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Could optical computing be poised to enter the mainstream of aerospace and defense computing?

BY John Keller
EDITOR IN CHIEF

Optical computing has been "the next big thing" now for decades. This enabling technology holds so much potential because it offers huge advances in data throughput, information security, and resistance to the effects of electronic warfare (EW) jamming, and immunity to electronic interference.

The key to optical computing involves using optical fiber or free-space lasers to replace copper electronic interconnects in chip-to-chip, box-to-box, and system-to-system applications. There have been advances in box-to-box and even board-to-backplane optical computing as fiber and laser interconnects become more accessible.

Despite its promise, however, optical computing has been slow in coming. Industry advances in data throughput over conventional copper interconnects offers more affordable solutions with less technological risk than optical computing. There's a broad installed base of copper-based computing that offers economy of scale. Making the move to optical computing always has appeared to be a bridge too far.

The roadblock in optical chip-to-chip interconnects may be loosening with new research projects that involve developing optical chip-to-chip interconnects, as well as quantum computing.

Researchers at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced three contracts in March for exploration of into 3D chip-to-chip and intra-chip photonic interconnects to speed information throughput and reduce vulnerability to electromagnetic interference.

DARPA is asking SRI International in Menlo Park, Calif.; the RTX Raytheon segment in Arlington, Va.; and North Carolina State University in Raleigh, N.C., to participate in the Heterogenous Adaptively Produced Photonic Interfaces (HAPPI) program.

SRI, RTX Raytheon, and N.C. State will demonstrate low-loss, high-density optical interconnects for 3D chips using a scalable manufacturing process that is compatible with microelectronics. The project emphasizes vertical connections between routing layers that can traverse substrate thickness, and surface methods for coupling light from one photonic chip to another. Chip-to-fiber coupling and chip-to-chip edge coupling are not part of the program.

The HAPPI program aims to create a 1000x increase microsystem information transmission density by exploiting photonic signaling. The ability to move and process information efficiently throughout a microsystem requires signal routing technology with high data rates and dense access points. Interfaces should resist the effects of typical microsystem misalignments due to fabrication and assembly variability.

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

Contractors will take-on challenges of coupling to a photonic integrated circuit with demonstrated optoelectronic sources, amplifiers, modulators, multiplexers, filters, detectors, and other electro-optical components. The operating wavelengths may be within the visible or near infrared optical bands.

The project isn't talking big money yet; funding so far falls just short of $20 million divided among SRI, Raytheon, and NC. State. Still, it's an attempt at technology breakthroughs that have the potential to move optical computing into the mainstream. ⬅

▲ The future of commercial aviation has taken a step forward with demonstration of a hydrogen-fueled gas turbine aeroengine.

Safran photo

French companies demonstrate hydrogen-fueled gas turbine engine for future commercial flight

BY **Jamie Whitney**

SASSENAGE, **France**–Safran and Air Liquide in Paris and Turbotech in Toussus-le-Noble, France, have demonstrated a hydrogen-fueled gas turbine aeroengine. The engine operates on an efficient regenerative cycle and uses liquid hydrogen stored in a cryogenic tank.

The test followed an earlier phase in January 2024, during which the engine was fueled by gaseous hydrogen for initial characterization. This second phase integrated a cryogenic liquid hydrogen storage system, developed by Air Liquide, with the turbine to replicate the complete functionality of an aircraft propulsion system.

"This is a major step forward in the transition to fully decarbonized aircraft propulsion, which will be ready to fly as soon as the world mass-produces green hydrogen," said Damien Fauvet, CEO of Turbotech. "The aim of this work was to achieve a similar energy density to conventional Avgas or Jet A-1 fuel systems while addressing the challenges of retrofitting, operability, and certification for cryogenic hydrogen propulsion. This project's success is thanks to a remarkable team effort."

Pierre-Alain Lambert, Safran's Vice President of Hydrogen Programs, emphasized the significance of the collaboration. "By coupling our technology to Air Liquide's cryogenic storage system, which provides the energy density needed for aircraft applications, we've demonstrated that a complete high-tech propulsion solution with zero carbon emissions in flight is possible and can be integrated into light aircraft," Lambert said.

Xavier Traversac, Air Liquide's Vice President of Advanced Technologies, highlighted the importance of partnerships in advancing hydrogen technology. "Decarbonization calls for close collaboration between industry players. We're proud to contribute as experts in hydrogen technologies and to accelerate innovation through our Grenoble Technologies Campus. Hydrogen is a key element in the energy transition, and this success is a step toward low-carbon flying," Traversac said.

The testing is part of the BeautHyFuel joint research project, established in June 2022 by Turbotech, Safran, Air Liquide, Elixir Aviation, and Daher. The project aims to design and test a hydrogen propulsion system for light aircraft and develop a certification methodology for retrofit applications. ←

Researchers ask industry for ruggedized MEMS inertial sensors for positioning and navigation

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers are approaching industry to develop high-performance inertial sensors with excellent sensitivity and resilience to shock and vibration in one sensing proof-mass for precision positioning and navigation applications.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a solicitation (DARPA-PA-24-04-05)

in December for the Higher-Order Composite Resonators for Extra resilience (HORCREX) project.

The goal of this $2 million program is to develop micromechanical oscillators for applications toward precision positioning and navigation systems.

The last two decades have seen technology innovation in microelectromechanical systems (MEMS) for military positioning and navigation applications. Still, the core technology has not been able to provide precise navigation for an

Northrop Grumman to build cyber security-enhanced EC-130J airborne command post

U.S. Navy strategic communications experts are asking Northrop Grumman Corp. for full-scale development of the E-30J strategic airborne command post to maintain communications with U.S. nuclear forces during times of intense international conflict. Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $3.5 billion contract to the Northrop Grumman Aeronautics Systems segment in Melbourne, Fla., for engineering and manufacturing development (EMD) of the E-130J Take Charge and Move Out (TACAMO) aircraft. The E-130J is a strategic communications aircraft able to communicate on virtually every radio frequency band from very low frequency (VLF) up through advanced extremely high frequency (AEHF) using a variety of modulations, encryptions, and networks to keep to a minimum the likelihood an emergency message being jammed by an enemy. The TACAMO mission provides an airborne capability for survivable, endurable and reliable airborne command, control and communications between U.S. national command authorities and U.S. nuclear forces of bomber aircraft, nuclear intercontinental ballistic missile sites, and deployed submerged nuclear ballistic missile submarines. For more information contact Northrop Grumman Aeronautics online at www.northropgrumman.com/what-we-do/air/manned-aircraft/e-130J-tacamo RTX Collins Aerospace at www.collinsaerospace.com; Lockheed Martin Aeronautics at www.lockheedmartin.com/en-us/products/c130/c-130j-30-super-hercules.html; or Naval Air Systems Command at www.navair.navy.mil.

Researchers eye space nuclear thermal propulsion for space maneuver warfare

U.S. military researchers are surveying industry for companies able to design space-qualified nuclear thermal rocket propulsion engines for future military and commercial space applications. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued a request for information (DARPA-SN-25-21) for the Nuclear Thermal Rocket Propulsion project. Nuclear thermal propulsion (NTP) is a fission-powered system that uses a reactor to heat a liquid propellant into a gas, which shoots through a nozzle to propel a spacecraft. This approach reportedly is twice as efficient than chemical rockets. The project seeks information and industry expertise in space-qualified nuclear thermal rocket propulsion engine design; development, modeling, and simulation; engine integration; autonomous engine and reactor control; engine instrumentation; and engine system integration. For the military, nuclear thermal propulsion holds the potential to enable combat forces no longer to be static and predictable, and achieve space maneuver — particularly in the face of an adversary — to maintain initiative, achieve surprise, and outmaneuver an adversary in space. Companies interested were asked to respond in January. More information is online at https://sam.gov/opp/c3e7831fb-2ca46c49363ec10994bfaf6/view. ←

individual warfighter or a small vehicle in GPS-denied environments.

A key limitation is the inability of inertial sensors to operate in extremely dynamic scenarios, such as executing precise maneuvers in contested airspace and during vehicle launch and landing.

The current approach is using sensors with different bandwidths and dynamic ranges, yet this adds unnecessary size, weight, and power consumption.

HORCREX will use mechanical frequency combs to develop one inertial sensor with dramatically increased dynamic range and resistance to the effects of shock and vibration across a broad range of velocity and acceleration.

Today's inertial sensors tend to be large and operate at low frequencies so they can measure very small signals that vary over long times and distances, DARPA researchers explain. High-frequency MEMS sensors offer good shock resilience, but at the cost of poor sensitivity.

While sensors with different dynamic ranges can extend operational capabilities, they suffer from poor size and weight scaling, and suffer from mechanical crosstalk and unintentional mode-locking because of acoustic energies.

HORCREX aims to develop high-performance inertial sensors while achieving excellent sensitivity and resilience to shock and vibration in one sensing proof-mass. The concept of mode-locking provides a possible pathway to achieve low-frequency modes that can demonstrate low noise and shock and vibration resilience.

HORCREX will improve sensor survivability and ensure sensor operation through extremes of dynamic range, such as pinpoint landing of an unmanned aerial vehicle (UAV). The project's first

phase will demonstrate a locked mechanical frequency comb, and second phase will scale the design.

Companies interested were asked to submit unclassified proposals in February to the DARPA Broad Agency Announcement Portal online at https://baa.darpa.mil. Email questions or concerns to Sunil Bhave, the HORCREX program manager, at HORCREX@darpa.mil. More information is online at https://sam.gov/opp/05d065e9eef-1453093fb4762744c445e/view. ◀

HYPERSON

▲ U.S. Air Force technicians prepare a B-52H bomber ejector rack at Barksdale Air Force Base, La., in November 2022 to validate the loading procedures for the Air Force's first hypersonic weapon.

IC RESEARCH

progressing toward possible future weapons and aircraft deployment

The Navy and Army are collaborating on hypersonic development that involves paring a Common Hypersonic Glide Body with a booster system to create a common hypersonic weapon for use by the two services.

BY **John Keller**

U.S. hypersonic weapons and aircraft development has progressed over the past year, bringing several trends into focus, and helping to chart a future for future weapons and planes that can travel at speeds of at least five times the speed of sound — or nearly 4,000 miles per hour.

Such capability could deliver guided munitions able to attack an adversary virtually before he could activate air defenses. It could help deliver an aircraft able to fly coast-to-coast in less than an hour. It could provide weapons that might not need explosives at all, but instead rely on the destructive force of their high kinetic energy alone.

Several research programs are planned, in progress, or completed to develop enabling technologies for hypersonic projects, and top U.S. Department of Defense (DOD) leaders have identified hypersonics as one of the Pentagon's top priorities, which has the potential to create deployable hypersonic systems within the next decade. It all depends on whether

USAF photo

these kinds of technologies retain their priorities at the top of the military's list.

Stages of development

The Pentagon's 2025 budget request for hypersonic research was $6.9 billion — up from $4.7 billion in the 2023 request. Despite this funding increase, the Pentagon still has not established any programs of record for hypersonic weapons, according to the report Hypersonic Weapons: Background and Issues for Congress, submitted by the U.S. Congressional Research Service in February.

This suggests that Pentagon leaders have approved neither solid mission requirements or long-term funding plans, the report states. In fact, DOD has not yet made a decision to buy hypersonic weapons and instead is only going as far as developing research prototypes. Today it's unclear when, or even if, the DOD will move hypersonics out of solely research projects and into well-defined procurement programs, despite spending billions on these technologies.

Hypersonic weapons development still is in its early stages, and it's an open question how urgent it is for U.S. military researchers and systems designers to develop these kinds of weapons quickly. It's plain, though, according to the Congressional Research Service, that the United States does not have systems that can hold adversaries like China and Russia at risk of hypersonic missile attacks, and that the U.S. military does not yet have defenses against adversary hypersonic weapons. Furthermore, the Congressional Research Service says, U.S. defense officials believe that today's terrestrial and space-based sensor architectures are insufficient to detect and track adversarial hypersonic weapons.

Current hypersonic research

The Pentagon has four primary hypersonics research programs in progress: the Navy Conventional Prompt Strike (CPS) and Offensive Anti-Surface Warfare Increment 2 (OASuW Inc 2), also known as Hypersonic Air-Launched OASuW (HALO); the Army Long-Range Hypersonic Weapon (LRHW); and the Air Force Hypersonic Attack Cruise Missile (HACM) projects. There may be more hypersonic research being conducted at the classified level.

Perhaps the DOD's most high-profile hypersonics research project is the Navy Conventional Prompt Strike (CPS), which is a hypersonic boost-glide missile development and test program that provides long range, short flight times, and high survivability against enemy defenses.

The Navy and Army are collaborating on hypersonic development that involves paring a Common Hypersonic Glide Body with a booster system to create a common hypersonic all-up round (AUR) for use by the Navy and Army. The first test of the AUR in June 2022 was failure, but tests last December succeeded.

▼ Soldiers prepare one of the Long Range Hypersonic Weapon Transporter Erector Launchers for transportation during exercise Resolute Hunter at Joint Base Lewis-McChord, Wash., last June.

U.S. Army photo

Last February the Navy Strategic Systems Programs office in Washington announced an $86.7 million contract to the Lockheed Martin Space segment in Littleton, Colo., for Advanced Payload Modules (APMs) for the Navy's three Zumwalt-class destroyers. The APM is to enable the Zumwalt-class destroyer to fire the hypersonic Lockheed Martin CPS hypersonic missile in packages of three. Each APM will hold three Conventional Prompt Strike hypersonic missiles, for a total of 12 missiles aimed at a variety of high-priority and time-critical targets.

Conventional Prompt Strike (CPS)

Lockheed Martin's CPS is a boost-glide hypersonic missile with a two stage solid rocket motor, a hypersonic glide body, and kinetic-energy warhead. DOD leaders say they eventually plan to launch CPS from Zumwalt-class destroyers and Virginia-class attack submarines to strike valuable mobile targets. First deployment of the CPS is scheduled for as early as 2028 aboard Virginia-class attack submarines.

While the Advanced Payload Module is a hypersonic missile launcher for Zumwalt-class destroyers, the so-called Virginia Payload Module is the hypersonic missile launcher for Virginia-class attack submarines.

The three Zumwalt-class destroyers — USS Zumwalt (DDG 1000), USS Michael Monsoor (DDG 1001), and USS Lyndon B. Johnson (DDG 1002) — are multi-mission stealth ships with onboard computers and computer networking that focus on land attack, with secondary roles of surface warfare, anti-aircraft warfare, and naval gunfire support.

The Zumwalt-class destroyer has a specially shaped hull and superstructure that scatters radar signals and gives the ship a much smaller radar cross section that it otherwise would have with a conventional design.

