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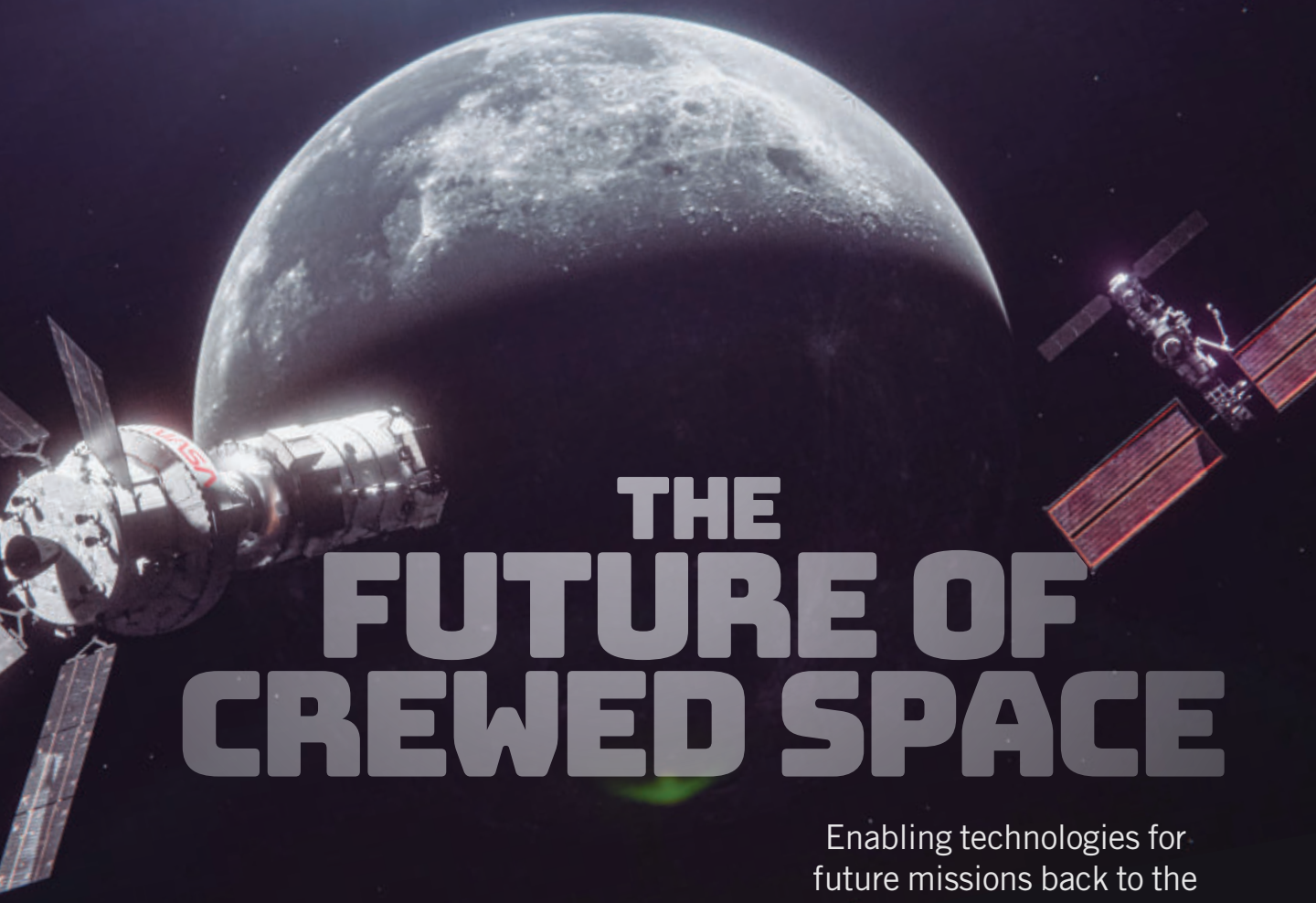

THE FUTURE OF CREWED SPACE

Enabling technologies for future missions back to the moon, and on to Mars

PG. 10

Newsletter

July/August 2025

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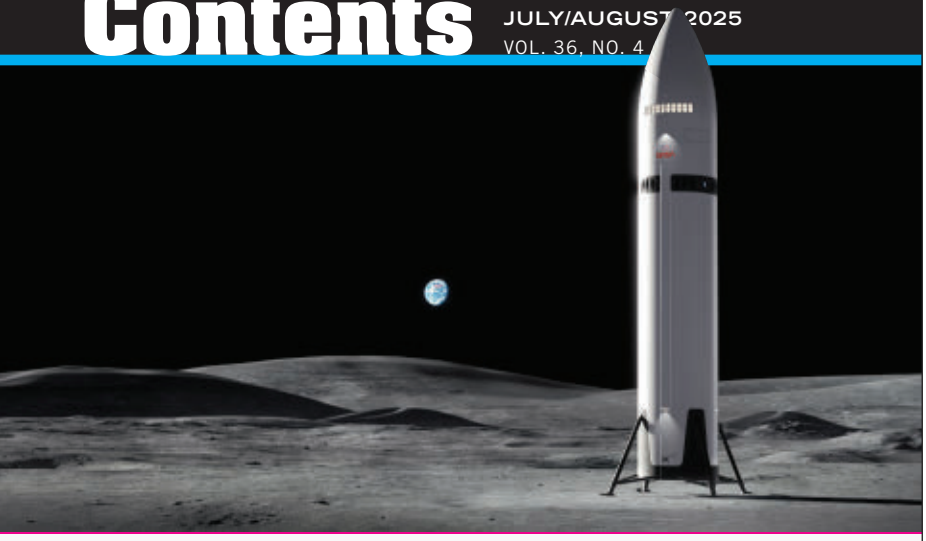

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We stand on the precipice of a new era in high-performance optical computing

BY **John Keller**
EDITOR IN CHIEF

We're on the verge of a new era in high-performance military computing and data networking that could offer unprecedented advantages in extreme data throughput and bandwidth; small size, weight, and power (SWaP); and low power consumption. Affording this are new developments in optical computing.

This design approach capitalizes on the intensity, phase, polarization, and wavelengths of light to encode, process, and transmit information in applications like artificial intelligence (AI), data processing, data storage, and communications.

Last month the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., approached industry with a request for information (DARPA-SN-25-88) for the Very Large-scale Photonic Integration (VLPI) project.

VLPI seeks to develop new approaches to manufacturing optical integrated circuits in large-format wafers for power-efficient computing that requires little thermal management compared to today's high-performance processors.

Developing VLPI integrated circuits at scale could unleash entirely new computational approaches to intelligence, surveillance, reconnaissance, automatic target recognition, predictive maintenance and logistics, battlefield command and control, and other computationally intensive aerospace and defense applications.

If you've been around long enough, VLPI probably sounds familiar; it's reminiscent of a military research project in the late 1970s to improve Very Large-Scale Integration (VLSI) integrated circuit technology.

The VLSI program led to microprocessor and computing innovations for the time like the Unix BSD software operating system, the RISC processor architecture, new computer-aided design tools, 32-bit graphics workstations, and other advanced microelectronics that enhanced national security and commercial computing applications.

Optical computing, compared to electronic computing, uses photons instead of electronics to process and move data. Some estimates suggest optical computing can work 10 million times faster than today's electronic computers, which could reduce computations taking years to just hours.

For the early stages of the VLPI program, DARPA is seeking to understand what capabilities might come from advanced photonic integrated circuit technology, today's state of the art, and to determine what remaining technological barriers remain in the design of such circuits.

It seeks to enable fabrication of high-performance photonic integrated circuits in large-format wafers. Light-based processing can be extremely fast, energy efficient, and aid thermal management and system cooling.

DARPA is asking industry to suggest applications that VLPI photonic circuits could enable; the performance benefits of the VLPI circuits; how applications could reduce the need for electro-optical transducers; software algorithms that VLPI integrated circuits could enable; and design approaches that could mimic digital computing using optical computing.

DARPA also wants industry's opinions on limitations and new approaches in design automation for VLPI photonic circuits; the state-of the-art in today's photonics design tools; limits on the maximum size of photonic circuit modeling; and photonic design algorithms.

Companies interested were asked to email unclassified responses by 15 July 2025 to DARPA at DARPA-SN-25-88@darpa.mil. Email questions or concerns to DARPA's Anna Tauke-Pedretti at DARPA-SN-25-88@darpa.mil. More information is online at https://sam.gov/opp/0d91f604d4d54bd79881be8b9f9721be/view.

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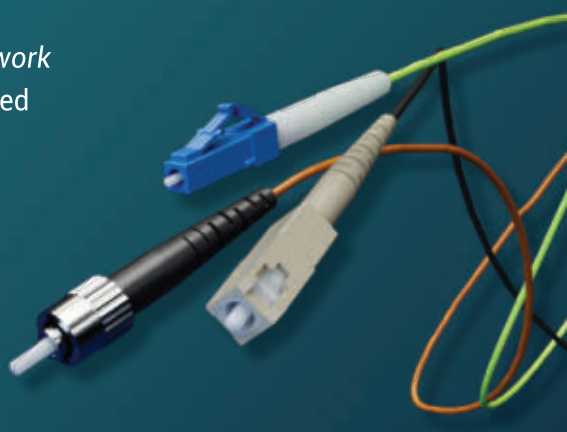

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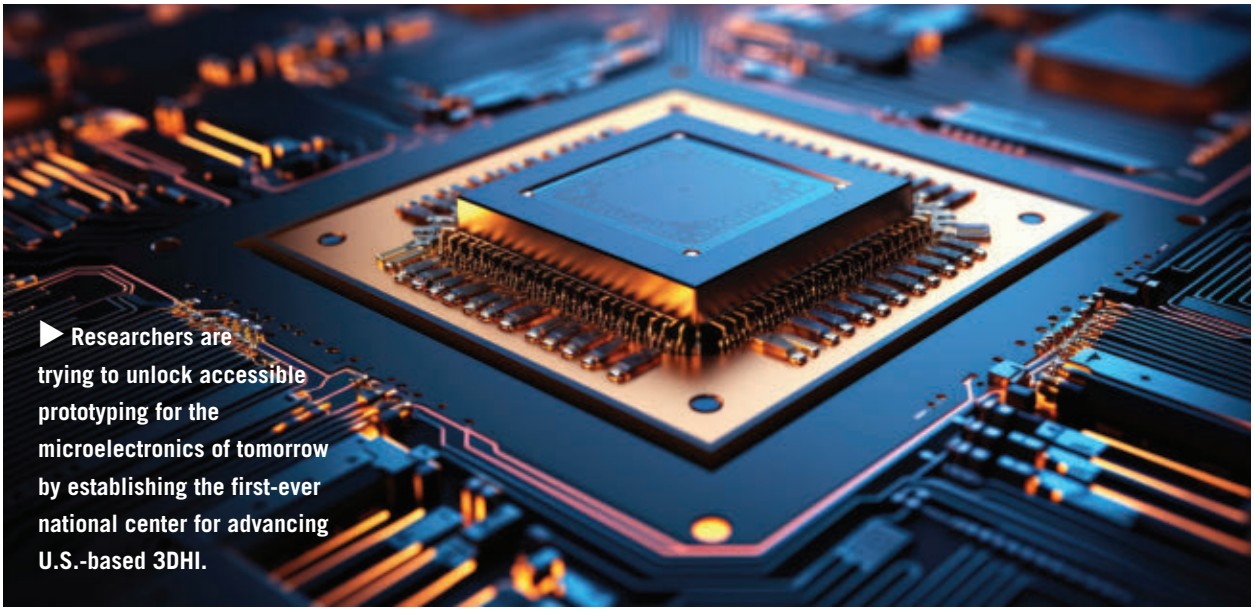

▶ Researchers are trying to unlock accessible prototyping for the microelectronics of tomorrow by establishing the first-ever national center for advancing U.S.-based 3DHI.

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Industry briefings set for 3D heterogeneous integration (3DHI) military microelectronics manufacturing

BY **John Keller**

AUSTIN, Texas – U.S. military researchers will brief industry in October on their latest plan to boost future military microelectronics manufacturing technologies by establishing a national center for advancing U.S.-based 3D heterogeneous integration (3DHI).

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., conduct industry briefings at the Next-Generation Microelectronics Manufacturing (NGMM) Summit from 8:30 a.m. to 5 p.m. on 27 2025, and from 7:30 a.m. to 1:30 p.m. on 28 Oct. 2025 at the University of Texas AT&T Hotel and Conference Center in Austin, Texas.

NGMM, aims to unlock accessible prototyping for the microelectronics of tomorrow by establishing the first-ever national center for advancing U.S.-based 3DHI. The goal is to develop a self-sustaining manufacturing center for research and pilot production of high-performance 3DHI microelectronics.

Highlights of the conference will include participation; program timeline; how to get involved in 3DHI research and prototyping; a technology roadmap overview of 3DHI technology development; and the latest on facility, infrastructure, equipment, and key milestones.

The NGMM Summit will include presentations by government, industry, and academic personnel, with time for discussions and networking. All presentations and discussions will be unclassified.

3DHI enables the integrated stacking of several different semiconductor types, like processors, memory, MEMS, RF, and photonic chips. 3DHI fundamentally different from traditional monolithic or 2D semiconductor manufacturing because integration because each die may employ different manufacturing processes and materials.

Those interested in attending the NGMM Summit should register online no later than 6 Oct. 2025 at https://web.cvent.com/event/a2008e16-1158-40e0-a82b-f40f25180ede/websitePage:2fc2ad49-a6c5-49fd-ad2e-c256ec101e52. Email administrative and technical questions to NGMM_Summit@darpa.mil. More information is online at https://sam.gov/opp/f70211813b674e99a314d44f2d66ff44/view.

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SCAN TO LEARN MORE ABOUT THE X9 VENOM FAMILY OF PRODUCTS

GE Vernova to provide megawatt-scale hybrid modular converter for electric power ship propulsion

BY **John Keller**

ARLINGTON, Va. – U.S. Navy researchers needed to develop a megawatt-scale advanced converter to provide enough electric power for Navy propulsion drive applications. They found a solution from GE Vernova naval systems segment in Imperial, Pa.

Officials of the Office of Naval Research in Arlington, Va., announced a $10.4 million order to GE Vernova Naval Systems in late June for rapid prototyping of the power electronics building block (PEBB) and hybrid modular multi-level converter (HMMC) Phase 3 effort.

GE Vernova will continue developing and prototyping of a megawatt scale hybrid modular multi-level converter to validate, test, and mature hybrid modular multi-level power conversion technology for Navy propulsion drive applications.

The Navy will use hybrid modular multi-level converter technology for nuclear propulsion for submarines and aircraft carriers; gas turbine propulsion in naval aviation; electric drive propulsion for surface warships; and efficient power distribution for weapons and sensors like laser weapons, RF electromagnetic weapons, and radar.

The Power Electronics Building Block is part of different power-conversion applications, like AC-DC, DC-DC, and DC-AC conversion. These subsystems help with rapid assembly of complex power electronic systems by combining several blocks.

