HALO engineering and manufacturing development (EMD) will design, develop, and test this weapon system, including the HALO all-up-round; system security; operational test and evaluation; and moving the HALO system into production. More information is online at <https://sam.gov/opp/af555b72c98b424bbccc0141302daa46/view>.

Additional hypersonic projects are in progress throughout the U.S. military services.

### **HACM program**

The HAWC program gave rise to the U.S. Air Force Hypersonic Attack Cruise Missile (HACM) program to create a scramjet-powered hypersonic missile as an operational weapon. HACM contractors include Raytheon Technologies Corp. in Arlington, Va., and Northrop Grumman Corp. in Falls Church, Va. Future HACM munitions will go aboard

aircraft such as the Boeing F-15EX and F-15E Strike Eagle jet fighter bombers.

Raytheon and Northrop Grumman are working under terms of a \$985.3 million order announced in September 2022 to develop one of the first hypersonic cruise missiles to be in the U.S. inventory.

The hypersonic operating environment involves heavy exposure to shock, vibration, heat, and thermal shock, so its guidance and navigation technologies must be specially hardened to withstand such severe operating conditions.

The HACM hypersonic missile will have scramjet engines, which use high vehicle speed to compress incoming air forcibly before combustion, which enables sustained flight at hypersonic speeds. By traveling at these speeds, hypersonic weapons like HACM can reach their targets more quickly than similar traditional missiles, and potentially evade air defenses.

Raytheon and Northrop Grumman have worked together since 2019 to develop, produce, and integrate Northrop Grumman's scramjet engines onto Raytheon's air-breathing hypersonic weapons.

The HACM project incorporates enabling technologies from other research projects. In 2020, the Air Force joined Australia in a multi-year project called the Southern Cross Integrated Flight Research Experiment (SCIFiRE) to develop air-breathing hypersonic cruise missile prototypes. The Air Force awarded three 15-month SCIFiRE contracts in June 2021 to Boeing Co., Lockheed Martin Corp., and Raytheon to complete preliminary designs of a hypersonic cruise missile.

The HACM program will bring the Raytheon SCIFiRE prototype design into production for fighter aircraft integration, and deliver two leave-behind assets with operational



utility. Through SCIFiRE, the U.S. and Australia will continue collaborating on HACM design and development, including using Australian test sites for the initial all-up-round flight tests. The Air Force plans to deliver a HACM capability with operational utility by 2027.

### Hypersonic aircraft

Today's hypersonic research initiatives are not limited only to missiles. The U.S. National Aeronautics and Space Administration (NASA) Glenn Research Center in Cleveland has awarded contracts collective worth \$5.1 million to The Boeing Co. and Northrop Grumman Corp. for the High-Speed Endoatmospheric Commercial Vehicle Conceptual Design Study and Technology Roadmaps Development project.

NASA is seeking to develop enabling technologies for high-speed commercial transports able to fly at speeds between Mach 2 and Mach 5 that could enter service as early as the 2030s. Mach 3 to Mach 5 represent speeds between 1,535 and 3,836 miles per hour.

The Boeing Defense, Space & Security segment in St. Louis won a \$2.6 million contract, and the Northrop Grumman

Aeronautics Systems segment in Palmdale, Calif., won a \$2.5 million contract.

These studies will identify key technology needs and opportunities to enable high-speed commercial passenger aircraft. Specific speed, passenger count, range, and allowable technology readiness level has yet to be negotiated.

NASA's Hypersonic Technology and Commercial Supersonic Technology projects fall under the NASA Advanced Air Vehicles Program, which will lead efforts to develop an environmentally sustainable civilian high-speed aircraft.

### Hypersonic flight isn't new

There's a widely held perception that hypersonic flight is a recent innovation, and that its enabling technologies represent the cutting-edge of development. Nothing could be farther from the truth, experts say. The U.S. Air Force-NASA North American X-15 rocket-powered experimental aircraft first broke the Mach-5 hypersonic barrier nearly 63 years ago on 23 June 1961.

That aircraft flew experimental flights for nearly a decade from 1959 to 1968, and for its day set speed and altitude records and crossed the edge of outer space. That plane's fastest speed



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was Mach 6.7 (5,140.7 miles per hour) during a flight on 3 Oct. 1967. Later on, the NASA Space Shuttle flew as fast as Mach 25 as it re-entered the Earth's atmosphere. Aeronautical and electronics engineers have had more than six decades to apply the lessons learned since the first hypersonic flights. They've shown that it can be done.

"There's a lot of hype in hypersonics," says Andrew Knoedler, a program director for the adaptive communications and sensing product line at the BAE Systems Electronic Systems segment in Nashua, N.H. "There was a lot of hype over the last five years, maybe longer, that hypersonics is really, really hard. I think we need to do our deliberate engineering as we have done before. Many of these lessons learned can be applied to hypersonic munitions and manned aircraft." Knoedler also has experience with the Air Force and DARPA on hypersonics research projects.

### Ruggedizing electronics for hypersonics

Hypersonic aircraft and munitions must withstand environmental extremes in temperature, shock, and vibration. The electronics for communications, navigation, guidance, and sensors must have the ability to operate through the shock of launch, vibration from the buffeting the munitions experience while traveling through the turbulent atmosphere at high speeds, the high temperatures of friction through the atmosphere, and the temperature shock of moving rapidly from high to low altitudes.

▲ **The U.S. Navy's Conventional Prompt Strike (CPS) is a hypersonic boost-glide missile development and test program that provides long range, short flight times, and high survivability against enemy defenses.**

Several research projects are in progress to help the electronics in hypersonic vehicles operate reliably in these kinds of difficult conditions. One particular challenge is to enable commercial-grade cutting-edge electronic technologies to function aboard hypersonic vehicles so that these new designs can be reliable and affordable.

Lockheed Martin officials say the biggest challenge when developing hypersonic munitions are the effects speed has on the system. Going greater than Mach 5 speeds bring multi-faceted heat related challenges. For example, you're not just managing the heat for the flight vehicle externally, but our engineers also are challenged to keep the internal capability of high-speed objects functioning throughout that heat load.

Last fall the Northrop Grumman Mission Systems segment in Linthicum Heights, Md., won a \$9.2 million DARPA contract for the Miniature Integrated Thermal Management Systems for 3D Heterogeneous Integration (Minitherms3D) project. Minitherms3D seeks to develop scalable thermal management technologies to help control heat in future electronics architectures that involve 3D heterogeneous integration (3DHI) chip stacks.



The Minitherms3D program seeks to revolutionize 3DHI thermal management and significantly reduce thermal resistances within the 3D stack and external to the stack of 3DHI systems, while increasing volumetric heat removal. The project seeks thermal management technology scalable to an arbitrarily large number of high-power tiers in 3DHI chip stacks. Northrop Grumman will handle the program's 18-month first phase. Program goals include 3D stacking of five tiers with total heat dissipation more than 6.8 kilowatts with the heat rejection system limited to less than 0.006 cubic meters.

Continued rapid growth of compact high-performance microsystems is limited by inadequate integrated thermal management, including acquisition of heat from 3D integrated circuits, to the heat's transport and ultimate rejection to the ambient environment. For example, the state of the art in 3DHI in high-performance computing typically uses one tier of logic and several tiers of high-bandwidth memory. Stacking of logic is currently limited to low-power tiers.

Three-dimensional (3D) stacking of several tiers of high-power logic and other functional blocks, including

radio frequency devices, offers significant advancement in future microsystems, but today is infeasible because of insufficient in-plane and out-of-plane heat acquisition from each tier, and poor thermal isolation between functional blocks.

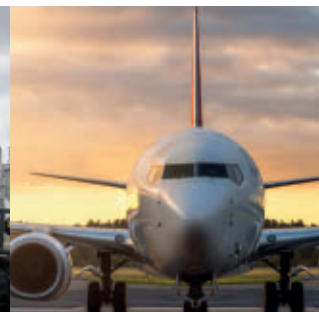
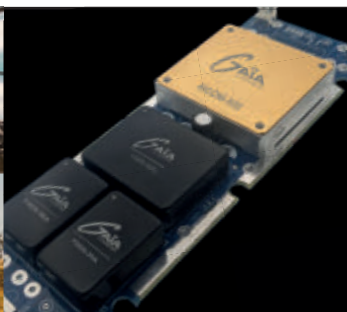
The Minitherms3D project has two technical challenges: reducing thermal resistances within the 3D stack; and reducing thermal resistance external to the 3D stack. Reducing thermal resistances within the 3D stack involves increasing in-tier heat transfer without increasing tier thickness. Regions of average heat flux more than 150 Watts per square centimeter along with localized hot spots more than 1 kilowatt per square centimeter in 3DHI tiers simultaneously must be managed thermally to maintain acceptable chip temperatures.

### DARPA HOTS

In March DARPA announced a \$10.9 million contract to Ozark Integrated Circuits Inc. in Fayetteville, Ark., for the High Operational Temperature Sensors (HOTS) program to design electronic components for extremely hot environments for future hypersonics and jet engine applications. The HOTS program will develop a technology for



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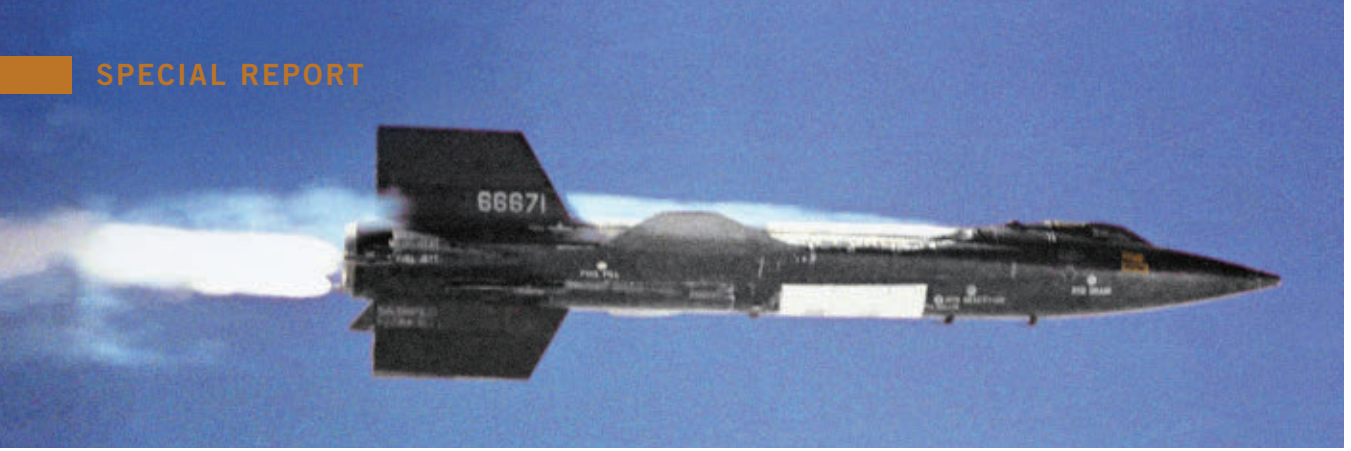


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Many commercial and defense systems such as hypersonic aircraft and missiles, automotive, jet engine turbine, and oil-and-gas systems experience thermal environments beyond the capability of today's high-performance physical sensors, DARPA researchers explain. Yet today's state of the art typically cannot operate in temperatures higher than 225 C because of intrinsic limitations to their complementary metal oxide silicon (CMOS) materials.

DARPA wants chip designers at Ozark Integrated Circuits to develop a pressure sensor module with an integrated transducer and signal-conditioning microelectronics, as a

▲ **The U.S. Air Force-NASA North American X-15 rocket-powered experimental aircraft first broke the Mach-5 hypersonic barrier nearly 63 years ago on 23 June 1961.**

demonstration of electronic components that could withstand the high temperatures of hypersonic missiles and aircraft, or for internal use in advanced jet engines.

While wide-bandgap materials like silicon carbide (SiC) or gallium nitride (GaN) have potential for use at high temperature due to their significantly lower intrinsic carrier concentration, today they do not support sensor microelectronics with high bandwidth and large dynamic range at high operating temperature for useful lifetimes.

