High-energy laser sources for counter-UAVs PG. 5

Rugged computers PG. 23

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Contents

JANUARY 2023
VOL. 34, NO. 1

Features

Columns

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Navy's latest CANES contract for computer and networking equipment more than likely to generate industry protests

BY **John Keller**
EDITOR IN CHIEF

The U.S. Navy in December awarded a collective $4.1 billion contract to eight companies to provide computers and networking equipment for cyber warfare over the next decade for surface warships and submarines.

It's part of the Consolidated Afloat Networks and Enterprise Services (CANES) project to provide computer hardware, software, spare parts, maintenance, and laboratory equipment for ships and submarines.

The companies taking part in this contract are BAE Systems Technology Solutions & Services Inc. in Rockville, Md.; Leonardo DRS Naval Electronics in Johnstown, Pa.; Global Technical Systems in Virginia Beach, Va.; L3Harris Technologies C5 Integrated Systems in Camden, N.J.; Leidos in Reston, Va.; Peraton in Herndon, Va.; Serco in Herndon, Va.; and VTG Milcom in Virginia Beach, Va. These companies will compete for orders over the next 10 years for CANES production units; software; software renewals; software maintenance; spares and system components; and lab equipment.

Conspicuously absent are General Dynamics C4 Systems, Northrop Grumman Corp., CGI Federal, and others that in the past have had a piece of CANES contracts. CANES will consolidate and replace existing afloat networks and networking infrastructure for applications, systems, and services for tactical cyber warfare. It will upgrade cyber security, command and control, communications and intelligence systems afloat, and replace unaffordable and obsolete networks.

The Northrop Grumman Corp. Information Systems segment in San Diego (now Northrop Grumman Mission Systems) was chosen in early 2012 to be the overall CANES shipboard electronics systems architect

CANES represents a critical component of the Navy's modernization planning by upgrading cyber security, command and control, communications, and intelligence systems afloat. The increased standardization will reduce the number of network variants by ship class across the fleet, Navy officials say.

A contract worth this much money could generate protests that could halt work temporarily until protest claims are sorted out -- just like the contracts that were awarded originally in 2014. We'll see how long the CANES project will be held up this time if protests come to pass.

The primary goals of the CANES program are to provide a secure afloat network for naval and joint operations; consolidate afloat networks using a common computing system; mature cross-domain computer technologies; reduce the size, training requirements, and logistics for shipboard networking; and increase reliability, security, interoperability, and application hosting.

CANES serves as the bridge to the future of Navy afloat networks, consolidating existing legacy and stand-alone networks, providing infrastructure for tactical applications, systems, and services, Navy officials say. CANES will consolidate and modernize shipboard network systems to improve operational effectiveness and affordability across the fleet.

CANES delivers its capabilities within one system, bringing infrastructure that will enable timely and interoperable information exchange among tactical, support, and administrative users, applications, and computer systems.

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General Atomics to design heavy-lift seaplane for operations in rough seas

BY John Keller

ARLINGTON, Va. – U.S. military researchers needed a futuristic seaplane able to operate in rough seas for weeks at a time, and carry payloads as heavy as 45 tons for distances between 4,000 and 6,500 miles. They found their solution from General Atomics Aeronautical Systems Inc. in Poway, Calif.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced an $8 million contract to General Atomics for the Liberty Lifter program to develop a heavy-lift, long-range seaplane that operates efficiently at very low altitudes in ground effect.

▲ General Atomics engineers will design a heavy-lift, long-range seaplane for operations in rough seas that offers aerodynamic efficiently at very low altitudes in ground effect.

For the Liberty Lifter project, General Atomics will focus on designing a seaplane with extended maritime operations in high sea states that is affordable to produce, and that involves complex flight and sea surface controls.

The Liberty Lifter long-range seaplane will provide smooth operations in ground effect in waves that are four to eight feet high. Ground effect describes the added aerodynamic buoyancy produced by a cushion of air below an aircraft moving closely to the ground or surface of the water.

General Atomics will try to achieve smooth flight while flying over waves as high as eight to 13 feet, with high lift at low speeds to reduce wave impact loads during takeoff and landing in waves from 4 to 8 feet high. The seaplane is expected to accommodate wave impact loads and be able to operate in high-traffic areas, and operate at sea for weeks at a time with long periods between land-based maintenance.

DARPA researchers are emphasizing low cost, easy-to-fabricate designs, with Liberty Ship-style manufacturing. The seaplane also should have complex aero and hydrodynamic interactions during takeoff and landing, with advanced sensors and controls to avoid rogue wave impacts.

The Liberty Lifter seaplane should be able to take off and land in waves from four to eight feet high; fly in ground effect above waves from 8 to 13 feet high; fly at altitudes from ground effect to 10,000 feet, and operate for four to six weeks at a time carrying payloads of at least 90 tons.

On-water amphibious payload deployment and retrieval should be via nose and tail ramps; the seaplane should be able to carry at least two U.S. Marine Corps Amphibious Combat Vehicles, and cargo in 20-foot container units.

General Atomics designers will use high-performance computing and multi-disciplinary analysis and optimization tools to model and analyze complex aerodynamic and hydrodynamic interactions; focus on affordable design and manufacturing approaches; use novel manufacturing approaches; and use industry best practices from commercial high-speed vessels.

The program consists of a three-phase developmental cycle with each phase building on the previous phase. For more information contact General Atomics Aeronautical Systems online at www.ga-asi.com, or DARPA at www.darpa.mil.

Northrop Grumman to develop affordable high-energy laser sources for counter-unmanned uses

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers are asking Northrop Grumman Corp. to develop affordable high-energy laser sources for future laser weapons that can destroy or disable enemy unmanned aerial vehicles (UAVs).

▲ The DARPA MELT program seeks to develop a semiconductor laser source with beam quality sufficient to create a small, mass-producible, and scalable laser source.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have announced a $7.8 million two-year contract to Northrop Grumman in Redondo Beach, Calif., for the Modular Efficient Laser Technology (MELT) program.

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

MELT aims to capitalize on technologies such as semiconductor fabrication techniques, coherent beam combining, photonic integration, and 3D integration and packaging. Today's laser weapons that use multiple beam-combined high-power fiber amplifiers as the high-energy laser sources, as well as large complex optical subsystems that condition and project the laser beam do not scale well, DARPA researchers say.

On the other hand, coherent beam combined tiled array high-energy laser sources are scalable because they eliminate these large subsystems.

Coherently beam combined tiled arrays offer a path to better high-energy laser sources because of the ability to generate and project the laser beam directly without bulk optics; the intrinsic scalability of a tiled array with no inherent limits; the ability to perform non-mechanical beam steering for beam jitter corrections; and the ability to apply complex phase corrections to compensate for atmospheric disturbances.

The proliferation of small, low-cost unmanned aerial vehicles (UAVs) on the battlefield requires a layered defense that includes low-cost laser weapons. The deep magazines of laser weapons are suited to counter swarms of hostile UAVs, and have the potential to achieve very low operating cost — assuming

low production costs can be achieved. Counter-UAV and similar applications need a broad range of power levels from a few kilowatts to megawatts, which isn't possible today.

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

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

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

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

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

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

On this contract Northrop Grumman will do the work in Redondo Beach and Goleta, Calif., and should be finished by October 2024. For more information contact Northrop Grumman online at www.northropgrumman.com/what-we-do/air/directed-energy, or DARPA at www.darpa.mil/program/modular-efficient-laser-technology.

Alaska Airlines launches electronic "bag tag" program

Alaska Airlines officials say they hope to offer all their passengers the opportunity to skip the line at the baggage check counter. The airline is the first in the U.S. to launch an electronic bag tag program. Alaska will using software and hardware from a Dutch company called BAGTAG. Several major international airlines such as Lufthansa, KLM, and China Southern, currently use BAGTAG's electronic bag tag technology. But will it become widely adopted here in the U.S.? The device enables passengers to tag their own luggage through Alaska's mobile app, provided that the carrier has selected them and sent them an electronic "bag tag." Paired with a smartphone, the bag tag will be updated with pertinent flight and passenger information to help travelers head straight to the baggage drop area. The Alaska Airlines electronic bag tag is estimated to reduce the time guests spend in airport lobbies by about 40 percent, including reducing lines and the use of paper bag tags. In addition to the device's lifespan and durability, the devices don't require charging or batteries. Alaska Airlines employees tested its ruggedness by running it over with a truck.

United Airlines invests in battery maker to electrify ground operations

United Airlines has announced a partnership with battery manufacturer Natron Energy to reduce the carbon footprint of United's ground operations. Company officials say they believe that with Natron's latest advancements in battery technology, the partnership will build a safer and more sustainable future. United has more than 12,000 pieces of motorized ground equipment across its operations, of which about one third are currently electric. Natron's batteries could potentially be deployed in support of a number of uses, including: Charging electric ground equipment Charging anticipated future electric aircraft such as electric air taxis Allowing airport operations to manage electricity demand Greatly improving resiliency related to inclement weather. The sodium-ion batteries contain several features that distinguish them from existing battery technology. In addition to better output and cycle life than their lithium counterparts, testing performed by an independent testing service has shown these batteries to be nonflammable, a critical safeguard for the high usage and power that would be required for certain operations. The minerals used in sodium-ion batteries are abundant worldwide and are easily sourced, unlike lithium which is in short supply with demand expected to triple by 2025. Launched in 2021, UAV is a first-of-its-kind sustainability-focused ventures fund that targets startups, upcoming technologies, and concepts that will complement United's goal of net zero emissions by 2050 – without relying on traditional carbon offsets such as planting trees. UAV's portfolio now includes SAF producers and other technologies including carbon utilization, hydrogen-electric engines, electric regional aircraft, and urban air mobility.

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Axiom Electronics

Lockheed Martin gets rush-order for HIMARS precision-munitions launchers

BY **John Keller**

REDSTONE ARSENAL, Ala. – Tactical missile designers at Lockheed Martin Corp. will build launchers for next-generation surface-to-surface rockets designed to destroy enemy targets as far away as 300 miles. under terms of a $430.9 million three-year order announced in December.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., are asking the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, for full-rate production of M142 High Mobility Artillery Rocket Systems (HIMARS) and support.

These launchers will fire the Army's future long-range Precision Strike Missile (PrSM) — a surface-to-surface, all weather, precision-strike guided missile fired from the M270A1 Multiple Launch Rocket System (MLRS) and the M142 HIMARS. PrSM should enter service in 2023.

This order is to satisfy an urgent need to support the Army and U.S. allies, Army officials say.

The High Mobility Artillery Rocket Systems (HIMARS) will fire the Army's future long-range Precision Strike Missile (PrSM), as well as other kinds of munitions at ranges from 43 to 250 miles.

The PrSM multimode seeker homes-in on an enemy target's radar or radio communications emissions to give the weapon passive stealth capability. It also uses an imaging infrared sensor for terminal guidance, and also takes guidance from Global Position System (GPS) and inertial measurement sensors.

The PrSM precision munitions are to replace non-insensitive and cluster munition versions of the Army MGM-140 Army Tactical Missile System (ATACMS). It will provide Army and U.S. Marine Corps field artillery units with long range and deep strike capability. The PrSM will destroy, neutralize, or suppress targets at ranges from 43 to 250 miles using indirect precision fires.

The baseline missile will be able to engage a wide variety of targets at ranges as long as 310 miles. It will emphasize imprecisely located area and point targets. Primary emphasis for follow-on upgrades will be on increased range, lethality, and ability to attack time-sensitive, moving, hardened, and fleeting targets.

By 2025 the Army will be able to use the long-range PrSM to attack and destroy moving enemy ships operating offshore at ranges out to about 310 miles. While the weapon primarily has surface-to-surface applications for use against enemy air defenses, troop fortifications, and armored vehicle columns, the PrSM is being configured with an advanced targeting multi-mode seeker to include maritime strike.

The new targeting seeker has completed a captive carry test wherein it flew aboard an aircraft against representative targets in preparation for further testing and ultimate deployment.

On this order Lockheed Martin will do the work in Brownsboro, Ala.; Camden, Ark.; Boca Raton, Clearwater, and Palm Bay, Fla.; Whippany, N.J.; Archbald and York, Pa.; and Dallas and Grand Prairie, Texas, and should be finished by December 2025.

For more information contact Lockheed Martin Missiles and Fire Control online at www.lockheedmartin.com/en-us/who-we-are/business-areas/missiles-and-fire-control.html, or the Army Contracting Command-Redstone at https://acc.army.mil/contractingcenters/acc-rsa/.

University of Dayton for electro-optical and EW onboard sensors research

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio – U.S. Air Force researchers needed electro-optical, hyperspectral, RF, and electronic warfare (EW) subsystems for onboard sensing. They found their solution from the University of Dayton Research Institute in Dayton, Ohio.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, have chosen University of Dayton for the Proficient Research of Onboard Subsystems Technology (PROST) project, which will capitalize on commercially and government-developed sensors, under terms of an $8 million six-year contract.

University of Dayton will conduct research and development of on-board sensor subsystems to combine heterogeneous devices such as central processing units (CPUs), graphics processing units (GPUs), field-programmable gate arrays (FPGAs), and artificial intelligence (AI) accelerators with open-system sensor architectures.

Research will include compression techniques for several sensor types including visible-light cameras, infrared sensors, radar, and RF jammers.

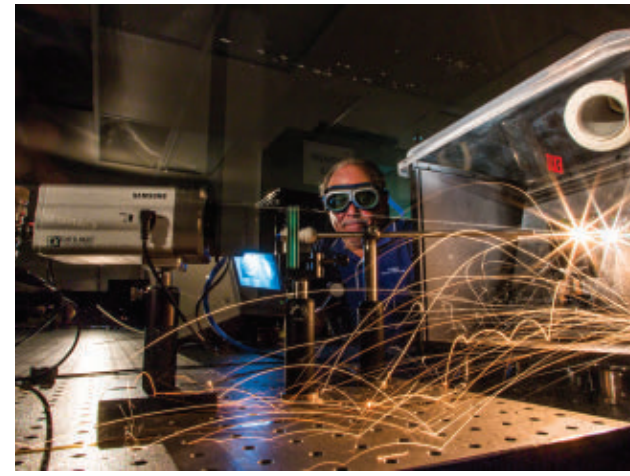
Researchers will test and evaluate using laboratory and field testing, which will lead to device characterization and performance metrics for comparison to current capabilities, Air Force officials say.