These power subsystems typically use semiconductors like insulated gate bipolar transistors (IGBT) and metal oxide silicon field effect transistors (MOSFETs), together with advanced driver circuits. They can offer charge-pump power supplies and optical isolation for high-voltage operations.

The Hybrid Modular Multi-Level Converter combines different types of submodules in series and in parallel to enhance performance, efficiency, and fault tolerance in high-power applications like ship propulsion, large-scale energy storage, and high-voltage DC transmission.

GE Vernova is focusing on scaling power and voltage levels for demanding environments; enhancing reliability and fault management; integrating next-generation semiconductors like SiC MOSFETs.

The company also is trying to improve power electronics building blocks to provide low-voltage direct current/alternating current applications and medium voltage direct-current and alternating-current applications.

On this order GE Vernova will do the work in Imperial, Pa., and should be finished by June 2027. For more information contact GE Vernova Naval Systems online at www.gevernova.com/power-conversion/industries/Marine/Naval, or the Office of Naval Research at


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THE FUTURE OF CREWED AND UNCREWED SPACE FL

.IGHT

Efforts revolve around developing enabling technologies for related crewed missions to the moon and Mars, with roadmaps set for uncrewed deep-space probes within and outside of the solar system.

BY John Keller

▲ The Orion spacecraft delivers the crew and science airlock to the Gateway Space Station on the Artemis VI mission.

It's been more than half a century since humans first walked on the moon. American astronaut Neil Armstrong first set foot there in July 1969. The last human on the moon left in the lunar modular just three years later, and no one has been there since. Fifty-three percent of the world's population today weren't even born when NASA astronaut Eugene Cernan climbed into the lunar module in December 1972 for humanity's final return trip from the moon.

Now United States space exploration is set to return to the moon as early as 2027. But why do this after pouring the equivalent of $300 billion in today's dollars into the mid-20th century's Apollo program? It comes down to establishing a stepping stone toward putting the first humans on Mars sometime in the mid-to-late 2030s, with permanently crewed bases on the moon to launch and support Mars missions and help humans learn how to live and work for long periods away from Earth.

Besides using the moon as a jumping-off place for future Mars missions, scientists want to capitalize on a permanent lunar presence to search for resources like water and valuable minerals that could help support humans on the moon and perhaps bring back home. Scientists also want to develop new space technologies like creating breathable air from elements found on the moon, and developing robots to support life away from Earth. Politically, a permanent presence on the moon could help maintain U.S. technological leadership in its continuing competition with Western Europe and countries like China, India, and Russia.

Establishing bases on the moon and a human presence on Mars won't come cheap. Estimates hover around half a

trillion dollars to get humans to Mars via the moon, and probably a lot more to keep them there for any length of time.

Moon to Mars Architecture

The foundation of U.S. efforts to return to the moon and use it as a springboard to Mars is the Moon to Mars Architecture plan of the U.S. National Aeronautics and Space Administration (NASA) in Washington. The plan has four parts: sending humans back to the moon; establishing long moon missions; establishing permanent human bases on the moon; and finding ways to send humans from the moon to Mars and back to Earth.

The Moon to Mars Architecture revolves around enabling technologies that involve autonomous systems and robotics; communications; habitation; finding and using resources on the moon; logistics for supporting humans on the moon; ways to ease human movement in low gravity on the lunar surface; generating electric power and using it efficiently; and finding ways to transport humans around the moon and Mars quickly and efficiently.

The Gateway space station will be a vital component of the Artemis missions to return humans to the lunar surface for scientific discovery and chart the path for the first human missions to Mars.

The Gateway space station will host the Orion spacecraft in a polar orbit around the Moon, supporting scientific discovery on the lunar surface during the Artemis IV mission.

The first segment of the Moon to Mars Architecture includes the NASA Artemis missions, which will return humans to the moon for the first time in 53 years. These missions will develop and test human and cargo transportation; lunar communication relays; and demonstrate technologies necessary for Mars exploration. The Artemis missions prepare the groundwork by proving key capabilities in lunar orbit and surface operations.

This involves developing crewed spacecraft and satellites that orbit the moon; deep-space communications and tracking; transportation between lunar orbit and the moon's surface; human landing systems; spacesuit and moon walking technologies; and moving uncrewed payloads between lunar orbit and the lunar surface.

The next segment will expand lunar surface operations with relatively long missions, increased mobility, and exploration of the lunar south pole — including sustained orbital operations, reconnaissance, initial infrastructure

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development for a long-term lunar presence, and develop enabling technologies for future Mars missions.

Next will be establishing long-term human presence on the moon by finding and using lunar resources for human survival, sustainment, and goods and services.

After this, NASA officials focus on attempts to place humans on Mars for the first time. This segment will find ways for humans to travel safely to Mars, land on the Martian surface, conduct scientific experiments, and then return to Earth. After the first Mars missions, NASA officials seek to undertake longer and more complex missions to the Mars.

The Moon to Mars Architecture will develop technologies for high-priority lunar exploration conducted best by on-site human astronauts; the influence of the sun on the lunar and Martian environments, and how the sun influences planetary weather; the influence of the lunar and Martian environments on human health; machine automation and robotics; and lunar and Martian orbital dynamics.

Human lunar return

Systems and technologies for human lunar return segment involve space launch systems; the Orion spacecraft; ground systems for surface exploration; and so-called Gateway technologies for an orbiting lunar space station that will be launched and assembled separately. Gateway technologies involve power and propulsion, habitation, and logistics.

Other technology-development goals of human lunar return involve lunar supply and resupply; landing systems to transport astronauts and cargo between lunar orbit and the lunar surface; space suits, tools, and lunar vehicles; and communications, positioning, navigation, and timing for maintaining communications among the lunar surface, lunar orbit, and controllers on Earth.

Moving humans to Mars initially will involve sending four astronauts to Mars orbit, and landing two of them on the Martian surface for 30 Martian days, which are slightly longer than Earth days. Estimates place this initial Mars mission to launch by the late 2030s or early 2040s, with round-trip travel taking about 500 days, or one year and five months.

Then several Mars landers will descend to the planet's surface to deploy cargo for future human missions. After that, NASA will develop an initial Mars surface infrastructure involving minimal surface power generation and communications, but no surface habitation. Then NASA will pursue an all-up mission approach to send astronauts from Earth to Mars with all the fuel they will need to get to Mars and then back to Earth.

The Orion spacecraft is designed for deep space exploration, including missions to the moon and eventually Mars. Orion has a crew module with life support, flight controls, and glass cockpit; the European Service Module for propulsion, solar power, air, and thermal control; can sustain astronauts for as long as 21 days undocked from other spacecraft, and as long as six months when docked. Orion offers radiation shielding, a heat shield for Earth reentry, and deep space communication and navigation systems.

▼ This high-resolution image, taken on the first day of the Artemis I mission when the spacecraft was 57,000 miles from Earth.

Artemis: the first step

The foundational project to get humans back to the moon — and eventually to Mars — is the NASA Artemis program, which seeks not only to develop the launch equipment, rockets, and spacecraft to return humans to the moon, but

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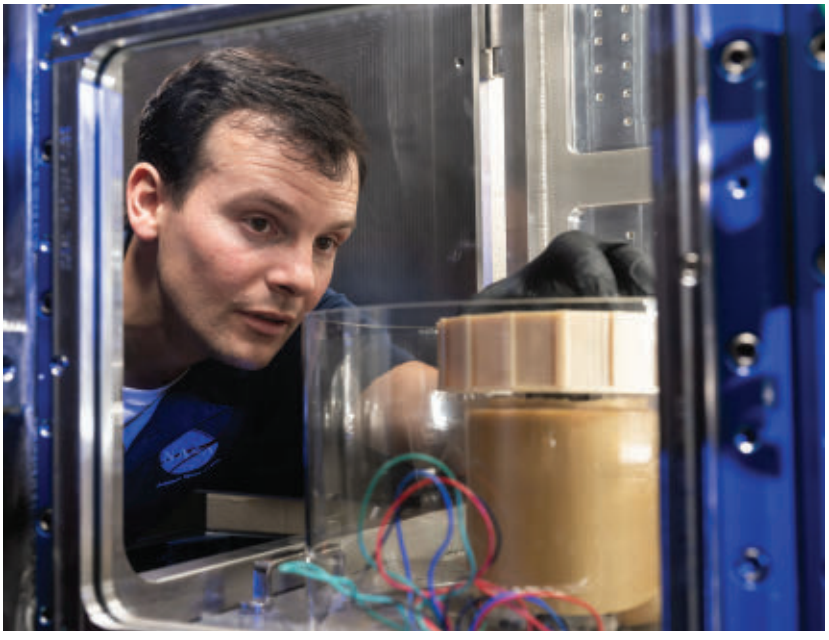


A NASA researcher leads a Gateway lunar dust adhesion testing campaign at NASA's Johnson Space Center in Houston.

also to build the habitation, power generation, and resource management to keep them there for sustained periods — leading eventually to a permanent human presence on the moon.

Plans include building places on the moon's surface for humans to live and work on a permanent basis, as well as building a space station called the Lunar Gateway that will orbit the moon to explore the lunar surface in detail and to make astronomical observations. The Gateway will support lunar landings — particularly the lunar south pole — and space exploration beyond the moon.

The Gateway space station also will be a communications relay between the moon and Earth, and will stage lunar landers and visiting crew vehicles. The Gateway will serve not only NASA, but also the European Space Agency (ESA), the Japan Aerospace Exploration Agency (JAXA), the Canadian Space Agency (CSA), and the Mohammed Bin Rashid Space Centre (MBRSC) of the United Arab Emirates.

The Gateway will provide solar electric power and propulsion, have living and work area for astronauts and visiting astronomers, and will support modules for storage, communications, refueling, and docking. Gateway will not be permanently crewed, but instead will operate autonomously between crewed Artemis missions, with astronauts visiting for weeks to months at a time. Artemis IV astronauts are to be the first to inhabit the Gateway in 2028 or 2029.

The Gateway's core modules, such as the Habitation and Logistics Outpost (HALO) and Power and Propulsion Element (PPE), are under construction, and should begin orbital assembly around the moon as early as 2027. The two Gateway modules are set to launch together on a SpaceX Falcon Heavy rocket within the next two years.

Artemis missions

The first Artemis mission, the uncrewed Artemis I, launched in November 2022 from Kennedy Space Center, Fla. The 25-day mission involved an Orion spacecraft lunar flyby, a distant retrograde orbit around the moon, and a second lunar flyby before returning to Earth in December 2022. This mission demonstrated the launch rocket and spacecraft, tested Orion's heat shield, and gathered data on radiation exposure, which showed lower cosmic ray exposure than expected.

The 10-day crewed Artemis II mission is set for next year, and will send four crew members around the moon and return to Earth. It will be the first crewed flight of the Orion spacecraft, and will test the performance of Orion systems like life support; perform rendezvous and proximity checks; demonstrate the Orion Artemis II optical communications system with downlink speeds as fast as 260 megabits per second; and validate crew interfaces, guidance, navigation, and spacecraft systems.

The Artemis III, which will land astronauts on the moon, is set for launch in mid-2027, and will be the first crewed lunar landing since 1972. Two astronauts will land at the moon's south pole aboard the SpaceX Starship Human Landing System. They will stay for about a week, while two astronauts remain aboard the orbiting Orion spacecraft before the crew reunites and returns to Earth. The moon's south pole receives only limited sunlight, and the sun never moves high in the sky there.

The goals of the Artemis III are to conduct as many as four moon walks for scientific observations, and collect samples of water ice to gauge the feasibility of using this water for long-term lunar habitation. Artemis III will drop-off a remote-control lunar rover for future missions to the dark side of the moon to search for more water ice deposits. This mission also will demonstrate advanced

space suits with improved mobility and flexibility on the moon.

The Artemis IV mission will launch in late 2028 or 2029, and will deliver and install the International Habitation Module (I-Hab) to the Lunar Gateway space station, and send two more astronauts to the lunar surface. This mission will start assembly, operations, and periodic habitation of the Gateway. On the lunar surface, meanwhile, astronauts will test using lunar habitation and the moon's resources for a long-term human presence.

The NASA payload is installed on the prototype rover Artemis Jr. for NASA's Regolith and Environment Science and Oxygen and Lunar Volatile Extraction, or RESOLVE, project in a test facility behind the Operations and Checkout Building at NASA's Kennedy Space Center in Florida.

The I-Hab module aboard the Lunar Gateway will provide orbiting living and working quarters for four astronauts during missions lasting 30 to 90 days. It will have four docking ports for other Gateway elements and cargo ships, lunar landers, and refueling spacecraft, as well as a telecommunications module. The I-Hab will have batteries, heating and cooling, refrigeration, a kitchen, bathrooms, and workstations. It also may have robotic arms and internal robotic interfaces for maintenance when humans are not aboard.

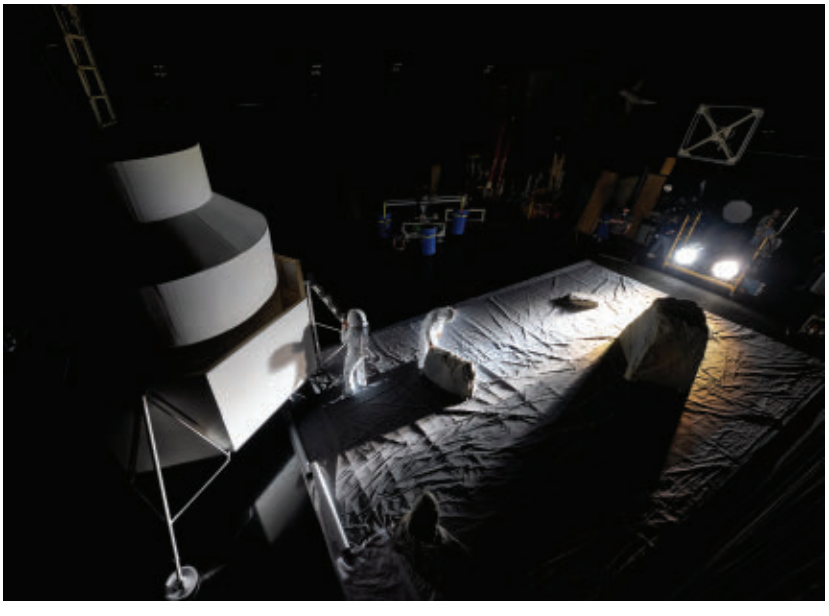
The Artemis V mission will launch in the early 2030s, and will use the Blue Origin Blue moon lander. As in previous missions, it will send two astronauts to the Gateway station, and land two astronauts on the moon's south pole. The mission also will deliver the European Space Agency's ESPRIT refueling and communications module, a Canadian-built robotic arm, and NASA's Lunar Terrain Vehicle.

Beyond the moon to Mars

NASA plans to send astronauts to the surface of Mars in the mid-to-late 2030s, potentially as early as 2035. Each mission could take as long as two years, with round-trip travel time of about six to seven months, and as long as 500 days on Mars. While on the Martian surface, astronauts will sustain themselves over the long term by conserving food, water, and other resources, as well as growing crops.

For the early Mars missions, NASA is developing advanced propulsion that could involve nuclear thermal and nuclear electric propulsion, life-support, radiation protection, and surface exploration equipment.