At high temperatures these materials can crack because of their coefficients of thermal expansion. They also can leak current because of the increase in thermal carriers. HOTS will be a 36-month program broken into two phases.

To overcome these kinds of thermal limitations, HOTS seeks to overcome three key technical challenges: achieving long lifetime and large bandwidth transistors at high temperature; achieving a high-sensitivity transducer at high temperature; and integrating a high operating temperature sensor without degrading performance.

### Electronics design challenges

Lockheed Martin officials say the primary enabling technologies for hypersonics are advanced high-temperature materials made from complex combinations of constituent compounds and elements. Company engineers are adapting these materials to aeroshells for vehicles such as for hypersonics.

Lockheed Martin engineers are learning how to take these exotic materials and create manufacturing processes that can produce them reliably by bringing together engineering across design, test, design for manufacturing, and design for producibility.

They key to designing electronics that can withstand the environmental challenges of hypersonic flight involves applying past lessons learned, as well as common-sense engineering, says BAE Systems's Knoedler.

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▲ **The U.S. Air Force Hypersonic Attack Cruise Missile (HACM) program seeks to create a scramjet-powered hypersonic missile as an operational weapon.**

“Look at the Space Shuttle. It had two different trajectories — getting into orbit for 10 to 15 minutes above Mach 1. Coming back it starts at Mach 25, and goes down to zero. A lot of those challenging conditions already have been figured out. In some situations you get a blackout, when the air ionizes, and you get a lot of interfering electricity around the vehicle itself. We make sure to place the antennas in the right places and choose the right frequencies.”

The first space shuttle flights did not involve satellite navigation with the Global Positioning System (GPS), but later flights had GPS navigation through technology upgrades. “They had to put those antennas in the right spots so they were not affected by the environment as much,” Knoedler says. “There always will be some ionization around the vehicle; it’s just about antenna location. That’s where the analysis comes in, a good understanding of the atmosphere where you will be at a certain time, and the trajectories. We have very good models of that.”

Hypersonic flight also has a similar challenge dealing with shock and vibration. “We need to know where those shocks might interfere with your other shocks, and this has to do with the vehicle geometry,” Knoedler says. “You have to understand shocks; you need to understand your thermal environment, when you get heating on the outside of the vehicle, and you have to manage the heat in that environment.”

Sometimes design tradeoffs in hypersonic vehicles involve the right choice of materials to survive high temperatures. “The trajectory you want the vehicle to fly through will determine your thermal profile,” Knoedler explains. “The Space Shuttle designers chose a ceramic for the heat-resistant tiles, and they had to design antennas to work with that ceramic.”

Just above hypersonic speeds, for example, designers might be able to use traditional materials that are not made from

exotic composites, such as a metal alloy that might survive that particular trajectory. Yet at upper hypersonic speeds near Mach 10, designers might have to make decisions about blending a metal alloy and composite materials, or not use metal at all.

“They are trying to make technology tradeoffs at the higher heat load of a hypersonic vehicle’s trajectory,” Knoedler explains. “They can manage the heat on the outside, and determine how that heat transfers from the outside to the inside of the vehicle, which leads to the internal thermal environment and how long you can last at a particular level.” ◀

The advertisement features a dark background with glowing blue lines. At the top left is the 'NEW WAVE DV Design &amp; Verification' logo. To the right are four circular icons showing a tank, a helicopter, a ship, and a jet. Below the logo is a yellow banner that says 'Now Shipping'. The main text 'VERSAL® HARDWARE' is in large, bold, white letters. To the right of this text is an image of a Versal AI-enabled chip. Below the main text are images of various electronic components and circuit boards. At the bottom left, a box contains contact information: 'Experts standing by. Contact us today!', 'newwavedv.com', 'info@newwavedv.com', and '+1-952-224-9201'. At the bottom right is the 'SOSA' logo with the text 'Sensor Open Systems Architecture MEMBER'.





# The next generation in digital sensor and signal processing

The latest data processors, artificial intelligence (AI), and open-systems standards help render mountains of sensor data into actionable intelligence at the edge.

BY Jamie Whitney

**T**oday's warfighters and those who command them have more intelligence at their fingertips than the combined generations that preceded them. Actionable intelligence comes from an exponentially larger amount of information, and all of this data stems from a torrent of sensors.

▲ A U.S. Air Force senior airman writes down radar data while Southwest Asia on a mission aboard the E-3 Sentry radar reconnaissance aircraft.

Sensor and signal processing, driven by cutting-edge technological advancements, has become the linchpin of military systems, reshaping the way armed forces perceive, analyze, and respond to threats.

In military systems, signal processing is crucial for various applications, including radar for target detection and tracking, communications for secure information

exchange, electronic warfare (EW) for signal jamming and deception, and intelligence gathering through signals intelligence (SIGINT). The ability to process and interpret signals accurately is vital for the success and efficiency of modern military operations.

Thanks to advancements in processing technology, even more of the information is turned into intelligence closer to the sensor resulting in the ability to seize an advantage more quickly than in the past.

Emil Kheyfets, director of engineering at Aitech Systems in Chatsworth, Calif., says that the biggest trend the company is seeing in sensor and signal processing is the movement of processing tasks to artificial intelligence at-the-edge (AIAE) systems.

“Modern sensors produce large amounts of data, so from a technology perspective, the growth area is to improve data processing and reaction time speed, Kheyfets says. “To do this, the data needs to be processed as close to the sensors as possible. In the mil-aero environment, reaction time is a critical factor for lives saving decisions.”

### AI-enabled

Artificial intelligence (AI) plays a significant role in enhancing military signal processing capabilities. The integration of AI into military systems brings about improvements in speed, accuracy, and adaptability, enabling more effective and efficient processing of signals.

AI algorithms can be trained to automatically recognize and classify different types of signals. This includes identifying specific communication protocols, radar signatures, or EW signals. Machine learning models, such as neural networks, can learn patterns and features from large datasets, allowing for rapid and accurate signal identification.

“Besides AIAE capabilities, high-performance AI-enabled embedded computing systems are capable of fully autonomous operation with minimal or with no interaction with command centers,” Aitech’s Kheyfets says. “The increased robustness of advancing AI algorithms enables their use in safety-critical applications throughout uncrewed and autonomous systems. It also helps missions continue when faced with jammed communications.”

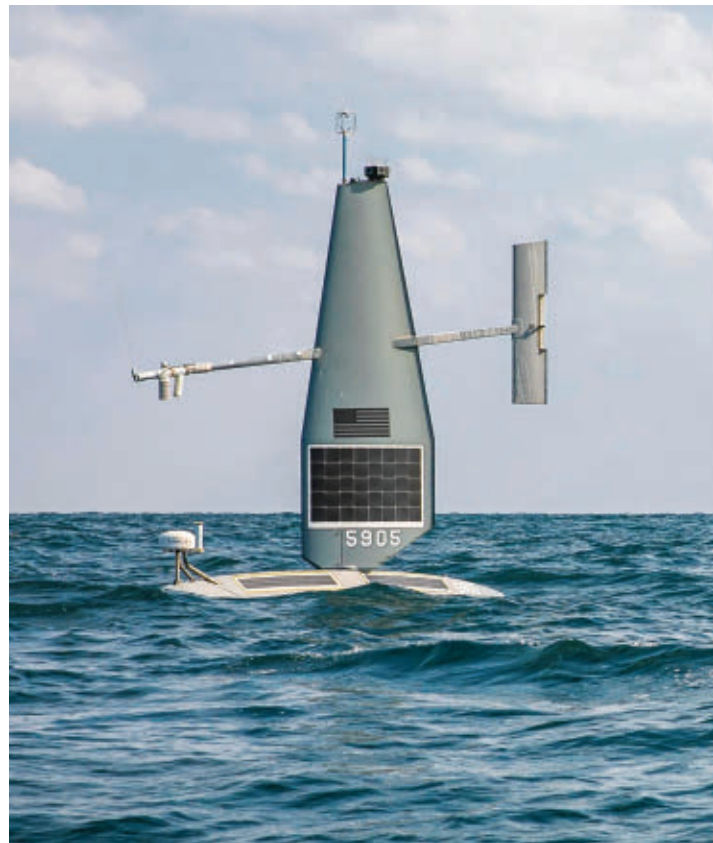
As AI and machine learning are effective at recognizing patterns in a mountain of data, it is also useful in finding anomalies in the same information. This capability is valuable for identifying potential threats or irregularities in the electromagnetic spectrum. Anomalous signal detection can help in early warning systems, where deviations from normal patterns could indicate the presence of adversarial activities or EW.

AI algorithms can help reduce false alarms by distinguishing between genuine threats and harmless signals or noise. By continuously learning and refining their models, AI systems become more adept at filtering out non-critical information and focusing on signals of strategic importance.

Kevin So, director of product marketing for the Microchip Technology communications business unit in Chandler, Ariz., says that processing power is key to enabling autonomous operations.

“Autonomous systems need to have the smarts to quickly process the necessary data to make real-time decisions, like vision systems in autonomous aircraft or spacecraft. This requires a certain level of AI/machine learning capabilities. More and more embedded processors will need to support various degrees of hardware accelerated vector processing to support the unique workloads in autonomous systems.”

Aitech’s Kheyfets concurs, saying “High-performance AI-enabled embedded computing systems, high-definition sensors, and related software enable AIAE capabilities, which



▲ Two Saildrone Explorer unmanned surface vessels operate in the Arabian Gulf during the International Maritime Security Construct’s Sentinel Shield exercise that emphasized unmanned and artificial intelligence systems and digital sensor and signal processing.



allow for high precision and high-speed data processing that enhance decision-making abilities. Making the right decisions faster than adversaries helps mission readiness and mission success on the battlefield.”

In radar and sensor systems, AI can track multiple targets simultaneously, and predict their future movements. This capability is crucial for air defense, missile systems, and surveillance applications.

AI algorithms enable adaptive digital signal processing, where systems can adjust their parameters dynamically based on changing conditions. This is important in EW scenarios, where adversaries may employ tactics to evade detection. AI allows military systems to learn and adapt to new signal characteristics and tactics, enhancing overall resilience.

### Open standards

While today’s embedded computing systems must process an incredible amount of information, such systems also must adhere to the U.S. Department of Defense (DOD) requirement for manufacturer-agnostic components and open system standards to enable interoperability in design.

One such avenue in this arena is seen in The Open Group’s Sensor Open System Architecture (SOSA) initiative. With SOSA, innovation and the insertion of new technologies become more straightforward. As new sensor technologies emerge, they can be integrated into existing systems without

disrupting the entire architecture. This facilitates the continuous improvement of military capabilities over time, and in the case of signals processing, intelligence is provided closer to the edge.

SOSA also supports scalability, allowing systems to be easily scaled up or down based on mission requirements. Whether it’s adding new sensors, expanding the capabilities of existing ones, or integrating with other systems, SOSA provides a scalable framework that accommodates evolving needs.

Standardization through SOSA simplifies maintenance and logistics. With a common set of interfaces and protocols, it becomes easier to manage and support sensor systems in the field. This is crucial for ensuring the reliability and availability of systems in mission-critical situations.

Microchip’s So says open systems requirements are taking off -- literally -- for non-terrestrial tech.

“While there are space-specific system standards, they often face interoperability challenges,” says So. “However, as the space market continues to expand, driven by both commercial/private



▲ The Aitech A179 Lightning rugged embedded supercomputer is optimized for low size, weight, and power consumption (SWaP) that houses an NVIDIA Jetson Xavier NX system-on-module with 6 TFLOP performance at 15 Watts of power.

▼ Microchip Technology is developing NASA’s High-Performance Spaceflight Computing (HPSC) processor that will provide at least 100 times the computational capacity of current spaceflight computers.



applications and as well as the new space race, we see SOSA as a natural model for this segment.

He continues, “Specifically, we are seeing strong interests in standardized, interoperable, and radiation-hardened embedded processing single board computers (SBCs) for space applications in systems for both defense and non-defense. Besides interoperable SBCs, we are seeing the need for systems to support SSD [solid state drive] based NVMe drives to support real-time, localized, data and imaging processing in conjunction with FPGA-based hardware accelerators cards – all of which are interconnected with standardized open networking protocols like Ethernet and PCI Express (PCIe).”