As operating environments become more contested and congested, aircraft survivability relies on the ability to sense the environment quickly, process the data on the edge, and react to the gathered information, researchers explain.

Meanwhile, sensor technology has improved to capture more data from the environment, and military has a critical need to exploit this additional information. Data compression is equally important to transmit the data for additional processing and forensic analysis.

Air Force researchers are asking University of Dayton to develop unique capabilities in edge processing and data compression to meet future and emerging military needs.

University of Dayton will investigate onboard sensor processing using all-weather radar for persistent surveillance across permissive, contested, and highly contested environments by using active, passive, and distributed sensing for onboard subsystems, data compression, and onboard sensor fusion.



University of Dayton will combine central processing units (CPUs), graphics processing units (GPUs), field-programmable gate arrays (FPGAs), and artificial intelligence (AI) accelerators with open-systems sensor architectures.

University of Dayton also will investigate onboard sensor processing using sensor technology throughout the optical to infrared regions of the electromagnetic spectrum. Researchers also will look into onboard sensor processing using resilient, adaptive multi-spectrum warfare technologies and techniques to ensure unrestricted access to the airspace and the electromagnetic spectrum in contested and congested environments.

Research will involve electro-optical countermeasures and counter-countermeasures, RF electronic support, RF electronic attack, and RF electronic protection, position, navigation, and timing (PNT), avionics assurance, compression techniques for onboard subsystems, and onboard sensor fusion.

Researchers also will look into autonomous techniques to develop biological-inspired neuromorphic systems to increase performance while decreasing the size, weight, and power consumption for sensor subsystems and emerging artificial intelligence technologies.

On this contract, University of Dayton will do the work in Dayton, Ohio, and should be finished by January 2028. For more information contact the University of Dayton Research Institute online at https://udayton.edu/udri/index.php, or the Air Force Research Lab at www.afrl.af.mil.

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#WEST2023

Boeing to build two KC-46A aerial refueling aircraft and avionics for Japan

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio – U.S. Air Force aerial refueling experts are asking the Boeing Co. to build two new KC-46A Pegasus military aerial refueling and strategic military transport aircraft for Japan under terms of a $398.2 million order.

Officials of the Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, are asking the Boeing Defense, Space & Security segment in Tukwila, Wash., to build the KC-46A aircraft for the Japan military.

The KC-46A aircraft is based on the Boeing 767-200 widebody passenger jet. The multirole aerial tanker can refuel all U.S., allied, and coalition military aircraft compatible with international aerial refueling procedures. In addition to refueling other aircraft in midair, the KC-46A also can carry passengers, cargo, and medical patients.

▲ The KC-46A aircraft is based on the Boeing 767-200 widebody passenger jet, and can refuel U.S., allied, and coalition military aircraft compatible with international aerial refueling procedures.

The KC-46A aircraft can detect, avoid, defeat, and survive threats using several layers of electronic protection that enable it to operate safely in medium-threat environments, Boeing officials say.

Honeywell Aerospace, Northrop Grumman Corp., and Raytheon Technologies Corp. are among the companies providing avionics subsystems and components for the KC-46A.

Honeywell Aerospace in Coon Rapids, Minn., provides the air data inertial navigation system for the KC-46A, while the company's facility in Phoenix provides the auxiliary power unit. The Honeywell Aerospace facility in Tucson,

Ariz., provides the KC-46A cabin pressure control system, while the company's facility in Urbana, Ohio, provides the tanker's lighting system.

The Northrop Grumman Electronic Systems segment in Rolling Meadows, Ill., provides the KC-46A's Large Aircraft Infrared Countermeasures (LAIRCM), while the Raytheon Intelligence & Space segment in El Segundo, Calif., provides the tanker's digital radar warning receiver and digital anti-jam global positioning system (GPS) receiver.

The Raytheon Collins Aerospace segment in Cedar Rapids, Iowa, provides the KC-46A integrated display system with 15.1-inch diagonal liquid crystal displays, which are based on the avionics suite for the Boeing 787 Dreamliner passenger jet.

Collins Aerospace also provides the KC-46A's tactical situational awareness system, remote vision system 3-D and 2-D technology for the boom operator, the communications, navigation, surveillance (CNI) system, networking, and flight-control systems.

The DRS Technologies Inc. Laurel Technologies Partnership in Johnstown, Pa., provides the KC-46A's aerial refueling operator station (AROS). The Eaton Aerospace facility in Grand Rapids, Mich., provides the tanker's electromechanical and cargo door actuation systems.

Woodward Inc. in Skokie, Ill., meanwhile, provides the sensor system, control unit, and telescopic and flight control sticks for the KC-46A-s aerial refueling boom.

GE Aviation Systems facilities in Grand Rapids, Mich., and Clearwater, Fla., provide the KC-46A mission control system avionics, which provide integrated communications management to support air traffic management data link, and enable the aircraft to perform with navigation precision not currently available to the tanker fleet.

GE Aviation also provides the KC-46A flight management system (FMS), which helps the aircraft fly relatively short flight paths and idle-thrust descents to reduce fuel consumption, while lowering emissions and reducing engine noise.

Japan will form a new squadron for its KC-46As at Miho Air Base to operate with the nation's existing tanker fleet of four KC-767 and two KC-130H tankers. The new tankers will help refuel the Japan's fleet of Lockheed Martin F-35A and F-35B joint strike fighters, Mitsubishi F-15 and F-2 jet fighters, and Bell-Boeing MV-22 Osprey tiltrotor aircraft.

On this order Boeing will do the work in Everett, Wash., and should be finished by June 2025. For more information contact Boeing Defense, Space & Security online at www.boeing.com/defense/kc-46a-pegasus-tanker, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Rolls-Royce low-emission combustion system moves into flight test phase

Rolls-Royce has entered the final phase of testing its Advanced Low Emissions Combustion System (ALECSys) demonstrator engine, this time at altitude. The demonstrator took to the skies attached to the Rolls-Royce Boeing 747 Flying Test Bed in Tucson, Ariz. The test program has included flights as high as 40,000 feet as well as several engine relights at different conditions. The lean-burn combustion system improves the pre-mixing of fuel and air prior to ignition, enabling cleaner combustion of the fuel, which results in lower NOX and particulate emissions. The lean-burn combustion system improves the pre-mixing of fuel and air prior to ignition, enabling cleaner combustion of the fuel, which results in lower NOX and particulate emissions. The ALECSys engine demonstrator has previously completed a comprehensive set of ground tests, including icing, water ingestion, ground operability, emissions and running on 100% sustainable aviation fuel (SAF).

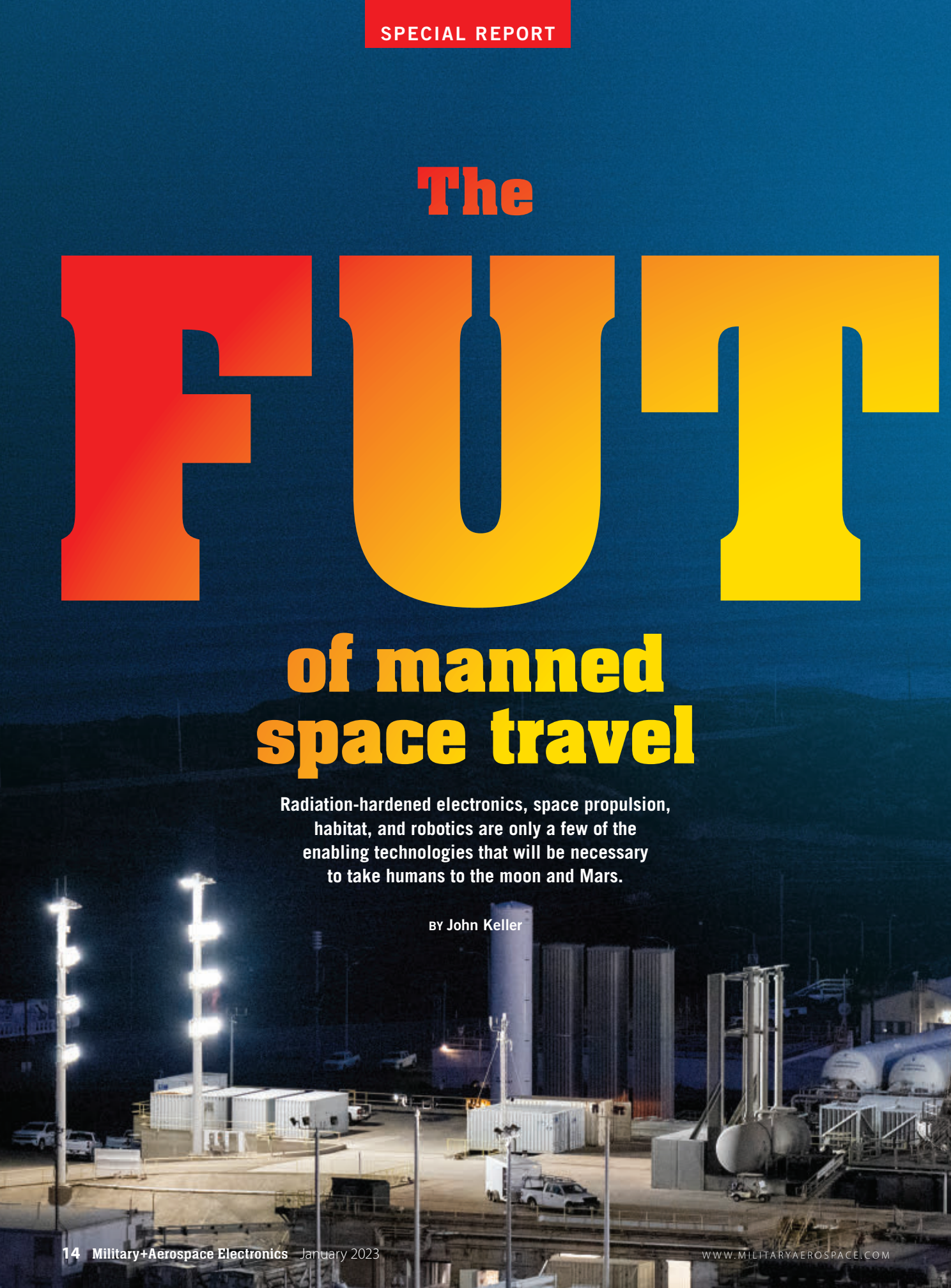
Rolls-Royce and easyJet hail successful hydrogen jet engine test

Engine maker Rolls-Royce and airline easyJet have achieved a new aviation milestone after completing the first ground test of a modern aero engine running on hydrogen. The ground test was conducted on an early concept demonstrator using green hydrogen created by wind and tidal power. The companies say it marks a major step towards proving that hydrogen could be a zero carbon aviation fuel of the future and is a key proof point in the decarbonisation strategies of Rolls-Royce and easyJet. The test took place at an outdoor test facility at MoD Boscombe Down, UK, using a converted Rolls-Royce AE 2100-A regional aircraft engine. Green hydrogen for the tests was supplied by the European Marine Energy Center generated using renewable energy at their hydrogen production and tidal test facility on Eday in the United Kingdom's Orkney Islands. Following analysis of this early concept ground test, the partnership plans a series of further rig tests leading up to a full-scale ground test of a Rolls-Royce Pearl 15 jet engine. The partnership is inspired by the global, UN-backed Race to Zero campaign that both companies have signed up to, committing to achieve net zero carbon emissions by 2050.

The FUT of manned space travel

Radiation-hardened electronics, space propulsion, habitat, and robotics are only a few of the enabling technologies that will be necessary to take humans to the moon and Mars.

BY John Keller



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U.S. and international space authorities have ambitious manned spaceflight schedules through the mid-21st century, which will call for enabling technologies ranging from radiation-hardened microelectronics components, to advanced robotics, and to habitat enhancements like water recycling, heating and cooling, and long-term food production and storage.

A SpaceX Falcon 9 rocket launches with the Surface Water and Ocean Topography (SWOT) spacecraft onboard in December 2022.

Perhaps the most important life- and mission-critical technologies will involve radiation-hardened and radiation-tolerant electronics, which will help ensure that crucial subsystems like communications, navigation, orbital-control, and life-support systems can survive and operate through the kinds of radiation levels found in high-Earth orbits, and into Earth's solar system.