A host of electronic technologies will be necessary to support an initial and eventually a sustained human presence on Mars. NASA and private industry have less than 15 years to develop them, if estimates of when the first people will land on Mars hold true.



Teams at NASA's Marshall Space Flight Center in Huntsville, Ala., are using the Flat Floor Facility to understand the lunar lighting environment in preparation for the Artemis III crewed lunar landing mission in 2027. The sun is visible at the south pole of the moon only at the horizon.

The Martian surface environment is far more harsh compared to Earth. Mars is cold, dry, and dusty, with a thin, carbon dioxide-rich atmosphere, and the surface is desert-like, with tall mountains and deep valleys. It has an atmospheric pressure less than 1 percent of Earth, which makes it impossible for humans to breathe unaided, for stable liquid water to exist, and that offers little protection from cosmic and solar radiation. Surface temperatures range from extremes of -225 and 70 degrees Fahrenheit, with strong winds and months-long dust storms. Gravity is about one-third that of Earth.

Still, compared to the moon, the Martian surface is not as harsh, which makes the moon a worthwhile proving ground for new systems and electronics. The moon, for example, has no atmosphere, while Mars has a thin atmosphere that can provide partial protection against radiation and micrometeorites. The moon has higher surface radiation than Mars, and is more vulnerable to solar flare radiation.

To ensure safety, health, and operational capability on Mars, new electronic systems will be necessary for power generation, communications, life support, mobility, medical care, environmental control, and automation. It's unknown if humans could live long-term on the Martian surface, or would have to live underground.

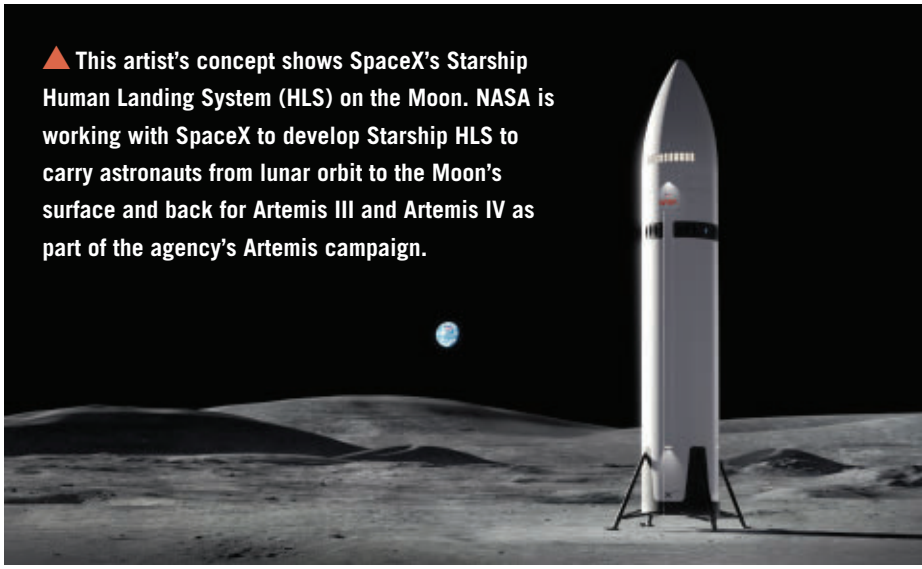
Nuclear fission reactors are being developed as the primary source of power on Mars due to their reliability compared to solar. Ruggedized power management electronics also will be necessary for Mars habitation. Laser communications on Mars will be necessary to transmit large amounts of data and video between Mars and Earth, because lasers offer far higher bandwidth than RF links, and will reduce

data transmission times from years to weeks for large files.

Electronics technologies for Mars

Advanced electronics also will be necessary to process breathable air and husband limited water supplies on Mars. These systems will need redundant sensors and intelligent automation to respond to changes and malfunctions without intervention from Earth. Electronic systems also will monitor for radiation, atmospheric conditions, and the structural integrity of human habitation. Industrial automation and sensors will help manage habitat temperature, humidity, air pressure, and filter out toxic gases.

Portable multi-function medical diagnostic and treatment devices able to work autonomously also will be necessary on Mars — especially with the expected communications lag between Mars and Earth. Mars is 140 million miles from Earth, and laser and RF signals take between 4 and 24 minutes, and even longer for large packages of data. Medical devices on Mars are expected to integrate with centralized health monitoring for crew status and environmental data.



▲ This artist's concept shows SpaceX's Starship Human Landing System (HLS) on the Moon. NASA is working with SpaceX to develop Starship HLS to carry astronauts from lunar orbit to the Moon's surface and back for Artemis III and Artemis IV as part of the agency's Artemis campaign.

Pressurized Martian rovers and robotic assistants must have electronic controls for navigation, life support, and scientific experiments. Space suits must have embedded electronics to monitor astronaut vitals, provide life support, and manage communications, and are expected to have flexible displays, environmental sensors, and self-diagnostics. Artificial intelligence will be necessary to monitor spacecraft and habitat systems, troubleshoot faults, and assist in complex tasks — particularly because of limited real-time support from mission control.

Enabling technologies in electronics on mars will involve radiation-hardened electronics; redundancy and fault tolerance; and efficient thermal management. Electronics must be able to withstand the effects of radiation, temperature extremes, and the lack of readily available replacements will require built-in redundancy, self-checks, and failover capabilities.

▲ **U.S. Navy divers are training in the Neutral Buoyancy Laboratory at NASA's Johnson Space Center in Houston using a test version of the Orion spacecraft.**

Deep-space exploration

Despite the attention to future crewed missions to explore the moon and Mars, not all future space exploration will be uncrewed — far from it. Much space exploration is the responsibility of the NASA Jet Propulsion Laboratory (JPL) in Pasadena, Calif. JPL has plans for several uncrewed deep-space probes targeting the moon, outer planets, and the broader universe.

The Europa Clipper mission launched to Jupiter in October 2024 to study the icy shell and subsurface ocean of Jupiter's moon Europa for its potential for future human habitation. The Europa Clipper spacecraft will arrive at Europa around 2030.

The JPL Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer — otherwise known as SPHEREx — launched last March on a 27-month mission to create detailed 3D maps of the universe, exploring the universe's expansion following the Big Bang, and locating life-supporting ingredients in cosmic ices.

The Lunar Trailblazer mission to map water distribution on the moon launched last February, but so far has not been successful. JPL controllers lost contact with the ship shortly after launch because a faulty power system, and as of July, controllers have not been able to re-establish contact. Scientists say they believe the ship went into a slow spin with its solar panels misaligned, which caused low power generation and eventual loss of telemetry. As of now, the spacecraft is off-course and drifting away from the moon, and it's likely the spacecraft has been lost.

The Cooperative Autonomous Distributed Robotic Exploration (CADRE) mission to place three small autonomous and collaborating rovers on the moon is set for launch next year to map the lunar surface and subsurface using stereo cameras and ground-penetrating radar. Rovers will operate for two weeks on the moon without human control and communicate via a mesh network among the rovers and a base station on the lander.

The VERITAS mission to orbit Venus is set for launch in 2031 to study Venus's geology and atmosphere to determine why that planet veered away from Earth's evolutionary path. The Interplanetary NanoSpacecraft Pathfinder In Relevant Environment (INSPIRE) mission to demonstrate cubesats outside Earth orbit does not yet have a scheduled launch date. It aims to validate cubesat communication, navigation, and data collection for future low-cost interplanetary missions.

Aside from specific deep-space missions, NASA JPL is working on optical deep-space communication technologies; exploring beyond the solar system.

Zero Trust becomes the foundation of cyber security

The treat of cyber-attacks have become so serious that no one on the inside or the outside or organizations can be trusted to prevent intentional or accidental data viruses

BY **Jamie Whitney**

The line between cyber and physical threats in today's digital battlespace continues to blur, and the consequences of a data breach can be catastrophic. Whether protecting avionics aboard a fighter jet or safeguarding mission data in a satellite ground station, trusted computing has become a fundamental requirement for military and aerospace systems. It's no longer enough to assume that networks, users, or even devices can be trusted.

To address this changing threat landscape, the U.S. Department of Defense (DOD) has adopted a Zero Trust Architecture approach, outlining a multi-year plan to strengthen military networks against increasingly advanced cyber threats. The DOD Zero Trust Strategy, issued in late 2022, requires implementation of Zero Trust across all components by 2027. This involves continuous verification of every access attempts — whether internal or external — as well as data segmentation, encrypted communications, and ongoing monitoring of system integrity.

"Zero Trust is a major effort that is rippling through mil/aero embedded systems," says Justin Moll, Vice President of Sales and Marketing at Pixus Technologies in Waterloo, Ontario. "In short, there is a DOD mandate of 'never trust, always verify,' but there are different tiers that a system will need to comply with. For a chassis vendor, a key

◀ The convergence of cyber and physical attack surfaces in modern warfare increases the risk of catastrophic breaches, making hardware- and software-level security measures a foundational requirement.

element is the chassis manager. In SOSA aligned and some other OpenVPX-based systems, the chassis manager is a major control point because it and the PCS on each card are the first processors running in the system.

"There are ways we can leverage the flexibility of the chassis manager without exposing it to external threats," Moll continues. "This includes removing accessibility to less secure ports such as Serial and JTAG. It may make sense to utilize something like Ethernet as the key access point where you can have longer message size limit and can layer in security. We'll see what direction is employed via VITA/SOSA committee efforts."

For defense contractors and technology suppliers, this shift means more than just meeting compliance; it's a call to rethink how trust is embedded into hardware and software from the ground-up. That includes everything from secure boot processes and hardware root of trust to real-time system authentication, supply chain integrity, and resilient architectures designed to withstand ongoing threats.

In conversations with defense electronics experts, one thing is clear: in the age of Zero Trust, experts must engineer, trust, and never assume the trust they have in computers and data networks.

Cyber threats

While Zero Trust is transforming how systems authenticate and communicate at the architectural level, the broader threat landscape continues to evolve. Nation-state actors and their affiliates are investing heavily in asymmetric cyber capabilities, targeting vulnerabilities in legacy infrastructure and next-generation platforms. These attacks increasingly are aimed at embedded computing, where the consequences of compromise can be severe and long-lasting.

"The biggest trend I see is the ever-increasing cyber-attacks from state-sponsored actors and their proxies that aim to disable and weaken our infrastructure and our military," says Rich Jaenicke, director of marketing at Green Hills Software in Santa Barbara, Calif. "Those attacks are carefully designed to cause significant damage without crossing some threshold that would escalate into physical conflict, and those thresholds are being stretched by increasing stealthiness and uncertainty in attribution. Although patching known vulnerabilities can reduce the impact of these attacks, a more comprehensive solution is to make security a priority in the design of embedded systems and upgrade infrastructure with these more secure systems."

▲ **The Air Force is using the Cyber Direct Commissioning Program to address current manning requirements in the cyber workforce. Leveraging this authority allows the Air Force to fulfill critical technical skills.**

As the threat landscape expands and Zero Trust principles take hold, hardware safeguards and data-centric protections are becoming critical. Chris Ciufo, chief technology officer at General Micro Systems in Rancho Cucamonga, Calif., points to three emerging priorities that defense integrators can no longer afford to overlook: The need for cross-domain solutions and NSA Type 1 encryption; the need to protect and encrypt data and then be able to erase the data at risk; and whole-system zeroization.

These capabilities are especially important in forward-deployed or contested environments, where sensitive data must remain secure even in the event of system compromise or physical capture.

"It's one thing to have encrypted data," Ciufo says. "It's another thing to be able to erase that data on one side or another, or erase the entire system because some of that data will reside in FIFOs [first in, first out data structure], some will reside in management information bases for networking, such as in network controllers, where they're using some of that data to make decisions. The ability to zeroize the entire system is critical to cyber security today."

The influence of AI

As trusted computing develops, artificial intelligence (AI) and machine learning increasingly are shaping how military systems detect, respond to, and even predict cyber threats. Just as these technologies are revolutionizing sensor fusion, autonomy, and mission planning, they are also transforming the cyber domain. Experts say that AI and machine learning can help shift cyber security from reactive patching to proactive defense by continuously analyzing system behavior, spotting anomalies, and responding to potential intrusions in real time.

However, leveraging AI for cyber defense presents its own challenges. Training models to distinguish between normal and malicious behavior in highly

complex, mission-critical environments requires vast amounts of data and careful tuning. There are also risks that adversaries could exploit AI systems through poisoning attacks or adversarial inputs. Still, defense technologists argue that when properly implemented, AI-enabled cyber security tools offer a level of speed and adaptability that traditional approaches can't match — especially in contested environments where decisions must be made in milliseconds and bandwidth may be limited.

"The challenge lies in designing AI systems that are robust, explainable, secure and resilient enough for the uniquely high stakes of national defense," says Ciufo at GMS.

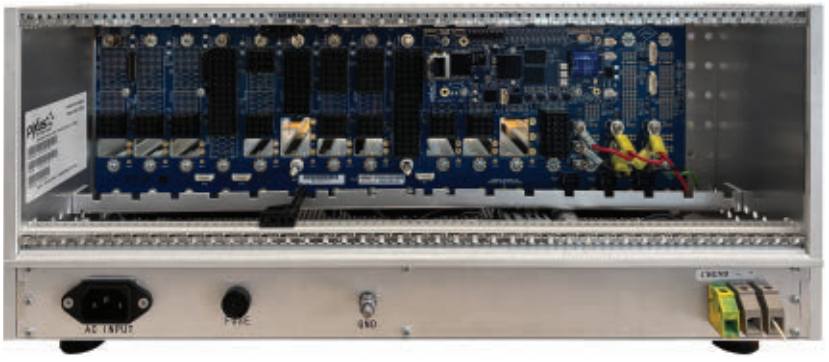
Ciufo explains that myriad positives and negatives come along with the wider adoption of AI and machine learning technologies in friendly and adversarial systems. The CTO and president says that AI and machine learning provides robust threat detection and rapid response along with automation of security operations.

▲ The U.S. Navy's Tactical Combat Training System Increment II (TCTS II) from Collin Aerospace is a real-time operational air combat training system that blends live, virtual, and constructive training elements.

"Beyond the basics of practicing 'safe systems,' humans continue to evolve their hacks at attack surface vulnerabilities," Ciufo says. "A human that is looking to 'harden' their system often makes

certain assumptions about how or what an attacker may attempt. AI doesn't get bored nor enter a discussion with any pre-conceived notions. Each engagement is brand new, so AI can take a fresh look at anticipating vulnerabilities as well as how to eliminate them."

He continues, "AI is streamlining Security Operations Centers by automating tasks such as incident triage, log analysis and threat intelligence correlation. This type of automation allows human analysts to focus on more complex decisions."



▲ The Pixus chassis manager affixes to the rear of the OpenVPX backplane, which is above the P2 RF/optical area, so that it does not consume any slots — as shown in this development chassis example.

Modern problems

While AI and machine learning offer advantages in detecting threats and securing embedded systems, experts caution that adversaries are rapidly adopting these same tools. Nation-state actors and advanced persistent threat groups are now leveraging AI to accelerate vulnerability discovery, craft highly targeted attacks, and evade traditional detection methods.