Microchip’s So explains that his company views the adoption of open and standardized technologies in networking as a key focus.

“Specifically, we see Time Sensitive Networking (TSN) being strongly evaluated and embraced by various [aerospace and defense] agencies, in everything from ground-based vehicles to fixed-wing aircraft and spacecraft.

He continues, “Today’s modern ground and aerospace platforms require high-bandwidth and deterministic

networking. Historically, with bandwidth not being a challenge, this requirement was met with legacy control bus protocols like MIL-STD-1553 or proprietary/single-vendor/expensive technologies like Time-Triggered Ethernet (TTE). However, these technologies are no longer sufficient in today’s high-bandwidth environments. This is where TSN comes in. TSN is an industry-standard, multi-vendor-based protocol that delivers deterministic and fault-tolerant networking with the bandwidth scalability of standard Ethernet. TSN is proven and used in a variety of non-[aerospace and defense] applications already today, from industrial automation to automotive networking. Most recently, IEEE has enhanced TSN with an aerospace-specific profile called ‘P802.1DP – TSN for Aerospace Onboard Ethernet Communications.’ These enhancements address the unique needs of [aerospace and defense] applications.”

### Staying open

So also notes that Microchip anticipates that the RISC-V ISA standard will be increasingly leveraged in the military and aerospace sector.

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“No longer just an emerging interest, but a growing requirement is to leverage the RISC-V ISA for embedded processing,” So says. “RISC-V is especially suitable for supporting the needs of workloads requiring power efficient vector instruction set processing in image and vision processing applications.

RISC-V is an open-source instruction set architecture (ISA) based on reduced instruction set computing (RISC) principles. It is designed to be simple, modular, and extensible, providing a foundation for building various processor implementations. RISC-V is unique in that it is open-source and freely available, allowing anyone to design, implement, and distribute processors based on the RISC-V ISA without licensing fees.

Like SOSA, the RISC-V ISA is designed to be scalable from small, embedded devices to large, high-performance computing systems. This scalability makes it suitable for a wide range of applications, from microcontrollers to data center servers.

According to RISC-V International, the nonprofit organization shepherding the instruction set, there are now nearly 4,000 RISC-V members across 70 countries, including processing giants like Qualcomm, Intel, and AMD.

“RISC-V combines a modular technical approach with an open, royalty-free ISA — meaning that anyone, anywhere can benefit from the IP contributed and produced by RISC-V,” the organization says. “As a non-profit, RISC-V maintains no commercial interest in products or services. As an open standard, anyone may leverage RISC-V as a building block in their open or proprietary solutions and services.”

Microchip’s So says that “As an open standard, RISC-V allows companies and agencies to innovate cost effectively. With the recent formation of RISC-V Software Ecosystem (RISE) by the Linux Foundation, the software ecosystem for RISC-V will further be accelerated to ensure broad market adoption.”

## Making space

Operating in the vacuum of space makes signal and sensor processing technologies a bit more difficult than their Earthbound cousins. In the latter half of 2022, officials of the U.S. National Aeronautics and Space Administration (NASA) announced the agency’s Jet Propulsion Laboratory

had tapped Microchip Technology to develop the agency’s High-Performance Spaceflight Computing (HPSC) processor that will provide at least 100 times the computational capacity of current spaceflight computers.

“This cutting-edge spaceflight processor will have a tremendous impact on our future space missions and even technologies here on Earth,” Niki Werkheiser, director of technology maturation within the Space Technology Mission Directorate at NASA headquarters in Washington said when the contract was announced. “This effort will amplify existing spacecraft capabilities and enable new ones and could ultimately be used by virtually every future space mission, all benefiting from more capable flight computing.”

Over three years, Microchip aims to architect, design, and deliver the HPSC processor, intending to use it in upcoming lunar and planetary exploration missions. Microchip’s processor architecture is anticipated to enhance overall computing efficiency for these missions by allowing scalability of computing power based on mission requirements.

The design will prioritize reliability and boast increased fault tolerance. The processor is expected to empower spacecraft computers to perform calculations at speeds as fast as 100 times quicker than current state-of-the-art space computers. This initiative is part of NASA’s ongoing commercial partnership endeavors and will be executed through a \$50 million firm-fixed-price contract, with Microchip making substantial contributions toward research and development costs to successfully conclude the project.

Existing computing technology designed for space missions tends to focus on addressing the most computationally demanding aspects of a mission, resulting in overdesign and inefficient utilization of computing power. Take a Mars surface mission, for instance, where high-speed data movement and intensive calculations are crucial during the planetary landing sequence.

However, routine mobility and science operations necessitate fewer calculations and tasks per second. Microchip’s innovative processor architecture introduces flexibility, allowing processing power to adapt based on current operational needs. Additionally, specific processing functions can be deactivated when not in use, effectively reducing power consumption. This capability is expected to significantly conserve energy and enhance overall computing efficiency for space missions.

When asked about technologies his company offered that showcased data processing prowess, Aitech’s Kheyfets cited their small form factor, rugged AI-capable supercomputers designed for uncrewed and autonomous systems like drones, uncrewed ground vehicles, and robotics. ◀



## SIGNAL PROCESSING

For more information on this topic search for "signal processing" at [www.militaryaerospace.com](http://www.militaryaerospace.com)

# Pacific Defense to develop electromagnetic warfare and cyber warfare technologies

BY John Keller

ARLINGTON, Va. — U.S. Navy researchers needed open-systems electromagnetic warfare enabling technologies based on artificial intelligence (AI) and machine learning. They found their solution from Pacific Defense Strategies Inc. in El Segundo, Calif.

Officials of the Office of Naval Research in Arlington, Va., announced a \$17.4 million contract to Pacific Defense for the Common Sensor Platform for Strategic and Distributed Autonomous Cyber-Electronic Warfare (EW) project.

Pacific Defense will develop an artificial intelligence (AI) and machine learning-enabled common EW sensor-effectuator for future tactical AI, machine learning, cyber warfare, and EW at the tactical edge.

The open-systems hardware and software standard called CMOSS — which is short for C5ISR/Electronic Warfare Modular Open Suite of Standards — will help guide Pacific Defense's technology development. C5ISR stands for command, control, computers, communications, cyber, intelligence, surveillance, and reconnaissance.

Pacific Defense will develop distributed AI capabilities such as autonomous cyber-EW effects for use in several vehicles in RF-denied and -intermittent environments; cooperative distributed EW; a web-based smart user interface for mission planning; and command, control, and situational awareness.

Pacific Defense also will build CMOSS-compliant marine electromagnetic warfare ground systems sensors for small unmanned aerial vehicles (UAVs). Electromagnetic warfare involves high-energy RF and laser weapons.

On this contract Pacific Defense will do the work in El Segundo, Calif.; Pittsburgh; and Fairfax, Va., and should be finished by March 2026. The contract is part of the Long Range Broad Agency Announcement (N00014-23-S-B001) for Navy and Marine Corps science and technology. ◀

For more information contact Pacific Defense Strategies online at [www.pacific-defense.com](http://www.pacific-defense.com), or the Office of Naval Research at [www.nre.navy.mil](http://www.nre.navy.mil).

◀ Pacific Defense will develop distributed AI capabilities such as autonomous cyber-EW effects for use in several vehicles in RF-denied and -intermittent environments







# Mercury to provide DRFM for electronic warfare (EW) on unmanned targets

BY John Keller

CHINA LAKE NAVAL AIR WEAPONS STATION, Calif. – U.S. Navy electronic warfare (EW) experts needed digital RF and microwave technology to support the AN/ULQ-21(V) EW jammer. They found their solution from Mercury Systems Inc. in Andover, Mass.

Officials of the Naval Air Warfare Center Weapons Division at China Lake Naval Air Weapons Station near Ridgecrest, Calif., announced a \$243.8 million contract to Mercury for digital radio frequency memory (DRFM) units and incidental teardown, repair, and upgrades to the AN/ULQ-21(V).

DRFM electronic jammers provide coherent time delay of RF signals in applications like radar and electronic warfare. It also produces coherent deception radar jamming by replaying a captured radar pulse with a small delay, which makes the target appear to move.

DRFM also can modulate captured pulse data in amplitude, frequency, and phase to provide other affects. A Doppler shift correlates range and range rate trackers in the radar.

▲ Mercury Systems will provide digital radio frequency memory (DRFM) for the U.S. Navy AN/ULQ-21(V) electronic countermeasures system for use in targets, aircraft external stores, and aircraft installations.

DRFM also can replay captured radar pulses many times to fool the radar into perceiving many targets.

The AN/ULQ-21(V) is an electronic countermeasures system that simulates electronic countermeasures threats. The digital computer-controlled electronic countermeasures system is for use in targets, aircraft external stores, aircraft internal installations, laboratory applications, and land-based instrumentation sites.

The ULQ-21 generates electronic noise, deception, transponder, and a combination electronic countermeasures to enable manned aircraft and unmanned targets to simulate observed and projected electronic countermeasures.

The current ULQ-21 countermeasures has several interchangeable modules for configuration versatility.

Experts also are developing miniaturized payloads for small aerial targets such as the BQM-74.

The Navy's AN/ULQ-21 can produce noise and deception techniques across the 850 MHz to 18 GHz frequency range that are either generic or validated high-fidelity simulations of specific foreign electronic attack systems.

Mercury also has developed the modular digital receiver exciter (MoDREx) to help generate electronic attack techniques, ranging from individual emitters to several independently operated emitters. MoDREx emitter filtering separates several emitter signals, while its adaptive technique generation responds to emitter changes.

MoDREx technology features integrated wideband digital; receiver and controller; one to six RF converter modules; one to 12 micro-DRFM modules; integrated wideband digital receiver and controller; emitter characterization and identification; a library of electronic attack techniques; ability to track as many as 12 simultaneous time coincident emitters; and multi-threat signal sorting and routing to assigned RF converter and micro-DRFMs.


On this contract Mercury will do the work in Cypress, Calif., and should be finished by February 2029. This contract supports Small Business Innovation Research Phase III topic N06-036 titled, "Advance Techniques for Digital Radio Frequency Memory" for the Navy. ←

For more information contact Mercury Systems online at [www.mrcy.com](http://www.mrcy.com), or the Naval Air Warfare Center Weapons Division-China Lake at [www.navair.navy.mil/nawcawd](http://www.navair.navy.mil/nawcawd).

### **SRI International test space high-power RF and microwaves with Stanford dish antenna**

U.S. Navy researchers needed a company to conduct experiments in low-frequency high-power RF and microwave signals for airplanes and spacecraft. They found their solution from SRI International in Menlo Park, Calif. Officials of the Naval Research Laboratory (NRL) in Washington have chosen SRI to conduct research experiments with the NRL-owned Bluestar 150-foot RF and microwave antenna located on the campus of Stanford University in Palo Alto, Calif. SRI experts will conduct low-frequency high-power RF experiments with the Bluestar antenna to take research into the next phase of RF exploration for space and aircraft where power levels will be pushed to maximum to determine what the antenna can produce. The Bluestar antenna, known at Stanford as The Dish, is a 150-foot-diameter radio antenna was built in 1961 by the Stanford Research Institute (now SRI International). In the 1960s the antenna provided information on Soviet radar by detecting radio signals bounced off the moon. Custom-designed hardware will execute the software. The contractor must have an access or right-to-use agreement with Stanford University to gain access to the system. In its 63-year history the Bluestar antenna also has transmitted signals to each of the Voyager spacecraft that NASA dispatched into the outer reaches of the solar system, and helped rescue the amateur radio satellite UoSAT-1. For more information contact SRI International online at [www.sri.com](http://www.sri.com), or the Naval Research Laboratory at [www.nrl.navy.mil](http://www.nrl.navy.mil). ←

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# Marine Corps orders 28 unmanned quadcopter aircraft for battlefield resupply

BY John Keller

**PATUXENT RIVER NAS, Md.** – U.S. Marine Corps logistics experts needed small unmanned aircraft to resupply warfighters on the battlefield. They found their solution from The Survice Engineering Co. LLC in Belcamp, Md.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced an \$11 million order to Survice Engineering for 28 TRV-150C Tactical Resupply Unmanned Aircraft Systems.