Last November Leidos Dynetics Technical Solutions (DTS) in Huntsville, Ala., won a $670.5 million U.S. Army contract to build the common hypersonic glide body and thermal protection system. DTS is a wholly owned subsidiary of Leidos Dynetics. DTS is working with Lockheed Martin Corp. to support integration and prototyping of the new common hypersonic glide body.

The Army is asking DTS to produce the first commercially manufactured set of common hypersonic glide body systems for prototyping the new common hypersonic glide body, which is expected to be available across military services to provide commonality to air-, land-, and sea-launched hypersonic weapons.

The common hypersonic glide body is being developed by the U.S. Navy and Army to travel at hypersonic speeds and glide towards its target. A booster rocket accelerates the common hypersonic glide body to hypersonic speeds, then releases it to glide on its own. Lockheed Martin also is working with the Army on multi-year hypersonic weapons development in support of the Army's focus on long-range precision-strike missiles.

Last June Lockheed Martin won a $534 million order for systems engineering and testing for CPS hypersonic missiles. Last July the Navy awarded a $22.9 million order to General Dynamics Bath Iron Works in Bath, Maine, to start building the Large Missile Vertical Launch System (LMVLS) launch module fabrication for the USS Michael Monsoor (DDG 1001) The LMVLS launcher will enable the three Zumwalt-class destroyers to launch the future CPS hypersonic missile.

LMVLS launchers are to replace or augment the Advanced Gun Systems (AGS) aboard the Zumwalt, Monsoor, and Johnson. The LMVLS launchers will shoot the CPS missile with a two stage solid rocket motor, a hypersonic glide body, and kinetic-energy warhead.

USAF Photo

▲ An Air Force ground crewman secures the AGM-183A Air-launched Rapid Response Weapon Instrumented Measurement Vehicle 1 (ARRW IMV-2) as it is loaded under the wing of a B-52H jet bomber at Edwards Air Force Base, Calif.
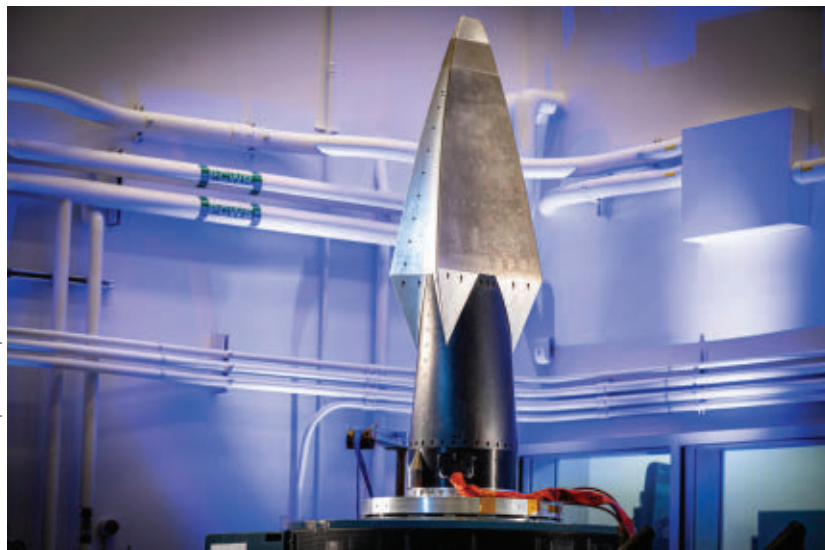
▲ **A John Hopkins Applied Physics Laboratory team tested the Boundary Layer Transition (BOLT) flight hardware in June 2021.**

A hypersonic projectile travels at speeds of at least five times the speed of sound, or about 3,800 miles per hour.

HALO project

The Navy's future Hypersonic Air-Launched Offensive Anti-Surface Warfare Weapon System project — collectively known as HALO — has been quiet over the past year. This development project is to enable carrier-based aircraft to conduct stand-off strikes against high-value surface threats. It penetrates near-peer air-defense systems to defeat high-value surface threats, so the Navy can operate in and control contested battles spaces.

The Navy has announced plans to approach industry to develop the HALO hypersonic munition that can be launched from carrier-based aircraft for attacking enemy surface ships and shore installations. If successful, this weapon may replace or augment a variety of today's anti-ship missiles.

Preliminary development of HALO has been handled by Lockheed Martin and by the RTX Corp. Raytheon
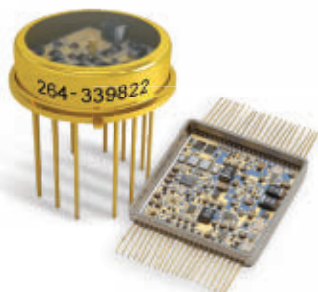
segment in Tucson, Ariz. HALO likely will augment or replace or anti-ship missile systems like the Long Range Anti-Ship Missile (LRASM), Harpoon, and Penguin missiles. Hypersonic missiles typically will be for attacking high-value targets like enemy capital ships, command posts, or forward-staging areas.

The HALO hypersonic weapon should have early fielding by 2029, and first operational capability by 2031. Only
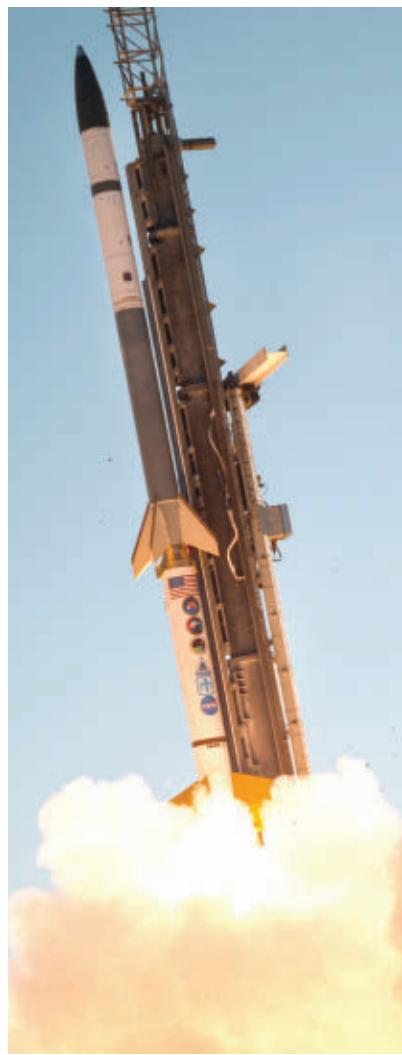
▲ **U.S. Navy and Army researchers conducted tests for the Navy's Conventional Prompt Strike and the Army's Long Range Hypersonic Weapon offensive hypersonic strike capability in 2021 at Wallops Island, Va.**

U.S. Navy photo

eligible prime contractors who have experience with carrier-based hypersonic weapons development — like Raytheon and Lockheed Martin — will have access to the upcoming HALO solicitations.

LRHW project

The Army's Long Range Hypersonic Weapon (LRHW) is to use a common hypersonic all up round. This project also will capitalize on the common hypersonic boost glide all up round and, in partnership with the Navy's CPS program, introduce a new class of ultrafast and maneuverable long-range missiles with the ability to launch from ground-mobile platforms.

Last May the Army awarded Lockheed Martin a $756.8 million order to provide LRHW ground support equipment. Lockheed Martin is prime contractor for LRHW systems integration. The Lockheed Martin-team is developing a land-based hypersonic strike missile prototype in partnership with the Army Hypersonic Project Office.

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

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

Hypersonic strike weapons are a key aspect of the Army's Long Range Precision Fires (LRPF) effort to develop

long-range artillery-delivered munitions able to fire as far as 187 miles, as well as the national security strategy to compete with and outpace potential enemies in hypersonics.

HACM program

The U.S. Air Force Hypersonic Attack Cruise Missile (HACM) program seeks to create a scramjet-powered hypersonic missile as an operational weapon. HACM contractors include RTX Raytheon and Northrop Grumman Corp. Future HACM munitions will go aboard aircraft such as the Boeing F-15EX and F-15E Strike Eagle jet fighter bombers.

RTX Raytheon and Northrop Grumman are working under terms of a $985.3 million order announced in September 2022 to develop HACM, which is to be one of the first hypersonic cruise missiles to be in the U.S. inventory. Last fall the Air Force awarded RTX Raytheon a $73 million contract to enhance the company's manufacturing capacity to produce HACM.

Last June the U.S. Government Accountability Office, the investigative arm of Congress, reported that Air Force leaders expect to fly 13 HACM tests between October 2024 and March 2027. A production decision may come after 2027 testing if all goes well. HACM may undergo a critical design review as early as this year, and has the potential to move to a military program of record as early as 2027.

The HACM project incorporates enabling technologies from other research projects. In 2020, the Air Force joined Australia in a multi-year project called the Southern Cross Integrated Flight Research Experiment (SCIFiRE) to develop air-breathing hypersonic cruise missile prototypes. The Air Force

awarded three 15-month SCIFiRE contracts in June 2021 to Boeing Co., Lockheed Martin Corp., and RTX Raytheon to complete preliminary designs of a hypersonic cruise missile.

The HACM program will bring the RTX Raytheon SCIFiRE prototype design into production for fighter aircraft integration, and deliver two leave-behind assets with operational utility. Through SCIFiRE, the U.S. and Australia will continue collaborating on HACM design and development, including using Australian test sites for the initial all-up-round flight tests.

Hypervelocity projectiles

While not technically part of military hypersonic programs, the U.S. Army is working on so-called "hypervelocity" projectiles that will be designed to fly through the air at speeds of 8 or 9 times the speed of sound. The Army issued a request for information last summer for the Hypervelocity Projectile (HVP) program.

Officials of the Army Rapid Capabilities and Critical Technologies Office (RCCTO) at Fort Belvoir, Va., are looking for companies able to deliver HVP prototypes no later than fall 2027 for operational demonstrations in 2028, and later for possible deployment.

The HVP for air defense applications seeks to reduce munition costs and enhance the value of wheeled 155-millimeter artillery systems firing HVPs. The HVP prototypes will communicate with off-board sensors that track the HVP and the threat to be intercepted. BAE Systems has developed a hypervelocity projectile for potential naval use.

The HVP prototypes should fire from rifled and smooth-bore 155-millimeter cannons; interface with Army-provided off-board sensors to intercept the incoming threat; interface with a data transmission device to receive pre-launch mission data; maintain projectile maneuverability through interception; keep flight time to a minimum; and be powerful enough to shoot down fixed-wing aircraft, helicopters, UAVs, and cruise missiles. Army officials also are interested in rapid ammunition resupply, as well as supportability, safety, and cyber security.

In a related hypervelocity munitions development, the Army issued a request for information last December

for the Multi-Function Precision Radar (MFPR) project, which seeks to find companies able to build four prototype surveillance radar systems by fall 2027 that are able to guide Army hypervelocity weapons to their targets.

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

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

The MFPR is to track the cannon-fired Hypervelocity Projectile, as well as incoming threats, and help guide the munition to incoming threats using external government-furnished Command and Control Battle Manager (C2BM) and the Integrated Air and Missile Defense (IAMD) Battle Command System (IBCS).

The MFPR must be accurate enough to help the hypervelocity projectile intercept incoming threats. What's significant is the hypervelocity projectile does not have an onboard seeker. Developing this kind of multi-function precision radar technology has the potential to help drive down the costs of air- and missile-defense munitions by enabling these weapons to operate without expensive onboard seekers and guidance systems.

The MFPR Prototypes should perform in an operational band that is available or could be available for military use

DARPA photo

▲ This illustration depicts the Defense Advanced Research Products Agency's (DARPA) Falcon Hypersonic Test Vehicle as it emerges from its rocket nose cone and prepares to re-enter the Earth's atmosphere.

worldwide; provide precision radar track data to support projectiles in flight via a communications link; provide long-range high-precision angular coverage for search detection; be able to detect threats and friendly projectiles; operable in high-clutter environments; interface with government-furnished command and control; and demonstrate supportability, safety, and cyber security.

Hypersonic aircraft research

Last fall Venus Aerospace in Houston introduced the VDR2 propulsion system to power high-speed vehicles such as drones and aircraft. The engine is engineered for long-range travel at high altitudes and can reach speeds as fast as Mach 6.

The VDR2 integrates two technologies: the Rotating Detonation Rocket Engine (RDRE), which provides high thrust, and a ramjet, which

ensures efficient cruising. This combination enables the engine to operate from takeoff through hypersonic speeds without complex mechanical systems. Venus Aerospace officials say they will fly the VDR2 engine in hypersonic test drone sometime this year.

Venus plans to equip its RDRE on its commercial hypersonic aircraft, the Stargazer M400. Venus officials say the aircraft will cruise at Mach 4 at altitudes to 110,000 feet with a top speed of Mach 9.

The plane is expected to take off from conventional runways using advanced propulsion systems, reach the edge of space, and cruise at extremely high altitudes before landing. Stargazer seeks to transform high-speed commercial and military travel with reusable technology.

Last summer GE Aerospace in Cincinnati demonstrated a hypersonic dual-mode ramjet that could enable

high-speed flight and long range air travel. The dual-mode ramjet began testing last March at the GE Aerospace clean air continuous flow high-speed propulsion testing facility in Evendale, Ohio. The dual-mode ramjet demonstration showed a threefold increase in airflow over previously flight-tested hypersonic technology demonstrators.

Other developments in hypersonics

Lockheed Martin was involved in the U.S. Air Force's Air-launched Rapid Response Weapon (ARRW), which sought to combine critical high-speed flight technologies and accelerate the conversion of air-to-ground hypersonic strike capabilities to actual weapons. The hypersonic weapon was designed to travel at 3,800 miles per hour.

The AGM-183 ARRW was to capitalize on Tactical Boost Glide (TBG) technology developed under supervision of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va. The air-launched hypersonic glide vehicle prototype completed a test flight in June 2019, but then had three successive failures before completing three flight tests in 2022. The Air Force conducted its final test of ARRW in March 2024, before emphasis shifted to HACM. The Air Force did not request money for ARRW in 2025 and budget documents say the program as completed.

The U.S. National Aeronautics and Space Administration (NASA) Glenn Research Center in Cleveland has awarded contracts collectively worth $5.1 million to The Boeing Co.

and Northrop Grumman Corp. for the High-Speed Endoatmospheric Commercial Vehicle Conceptual Design Study and Technology Roadmaps Development project.

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

These studies were to identify key technology needs and opportunities to enable high-speed commercial passenger aircraft. NASA's Hypersonic Technology and Commercial Supersonic Technology projects fall under the NASA Advanced Air Vehicles Program, which will lead efforts to develop an environmentally sustainable civilian high-speed aircraft. ←

Artificial intelligence (AI) takes its place in sensor, signal, and image processing

AI and machine learning are taking-on ever-larger roles for military surveillance and reconnaissance, as designers strive to process mountains of sensor data in real time.