"AI and machine learning technologies excel at pattern recognition, so they can learn the normal behavior of a system and flag deviations," says Jaenicke at GHS. "Such anomaly detection is potent against zero-day attacks and malware detection. Of course, attackers can use AI and machine learning as well. Attackers can train their own machine learning models to generate payloads that look normal to AI-based anomaly detectors. Other AI/machine learning tools can scan firmware, binaries, or communication protocols to identify exploitable vulnerabilities. machine learning improves upon random fuzz testing by learning which inputs are more likely to cause crashes or reveal bugs, such as rapidly discovering buffer overflows or logic flaws. With such an accelerating AI arms race, it is more important than ever that systems are secure by design, not just by policy or security add-ins."

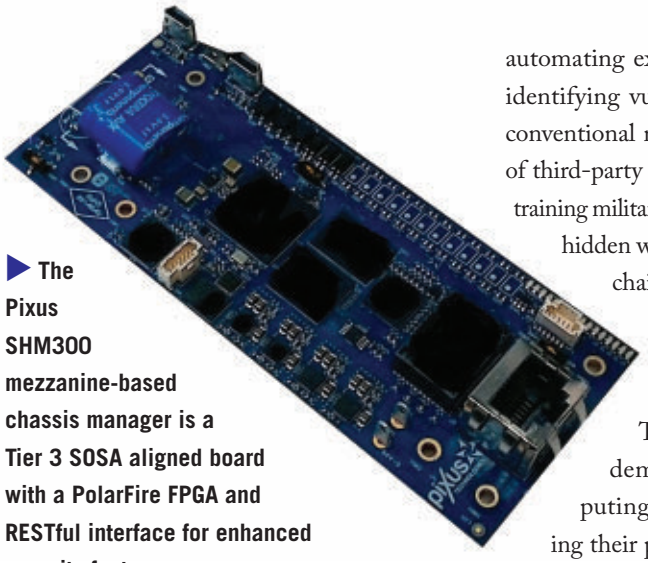
As defenders and attackers grow more sophisticated in their use of machine learning, trusted computing in military and aerospace environments must evolve to ensure resilience is built into systems at every level — from hardware and firmware to runtime protections and secure system updates.

"AI exacerbates the exposure risk in the system. If there is a weakness for

▲ Airmen assigned to the 612th Air Operations Center and 612th Air Communications Squadron conduct command and control operations during a mock deployment exercise at Nellis Air Force Base, Nev.

security, AI can be used to exploit it," says Pixus' Moll.

General Micro Systems's Ciufo also highlights several risks that come with integrating artificial intelligence into military and aerospace cyber security frameworks. One growing concern is the threat of adversarial AI. Defense systems that rely on machine learning are susceptible to subtle input manipulations that can deceive models, potentially causing misclassification in imagery analysis or spoofing sensor data. While AI is designed to adapt, current models often lack the complexity to be truly unpredictable, which can create exploitable patterns.



The Pixus SHM300 mezzanine-based chassis manager is a Tier 3 SOSA aligned board with a PolarFire FPGA and RESTful interface for enhanced security features.

"Despite AI's adaptability, many large language models are still relatively small, which means their outcomes can be too predictable," Ciufo says. "And if an adversary can anticipate those outcomes, the system becomes inherently vulnerable."

Another critical issue is data poisoning and model corruption. Attackers can intentionally insert compromised data during the training of an AI model, skewing its behavior or embedding hidden backdoors. This type of manipulation can compromise the integrity of systems designed to make autonomous decisions in the field.

Ciufo also points to the growing problem of over-reliance on opaque machine-learning models. Many of these systems operate as "black boxes," where decisions can't easily be traced or justified. In mission-critical scenarios where human oversight and accountability are essential, that lack of explainability becomes a liability.

Beyond that, adversaries are already using AI to enhance their own cyber capabilities, streamlining reconnaissance, automating exploit development, and identifying vulnerabilities faster than conventional methods. Finally, the use of third-party datasets and platforms in training military AI models can introduce hidden weaknesses into the supply chain, posing long-term risks to system security.

Modern solutions

To meet evolving security demands in defense computing, companies are adapting their products with Zero Trust and trusted computing principles in mind. At Pixus Technologies, that effort is reflected in the development of the SHM300 Tier 3 SOSA-aligned chassis manager, which incorporates several key architectural decisions aimed at hardening embedded system security.

Working alongside software and firmware partner Crossfield Technology, Pixus selected Microchip's PolarFire FPGA for the SHM300, citing its enhanced encryption and networking capabilities as essential for modern security requirements. "We made some key decisions early-on to prepare for security measures for our SHM300 Tier 3 SOSA aligned chassis manager," says

Justin Moll, Vice President of Sales and Marketing at Pixus Technologies. The company also opted for a full-feature Linux operating system, rather than a scaled-down version, in order to support a complete TCP/IP networking stack — enabling more robust communications and security protocols.

The SHM300 leverages a mezzanine-based design and utilizes a RESTful interface to implement and manage security features. To further reduce risk, Pixus has recently added a fiber Ethernet option, which helps deter electronic eavesdropping and physical snooping, particularly in environments where wired connections may be exposed.

At General Micro Systems, Ciufo says that the emphasis remains squarely on hardware-based security, which the company considers the gold standard for protecting sensitive military systems. While software-based protections are useful and often necessary, GMS customers consistently favor physical safeguards implemented at the hardware level.

"Given the choice between hardware-based security at the bare metal versus software security, customers choose hardware all day, every day," says Ciufo.

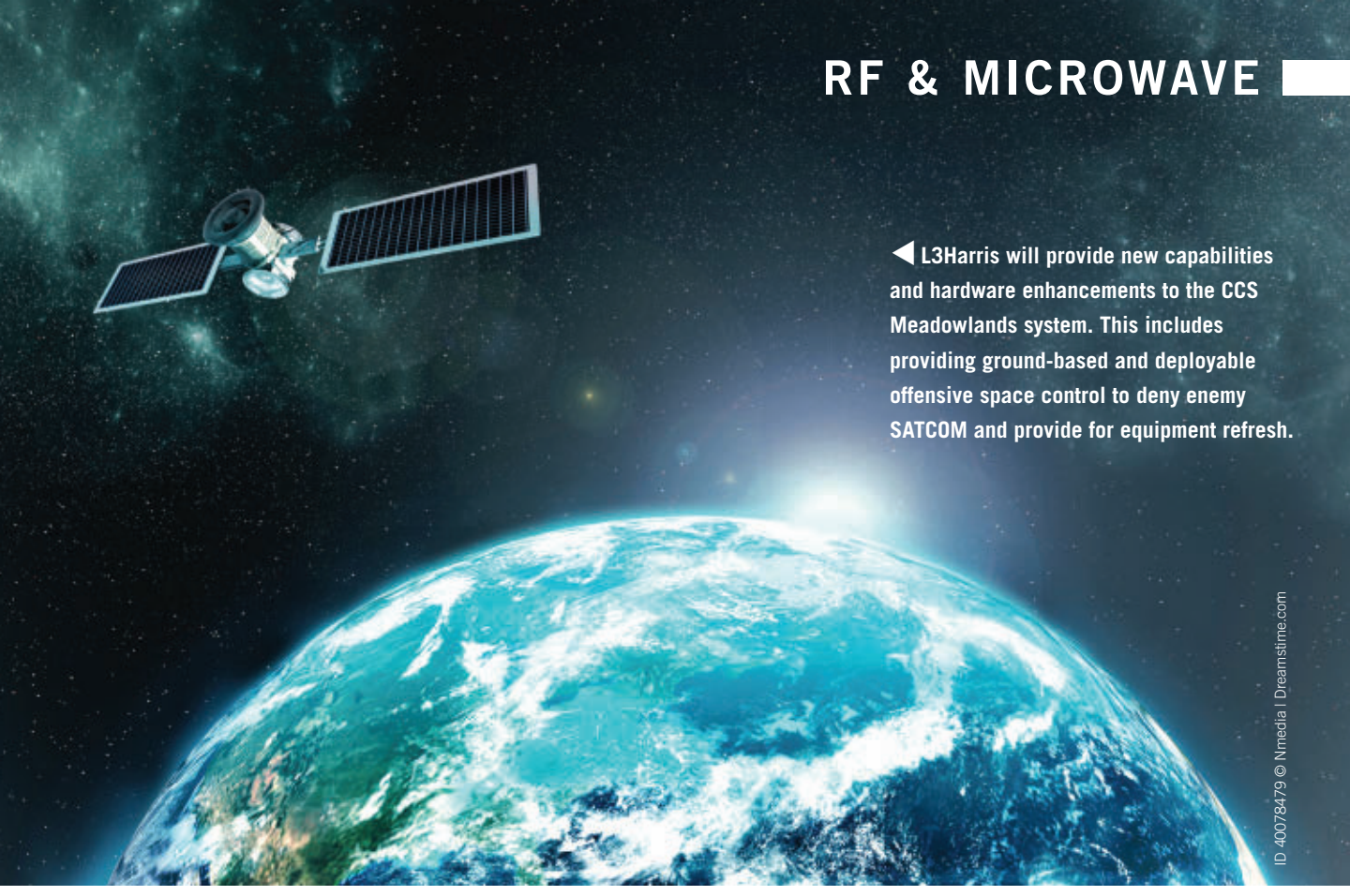
That preference drives demand for real, tactile controls rather than software-based interfaces — hardwired buttons instead of digital prompts, and direct security logic instead of watchdog timers that may be bypassed or delayed.

To meet these requirements, GMS integrates several layers of physical security features across its systems. Many platforms include a dedicated "Zero" button that triggers a secure zeroization process. A single press erases the drives, and a second press wipes the BIOS, effectively rendering the system inoperable. Anti-tamper switches and sensors detect unauthorized access to the chassis and initiate the same zeroization protocol. The company's Enhanced SecureDNA suite adds further protections, including daisy-chained "Intruder" cables. If disconnected during an attempt to extract hardware modules from a vehicle or system, these cables trigger a complete hardware lockout — bricking the device and preventing data exfiltration or reverse engineering.

"Hardware-based security can complement software-based security," says Jaenicke from Green Hills Software. "For example, a data diode, which provides one-way data transfer, is best implemented in hardware using optical isolation techniques to ensure there is no return data path. On the other hand, a data guard, which performs content inspection and filtering, is best implemented in software. The software data guard can more easily adapt to new types of malware and unauthorized data transfers. Using a hardware data diode and a software data guard together provides the highest level of protection against data leaks."

Jaenicke says that data diodes and data guards are two components of a cross-domain solution (CDS), which provides the ability to access or transfer information between different security domains. "Many CDSs live in data centers, but a tactical CDS can be used in deployed weapon systems," Jaenicke informs. "An example of a high-end, tactical CDS is the one used in the US Navy's Tactical Combat Training System Increment II (TCTS II) from Collins Aerospace. TCTS II is a real-time operational air combat training system that blends live, virtual, and constructive training elements. TCTS II fields the first certified multi-level security (MLS) training equipment in airborne and ground equipment to protect the tactics, techniques, and procedures being used.

He continues, "TCTS II also provides interoperability for joint and coalition training with fourth and fifth-generation platforms while aligning with industry software standards such as the FACE Technical Standard and Software Communications Architecture (SCA). Collins Aerospace uses the INTEGRITY-178 tuMP RTOS as the foundation of their tactical CDS in TCTS II, and that CDS is certified to NSA's 'Raise the Bar' security standard."



◀ L3Harris will provide new capabilities and hardware enhancements to the CCS Meadowlands system. This includes providing ground-based and deployable offensive space control to deny enemy SATCOM and provide for equipment refresh.

Space Force asks L3Harris for upgraded SATCOM electronic warfare jamming and enhanced multiband antenna

BY **John Keller**

LOS ANGELES AIR FORCE BASE, Calif. – U.S. Space Systems Command electronic warfare (EW) experts needed an upgraded counter-communications system (CCS) to jam enemy satellite communications (SATCOM) systems. They found a solution from L3Harris Technologies Inc. in Melbourne, Fla.

Officials of the Space Systems Command's Space Domain Awareness and Combat Directorate at Los Angeles Air Force Base, Calif., announced a $33.5 million contract to L3Harris for Counter Communication System Meadowlands development.

CCS Meadowlands refers to an upgraded version of the U.S. military's ground-based Counter Communications System designed to disrupt enemy satellite communications temporarily by electronic warfare jamming. Meadowlands signifies a more portable and advanced iteration of the CCS for easier deployment to counter adversarial SATCOM.

This contract calls for L3Harris to design new capabilities and hardware enhancements to the CCS Meadowlands

system. This includes providing ground-based and deployable offensive space control to deny enemy SATCOM and provide for equipment refresh.

Meadowlands interacts with the user via browser web pages, which help to set up, save, recall, create, and manage hardware and mission software.

L3Harris will add S-and X- bands to the Meadowlands Large Multiband Antenna (LMA) band additions to provide new dual-polarization feeds, low-noise amplifiers, power amplifiers, hardware, and interfaces with on-antenna trailer equipment, including an optional replacement Pol3 antenna that covers S-band.

The system's existing software code is a combination of CUDA, C/C++, and Java, and includes complex signal processing, which may require experienced signal processing programmers for the new Meadowlands environment, including the L3Harris Software-Defined Radio Daemon hardware abstraction layer.

The company also will develop new software applications and algorithms into the CCS Program, and begin testing CCS capabilities to refine space warfighting techniques and integrate into counter-EW architecture.

On this contract L3Harris will do the work at Cape Canaveral Space Force Station, Fla.; Colorado Springs and Greeley, Colo.; and Vandenberg Space Force Base, Calif., and should be finished by November 2028.

For more information contact L3Harris Technologies online at www.l3harris.com, or Space Systems Command's Space Domain Awareness and Combat Directorate online at https://www.ssc.spaceforce.mil/Program-Offices/Space-Domain-Awareness-Combat-Power.

Air National Guard photo

Air Force asks Raytheon to upgrade AMRAAM missile to mitigate effects of component obsolescence

BY **John Keller**

ROBINS AIR FORCE BASE, Ga. – U.S. Air Force airborne weapons experts are asking RTX Corp. to upgrade computer processors in variants of the Advanced Medium Range Air to Air Missile (AMRAAM) to mitigate the effects and risks of component obsolescence.

Officials of the Air Force Lifecycle Management Center at Robins Air Force Base, Ga., announced a $92 million contract to the RTX Raytheon segment in Tucson, Ariz., for the processor upgrade for mission alliance risk reduction project.

This contract asks RTX Raytheon to reduce risk of integrating AMRAAM C-8 and D-3 variants. The contract is awarded to RTX Raytheon sole-source, because the company is considered the only responsible contractor for the job.

The AIM-120C-8 and AIM-120D-3 are international variants of AMRAAM for air-to-air and surface-to-air missions. These AMRAAM versions have 15 upgraded circuit cards in their missile guidance sections and have the capability to upgrade future software continuously.

AMRAAM entered service in 1991 and will be augmented and eventually replaced by the AIM-260 Joint Advanced Tactical Missile (JATM) beyond-visual-range air-to-air missile (BVRAAM) from Lockheed Martin Corp. JATM will be able to deal with the Chinese PL-15 long-range air-to-air missile.