Survice Engineering is a partner to Malloy Aeronautics Ltd. in Berkshire, England, which manufactures the TRV-150 — a medium-size unmanned aerial vehicle (UAV) able to lift a 150-pound cargo payload as far as 44 miles at speeds close to 70 miles per hour. The order includes one year of support.

The TRV-150 can deliver ammunition, weapons, food and water, medical supplies, and other crucial equipment to Marines on the battlefield. The quadcopter UAV is 6.7 feet wide, 8.7 feet long, and 3.5 feet wide. One person can carry the UAV in a special carrying case.

▲ **The TRV-150 can deliver ammunition, weapons, food and water, medical supplies, and other crucial equipment to Marines on the battlefield.**

The TRV-150, designed for battlefield resupply, is a U.S. Marines for a program of record under NAVAIR PMA-263. The unmanned aircraft is for intra-installation logistics; base security and defense; search and rescue; disaster relief and humanitarian aid; aerial survey and detection; and island clean-up and invasive species control.

The UAV can lift 150-pound cargo payloads in all weather, and has a removable battery. The Marines first commissioned the UAV for battlefield use in 2022.

On this order Survice Engineering will do the work in Churchville, Md., and should be finished by March 2025. For more information contact Survice Engineering online at [www.survice.com](http://www.survice.com); Malloy Aeronautics at [www.malloyaeronautics.com/index.html](http://www.malloyaeronautics.com/index.html), or Naval Air Systems Command at [www.navair.navy.mil](http://www.navair.navy.mil). ◀



# Navy wants unmanned systems to detect and clear unexploded ordnance at airfields

BY John Keller

ARLINGTON, Va. — U.S. Navy researchers are asking industry to design lightweight systems to detect and clear unexploded ordnance rapidly in areas as large as military airfields from safe distances.

Officials of the U.S. Office of Naval Research in Arlington, Va., have issued a solicitation (N0001424SC001) for the Automated Target Recognition for Rapid Area Detection “ATR for RAD” and Rapid Large Area Clearance of Unexploded Ordnance “RLAC” project.

The project has two tracks: automated target recognition for rapid area detection; and rapid large area clearance.

Automated target recognition seeks commercial solutions to enable an automated target recognition for rapid assessment including detection, identification and mapping of unexploded ordnance in large operational airfields. Rapid large area clearance seeks enabling technologies to detect, identify, map, and clear unexploded ordnance at standoff distances. Proposers can participate in both tracks.

Technologies developed in the ATR for RAD and RLAC project should be able to detect and neutralize unexploded ordnance as small as a golf ball, and as large as 155-millimeter artillery shells. Solutions also should be able to identify other hazards such as impact craters, unexploded ordnance penetrator holes and debris.

The desired solution is an edge-processed capability with a high probability of detection and identification, low false alarm rate, and low circular error of probability for geolocation of unexploded ordnance.

Solutions should be as small as a small-unmanned system with as many as two small unmanned aircraft systems and one medium sized explosive ordnance disposal robot that can survey the airfield

autonomously. Solutions for ATR for RAD can be algorithms that can process video feed that can be trained on-site.

Proposers must provide small unmanned aircraft and sensor payloads with well-defined physical and logical interfaces, and that can be trained on site.

The RLAC capability should involve a modular architecture with known interface control documents for integration with several services and the capability to hand over unexploded ordnance geolocations to tools. It should mitigate or clear with techniques that can be deployed via small unmanned systems.

Companies interested were asked to email unclassified solution briefs by February to the Navy’s Jean McGovern at [jean.m.mcGovern.civ@us.navy.mil](mailto:jean.m.mcGovern.civ@us.navy.mil) and Patrick Smith at [patrick.j.smith5.ctr@us.navy.mil](mailto:patrick.j.smith5.ctr@us.navy.mil). Those submitting promising solution briefs may be asked to submit full proposals.

Email technical questions or concerns to the Navy’s Jean McGovern at [jean.m.mcGovern.civ@us.navy.mil](mailto:jean.m.mcGovern.civ@us.navy.mil) and Patrick Smith at [patrick.j.smith5.ctr@us.navy.mil](mailto:patrick.j.smith5.ctr@us.navy.mil). Email business questions to Derek Petersen at [derek.w.petersen.civ@us.navy.mil](mailto:derek.w.petersen.civ@us.navy.mil). More information is online at <https://sam.gov/opp/221a69be370a4f0cab32cec3560c1ef0/view>. ←

► **Researchers want technologies to detect and neutralize unexploded ordnance as small as a golf ball, and as large as 155-millimeter artillery shells.**





# Pyka delivers first large-scale autonomous electric cargo aircraft to AFWERX

BY Jamie Whitney

**NEW BRAUNFELS, Texas** - The U.S. Air Force has taken delivery of the first of three planned Pelican Cargo uncrewed aircraft from Pyka in Oakland, Calif.

Flight operations personnel from Pyka and the Air Force Research Laboratory Work Project (AFWERX) gathered on the tarmac at New Braunfels National Airport, Texas, to watch the arrival of Pyka's large-scale autonomous electric cargo aircraft with a 400-pound payload capacity and 200-mile range, built for remote off-airport operations.

Pyka's commercial-based aircraft were delivered on lease to AFWERX, the innovation arm of the Department of Air Force (DAF) and a directorate within the Air Force Research Laboratory, for the United States Air Force's Agility Prime program. The program will explore operational use cases for Pyka's technology to address challenges in the DAF.

"The AFWERX Agility Prime program looks forward to learning about the deployment and operational capabilities of electric aircraft through this contract," said Lt Col John Tekell, Agility Prime Branch Chief.

▲ **The Pyka large-scale autonomous electric cargo aircraft has a 400-pound payload capacity and 200-mile range; it's built for remote off-airport operations.**

The California-based startup's commercial solutions could strengthen the national defense of the United States of America. As the largest autonomous electric cargo aircraft in its class, Pelican Cargo can take off and land in remote

areas with minimal ground infrastructure can be recharged in under 90 minutes, and requires few personnel to operate.

Pyka says its Pelican Cargo is powered with a redundant power system, which includes three 25-kilowatt electric motors and three batteries, and its airframe and structural components are made of carbon fiber composite parts and features 3D printed assemblies and corrosion-resistant metallic components.

"We're proud to deliver Pelican Cargo to AFWERX for the United States Air Force's Agility Prime program," says Michael Norcia, chief executive officer at Pyka. "Our aircraft offers an unparalleled platform for heavy-payload and long-range autonomous electric cargo logistics. We believe the DAF is an ideal customer to harness the benefits of this technology and is helping to advance zero-emission aviation in the United States by partnering with companies like ours." ◀



# Reliable Robotics awarded military approval for its commercial autonomous flight system

BY Jamie Whitney

**MOUNTAIN VIEW, Calif.** - Reliable Robotics, an aircraft automation systems company in Mountain View, Calif., has received military airworthiness approval to begin flight testing and operational missions of its remotely piloted Cessna 208 Caravan for the U.S. Air Force.

This approval with the U.S. Department of Defense (DOD) enables Reliable to demonstrate dual-use automated flight capabilities for military use cases, including cargo missions.

DOD airworthiness policies require all Air Force aircraft to complete an airworthiness assessment for adherence to Air Force standards. To meet these requirements, Reliable completed a safety analysis, maintenance and operational evaluations, and testing of the automated flight technologies. This airworthiness achievement was a milestone of Reliable's Phase III Small Business Innovation Research (SBIR) contract.

The Reliable autonomous flight system enables the aircraft to be operated remotely by a pilot on the ground. The company says this improves safety by automating the aircraft through all phases of operation including taxi, takeoff, and landing.

Reliable's system is aircraft-agnostic and uses several layers of redundancy and advanced navigation technology for the integrity and reliability necessary for uncrewed flight. The system will prevent controlled flight into terrain (CFIT) and loss of control in flight (LOC-I), which account for most fatal aviation accidents.

The Cessna Caravan is designed and manufactured by Textron Aviation Inc. in Wichita, Kan. Reliable Robotics has been collaborating with Textron Aviation, which includes the Beechcraft, Cessna, and Hawker brands.

The Caravan, and other regional cargo aircraft like it, connect communities and businesses across the U.S. and



▲ The Reliable autonomous flight system enables a ground pilot to operate the aircraft to improve safety in automating the aircraft through taxi, takeoff, and landing.

around the globe. With a useful load of over 3,000 pounds, and a take-off performance to operate from short runways, these aircraft deliver time-sensitive shipments to many places that would otherwise not have next-day or same-day service. Remote piloting will allow even more areas to benefit from this critical service.

"Our AFWERX partners are developing exciting automation technologies through robust engineering and flight test campaigns," said Hank "Hog" Griffiths, AFWERX airworthiness and test lead. "The technology is maturing rapidly and this airworthiness approval for a certified aircraft retrofitted with an autonomous flight system provides significant opportunities for the military."

Reliable's collaboration with the Air Force Research Laboratory (AFRL) and AFWERX began in 2021 and includes SBIR awards, as well as a large aircraft automation study. In 2023, Reliable demonstrated automated flight for military personnel as part of the Golden Phoenix exercise at Travis Air Force Base in California. ◀



# Raytheon to build 53 glide bombs with imaging infrared guidance for attacking hard targets

BY John Keller

**PATUXENT RIVER NAS, Md.** — Precision-guided munitions experts at Raytheon Technologies Corp. (RTX) will provide the U.S. and Bahrain military forces with 53 hard-target-penetrating and data-linked medium-range precision-guided target-penetrating glide bombs under terms of a \$155.7 million order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the RTX Raytheon segment in Tucson, Ariz., to produce 53 AGM-154 Block 3 C Joint Standoff Weapon (JSOW) air-to-ground missile systems — 47 for Bahrain and six for the Navy.

The AGM-154 JSOW is medium range precision-guided weapon for attacking defended targets from outside the range of standard anti-aircraft defenses. Pilots typically fire JSOW from ranges of 22 to 70 nautical miles.

The order includes training and test supplies and services, containers, technical data, engineering technical services, and inert equipment.

▲ **The fire-and-forget JSOW uses GPS and inertial navigation for day/night and adverse weather operations, and adds an infrared seeker for terminal guidance.**

The weapon can be launched from F/A-18, F-16, F-15, F-35, and Jas Gripen jet fighter-bombers; as well as from B-1B, B-2A, and B-52H long-range jet bombers. The AGM-154C JSOW unitary variant uses an imaging infrared seeker with autonomous guidance.

The fire-and-forget JSOW has a tightly coupled global positioning system (GPS) and inertial navigation system (INS) for navigation, and is capable of day/night and adverse weather operations. The JSOW-C adds an infrared seeker for terminal guidance.

The two-stage AGM-154C carries the BROACH war-head made up from a WDU-44 shaped augmenting war-head and a WDU-45 follow through bomb, and is designed

to attack hardened targets like armor, concrete, and earth to enable a large following warhead to explode inside the target. The JSOW 13 feet long and weighs about 1,000 pounds.

On this order Raytheon will do the work in Tucson, Ariz.; Monmouthshire, Wales; Vergennes, Vt.; Reading, Scotland;

Joplin, Mo.; Goleta, Calif.; Loveland, Colo.; Richardson, Texas; Tulsa, Okla.; and Minneapolis, and should be finished by March 2028. For more information contact RTX Raytheon online at [www.rtx.com/raytheon](http://www.rtx.com/raytheon), or Naval Air Systems Command at [www.navair.navy.mil](http://www.navair.navy.mil). ◀

### **Lockheed Martin to build helmet-mounted displays for F-35 combat jet air crews**

U.S. Navy avionics experts will acquire one production lot of the third-generation helmet-mounted displays for the Lockheed Martin F-35 Lightning II joint strike fighter under terms of a \$174.6 million order. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Lockheed Martin Corp. Aeronautics segment in Fort Worth, Texas, for production lot 17 of the F-35's third-generation helmet-mounted displays for the U.S. military services. This advanced helmet-mounted display comes from a joint venture between Collins Aerospace in Cedar Rapids, Iowa, and in and Elbit Systems of America in Fort Worth, Texas. It serves as the pilot's primary display system. It blends head-up display (HUD), helmet-mounted display, and visor-projected night vision to enable pilots to target their weapons and maintain advanced spatial orientation while continually monitoring critical flight information. F-35 combat jets represent the first tactical fighter aircraft in 50 years without a traditional HUD. Virtual capabilities of the electro-optical helmet-mounted display enables the pilot virtually to see through the bottom of the F-35's fuselage or directly at a target to experience extreme spatial orientation, superior weapons targeting, and tactical superiority during the day and at night. At the same time, the pilot has an uninterrupted display of flight information and sensor data. On this order Lockheed Martin will do the work in Fort Worth, Texas, and should be finished by February 2028. For more information contact Lockheed Martin Aeronautics at [www.lockheedmartin.com/en-us/products/f-35.html](http://www.lockheedmartin.com/en-us/products/f-35.html), Collins Aerospace Vision Systems at [www.collinsaerospace.com/what-we-do/industries/business-aviation/flight-deck/vision-systems](http://www.collinsaerospace.com/what-we-do/industries/business-aviation/flight-deck/vision-systems), or Naval Air Systems Command at [www.navair.navy.mil](http://www.navair.navy.mil).