BY **Jamie Whitney**

Military threats are accelerating at machine speed, so military forces are adding artificial intelligence (AI) and machine learning to their arsenals of sensor, signal, and image processing to analyze vast streams of data in real time. By pushing computing power to the tactical edge in aircraft, armored vehicles, and even soldier-deployed systems, AI-driven systems minimize decision-making delays and enhance situational awareness. Coupled with distributed processing architectures, these technologies allow for autonomous platforms and crewed-uncrewed teams to act with greater speed, flexibility, and resilience in contested environments.

Adopting AI-driven sensor, signal, and image processing at the edge enhances military operations by reducing reliance on centralized command hubs and minimizing the effects of network latency or signal interference in contested environments. By decentralizing computational workloads across interconnected platforms, forces can analyze and respond to critical intelligence at the source — whether it's an uncrewed aerial system (UAS) detecting threats in real-time or a ground vehicle processing electronic warfare (EW) signals on the move. As defense organizations embrace these advancements, they speed autonomous decision-making, and strengthen mission effectiveness across land, sea, air, space, and cyber domains.

"There is a trend towards consolidating sensor processing onto a single platform often sharing common processing resources with an open standard architecture sub-system. This drives needs in SOSA aligned hardware for architecture that allows GPGPU plug-in cards to be mated with SBC plug-in cards, while supporting payload slots that may require RF payloads in the same system," says Mark Littlefield, director of system products at Elma Electronic in Fremont, Calif. Littlefield is active contributor to several VITA and Sensor Open Systems Architecture (SOSA) technical working groups.

▼ **PolarFire SoC and PolarFire FPGA Smart Embedded Vision solutions from Microchip Technology include video, imaging, and machine learning tools for accelerating high-performance designs in low-power small form factors.**

MPFS025T
11 × 11 mm²
0.5 mm

MPFS095T
11 × 11 mm²
0.5 mm

MPFS160T
11 × 14.5 mm²
0.5 mm

MPFS025T
16 × 16 mm²
0.5 mm

Microchip Technology photo
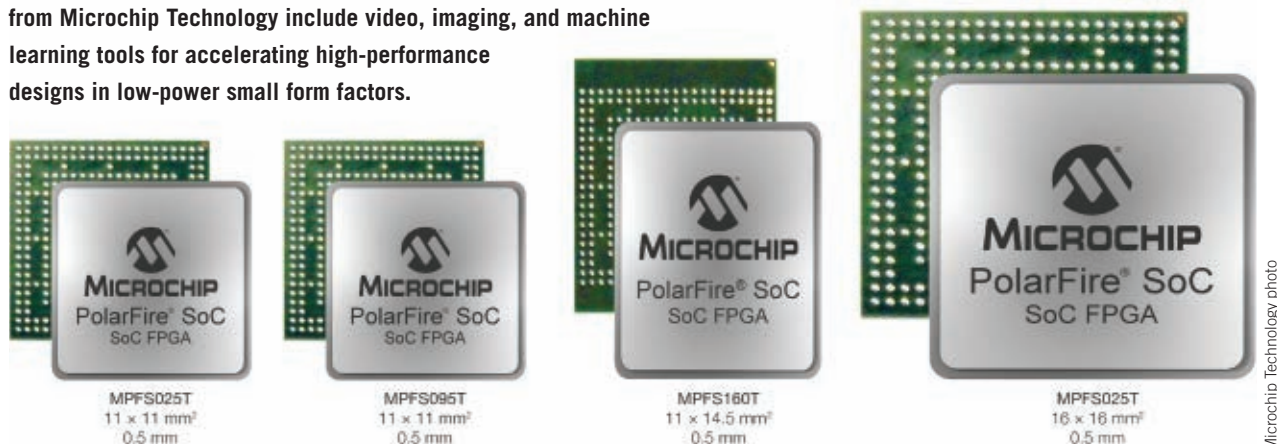
Situational awareness

Rodger Hosking, director of sales at Mercury Systems in Andover, Mass., explains that advanced signal processing aims to transform data into situational awareness through surveillance, targeting, and autonomous systems.

"New sensor initiatives include hyperspectral and multispectral imaging to gain information beyond human vision. Quantum sensors using ultra-sensitive gyroscopes, magnetometers, and accelerometers support GPS-denied navigation and submarine detection, and AI-enabled radar and LiDAR using machine learning algorithms improve target detection, tracking, and clutter reduction," Hosking says. "New signal processing strategies use AI and machine learning for deep learning-based signal analysis to automate EW threat identification and RF spectrum management. Cognitive EW enhances adaptive jamming and electronic countermeasures to counter enemy signals in real time. Neural network-based noise reduction enhances signal clarity in high-interference environments."

Mercury's Hosking explains that advanced image processing for developments in intelligence, surveillance, and reconnaissance (ISR) technologies includes AI-powered synthetic aperture radar (SAR) image analysis for all-weather, day-and-night surveillance, along with real-time object recognition.

"Deep learning models rapidly detect, classify, and track objects from satellite and drone imagery. Edge AI is being used to reduce reliance on cloud-based computation, allowing real-time image analysis on UAVs and satellites," Hosking says. "New sensor fusion initiatives include cross-domain data fusion to integrate radar, IR, EO, sonar, and SIGINT data for a comprehensive battlefield picture. Distributed sensing networks help swarm UAVs and smart sensor grids share real-time data for collaborative targeting. Automated anomaly detection exploits AI-assisted correlation of sensor feeds to detect hidden threats, like stealth aircraft and cyber intrusions."

Fusion power

Brian Russell, director of mil-aero solutions at Aitech in Chatsworth, Calif., explains that the trends of bringing robust capabilities to the battlefield and embracing uncrewed platforms of all sizes are evident. "is a there is an increasing need for smaller and lighter sensor packages as well as multi-sensor fusion of that data via edge computing. In addition, the use of robust AI/machine learning algorithms to reduce both operator workloads and the amount of data moving across the battlefield is just as critical to data processing in today's military and aerospace applications."

▲ The Mercury Systems DRF2270 is an eight-channel system on module that converts analog and digital signals at a rate of 64 gigasamples per second.

David Tetley, director of embedded computing at Elma Electronic, says combining data into actionable intelligence from seemingly unrelated technologies, such as electro-optical (EO) and infrared
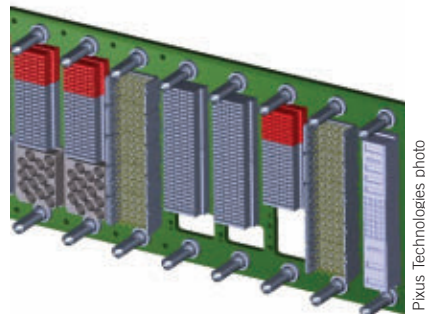
▲ The Pixus 3U OpenVPX ATR enclosures incorporate optical fiber interfaces through the backplane, advanced cooling over fins for the hotter modules, and speeds of 100 Gigabit Ethernet and beyond.

(IR), presents an initial challenge.

"The first challenge is data ingest," Tetley says. "Different sensor types have very different digitization front ends and convey the data using different protocols and electrical standards. For example, EO/IR data from a camera gimbal may present its data on a 3G-SDI interface, whilst RF data may be transmitted as IQ data over a high-speed network or over PCIe from a RF data acquisition board. Therefore, system architectures need flexibility to accommodate different sensor interface types and data bandwidths.

He continues, "As different sensors have different latencies, there is also the challenge to register and align the data from the different sensor entities in the time domain. This is facilitated by accurate timestamps via global clocking mechanisms and use of IEE802.1AS."

Denis Smetana, senior product manager at Curtiss-Wright Defense Solutions in Ashburn, Va., says "Any time you are trying to combine data from different sources you need to normalize the data so that sampling rates, resolution, data characteristics, etc. can be combined together in meaningful ways. Otherwise,

a difference in the definition of the data can cause distorted results."

Mercury's Hosking notes that as sensors operate at different frequencies, resolutions, and bandwidth and produce diverse data formats and sampling rates in addition to different military platforms in coalition forces, the resultant data can result in costly errors.

"Time delays between different sensors can cause misalignment in data fusion, and out-of-sync timestamps can lead to incorrect object tracking or misinterpretation of threats," Hosking says. "Bandwidth constraints may prevent real-time data transmission from distributed sensors. Noisy or incomplete data from one sensor may mislead fusion algorithms, and sensor biases, drifts, or environmental interferences need compensation."

He continues, "Multiple sensors may provide contradictory data, and false alarms from one sensor can bias the entire fusion system. Accurate object association is difficult when tracking several entities across sensors with different fields of view."

While modern systems enable unprecedented situational awareness, they also produce vast amounts of data. This leads to increased power consumption. Justin Moll, vice president of sales and marketing for Pixus Technologies in Waterloo, Ontario, states that these trends will necessitate the development of new architectures. "AI and machine learning are generating unprecedented capabilities for advanced signal processing and data crunching. The drawback from a chassis perspective is these powerful chipsets are driving up the wattage of the PICs [plug-in cards]. The extreme high speeds and performance requirements of these systems will start to drive the market to a new generation of architecture, such as VITA 100."
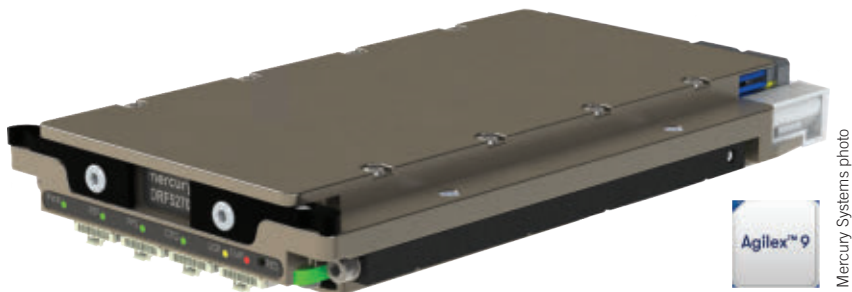
▲ The Mercury Systems DRF5270 integrates the DRF2270 system on module into a 3U defense-ready board, featuring 10-, 40-, and 100-Gigabit Ethernet optical interfaces.

Eye on AI

According to Ken Grob, director of embedded technologies at Elma Electronic, AI is providing a helping hand in sifting through the mountain of data that today's sensor technologies provide. "Bringing in AI processing into a sensor can assist in processing the data stream. In image sensors, data streams can be preprocessed at the sensor. In the case of RF systems signals can be analyzed through the use AI processing. Further, in a communication example, voice comms can be converted from language to language, and processed for keywords of phrases. Outputs can be audio or text."

Aitech's Russell says that AI and machine learning has enabled processing more data at the edge and send only the pertinent data packets and information to centralized computing and operators. "An example would be target recognition using AI/machine learning via a sensor," Russell says. "Instead of sending data and image for every target in the field of view, the user could select basic 'only send defined threats' data, hence reducing the required bandwidth of data flow and also reducing operator workload and latency. The operator would only have to process and react to true threats."

Russell remarks that Aitech's A230 Vortex is a standout as a rugged edge compute system ideal for AI at the edge

and distributed systems and is available with the NVIDIA Jetson AGX Orin Industrial System-on-Module. "Its Ampere GPU features up to 2048 CUDA cores and 64 Tensor cores, delivering up to 248 TOPS and ensuring remarkable energy efficiency for AI-based local processing right alongside your sensors," Russell says. "In addition, the system includes two dedicated NVIDIA Deep-Learning Accelerator (NVDLA) engines, tailored for deep learning applications. With its compact size, the A230 Vortex sets the standard as the most advanced solution for AI, deep learning, and video and signal processing in next generation autonomous vehicles, surveillance and targeting systems, EW systems, and more."

Hosking at Mercury Systems says that in addition to target identification with EO/IR, SAR, and radar imagery, "Cognitive radar systems dynamically adjust waveforms based on environmental conditions and threats. AI improves clutter suppression, reducing false alarms in maritime and airborne surveillance. machine learning-based electronic warfare (EW) threat classification enables real-time signal identification and jamming. Bayesian networks and deep learning improve sensor fusion for more accurate tracking of fast-moving threats, and AI-driven data association algorithms resolve conflicting

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sensor inputs and enhance object correlation."

Mercury's DRF2270 System-on-Module (SoM) and DRF5270 3U board are the latest additions to its direct RF digital signal processing product line, using Altera FPGAs to analyze data across a broad range of the electromagnetic spectrum. The DRF2270 is an eight-channel SoM capable of converting analog and digital signals at a rate of 64 gigasamples per second.

▲ The Aitech A230 offers as many as 2048 CUDA cores and 64 Tensor cores to deliver as fast as 248 tera-operations per second and ensure energy efficiency for AI-based local processing.

The DRF5270 integrates the DRF2270 SoM into a 3U defense-ready board, featuring 10, 40, and 100 Gigabit Ethernet optical interfaces. The modular design of the SoM allows for customization to specific applications without requiring a full board redesign. Additionally, the DRF2270 can be incorporated into other small-form-factor or custom configurations.

Speed needs

Bob Vampola, vice president of aerospace and defense business at Microchip Technology in Chandler, Ariz., identified a quartet of trends driving the development needs of today's signal processing technologies. First, Vampola says there is a need for more resolution at a higher number of frames per second.

"One consequence is higher bus speeds to accommodate the increase in data," Microchip's Vampola says. "The second is high-speed Ethernet for the data bus. This trend isn't new, however, it is gaining speed and broader acceptance. The third, for many imaging applications, constraints like available power, power dissipation and available volume drive a non-GPU approach. The trade-off is around performance (typically speed) vs size and power budgets. And lastly, image processing at the edge is gaining traction. In this case, edge means placing a dedicated processor near the camera, extracting meaning from the image data there, and transmitting the meaning rather than the entire image data to a more central node. The result is lower bus speeds and relaxed thermal management concerns.

"As compute workloads move to the edge, [Microchip's] PolarFire SoC and PolarFire FPGAs offer 30–50% lower total power than competing mid-range FPGAs, with five to ten times lower static power, making them ideal for a new range of compute-intensive edge devices, including those deployed in thermally and power-constrained environments," Vampola continues. "PolarFire SoC and PolarFire FPGA Smart Embedded Vision solutions include video, imaging and machine learning IP and tools for accelerating designs that require high performance in low-power, small form factors across the industrial, medical, broadcast, automotive, aerospace and defense markets."