On this contract, Raytheon will handle test and support equipment, and diminishing manufacturing sources and material shortages (DMSMS) purchases. Efforts will include identifying, resolving, and mitigating obsolescence issues. Raytheon will do the work in Tucson, Ariz., and should be finished by August 2027.

For more information contact RTX Raytheon online at www.rtx.com/raytheon, or the Air Force Lifecycle Management Center at www.aflcmc.af.mil.

▲ Anduril Industries will provide a counter-unmanned aircraft system to help protect deployed Marines and their equipment.

Air Force photo

Marine Corps chooses Anduril Federal for EW for air defense against uncrewed aircraft

BY **John Keller**

QUANTICO MARINE BASE, Va. – U.S. Marine Corps air defense experts needed state-of-the art systems to counter small unmanned aircraft to protect deployed Marines and their equipment. They found a solution from the Anduril Federal division of Anduril Industries in Washington.

Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., announced $642.2 million contract to Anduril to install the Counter Small Unmanned Aircraft System (I-CsUAS).

The Marine Corps requires a modernized C-sUAS capability to counter evolving threats from small uncrewed aircraft by using advanced technologies to detect, track, identify, and defeat small unmanned aerial systems, Marine Corps officials say.

Anduril will develop counter-unmanned capabilities in integrated and networked sensor nodes to protect Marines using conventional weapons or electronic warfare (EW) means to prevent small unmanned aircraft from threatening Marines and their equipment.

These new capabilities will help close an installation security capability gap that exists today in detection, tracking, identification, and defeat of small unmanned aircraft operating near covered Marine facilities and assets. The sUAS threat poses unique challenges to military installations when compared to those of operational forces, Marine Corps experts explain.

Specifics of I-CsUAS enabling technologies and development plan are considered controlled unclassified information (CUI), and generally are not available to the public.

Questions or concerns can be emailed to Marine Corps contacts Shannon Graves at Shannon.Graves@usmc.mil or Stasia Baker at Stasia.Baker@usmc.mil. More information is online at https://sam.gov/opp/7f99d46d0f5040ed-9691edcf343d9810/view.

For more information contact Anduril Federal online at www.anduril.com/capability/counter-uas, or Marine Corps Systems Command at https://www.marcorsyscom.marines.mil.

Army searching industry for medium-range low-power radar systems to evaluate threat test range scenarios

BY **John Keller**

Air Force photo

▲ **Radar prototypes are to support evaluation of critical range scenarios.**

REDSTONE ARSENAL, Ala. – U.S. Army radar experts are surveying industry for qualified radar vendors able to build as many as six prototype medium-range radar — low power (MRR-LP) instrumentation radar systems to help evaluate critical test range scenarios in Arizona and New Mexico.

Officials of the U.S. Army Program Executive Office Missiles and Space (PEO MS) Search Track Acquire Radiate Eliminate (STARE) program office at Redstone Arsenal, Ala., issued a request for information (W9124P-25-S-RRRP-MRRLP) for the Instrumentation Radars In The Medium Range Radar-Low Power (MRR-LP) Configuration project.

These six radar prototypes, which would be installed at White Sands Test Center (WSTC), N.M., and at Yuma Test Center (YTC), Ariz., are to support evaluation of critical range scenarios. Low-power medium-range radar prototypes should be at least as mature at Technology Readiness Level 5, which describes breadboard validation in a relevant environment.

From radar designers, the Army wants descriptions of efforts and progress made toward developing a radar system that is unclassified; operates in C-band; and is tunable between 5.4 and 5.9 GHz.

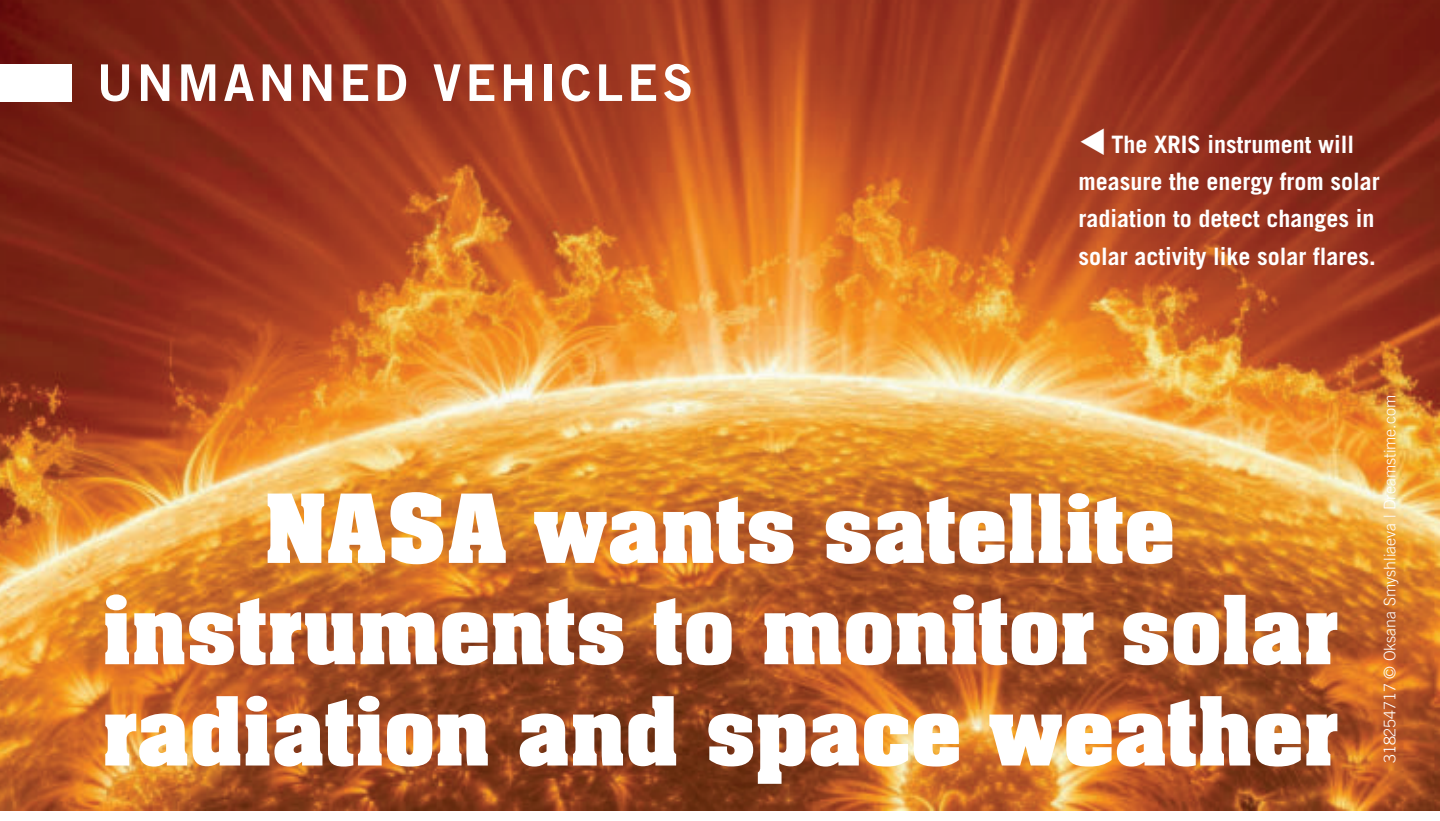
These low-power radar systems must initiate and maintain tracks independently on as many as 15 objects in a 30-degree field of view. The radar must be able to detect a 6-inch sphere in clear weather from 28 miles away with a 99 percent probability of detection with a low probability of false alarm.

The Army PEO MS develops and sustains defensive and offensive integrated fires capabilities for the joint all-domain battlespace, and is on the cutting edge of the Army's long-range precision fires, air and missile defense, hypersonic, directed energy, counter-unmanned aerial systems, integrated fires mission command, and aviation and ground missiles modernization initiatives.

Search Track Acquire Radiate Eliminate (STARE) is one of six project offices under PEO MS. The STARE mission is to develop and sustain advanced radar and sensor technologies for long-range detection, discrimination, tracking, and destruction of enemy crewed and uncrewed aircraft, missiles, and munitions. STARE also delivers cyber security, electronic countermeasure, and logistics for the controlled sale of radar and sensors to U.S. allies.

Companies interested were asked to email responses by March 2025 to the Army's Justin Nabity at justin.a.nabity.civ@army.mil and Thomas Hibbett at thomas.g.hibbett.civ@army.mil, with W9124P-25-S-RRRP-MRRLP in the subject line.

Email questions or concerns to Justin Nabity at justin.a.nabity.civ@army.mil and Thomas Hibbett at thomas.g.hibbett.civ@army.mil. More information is online at https://sam.gov/opp/e4d461369c2f47febd6336f4872c108f/view.



◀ The XRIS instrument will measure the energy from solar radiation to detect changes in solar activity like solar flares.

NASA wants satellite instruments to monitor solar radiation and space weather

BY **John Keller**

GREENBELT, Md. – U.S. space weather researchers are making plans to approach industry later this year for a project to design and build two space-based instruments to monitor solar activity that threatens to disrupt RF and microwave systems like radio and satellite communications, and navigation systems.

Officials of the U.S. National Aeronautics and Space Administration (NASA) Goddard Space Flight Center in Greenbelt, Md., and the U.S. National Oceanic and Atmospheric Administration (NOAA) in Washington plan to issue a solicitation for the Space weather Observations at Lagrange 1 (SOL) X-Ray Irradiance Sensor (XRIS) instrument.

The XRIS instrument will measure the energy from solar radiation to detect changes in solar activity like solar flares, which will help predict solar energetic particle events that could penetrate the Earth's magnetic field.

The instrument will monitor X-ray flares that can cause changes in the Earth's ionosphere such as strong radio bursts that may interfere with radio frequencies and cause problems for satellite communications and navigation systems.

SOL is a high-priority joint undertaking by NASA and NOAA. The two SOL Observatories will provide NOAA with the continuity of solar wind data, coronal mass ejection (CME) imagery, and the second observatory will provide X-ray irradiance data from the XRIS instrument.

SOL will procure two XRIS satellite instruments that will provide NOAA with the continuity and resilience of space weather observations for the X-ray irradiance.

The X-ray irradiance measurement is a high availability (HAP) product, which is one of the National Weather Service's highest priorities for space weather observations. The continuation of these observations is essential for space weather predictions to protect critical infrastructure like aviation, commerce, energy, space exploration, and defense.

XRIS will fly on the second observatory, SOL-B, which is set for launch in October 2032. NASA and NOAA officials plan to ask industry to integrate, test, calibrate, evaluate, support launch, perform on-orbit check-out of the X-Ray irradiance sensors, supply and maintain the instrument ground support equipment, ground processing algorithms, and support the mission operations center at the NOAA satellite operations facility.

Contract work should extend through January 2034. Work will include operational handover to NOAA of the final instrument. The handover to NOAA will happen after successful launch, post launch evaluation, calibration, data validation, and on-orbit anomaly investigations. The first flight model should be delivered by June 2029 and the second by December 2029.

The anticipated release date of the draft solicitation is sometime this spring, while the final solicitation is expected by this June. Contract award date is expected in January 2026.

Companies interested should email questions, concerns, and their intent to submit an offer to NASA's Suzanne Sierra at suzanne.k.sierra@nasa.gov. More information is online at https://sam.gov/opp/f2d5670b4bf34e1697add00ef45781a4/view. ←

Boeing Insitu to provide small- and medium-sized unmanned aircraft and sensor payloads

U.S. Navy unmanned aerial vehicle (UAV) experts are ordering 68 small and medium-sized UAVs from Boeing Insitu Inc. in Bingen, Wash., under terms of a $102.4 million order. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking Boeing Insitu to provide 21 RQ-21A Blackjack and 47 ScanEagle UAVs. The contract also calls for Boeing Insitu to provide UAV sensor payloads, turrets, spare parts, tools, and training for the Navy, U.S. allies, and other international business partners. The Boeing Insitu RQ-21 is a twin-boom, single-engine, monoplane UAV for surveillance and reconnaissance. Users can launch and recover the reconnaissance drone on land or at sea without runways by using a pneumatic launcher and net-type recovery system. The 81-pound Blackjack is eight feet long with a 16-foot wingspan, and is designed to carry multi-sensor payloads in a large pod below its nose. The UAV can fly as quickly as 104 miles per hour, cruises at 63 miles per hour, can fly as long as 24 hours, and can fly as high as 19,500 feet. It is a version of the Insitu Integrator UAV. Users can customize the RQ-21A Blackjack's multi-mission open-architecture payload bays with visible-light and infrared cameras, communications, and other tools to provide situational awareness information to warfighters on the forward edge of battle. On this order Boeing Insitu will do the work in Bingen, Wash., and at locations outside the Continental U.S., and should be finished by June 2026. For more information contact Boeing Insitu online at www.insitu.com Naval Air Systems Command at www.navair.navy.mil.

Meridian selects Altair's ASAP to aid development of its Corra UAV and HERMES project

Meridian Flight Systems in Leamington Spa, U.K., has joined Altair's Aerospace Startup Acceleration Program (ASAP). The company will use Altair's simulation, data analytics, and high-performance computing software to develop its Corra uncrewed aerial vehicle (UAV) and Hybrid Electric Range-Extending Microturbine Energy System (HERMES). Under the collaboration, Meridian will use Altair's software for aerodynamic, structural, and thermal system analysis, while Altair will provide technical support for aerospace applications.

Pipistrel announces first flight of its hybrid-electric Nuuva V300 cargo UAV

Pipistrel, a Textron company in Ajdovščina, Slovenia, announced the first hover flight of its Nuuva V300, a hybrid-electric vertical takeoff and landing (VTOL) unmanned aircraft designed for long-range cargo transport. The Nuuva V300 is designed to carry up to 600 pounds over a range of 300 nautical miles, operating from both paved and unimproved surfaces. The aircraft features nose-loading capability for easier cargo handling and can accommodate more than 100 cubic feet of payload, including three cargo pallets or loose freight. The aircraft uses a zero-emission electric vertical takeoff system combined with a dedicated cruise propulsion system. A ground control station, developed in partnership with Textron Systems, enables remote monitoring and fully automated operations. The Nuuva V300 features Beyond Visual Line of Sight (BVLOS) flight capabilities and a Honeywell-supplied fly-by-wire, triple-redundant flight control system.

NASA's pathfinding project works to integrate autonomous air vehicles

Remotely piloted aircraft could transform the way we transport people and goods and provide our communities with better access to vital services, like medical supply deliveries and efficient transportation. The U.S. air cargo fleet is projected to grow significantly through 2044, but pilot shortages remain a challenge. Remote piloting could help address this issue while reducing costs and increasing deliveries. Additionally, air taxis could ease traffic congestion by bypassing roads. Commercial companies and NASA are advancing autonomous technologies to support remote air cargo and air taxi operations. Key challenges include airspace integration, hazard detection, and resilient communication systems. Remote pilots require automation and decision-support tools since they lack a cockpit view, relying instead on detect-and-avoid systems and ground surveillance. To ensure safe operations, aircraft must have autonomous backup systems in case of communication loss. Air Traffic Control may assist, but onboard automation must handle navigation and traffic avoidance. Industry is also developing automated taxi, takeoff, and landing capabilities to integrate remote aircraft into airport environments.