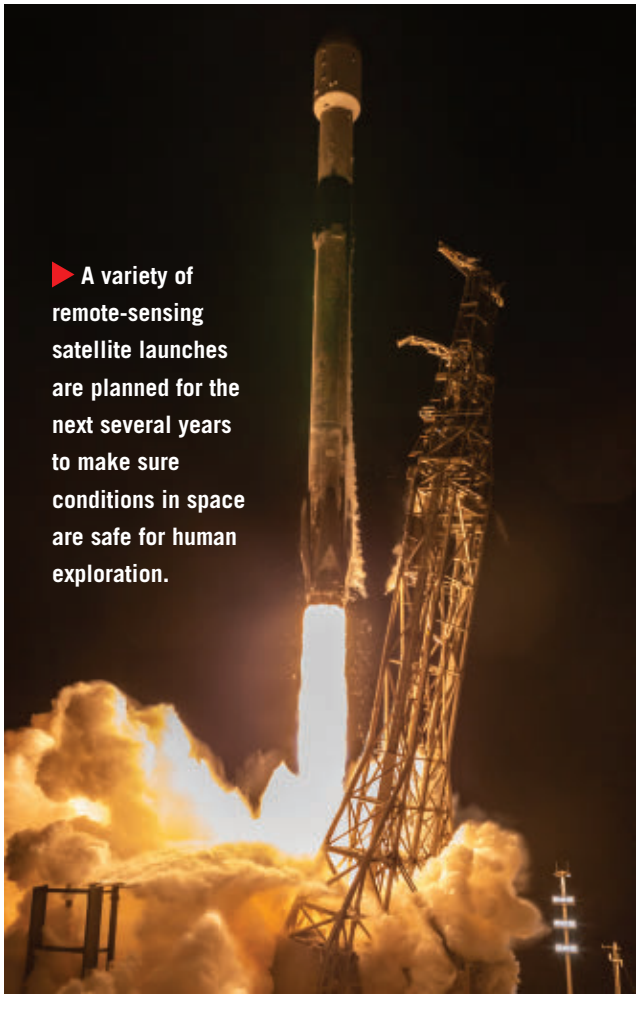
"The biggest differentiator for manned vs. unmanned space flight is radiation hardened electronics for single-effects performance," explains Leonard Leslie, vice president of engineering at power electronics specialist VPT Inc. in Blacksburg, Va.

Radiation-hardened electronics

Single-event effects are not immediately the most destructive radiation things that can happen to electronics in space, but can cause quick malfunctions in computer memory and processing that can be difficult to detect and diagnose. The most damaging radiation effects are latchup and burnout, which can cause catastrophic electronics failures.

Single-event effects, on the other hand, are more sneaky. A single-effect event happens when a charged radiation particle hits an electronic device like a memory, processor, or power controller just right and causes a bit flip — essentially changing a piece of digital information from a one to a zero — and produce unreliable information.

"Single-events occur from a particle, and the response can occur the moment the spacecraft is out of the atmosphere," says VPT's Leslie. "There is a wide range of single events, from small transients or corruption of computer memory or instruction registers, to the more-severe effects such as latchup or burnout that can destroy devices."



A variety of remote-sensing satellite launches are planned for the next several years to make sure conditions in space are safe for human exploration.

In the case of single-event risk, space electronics designers do their best either to acquire components that are radiation-hardened by design or that are shielded from charged particles, or design subsystems with error-correction approaches.

The same idea applies to risks from single-event latchup or burnout, which typically can happen when vulnerable electronics devices are subject to high radiation levels for long durations, which the industry refers to as total-dose radiation.

"In the case of flight-critical components, we try to increase radiation requirements to the highest levels possible in a manned-space mission," VPT's Leslie says.

The humans involved, and their vulnerability to radiation, are the primary reasons that human-crewed space missions will require much higher levels of radiation resistance than do unmanned satellites and deep-space probes. Space authorities want to avoid risks to human life in space as their highest goal.

"Unmanned missions may not be as risk-averse, like a satellite that is not high-value, where single-event performance can be reduced," VPT's Leslie says. "Even short-duration manned missions generally increase the single-event performance requirements to the highest levels for safety."

Priority on crew safety

When it comes to the safety of human space crews, "radiation-hardened is the biggest challenge of space flight," Leslie continues. "You get into varied radiation environments even within orbit. In low-Earth orbit you are under the radiation belts for the most part. But once you get beyond low-Earth orbit, you start to get into higher radiation levels from the Van Allen belt. Once you are outside of that, the radiation levels will fall off, but always pose the risk of single-event effects from the sun or other sources in the galaxy. It depends on location and duration of the mission."

While U.S. and international space authorities are planning manned space missions to the moon and later to Mars, some places in Earth's galaxy may pose radiation challenges that as yet cannot be met.

"One location that is difficult for manned mission — almost impossible — would be close to Jupiter, where the radiation levels are very high," VPT's Leslie points out. "We must do significant radiation hardening for even the unmanned probes that go toward Jupiter, because of the magnetic fields there. Jupiter has a significantly stronger magnetic field than Earth does."

The enabling technologies in electronics radiation hardening necessary for such a manned near-Jupiter mission are yet to be developed — and perhaps never be sufficient for manned Jupiter missions — at least not without substantial shielding and other protective equipment.

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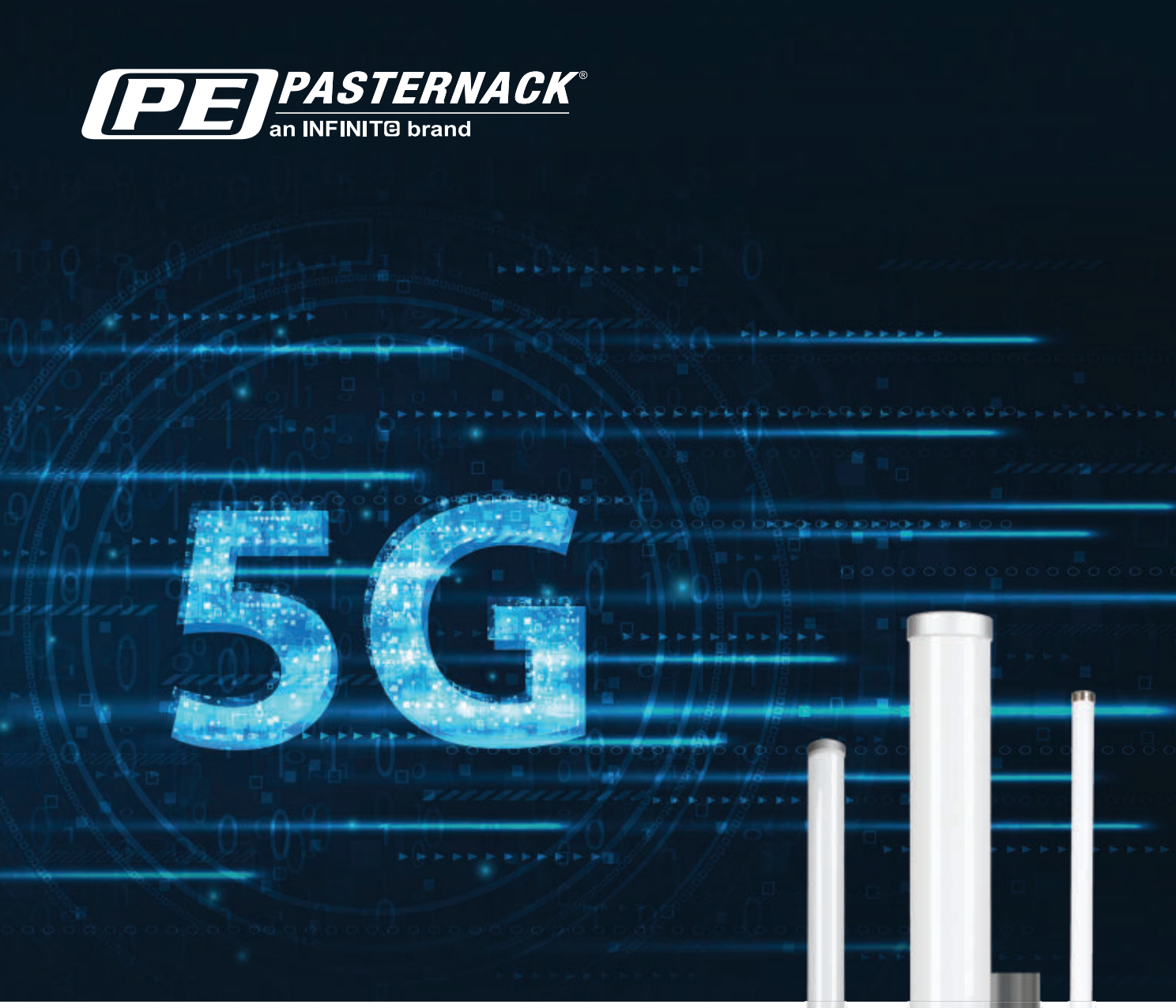

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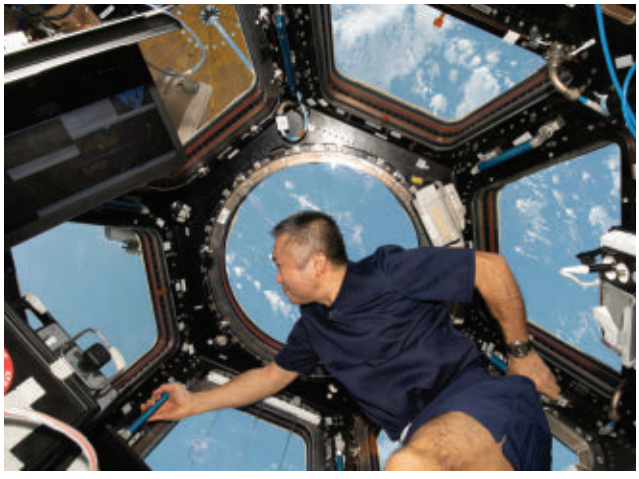

Wakata of the Japan Aerospace Exploration Agency (JAXA) peers at the Earth below from inside the cupola as the International Space Station orbiting 261 miles above the Pacific Ocean off the coast of Peru.

"You would need to have electronics that could stand that environment if you were to spend any time near Jupiter," VPT's Leslie says. "There would be significant challenges to have manned missions in that vicinity. Poorly performing radiation-hardened parts could stand a kilorad of total-dose radiation, but that level is lethal to a human."

One approach to mitigate radiation exposure near Jupiter might involve highly elliptical orbits to give humans and electronics a periodic break from Jupiter's intense radiation.

"For manned space flights, the level of reliability based on the margin you put into electronics is greater than for non-manned space flights," says Pratish Shaw, general manager of Aitech North America, an embedded computing and radiation-hardened electronics specialist in Chatsworth, Calif.

Shah points out that unmanned spacecraft electronics can operate well at temperatures of 80 or 90 degrees Celsius (176 to 194 degrees Fahrenheit). Manned missions would require more stringent requirements. "Mankind can't survive at 80 degrees C," he says.

Transport and habitat

Manned space experts like Shah divide manned spaceflight into two basic applications — both of which require life- and mission-critical radiation-hardened electronics: transport and habitat. Transport involves propulsion, navigation and guidance, sensors, and other systems to get humans safely into space and back to Earth. Habitat, on the other hand, involves heat and air conditioning, safe food storage, water storage and recycling, and other systems to keep humans safe and healthy while in space, going to space, or coming home from space.

"The transportation aspect is how you get someone from here on the ground to low-Earth orbit or to lunar orbit, says Aitech's Shaw. "For the transport of individuals, the requirements are very stringent. The amount of pace you have in the capsule and the rocket, and the information that needs to be conveyed and acted on. The shock and vibration, environmental aspects, and acceleration impose stringent requirements in a very big way."

Habitat involves creating a human-friendly environment in space that will help enable humans to establish a more permanent presence in space.

"Everything that is life-critical requires redundancy and radiation hardness for extended-life operation," Aitech's Shaw says. "Anything that controls life-critical systems will be subject to the most stringent requirements."

Where spacecraft designers might be able to compromise on radiation-hardening requirements might involve space experiments and other space activities that might not put human lives in jeopardy in the event of system failures or malfunctions. Using only radiation-tolerant electronic technologies in these areas has the potential to save money.

The lessons of NewSpace

In many ways, the legacy of recent technological developments in the commercialization of space are beginning to present tangible benefits to future manned space missions. Experiments in small orbiting satellites for telecommunications, cable television, and other commercial uses are teaching space systems designers about where they can compromise on stringent electronics requirements, and where they can't.

So-called "NewSpace" refers to the emergence of the private spaceflight industry, spanning areas such as private launch companies, small satellite constellations, or sub-orbital tourism, as well as other efforts that aim to reinvent the traditional space industry supply chain.

Recent experiences of placing pure-COTS parts in space has led NewSpace designers to put more thought into some levels of ruggedization for space components. This is not to say the COTS approach has been abandoned — far from it — but industry consensus is coming around to some levels of value-add for space parts.

Systems designers have found that using pure-COTS parts can be risky, depending on the application, and has led to unanticipated on-orbit failures that can destroy or degrade the performance of NewSpace satellites. The solution often involves starting with pure-COTS parts and designing a test and measurement regimen to help prevent unexpected on-orbit systems failures or performance degradation.

Some electronics companies are turning to automotive-qualified electronic components from different chip fabs, can provide adequate ruggedization to survive the space environment. The trick is testing just enough to meet the application and the radiation environment.

Negotiating the middle ground between expensive and time-consuming radiation testing and non-tested full-COTS use can provide fast time to market and can less expensive than extensive testing. Selective radiation testing also encourages space systems designers to pay close attention to specific space applications that may or may not require addition radiation testing.

For unmanned commercial space endeavors, systems designers are finding ways to balance the risks, costs, and potential payoffs of which parts they choose ultimately for their spacecraft.

Lessons also are coming from the different orbits in which NewSpace satellites must operate, ranging from relatively benign low-Earth orbit (LEO) to geosynchronous and polar orbits, which have much higher exposure to space radiation.

In short, NewSpace is teaching spacecraft designers about how commercial and ruggedized electronics perform in space, where they could be used safely for non-life-critical applications, and where they cannot. NewSpace trends in determining just the right amount of testing and shielding for different space environments have the potential for bit payoffs in future manned space missions.

The Orion crew module comes from Lockheed Martin, and integrates the European Service Module into a completed Orion spacecraft — a prototype of a spacecraft that will carry humans into space.

"Without a doubt, we are seeing that trend today for space transport and habitat in the transition to COTS for manned space," says Aitech's Shah. "We can benefit from the experiences

of commercial and NewSpace. Unmanned flights have hundreds and thousands of hours of real-life experience in space. This is very important — and perhaps is more important that analysis in the theoretical environment."