Curtiss-Wrights' Smetana also identified four sensor processing trends in mil-aero systems, including the necessity to manage a large volume of high-resolution data, resulting in a demand for increased bandwidth capacity. "In order to accommodate the higher bandwidth there is a stronger push for 100 Gigabit Ethernet fabrics, Gen4 or even Gen5 PCIe links, and an acceleration in smart sensors with fiber optic connections to FPGAs," says Smetana, acknowledging a growing demand for several intelligence (multi-INT) capabilities and sensor fusion and the necessity of incorporating GPUs to assist with the required processing volume.

"Although this has to be balanced with the power and heat they generate and challenges related to securing GPU data," notes Smetana. "For larger systems where 6U VPX cards are used, we are seeing a significant increase in the need for Liquid Flow Through (LFT) cooling as it is the only way to cool the higher-end processing devices whether they are general purpose processors, FPGAs, or GPUs."

Curtiss-Wright Defense Solutions' CHAMP-FX7 is a rugged real-time processing board featuring AMD's Versal Adaptive SoC devices. These Adaptive

SoCs integrate FPGA programmable logic with Arm-based processing and high-performance I/O, supporting floating-point and integer arithmetic for signal processing and AI applications.

The board is designed for high-speed data processing, with over 100 transceivers supporting 100-Gigabit Ethernet, PCIe Gen4, and other high-rate protocols over VPX backplanes. It includes hard IP blocks for DDR4 SDRAM, PCIe, and Ethernet, with a low-latency Programmable Network-on-Chip for efficient data movement.

The CHAMP-FX7 incorporates two VP1702 Versal Premium devices on a 6U SOSA-aligned VPX platform. It features quad 100-Gigabit Ethernet ports and 32-lane PCIe Gen4 connectivity, enabling high-speed data transfer between SoCs, processors, GPUs, and network switches within embedded VPX systems.

Looking forward

Elma Electronic's Littlefield explains that the forthcoming VITA 100 standard will play a large role starting in 2026. "Elma is not only participating in the crafting of the VITA 100 standard, but it is taking steps to ensure that we can create and manufacture VITA 100 products that perform to expectations," says Littlefield. "It's not simply a matter of sticking the new connectors on the board, it requires careful consideration of signal integrity issues, the proper choice of materials and route paths and dimensions, and an infrastructure to test and validate that performance targets — with proper margins — are being met. The performance increases that VITA 100 will bring will be critical for next-generation signal and image processing platforms.

He continues, "Elma is introducing its 'AI-Ready' SOSA aligned

CWDS photo

▲ **The Curtiss-Wright Defense Solutions CHAMP-FX7 is a rugged real-time processing board featuring AMD's Versal Adaptive system-on-chip devices.**

backplanes that support a x16 Gen 4 PCIe interface on the Expansion Plane between a Computer Intensive SBC and NVIDIA GPU, thus maximizing sensor data bandwidth and minimizing latency. This is coupled with support of 100-Gigabit Ethernet on the data plane to support the wide bandwidth need for VITA 49 RF data, as required by MORA and SOSA, to convey data

between the front-end and back-end RF processing entities."

Pixus Technologies also has its eyes on the coming VITA 100. Moll remarks that "Pixus has developed several 3U OpenVPX ATR enclosure designs for SOSA requirements. This includes incorporating fiber and optical interfaces through the backplane, advanced cooling over fins for the hotter modules, and speeds of 100-Gigabit Ethernet and beyond.

He continues, "Pixus has also designed a SOSA aligned backplane that incorporates the VITA 91 high density connector in the switch slots. This specification allows double the bandwidth with speeds to 56 gigabaud per second across a single channel. This is a currently available stepping stone to the next generation VITA 100 standard, which will take some time to be fully developed and tested." ←

▲ **The Small Satellite Cross-Link Systems project will conduct a V-band small satellite crosslinks demonstration of V-band crosslink space communications..**

NASA taps Morehead Space Science Center to demonstrate V-band satellite crosslinks for remote-sensing

BY **John Keller**

CLEVELAND – U.S. space researchers needed to demonstrate V-band satellite crosslinks to transmit large volumes of science and Earth remote-sensing data with high-speed and low latency. They found a solution from the Morehead State University Space Science Center in Morehead, Ky.

Officials of the U.S. National Aeronautics and Space Administration (NASA) Glenn Research Center in Cleveland announced a $14.2 million contract to the Morehead Space Science Center for the Small Satellite Cross-Link Systems project.

The Small Satellite Cross-Link Systems seeks to conduct a small satellite flight demonstration of V-band crosslinks in performing V-band cross-link space-communications experiments.

V band describes microwave frequencies from 40 to 75 gigahertz. The V band is not heavily used, except for millimeter wave radar research and other kinds of scientific research.

Scientific and Earth remote-sensing missions are primary users of Earth-proximity space-relay communication services for climate monitoring, resource management, oceanography, and disaster response.

As sensing technologies develop, the data volume needs for remote sensing missions in real time are

increasing, which requires high-speed, low- latency communications, NASA researchers explain.

NASA wants a Morehead Space Science Center to conduct a small satellite flight to demonstrate the performance of V-band high-speed data crosslinks, and work with colleges and universities to perform V-band cross-link space-communication experiments.

The Morehead Space Science Center will conduct a small satellite-based flight demonstration of a V-band crosslink capability, and complete a mission concept review, mission design review, characterization and experiment plan review, and launch and operational readiness review with NASA experts prior to launching the small satellites.

NASA officials are asking the Morehead Space Science center to address:

- antenna pattern and pointing performance to quantify realized antenna gain as a function of the relative position between satellites and pointing stability under various spacecraft conditions;
- link budget performance to quantify realized link margins and signal to noise ratios as a function of various

systems parameters and relative position between satellites;

- bit error rate performance curves for available modulation and coding schemes to quantify the quality of the crosslink communications channel;
- data throughput and latency performance under various spacecraft conditions and use cases to quantify the ability of V-band crosslink systems to support remote sensing and Earth observation science use-cases;
- ranging and positioning performance to quantify the ability of V-band crosslink capability to support range and velocity measurements between the small satellites; and
- end-to-end system performance to evaluate the ability to use the V-band cross- link capability in real-world use-cases and applications.

For more information, contact the Morehead Space Science Center online at www.moreheadstate.edu/academics/colleges/science/engineering-sciences/space-science-center, or NASA Glenn Research Center at www.nasa.gov/glenn. Email questions or concerns to NASA's Tyler Braden at tyler.r.braden@nasa.gov. ←

Secure 5G military networking with encryption to link warfighters globally introduced by Persistent Systems

Persistent Systems LLC in New York is introducing the Personal Transport 5 (PT5) accessory for the handheld MPU5 MANET radio networking device to connect teams of warfighters around the world. The PT5 is a dual-function device that connects to the MPU5, simultaneously delivering 5G cellular and Wi-Fi connectivity. The lightweight PT5 securely connects soldiers to host-nation 5G cellular networks, and facilitate Persistent's over-the-horizon Cloud Relay networking to connect warfighters in a global communication fabric. Two independent layers of accredited encryption enable data to traverse foreign host-nation cellular networks securely. Cloud Relay automates establishing Internet Protocol Security (IPsec) VPNs and protects data with Media Access Control Security (MACsec).
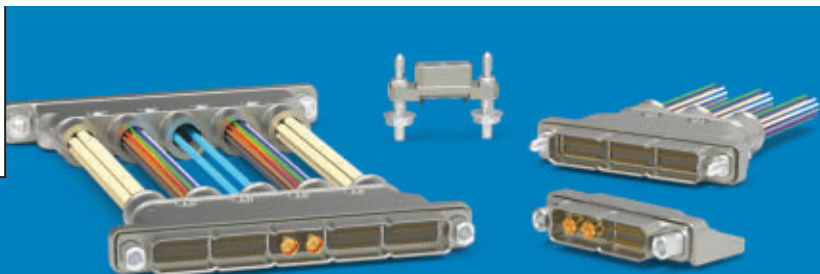
Lockheed Martin to build EW systems to help submarines detect hostile radar

BY **John Keller**

WASHINGTON – Submarine combat systems experts at Lockheed Martin Corp. will develop and build electronic warfare (EW) systems for Navy submarines under terms of a $130.3 million order.

Officials of the Naval Sea Systems Command in Washington are asking the Lockheed Martin Rotary and Mission Systems segment in Syracuse, N.Y., for development and production of submarine EW equipment.

Lockheed Martin builds the BLQ-10 submarine EW equipment, which provides automatic detection, classification, localization, and identification of potentially hostile radar and communications signals at sea.

The AN/BLQ-10 helps Virginia-, Los Angeles-, and Seawolf-class fast-attack submarines, Ohio-class conventional guided-missile submarines, and future Columbia-class ballistic-missile submarines detect enemy radar and communications. It is not for existing Ohio-class ballistic-missile submarines.

The AN/BLQ-10 processes signals from the submarine's imaging mast or periscope when the boat is at periscope depth. It provides threat warning to avoid counter-detection and collision; determines the number and location of targets for subsequent prosecution; and conducts intelligence, surveillance, and reconnaissance (ISR) to support the fleet or battle group.

The program is adopting an open-architecture, incremental development process that fields hardware and software technology insertions every two years. The AN/BLQ-10 blends modular interoperable systems that adhere to open standards with published interfaces.

The system's first technology insertion in 2008 added a subsystem to intercept some low-probability-of-intercept radar signals. Fielded upgrades from the 2010 technology insertions updated commercial off-the-shelf (COTS) processors and displays, and Improved Communications Acquisition and Direction Finding (ICADF) system.

For TI-20, Lockheed Martin built an upgraded AN/BLQ-10 for Virginia- and Columbia-class submarine new construction, and in-service Virginia-class modernization.

TI-22 work upgraded AN/BLQ-10 systems for in-service Los Angeles- and Seawolf-class attack submarines, as well as for Ohio-class conventional missile submarines. TI-24 work builds an upgraded AN/BLQ-10 for Virginia-class and Columbia-class new construction, as well as for in-service Virginia-class modernization.

On this order Lockheed Martin will do the work in Syracuse, N.Y., and should be finished by October 2027. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com/en-us/who-we-are/business-areas/rotary-and-mission-systems.html, or Naval Sea Systems Command at https://www.navsea.navy.mil.

▲ The AN/BLQ-10 helps Virginia-, Los Angeles-, and Seawolf-class fast-attack submarines, Ohio-class conventional guided-missile submarines, and future Columbia-class ballistic-missile submarines detect enemy radar and communications.

Leonardo DRS photo

Leonardo DRS to build shipboard missile-defense radar systems to counter anti-ship missiles

BY **John Keller**

WASHINGTON – U.S. Navy missile-defense experts are asking the Leonardo DRS Naval Electronics segment in Largo, Fla., to provide AN/SPQ-9B shipboard anti-ship missile defense (ASMD) radar systems to help protect U.S. Navy surface warships from enemy anti-ship missiles.

Officials of the Naval Sea Systems Command in Washington announced a $66.2 million order to DRS Laurel to build AN/SPQ-9B radar systems and support equipment.

The AN/SPQ-9B is an X-band pulse-Doppler frequency-agile radar that scans out to the horizon and performs simultaneous and automatic air and surface target detection and tracking of low flying anti-ship cruise missiles, surface threats, low-and-slow-flying aircraft, unmanned aerial vehicles (UAVs), and helicopters.

The missile-defense radar is designed for the littoral environment

▲ The Leonardo DRS AN/SPQ-9B shipboard anti-ship missile defense (ASMD) radar systems are for aircraft carriers, amphibious assault ships, cruisers, Coast Guard maritime security cutters, Arleigh Burke-class destroyers, and allied cruisers and destroyers.

in harbors and along coastlines, rejects clutter, and has a low false track rate in the littorals and in other high-clutter environments. Its design makes the most of commercial off-the-shelf (COTS) and non-developmental item (NDI) equipment.

The unattended radar consists of four air-cooled below-deck cabinets, a motor generator, and one above-deck antenna unit designed for low-radar-cross-section reflectivity appropriate for stealth ship design.

The AN/SPQ-9B is for aircraft carriers, amphibious assault ships, cruisers, Coast Guard maritime security cutters, Arleigh Burke-class destroyers, and allied cruisers and destroyers.

Above decks, the radar uses a mechanically rotating, electronically stabilized antenna. The 1,500-pound antenna consists of dual planar arrays mounted back-to-back, each connected to independent transmitters and receivers. Below decks, the radar consists of processor, receiver/exciter, and transmitter cabinets; radar set control; and motor generator.

The processor cabinet performs signal processing, tracking, and interface functions. The receiver/exciter has three receivers, and generates system frequencies and clocks. The transmitter cabinet receives the RF pulses from the receiver/exciter and amplifies them for output to the antenna.

The radar set control provides remote control and monitoring of radar operation in the ship's combat information center. The output of each receiver is converted to digital baseband I-Q data for Doppler processing in the processor cabinet. The system has an auxiliary antenna for electronic counter-countermeasures.

The AN/SPQ-9B radar has digital interfaces to the Aegis combat systems, the MK 34 gun weapon system (GWS), the MK 48 GWS, the Cooperative Engagement Capability, and ship self-defense system.

On this order DRS Laurel will do the work in Largo, Fla.; and Johnstown, Pa., and should be finished by May 2027. Exercising all options would extend the contract through July 2030. For more information contact Leonardo DRS Naval Electronics online at https://www.leonardodrs.com/locations/naval-electronics-laurel-technologies-largo-fl/, or Naval Sea Systems Command at www.navsea.navy.mil. ←

The PT5 also provides two Wi-Fi 6e access points to create a personal-area network on the soldier, simplifying connectivity of third-party Wi-Fi devices such as computers, sensors, and cameras. The Wi-Fi access points run simultaneously on two frequency bands providing compatibility with legacy 2.4 GHz devices while delivering maximum performance to modern 5 GHz and 6 GHz Wi-Fi 6e devices. For more information contact Persistent Systems online at www.persistentsystems.com/pt5. ⬅

Mil-spec VCSOs for mission-critical applications like radar and test offered by Microchip

Microchip Technology Inc. in Chandler, Ariz., is introducing the 101765 family of voltage-controlled surface acoustic wave (SAW) oscillators (VCSOs) for mission-critical applications like radar and test and measurement. These specialized RF and microwave components with precise frequency control and ultra-low phase noise help enhance signal clarity, stability and overall system performance, and deliver ultra-low phase noise and operate at 320 MHz and 400 MHz. The 101765-320-A VCSO delivers ultra-low phase noise performance of 166 decibels relative to the carrier (dBc) at 10 kHz offset and a 182 dBc floor. Low phase noise is crucial for improving the lower limit of detection in radar and other sensing applications. These devices are active electronically scanned array (AESA) radar systems that demand high fidelity in critical phase-locked loop timing applications. For more information contact Microchip Technology online at www.microchip.com.