The Marine Corps requires a modernized C-sUAS capability to counter evolving threats from small uncrewed aircraft by using advanced technologies to detect, track, identify, and defeat small unmanned aerial systems.

USMC Photo

Anduril Federal to develop electronic warfare (EW) for air defense against uncrewed aircraft

BY **John Keller**

QUANTICO MARINE BASE, Va. – U.S. Marine Corps air defense experts needed state-of-the art systems to counter small unmanned aircraft to protect deployed Marines and their equipment. They found a solution from the Anduril Federal division of Anduril Industries in Washington.

Officials of the Marine Corps Systems Command at Quantico Marine Base, Va., announced $642.2 million contract to Anduril earlier this month to install the Counter Small Unmanned Aircraft System (I-CsUAS).

The Marine Corps requires a modernized C-sUAS capability to counter evolving threats from small uncrewed aircraft by using advanced technologies to detect, track, identify, and defeat small unmanned aerial systems, Marine Corps officials say.

Anduril will develop counter-unmanned capabilities in integrated and networked sensor nodes to protect Marines using conventional weapons or electronic warfare (EW) means to prevent small unmanned aircraft from threatening Marines and their equipment.

These new capabilities will help close an installation security capability gap that exists today in detection, tracking, identification, and defeat of small unmanned aircraft operating near covered Marine facilities and assets. The sUAS threat poses unique challenges to military installations when compared to those of operational forces, Marine Corps experts explain.

Specifics of I-CsUAS enabling technologies and development plan are considered controlled unclassified information (CUI), and generally are not available to the public.

Questions or concerns can be emailed to Marine Corps contacts Shannon Graves at Shannon.Graves@usmc.mil or Stasia Baker at Stasia.Baker@usmc.mil. More information is online at https://sam.gov/opp/7f99d46d0f5040ed-9691edcf343d9810/view.

For more information contact Anduril Federal online at www.anduril.com/capability/counter-uas, or Marine Corps Systems Command at https://www.marcorsyscom.marines.mil.

MELT will demonstrate a compact high-power laser tile as the key building block for next-generation scalable high-energy-laser sources in counter-uncrewed laser weapons.

Northrop Grumman to develop high-power laser weapons technology for counter-uncrewed vehicles

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers needed affordable high-energy laser sources for future laser weapons to destroy or disable enemy unmanned aerial vehicles (UAVs). They found a solution from Northrop Grumman Corp.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced an $8 million order to the Northrop Grumman Space Park segment in Redondo Beach, Calif., for the Modular Efficient Laser Technology (MELT) program.

MELT will demonstrate the first compact high-power laser tile as the key building block for next-generation scalable high-energy-laser sources in counter-uncrewed laser weapons.

Northrop Grumman engineers will develop a compact, scalable, and actively coherently beam combined semiconductor laser source with excellent beam quality to create a mass-producible, low size, weight, and power (SWaP) scalable laser source.

Northrop Grumman seeks to develop enabling technologies in semiconductor manufacturing, photonic integrated circuits, coherent beam-combining algorithms, semiconductor cooling, and optical lithography, and will move these new laser weapons technologies into Army, Air Force, and Navy programs.

In 2024, the MELT program sought to design thermal management for a semiconductor amplifier planar array; simulate thermal management for electrical-to-optical efficiency; and demonstrate a planar array of emitters in a laboratory.

This year the program seeks to fabricate a full laser tile array of semiconductor amplifiers with good electrical-to-optical efficiency; and design an integrated laser tile with good beam quality.

Today's laser weapons use fiber laser array high-energy laser sources, complex optical benches, and beam directors, which are large, heavy, contain many separate components, and costly to fabricate and integrate.

MELT will capitalize on recent advances in coherent beam combining and photonic integrated circuit fabrication to develop tiled arrays integrated with semiconductor-based optical systems, low-loss waveguides, optical interconnects, and application-specific integrated circuits (ASICs) into a compact laser tile that can be integrated with a supporting backplane to provide scalable high-energy laser sources.

This will provide a scalable high-energy-laser architecture that maintains excellent beam quality and enables laser weapons deployment on small systems like uncrewed vehicles.

MELT aims to capitalize on technologies such as semiconductor fabrication techniques, coherent beam combining, photonic integration, and 3D integration and packaging.

The proliferation of small, low-cost uncrewed aerial vehicles (UAVs) on the battlefield requires a layered defense that includes low-cost laser weapons. The deep magazines of laser weapons are suited to counter swarms of hostile UAVs, and have the potential to achieve very low operating cost — assuming low production costs can be achieved. Counter-UAV and similar applications need a broad range of power levels from a few kilowatts to megawatts, which isn't possible today.

Instead, MELT seeks to develop a laser tile as the building block for compact, scalable, panelized laser weapons. The laser tiles will integrate into planar arrays for scalable laser weapons with comparable or better performance than current laser weapons.

MELT seeks to demonstrate a 3-by-3 panelized array of laser tiles with excellent beam quality as a scalable high-energy laser source.

The mass, volume, and size goals for the laser tiles and panelized array of laser tiles include the semiconductor amplifier emitters, optics, phase sensing and control, power delivery, power conversion, thermal dissipation, computing, external connections, inter-tile electrical, coolant, and data connections.

Each MELT tile will contain a 2D array of laser emitters whose phase can be sensed and controlled continuously to achieve coherent beam combination. For scalable output power, several to several hundred of these tiles may be arranged as a panelized, gimbal-mounted laser weapon source that produces a usable output beam.

The DARPA MELT project has three technical challenges: a dense planar tiled array of amplifiers with uniform spacing and emission normal to the 2D surface; realizing a scalable phase sensing architecture for a panelized high-energy laser source; and realizing a compact scalable cooling solution to remove the anticipated thermal load from a panelized high-energy laser source.

The goal of this program is to develop a mass-producible, low SWaP, scalable laser source. This will require the development of a new type of high-energy laser source. The MELT program is interested only in semiconductor diode-based laser technologies that do not include optically pumped brightness converters.

For more information contact Northrop Grumman Space Park online at www.northropgrumman.com/what-we-do/microelectronics, or DARPA at www.darpa.mil/research/programs/modular-efficient-laser-technology.

L3Harris to provide spares for shipboard electro-optical targeting sensor aboard surface warships

Military electro-optics experts at L3Harris Technologies Inc. will support shipboard sensors for the fire-control systems necessary for U.S. Navy and Coast Guard warships to hit enemy ships and aircraft with naval gun fire under terms of an $8.8 million order. Officials of the Naval Sea Systems Command in Washington are asking the L3Harris KEO segment in Northampton, Mass., to produce spare components for the MK 20 Electro-Optical Sensor System (EOSS), MK 46 Optical Sight System (OSS), MK 48 and MK 34 gun weapon systems. The EOSS electro-optics system is a check sight and targeting sensor for anti-surface and anti-air warfare and naval gun fire support missions, Navy officials say. The MK 20 EOSS is a major component of the MK 34 5-inch guns aboard Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers, as well as aboard the U.S. Coast Guard Offshore Patrol Cutter, for use against enemy ships, boats, and aircraft during operations. L3Harris KEO has been building the EOSS since 2005. On this contract modification L3Harris will do the work in Northampton, Mass.; Orlando, Fla.; Moonachie, N.J.; Keene, N.H.; and Radford, Va., and should be finished by April 2027. For more information contact L3Harris KEO online at www.l3harris.com/all-capabilities/naval-platform-imaging, or Naval Sea Systems Command at www.navsea.navy.mil.

MISSILE UPGRADES

▼ RTX Raytheon eyes upgrading Tomahawk Block IV cruise missiles to add 15 years of life

U.S. Navy guided missile experts are asking RTX Corp. to prepare to upgrade and recertify a version of the BGM-109 Tomahawk land-attack missile to add 15 years of service to the weapon's lifetime.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $31.2 million contract to the RTX Raytheon segment in Tucson, Ariz., for long-lead hardware for recertification and modernization of 257 Tomahawk Block IV missiles — 218 for the Navy and 39 for U.S. allies.

The contract includes 24 Maritime Strike Tomahawk missile vertical launch systems and 11 Maritime Strike Tomahawk missile capsule launch systems for the Navy. Long-lead items either are difficult and time-consuming to obtain, and are funded early in design process to keep overall production on schedule. Contracts to recertify the missiles will come later.

Tomahawk Block IV cruise missiles are for land-attack missions, and in recent years have been upgraded to attack moving ships at sea. The missiles launch from surface warships and submarines. Its users are the U.S. Navy and the United Kingdom Royal Navy.

The RGM/UGM-109E Tomahawk Block IV is one of the latest versions of the 1970s-vintage Tomahawk cruise missile with digital scene matching area correlator system and improved turbofan engine. The subsonic long-range cruise missile is designed to attack targets on land, as well as large hardened surface warships.

The Tomahawk Block IV's guidance system allows for precise targeting over long distances. It combines inertial navigation; Global Positioning System (GPS) satellite navigation; terrain contour matching; and digital scene matching area correlation.

Its GPS and gyro-based inertial navigation helps keep the missile on target from long ranges, and its terrain- and scene-matching capabilities use optical sensors to view the ground below to ensure the weapon is on the right path.

The Tomahawk Block IV cruise missile, which can attack targets from as far away as 900 nautical miles, can be controlled in flight, and has a real-time targeting system for striking moving targets. Controllers reprogram the missile in flight to send it to alternate targets preprogrammed before launch, or redirect it to a new target.

The Tomahawk Block IV has a two-way satellite data link that enables the missile to respond to changing battlefield conditions. The missile can loiter over the battlefield to wait for the most valuable target to attack, and can transmit battle damage indication imagery and missile health, as well as status messages, the weapon's satellite data link. The missile also can fly GPS-only missions.

The Block IV Tomahawk has an anti-jam capability, a 1,000-pound warhead of either high explosives, polymer-bonded explosives, or the BLU-97/B combined effects weapon with independent bomblets designed to cause fragmentation and incendiary damage to enemy fighters, supply depots, and vehicles.

On this contract, RTX Raytheon will do the work in El Segundo and Los Alamitos,, Calif.; Tucson and Chandler, Ariz.; and Pontiac, Mich., and should be finished by November 2026. For more information contact RTX Raytheon online at www.rtx.com/raytheon/what-we-do/sea/tomahawk-cruise-missile, or Naval Air Systems Command at www.navair.navy.mil.

Navy photo

TORPEDO ELECTRONICS

▶ Advanced Acoustic Concepts to provide submarine torpedo sonar signal transmitters and warhead electronics

U.S. Navy undersea warfare experts needed electronic components for the Navy MK 48 heavyweight torpedo for a variety of U.S. and allied submarines. They found a solution from Advanced Acoustic Concepts LLC in Washington.

Officials of the Naval Undersea Warfare Center Division Newport in Newport, R.I., announced a $21.2 million contract to Advanced Acoustic Concepts for MK 48 sonar signal transmitters, warhead electronic system assemblies, and test sets.

The MK 48 torpedo is standard armament for the Navy's fleet of Los Angeles-, Virginia-, and Seawolf-class fast attack submarines, as well as Ohio-class ballistic- and cruise-missile submarines. The torpedo also is for Australian Collins-class attack submarines, and Taiwanese submarines. The MK 48 relies on crucial electronic components like sonar signal transmitters and warhead electronics.

The MK 48 torpedo is 19 feet long, 21 inches in diameter, and weighs 3,500 pounds. It can dive as deeply as 1,200 feet to attack enemy submarines and surface warships as far away as five miles. The torpedo can travel as fast as 28 knots and has a 650-pound high-explosive warhead.

The much-upgraded MK 48 torpedo has been in service since 1972, and is the U.S. Navy's primary submarine weapon for use against enemy submarines and surface ships.

The MK 48 and its improved Advanced Capability (ADCAP) torpedoes can be guided from a submarine by wires attached to the torpedo. They also can use their own active pinging sonar or passive listening sonar to carry out programmed target search, acquisition, and attack procedures.

The torpedo is designed to detonate under the keel of a surface ship to break the keel and sink the ship quickly. After a miss, the torpedo can circle back for another attempt at hitting its target. The torpedo's seeker has an active electronically steered 2D phased array active sonar.

The latest version of the MK 48 is the MK 48 Mod 7 Common Broadband Advanced Sonar System (CBASS) with expanded operational capabilities for shallow waters along coastlines and inside harbors, as well as in the deep-water open ocean.

The CBASS broadband sonar enhancement makes the torpedo more effective against new enemy submarines in harsh acoustic environments. It uses modern commercial-off-the-shelf (COTS) technologies in an open-architecture computing environment, and can be improved with regular hardware and software upgrades.

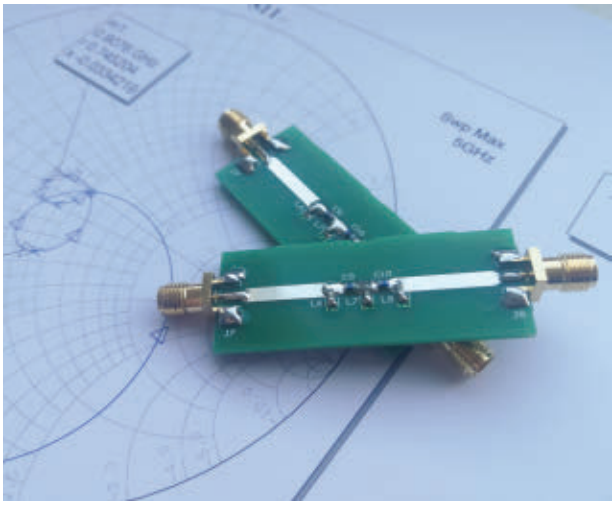
The MK 48 Mod 7 CBASS kit's evolutionary design and modular nature makes the upgrade of older version MK 48 torpedoes to the Mod 7 CBASS capability a relatively straightforward effort without requiring significant torpedo redesign and certification.

The CBASS torpedo also has the ability of multiband operation with active and passive homing; advanced counter-countermeasure capabilities; effectiveness against low-Doppler shallow submarines, fast deep diving submarines, and high-performance surface ships; autonomous fire-and-forget operation or wire-guide capability to enable post-launch monitoring and updates via the submarine combat system; and running Otto Fuel II as the propellant.

The MK 48 Mod 7 CBASS provides the ability to transmit and receive over a wide frequency band and use broadband signal processing techniques to improve the torpedo's search, acquisition, and attack effectiveness.

On this contract Advanced Acoustic Concepts will do the work in Lemont Furnace and Johnstown, Pa.; Reston, Va.; and Keyport, Wash., and should be finished by November 2027.

For more information contact Advanced Acoustic Concepts online at https://advancedacousticconcepts.com, or the Naval Undersea Warfare Center Division Newport at https://www.navsea.navy.mil/Home/Warfare-Centers/NUWC-Newport/.