Putting plans into action

One of the most significant steps toward the future of human space missions happened in late 2022 with the Artemis 1 mission, launched by the U.S. National Aeronautics and Space Administration (NASA) from the Kennedy Space Center at Cape Canaveral, Fla. The goal of the 25-day mission was to test the Orion spacecraft and its heat shield in preparation for future Artemis missions to reestablish a human presence on the moon and demonstrate enabling technologies for future scientific studies, which may include a manned mission to Mars.

Artemis 1 launched on 16 Nov. 2022 as an uncrewed moon-orbiting mission to test the Orion spacecraft using a super-heavy-lift rocket. After reaching Earth orbit, the mission deployed 10 cubesat satellites, and then headed for the moon, which the Orion spacecraft reached five days later. It performed a distant retrograde orbit of the moon for six days, completed one flyby of the moon on 21 Nov., and completed a second flyby of the moon on 25 Nov.

The Orion spacecraft then returned and reentered the Earth's atmosphere with the protection of its heat shield, and splashed down in the Pacific Ocean on 11 Dec.

Artemis I was the first in a series of increasingly complex missions to provide a foundation for human deep-space exploration. The mission traveled 280,000 miles from Earth and 40,000 miles beyond the far side of the moon.

With Artemis I, NASA sets the stage for human exploration into deep space, where astronauts will build and begin testing the systems near the moon needed for lunar surface missions and exploration to other destinations farther from Earth, including Mars.

▲ **This image depicts the Lockheed Martin NASA Orion spacecraft during a recent orbit of the moon in preparation for future international space missions back to the moon.**

For Artemis I, NASA's Near Space Network and NASA's Deep Space Network supported communications and navigation to enable flight controllers to send commands to the spacecraft and receive data from the spacecraft. Navigation enables the flight controllers to calculate the location of the spacecraft along its way through space.

The mission Near Space Network's Launch Communications Segment provided links to Orion and its launcher on the ground, and NASA's constellation of Tracking and Data Relay Satellites (TDRS) provided near-continuous communications during launch and low-Earth orbit phases. Then NASA's Deep Space Network took over to provide communications during Orion's return to Earth, final return trajectory, and splashdown.

Lead contractors for the Artemis 1 rocket, spacecraft, and ground-support equipment are the Lockheed Martin Corp. Space segment in Denver; Aerojet Rocketdyne in Sacramento, Calif.; Northrop Grumman Corp. in Falls Church, Va.; The Boeing Co. in Chicago; Teledyne Brown Engineering in Huntsville, Ala.; and Jacobs in Dallas.

The European Service Module is the European Space Agency (ESA) contribution to NASA's Orion spacecraft. It provides electricity, water, oxygen, nitrogen, and keeps the spacecraft at the right temperature and on course. Technicians at the Airbus facility in Bremen, Germany, prepare the European Service Module for shipment to Kennedy Space Center. The service module provides propulsion to get to the moon, and provides astronaut life support systems like water, oxygen, and nitrogen.

The Orion crew module comes from Lockheed Martin, and integrates the European Service Module into a completed Orion spacecraft. Lockheed Martin performs the majority of the Orion engineering work in Denver, and manufactures the crew module pressure vessel and thermal protection materials, and assembles the spacecraft at Kennedy Space Center, Fla.

Aerojet Rocketdyne is the lead contractor for the four RS-25 engines that propelled the Artemis 1 mission during its 8.5-minute climb to space, and the RL10 engine that powers the rocket's interim cryogenic propulsion stage.

Boeing is the lead contractor for the rocket's core stage and flight avionics. Northrop Grumman designs the twin solid rocket boosters that provide nearly 80 percent of initial thrust. Teledyne Brown Engineering designs the launch vehicle stage adapter, providing engineering, technical support, and hardware for the Artemis I adapter and structural test article. Jacobs builds the NASA Exploration Ground Systems Program.

Several follow-on missions are on the schedule. Artemis 2 will perform a crewed lunar flyby in 2024, and then Artemis 3, set for launch in 2025, will be the second crewed Artemis mission and the first crewed lunar landing since Apollo 17 in 1972.

Upcoming manned space launches

There will be three NASA-related manned space missions next year. The NASA SpaceX Crew-6 launch is set for mid-February 2023 to launch a crew to the International Space Station.

In April 2023 the NASA Crew Flight Test will demonstrate the ability of Starliner and the United Launch Alliance's Atlas V rocket to carry astronauts safely to and from the International Space Station. Following a successful test flight with astronauts, NASA will begin certifying the Starliner spacecraft and systems for regular crew rotation flights to the space station.

Fall 2023 will see launch of the NASA Crew-7 mission to the International Space Station, ahead of the return of Crew-6.

Five space missions related to manned space flight are on schedule to launch over the next two years. In March 2023 the Intuitive Machines Commercial Payload Lunar Services project will launch robotic NASA payloads to the lunar surface to help prove the feasibility of delivering commercial payloads to the moon.

In mid-2023 the Lunar Trailblazer satellite will launch to provide an understanding of the form, abundance, and distribution of water on the moon, as well as the lunar water cycle. Also in 2023 nine science and technology instruments will launch to the moon's south pole.

2023 also will see launch of the JUpiter ICy moons Explorer (JUICE) European Space Agency spacecraft to carry the most powerful scientific payload ever flown to study Jupiter and its moons to help scientists understand how habitable worlds might emerge around gas giant planets.

November 2024 will see launch of the Astrobotic Commercial Lunar Payload Services robotic NASA payloads to the lunar surface as part of a Commercial Lunar Payload Services delivery.

The importance of robotics

Manned space flight and robotics often are considered to be separate topics, but in reality the future of manned space will rely heavily on robotics to handle danger, dirty, and dull jobs in space, as well as to help pave the way for humans to explore and inhabit the moon and other planets in the solar system.

A 2018 report of the International Space Exploration Coordination Group (ISECG) in Montreal, an organization of 27 global government space authorities, points out the importance of robotics in the future of human space flight.

WHO'S WHO IN MANNED SPACE ELECTRONICS

3D Plus, a Heico company
San Leandro, Calif.
https://www.3d-plus.com/index.php

Aerojet Rocketdyne
Sacramento, Calif.
https://www.rocket.com

Aitech
Chatsworth, Calif.
http://www.rugged.com

Apogee Semiconductor
Plano, Texas
https://apogeesemi.com

BAE Systems
Manassas, Va.
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Chicago
https://www.boeing.com/space/

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Denver
https://www.lockheedmartin.com/en-us/capabilities/space.html

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San Diego
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https://www.mrcy.com

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https://www.gsitech.com

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Huntsville, Ala.
https://www.tbe.com/en-us

Times Microwave Systems, an Amphenol company
Wallingford, Conn.
https://timesmicrowave.com

Triad Semiconductor Inc.
Winston-Salem, N.C.
https://www.triadsemi.com

VORAGO Technologies Inc.
Austin, Texas
https://www.voragotech.com

VPT Components
Lawrence, Mass.
https://www.vptcomponents.com

VPT Inc.
Blacksburg, Va.
http://www.vptpower.com

VPT Rad
Chelmsford, Mass.
http://www.vptrad.com

Xilinx Inc.
San Jose, Calif.
https://www.xilinx.com

"A partnership between humans and robots is essential in the success of this venture [manned space exploration]," states the 2018 ISECG report, The Global Exploration Roadmap. "Robotic missions accomplish world-class science while also servicing as our scouts and proxies, venturing first into hostile environments to gather critical information that makes human exploration safer."

ISECG members are the AEB in Brazil; AEM in Mexico; ASA and CSIRO in Australia; ASI in Italy; CNES in France; CNSA in China; CSA in Canada; DLR in Germany; the European Space Agency in Paris; GISTDA in Thailand; ISRO in India; JAXA in Japan; KARI in the Republic of Korea; LSA in Luxembourg; NASA in the U.S.; NOSA in Norway; NZSA in New Zealand; POLSA in Poland; PT Space in Portugal; ROSA in Romania; Roscosmos in Russia; SSAU in Ukraine; SSO in Switzerland; UAE Space Agency in the United Arab Emirates; UK Space Agency in United Kingdom and VNSC in Vietnam.

"In this global vision, robotic missions precede human explorers to the moon, near-Earth asteroids, and Mars in order to unveil many of their secrets, characterize their environments, and identify risk and potential resources," the report states. "Human exploration then follows in a coordinated manner that is affordable and sustainable, which both benefits and contributes to space agencies around the world achieving their goals and objectives."

Robotics research is being conducted for space-based remote manipulation, medical care, plant research for space food supplies, and related missions. NASA and other international space agencies also are developing robotic prototypes of lunar and Mars landers to prove-out enabling technologies before placing humans on those planets.

Rugged computers take-on the shock and the heat

BY **Jamie Whitney**

Warfighters expect the technology that they take to forward deployments and other hazardous environments to be as tough as they are. Thankfully, they and the experts that support them have an incredible amount processing power in fully rugged enclosures at their disposal thanks to today's computers designed for the modern battlefield.

For years, a consortium of experts in the defense technology business have worked to roll out an open-systems industry standard dubbed the Sensor Open System Architecture (SOSA). The high-level goals of SOSA include openness and being platform- and vendor-agnostic while being aligned with Modular Open Systems Approach (MOSA) using standardized software and hardware. The consortium aims to leverage existing and emerging open standards and align with DOD service objectives. Finally, SOSA aims to keep technology affordable and adaptable.

The consortium, called the Open Group in San Francisco, unveiled its SOSA 1.0 standard in the fall of 2021, and that open architecture remains a major driving force in industry trends in the development of deployable rugged computing systems.

Justin Moll, vice president of sales and marketing at Pixus Technologies Inc. in Waterloo, Ontario, notes that the SOSA efforts have been front of mind as engineers build components for defense system.

"A key question in defense-based embedded computing systems is whether it is required to be SOSA-aligned or not," Moll explains. "If SOSA aligned, there is constant drive for performance within the typical space limits of deployed systems. For chassis platforms, this greatly affects how we balance the thermal management, I/O configuration including fiber and optical interfaces, backplane speeds, chassis management, etc. If the project is not SOSA aligned, there is a broader spectrum of performance criteria from lower end to very powerful systems without the potential restraints of falling within a specific profile."

The Open Group says that systems designed with SOSA in mind finally will be able to put their technology to the test — literally — to see if it meets muster to be called conformant to the standard. While SOSA is working to create its Conformance Test Tool Framework to automate the process, when testing initially rolls out — possibly as early as February 2023 — it will be more of a manual process.

With SOSA in mind, Pixus introduced its SHM300 SlotSaver VPX VITA 46.11-compliant chassis manager that enables embedded computing designers to manage the chassis without sacrificing a slot.

The SHM300 is designed to the latest SOSA requirements, and uses all U.S.-based software and firmware. The chassis manager monitors and manages the field-replacement units plugged into the SOSA/OpenVPX chassis.

Features include chassis discovery of plug-in boards, information storage, cooling management, SDR-based sensor initialization, and other chassis control and event handling.

The compact design of the Pixus SOSA-aligned chassis manager ensures that the size and spacing do not interfere with VITA 66 or 67 interfaces and cabling. The SHM300 also supports redundant options.

U.S. Air Force mobile data manager, supervises Airborne Extensible Relay Over-Horizon Network integration for Royal Thai Air Force Flying Officer Apisit Kitchoke at Moody Air Force Base, Ga.

Bringing the heat

Pixus's Moll says that SOSA conformance is adding a bit of a wrinkle to a problem that has kept engineers up at night: how do we keep this technology cool enough?

"Thermal management for embedded enclosure systems has been an ongoing challenge for decades, but there is a noticeable difference in many of the latest generation SOSA-aligned and OpenVPX-based systems," Moll says. "In some cases, the traditional cooling approaches are not going to cut it. There is an increased openness to utilizing air flow through, where air passes directly through the plug-in cards per VITA 48.8, and air flow by with airflow passing over the fins of the boards. Although most applications try to avoid the cost/complexity of liquid cooling, there is increased consideration of that approach as well."

▲ **Systel's Kite-Strike II embedded computing solution is purpose-built for demanding edge AI workloads for mission-critical applications in austere environments and designed using a Modular Open Systems Approach (MOSA).**

Aneesh Kothari, vice president of marketing for Systel Inc. in Sugar Land, Texas, agrees that thermal management remains a massive consideration in the mil-rugged development world.

"A senior leader from the U.S. Army stated, 'On the combat side, the biggest challenge we face is cooling. We operate under armor and most of our systems are reduced in size and cannot provide the airflow you find in the commercial sector.' At Systel, we have found that to be absolutely true in our approach to system design and testing; the most significant consideration for forward-deployed hardware is accommodating for the heat demands of powerful electronics," Kothari says.

"We integrate high-wattage commercial electronics into our edge server-class systems, with a single GPU producing up to 300 Watts and some total system wattages approaching 1000 Watts," Kothari continues. "Reliably dissipating that amount of heat in a sealed system which is exposed to high operating temperatures — routinely 55 degrees Celsius and up to 75C in extreme applications — is paramount. In our designs, we carefully consider wattage and junction temperatures of every component on every board in the system. We design for absolutely worst-case conditions, making no assumptions on customer-provided cold plates or available air flow. Our thermal management is self-contained to the computer; it's the best way to ensure reliability."

Kothari concludes, "On average, the next generation of CPUs, GPUs, NICs, FPGAs, and other electronics will produce more heat than the current generation; this will continue to pose a significant challenge. Thermal management is a critical decision variable and a major source of program risk if not properly engineered and tested for."

Piece of Pi

Last year marked the tenth anniversary of Raspberry Pi small-form-factor single-board computer. The "RPi" was launched with computer science education in mind, but the low cost, modular, open computer board proved to be incredibly popular outside its original audience thanks to its accessibility and development-friendly design, including standard USB and HDMI ports.

Last year, Curtiss-Wright Defense Solutions in Ashburn, Va., brought the Raspberry Pi to the world of rugged computing for aerospace and military applications.