### **CMOS imaging sensors for surveillance and machine vision introduced by Teledyne e2v**

Teledyne e2v, a Teledyne Technologies company in Grenoble, France, is introducing the Emerald Gen2 state-of-the-art

complementary metal-oxide-semiconductor (CMOS) family of imaging sensors for machine vision, outdoor surveillance, and traffic detection and monitoring. Built on Teledyne e2v's advanced imaging technologies, this new imaging sensors family is available in 8.9 megapixels (4,096 x 2,160) or 12 megapixels (4,096 x 3,072), in monochrome or color, and in two-speed grades, standard and high. The high-speed models are for demanding applications that require sharp images at very high speeds, such as food sorting, inspection, and intelligent traffic systems. The family of imaging sensors has a 2.8-micron global shutter pixel, designed with Teledyne e2v's latest generation light pipe technology, provides as much as 67 dB dynamic range in 10-bit and 12-bit A/D converter mode to enable cameras to work in high-contrast scenes without exposure issues in the images. This new generation of CMOS imaging sensors has a matrix that is centered in a 21-by-20 square-millimeter ceramic land grid array (CLGA) package, which fits 1-inch optical formats. It has two types of output, LVDS and MIPI CSI 2. For more information contact Teledyne e2v online at <https://imaging.teledyne-e2v.com>.

### **Forge camera for machine vision and factory automation introduced by Teledyne FLIR**

Teledyne FLIR IIS in Richmond, British Columbia, is introducing the Forge camera in a variety of models across several sensors for machine vision and factory automation applications. The camera is designed to help designers build imaging systems quickly with flexible link speeds and the ability to go beyond 5 Gigabit Ethernet performance and control data transfer to the host. The Forge is based on an all-new camera, and provides features for integration, and an upgrade path from 1 Gigabit Ethernet systems; it supports a choice of SDKs and Gigabit Ethernet vision-compliant software packages. The Forge camera works under extreme conditions. Forge uses the Spinnaker 4 next-generation GeniCam3 API software library for machine vision developers to evaluate, test, and deploy products quickly. For more information contact Teledyne FLIR online at [www.flir.com/iis/machine-vision](http://www.flir.com/iis/machine-vision). ◀



# Anduril to use AI and sensor fusion for IR-based counter-UAV perimeter security

BY John Keller

**EDWARDS AIR FORCE BASE, Calif.** – U.S. Air Force perimeter security experts needed passive sensing and sensor fusion for counter-intrusion and counter-unmanned-aerial-vehicle (UAV) capability. They found their solution from Anduril Industries Inc. in Costa Mesa, Calif.

Officials of the Air Force Test Center at Edwards Air Force Base, Calif., announced a \$31.1 million sole-source order to Anduril for the Wide-Area Infrared System for Persistence Surveillance SkyFence project.

The order provides for a passive sensing capability, sensor fusion, and artificial intelligence (AI) for the Air Force 412th Test Wing to provide situational awareness and multi-mission counter-intrusion and counter-UAV capability for perimeter security in sensitive areas.

Anduril has designed the Wide-Area Infrared System for Persistent Surveillance (WISP), which relies on artificial intelligence (AI) for passive full-motion 360-degree wide-area high-quality imaging for persistent automated

threat detection and situational awareness.

The WISP counter-UAV system is built on an infrared imager design that combines real-time AI and a compact hardware frame to support several different kinds of perimeter security and defense missions.

WISP is designed to reduce response times and improves coverage of critical areas and blind spots, and provide 24/7 long-range wide-area passive surveillance of areas that previously could be monitored only intermittently, company officials say.

WISP can be adapted to applications like border and base security, counter drone missions, and maritime surface threat detection.

WISP emits no signal, and can detect without being detected while retaining radar-like capability for contested environments, Anduril officials say. The system can be configured to operate on several different platforms like fixed towers, tactical vehicles, boats and ships, or on a tripod fixed to a structure.

WISP is built using an open-architecture software design and can integrate with many other kinds of sensor systems. One person can operate WISP to provide day and night alarm-based security against ground and airborne threats, across 360-degree surroundings using only a laptop workstation.

WISP has an automated UAV detection range of about 3 to 10 miles, and can pick commercial aircraft operating at 12,000 feet from about 93 miles away. Its sensor field of view is 360 degrees horizontal and 125 degrees vertical, and uses infrared sensors that measure 15 by 15 by 22 inches, with a processor that measures 19 by 8 by 26 inches.

On this order Anduril will do the work in Fort Worth, Texas, deliver the system to Edwards Air Force Base, Calif., and should be finished by December 2027. ←



▲ WISP relies on artificial intelligence (AI) for passive full-motion 360-degree wide-area high-quality imaging for persistent automated threat detection and situational awareness.

For more information contact Anduril Industries online at [www.anduril.com](http://www.anduril.com), or the Air Force Test Center-Edwards Air Force Base at [www.aftc.af.mil](http://www.aftc.af.mil).



## POWER GENERATION

### ▲NASA selects Solestial for space solar array to power future space stations

U.S. space station designers needed space solar arrays to power future space stations and other permanent space infrastructure. They found their solution from Solestial Inc. in Tempe, Ariz.

Officials of the U.S. National Aeronautics and Space Administration in Washington awarded an \$849,954 Phase II Small Business Innovation Research (SBIR) contract for the Next Generation Silicon Based Solar Arrays for Space Stations and Other Permanent Space Infrastructure project. The SBIR award comes on the heels of a \$149,987 Phase I contract in January 2023.

The 18-month SBIR Phase II contract will develop next-generation 50-kilowatt-class solar array wings. Solestial's silicon solar blanket technology will allow for arrays larger than any ever built, while also maintaining relatively low mass and competitive efficiency.

The array will be developed in collaboration with Opterus Research & Development Inc., which will develop a low-cost, novel deployment system for Solestial's ultra-thin flexible silicon solar blankets.

Solestial will focus on integrating the company's ultra-thin low-mass radiation-hardened solar blankets with the Opterus Retractable-Rollable Mast Array advanced deployable solar array structure. The R-ROMA is a scalable tensioned solar blanket array with double z-folding panels deployed by a rollable composite boom.

The partnership between Solestial and Opterus will marry the two technologies to overcome the size, cost, and mass limitations of existing solar array technologies.

Ultimately, Solestial hopes to achieve 50-kilowatt scale and 200-Watts per kilogram power array while simultaneously reducing costs.

Solestial's Phase I SBIR Ignite contract made it possible to develop the critical technologies required to create a working prototype of the silicon blanket technology. The Phase II award will fund a full-size 50-kilowatt solar array design and space testing of a scaled model.

For more information contact Solestial online at [www.solestial.com](http://www.solestial.com), or Opterus Research & Development at [www.opterusrd.com](http://www.opterusrd.com).

## SPACECRAFT VALVES

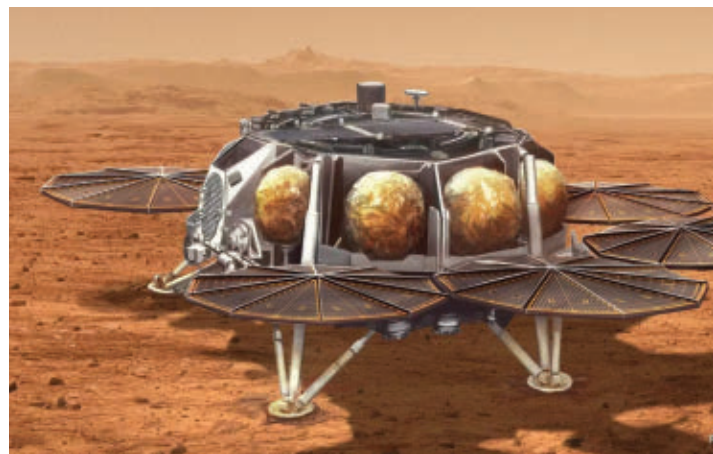
### ▼NASA JPL selects Marotta Controls components for Mars sample retrieval mission

The U.S. National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) in Pasadena, Calif., needed valves for the agency's Sample Retrieval Lander (SRL) -- a key element of NASA's Mars Sample Return program. They found their solution from Marotta Controls Inc. in Montville, N.J.

Marotta will supply two types of valves for the SRL, which will carry the Mars Ascent Vehicle (MAV), a rocket charged with launching samples off the surface of Mars for return to Earth for study.

The first is a customized valve based on the MV130HLT, a heritage design from Marotta's CoRe Flow Control series. This valve will pressurize the liquid propellant tanks, starting the SRL's engines.

The second Marotta valve, the SPV795, is brand new and designed specifically to shut off the SRL's descent engines to facilitate a safe landing; this is to accommodate the very thin atmosphere on Mars. Both valves have been optimized to reduce the risk of sample contamination and



safeguard the integrity of each vial's contents.

The Mars Perseverance rover is collecting and caching samples on Mars. NASA plans to land a Sample Retrieval Lander near or in Jezero Crater no earlier than 2028, bringing a small rocket (MAV) on which the samples collected by Perseverance would be loaded.

Once the samples are launched off the Red Planet, another spacecraft would capture them in Mars' orbit, and then ferry them to Earth safely and securely in the early to mid-2030s. "Valves are crucial to the safe and effective launch and landing of the SRL," says Max Wolfinger, vice president of space systems at Marotta Controls.

For more information contact Marotta Controls online at <https://marotta.com>.



### DATA RECORDING

#### ▲ Navy chooses Mercury for data transfer units and video recorders for F/A-18 avionics

U.S. Navy combat aircraft avionics experts needed ruggedized data transfer units for F/A-18C-F jet fighter-bomber. They found their solution from Mercury Systems Inc. in Torrance, Calif.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced an \$16.8 million order to Mercury for data transfer units, high-definition video recorders, and other avionics accessories for the F/A-18C-F jet fighter-bombers and EA-18G Growler electronic warfare (EW) aircraft.

Mercury Mission Systems (formerly Physical Optics Corp.) will provide 48 data transfer units and 121 high-definition video recorders for the F/A-18 aircraft. This equipment is part of a Small Business Innovation Research Phase III topic N102-0129 called Automatic Real-Time, Reconfigurable Interface Generalization Hardware Multiprotocol Data Recorder.

Mercury predecessor Physical Optics developed a new Automatic Real-Time, Reconfigurable interface Generalization Hardware (ARRGH) multiprotocol data recorder and data storage system as part of the Automatic Real-Time, Reconfigurable Interface Generalization Hardware Multiprotocol Data Recorder project. Mercury acquired Physical Optics in late 2020.

The phase-one ARRGH design is based on integrating hybrid transcoding hardware, RAID-based mass storage, and intelligent transcoding heuristic software, Navy officials say.

This 40-Watt, 11-pound design offers seamless on-the-fly rerouting and data translation of input signals to and from the data recorder irrespective of interfaces involved.

A plug-and-play self-sealing environmentally protected removable memory unit (RMU) enables rapid upgrades to avert obsolescence by capitalizing on commercial solid-state memories. The prototype includes shell adapters to ensure form-factor compliance with a variety of current data recorders, including the RM-6000f on F/A-18.