Circuit board connectors for high-signal-integrity applications introduced by Fairview

Fairview Microwave in Lewisville, Texas, is introducing angled printed circuit board connectors for modern RF and microwave applications. These circuit board connectors come in 1.85-, 2.4-, and 2.92-millimeter sizes, and feature interfaces for frequencies ranging from DC to 67 GHz in military and test and measurement applications. These connectors are for use where signal integrity is paramount. The angled design optimizes board layout by reducing signal interference, and facilitates easy routing of signals in densely packed environments. Fairview's new RF angled computer board connectors are in stock and available for same-day shipping. For more information contact Fairview Microwave online at www.fairviewmicrowave.com.

Time reference and rubidium frequency gear for PNT applications introduced by Pendulum

Pendulum Instruments in Redwood City, Calif., is introducing the FTR-210R GNSS-disciplined rubidium frequency and time reference system for use as a stand-alone frequency standard, or as a GNSS disciplined time standard. The Pendulum FTR-210R rubidium frequency and time reference for position, navigation, and timing (PNT) applications has no need for yearly expensive calibration services from metrology labs. An optional input for frequency measurements to 400 MHz turns the FTR-210R into a one-box ultra-high performance frequency calibrator with up to 13-digit resolution in a second. When used as a GNSS disciplined frequency standard, the short-term stability is high, and ageing is virtually zero. When used as a stand-alone frequency standard, the stability is ultra-high. When used as a GNSS disciplined time standard, the 1 pps time reference output differs less than 10 nanoseconds rms from UTC. . For more information contact Pendulum Instruments online at https://pendulum-instruments.com/products/frequency-time-standards/ftr-210r/. ⬅

Researchers eye bio-hybrid robots with engineered and biological parts for self-healing

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers are approaching industry to find ways of integrating synthetic and biological components to design bio-hybrid robots that outperform traditional robots.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., issued an advanced research concepts opportunity (DARPA-EA-25-02-02) for the Hybridizing Biology and Robotics through Integration for Deployable Systems (HyBRIDS) program.

Bio-hybrid robotics combines living organisms and synthetic materials to create biorobots that compared to traditional robots can offer adaptability, self-healing, and energy efficiency.

Bio-hybrid robots aim to capitalize on the precise control of traditional engineered robotic parts while harnessing the capabilities of biological elements. Integrating biological components like cells, tissues, or organisms could extend the functionality of robots, DARPA researchers say.

Recent advancements in engineering and biology have led to development of bio-hybrid robots, which combine biological and synthetic components. Yet today's bio-hybrid robots typically under-perform their synthetic counterparts.

A bio-hybrid robot is defined as a scaffold equipped with actuators, sensors, and control mechanisms that enable it to interact with its surroundings in an autonomous or semi-autonomous fashion, achieved by merging functional, engineered components with biological materials and components.

Nature provides inspiration to advance robotic technologies, but the performance of biological systems remains largely unmatched even as robotic systems become increasingly sophisticated.

Key technical challenges of HyBRIDS ARC include biological component integration into robots; design

◀ **Bio-hybrid robotics combines living organisms and synthetic materials to create biorobots that compared to traditional robots can offer adaptability, self-healing, and energy efficiency.**

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methods for integrating biological and synthetic materials; approaches to characterize interfaces.

Moving beyond readily available and well-characterized biological materials requires systematically assessing possible components and developing methods to modify biological materials to enhance systems integration.

Improved computer-aided approaches are necessary to represent, analyze, and predict the relationships between system- and component-level properties and performance.

Companies interested were asked to submit abstracts by early April. Email questions or concerns to DARPA at HyBRIDS@darpa.mil. More information is online at https://sam.gov/opp/580b34f2b653452badd8e-c37590e27ec/view. ←

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◄ **The future Pulling Guard project seeks to develop miniaturized sensors from existing technologies in a software and hardware modular architecture.**

Researchers brief industry on uncrewed boat with modular architecture and miniaturized sensors

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers briefed industry in March on an upcoming project to develop a semi-autonomous ocean vessel with a modular architecture that can defend unarmed cargo ships from enemy uncrewed surface vessels and other maritime threats.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., are ready to launch the future Pulling Guard (DARPA-SN-25-08) project. Pulling Guard project seeks to develop miniaturized sensors from existing technologies in a software and hardware modular architecture to facilitate rapid development that evolves as new threats emerge.

Solutions will retain a remote supervisor in the loop who retains authority for engagement decisions, yet the project requires sufficient machine autonomy to enable the supervisor to control several systems over a secure connection.

Pulling Guard will be in two phases: an 18-month development phase, and a 21-month Integration, manufacturing, and commercial transition phase.

The development phase has two technology focus areas: platform development, and sensor and kill chain development. Both phases will involve several contractors, and may require collaboration on physical and digital interfaces, and on the design approach.

The Pulling Guard uncrewed surface vessel project focuses on resilient software that starts secure and builds capability through formal methods that involve mathematically rigorous techniques for producing software and machine-checkable evidence of software performance.

Integration, manufacture, and commercial transition may include a mix of phase-one performers with focus on final design, manufacture of initial variants, demonstration events, and execution of commercial strategy.

Email questions or concerns to DARPA's Christopher Kent at DARPA-SN-25-08@darpa.mil. More information is online at https://sam.gov/opp/e3d90d0495c94fe3b3930103240652a7/view. ←

Sikorsky

Sikorsky's rotor blown wing UAS flies in helicopter and airplane modes

▲ Future applications for the rotor blown wing aircraft include search and rescue, fire fighting monitoring, humanitarian response, and pipeline surveillance.

BY **Jamie Whitney**

STRATFORD, Conn.–Sikorsky, a Lockheed Martin company in Stratford, Conn., has validated advanced control laws for a "rotor blown wing" uncrewed aerial system (UAS), demonstrating stable flight in both helicopter and airplane modes.

The battery-powered, 115-pound twin prop-rotor prototype has completed extensive flight testing, proving its maneuverability across various flight regimes. The vertical takeoff and landing (VTOL) design has potential scalability for larger aircraft requiring hybrid-electric propulsion.

"Combining helicopter and airplane flight characteristics onto a flying wing reflects Sikorsky's drive to innovate next-generation VTOL UAS aircraft that can fly faster and farther than traditional helicopters," said Sikorsky Vice President and General Manager Rich Benton.

The aircraft, developed by Sikorsky Innovations, has undergone a year-long testing process, progressing from preliminary design to flight trials. In January, the 10.3-foot composite wing-span prototype completed more than 40 takeoffs and landings, including 30 transitions between helicopter and airplane modes—the most complex maneuver of the design. It reached a top cruise speed of 86 knots in horizontal flight. Simultaneous wind tunnel testing on a full-scale model validated the control laws with real-world data.

"Our rotor blown wing has demonstrated the control power and unique handling qualities necessary to transition repeatedly and predictably from a hover to high-speed wing-borne cruise flight, and back again," said Sikorsky Innovations Director Igor Cherepinsky. "The data indicates we can operate from pitching ship decks and unprepared ground when scaled to much larger sizes."

Future applications for the rotor blown wing aircraft include search and rescue, fire fighting monitoring, humanitarian response, and pipeline surveillance. Larger variants could support long-range intelligence, surveillance, and reconnaissance (ISR) missions, as well as crewed-uncrewed teaming operations.

Sikorsky plans to integrate its MATRIX autonomy system into all rotor blown wing variants. The design is part of a broader family of VTOL UAS and single-main-rotor aircraft under development by the company.

Sikorsky is also working on a 1.2-megawatt hybrid-electric demonstrator (HEX) with a tilt-wing configuration designed for passenger and cargo transport. The HEX power system testbed is expected to demonstrate hover capability by 2027. ⬅

▶ The AMOS site on Maui consists of two facilities: the
Maui Space Surveillance System (MSSS), and the second is
the Maui High Performance Computing Center.

NASA Orbital Debris Program Office photo

KBR to upgrade Air Force supercomputer and electro-optical center for space domain awareness

BY **John Keller**

KIRTLAND AIR FORCE BASE, N.M. – U.S. Air Force researchers needed technology upgrades and maintenance for the Air Force Maui Optical and Supercomputing Site (AMOS) on Maui, Hawaii. They found a solution from KBR Inc. in Houston.

Officials of the Air Force Research Laboratory Directed Energy Directorate at Kirtland Air Force Base, N.M., announced a $176 million seven-year contract to KBR for AMOS support.

KBR will provide operations and equipment maintenance support, site modernization, and recapitalization to the existing legacy space domain awareness capabilities at Maui.

The AMOS site helps the Air Force operate and maintain satellites in space, and helps track man-made objects in space. Site facilities maintain an awareness of the locations and capabilities of all man-made objects in space, also called space domain awareness.

The Air Force Research Lab's Directed Energy Directorate operates two major telescope sites for situational awareness:

one at the AMOS site on Maui, and the other at Kirtland Air Force Base.

The AMOS site on Maui consists of two facilities: the Maui Space Surveillance System (MSSS), and the second is the Maui High Performance Computing Center.

AMOS research includes satellite detection and identification, atmospheric compensation and resolved imaging, astrodynamics and orbital metrics, sensor development, laser propagation through the Earth's atmosphere, database cataloging of satellite images, and high-performance computer modeling

and simulation. In addition to its use as an R&D facility, AMOS has been called upon to help identify and track spacecraft payloads and communication satellites.

AMOS produces satellite imagery, space object signature data, space object positional data, advanced image post processing, data exploitation tools and techniques, laser propagation through the Earth's atmosphere, and high performance computer modeling and simulation. Most recently Air Force Research Lab installed a sodium guidestar, which has the ability to propagate light into the sodium layer of the atmosphere and create an artificial star.

The Maui Space Surveillance System electro-optical facility is at 10,000 feet above sea level and Maui's stable climate with minimal scattered surface light provide excellent viewing conditions most days.

The Maui Space Surveillance System uses its visible and infrared sensors, adaptive optics, and telescopes to collect imaging and signature data on near-Earth and deep-space objects. Air Force Research Lab scientists and engineers analyze this data and disseminate imaging and signature products in support of space domain awareness current needs.

The Maui High-Performance Computing Center helps to evaluate and optimize early production supercomputer technology and provide breakthrough software for military research. It investigates emerging supercomputer technology, and provides supercomputer-backed solutions for high-priority defense programs.

On this contract, KBR will do the work in Maui, Hawaii, and should be finished by April 2032. For more information contact KBR online at www.kbr.com, or the Air Force Research Laboratory Directed Energy Directorate at www.afrl.af.mil/RD ⬅

RTX Raytheon for StormBreaker smart munitions with multimode seeker and imaging infrared

Smart munitions experts at RTX Corp. will provide the U.S. military with additional GBU-53/B StormBreaker radar- and infra-red-guided air-to-ground glide bombs under terms of a $282.3 million contract. Officials of the U.S. Air Force Life Cycle Management Center at Hill Air Force Base, Utah, are asking the RTX Raytheon segment in Tucson, Ariz., for additional munitions in GBU-53/B production lot 11. The 208-pound StormBreaker is six to seven inches in diameter. Eight of these smart weapons can fit in the F-35's confined internal weapon bays. If stealth is not a factor, about 16 more can fit on the F-35's wings. The GBU-53/B, previously known as the Small Diameter Bomb II, is an air-to-ground smart weapon with multimode seeker can hit moving targets in bad weather. The winged munition autonomously detects and classifies moving targets in darkness, rain, fog, smoke or dust. The smart munition for guidance uses millimeter wave active radar homing, semi-active laser guidance, infrared homing with an uncooled imaging infrared camera, GPS-coupled inertial guidance, and radio data-links back to the aircraft. Its millimeter-wave radar detects and tracks targets through weather; imaging infrared provides enhanced target discrimination; and its semi-active laser enables the weapon to track a laser designator on the aircraft, or on the ground. On this order RTX Raytheon will do the work in Tucson, Ariz., and should be finished by March 2029. For more information contact RTX Raytheon online at www.rtx.com/raytheon, or the Air Force Life Cycle Management Center www.aflcmc.af.mil.

German Aerospace Center explores using drones to sniff out hazardous gasses

In the event of an accident involving dangerous substances, effective disaster management hinges on understanding precisely how these harmful substances move through the air. Such knowledge can mean the difference between life and death, helping emergency services to respond swiftly and take appropriate action. This is where the STARE (Swarm Technology for Autonomous Robotic Exploration) project, led by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), plays a pivotal role. The STARE project, led by the DLR Institute of Communications and Navigation, aims to develop autonomous robot swarms for monitoring atmospheric gases. Inspired by the synchronized flight of starlings, these decentralized robotic systems combine advanced machine learning (ML) techniques with physical gas-dispersion models. Each robot, whether ground-based or aerial, is equipped with sensors to detect and predict the spread of airborne chemicals. By sharing data, the swarm can cover extensive areas, offering valuable insights for disaster response. A standout feature of STARE is its integration of ML with physical models, enabling adaptive, real-time environmental exploration with minimal training data. This innovation supports the development of robots capable of navigating hazardous environments and delivering data for disaster relief. ⬅

DARPA asks industry for MEMS gyros rugged enough for fast unmanned vehicles

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers are asking industry to develop tiny gyros and accelerometers able to withstand the structural rigors of fast maneuvering unmanned vehicles to improve precise positioning and navigation.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., has issued a disruption opportunity (DARPA-PA-24-04-03) for the Nimble Ultrafast Microsystems (NIMBUS) project.

One goal of the NIMBUS project is to design micro-electro-mechanical systems (MEMS) gyros and accelerometers that can help uncrewed vehicles operating in the air, on land, or in the water maneuver quickly without G-forces damaging or destroying these MEMS devices.

Warfighters in the field must make rapid course corrections that require positioning or dead reckoning with accuracy and speed, DARPA researchers explain. In such cases, fast sensor resolution is critical to enhance the sensors' scale-factor to achieve high accuracy.

NIMBUS aims to demonstrate tethered resonant systems that operate just below the mechanical fracture velocity of the MEMS. Today's MEMS oscillators are limited to a maximum velocity of five meters per second because of fabrication, anchor design, transducer defects, and chaotic motion caused by non-linear mechanical springs.

NIMBUS performers will co-design the fabrication process such that select performers will improve on their approaches to achieve velocities greater than 200 meters per second.

The last two decades have seen technology advanced in MEMS devices for commercial positioning and navigation

Analog Devices photo

▲ **Warfighters in the field must make rapid course corrections that require positioning or dead reckoning with accuracy and speed.**

applications, yet have not been able to provide military navigation in GPS-denied environments with hand-held devices.

NIMBUS performers must address velocities to the fracture velocity limit of poly-silicon, and achieve velocities exceeding the limits of poly-silicon, and reach the fundamental velocity limits of single-crystal materials such as silicon, silicon carbide, or similar materials.