RF AND MICROWAVE

▲ Collins Aerospace joins DARPA project to suppress RF interference with new kinds of high-frequency filters

U.S. military researchers needed new RF and microwave technologies to suppress RF interference, and demonstrate these technologies for future military use. They found a solution from the RTX Corp. Collins Aerospace segment in Cedar Rapids, Iowa.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $4.5 million contract to Collins Aerospace for the COmpact Front-end Filters at the ElEment-level (COFFEE) Program, Technical Area 2 (TA2).

While the COFFEE program is developing interference-mitigating RF and microwave technologies for active electronically scanned array (AESA) transmit-and-receive antennas, the project's technical area 2 seeks to demonstrate COFFEE-developed technologies in military applications.

Collins Aerospace joins the Northrop Grumman Corp. Mission Systems segment in Linthicum, Md., on the COFFEE program technical area 2. Northrop Grumman won a $4.7 million contract for this project in January.

COFFEE seeks to suppress RF interference with a new class of high-frequency filters with low loss and high power handling. COFFEE contractors are Northrop Grumman Corp., Raytheon Technologies Corp., Akoustis, BAE Systems, Metamagnetics, Georgia Institute of Technology, Columbia University, Carnegie Mellon University, University of Michigan, University of Texas at Austin, and University of California at Los Angeles.

Collins Aerospace and Northrop Grumman engineers will seek to develop the ability of an AESA antenna to reconfigure radar beams dynamically and communicate across a range of frequencies in congested environments. This helps resist signal jamming and interception while mapping, navigating, sensing, tracking and creating high-bandwidth data links.

The COFFEE technical area 2 asks the two companies to demonstrate the newly expanded potential of COFFEE high-frequency filters technology by integrating COFFEE filters to demonstrate interference suppression in all or parts of the 2 to 18 GHz frequency range; incorporate frequencies above 8 GHz; and create RF and microwave filters with compact size and high performance.

COFFEE technical area 2 also seeks to demonstrate acceptable manufacturability of COFFEE RF filters; and develop disruption potential that departs from current practices in filter design and manufacture.

The overall COFFEE program seeks to create RF and microwave filter technology to mitigate AESA interference and enhance performance in 2 GHz to 18 GHz frequency ranges. These filters will distill signals while operating within an 18 GHz half-wavelength array pitch, and account for digital-at-every-element advances.

The primary focus of the COFFEE program is on emerging microelectronics materials for integrable filters; new classes of miniaturized resonators; millimeter-wave frequencies beyond 18 GHz; and future communications for the 5G era.

Collins Aerospace and Northrop Grumman experts will integrate COFFEE filters into systems and external components such as switches, controls, interconnects, interposers, and tuning elements that risk degrading system performance and increasing overall filter size.

The companies also will apply COFFEE filter technology currently under development. The effort will highlight technical risks, mitigation strategies, and recent innovations. Solutions that use domestic manufacturing are preferred.

COFFEE technical area 2 is an 18-month effort, starting this year, that will validate COFFEE technologies by integrating 2–18 GHz filters with switches, controls, interconnects, and interposers into a filter tile. Several contract awards are expected. The effort will culminate with delivery of integrated filter tiles to demonstrate the potential for scalable manufacturing and interference suppression.

For more information contact RTX Collins Aerospace online at www.collinsaerospace.com, Northrop Grumman at www.northropgrumman.com, or DARPA at www.darpa.mil/research/programs/compact-front-end-filters-at-the-element-level.

SATELLITE CONNECTIVITY

▼ Space Norway selects Telesat Lightspeed for satellite connectivity

Space Norway in Oslo has signed an agreement with satellite operator Telesat in Ottawa, Ontario to integrate Telesat's Lightspeed Low Earth Orbit (LEO) network into its service portfolio. The companies expect to finalize definitive agreements by the second half of 2025.

The agreement will allow Space Norway to use a multi-gigabit-per-second capacity pool from the Lightspeed network to provide secure, low-latency connectivity for defense, enterprise, maritime, and land-based customers. The service will enable Space Norway to prioritize services across remote sites.

Telesat's Lightspeed network is designed with a zero-trust architecture and strict cybersecurity standards, offering resilient communications for Norway and allied partners in the Arctic region, as well as enterprise customers across Europe, the Middle East, and Africa.

"Space Norway found the Telesat Lightspeed network to be a natural next step in the continued evolution of our multi-orbit strategy," said Morten Tengs, Space Norway's chief executive officer. "Its advanced architecture, including inter-satellite links and support of private landing stations, allows us to serve national requirements adhering to the strictest security and privacy standards."

Telesat President and CEO Dan Goldberg said the company is "honored" to support Space Norway's multi-orbit strategy. "Together, we will bring innovative space-based capabilities that enable defense and enterprise transformation, anywhere in the world," he said.

DIGITAL SIGNAL PROCESSING

▼ Navy chooses Serco for research in advanced sonar signal processing for anti-submarine warfare (ASW)

U.S. Navy ocean systems experts needed active sonar signal processing for undersea warfare applications. They found a solution from Serco North America in New London, Conn.

Officials of the Naval Sea Systems Command in Washington announced plans to negotiate a contract with Serco for anti-submarine warfare (ASW) development for undersea systems.

Serco will handle research, development, and technology upgrades for advanced undersea technologies related to active sonar signal processing. The upcoming contract has yet to be negotiated, and should begin this summer.

The Serco contract is based on a white paper the company submitted to Naval Sea Systems Command in 2023 concerning submarine and surface combat systems sensor and signal processing technologies.

Serco will perform research in computing technologies, cyber security, imagery classification, sensors, ASW prediction, assessment, and situational awareness, electronic warfare (EW), torpedo defense, target motion analysis, and training.

The company will handle research in:

- undersea technologies in submarine and surface ship sensors and signal processing;
- Artificial intelligence
- artificial intelligence (AI), deep learning, machine learning, and predictive analytics as these technologies relate to detecting man-made signals, cyber security, decision support, ship classification;
- sensors related to open-architecture towed-array telemetry, and prototyping submarine imaging and EW sensors;
- active sonar signal processing technologies such as bistatic sonar, parametric sonar, and parasitic sonar;
- EW detection, localization, and recognition;
- active and passive torpedo defense; and
- automated target motion analysis, path determination, and contact correlation.

For more information contact Serco North America online at www.serco.com/na, or Naval Sea Systems Command at www.navsea.navy.mil.

BATTERIES

▶ Air Force picks EaglePicher for batteries with 20-year shelf life for Minuteman III ballistic missiles

U.S. strategic weapons experts needed batteries for Minuteman III nuclear intercontinental ballistic missiles. They found a solution from EaglePicher Technologies in Joplin, Mo.

Officials of the Air Force Sustainment Center's Supply Chain Management Contracting Division at Hill Air Force Base, Utah, announced a $20 million contract to EaglePicher last week for missile guidance system batteries for the Minuteman III strategic missile system.

EaglePicher specializes in military batteries for missiles and munitions. The company's batteries and energetic devices are installed in hundreds of defense programs, including Paveway, Trident, Harpoon JDAM, TOW, Tomahawk, Patriot, Hellfire, THAAD, and Standard Missiles, company officials say.

The company's military batteries offer long-run-time, ballistic survivability, cold-temperature operation, and 20-year shelf life.

EaglePicher also offers silver-zinc batteries for missile guidance control, telemetry, tracking, flight termination, and actuator systems. Silver-zinc batteries offer high energy to weight and volume ratios, and high reliability.

EaglePicher silver-zinc batteries offer safety; high-energy density; flexible configurations; numerous qualified designs; long-active life; can be remotely activated; quick rise times; and long-shelf life.

EaglePicher also offers energetic device for applications such as missiles, ordnance, cartridge- and propellant-actuated devices.

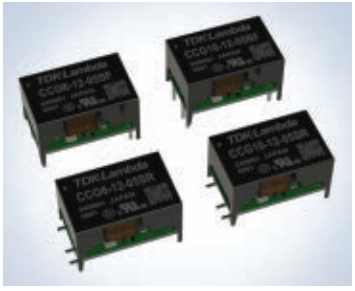
EaglePicher offers lithium silicon/iron disulfide (LiSi/FeS2) thermal batteries, which are widely used in missiles and munitions. Thermal batteries provide extreme high-energy density in a low volume and can be store up to 20 years making them idea for these weapons systems.

On this contract EaglePicher will do the work in Joplin, Mo., and should be finished by March 2030. For more information contact EaglePicher Technologies online at www.eaglepicher.com. ←

POWER CONVERSION

▶ DC-DC converters for power applications in harsh environments introduced by TDK

TDK-Lambda Americas Inc. in San Diego is introducing two options to the TDK-Lambda brand CCG series of 1.5-to-10-Watt isolated DC-DC converters. The

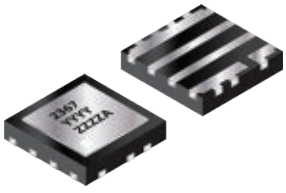


two-sided board coating provides extra protection for use in harsh environments, including rail and industrial applications. Also introduced is a larger, 40-piece tray size. The series comprises 144 voltage and current combinations with 3.3-, 5-, 12-, 15-, and dual +/-12-, and +/-15-volt outputs. The dual output models can be configured to supply single 24-volt and 30-volt outputs. All models can operate from a wide range of 4.5-to-18-volt, 9-to-36-volt, or 18-to-76-volt DC inputs to support operation from 5, 12, 24, and 48 volts DC power sources. The 1.5- and 3-Watt units measure 15.7 by 10.4 millimeters, with the 6-Watt and 10-Watt models measuring 19 by 12.4 millimeters. The plastic case is not encapsulated, avoiding quality risks associated with silicone potting compounds during reflow soldering. The CCG series can operate in ambient temperatures of -40 to 100 degrees Celsius using convection or forced-air cooling. Input to output isolation is 1,500-volt DC. The models are certified to IEC/UL/CSA/EN 62368-1 safety standards with the CE and UKCA marks for the Low-Voltage and RoHS directives. For more information contact TDK Lambda Americas online at https://product.tdk.com/en/search/power/switching-power/dc-dc-converter/list#psts%5B%5D=0&type=CCG&_l=100&_p=1&_c=part_no-part_no&_d=0.

RF AND MICROWAVE

▶ GaN FET for advanced power conversion applications introduced by EPC

Efficient Power Conversion Corp. (EPC) in El Segundo, Calif., is introducing the EPC2367 next-generation 100-volt gallium nitride (GaN) field-effect transistor (FET) for power conversion applications. Designed for demanding applications such as 48-volt DC-DC converters, motor drives, and high-power computing, the EPC2367 outperforms traditional silicon metal oxide field effect transistors (MOSFETs). The EPC2367 offers ultra-low on-resistance (RDS(on)); a 3.3-by-3.3-millimeter QFN package; switching figures of merit (FoM); enhanced thermal performance; and temperature cycling reliability. The EPC2367 has been tested in hard- and soft-switching power conversion applications. Performance results demonstrate



higher efficiency, with significant power loss reductions. In a 1 MHz, 1.25 kW system, EPC2367 reduces power losses while achieving 1.25 times the output power compared to previous gallium nitride (GaN) and silicon MOSFET alternatives. For more information contact EPC online at https://epc-co.com/epc/.

TEST AND MEASUREMENT

▶ Artificial intelligence (AI)-based test for mobile devices introduced by Rohde & Schwarz

Rohde & Schwarz in Munich is introducing the CMX500 AI Scripting Assistant for testing mobile devices to simplify and accelerate scripting for test engineers who deal

with the complexities of script generation. The tool uses generative artificial intelligence (AI) and natural language processing to streamline workflows and reduce the risk of errors. The tool's access to proprietary data from Rohde & Schwarz enables users to generate XLAPI scripts quickly. The assistant can extend existing scripts and provide explanations to help less experienced users understand the structure and logic of these scripts. The CMX500 AI Scripting Assistant ensures the test and measurement solution stays current and accurate by automatically

integrating updates. For more information contact Rohde & Schwarz online at www.rohde-schwarz.com.

EMBEDDED COMPUTING

▶ Microcontrollers for wireless connected smart devices introduced by STMicroelectronics

STMicroelectronics in Geneva is introducing the next-generation STM32 power-efficient short-range wireless microcontrollers for industrial and consumer electronics in internet of things (IoT) applications. The STM32WBA6 series is for connected smart devices like remote weather sensors, electronic locks, and wearable health care. The STM32WBA6 microcontrollers also embed SESIP3 and PSA Level3 certifiable security assets, such as cryptographic accelerators, TrustZone isolation, random generator, and product life cycle. The wireless subsystem in the STM32WBA6 microcontrollers supports Bluetooth, Zigbee, Thread, Matter, and other protocols operating at 2.4 GHz, and enables communications using several protocols concurrently. It's how a system like a smart-home bridge can communicate with the homeowner's mobile app over Bluetooth and simultaneously manage lights or thermostats through mesh networking such as Zigbee. The STM32WBA6 series also contains single-protocol variants for simpler and more cost-conscious applications. For more information, contact STMicroelectronics online at www.st.com/en/microcontrollers-microprocessors/stm32wba-series.html.

POWER ELECTRONICS

▶ DC-DC converters for military, aviation, and space introduced by Crane Aerospace

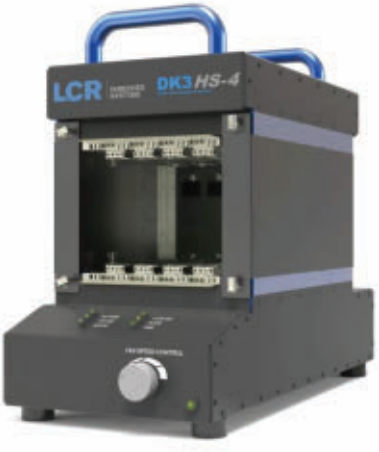
Crane Aerospace & Electronics in Lynnwood, Wash., is introducing Interpoint cMOR (COTS), hMOR (Class-H defense), rMOR (new space), and sMOR (deep space) 120-Watt DC-DC converters for deep space, new space, and high-reliability defense and commercial applications. The

hMOR power converter offers improved performance for mission-critical defense applications. The hMOR converter is MIL-PRF-38534 Class H compliant, lightweight, efficient, and supports fast start-up for quick boot-up systems. Features of these DC-DC converters include input voltage 15 to 50 volts; output flexibility trim of 80 percent to 110 percent; operating temperature of -55 to 125 degrees Celsius; transient protection 80 volts for 120 milliseconds; isolated magnetic feedback; fixed high-frequency switching; remote sense on single output models; primary and secondary inhibit function; sync in and sync out; indefinite short circuit protection; high power density with as much as 81 percent efficiency; soft-start function limits inrush current during start-up; and parallel operation with current share of as much as 540 Watts. The Interpoint cMOR power converter is for commercial aerospace and defense applications. For more information contact Crane Aerospace & Electronics online at www.craneae.com/interpoint.