The ARRGH provides 1 terabyte of removable memory, sustained write speeds of 550 megabits per second (2700 megabits per second burst) and has a built-in self-test.

The second phase of the ARRGH project produced a fully functional ground-tested prototype and a flight-test-ready prototype, as well as defined a platform integration roadmap, got started on device certification.

On this order, Mercury will do the work in Torrance, Calif., and should be finished by June 2026. For more information contact Mercury Mission Systems online at [www.mrcy.com/products/data-storage-and-transfer](http://www.mrcy.com/products/data-storage-and-transfer), or Naval Air Systems Command at [www.navair.navy.mil](http://www.navair.navy.mil).

### WIRE INTERCONNECTS

#### ► Boom Supersonic selects Latécoère to develop electrical wiring interconnection system

Boom Supersonic in Denver needed a company to its complete electrical wiring interconnection system (EWS) architecture, a key system for both its Overture supersonic commercial jet and Symphony, the engine that will power it. They found their solution from Groupe Latécoère in Toulouse, France.

As part of the agreement, Latécoère's engineering team in Toulouse will work with Boom engineers to define the complete electrical wiring interconnection



system (EWIS) architecture, a key system for Overture and Symphony.

The EWIS will comprise more than 64 miles of wiring, and require more than 45,000 electrical connections for Overture and Symphony. Latecoere has expertise in complex aircraft development processes and methods, and Boom will leverage the company's harness architecture definition software stack.

"Among the major aerostructures and systems suppliers announced for Overture, Latecoere brings tremendous experience in developing and manufacturing certifiable EWIS and advanced aircraft technologies," says Kathy Savitt, president and chief business officer of Boom Supersonic.

Boom continues toward production, lining up many of its critical aerostructures and systems suppliers for Overture and Symphony. At the Paris Air Show in June 2023, Boom also shared a comprehensive look at the systems configuration for Overture including avionics, flight controls, hydraulics, fuel systems, and landing gear.

Symphony, the Boom-developed engine that will power Overture, continues to advance through design. Boom conducted the Conceptual Design Review (CoDR) engineering milestone for Symphony, which paves the way toward Symphony's first hardware rig tests planned for 2024.

For more information contact Groupe Latécoère online at [www.latecoere.aero/en/](http://www.latecoere.aero/en/), or BOOM Supersonic at <https://boomsupersonic.com>.



#### RADAR

### ▲ SRCTec to build exportable counter-fire radar to defend against rockets and mortars

U.S. Army air-defense experts are asking SRCTec LLC in Syracuse, N.Y., for exportable lightweight counter-fire radar (LCMR) systems to help defend warfighters from rocket, artillery, and mortar (RAM) attacks.

Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., announced a \$100 million five-year order to SRCTec to procure AN/TPQ-50 exportable systems, spare parts, and repair parts.

The LCMR family of counter-fire radars from SRCTec provides 360-degree surveillance and 3D rocket, artillery, and mortar location using a non-rotating, electronically steered antenna.

The SRCTec LCMR family consists of the AN/TPQ-49 and AN/TPQ-50. The TPQ-50 is the official Army program of record, while the TPQ-49 is designed for expeditionary forces, company officials say.

The radar systems detect and track several different rounds fired from separate locations, and send early warning messages indicating a round is incoming. The radar also pinpoints the location of the incoming round's launcher for counter-fire from friendly artillery, mortars, or aircraft.

Both systems are designed to cover 360 degrees over a nearly 200-square-mile area. The systems can be adapted to cover narrower sectors at longer ranges, if necessary.

In November 2022 the Army



awarded a \$12.1 million order to SRCTec to build LCMR systems for Ukraine as part of the Ukraine Security Assistance Initiative.

Planned upgrades for the TPQ-50 radar include modernization efforts for electronic protection and to deal with new and emerging threats. Army officials also are developing an integrated hypervelocity armament system (HAS) for future advanced gun weapon systems, command guided maneuverable projectiles, and tactical sensors.

HAS is to include integrating the TPQ-50 radar into future artillery powder guns firing hypervelocity projectiles, resulting in next-generation, common, low drag, guided cannon artillery projectiles capable of completing several different missions with improved cost effectiveness across different gun systems.

Integrating the TPQ-50 and other fire-control radar systems and sensor arrays is expected to enable closed-loop targeting of moving and relocatable targets beyond the range of conventional artillery.

The LCMR AN/TPQ-50 L-band radar system detects incoming RAM from low-quadrant elevations, and provides a more accurate point of origin calculation from greater distances than its predecessors. The radar has a range of nearly 10 miles, can be transported and operated on a vehicle such as a HMMWV, or rapidly placed in rugged terrain by installing it on a tripod.

The LCMR AN/TPQ-49 radar can be assembled or disassembled by two soldiers in 20 minutes. It mounts on a tripod using lightweight antenna hardware. The relatively small system consumes low prime power, making it suitable for low-profile operation.

On this order SRCTec will do the work at locations to be determined with each order, and should be finished by January 2028. For more information contact SRCTec online at [www.srcinc.com/products/radar/aesa50-multi-mission-radar.html](http://www.srcinc.com/products/radar/aesa50-multi-mission-radar.html), or the Army Contracting Command-Aberdeen at <https://acc.army.mil/contractingcenters/acc-apg>.

### SECURE COMMUNICATIONS

#### ► **BAE Systems to provide secure satellite navigation and positioning for Army infantry and combat vehicles**

U.S. military information technology experts needed satellite navigation capability that not

only is compatible with existing systems, but also that can receive new secure M-code signals. They found their solution from BAE Systems.

Officials of the Defense Information Systems Agency (DISA) Defense Information Technology Contracting Organization at Scott Air Force Base, Ill., announced a potential \$319 million contract this week to the BAE Systems Electronic Systems segment in Cedar Rapids, Iowa, for Miniature PLGR Engine-M-code (MPE-M) receiver cards for the U.S. Army.

The contract includes MPE-M Dismounted Assured Positioning, Navigation, and Timing (A-PNT) System (DAPS) and Mounted A-PNT System (MAPS) versions, to accommodate infantry soldiers on foot and in combat vehicles. The potential five-year contract also covers software updates.

The BAE Systems MPE-M receiver delivers geolocation and precise positioning capabilities for space-constrained applications while providing increased security, and anti-jamming capabilities, company officials say.

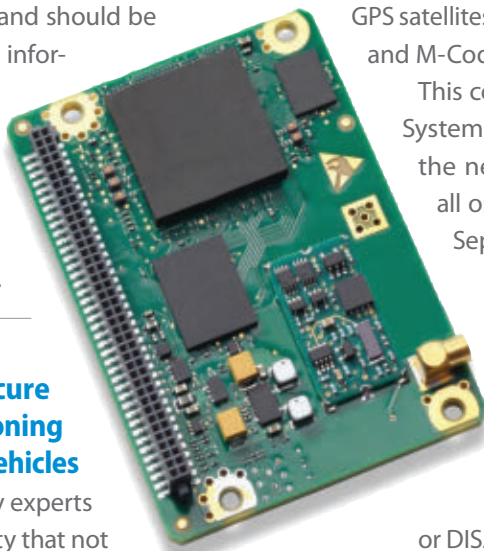
The MPE-M is size-compatible with the Miniature PLGR Engine-SAASM (MPE-S) receiver, while offering a new security architecture for enhanced integrity, exclusivity, and resiliency.

The MPE-M contains the required Selective Availability Anti-spoofing Module (SAASM) functionality while providing increased mission effectiveness and safety enabled through operation with the M-Code signal.

It offers advanced correlator engine for accelerated Direct-Y and Direct-M code acquisitions; next-generation modernized security architecture; unclassified-when-keyed operation; black key capabilities that include over-the-air-rekeying (OTAR) when available from GPS satellites; and operations in a mixed Y-Code and M-Code constellation.

This contract, at minimum, calls for BAE Systems to deliver 50 MPE-M cards over the next two years for \$494,270. With all options, the contract could go until September 2028.

On this contract BAE Systems will do the work in Cedar Rapids, Iowa. For more information contact BAE Systems Electronic Systems online at [www.baesystems.com/en-us/our-company/inc-businesses/electronic-systems](http://www.baesystems.com/en-us/our-company/inc-businesses/electronic-systems), or DISA at [www.disa.mil](http://www.disa.mil).



## POWER SUPPLIES

▼ **Mil-spec power supply for military, and test applications offered by TDK Lambda**

TDK-Lambda Americas Inc. in San Diego is introducing the TPS4000-12 mil-spec power supply for test and measurement equipment, semiconductor fabrication, additive manufacturing, printers, lasers, and RF power amplifiers. The power electronics device offers as much as 2040 Watts output power (12 volts at 170 amps) in a 2U high package, and operates from a wide range Delta or Wye 350 to 528-volt-AC three phase input. The TPS4000 series offers isolated AC fail, DC good and dropped phase signals, remote on/off, remote sense, and a 12 volts 0.3 amps standby supply. A PMBus communications interface enables remote monitoring of the output voltage, output current, internal temperature, status signals, and fan speed. In addition, the output voltage, over current limit and the remote on/off can be programmed by the PMBus. The power supply output voltage can be adjusted from 9.6 to 14.1 volts and the current limit point by 70 to 105 percent using front panel potentiometers or an analog 0 to 5 volts DC voltage. Users can connect as many as eight units in parallel for high power, and internal ORing FETs allow redundant operation. The TPS4000-12 can operate at full load in ambient temperatures as high as 50 degrees Celsius and deliver as much as 55 percent load at 70 C. Cooling is provided by an internal temperature controlled fan to reduce acoustical noise. The case measures 107 by 84.4 by 335 millimeters, making it suitable for 2U-high racking systems. The weight of the product is 4 kilograms. For more information contact TDK Lambda Americas online at [www.us.lambda.tdk.com](http://www.us.lambda.tdk.com).



## ADAPTERS

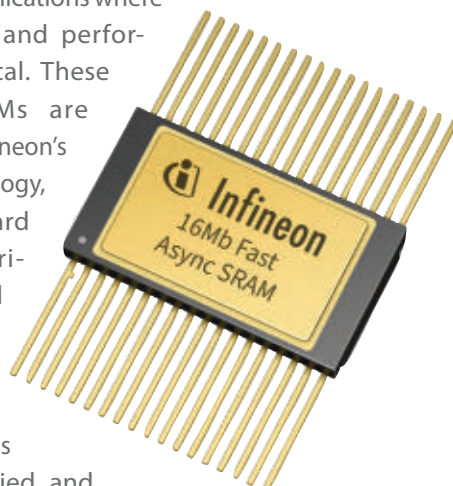
▲ **Female-to-female bullet adapters for high shock and vibration introduced**

Cinch Connectivity Solutions, a Bel group company in Lombard, Ill., is introducing Johnson female-to-female bullet adapters for laboratory radio frequency testing and measurement, satellite communication equipment, GPS and phased array antennas, radar systems, remote monitoring communications, and automated test equipment. The adapters support connections between SMP to SMPM standards. With superior voltage standing wave ratio (VSWR) and insertion loss to 40 GHz, the adapter is for converting between two interfaces while maintaining performance. The SMP and SMPM product families are for high shock and vibration applications, meet MIL-STD-348 standards, and can support both interfaces when they are axially or radially misaligned by 0.010 inches. More information about the Johnson SMP-SMPM bullet adapter is online at [www.belfuse.com/cinch](http://www.belfuse.com/cinch)

## SPACE ELECTRONICS

▼ **Radiation-hardened asynchronous SRAM chips for space introduced by Infineon**

Infineon Technologies AG in Munich is introducing radiation-hardened asynchronous static random-access memory (SRAM) chips for use in space and other harsh environment applications where high reliability and performance are critical. These rad-hard SRAMs are designed with Infineon's RADSTOP technology, which is rad hard through proprietary design and process hardening techniques. The rad hard memories are QML-V certified, and





## NEW PRODUCTS

feature access times down to 10 nanoseconds. These rad-hard memory chips address high-performance computing requirements in space applications. Data buffering in space computing can require more memory than the on-chip memory of an MCU or FPGA can provide. Infineon's rad hard SRAMs are available in 8-, 16- and 32-bit wide configurations and offer embedded error correction code (ECC) for single-bit error correction. For more information contact Infineon online at [www.infineon.com/hirelmemory](http://www.infineon.com/hirelmemory).