Five factors have played a prominent role preventing high velocities on tethered chip-scale microsystems: inefficient transducers, weak anchors, micro cracks and their propagation, nonlinear chaotic behavior of the oscillating proof-mass, and material fatigue.

NIMBUS phase-one will demonstrate tethered microsystems with velocity greater than 65 meters per second — the fracture velocity of poly-silicon — and show wafer-scale yield of greater than 50 percent.

The second phase will achieve a velocity greater than 200 meters per second with a wafer-scale yield of greater than 70 percent to study material fatigue and fracture.

Improving sensor velocity and momentum by 40X will result in superior sensor performance, researchers say. If a commercial off-the-shelf gyroscope today can resolve the rotation rate of the Earth in 10 minutes, for example, a NIMBUS-enhanced gyroscope could do that job in less than a minute. Companies interested were asked to submit responses in December. Email questions or concerns to Sunil Bhave, the DARPA NIMBUS program manager, at NIMBUS@darpa.mil. More information is online at https://sam.gov/opp/4ecb49f774784c0e-a5e538348a3b6368/view. ◄

U.S. Navy photo.

ANTI-SUBMARINE WARFARE

▲ Sparton to provide 20,000 multistatic sonobuoys for anti-submarine warfare

U.S. Navy anti-submarine warfare (ASW) experts are replenishing their supplies of advanced multistatic air-launched sub-hunting sonobuoys that work together with other sonobuoys to detect, pinpoint, and track enemy submarines.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $107.1 million order to Sparton, an Elbit Systems of America company in De Leon Springs, Fla., for as many as 20,000 AN/SSQ-125 multistatic sonobuoys for airborne ASW operations.

Sonobuoys acquired under this contract are for annual training, peacetime operations, and testing, and to maintain sufficient inventory major naval combat operations.

The AN/SSQ-125 modified high-duty-cycle sonobuoys work together with the Navy's AN/SSQ series of sonobuoys, which consist of the SSQ-36 bathythermograph (BT); SSQ-53 passive directional low frequency analyze and record (DIFAR); SSQ-62 directional command active sonobuoy system (DICASS); SSQ-101 air deployed active receiver (ADAR); SSQ-110 multi-static non-coherent source; and SSQ-125 multi-static coherent source.

The AN/SSQ-125 sonobuoy is a source in a multistatic field, and can generate a variety of waveforms, and is designed to work with the AN/SSQ-53F, AN/SSQ-77C, and AN/SSQ-101 (ADAR) sonobuoys.

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

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

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The AN/SSQ-36B provides vertical temperature profiles of the ocean layer for ASW and research, and used

widely in ASW operations to evaluate local effects of sea-water temperature on sonar propagation and acoustic range prediction.

The AN/SSQ-53F uses four hydrophones — each one a multichannel directional piezoelectric ceramic trans-ducer — that operate at depths of 90, 200, 400, and 1,000 feet to listen for potentially hostile submerged enemy submarines. Aircraft can drop a pattern of sonobuoys, which relay information back to the aircraft by radio link, to determine the exact locations of enemy submarines.

The SSQ-53F has three sensors: a constant shallow omni (CSO), an advanced DIFAR sensor, and a calibrated wideband omni. The buoy digitally conditions and ampli-fies the acoustics and provides directional data that helps establish azimuthal bearing to the submarines being tracked.

The AN/SSQ-62E DICASS sonobuoy is for detecting and localizing submarines in preparation for attack. It can provide range and bearing to the target to fix position, and can support any of the four acoustic frequencies as selected via the Electronic Function Select.

The AN/SSQ-101 ADAR sonobuoy provides a com-mandable passive search capability, and functions as the receiver in a multistatic active receiver system. The device uses a pentagon-shaped horizontally oriented pattern of hydrophones to detect and beam form under-water sound waves.

The company will do the work on this contract in DeLeon Springs, Fla. and Columbia City, Ind., and should be finished by March 2026. For more information con-tact Sparton online at www.sparton.com, or Naval Air Systems Command at www.navair.navy.mil.

SENSORS
▶ Johns Hopkins to make Suprathermal Ion Sensors for NOAA space weather program

The National Aeronautics and Space Administration (NASA) has selected Johns Hopkins University's Applied Physics Laboratory in Laurel, Md., to develop Suprathermal Ion Sensors for the National Oceanic and Atmospheric Administration's (NOAA) Lagrange 1 (L1) Series project, part of NOAA's Space Weather Next Program.

The cost-plus-fixed-fee contract is valued at approxi-mately $20.5 million and covers the design and develop-ment of two sensors. Work under the contract is expected to continue through 31 Jan. 2034, at facilities in Maryland,

NASA's Goddard Space Flight Center in Greenbelt, Md., and Kennedy Space Center in Fla.

The scope of work includes designing, fabricating, inte-grating, and testing the instruments, along with ground support equipment. The contract also includes launch support and post-launch mission operations at NOAA's Satellite Operations Facility.

The Suprathermal Ion Sensors will provide critical data for NOAA's Space Weather Prediction Center, which issues forecasts, warnings, and alerts to mitigate the impacts of space weather events. These include disruptions to power grids, communication systems, and navigation networks.

The instruments will measure ions and electrons across a wide energy range, delivering continuous, real-time observations to aid in early detection of space weather events. They will also track solar phenomena such as cor-

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onal mass ejections, co-rotating interaction regions, and interplanetary shocks. This data will help estimate the arrival time and intensity of solar wind shocks.

NOAA manages the overall program, including fund-ing, operations, and data dissemination. NASA oversees the development, launch, and testing of the instruments and spacecraft in collaboration with commercial part-ners. The L1 Series is part of NOAA's efforts to enhance the nation's ability to monitor and respond to space weather threats.

▶ Honeywell to upgrade Navy airborne electronic warfare (EW) jammer with gallium nitride (GaN) technology

U.S. Navy airborne electronic warfare (EW) experts are asking Honeywell Aerospace for Low-Band Consolidation (LBC) transmitter modifications for the AN/ALQ-99 EW system aboard the carrier-based EA-18G Growler electronic attack jet.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $29.9 million order to Honeywell Aerospace for six 6 LBC modifications for the Navy and 16 LBC modifications for Australia in support of EA-18G Growler upgrades.

The ALQ-99 is an airborne integrated EW jammer designed and manufactured by EDO Corp., which since has been consolidated into L3Harris Technologies. Honeywell Aerospace acquired CAES — formerly known as Cobham Advanced Electronics Solutions — last September for $1.9 billion.

Honeywell is building EW transmitters with gallium nitride (GaN) technology for the ALQ-99, as well as an improved universal exciter upgrade (iUEU) that solves obsolescence problems with application-specific integrated circuit (ASIC) prototypes.

The ALQ-99 receiver and antennas are mounted in a fin-tip pod on the EA-18G, while jamming transmitters and exciter equipment are located in under-wing pods.

The system is designed to intercept, automatically process, and jam enemy RF signals from radio communications and radar. It also can detect, identify, and locate radio waves in a signals intelligence (SIGINT) mode.

The ALQ-99's low-band transmitter has replaced the ALQ-99's tactical jamming system in EW bands 1, 2, and 3, ranging from 20 MHz to 1 GHz. Building transmitters with GaN technology will enable the transmitters to include band 4, which operates from 1 to 3 GHz, and to consolidate several transmitters into one transmitter.

Honeywell also is mitigating obsolescence within the ALQ-99's transmitters, and updating the technology to use GaN materials for semiconductor power devices. The goal is not to increase the system's power output, but instead to address diminishing manufacturing sources, material shortages, and mitigate band 4 hardware inventory shortages.

On this order, Honeywell will do the work in Lansdale, Philadelphia, and Lancaster, Pa.; Patterson and Purchase,

U.S. Department of Defense photo

N.Y.; Woburn and Haverhill, Mass; Ventura, Calif.; and Shelton, Conn., and should be finished by May 2027.

For more information contact Honeywell Aerospace online at aerospace.honeywell.com, or Naval Air Systems Command at www.navair.navy.mil.

▼ Radiance Technologies to refine faster-than-real-time simulation for evolving military CONOPS

U.S. military researchers are asking Radiance Technologies Inc. in Huntsville, Ala., to continue it work to develop a faster-than-real-time system to enable senior military commanders to practice developing concepts of operations (CONOPS), composing force structures, allocating resources, and planning for technology insertion.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $49.3 million contract to Reliance Technologies for the fourth phase of the Secure Advanced Framework for Simulation and Modeling (SAFE-SiM) program.

The SAFE-SiM modeling and simulation architecture should enable military commanders to conduct theater-wide, multi-domain, mission-level modeling and simulation, from seafloor to space, including cyber and electromagnetic spectrum capabilities.

This contract asks Radiance to continue its phase-three SAFE SiM research, which is critical to meeting the DARPA,s joint all domain theater-wide analysis goals, DARPA officials say. Radiance won a $10.1 million contract SAFE-SiM contract in 2020, joining Cole Engineering Services Inc. in Orlando, Fla., on the project.

Over the past few decades, projecting military power has relied on complex capabilities to achieve results that

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separate weapon systems or segments of military power cannot handle.

U.S. military and intelligence modeling, furthermore, cannot provide the necessary support. Existing simulation and modeling typically is limited to specific mission areas, and are not well suited for interactions across the cyber, space, air, ground, and sea domains. Creating mission-level scenarios, moreover, is time consuming and requires specialized training.

The SAFE-SiM project is creating an intuitive modeling and simulation user interface for rapid scenario construction, advanced visualization capabilities, and analytical tools that enable broad analysis of simulated data for new and evolving CONOPS.

Radiance Technologies is developing theater-wide, multi-domain, mission level modeling; user interface; analytic and visual tools; and hardware and software solutions with multi-level security.

These information security tools should enable the system to ingest modeling and simulation data up to and including SECRET, TOP SECRET, SCI, and Special Access (SAP) classification levels through external network connections, rapid reconfigure the classification level of the modeling and simulation environment, and dynamically tailor analytical results several kinds of end users. On this contract, Radiance will do its SAFE-SiM work Huntsville, Ala.; Dayton, Ohio; Rome, N.Y.; Basking Ridge, N.J.; and Albuquerque, N.M., and should be finished by November 2026. ←

For more information contact Radiance Technologies online at www.radiancetech.com, or DARPA at www.darpa.mil.

TEST AND MEASUREMENT
▼ Lockheed Martin to provide 14 eCASS test components to troubleshoot and repair avionics

Aircraft test and measurement experts at Lockheed Martin Corp. will provide 14 more eCASS advanced combat avionics test instruments under terms of a $26.2 million order.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., are asking engineers at the Lockheed Martin Rotary and Mission Systems segment in Orlando, Fla., to build 14 electronic Consolidated Automated Support System (eCASS) RF mission equipment kits and 4 eCASS RF mission equipment kits integrated configuration.

The eCASS equipment is designed to help sailors and Marines to troubleshoot and repair aircraft assemblies at sea or ashore and return the avionics to service quickly.

The eCASS test equipment is replacing the Navy's legacy CASS test equipment originally fielded in the early 1990s. CASS is the Navy's standard automatic test equipment family supporting electronics on naval aircraft.

The first eCASS station went to the Navy in February 2014 to support all the aircraft in the Navy's fleet, extending to new weapons systems such as the F-35 Lightning II joint strike fighter.

The eCASS station is the workhorse for avionics repair across the naval aviation enterprise, Lockheed Martin

U.S. Navy photo

officials say. The test gear helps aircraft maintenance technicians return equipment to readiness status quickly and efficiently. Compatibility with legacy CASS stations preserves the Navy's investment in more than 550 test program sets supporting 750 avionic components.

The eCASS architecture is based on the Lockheed Martin LM-STAR commercial automated testing system that is designed to facilitate technology insertion and long-term supportability.

LM-STAR serves as the cornerstone of the F-35 Lightning II harmonization plan, which helps enable several different avionics manufacturers to develop tests to help electronics move from the factory floor to fleet maintenance depots, Lockheed Martin officials say.

On this contract Lockheed Martin will do the work in Orlando, Fla., and should be finished by April 2027. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com/us/rms.html, or the Naval Air Warfare Center Aircraft Division-Lakehurst at www.navair.navy.mil.

DATA STORAGE

▶ Mercury to supply data transfer units and removable storage for V-22 tiltrotor avionics

U.S. Navy combat aircraft avionics experts needed ruggedized data transfer units for versions of the U.S. and allied V-22 Osprey tiltrotor aircraft. They found their solution from Mercury Systems Inc. in Torrance, Calif.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced an $16.5 million order to Mercury for data transfer units, removable storage modules, and 51 docking station cables for V-22 tiltrotor aircraft.

Mercury Mission Systems (formerly Physical Optics Corp.) will provide five data transfer units, 102 removable storage modules, and 51 docking station cables U.S. Air Force CV-22 aircraft; 277 data transfer units, 554 removable storage modules, and 277 docking station cables in support of the V-22 Osprey for the Navy; 17 data transfer units, 34 removable storage modules, and 17 docking station cables for Japan.

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

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

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

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

USAF photo

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

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

On this order, Mercury will do the work in Torrance, Calif., and should be finished by February 2027. For more information contact Mercury Mission Systems online at www.mrcy.com/products/data-storage-and-transfer, or Naval Air Systems Command at www.navair.navy.mil.

TORPEDOES

▼ Progeny Systems to supply upgrade kits to improve anti-submarine hit performance of MK 54 torpedo

Undersea warfare experts at Progeny Systems, a General Dynamics Mission Systems business in Manassas, Va., will build kits to upgrade the MK 54 lightweight hybrid torpedo for surface ships and aircraft under terms of a $139.2 million contract.

Officials of the Naval Sea Systems Command in Washington are asking Progeny Systems to produce MK 54 Mod 1 lightweight torpedo kits and test equipment, spare parts, engineering, and hardware support. This contract has options that could increase its value to $808.6 million.

The MK 54 Mod 1 is the newest version of the Navy's MK 54 Lightweight Torpedo, which is the primary anti-submarine warfare (ASW) weapon for U.S. surface ships, fixed-wing aircraft, and helicopters. The MK 54 combines the advanced sonar transceiver of the MK 50 torpedo with the legacy warhead and propulsion system of the older MK 46. The MK 54 Mod 1 is scheduled for operational test and evaluation in 2020.

U.S. Navy photo

The MK 54 works together with the analog or digital combat control systems and software variants installed on all ASW fixed-wing aircraft, helicopters, and surface ship ASW torpedo tubes and rocket launchers. MK 46 and MK 50 torpedoes are converted to an MK 54 via an upgrade kit.