DESIGN AND DEVELOPMENT TOOLS

▶ VPX embedded computing design and development tools backplane introduced by LCR

LCR Embedded Systems Inc. in Jeffersonville, Pa., is introducing the next generation in the company's DK3 VPX design and development tools for high-performance systems in electronic warfare (EW), RF, signals intelligence (SIGINT) and radar applications. The DK3HS-4 embedded computing development system is 4-slot system that supports 100-gigabit data rates (25 gigabits per lane). The



development platform is more compact and lighter weight than other DK3 models, and is for test and integration of and emerging 3U VPX, OpenVPX, and SOSA-aligned plug-in cards in systems with low slot counts. The DK3HS-4 backplane supports high speed 100GBASE-KR4 and PCI Express Gen 4/Gen 5 protocols. The open-frame benchtop chassis weighs 16 pounds and is available with a standard 4-slot power and ground backplane. It enables easy access for Meritec cabling, so systems designers can establish the data flows and backplane profile necessary for system integration. The DK3HS-4 is also available with custom routed backplanes. The standard backplane has two populated slots and two slots with VITA 67 full-width apertures for any connector type required. Apertures facilitate VITA 66 and 67 connectors for plug-in cards with optical and RF connectivity. For additional I/O, the DK3HS-4 has an open-access 4-slot rear transition area. Card slots are configurable and can be adapted to accept conduction-cooled VITA 48.2 or air-cooled plug-in cards on a slot-by-slot basis. High speed fans keep high power cards cool during functional testing. For more information contact LCR Embedded Systems online at www.lcrembeddedsystems.com/4-slot-3u-vpx-system.

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Draper completes flight tests of GPS-alternative navigation technologies

BY **Jamie Whitney**

◀ Draper's APNT system mounted on the test aircraft.

CAMBRIDGE, Mass.–Draper in Cambridge, Mass., recently concluded a series of successful flight tests of its Assured Positioning, Navigation, and Timing (APNT) technologies, including its airborne celestial navigation system (CNS), as part of ongoing efforts to develop alternatives to the Global Positioning System (GPS) for military and aerospace applications.

The tests were conducted over more than 30 flight hours aboard a twin turboprop aircraft, flying in both day and night conditions at altitudes up to 25,000 feet. Draper's CNS unit, a 1.5-cubic-foot line replaceable unit (LRU), demonstrated navigation accuracy within 30 meters and operated in an unpressurized, unconditioned compartment. The device is qualified to meet MIL-STD-810 and MIL-STD-461 environmental standards.

"The test results show that a producible airborne CNS can meet operational requirements and is ready for integration into customer platforms," said Scott Dellicker, director of GN&C Solutions at Draper. "This is an important development for our customers' ability to maintain freedom of maneuver in highly contested and challenging environments."

The CNS uses Draper's Skymark technology, a form of celestial navigation designed for use in GPS-denied and degraded environments. Originally developed for aircraft and missile guidance, Skymark is now being adapted for ground and space vehicles as well. A version of the technology is already in production for the U.S. Navy's Arleigh Burke-class destroyers.

The flight campaign also tested other systems from Draper's "Anytime, Anywhere, Any-threat Position Navigation and Timing" (A3PNT) portfolio, which includes multiple modalities designed to function in denied environments.

Among them was Draper's vision-aided navigation (VAN) system, which uses visible and infrared imagery to maintain navigation without GPS. According to Draper, VAN has supported operations from altitudes of 100 meters to 100 kilometers and was tested under challenging conditions, including high-altitude night flight and over-water navigation.

Another system evaluated was the Signals of Opportunity (SOOP) unit, which collects radio frequency signals from low Earth orbit satellite internet constellations using a Ku-band receiver. The SOOP system, designed to operate with low size, weight, and power demands, enables Doppler-based navigation using non-traditional radio frequency (RF) sources.

"This internally funded test flight demonstrates our commitment to producing alternatives to GPS in highly contested and challenging environments," said Chris McDowell, director for Assured PNT Solutions at Draper. "As related technologies continue to mature, our portfolio of A3PNT options will expand further, lessening our dependence on GPS and enabling operations across multiple domains and platforms." ←

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NASA seeks industry input on 10-kilowatt prototype for space fission power

BY **Jamie Whitney**

CLEVELAND–The National Aeronautics and Space Administration's Glenn Research Center in Cleveland is requesting input from industry and research organizations on the development of a 10-kilowatt Closed Brayton Cycle (CBC) Power Conversion System (PCS) prototype to support future space-based fission surface power systems.

The agency issued a request for information (RFI) aimed at identifying capable sources to design, manufacture, and test a CBC PCS unit. The effort is part of NASA's goal to demonstrate reliable, long-duration surface power systems for missions to the Moon and Mars.

The prototype will serve two primary purposes: to inform system-level requirements for a future flight-qualified fission power system, and to provide a testbed for long-term hardware evaluation and alternate configuration testing, including integration with power management and distribution (PMAD) components.

According to the RFI, the system must achieve a nominal turbine inlet temperature of 1,100 to 1,200 Kelvin, a water coolant supply temperature near 375 Kelvin, and deliver approximately 10 kilowatts of electrical power. While the system should be based on technologies compatible with a notional 10-year mission life, the delivered prototype is not expected to meet full life-duration requirements.

NASA expects the contractor to deliver a complete electrically heated CBC PCS test loop, including instrumentation for performance verification, a gas management system to supply working fluid, and electronics to control the alternator and the heater. Once delivered, the test article will be integrated into NASA's ground test infrastructure, including data acquisition systems and a water cooling supply.

The agency plans for hardware delivery within 18 months of contract award. As part of the RFI, NASA is also asking respondents to comment on the feasibility of manufacturing or procuring major custom-designed components–specifically the turbo-alternator-compressor (TAC) and heat exchangers–within that timeframe.

This request is for information only; no solicitation currently exists. If a formal solicitation is issued, it will be published on SAM.gov, and interested parties are responsible for monitoring that site for updates.

Capability statements were due to be submitted electronically no later than 5:00 p.m. EDT on 2 June 2025 to Linda M. Nabors at linda.m.nabors@nasa.gov. Comments on manufacturing feasibility do not count toward the three-page limit. All correspondence should reference announcement number 80GRC025R7013.

NASA selects three new instruments to advance lunar science

BY **Jamie Whitney**

WASHINGTON– The National Aeronautics and Space Administration (NASA) has chosen three new scientific instruments to support its Artemis lunar exploration program, including two slated for deployment on the agency's next-generation Lunar Terrain Vehicle (LTV) and one for a future orbital mission.

The instruments will help advance NASA's understanding of the Moon's surface and subsurface composition, as well as support safe and effective astronaut operations. The LTV, the first crew-driven vehicle to operate on the Moon in more than five decades, is designed to carry up to two astronauts or operate remotely to explore broad areas of lunar terrain.

"The Artemis Lunar Terrain Vehicle will transport humanity farther than ever before across the lunar frontier on an epic journey of scientific exploration and discovery," said Nicky Fox, associate administrator for NASA's Science Mission Directorate.

One instrument, the Artemis Infrared Reflectance and Emission Spectrometer (AIRES), will map lunar minerals and volatiles in the Moon's south polar region. Another, the Lunar Microwave Active-Passive Spectrometer (L-MAPS), combines ground-penetrating radar and spectroscopy to search for subsurface ice and measure temperature and density to depths exceeding 130 feet.

NASA also selected the Ultra-Compact Imaging Spectrometer for the Moon (UCIS-Moon) for a future orbital flight. This instrument will provide high-resolution imaging of surface water, mineral composition, and the impact of human activity on the Moon's volatile materials.

"These three scientific instruments will make significant progress in answering key questions about what minerals and volatiles are present on and under the surface of the Moon," said Joel Kearns, deputy associate administrator for exploration at NASA.

NASA is currently reviewing design proposals from three commercial LTV vendors–Intuitive Machines of Houston, Lunar Outpost of Golden, Colo., and Venturi Astrolab of Hawthorne, Calif. A final decision on the demonstration mission is expected by the end of 2025.

The Artemis program aims to enable sustained lunar exploration and prepare for eventual crewed missions to Mars by combining robotic and human capabilities to study Earth's natural satellite.

An artist's concept design of NASA's Lunar Terrain Vehicle. NASA image.

AIRO unveils medium-lift cargo drone

AIRO Inc. in Albuquerque, N.M., announced the development of a new medium-lift cargo drone and the expansion of its advanced air mobility operations into the YMX Innovation Zone in Mirabel, Quebec, during EAA AirVenture 2025 in Oshkosh, Wis. The project is being led by Jaunt Air Mobility, AIRO's electric air mobility segment, and its Canadian subsidiary. The drone is designed to carry between 250 and 500 pounds over distances greater than 200 miles, targeting the middle-mile logistics market. It aims to offer a lower-emission alternative to traditional freight transportation like box trucks and tractor-trailers. The aircraft uses Jaunt's proprietary Slowed-Rotor Compound (SRC) technology, which combines vertical takeoff like a helicopter with the cruising efficiency of a fixed-wing airplane. AIRO said the technology improves safety and performance in the growing advanced air mobility (AAM) sector. AIRO is also developing a modular ground control system and advancing Command and Control (C2) capabilities with support for cellular and satellite communications. The aircraft will support beyond visual line-of-sight operations through dual-redundant data links, pending regulatory approvals.

Southwest selects Honeywell runway safety tech

Southwest Airlines in Dallas and Honeywell in Phoenix announced that the commercial carrier is equipping its entire fleet of Boeing 737 aircraft with Honeywell's SmartRunway and SmartLanding software to improve runway safety during taxi, takeoff, and landing. More than 700 Southwest aircraft have already been activated with the software, which operates through the Honeywell Enhanced Ground Proximity Warning System (EGPWS) already installed on the fleet. The system is designed to enhance flight crew situational awareness by providing real-time aural and visual alerts, particularly during critical phases of flight. SmartRunway and SmartLanding notify pilots of key safety concerns, including excessive speed during taxi, approaches that are too high or too fast, or incorrect runway alignment. The software aims to prevent runway incursions and unstabilized approaches–scenarios that can lead to accidents. It is certified for most Boeing and Airbus aircraft as well as many business jets. Honeywell is also developing Surface Alerts (SURF-A), a new cockpit safety feature expected to be certified on commercial aircraft in 2026, pending regulatory approvals. SURF-A uses GPS, Automatic Dependent Surveillance-Broadcast (ADS-B) technology, and analytics to warn pilots of potential runway traffic conflicts. Like SmartRunway and SmartLanding, SURF-A will also be enabled through the EGPWS. In 2015, Southwest selected Honeywell cockpit systems for its order of 240 Boeing 737 MAX aircraft. The carrier was also the first to adopt Honeywell's Integrated Multi-Mode Receiver technology across its fleet.

Electra teams with Lockheed Martin to collaborate on dual-use STOL aircraft

Lockheed Martin's Skunk Works division and Electra.aero have signed a memorandum of understanding to advance development of Electra's hybrid-electric ultra-short takeoff and landing (Ultra-STOL) aircraft, the EL9, with an eye toward both defense and commercial applications. The agreement will support collaboration in areas such as digital engineering, manufacturing, supply chain development, sustainment, and global business strategy. The companies also plan to evaluate potential programs of record with the U.S. Department of Defense and international defense customers. Designed for operations in austere and remote environments, the nine-passenger EL9 is powered by a hybrid-electric propulsion system that uses a small turbine-powered generator to charge onboard batteries in flight. The aircraft can take off and land in as little as 150 feet, including from unprepared surfaces such as grass or gravel. According to Electra, the EL9 will offer the performance and range of a conventional fixed-wing aircraft, while delivering the flexibility of a vertical lift platform with significantly lower operating costs and noise levels. Capable of carrying 1,000 pounds of cargo or up to nine passengers over a distance of 1,000 miles, the EL9 is designed for commercial use cases, including regional air mobility, cargo transport, disaster relief, humanitarian aid, and emergency medical evacuation. Its ability to operate from parking lots, rooftops, or soccer fields is expected to open new air routes in underserved areas without the need for runways or expensive infrastructure.

Wisk acquires SkyGrid to advance AAM operations

Wisk Aero, a Boeing-owned developer of autonomous electric air taxis, has acquired SkyGrid, an Advanced Air Mobility (AAM) third-party service provider, as a

NASA contracts American Aerospace for uncrewed wildfire-monitoring flights

BY **Jamie Whitney**

HAMPTON, Va.–The National Aeronautics and Space Administration (NASA) has awarded a sole-source contract to American Aerospace Technologies Inc. (AATI) in Conshohocken, Pa., to provide high-altitude, long-endurance uncrewed aircraft services for monitoring wildfires across the continental United States.

Under the agreement, AATI will operate its AiRanger aircraft, or a comparable uncrewed platform, to collect critical atmospheric and remote sensing data over active wildland fires. The flights are scheduled for up to 96 hours over a 14-day period between February and April 2026. The missions support NASA's Earth Science Division and its FireSense Project, which aims to improve wildfire detection, monitoring, and response through advanced aerial surveillance technologies.

NASA's Shared Services Center determined that AATI was uniquely capable of meeting the contract's requirements, citing the company's ability to deliver long-duration UAS services at high altitude with integrated detect-and-avoid capabilities. All missions will be conducted under NASA's aviation standards and oversight protocols, including engineering reviews, airworthiness assessments, and mission readiness evaluations.

The AiRanger is a fixed-wing UAS designed for beyond visual line-of-sight (BVLOS) operations. With a wingspan of 16 feet and a flight endurance of more than 20 hours, the aircraft can carry payloads exceeding 65 pounds and operate at altitudes up to 12,000 feet. It is equipped with autonomous flight controls, satellite communications, and safety systems for national airspace integration. The platform has been reviewed under NASA's Commercial Aviation Services process and is tailored for civil missions such as disaster response, environmental monitoring, and infrastructure inspection.

▲ **AATI's AiRanger UAS. AATI photo**

As part of the contract, AATI will modify the aircraft to integrate a suite of NASA-provided sensors, including a FLIR midwave infrared camera, a FLIR longwave infrared camera, and a RedEdge multispectral camera, all installed via nadir-mounted ports. The company will also supply custom instrument racks, assist with payload integration, and provide collected flight data, including GPS logs. NASA expects this configuration to yield high-resolution imagery and data on aerosols, greenhouse gases, and reactive trace gases during fire events.

NASA officials say the initiative is part of a broader push to integrate commercial uncrewed systems into the agency's Earth observation efforts, with the goal of enabling faster, safer, and more cost-effective responses to climate-related disasters such as wildfires.

subsidiary. The move aligns the two companies in their efforts to integrate autonomous aircraft into the national airspace and bring Wisk's self-flying Generation 6 aircraft to market. Wisk is currently pursuing Type Certification for its Generation 6 aircraft from the Federal Aviation Administration. SkyGrid will support Wisk's future operations by providing airspace integration and automation tools to enhance situational awareness, support decision-making, and enable safe scaling of autonomous flights. SkyGrid, whose platform supports multiple aircraft types, will continue to serve external customers with capabilities across airspace integration, autonomous aviation, and Air Traffic Management automation. The company's work will focus on enabling Automated Flight Rules, a key requirement for the safe and efficient use of autonomous aircraft. Wisk and SkyGrid plan to expand collaboration beyond certification, focusing on sustained testing, operational validation, and international deployment opportunities. The partnership aims to support industry-wide efforts to make autonomy in aviation both scalable and viable.