### RF AND MICROWAVE

#### ► **RF and microwave adapter for fixing mixed connector issues introduced by BroadWave**

BroadWave Technologies Inc. in Greenwood, Ind., is introducing the model 431-442-333 push on RF and microwave adapter. The adapter is for resolving mixed connector interconnect issues in RF test and

measurement, RF equipment manufacturing, and RF measurements. The model 431-442-333 push-on RF adapter has a 50 Ohm impedance and DC-to-5 GHz operating frequency range. The connector configuration is BNC female to TNC male push on. For more information contact BroadWave Technologies online at [www.broadwavetechnologies.com](http://www.broadwavetechnologies.com).



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ASSOCIATE GROUP PUBLISHER **Peter Fretty**  
435-233-7716 / [pfretty@laserfocusworld.com](mailto:pfretty@laserfocusworld.com)

EDITOR-IN-CHIEF **John Keller**  
603 891-9117 / [jkeller@endeavorb2b.com](mailto:jkeller@endeavorb2b.com)

SENIOR EDITOR **Jamie Whitney**  
603 891-9135 / [jwhitney@endeavorb2b.com](mailto:jwhitney@endeavorb2b.com)

CHIEF CONTRIBUTOR **Jim Romeo**

ART DIRECTOR **Tracy Arendt**

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AUDIENCE DEVELOPMENT MANAGER **Debbie Bouley**  
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## RF AND MICROWAVE

### ▲ Mil-spec frequency multipliers and frequency dividers introduced by Fairview

Fairview Microwave, an Infinite Electronics brand in Lewisville, Texas, is introducing mil-spec frequency multipliers and dividers for frequency management in rugged environments. The active frequency dividers have an input frequency range of 6.5 to 16.5 GHz. Their output spectrum stretches from 13 GHz to 33 GHz. These dividers necessitate a DC bias, ensuring accurate and efficient frequency bifurcation. These devices have divide-by configurations of 2, 4 and 8. Embedded within compact coaxial packages, all models come with SMA connectors. The active frequency multipliers double input frequencies, catering to output bands stretching from 13 GHz to 29 GHz. Built for resilience, these models sport rugged construction that can withstand the MIL-STD-202 environmental test conditions. Furthermore, with their support for SMA female connectors and solder pins for voltage and ground connections, they are a beacon of reliability and convenience. These frequency multipliers cover broadband frequencies, and are made for several market bands spanning VHF, UHF, L, S, C, X and Ku bands. For more information contact Fairview Microwave online at [www.fairviewmicrowave.com](http://www.fairviewmicrowave.com).

## AVIONICS

### ► MIL-STD-1553 databus application programming interface (API) software introduced by Holt

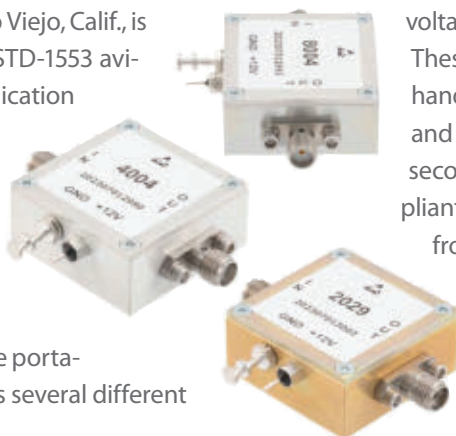
Holt Integrated Circuits in Aliso Viejo, Calif., is updating the company's MIL-STD-1553 avionics integrated terminal application programming interface (API). The Holt Portable Library (HPL) API now supports all Holt's MIL-STD-1553 terminal devices to provide a layer of abstraction using standardized functions, and enable software portability for all Holt devices across several different

platforms and processors. The MIL-STD-1553 avionics interface HPL release is thread-safe and re-entrant, ensuring that several threads can operate on the same code without errors. A new RT-MT Stack Assist Mode monitor feature enables more efficient handling of interrupts. Holt provides an Application Development Kit (ADK-2130mPCIe-2) reference design in the form of a full-size F2 Mini PCI Express card, which features two of Holt's HI-2130 MIL-STD 1553 terminals with integrated transformers. The card is designed to operate in a PC or single-board computer running Linux. The reference design includes a schematic, BOM, board layout files, PCI Express interface FPGA source code, HPL API, and a sample project. For more information contact Holt Integrated Circuits online at [www.holtic.com](http://www.holtic.com).

## RF AND MICROWAVE

### ► PIN diode switches for phased-array radar introduced by Pasternack

Pasternack, an Infinite Electronics brand in Irvine, Calif., is introducing 10 different models of military-grade ultra-broadband PIN diode switches for phased-array radar, broadband jamming, wireless infrastructure, and 5G communications. These switches come in SP2T, SP4T, and SP8T configurations, all featuring integrated TTL drivers and rugged military-grade coaxial-packaged designs. These cutting-edge RF and microwave switches operate at frequencies from 1 MHz to 75 GHz. This wide-band frequency coverage encompasses UHF, VHF, L, S, C, X, Ku, K, Ka, Q, U, and V. The product line includes reflective and absorptive designs, with the latter ensuring low voltage standing wave ratio (VSWR) performance. These high-precision switches offer input power handling of as much as 1 Watt continuous wave, and rapid switching speeds as low as 50 nanoseconds. The PIN diode switches are RoHS compliant and can function reliably in temperatures from -40 to 85 degrees Celsius. Moreover, and resist environmental conditions such as altitude, vibration, humidity, and shock. For more information contact Pasternack online at [www.pasternack.com](http://www.pasternack.com). ◀







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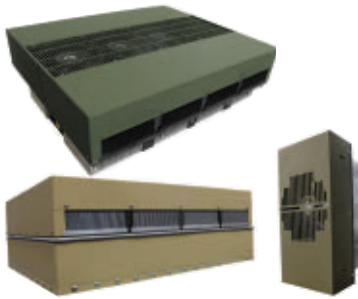
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# Aireon to begin development of space-based VHF communications services

BY Jamie Whitney

**MCLEAN, Va.** - Aireon, a provider of space-based air traffic management data solutions in McLean, Va., is leading the Aireon Space-Based VHF Coalition to develop the concept of operations for space-based VHF voice and data communications within the aviation sector.

The initiative comprises organizations such as Iridium, NAV CANADA, NATS, AirNav Ireland, ENAV, and Naviair. This move follows Aireon's introduction of space-based Automatic Dependent Surveillance-Broadcast (ADS-B) surveillance to remote and oceanic airspace operations five years ago.

Space-based VHF radio communications may offer capability to the aviation industry in remote regions and oceanic routes with limited connectivity or without ground infrastructure.

Similar to space-based ADS-B, space-based VHF may enhance airspace safety, efficiency, and sustainability by reducing aircraft separation and facilitating more efficient routing.

The International Telecommunications Union (ITU) recently approved the allocation of new radio frequencies for aeronautical use, paving the regulatory path for space-based VHF communications. Aireon, in support of this frequency allocation, intends to apply for a license to operate a space-based VHF system within the newly designated spectrum band.

Working collaboratively with coalition partners, Aireon is committed to supporting efforts at the International Civil

▲ **Space-based VHF may offer communications capability to the aviation industry in remote regions and oceanic routes with limited connectivity or without ground infrastructure.**

Aviation Organization (ICAO), where work on technical and operational requirements, as well as coordination, will be addressed.

Don Thoma, CEO of Aireon, expressed the coalition's dedication to overcoming the challenges of space-based VHF. With over 12 years of experience deploying and operating the space-based surveillance system, Aireon's data is currently employed by approximately 50% of the world's airspace, with over 40 countries and more than 20 Air Navigation Service Providers (ANSPs) as customers.

"At Aireon, we understand the complexities and challenges of operating space-based safety-of-life services. We've been doing it for years," Thoma stated. "As we embark on this new initiative, we will apply the same rigorous process to deploy and operate space-based VHF services as we did when we launched space-based ADS-B. We are confident that this coalition is best suited to address the high standard of quality that space-based VHF technology requires and is best suited to deploy another game-changing service to the aviation community." ◀



# NASA seeks industry proposals for commercial services related to Mars exploration

BY Jamie Whitney

**WASHINGTON** - The National Aeronautics and Space Administration (NASA) officials have issued a request for proposal (RFP) to industry for paid Design Reference Missions (DRM) as it looks to find commercial solutions for space exploration.

Guiding principles for commercial services include utilizing innovative commercial space systems, particularly those aligned with NASA's Moon-to-Mars initiatives, to expedite Martian exploration; facilitate one or more missions per Mars launch opportunity through profitable partnerships with U.S. industry; significantly reduce costs while maintaining an acceptable level of risk; empower U.S. industry leadership in deep space endeavors; and progress towards establishing a sustainable human-robotic presence on Mars.

As part of the Mars Exploration Program (MEP) draft plan, NASA's Jet Propulsion Laboratory (JPL) says each DRM proposal is expected to be self-contained and will undergo separate evaluations. NASA notes that JPL retains the right to consider only one proposal if a proposer opts to submit proposals

for two DRMs. JPL intends to award multiple Fixed Price Non-Research & Development study subcontracts, each valued at \$200,000 for one DRM or a maximum of \$300,000 for two DRMs.

MEP envisions one or more government payloads per Mars opportunity, with compensation for transportation and payload hosting services. It should be noted that launch services are excluded from these studies but may be included in future services at NASA's discretion. MEP is open to compensating continuous services at Mars, such as proximity and Earth communications and Mars imaging. Furthermore, the company providing services may extend its offerings to other commercial and international clients simultaneously with MEP to contribute to the development of a profitable Mars economy. Future service scenarios outlined in the Design Reference Missions (DRMs) in the Exhibits provide critical cost and program information for the subsequent phases of the MEP plan.

For these studies, services encompass the complete spectrum of what the industry can profitably provide, including design, construction, integration, testing, and operations for the specified DRMs. NASA MEP assumes that the industry

▼ **NASA has reached out to industry for commercial solutions to aid in a future manned space mission to Mars**

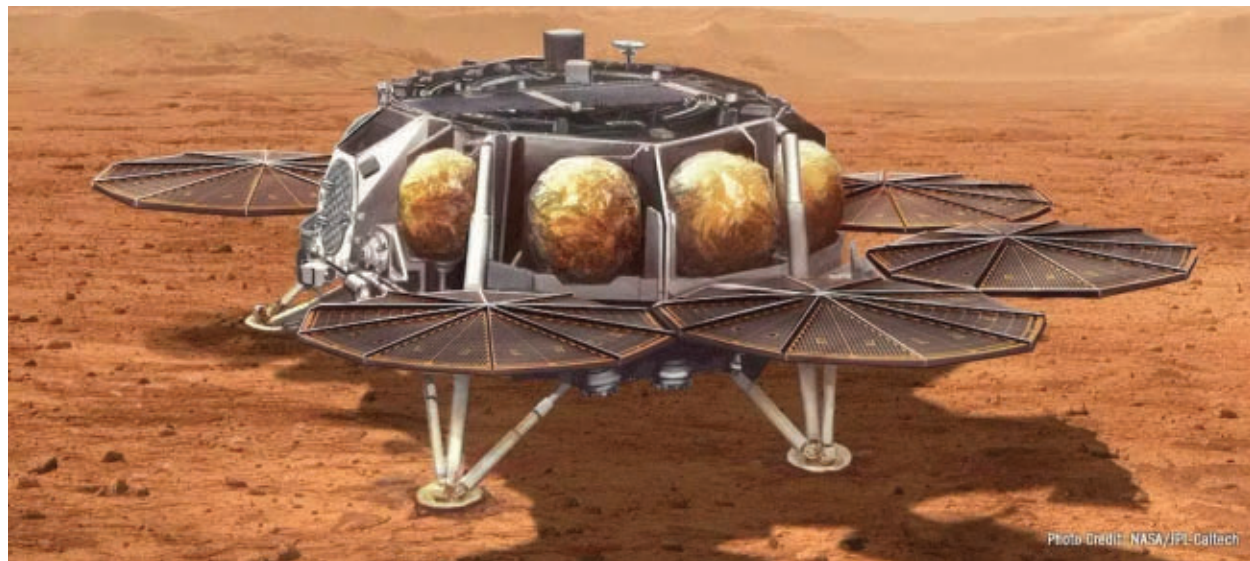


Photo Credit: NASA/JPL-Caltech

owns the assets and can offer services to entities beyond NASA. The MEP aims to minimize the extent of government contributions to maximize cost savings, acknowledging the potential necessity of a public-private partnership (PPP) period to fully realize services and mutually mitigate risks. Furthermore, MEP recognizes that Mars-specific services have applicability to deep space exploration and encourage the utilization

of services and products for broader scientific and exploratory endeavors.