The MK 54 is for shallow-water environments and in the presence of countermeasures. It uses an expandable open-architecture system, and combines software algorithms from the MK 50 and MK 48 torpedo programs with commercial off-the-shelf technology.

Mission commanders employ naval surface ships and aircraft equipped with the MK 54 torpedo for offense when deployed from fixed-wing aircraft and helicopters, and or defense from surface warships.

The Navy developed the MK 54 Mod 1 upgrade to improve the MK 54's hit performance by increasing the torpedo's sonar array from 52 to 112 elements, providing higher resolution. Software upgrades are to improve target detection and enhance false target rejection.

The new torpedo's 112-element hydrophone front end, new processors, and new software are to improve the munition's detection, classifier, and tracker performance for use on surface ships and aircraft. The MK 54 Mod 1 torpedo is for use in open-ocean deep water and for shallow-water littoral environments against fast deep-diving nuclear submarines and slow-moving quiet diesel-electric submarines.

The MK 54 has better performance than the Mark 46 in shallow-water, and reduces the costs of the Mark 50 torpedo with commercial off-the-shelf (COTS) components. Navy submarines use advanced versions of the larger Mark 48 heavy torpedo.

The MK 54 can be fired from surface ships via the Mark 32 surface vessel torpedo tubes or the vertical launch anti-submarine rocket (ASROC) systems, and also from most ASW aircraft, although they are slightly different lengths and weights.

The contract calls for Progeny Systems to produce MK 54 Mod 1 torpedo kits for the U.S. Navy, as well as for U.S. allies. Progeny Systems will do the work in Canonsburg, Pa.; Salt Lake City; Andover, Mass.; Bloomington, Ind.; Manassas, Va.; and Port Orchard, Wash., and should be finished by December 2027. Options could continue work through December 2033.

For more information contact Progeny Systems online at https://gdmissionsystems.com/sea/progeny-systems, or Naval Sea Systems Command at www.navsea.navy.mil. ←

▼ Embedded computing systems with cyber security introduced by General Micro Systems

General Micro Systems Inc. (GMS) in Rancho Cucamonga, Calif., is introducing four cross-domain systems: an airborne 3-domain system; two ground-based systems, and a 1/4 ATR OpenVPX system for mission processing, secure storage and authentication, encryption, networking, and options for SATCOM, AI and data diodes. Each system supports the GMS Enhanced SecureDNA cyber security suite and will be TEMPEST certified. This lightweight compact form factor combines four customizable airborne and ground-based

cross-domain systems by GMS, and provides secure gigabit battlefield communications between secure, classified, and insecure communications links. Different from multi-domain Red/Black systems, cross-domain systems provide the gateway between secure classified systems and insecure-often public-systems and networks. These embedded computing systems offer higher levels of security than multi-domain, such as via data diodes for rules-based routing, and beefier crypto and sanitization for data-at-rest within storage devices. Generically and insufficiently called Red/Black systems, the U.S. Department of Defense SIPR (classified) and NIPR (unclassified) networks co-exist because data often must transit between U.S. allies and disparate networks, and often travels across public networks like Wi-Fi, 5G cellular, and satellite communications. The cross-domain system filters the data, makes decisions about what data can pass between the domains, and encrypts/de-crypts data

on-the-fly and at-rest on storage drives-all in real time. For more information contact General Micro Systems online at www.gms4sbc.com.

▼ MANET radio module for uncrewed communications networking introduced by Silvus

Silvus Technologies Inc. in Los Angeles is introducing the StreamCaster LITE 5200 (SL5200) next-generation mobile ad-hoc network (MANET) radio module. Designed for uncrewed systems, the SL5200 unifies command and control, sensor, and telemetry data with communications relay capabilities in a 52-gram easy-to-integrate MANET radio module. The MANET radio communications networking module offers as much as 2 Watts of native output power — or 4 Watts of effective power — and as much as 100 megabits per second data rate. It has several I/O interface options, and is designed for tactical unmanned systems and other small embedded applications. At the heart of the SL5200 is the Silvius proprietary MN-MIMO waveform that can link hundreds of nodes in any operational environment, and enables operators to connect several different unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs), and unmanned sur-

face vessels (USVs), as well as sensors, personnel, and manned and unmanned platforms through one massively scalable mesh network. The SL5200 is compatible with 4000-series StreamCaster MANET radios, ensuring interoperability across a diverse range of applications. In

addition to AES256 and FIPS 140-3 encryption for secure operations, the SL5200 provides available access to the Silvius Spectrum Dominance expansive suite of LPI/LPD and Anti-Jamming resiliency capabilities. For more information contact Silvius Technologies online at https://silvustechnologies.com.

TEST AND MEASUREMENT

▼ Portable test and measurement system for handheld radio offered by Astronics

The Astronics Corp. test systems segment in Orlando, Fla., is introducing the ATS-6100 handheld radio test set for military tactical radios. The ATS-6100 offers more than 19 instruments to detect faults and verify the readiness of radio communications across all deployment levels. The ATS-6100 several kinds of communications systems, including SINCGARS, SRW, WNW, and HAVEQUICK.

Astronics also offers a library of test program sets for tactical radios from virtually any Original Equipment Manufacturer (OEM). The software-driven radio test and measurement system can accommodate future waveform upgrades, and its Windows 10-based user interface features guided test scripts to enable automated testing of tactical radios. "This next-gen handheld radio test solution empowers users on the front lines, or in any critical location, with testing capabilities to ensure the performance of their essential communications systems," says Jim Mulato, president of Astronics Test Systems. For more information contact Astronics online at www.astronics.com/subsidiary?subsidiaryItem=astronics%20test%20systems.

ADHESIVES AND ENCAPSULANTS

▼ Two-part epoxy adhesive that acts as an electrical insulator introduced by Master Bond

Master Bond Inc. in Hackensack, N.J., is introducing the EP21ARHTND-2 two-part epoxy adhesive that will withstand prolonged exposure to a wide range of chemicals. The EP21ARHTND-2 two-part epoxy adhesive is a reliable electrical insulator with a volume resistivity greater than 1014 ohm-cm at 75 F, and dielectric strength of 440 volts/mil at 75 F for a 1/8-inch test specimen. The
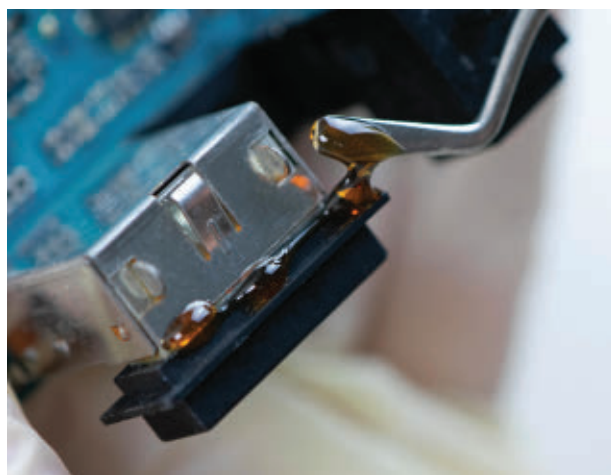
system's chemical resistance was tested in chemicals such as 98 percent sulfuric acid, 25 percent hydrochloric acid, 20 percent phosphoric acid, and 15 percent nitric acid, by soaking cured samples for more than 12 months, says Rohit Ramnath, senior product engineer at Master Bond. The EP21ARHTND-2 also passes the damp heat reliability testing by withstanding 1000 hours of 85 degrees Celsius and 85 percent relative humidity. Other noteworthy properties include a tensile strength of 9,000-10,000 psi, and a Shore D hardness of 75-85. The adhesive provides good heat resistance and is serviceable from -60 F to 400 F. Although EP21ARHTND-2 can cure at room temperature, a cure schedule of overnight at ambient temperatures, followed by a heat cure of 150 to 200 degrees Fahrenheit for two to four hours or longer is typically recommended to optimize its acid resistance. EP21ARHTND-2 does not contain solvents and is RoHS compliant. The product bonds well to metals, ceramics, composites, rubbers, and plastics. It features a smooth paste-like consistency and will not flow or sag once applied, so it is suitable for bonding

and sealing. It comes in half-pint, pint, quart, and gallon containers. For more information contact Master Bond online at www.masterbond.com.

EMBEDDED COMPUTING

▼ Curtiss-Wright, DDC-I eye embedded computing real-time safety-certifiable avionics

Two U.S. embedded computing companies are working together to introduce computer hardware and real-time software for safety-certifiable multi-core computing in avionics applications. The Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va., is collaborating with DDC-I Inc. in Phoenix on Future Airborne Capability Environment (FACE)-conformant DO-178C/ED-12C Design Assurance Level A (DAL A) avionics. The Curtiss-Wright rugged V3-1708 single-board computer with off-the-shelf AC 20-152A DAL A certification packages is combining with DDC-I's Deos configurable multi-core real-time operating system (RTOS) for new safety-certifiable avionics. Deos partitions the L2 and L3 cache memory on the V3-1708's NXP LX2160A Arm Cortex A72 system on chip (SoC) processor on a core and application basis. This provides a dedicated isolated region of L2 and L3 cache and speeds real-time software performance by eliminating cache flushing or processor core access the main memory, memory bus, or mem-

ory controller. The V3-1708 3U VPX processor module brings the high-core-count NXP LX2160A Arm Cortex A72 system-on-chip (SoC) processor to rugged deployed DO-254 DAL A safety-certifiable applications. The NXP LX2160A features 16 A72 cores for compute-intensive applications such as flight control computers, mission control, and primary flight displays. For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com/products/computing/processors/3u-vpx/vpx3-1708-v3-1708, or DDC-I at www.ddci.com/solutions/products/deos.

RF AND MICROWAVE

▼ Radar MMIC for autonomous land vehicles sense-and-avoid introduced by Infineon

Infineon Technologies AG in Munich is introducing the
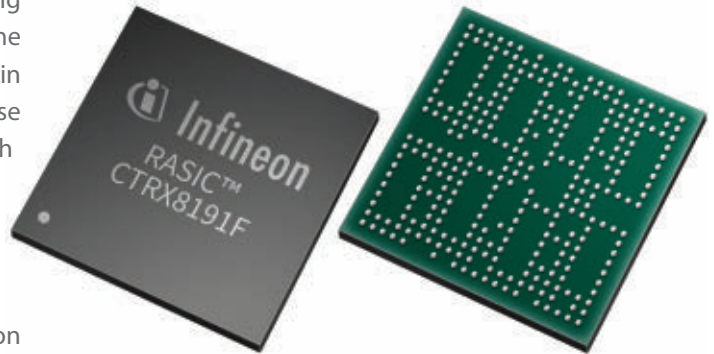
RASIC CTRX8191F state-of-the-art 28-nanometer radar monolithic microwave integrated circuit (MMIC) for land vehicle radar that helps enable SAE-defined L2+ to L4 automated and autonomous driving. The CTRX8191F helps land vehicles use radar to detect vulnerable road users and vehicles at distances as long as 415 yards using system configurations with eight transmitters and eight receivers. The radar MMIC enables cascading of several devices at low frequencies, reducing the need for expensive RF materials on the circuit board. In addition, the CTRX8191F features an optimized launcher-on-package design for low-cost waveguide antennas. Infineon offers a radar development kit called CARKIT to facilitate the rapid design and deployment of radar systems. CARKIT is based on the CTRX8191F sensor prototyping module, which supports various system configurations, including the transmission of raw A/D converter data, FFT intermediate results, or radar detections via a Gigabit Ethernet interface. Also included is a waveguide antenna that can be replaced with a custom antenna. Several versions of CARKIT are available, including a next-generation 4D front radar configuration with eight transmitters and eight receivers, and a cost-effective corner/front radar solution for the standard market with four transmitters and four receivers. For more information contact Infineon Technologies online at www.infineon.com/cms/en/product/sensor/radar-sensors.

POWER ELECTRONICS

▶ AC-DC power supplies for industrial and communications applications offered by TDK-Lambda

TDK-Lambda Americas Inc. in San Diego is introducing the TDK-Lambda HWS-A family of AC-DC power supplies with push-in wire terminations for industrial and communications equipment, factory automation, and semiconduc-

tor fabrication. The HWS-A/E models are available with vertical or horizontal terminals to simplify cable harnessing. The terminal levers enable the insertion of wires and ferrules without tools. The HWS-A/E series power supplies accepts an 85-to-265-volt AC input, withstanding a peak voltage of 300 volts AC for five seconds. Push-in terminal options are available for 12-, 15-, 24-, and 48-volt outputs and 50-, 100-, and 150-Watt models. All AC-DC power supply models are certified to IEC / EN / UL / CSA 62368-1, IEC / EN 62477-1 (OVC III) and UL 508, with CE and UKCA marking to the Low Voltage, EMC, and RoHS Directives. For more information contact TDK-Lambda online at https://www.tdk.com/en/index.html.

TRUSTED COMPUTING

▶ Encryption and cyber security for Linux embedded computing software introduced by SYSGO

SYSGO GmbH in Klein-Winternheim, Germany, is introducing Trusted Platform Module (TPM) support in the embedded computing Linux development software ELinOS to enable advanced cryptographic services for embedded security. The integration of TPM trusted computing capability enables advanced cryptographic services and provides hardware-based security features that enhance secure boot processes, file encryption, and system integrity. TPM, a dedicated crypto-processor chip embedded in the system's main board, stores cryptographic

keys, provides cryptographic services such as random number generation, and enables developers to build secure embedded computing systems. ELinOS provides TPMv2 tools and libraries, and enables secure automatic encryption of hard disks. The decryption keys are stored and retrieved securely from the TPM during system boot. TPM also includes tools to manage board-specific devices. TPM support is available as part of ELinOS 7.2.1. For more information contact SYSGO online at https://www.sysgo.com/elinos.

RF & MICROWAVE

▶ Thin-film bandpass filters for military radio and radar offered by KYOCERA AVX

KYOCERA AVX Components Corp. in Fountain Inn, S.C., is introducing the BP1206 and BP2816 series thin-film bandpass filters for military and handheld radios, radar systems, wireless networking, and test equipment. Designed to satisfy demand for small, high-power bandpass filters in RF and microwave applications, the BP1206 and

BP2816 series bandpass filters use multilayer integrated thin-film (ITF) technology to deliver RF performance with low insertion loss, steep attenuation, sharp roll-off, low-noise, and high temperature stability. Both series also enable the quick and easy adjustment of RF parameters and feature ruggedly constructed compact low-profile cases equipped with lead-free solder-coated-nickel land grid array (LGA) terminations. These devices are compatible with automated assembly processes such as reflow, wave, and vapor phase soldering. The BP1206 and BP2816 series thin-film bandpass filters exhibit 8 Watts of continuous power handling and 50 Ohms characteristic impedance. They are rated for operating temperatures from -40 to 85 degrees Celsius. The BP1206 series features a miniature 1206 case, and supports frequencies from 1,250 to 6,100 MHz with in-band performance, and exhibit out-of-band rejection values spanning -25 to -40 decibels. The BP2816 series supports frequencies from 240 to 1,260 MHz. They also exhibit in-band performance and out-of-band rejection values from -20 to -45dB. For more information contact KYOCERA AVX online at www.kyocera-avx.com.