David Jedynak, general manager of the Parvus business unit of the Curtiss-Wright Corp. Defense Solutions segment, explains that the company's DuraCOR Pi Raspberry Pi Mission Computer addresses a need for a rugged, ultra-small form factor, lower-cost computer board that isn't overpowered for the task it is asked to do.

▲ **The ultra-small-form-factor DuraCOR Pi is ruggedized to deliver optimal performance in harsh operating environments, and is compatible with the Pi Developer Ecosystem in a MIL-STD rugged sealed housing.**

"Full military, rugged standards — the whole works," says Curtiss-Wright's Jedynak. The DuraCOR Pi has undergone qualification testing per MIL-STD-810, MIL-STD-461, MIL-STD-1275, MIL-STD-704, and RTCA/DO-160 conditions for environmental, power, and EMI compliance.

The Raspberry Pi-enabled rugged mission computer is small enough to fit in the palm of a hand; it weighs half a pound, and

measures 1.2 by 2.49 by 3.34 inches. It can be stacked to extend functionality and performance via an expandable ring system design that enables system designers to configure the mix of DuraCOR Pi mission computers and hardware attached on top modules.

The DuraCOR Pi also can combine in a stack with the miniaturized Parvus DuraNET 20-11 network switch, which provides carrier-grade Ethernet software Level-2+ management and support for IEEE-1588v2 precision timing protocol.

DuraCOR Pi is able to run Pi operating systems such as NSA STIGd Raspian Linux, VxWorks, Windows and IoT Core, as well as Pi toolsets, and programming frameworks like Python, Java, C, and C++.

"Security is obviously really important," Jedynak says of the DuraCOR Pi. "One of the things that's available — there are various organizations who provide lockdown versions of the Linux that's on the Raspberry Pi. One of our goals in all of this is to make sure that the standard Raspberry Pi ecosystem, all the software, all those sorts of things, it's 100 percent read across.

We're not going and trying to do something custom with all that, Jedynak continues. "In fact, the benefit is you can go grab a commercial Raspberry Pi. It's just an off-the-shelf one that you would use. You go and buy it online or in a big box store, go get that, you can do all your development, then you take ours, you can just move it right over without a bunch of changes. And that way you can leverage all the strength of the ecosystem that's already doing things to harden the Raspberry Pi's operating system and other software."

Printing parts

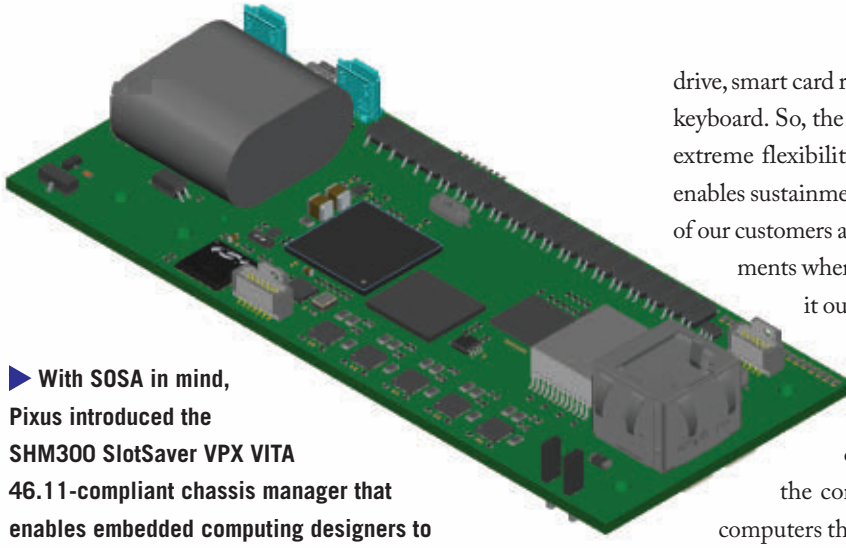
A benefit of SOSA is having vendor-agnostic components that can be replaced on-the-ground without having to be shipped stateside or off base. That same mindset is being embraced outside of SOSA when it comes to additive manufacturing — also known as "3D Printing."

▲ The rugged TOUGHBOOK 40 laptop computer provides advanced docking support, and quad pass-through connectors. Additionally, it offers 4x4 MIMO, faster USB and Ethernet ports, and software selectable pass-throughs for each antenna.

Panasonic Corp. of North America in Newark, N.J., sees its TOUGHBOOK 40 as a technology that will put the power of 3D printing into the hands of warfighters when time is of the essence when they are deployed away from a supply depot.

Valerie Flores, executive account manager for Navy/USMC federal mobility at Panasonic Connect, says that their customers seek to leverage technologies like artificial intelligence (AI), augmented reality (AR), and additive manufacturing.

"And that requires a high-performance device capable of handling graphic, intense applications," Flores says of AI, AR, and 3D printing. "So, take additive manufacturing, for example...This emerging technology gives our customers unprecedented agility to produce products quickly and on-demand, and even in remote austere environments. That's really where our TOUGHBOOK 40 is purpose built for these types of use cases with a high-performance



With SOSA in mind, Pixus introduced the SHM300 SlotSaver VPX VITA 46.11-compliant chassis manager that enables embedded computing designers to manage the chassis without sacrificing a slot.

Intel chipset. It has a dedicated AMD graphics card. It has a 14-inch high resolution display. So really, this is perfect in those applications. And I know that these types of technologies have been around for a while, but I think the recent advancements made, as well as advancements in data processing and graphics have really expanded their potential and how our customers are harnessing that potential and utilizing those."

Flores explains another trend in rugged computing solutions is the requirement for scalability and future-proofing.

"So, all of our customers, I think they have always been they're looking for ways to optimize their budget, so the decisions they make today will be capable of supporting their missions tomorrow," Flores says. "And one of the key features in the TOUGHBOOK 40, the design gives them eight modular areas, including modular expansion packs. And since these are user-upgradable, our customer can change out and customize these areas, such as optical drive, smart card readers, I/O ports, barcode readers, and even the keyboard. So, the modular design not only offers our customers extreme flexibility to meet changing requirements, but it also enables sustainment to improve efficiency. And as you know, a lot of our customers are in remote locations or they're on long deployments where this feature is critical because they can change it out and they get their users back up and running."

Rugged unmanned

Technology that is driving the revolution of unmanned military systems is enabled by the compute power delivered by rugged embedded computers that can operate in the harshest of environments.

"The proliferation of unmanned vehicles and autonomous capabilities is driving the need for higher performance electronics in ultra-compact form factors," says Systel's Kothari. "It's the fundamental push to do more with less. Platforms are becoming more densely sensored and more connected across the battlefield. Especially when you talk about unmanned, you have vehicles that are smaller and can range further than manned vehicles. The computer hardware and electronics architectures that power these missions have to be SWaP-optimized and MIL-SPEC rugged with extended capabilities; in effect taking data center performance and putting it out to the edge. Successfully harness and exploiting sensor data at the edge must be done 'on-prem'; it can't be sent to the cloud because of latency, bandwidth, and security considerations. Small and rugged-edge computers is the solution to the emerging problem set of conducting tactical AI edge processing for data-centric operations."

Systel's fully-rugged Kite Strike II small form factor embedded computing solution integrates the latest NVIDIA Jetson AGX Orin embedded AI compute module which features up to 275 TOPS of performance. "Kite-Strike II is purpose-built to conduct tactical AI edge processing for data-centric operations in austere environments, and offers 10Gbe TSN-compliant capability, allowing data to be pushed through in-vehicle networks in a JADC2 environment," Kothari says. "In a battlespace where every soldier and vehicle is a sensor, actionable data and interconnectivity are critical. Kite-Strike II is a complete compute at the sensor solution, reducing overall equipment SWaP by integrating AI processing, high-bandwidth networking, high-speed and secure storage, robust IO, and modular expansion capabilities in a single line replaceable unit (LRU)."

WHO'S WHO IN RUGGED COMPUTING

Abaco Systems
Huntsville, Ala.
www.abaco.com

Aitech Defense Systems, Inc.
Chatsworth, Calif.
www.rugged.com

Curtiss-Wright Defense Solutions
Ashburn, Va.
www.curtisswrightds.com

Combat Proven Technologies (CP Tech)
San Diego
https://cp-techusa.com

Core Systems
Poway, Calif.
https://core-systems.com

Crystal Group Inc.
Hiawatha, Iowa
www.crystalrugged.com

Extreme Engineering Solutions (X-ES)
Verona, Wis.
www.xes-inc.com

Panasonic Corporation of North America
Newark N.J.
https://na.panasonic.com/us

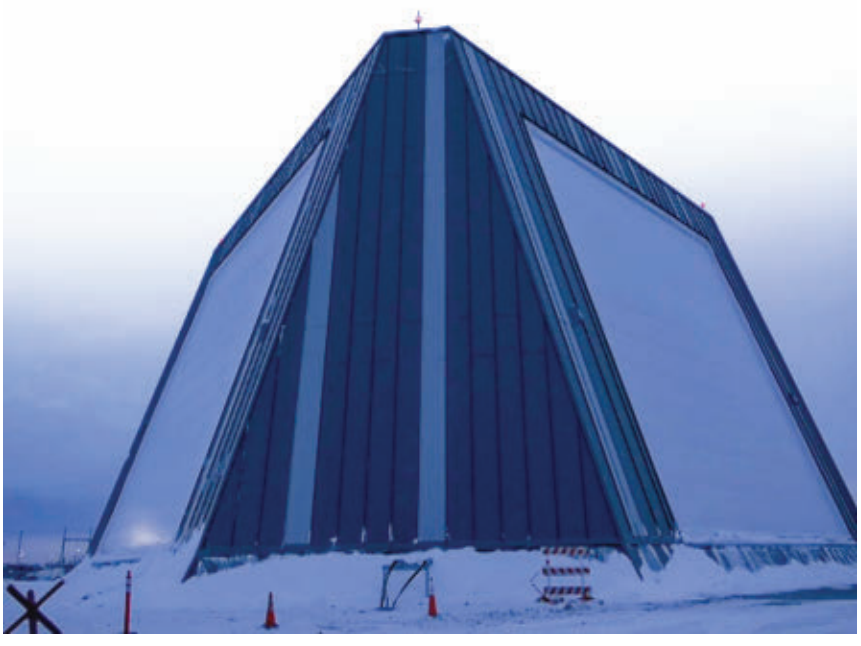
Pixus Technologies Inc.
Waterloo, Ontario
www.pixustechnologies.com

Samsung Electronics America, Inc.
Ridgefield, N.J.
https://www.samsung.com/us/

Systel Inc.
Sugar Land, Texas
www.systelusa.com

InDyne to maintain Alaskan long-range missile-defense radar system

BY **John Keller**



The LRDR provides a persistent midcourse ballistic missile defense system discrimination capability as part of a layered defense of the U.S.

PETERSON AIR FORCE BASE, Colo. – Radar experts from InDyne Inc. in Lexington Park, Md., will operate and maintain a long-range radar system near Fairbanks, Alaska, to help protect the U.S. from ballistic missile attack.

Officials of the U.S. Space Operations Command at Peterson Space Force Base, Colo., announced a $31.1 million four-year order to InDyne to operate and maintain the Long Range Discrimination Radar (LRDR). With options the contract should be worth $316.9 million.

The LRDR program is the backbone of the MDA's layered defense to protect the U.S. homeland from ballistic missile attack. It is a long-range radar that will provide precision metric data to improve ballistic defense discrimination and replace existing sensors in the Ballistic Missile Defense System (BMDS).

The Lockheed Martin Rotary and Mission Systems segment in Moorestown, N.J., won a $784.3 million contract from the U.S. Missile Defense Agency (MDA) in 2015 to build and operate the LRDR at Clear Space Force Station, Alaska.

LRDR keeps pace with evolving ballistic missile threats and increase the effectiveness of ground based interceptors, Lockheed Martin officials say.

LRDR combines proven solid-state radar technologies with proven ballistic missile defense algorithms on an open-architecture designed for future growth. The solid state, gallium nitride (GaN)-based radar uses Lockheed Martin's Open GaN Foundry model, which leverages relationships with strategic GaN suppliers, company officials say.

The LRDR provides a persistent midcourse ballistic missile defense system (BMDS) discrimination capability as part of a layered defense of the U.S. from ballistic missile attacks of all ranges in all phases of flight.

The LRDR serves as a BMDS midcourse sensor to counter evolving ballistic missile threats, as well as improve the ability to tell real ballistic missile warheads from decoys in any attack in the Pacific Ocean area.

Lockheed Martin experts have investigated issues related to graceful processor re-hosting, such as modular, loosely coupled software design, with documented interfaces that facilitate LRDR sustainment efforts.

The 2015 contract for Lockheed Martin to build the LRDR runs through January 2024. The contract called for the company to finished the LRDR installation by 2020.

On this most recent order, InDyne will do the work at Clear Space Force Station, Alaska, and is should be finished by October 2026. For more information contact InDyne online at www.indyneinc.com/corporate, or the Space Operations Command at www.spoc.spaceforce.mil.

Lockheed Martin to build 57 missiles with radio homing and infrared guidance

BY **John Keller**

REDSTONE ARSENAL, Ala. – Tactical missile designers at Lockheed Martin Corp. are building some of the first U.S. Army long-range Precision Strike Missiles (PrSM) to destroy enemy targets as far away as 300 miles.

Officials of the Army Contracting Command at Redstone Arsenal, Ala., announced a $77.4 million order to the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, for 54 PrSM missiles.

The PrSM, which should enter service in 2023, will be a surface-to-surface, all weather, precision-strike guided missile fired from the M270A1 Multiple Launch Rocket System (MLRS) and the M142 High Mobility Artillery Rocket System (HIMARS).

The PrSM missile has the ability to home-in on radio signals from enemy radar or communications to refine its targeting before impact.

Last December Lockheed Martin won a $23.9 million order for PrSM full-scale development and early operational capability. The long-range precision-attack PrSM is to replace non-insensitive and cluster munition versions of the Army MGM-140 Army Tactical Missile System (ATACMS).