NASA asks industry to respond by February. Jessica Luong is the primary point of contact for this project and can be emailed at [jessica.luong@jpl.nasa.gov](mailto:jessica.luong@jpl.nasa.gov). Additional information can be viewed at <https://sam.gov/opp/2e8a0f38466b47808c-de036eac9a2a86/view>. ◀

### Airlines and airports increase IT spending, says SITA

Air transport information technology (IT) and telecommunications group SITA in Geneva, Switzerland released its 2023 spending report on technology trends and showed strong growth in investments for airlines and airports. SITA's Air Transport IT Insights report finds that both airports and airlines saw IT spending increase year on year into 2023, reaching an estimated 10.8 billion USD and 34.5 billion USD respectively, with over two-thirds of airport and airline CIOs expecting continued growth into 2024. Airports also boosted IT spending as a percentage of revenue in 2022 and 2023 even as businesses benefitted from an uptick in travel demand, signaling just how crucial a role technology will play in the next-generation travel experience. Aviation CIOs' key investment priorities include a biometrically enabled passenger journey, leveraging data to unlock operational efficiencies, and green solutions to optimize energy consumption and emissions. Airlines and airports have made strides in optimizing the passenger experience, with over half having implemented IT to improve efficiency across check-in, bag tag, and boarding in 2023. Biometrics are becoming commonplace to help curb congestion, with 70% of airlines expecting to have biometric ID management in place by 2026, and 90% of airports investing in major programs or R&D in this area. The SITA 2023 Air Transport IT Insights research was conducted from August to November 2023. It represents the views of over 250 senior airline and airport executives, covering a quarter of global passenger traffic. The full report is available on SITA's website at <https://www.sita.aero/resources/surveys-reports/air-transport-it-insights-2023/>.

FMI projects global aircraft flight control system market to more than double in the next decade

Future Market Insights in Newark, Del. reports that it projects the global aircraft flight control system market to grow from \$17.5 billion in 2024 to \$40.2 billion by

2034. Flight controls are crucial components that manage the aircraft's orientation and flight while ensuring stability and maneuverability of the aircraft by controlling pitch, control, and yaw. These systems can be traditional and utilize mechanical linkages and control cables, or fly-by-wire, which uses electronic sensors that measure pilot input, and the data is transmitted to a computer, which then interprets and adjusts control surfaces through electronic signals. FMI says that the global aircraft flight control system market value in 2019 was \$10.4 billion. In the following five years, the demand for aircraft flight control systems increased at an annual growth rate of 11.2%. By 2023 end, the total value of the market was \$15.8 billion. In 2024, the worth of the aircraft flight control system industry is estimated to be around \$17.5 billion. Over the next ten years, the sales of aircraft flight control systems are projected to rise overall at an 8.7% rate. The total valuation of the market is forecast to reach up to US\$ 40.2 billion by the end of this forecast period. To learn more about FMI's flight control market projections, please visit <https://www.futuremarketinsights.com/reports/aircraft-flight-control-system-market>.

### Founding members of the Aviation Supply Chain Integrity Coalition announced

Aerospace industry leaders in the United States and Europe announced the creation of a coalition to help prevent unauthorized parts from entering the aviation supply chain and to strengthen the supply chain's overall integrity. Founding members of the Aviation Supply Chain Integrity Coalition include senior representatives from Airbus, American Airlines, Boeing, Delta Air Lines, GE Aerospace, Safran, StandardAero and United Airlines. Former NTSB Chairman Robert Sumwalt and former U.S. Transportation Deputy Secretary John D. Porcari will serve as coalition co-chairs. The coalition's efforts build on CFM International and its parent companies' [GE Aerospace and Safran Aircraft Engines] actions last year when AOG *Continued on D5*



# NASA selects 11 teams to collaborate on new Science Mission Directorate program

BY Jamie Whitney

**WASHINGTON** - The U.S. National Aeronautics and Space Administration (NASA) has selected 11 teams to support new collaborations between the agency and U.S. institutions not historically part of the agency's research enterprise.

These are the first awards given through a new program from the agency's Science Mission Directorate (SMD) to improve diversity, equity, inclusion, and accessibility in the science and engineering communities, as well as NASA's workforce.

NASA's SMD Bridge Program provides seed funding for research projects that will build strong foundations for long-lasting relationships with the agency.

The projects offer hands-on training and mentorship for students, as well as new research opportunities for faculty, to help science and engineering students transition into graduate schools, employment by NASA, or science, technology, engineering, and math careers generally. There is an additional opportunity to apply for seed funding through the SMD Bridge Program. Applications closed in March.

These projects were selected as the first cohort to receive seed funding:

**Diversifying Student Pipelines in STEM: Environmental Pollution Reduction Inspired by Planetary Science.** This project, a collaboration that brings California State University, Los Angeles, with NASA's Jet Propulsion Laboratory in Southern

▲ **The projects offer hands-on training and mentorship for students, as well as new research opportunities for faculty, to help science and engineering students transition into graduate schools.**

California, and California State Polytechnic University, Pomona, draws from the field of planetary science to address environmental pollution.

**FireSage: SJSU-NASA ARC Bridge Seed Program.** This is a collaboration between San Jose State University's Wildfire Interdisciplinary Research Center and the Earth Science Division at NASA's Ames Research Center in California's Silicon Valley. It engages students in a computing, artificial intelligence, and machine learning research project and training activities in wildfire science.

**Hampton University STEM Experience with NASA Langley Research Center Doppler Aerosol Wind Lidar.** This collaboration between Hampton University and NASA's Langley Research Center in Hampton, Virginia, offers a foundation in the advancement of planetary boundary layer studies with Lidar remote sensing.

**Development of Antireflection Coatings for Future NASA Missions.** This project is a collaboration between Delaware State University and NASA Goddard, working with transparent,



electrically conductive films to design and produce an environmentally durable anti-reflection coating for guidance, navigation, and control Lidar.

**CUBES: Capacity Building Using CubeSats for Earth Science.** This collaboration between Tuskegee University, the Laboratory for Atmospheric Science and Physics at University of Colorado, and NASA Ames uses CubeSats to provide faculty and students with experience designing and executing science mission flight projects.

**Space Materials and Microbiome Research: A Bridge to Future JSC Workforce.** In this project, the University of Houston-Clear Lake collaborates with NASA's Johnson Space Center in Houston. The project's Composite Materials track will develop a protective nanocomposite shield for spacecraft materials, while the Microbiome track will create a comprehensive library of draft bacterial genomes.

**The HALOQUEST: Halobacterium Astrobiological Laboratory for Observing and Questioning Extraterrestrial Signatures and Traits Project.** This collaboration between California State University, Northridge, and NASA JPL will study *Halobacterium salinarum* NRC-1 grown under simulated stressful environmental conditions, which could help understand possibilities for life on other planets.

**Observations of Ice-Water and Isotopes Using Mid-Infrared Laser Heterodyne Radiometer LIDAR.** In collaboration with NASA Goddard, Delaware State University will develop Earth science, planetary exploration, and sensing technologies, including a lunar rover payload with instruments to simultaneously detect and correlate water isotopes with other trace gas species.

**Application of Remote Sensing for Predicting Mosquito-Borne Disease Outbreaks.** This project is a collaboration between Southern Nazarene University and NASA JPL to identify areas at risk for mosquito-borne disease outbreaks using remote sensing data.

**Building a Diverse, Sustainable, and Robust Undergraduate-to-Graduate STEM Network through Inter-Institutional, Interdisciplinary Research Collaborations in Complex Fluids/Soft Matter.** This project is a collaboration between Colorado Mesa University and NASA's Glenn Research Center in Cleveland to strengthen and grow a research, education, and training network centered around problems in complex fluids and soft matter, with initial emphasis on heat transfer and multiphase flows.

**Additive Manufacturing of Electronics for NASA Applications.** This project, a collaboration between Florida A&M University and NASA's Marshall Space Flight Center in Huntsville, Alabama, and NASA Goddard, will explore

technology solutions through additive manufacturing approaches to manufacture strain and gas sensors. ←

#### *Continued from D3*

Technics in London sold engine parts with forged documents. CFM International says that a review found that less than one percent of its engines were affected and most parts involved were non-serialized items like bolts, washers, and bushings, the coalition will take a broader look at preventing future similar actions. The coalition began its work this month, launching a 90-day review to determine opportunities to strengthen existing supply chain operations. This work will form the basis of a comprehensive report with recommendations to ensure compliance with safety standards and prevent the introduction of unapproved aviation parts into the supply chain. The coalition's approach spans the industry, drawing on expertise from manufacturers and airlines to maintenance, repair and overhaul stations, among others. The report is expected later this year.

#### **Saudia Technic unveils mobile MRO base**

Maintenance, repair, and overhaul (MRO) specialists Saudia Technic in Jeddah, Saudi Arabia unveiled its Mobile MRO Base at the World Defense Show 2024 held in Riyadh. The Mobile MRO Base is a fully-equipped unit that offers maintenance services for helicopters, military aircraft, and advanced air mobility. According to Saudia Technic, this facility is the first in the Middle East and North Africa. Equipped with the latest tools, maintenance equipment, and a wide range of spare parts, the Mobile MRO Base can handle a broad spectrum of on-site repairs and maintenance. Its response time aids prompt assistance during emergencies and sudden maintenance needs, reducing downtime and maintaining aircraft operational efficiency. The Mobile MRO Base features fully equipped workstations, providing an efficient workspace for managing operations and coordinating repairs. It also incorporates drone technology for visually inspecting inaccessible areas, enhancing inspection speed and accuracy. The company also announced it had inked a deal with Brazil's Embraer at the Riyadh event, which would see the aircraft manufacturer and Saudia Technic collaborate on MRO and training capabilities. The agreement aims to enhance cooperation in commercial aviation, with a focus on the E2 jets family and executive aviation maintenance. ←

# SpecQtral launches quantum optical ground station TarQis

BY Jamie Whitney

**SINGAPORE** - SpeQtral, a Singapore-based quantum communications technology, announced the launch of TarQis, a mobile quantum-optical ground station (Q-OGS) for access to secure communication through satellite quantum key distribution (QKD).

TarQis will work with SpeQtral's upcoming quantum satellites, allowing users to test satellite QKD technology, prove out use cases, and prepare for deploying and integrating QKD solutions into their institutions.

SpeQtral's Q-OGS features a modular quantum receiver unit, QKD control server, and optical telescope, all housed within a standard 20-foot container for global transport.

The product utilizes standard data interfaces, allowing users to deploy TarQis at selected locations to facilitate long-distance satellite QKD connectivity.

TarQis provides a plug-and-play solution for government and defense, telecommunications, financial services, and data center sectors. It can be situated at a user's secure premises for

direct access to satellite QKD solutions or function as a node within a metropolitan fiber-QKD network, enabling extended QKD connectivity to other metropolitan QKD networks.

SpeQtral says current solutions entail substantial infrastructural investments and long-term commitments. The TarQis solution offers a quick-deploy solution without the need for permanent infrastructural fixtures.

SpeQtral currently offers short-term commercial demonstration campaigns for satellite QKD between any two or more global locations, allowing users to gain hands-on experience with this strategic technology and plan for broader adoption and operational deployment across their organizations.

This offering has been developed based on feedback from users in the financial services, government, and defense sectors. TarQis has generated interest from stakeholders during pre-launch engagements, signifying advancement in the adoption of satellite QKD technologies within an organization's communication infrastructure and applications. ◀

**TarQis, a mobile quantum-optical ground station (Q-OGS) for access to secure communication through satellite quantum key distribution (QKD).**