POWER ELECTRONICS
▼ High-reliability power bus conditioner for military and aerospace uses introduced by Gaia

Gaia Converter in Le Haillan, France, is introducing the high-reliability FLHG-60 multi-function bus conditioner module for military and aerospace distributed power systems. The FLHG-60 has a 60-Watt-input front-end that

enables and speeds the construction of high-reliability power architectures for 24- and 2-volt military and avionics applications. The FLHG-60 features include ultra-wide input range of 12 to 100 volts DC; an input EMI filter

that complies with MIL-STD-461 or DO160 standards; an input spike & surge limiter to comply with MIL-STD-704, MIL-STD-1275, ABD100, and DO160 over-voltages; reverse polarity protection; soft start functionality; hold-up function; inrush current limiting; shielded metal case construction. By combining many essential functions, the FLGH-60 replaces individual input stage components such as filters, voltage limiter, reverse polarity protection, inrush current limiter and hold-up modules. The bus conditioner module measures 1.58 by 1.03 by 0.32 inches, and allows for a drastic reduction in space as well as simplifying the overall power architecture design. For more information contact Gaia Converter online at www.gaia-converter.com.

SAFETY-CRITICAL COMPUTING
▲ STMicro offers microcontrollers and Rust compilers for safety-critical applications

STMicroelectronics in Geneva is teaming with HighTec EDV-Systeme GmbH Saarbrücken, Germany, to accelerate development of safety-critical microcontrollers and software to make software-defined vehicles safe and affordable. The solution supports the Rust programming language and combines HighTec's Rust software programming language compiler, qualified to ISO 26262 ASIL D, with STMicro's Stellar 28-nanometer microcontrollers certified to the same safety standard. Rust is gaining significant momentum in the automotive industry for its strong safety and reliability features. This provides for safety-critical automotive software development. The integration of the ASIL D qualified Rust compiler into the Stellar microcontroller family

accelerates the development of safety-critical systems, reducing time-to-market while maintaining strict compliance with automotive safety requirements. The STMicro and HighTec cooperation helps developers integrate Rust with C/C++ code into safety-critical projects with Stellar and accelerate the development of safety-critical systems, reducing time-to-market while maintaining strict compliance with automotive safety and security requirements. STMicro's Stellar automotive microcontrollers are built on Arm Cortex-R52+ cores and a robust safety-focused hardware architecture. They achieve an ISO 26262 ASIL D certification, and adhere to ISO 21434 cyber security standards and comply with UN155 requirements. For more information contact STMicroelectronics online at www.st.com, or HighTec EDV-Systeme at https://hightec-rt.com/rust.

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▲ Participating companies will develop solutions that mitigate and recover from irregular operations events. These prototypes will be tested in a lab environment.

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RTX Collins Aerospace looks for collaboration with small- and medium-sized businesses

BY **Jamie Whitney**

BENGALURU, India–Collins Aerospace, an RTX business in Cedar Rapids, Iowa, has launched the 2025 edition of its Powered by Collins Initiative at Aero India in Bengaluru. The program invites small- and medium-sized deep tech enterprises to collaborate on aerospace and defense technologies.

Collins says that this year's focus areas include real-time airport operating conditions, quantum-enabled navigation, and material informatics. Selected businesses will participate in funded rapid-development demonstration programs aimed at accelerating solutions for active aerospace and defense projects.

Regarding real-time airport conditions, Collins said participating companies will work with its connected aviation systems team to develop solutions that mitigate and recover from irregular operations events. These prototypes will be tested in a lab environment.

For quantum-enabled navigation, Collins seeks partners to enhance positioning, navigation, and timing (PNT) capabilities for commercial aircraft in adverse conditions. "As we continue to evolve our products to meet the needs of the changing global environment, we are looking to collaborate with sensor, sensor fusion, and novel PNT algorithm technology providers utilizing quantum-based technologies," the company stated.

In material informatics, Collins is looking for collaborators to use

computational tools to develop advanced polymer composites for aerospace applications. "Leveraging AI, integrated computational materials engineering, and data analytics, such providers will work with our advanced materials and methods team to integrate their solutions with our aerospace product requirements and validate the optimized solutions experimentally," the company said.

Since its inception in 2023, the Powered by Collins Initiative has engaged companies in aerospace, defense, and adjacent industries. This year, Collins is expanding the program by launching the Powered by Collins ecosystem on SwitchPitch, an online platform that connects startups with enterprises, investors, and technology accelerators.

"Innovation and Collins' technology development needs are constantly evolving, and the Powered by Collins Ecosystem serves as a complement to our existing collaboration network, enabling Collins business teams to engage potential solution providers throughout the year," said Mary Lombardo, vice president of Advanced Technology at Collins. "We believe this will unlock even more dynamic collaboration and rapidly provide solutions to meet our customers' needs."

More information is available at https://www.collinsaerospace.com/poweredbycollins. ←

NASA's VIPER (Volatiles Investigating Polar Exploration Rover) sits outside a testing chamber after completing its thermal vacuum testing in the fall of 2024.

NASA seeks proposals for VIPER lunar rover partnership

BY **Jamie Whitney**

WASHINGTON–The National Aeronautics and Space Administration (NASA) announced it is seeking proposals from United States companies for a Lunar Volatiles Science Partnership to support its VIPER [Volatiles Investigating Polar Exploration Rover] mission on the Moon as part of the Artemis campaign. The mission aims to demonstrate the ability to search for ice and collect scientific data on the lunar surface.

The announcement for the Partnership Proposal provides instructions and evaluation criteria for submissions, which are due 3 March 2025. Following an initial review, selected respondents must submit a more detailed proposal. NASA expects to decide on the VIPER mission this summer.

"Moving forward with a VIPER partnership offers NASA a unique opportunity to engage with the private sector," said Nicky Fox, associate administrator in the Science Mission Directorate

at NASA Headquarters in Washington. "Such a partnership allows NASA to collect VIPER science that could tell us more about water on the Moon while advancing commercial lunar landing capabilities and resource prospecting possibilities."

Under a Cooperative Research and Development Agreement, NASA will contribute the existing VIPER rover as-is., At the same time, potential partners are responsible for integrating it, ensuring a successful lunar landing, conducting a science and exploration campaign, and openly sharing the data collected. Partners may not disassemble the rover to use its instruments or components separately from the VIPER mission.

"Being selected for the VIPER partnership would benefit any company interested in advancing their lunar landing and surface operations capabilities," said Joel Kearns, deputy associate administrator for exploration in the Science Mission Directorate. "This solicitation seeks proposals that clearly describe what is needed to land and operate the rover successfully and invites industry to propose their own complementary science goals and approaches. NASA is looking forward to partnering with U.S. industry to meet the challenges of performing volatiles science in the lunar environment."

NASA previously issued a Request for Information on 9 August 2024, seeking interest from American companies and institutions after the VIPER program was canceled in July 2024. The agency said any partnership would operate under terms that allow both NASA and its industry partner to contribute services, technology, and hardware to the mission.

Additional information is available at https://science.nasa.gov/lunar-science/volatiles-partnership/. ←

New open-systems standard for high-performance I/O on the horizon small embedded computing

BY **John Keller**

SAN ANTONIO, **Texas** – The embedded computing industry is on the verge of a new open-systems standard for small-form-factor high-performance I/O for military, industrial, and commercial aviation applications.

The VITA 93 QMC standard, soon to be released, will be for small-form-factor embedded computing architectures such as VNX and VITA 90 VNX+, which are credit card-sized computer boards, as well as for the emerging VITA 100 standard, expected sometime next year, which will involve 3U, 6U, and perhaps other form factors, and is expected to replace and augment OpenVPX embedded computing.

▲ The emerging VITA 93 standard is for small-form-factor high-performance I/O for military, industrial, and commercial aviation applications.
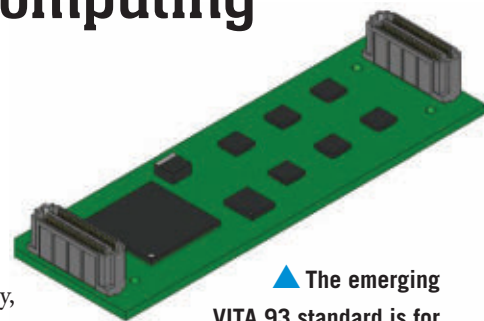
VITA 93 QMC is scalable, designed from the ground-up to be rugged enough for military, aviation, industrial, and rail applications. "It's a small-form-factor I/O mezzanine card, with the same concept as XMC, but in a smaller package," says Mark Littlefield, director of systems products at Elma Electronic in Fremont, Calif.

Littlefield made his comments Monday at the Embedded Tech Trends conference in San Antonio, Texas. QMC will have conduction- and convection-cooled versions, yet will be able to mix-and-match conduction and convection cooling in the same enclosure.

One of the goals QMC is to support other embedded computing form factors, such as VME, CompactPCI, CompactPCI Express, and PCI Express edge finger modules, Littlefield says. "It's all about expansion — adding I/O ports to the modules for functionality and storage."

Among the expected applications for QMC are autonomous vehicles, edge computing, and artificial intelligence, Littlefield says. Some of the first designs for QMC will be as replacements for MIL-STD-1553 and CAN bus data interconnects.

Littlefield adds that QMC also could be a replacement for commercial aviation databuses such as ARINC-429. "I see no reason that ARINC 429 couldn't be part of this evolution," Littlefield says, adding that he sees no significant issues of certifying QMC for military and commercial applications. ←

NASA announces contract awardees for lunar logistics and mobility technologies

BY **Jamie Whitney**

WASHINGTON–The National Aeronautics and Space Administration (NASA) announced that the agency has awarded $24 million in contracts to nine U.S. companies across seven states to develop strategies and technologies for managing logistical challenges on the lunar surface. These awards are part of the Next Space Technologies for Exploration Partnerships (NextSTEP-2) Appendix R program, which supports the Artemis campaign and the agency's broader Moon to Mars architecture.

"These contract awards are the catalyst for developing critical capabilities for the Artemis missions and the everyday needs of astronauts for long-term exploration on the lunar surface," said Nujoud Merancy, deputy associate administrator of NASA's Strategy and Architecture Office. "The strong response to our request for proposals is a testament to the interest in human exploration and the growing deep-space economy. This is an important step to a sustainable return to the Moon that, along with our commercial partners, will lead to innovation and expand our knowledge for future lunar missions, looking toward Mars."

The selected companies are tasked with exploring logistics and mobility solutions to address the complex challenges of operating in the lunar environment. Projects include developing advanced robotics, autonomous capabilities, and other innovative approaches to support long-term lunar exploration.

The awarded companies and their project focus areas are:

- **Blue Origin, Merritt Island, Fla.** – logistical carriers; logistics handling

▼ Artist's rendering of astronauts managing logistics on the lunar surface.

and offloading; logistics transfer; staging, storage, and tracking; surface cargo and mobility; and integrated strategies.

- **Intuitive Machines, Houston** – logistics handling and offloading; and surface cargo and mobility.
- **Leidos, Reston, Va.** – logistical carriers; logistics transfer; staging, storage, and tracking; trash management; and integrated strategies.
- **Lockheed Martin, Littleton, Colo.** – logistical carriers; logistics transfer; and surface cargo and mobility.
- **MDA Space, Houston** – surface cargo and mobility.
- **Moonprint, Dover, Del.** – logistical carriers.
- **Pratt Miller Defense, New Hudson, Mich.** – surface cargo and mobility.
- **Sierra Space, Louisville, Colo.** – logistical carriers; logistics transfer; staging, storage, and tracking; trash management; and integrated strategies.
- **Special Aerospace Services, Huntsville, Ala.** – logistical carriers; logistics handling and offloading; logistics transfer; staging, storage, and tracking; trash management; surface cargo and mobility; and integrated strategies.

The Exploration Systems Development Mission Directorate (ESDMD) oversees the NextSTEP-2 Appendix R program, focusing on several core objectives. These include identifying innovative logistics and mobility strategies, evaluating the maturity and feasibility of proposed technologies, and generating data to validate requirements and inform operational concepts.

This initiative also seeks to uncover synergies between logistics and mobility capabilities and address gaps in commercial offerings. ⬅

JetZero selects RTX companies to lead engine integration and supply power units for its BWB aircraft

▲ **JetZero Z4 jetliner.**

BY **Jamie Whitney**

ARLINGTON, Va.–RTX in Arlington County, Va. announced it has signed three agreements with JetZero in Long Beach, Calif., to supply key systems for the company's full-scale blended wing body (BWB) aircraft demonstrator.

Under the agreements, RTX subsidiaries Pratt & Whitney, Pratt & Whitney Canada, and Collins Aerospace will provide propulsion and structural components. Pratt & Whitney will integrate its PW2040 engine and auxiliary power unit, while Collins Aerospace will develop the nacelle and propulsion mounting structure.

"The aviation industry is focused on efforts to reduce operational costs by improving fuel efficiency, and RTX has an extensive portfolio of technologies to help companies like JetZero do just that," said Juan de Bedout, RTX's chief technology officer.

JetZero's blended wing design aims to cut fuel consumption by 50% compared to conventional aircraft. The company plans to begin test flights in 2027.

Dan da Silva, JetZero's chief operating officer, said securing propulsion system

partnerships marks a major step toward bringing the demonstrator from design to testing. "We welcome these industry-leading suppliers to the program and are inspired to see the industry's investment and belief in the blended wing airplane," he said.

Pratt & Whitney's PW2040 engine, part of the PW2000 family, generates 37,000 to 43,000 pounds of thrust and powers the Boeing 757 and its military derivative, the C-17 Globemaster III. The company will also supply the APS3200 auxiliary power unit, which has been used in nearly 3,800 aircraft.

Collins Aerospace will design and build nacelle structures, including inlets, fan cowls, fan ducts, fairings, and engine support structures. The company has supplied nacelles for aircraft such as the Boeing 787, Airbus A350, and A320neo.

JetZero's demonstrator is expected to validate technologies for commercial, cargo, and military applications, including a potential future aerial refueling tanker.

The BWB company also announced it was working with Delta Air Lines in Atlanta on development of the aircraft. JetZero received a U.S. Air Force grant in 2023 to develop a full-scale demonstrator, with a test flight planned for 2027. Delta will provide operational expertise through its Sustainable Skies Lab. ⬅