PrSM will provide Army and Marine Corps field artillery units with long range and deep strike capability. The PrSM will destroy, neutralize, or suppress targets at ranges from 43 to 250 miles using indirect precision fires.

Lockheed Martin and the Army are developing multi-mode terminal guidance for PrSM that combines RF signal sensors and electro-optical infrared sensors.

The missile uses Global Positioning System (GPS) satellite navigation and inertial gyro navigation to reach the vicinity of its targets. Once the missile reaches its target area, it listens for radio signals from enemy radar or communications to refine its targeting, and finally uses an imaging infrared sensor to pinpoint its target before impact.

Its radio homing and imaging infrared guidance also will help the missile eventually reach moving targets on land and at sea.

The baseline missiles will be able to engage a wide variety of targets at ranges as long as 310 miles. It will emphasize imprecisely located area and point targets. Primary emphasis for follow-on upgrades will be on increased range, lethality, and ability to attack time-sensitive, moving, hardened, and fleeting targets.

By 2025 the Army will be able to use PrSM to attack and destroy moving enemy ships operating offshore at ranges out to about 310 miles. While the weapon primarily has surface-to-surface applications for use against enemy air defenses, troop fortifications, and armored vehicle columns, the PrSM is being configured with an advanced targeting multi-mode seeker to include maritime strike.

The new targeting seeker has completed a captive carry test wherein it flew aboard an aircraft against representative targets in preparation for further testing and ultimate deployment.

On this order Lockheed Martin will do the work in Grand Prairie, Texas, and should be finished by September 2025. For more information contact Lockheed Martin Missiles and fire control online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at https://acc.army.mil/contractingcenters/acc-rsa/.

Lockheed Martin to upgrade and redesign software for AH-64E helicopter EW

U.S. Army combat helicopter designers a company to upgrade and redesign software for an electronic warfare (EW) system that enables the AH-64E Apache Guardian attack helicopter to detect and identify enemy radar threats. They found their solution from Lockheed Martin Corp. Officials of the Army Contracting Command at Redstone Arsenal, Ala., announced a $13 million order to the Lockheed Martin Rotary and Mission Systems segment in Owego, N.Y., to upgrade and redesign software for the Apache Modernized-Radar Frequency Interferometer (MRFI). The MRFI identifies intelligence, surveillance, and reconnaissance (ISR) emitters, and helps the AH-64E pilot to detect and engage an enemy radar threat long before the aircraft becomes vulnerable. The MRFI avionics system quickly detects, identifies, and locates enemy radar, and then ranks these hostile radars in order of priority for subsequent ground attack. The MRFI is part of the AH-64E's digital receiver-based AN/APR-48B system, which performs target acquisition and cueing for the helicopter's fire-control radar system. It also can deliver warning of radar directed antiaircraft threats and serve as the controller for an integrated aircraft survivability equipment. The system provides high sensitivity and precision angle of attack in a lightweight modular configuration. The AN/APR-48B system primarily operates on a dual-redundant MIL-STD-1553B databus. Other commercial I/O interfaces available for future growth include Gigabit Ethernet, RS-232, and RS-422. On this contract Lockheed Martin will do the work in Owego, N.Y., and should be finished by October 2023. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or the Army Contracting Command-Redstone at https://acc.army.mil/contractingcenters/acc-rsa.

Northrop Grumman to provide spares for surface warship missile-defense EW

U.S. Navy surface warfare experts are ordering spare parts for an advanced electronic warfare (EW) systems aboard guided missile destroyers, aircraft carriers, and amphibious assault ships under terms of a $31.8 million order. Officials of the Naval Sea Systems Command in Washington are asking engineers at the Northrop Grumman Corp. Mission *Continued on page 31*

Raytheon to build hundreds of AMRAAM radar-guided air-to-air missiles

BY **John Keller**

EGLIN AIR FORCE BASE, Fla. – Aircraft missile experts at Raytheon Technologies Corp. are gearing-up to produce upgraded versions of the U.S. Air Force and Navy AIM-120 Advanced Medium Range Air to Air Missile (AMRAAM) that will extend the missile's lifetime well into the 2020s.

Officials of the U.S. Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., have announced nearly a billion-dollar order for a redesigned radar-guided AMRAAM missile with a new guidance section.

The Air Force is awarding the Raytheon Missiles & Defense segment in Tucson, Ariz., a $972.2 million order for AMRAAM production lot 36, as well as for AMRAAM Telemetry System (ATS), initial and field spares, and other production engineering support hardware and activities.

This order involves AMRAAM sales to Australia, Bahrain, Bulgaria, Canada, Denmark, Finland, Hungary, Italy, Japan, Korea, The Netherlands, Norway, Qatar, Saudi Arabia, Singapore, Slovakia, Spain, Switzerland, and the United Kingdom. Each AMRAAM lot roughly consists of 400 to 500 missiles.

Since AMRAAM lot 32, Raytheon AMRAAM production has involved missiles that integrate the form, fit, function refresh (F3R) of the AMRAAM guidance section, which seeks to mitigate the effects of parts obsolescence and diminishing manufacturing sources in the missile's guidance section.

The Air Force and Navy AMRAAM is one of the nation's most sophisticated radar-guided air-to-air missiles, and one of the world's most advanced all-weather, all-environment, medium-range air-to-air missiles for engaging enemy aircraft and missiles from beyond visual ranges.

AMRAAM is an active radar-intercept missile with inherent electronic protection capabilities for air-to-air applications against massed penetration aircraft. AMRAAM has been in service since 1991, and was designed to replace the AIM-7 Sparrow radar-guided air-to-air missile.

AMRAAM is an active radar-intercept missile with inherent electronic protection capabilities for air-to-air applications against massed penetration aircraft.

Mitigating the effects of obsolescence and diminishing manufacturing sources can involve the substantial redesign of subsystems by replacing electronic chips and other components that the original manufacturers no longer can produce.

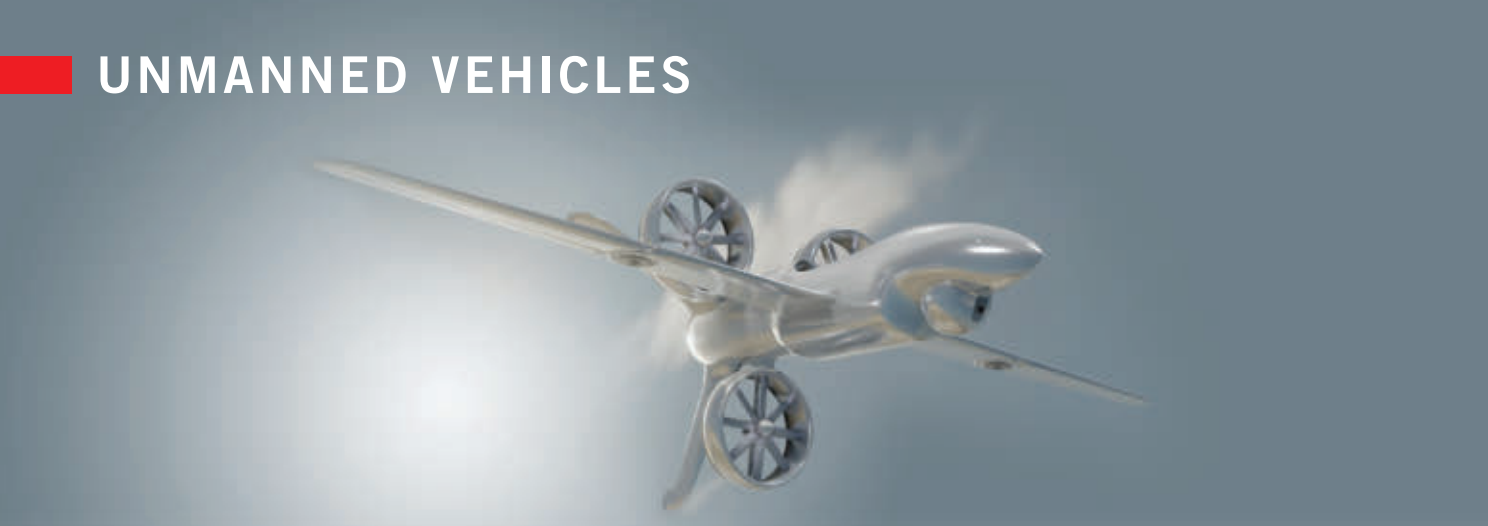
In 2015 Raytheon experienced technical difficulties with the AMRAAM F3R application-specific integrated circuit (ASIC) design, hardware integration, and guidance section performance demonstration, which delayed the program's critical design review (CDR) for a year.

In January 2017 Raytheon officials announced a project to develop a new signal processor for the AMRAAM under the F3R project to help ensure AMRAAM production well into the 2020s.

On this order Raytheon will do the work in Tucson, Ariz., and should be finished by August 2025. For more information contact Raytheon Missiles & Defense online at www.raytheonmissilesanddefense.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Continued from page 29

Systems segment in Linthicum Heights, Md., for provisioned item order spare parts in support of the Surface Electronic Warfare Improvement Program (SEWIP) Block 3 full-rate production. SEWIP is an evolutionary acquisition program to upgrade the existing AN/SLQ-32(V) surface warship EW system and provide improved anti-ship missile defense and situational awareness. Northrop Grumman won $267 million Navy contract in 2015 to develop and build SEWIP Block 3 to make further upgrades to the AN/SLQ-32 with new technologies for early detection, signal analysis, threat warning, and protection from anti-ship missiles. There are three established SEWIP block upgrades and a fourth is planned. On this contract Northrop Grumman will do the work in Baltimore, Sykesville, and Windsor Mill, Md.; Andover and Chelmsford, Mass; Tampa, Fla.; Newport Beach, Chatsworth, Redondo Beach, and San Diego Calif.; Littleton, Colo.; and Chandler, Ariz., and should be finished by September 2025. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or Naval Sea Systems Command at www.navsea.navy.mil.



Researchers eye unmanned X-plane to operate from small surface warships

BY **John Keller**

ARLINGTON, Va. – U.S. military researchers are asking industry to develop and demonstrate an advanced unmanned X-plane for long-endurance, vertical takeoff and landing (VTOL) from small-ship flight decks and austere land locations in bad weather and with sparse infrastructure.

ANCILLARY seeks to launch and recover UAVs without infrastructure; extended endurance and range; high payload to weight ratio; and robust flight controls and navigation.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a solicitation (DARPA-PS-23-03) for the AdvaNced airCraft Infrastructure-Less Launch And RecoverY (ANCILLARY) project.

The ANCILLARY program's primary objectives are launch and recovery without infrastructure; extended endurance and range; high payload to weight ratio at a tactical scale; and robust flight controls and relative navigation.

ANCILLARY contractors will focus on three technical areas: advanced VTOL configurations; power and propulsion architecture; and controls and automation.

DARPA researchers expect contractors to develop a prototype unmanned X-plane initially that has a gross takeoff weight of less than 250 pounds, and eventually to have a gross takeoff weight of less than 330 pounds.

These unmanned X-planes will function as communications relays, redundant sensors, multi-intelligence , surveillance and reconnaissance aircraft. The X-lane unmanned aerial vehicle (UAV) will have a new kind of propulsion with a challenging thrust-to-weight ratio, and low fuel consumption.

It is expected that performers will explore several power and propulsion designs in initial phases that could involve hybrid electric propulsion, internal combustion engines, or small turbines that use heavy fuel. Gasoline and hydrogen-based fuels are specifically excluded.

Other technology focuses of the project will involve thrust generators, power sources, power storage and distribution, automated ship deck landings, optical-based relative navigation, advanced control effectors, and direct-to-axis flight control.

Using all-axis control will enable precise position, velocity, and pose necessary for automated shipboard recovery, DARPA researchers say. Automated launch and recover are key research areas. ANCILLARY is a three-phase program spanning four years, including conceptual design through at-sea flight demonstration. Phase 1a involves conceptual design, phase 1b is preliminary design to a preliminary design review, and phase 2a is detailed design.

Companies interested were asked to email 10-page abstracts by 6 Jan. 2023 at DARPA-PS-23-03@darpa.mil. Companies submitting promising abstracts may be invited to give oral proposal presentations in late February 2023. Email questions or concerns to DARPA at DARPA-PS-23-03@darpa.mil. More information is online at https://sam.gov/opp/407db2a2ff594e7f9383bb01fb1c98f2/view.

Navy orders amplifier chassis from Argon ST for SIGINT Triton unmanned aircraft

U.S. Navy unmanned aerial vehicle (UAV) experts needed amplifier chassis to support the MQ-4C Triton maritime patrol UAV with the first deployment of IFC 4.0-configured unmanned aircraft. They found their solution from Argon ST, a Boeing company in Fairfax, Va. Officials of the Naval Supply Systems Command Weapon Systems Support activity in Philadelphia has announced a $21 million order to Argon ST for nine amplifier chassis in support of IFC 4.0-configured Triton UAVs. The MQ-4C Triton is a maritime patrol version of the Northrop Grumman RQ-4 Global Hawk long-range reconnaissance UAV. The Triton provides real-time intelligence, surveillance, and reconnaissance missions (ISR) over vast ocean and coastal regions. The unmanned aircraft is designed to perform continuous maritime surveillance, conduct search and rescue missions, and to complement the Boeing P-8 Poseidon crewed maritime patrol aircraft. The Integrated Functional Capability (IFC) 4.0 version offers signals intelligence (SIGINT) capability to match that of the Navy's EP-3 manned SIGINT aircraft, which the IFC 4.0 version of the Triton is replacing. The IFC-4 upgrade includes the Minotaur mission system used on the EP-3E. The Triton program is installing a SIGINT sensor payload with components from Boeing Argon ST in Fairfax, Va., and Sierra Nevada Corp. in Sparks, Nev. On this order, Argon ST will do the work in Fairfax, Va., and should be finished by March 2025. For more information contact Argon ST online at www.argonst.com, or the Naval Supply Systems Command Weapon Systems Support activity-Philadelphia at www.navsup.navy.mil/NAVSUP-Enterprise/NAVSUP-Weapon-Systems-Support/About-NAVSUP-WSS.

Army researchers eye unmanned aerial vehicle weapons for small units

U.S. Army combat experts are reaching out to industry to find companies interested in developing lethal and non-lethal weapons for deployment on small unmanned aerial vehicles (UAVs). Officials of the Army Contracting Command at Research Triangle Park, N.C., have issued a request for information (W911NF-23-AAL-04) for the Loitering Munitions project, which seeks to develop UAVs armed with weapons that have carry-and-release capabilities. These UAVs would have lethal and non-lethal effects delivery capabilities, and would be for forces ranging from the 4,413-soldier brigade combat team, to the 10-soldier infantry squad. The Army Contracting Command issued this request for information on behalf of the Army Application Laboratory of Army Futures Command in Austin, Texas. Lethal weapons can involve bombs and bullets, while non-lethal weapons can involve bright lights, loud noises, or low-power microwave weapons. With inspiration from the Russia-Ukraine war, the Army Futures Command-Army Application Laboratory is investigating the use of unmanned systems at increasingly lower Army command echelons for armed strike, as well as for intelligence gathering and reconnaissance. The Army is analyzing the loitering munitions market to identify candidate technologies for these applications, which will be primarily for small units. The most likely contractors to be involved in this project are small businesses with fewer than 1,000 employees. Companies were asked to email 10-page white papers by December. More information is online at https://sam.gov/opp/70c131e7549941e18b5b3eca8728c618/view.

Navy asks Boeing Insitu to build Blackjack and ScanEagle UAVs and sensors

BY **John Keller**

PATUXENT RIVER NAS, Md. – U.S. Navy unmanned aerial vehicle (UAV) experts are ordering 38 small and medium-sized UAVs from Boeing Insitu Inc. in Bingen, Wash., under terms of a $191.8 million order.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking Boeing Insitu to provide 13 RQ-21A Blackjack and 25 ScanEagle UAVs, as well as 48 RQ-21A and ScanEagle sensors and turrets, support equipment, tools, and spare parts. These reconnaissance UAVs are for the U.S. Navy, Marine Corps, and U.S. allies.

The Boeing Insitu RQ-21 is a twin-boom, single-engine, monoplane UAV for surveillance and reconnaissance. Users can launch and recover the reconnaissance drone on land or at sea without runways by using a pneumatic launcher and net-type recovery system.

The 81-pound Blackjack is eight feet long with a 16-foot wingspan, and is designed to carry multi-sensor payloads in a large pod below its nose. The UAV can fly as quickly as 104 miles per hour, cruises at 63 miles per hour, can fly as long as 24 hours, and can fly as high as 19,500 feet. It is a version of the Insitu Integrator UAV.

Users can customize the RQ-21A Blackjack's multi-mission open-architecture payload bays with visible-light and infrared cameras, communications, and other tools to provide situational awareness information to warfighters on the forward edge of battle.

The ScanEagle UAV is 5.1 feet long with a 5.6-foot wingspan. It weighs as much as 48.5 pounds and can carry a 7.5-pound sensor payload. The UAV can fly for more than 24 hours at altitudes as high as 19.500 feet, and at speeds to 80 knots.

The drone can integrate new payloads quickly, offers roll-on, roll-off capability to move the system quickly from ship to shore, as well as to and from cargo aircraft. The UAV can carry sensor payloads as heavy as 39 pounds.

The Blackjack's standard sensor payload consists of a visible-light imager, mid-wave infrared imager, laser rangefinder, infrared marker, communications, and automatic identification system.

The RQ-21A will provide persistent maritime and land-based tactical reconnaissance, surveillance, and target acquisition (RSTA) data collection and dissemination capabilities to sailors and Marines.

For the Marine Corps it will provide the marine expeditionary force, divisions, and regiments with a dedicated intelligence, surveillance, and reconnaissance (ISR) system that sends information to the tactical commander in real time.

For the Navy the Blackjack will provide persistent RSTA information to Navy ships, Marine Corps land forces, Navy expeditionary combat command forces, and Navy special warfare units.

The Boeing Insitu ScanEagle UAV is 5.1 feet long with a 5.6-foot wingspan. It weighs as much as 48.5 pounds and can carry a 7.5-pound sensor payload. The UAV can fly for more than 24 hours at altitudes as high as 19.500 feet, and at speeds to 80 knots.

The ScanEagle UAV can fly on gasoline or heavy fuels like jet fuel, diesel, or kerosine. It provides persistent surveillance and reconnaissance imagery on land or at sea at lower costs than other surveillance methods for military and agriculture missions.

ScanEagle can carry a sensor payload consisting of visible-light camera, medium-wave infrared imager, or both integrated in one turret. The UAV ans has an analog digitally encrypted video data links, as well as encrypted or unencrypted command-and-control data links.

The UAV can be launched autonomously and uses a no-nets recovery system that recovers with its wing tip on a rope that hangs from a boom.

On this order Boeing Insitu will do the work in Bingen, Wash., and at locations outside the Continental U.S., and should be finished by June 2026. For more information contact Boeing Insitu online at www.insitu.com, or Naval Air Systems Command at www.navair.navy.mil.

Saab to build ASW unmanned submersibles that mimic enemy submarines

BY **John Keller**

NEWPORT, R.I. – U.S. Navy anti-submarine warfare (ASW) experts needed target underwater unmanned underwater vehicles (UUVs) that mimic the acoustic and non-acoustic signatures of advanced nuclear- and diesel-powered submarines. They found their solution from Saab Inc. in East Syracuse, N.Y.

Officials of the Naval Undersea Warfare Center (NUWC) in Newport, R.I., have announced a $173.2 million contract to Saab to build, test, and deliver drones able to emulate the behavior and sensor signatures of enemy submarines to help Navy ASW experts practice their skills from surface warships, submarines, helicopters, and fixed-wing aircraft.

These Saab UUVs that can disguise themselves as potentially hostile submarines are called the MK 39 Mod 2 expendable mobile antisubmarine warfare training targets (EMATT).

These next-generation ASW training targets are designed to help Navy submarine-, surface ship-, and aircraft-based ASW forces train to detect, hunt, and destroy quiet enemy submarines.

The MK 39 Mod 2 expendable mobile antisubmarine warfare training targets (EMATT) mimic the sounds and behavior of enemy submarines for anti-submarine warfare training.

Navy aircraft and surface warship crews will use the EMATT to train in open-ocean, unrestricted, and on-range ASW training missions. The Navy can launch EMATT out of sonobuoy launchers on ASW helicopters and fixed-wing aircraft, and from moving surface warships.

The EMATT is 3 feet long, 5 inches in diameter, and weighs 22 pounds, so it is small enough to be dropped into the ocean by hand from ships or helicopters.

The submarine-emulating UUV has sensors that emulate acoustic and non-acoustic signatures of advanced nuclear- and diesel-powered submarines, and can operate for as long as eight hours on one battery charge.

Control software for the Saab EMATT runs on a Windows PC or laptop computer, and can program the target's course, depth, speed, time, and passive tonal changes. The software also can program the EMATT to maneuver automatically in response to active sonar pings.

Saab engineers are designing the latest version of EMATT to be more affordable than previous generations of ASW training targets. The latest version has programmable acoustics, better representation of hostile submarines than previous versions, and acoustic communications links that Navy forces can use in daytime, at night, and in rough seas.

Saab will do the work on this contract in East Syracuse, N.Y., and with options should be finished by September 2032. For more information contact Saab online at www.saab.com, or the Naval Undersea Warfare Center-Newport at www.navsea.navy.mil/Home/Warfare-Centers/NUWC-Newport.

Leonardo DRS to build electro-optical targeting for Bradley armored vehicles

BY **John Keller**

REDSTONE ARSENAL, Ala. – U.S. Army armored combat vehicles experts needed electro-optical sensor systems to enable commanders of the M2 Bradley Fighting Vehicle to search the surrounding area while safely inside their vehicles. They found their solution from Leonardo DRS.

▲ The IBAS viewer provides targeting, tracking, engagement, and fire control for the vehicle's TOW missile system and 25- and 7.65-millimeter machine guns.

Officials of the U.S. Defense Logistics Agency Aviation segment at Redstone Arsenal, Ala., have announced two orders to the Leonardo DRS Electro-Optical & Infrared Systems segment in Melbourne, Fla., collectively worth $234.1 million for the Improved Bradley Acquisition System (IBAS) commander's viewer unit.

The IBAS viewer for Bradley armored combat vehicles provides targeting, tracking, engagement, and fire control for the Bradley vehicle's tube-launched, optically tracked, wire-guided (TOW) missile system, as well as its 25- and 7.65-millimeter machine guns.

Using forward looking infrared sensors and an eye-safe laser rangefinder, the system enables the vehicle's commander and gunners to detect, identify, and acquire targets at long ranges to make the most of the vehicle's weapons. As a result, these systems give warfighters major battlefield advantages at night and in poor visibility.

The IBAS commander's viewer is an updated version of the Bradley Fighting Vehicle commander's independent viewer — a 360-degree panoramic surveillance sight that gives the Bradley fighting vehicle improved hunter and killer capabilities, increases situational awareness, and boosts weapon effectiveness for the Bradley commander.

The second-generation infrared vision system for Bradley armored combat vehicles includes enhanced capabilities for early threat detection from long stand-off ranges.

On these orders, Leonardo DRS should be finished with the work in December 2026. For more information contact Electro-Optical & Infrared Systems online at www.leonardodrs.com, or the Defense Logistics Agency Aviation division at https://www.dla.mil/Aviation/.

Clear Align systems designers increase range for persistent surveillance

EAGLEVILLE, Pa. – Electro-optics specialist Clear Align LLC in Eagleville, Pa., is introducing the VZ 1200 series of medium-wave infrared (MWIR) multimodal wide area surveillance systems for long-range persistent-surveillance applications like perimeter security and border control.

These next-generation thermal or cooled MWIR cameras are for day or nighttime wide-area surveillance, and offer 26 to 42 percent longer range than their nearest competitors, based on testing conducted on 12-to-40-mile ranges in several countries, company officials say.

Performance enhancements of these electro-optical sensors are based on advances in MWIR camera design and image processing. Thermal imagers incorporated technical advances in material science for mid-wave infrared, high transmission optical coatings, optical component fabrication precision, and mechanical design.

Detection, recognition, and identification at long ranges provide additional time to assess, decide, and act on threats such as people, unmanned aerial vehicles (UAVs), land vehicles, and boats.

Clear Align customers evaluated the cameras in the visible and MWIR spectra to human and vehicle targets. The evaluation of multimode surveillance systems for day and night imaging demonstrated an increase in target recognition ranges of 26 percent, on average, in side-by-side competition on measured ranges, when compared to five tier-one competitors.

Sensitivity improvements in the mid-wave infrared sensors outperformed the competition with data supporting up to 42 percent longer ranges without increasing camera size, weight, power, and cost (SWaP-C).

The VZ 1200 MWIR long-range camera system integrates a 1200-millimeter MWIR spectral range camera monitoring electrical transmission towers as far out as 38 miles. Also available for performance imagery are systems with 900- and 600-millimeter standard and high-definition cooled MWIR sensor technology.

MWIR camera or thermal camera sensors include either standard 640-by-512-pixel indium antimonide detectors or premium high-definition 1280-by-1024-pixel indium antimonide detectors.

The cameras offer integrated artificial intelligence (AI) and machine learning that enable multimodal sensor systems automation to detect and recognize crewed and unmanned aircraft, land vehicles, people, and even weapons.

Clear Align designers have found ways to increase the range of electro-optical sensors for persistent surveillance applications by as much as 42 percent.

The Clear Align embedded processing architecture enables deployments either at the edge, or centralized processing at an operations center. Also provided is networking technology to link the Clear Align systems for automated command and control, target handoff, and local communications between users and the sensor suite.

This handoff can be done sensor-to-sensor and sensor to the user, whether they are deployed in the field, at the operations center, or at higher-level command centers.

The Clear Align integrated sensor systems implement a modular open system architecture (MOSA) to alleviate long-term electronic component obsolescence or COVID-era electronics shortages and supply chain disruptions.

MOSA design also enables software upgrades to maintain performance long term. The Clear Align open-systems architecture is upgradable, scalable, and designed to manage obsolescence.

The VZ 1200 series of MWIR camera systems provide 100,000 hours of electromechanical reliability when deployed in harsh environments such as arctic cold, and can deploy in temperatures from -32 to 65 degrees Celsius.

These cameras can incorporate radar, infrared cameras, daytime cameras, laser rangefinders, and other sensor technologies on mobile and stationary towers. For more information contact Clear Align at https://clearalign.com.

L3Harris to provide electro-optics sensors fire control for warship deck guns

BY **John Keller**

WASHINGTON – Military electro-optics experts at L3Harris Technologies Inc. will provide shipboard sights for the fire control necessary for U.S. Navy surface warships to hit enemy ships and aircraft with naval gun fire under terms of an $8.9 million order announced

Officials of the Naval Sea Systems Command in Washington are asking the L3Harris KEO segment in Northampton, Mass., to produce additional MK 20 electro-optical sensor systems (EOSS), radar cross section kits, installation and checkout, and on-board repair parts kits, and depot spares.

The EOSS electro-optics system is a check sight and targeting sensor for anti-surface and anti-air warfare and naval gun fire support missions, Navy officials say. The order is for the U.S. Navy and government of Australia.

The MK 20 EOSS sensors are a major components of the MK 34 5-inch guns aboard Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers, as well as aboard the U.S. Coast Guard Offshore Patrol Cutter, for use against enemy ships, boats, and aircraft.

The MK 20 electro-optical sensor systems (EOSS) helps enable Navy surface warships to hit enemy ships and aircraft with naval gun fire.

L3Harris KEO has been building the EOSS since 2005. That year the company won a Navy contract to provide the EOSS for the Ticonderoga-class Cruiser Modernization Program. Company electro-optical engineers built on the MK 46 Optical Sight System to blend new technologies into the MK 20 shipboard MOD 0 EOSS, as well as integrate the system into the MK 34 5-inch deck guns.

The MK 20 EOSS has digital stabilization with fiber-optic gyros, a separate eye-safe laser rangefinder with diode-pumped laser, enhanced built-in test, and improved sensor-to-sensor boresight alignment. The EOSS meets MIL-S-901D heavyweight and large-displacement shock tests.

The MK 20 MOD 0 incorporates several technology improvements over the MK 46, and new features that support integration with the MK 34 Gun Weapons System (GWS).

To integrate with the MK 34 deck gun, the EOSS has a new interface electronics unit (IEU) that interfaces with as many as two deck gun computers and three deck gun consoles to provide video, target bearing and range, and system status data to all three, while taking commands from any one, L3Harris officials say.

On this contract modification L3Harris will do the work in Northampton, Mass., and should be finished by March 2026. For more information contact L3Harris KEO online at www.l3harris.com/all-capabilities/naval-platform-imaging, or Naval Sea Systems Command at www.navsea.navy.mil.

Nightforce to provide special-operations electro-optical sniper rifle scopes

BY **John Keller**

MacDILL AIR FORCE BASE, Fla. – U.S. special operations experts needed standard and long-range daylight and nighttime rifle scopes for special operations warfighters. They found their solution from Nightforce Optics Inc. in Orofino, Idaho.

▲ The rifle sight is slightly longer than 10 inches, weighs 21 ounces, and its daylight visible center red dot allows for rapid engagements.

Officials of U.S. Special Operations Command at MacDill Air Force Base, Fla., announced a $17.7 million order last week for Squad-Variable Powered Scopes (S-VPS) and Precision-Variable Power Scopes (P-VPS) rifle scopes.

The S-VPS is the Nightforce ATACR 1-8X24 F1 low-power electro-optical variable rifle scope that includes ED glass, daylight illumination, an intelligent reticle, low-profile adjustments, and a field of view at 1x equivalent to open sights, yet more precise, company officials say.

The rifle sight is slightly longer than 10 inches, and weighs 21 ounces. Its daylight visible center red dot allows for rapid engagements.

The sight provides as much as 8x zoom to help locate, identify, and engage targets at the maximum effective range of most rifles. Its intelligent FC-DM first focal plane reticle provides precise hold and hold-off points.

The rifle sight low-profile turrets are capped to prevent accidental adjustment and offer 0.1 mil-radian adjustment. The sight has an integrated power throw lever to aid in fast magnification adjustments.

The P-VPS consists of the Nightforce MIL-SPEC ATACR 5-25×56 F1 and the MIL-SPEC ATACR 7-35×56 F1, which will be integrated as the standard and the long-range solutions for U.S. Special Operations Command's Sniper Weapon Systems.

The Nightforce MIL-SPEC ATACR 5-25 and 7-35 are designed to provide improved target detection, acquisition, and hit probability for engagements out to 1500 meters and beyond.

The Nightforce MIL-SPEC ATACR 5-25 and 7-35 enable extended-range target detection and mechanical adjustment. Both optics feature Nightforce's ED glass, 0.1 Mil-Radian adjustment value for windage and elevation, the Horus Vision TREMOR3 reticle, and a tan, hard-coat anodized finish.

These rifle sights optics also use a Nightforce scope mount and laser range finder to enable special operations snipers quickly to detect, range, and receive firing solutions.

The new optics are to augment several different systems in the Special Operations Command inventory and will coincide with the release and fielding of the Mk22 Sniper System, based on the Multi-role Adaptive Design (MRAD) bolt-action rifle from Barrett Firearms Manufacturing in Murfreesboro, Tenn.

For more information contact Nightforce Optics online at www.nightforceoptics.com, or Special Operations Command at www.socom.mil.

POWER ELECTRONICS

▲ Champion Aerospace to provide power electronics for combat aircraft avionics

U.S. Navy combat aircraft experts needed power conditioning and control retrofit kits for the F/A-18E/F Super Hornet jet fighter bomber and the EA-18G Growler electronic warfare (EW) jet. They found their solution from Champion Aerospace LLC in Liberty, S.C.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $9 million contract to Champion Aerospace for 252 175-amp transformer rectifier unit (TRU) retrofit kits for Super Hornet and Growler carrier-based combat jets.

A TRU combines a transformer and a rectifier into one unit. In aircraft it converts 120-volt AC power from the aircraft engine, auxiliary power unit (APU), or ground power unit (GPU) to 28-volt DC power for onboard avionics.

Of 252 TRU power electronics units, 240 are for the F/A-18E/F fleet and EA-18G squadrons, and 12 are for EA-18G Growler capability modification operational test for upgrading the current 150-amp TRU to a 175-amp TRU.

The F/A-18E/F Super Hornet is a twin-engine carrier-capable multirole fighter and light-attack bomber based on the McDonnell Douglas F/A-18 Hornet, which entered U.S. Navy squadrons in 1983. Super Hornets are larger and more advanced derivatives, with a larger wing and a longer fuselage to carry more fuel and more powerful engines.

The Super Hornet has an internal 20-millimeter M61 rotary cannon and can carry air-to-air missiles and air-to-surface weapons, and has improved active electronically scanned array (AESA) radar, large displays, the joint helmet mounted cuing system, and several other avionics systems.

The EA-18G Growler is a specialized version of the F/A-18E/F Super Hornet that is adapted for jamming enemy radar and communications, as well as attacking enemy radar installations with missiles that home-in on radar signals.

The Growler is designed for suppressing enemy air defenses; stand-off and escort jamming; non-traditional electronic attack by integrating with ground EW operations; self-protect and time-critical strike support; and cost-effective technology insertion and system upgrades.

The Growler's EW gear includes AN/ALQ-218 wideband receivers on the wingtips, and ALQ-99 high- and low-band tactical jamming pods. The ALQ-218 and ALQ-99 form an EW suite that provides detection and jamming against all known surface-to-air missiles. The aircraft is being readied for future threats with the Raytheon Next-Generation Jammer (NGJ).

The Growler can carry as many as five ALQ-99 jamming pods and two AIM-120 AMRAAM air-to-air missiles or AGM-88 HARM anti-radar missiles. It uses an interference cancellation system that allows radio voice communication during jamming.

On this contract Champion Aerospace will do the work in Liberty, S.C., and should be finished by December 2023. For more information contact Champion Aerospace online at www.championaerospace.com, or Naval Air Systems Command at www.navair.navy.mil.

SENSORS

▼ Navy orders 126,000 air-launched sonobuoys for anti-submarine warfare (ASW)

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 $181.9 million order to ERAPSCO in Columbia City, Ind., for 126,000 sonobuoys for airborne ASW operations.

Sonobuoys are air launched expendable, electro-mechanical ASW acoustic sensors designed to relay underwater sounds of ships and submarines. Sonobuoys enable Navy ASW forces

to track potentially hostile submarines operating in the open ocean and in coastal areas that could be threats to Navy carrier battle groups or other forces. Information from these systems can help enable precision attacks with air-launched torpedoes.

This order is for 100,000 AN/SSQ-53, 16,000 AN/SSQ-101, and 10,000 AN/SSQ-62 production sonobuoys for annual training, peacetime operations, and testing.

Navy fixed-wing aircraft and helicopters 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 wide-band omni. The buoy digitally conditions and amplifies the acoustics and provides directional data that helps establish azimuthal bearing to the submarines being tracked.

The AN/SSQ-53F directional frequency and ranging (DIFAR) sonobuoy, which is dropped from fixed-wing aircraft or helicopters, uses four hydrophones — each one a multichannel directional piezoelectric ceramic transducer — that operate at depths of 90, 200, 400, and 1,000 feet to listen for potentially hostile submerged enemy submarines.

Each AN/SSQ-53F sonobuoy is designed to determine the direction from which it can hear submarine noises, so a pattern of sonobuoys can determine a submarine contact's range, bearing, and location by using triangulation.

The Navy Boeing P-8A Poseidon maritime patrol jet will be able to drop sonobuoys from relatively high altitudes on large-area patterns. The aircraft will be able to monitor signals from sonobuoy fields, or hand off that job to the Navy MQ-4C Triton broad-area maritime surveillance unmanned aerial vehicle (UAV).

The AN/SSQ-101 ADAR sonobuoy provides a commandable 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 underwater sound waves.

The AN/SSQ-101B is a NATO A-size sonobuoy that has a commandable passive search capability. When deployed, the ADAR array uses a pentagon shaped, horizontally oriented pattern of hydrophones to detect and beam form underwater sound waves. All of the 40 hydrophones are located along the circumference and radials of the array structure.

The AN/SSQ-101B from helicopters, fixed-wing aircraft, or from the deck of a surface vessel. When air deployed, the sonobuoy's descent is stabilized and slowed by a parachute.

The AN/SSQ-62E DICASS sonobuoy is for detecting and localizing submarines in preparation for attack. I 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-62 sonobuoys work together with the Navy's AN/SSQ series of sonobuoys, which in addition to the AN/SQQ-62 consist of the SSQ-36 bathythermograph (BT); SSQ-53 passive directional low frequency analyze and record (DIFAR); SSQ-101 air deployed active receiver (ADAR); SSQ-110 multi-static non-coherent source; and SSQ-125 multi-static coherent source.

ERAPSCO operates as a joint venture between the Sparton Corp. in Le Leon Springs, Fla., and the Ultra Group Maritime segment in Columbia City, Ind.

The company will do the work on this order in De Leon Spring, Fla., and Columbia City, Ind., and should be finished by September 2025. For more information contact ERAPSCO online at www.erapsco.com, Sparton Defense & Security at www.sparton.com, Ultra Maritime at www.ultra.group/us/our-business-units/maritime, or Naval Air Systems Command at Paste link here.

RADAR

▼ Raytheon to upgrade radar-guided machine guns for South Korea surface warships

Shipboard weapons experts at Raytheon Technologies Corp. will upgrade computer-controlled and radar-guided Gatling guns that defend surface warships of the Republic of Korea from anti-ship missiles, manned aircraft, and drones under terms of a $49 million order.

Officials of the Naval Sea Systems Command in Washington are asking the Raytheon Missiles & Defense segment in Tucson, Ariz., for four MK-15 Close-In Weapon Systems (CIWS) Block 0 to Block 1B Baseline 2 upgrade and conversion and related equipment for Korean warships under the foreign military sales program.

CIWS, often pronounced "sea-wiz," is a fast-reaction radar-guided terminal shipboard air defense against low- and high-flying, high-speed maneuvering anti-ship missile threats that have penetrated all other defenses. These high-volume machine guns, deployed since the early 1980s, designed to throw out a curtain of bullets.

These ship-defense systems are for the Korean Sejong the Great-class guided-missile destroyer, and for Korean destroyers in development under the Korean Destroyer Next Generation project.

At sea, the CIWS is designed to defeat anti-ship missiles and other close-in threats that have pierced other lines of defense. It also has a land use as a counter-rocket, artillery, and mortar system that detects and destroys incoming rounds.

A self-contained package, the CIWS shipboard weapons automatically handle search, detection, threat evaluation, tracking, engagement, and kill assessment. The Block 1B version of the system adds control stations that enable operators to track and identify targets visually before engagement.

The 1B variant's configuration augments the CIWS anti-air warfare capability by adding a forward-looking infrared sensor for use against helicopters and high-speed surface craft at sea. The CIWS is installed on all U.S. Navy surface combatant ship classes and on those of 24 allied nations.

On this contract Raytheon will do the work in Louisville, Ky.; Anaheim and Palo Alto, Calif.; Williston, Vt.; Tucson, Phoenix, and Tempe, Ariz.; Andover, Mass.; Mason and Dayton, Ohio; Melbourne, Fla.; Joplin, Mo.; Hauppauge, N.Y.; Grand Rapids, Mich.; and Norcross, Ga., and should be finished by May 2025.

For more information contact Raytheon Missiles & Defense online at www.raytheonmissilesanddefense.com, or Naval Sea Systems Command at www.navsea.navy.mil.

EMBEDDED COMPUTING

▲ Boeing to provide 6U VPX signal-processing and targeting computers for Navy combat jets

U.S. Navy combat avionics experts are asking the Boeing Co. to provide components for data- and signal-processing targeting computers for the F/A-18E/F Super Hornet jet fighter-bomber and EA-18G Growler electronic warfare

(EW) jet under terms of a $34.7 million order.

Officials of the Naval Supply Systems Command's Weapons Systems Support segment in Philadelphia are asking the Boeing Defense, Space & Security segment in St. Louis to provide 57 each of processor and target lo for the Distributed Targeting Processor-Network (DTP-N) system on Super Hornet and Growler aircraft.

The DTP-N from the L3Harris Technologies Inc. Space & Airborne Systems segment in Palm Bay, Fla., is a high-performance data and signal processing computer that bridges gaps between Hornet and Growler onboard and external data networks in real time. The DTP-N) is 17-times more powerful than the previous systems.

DTP-N helps reduce pilot workload by providing actionable information on the Super Hornet and Growler large-area display. It has the power to compute algorithms quickly to deal with the complex battlespace of the future, L3Harris officials say.

It provides performance scalability, technology insertion, and functional growth capability via an open-systems architecture design. It also has multiple levels of security and complies with standard electronics architectures for Super Hornet and Growler aircraft.

Multilevel security supports multiple security trusted computing enclaves on the aircraft, and provides secure interoperability among several subsystems.

The DTP-N improves mission processing, subsystem interfacing, display generation, and secure, multilevel information management. It hosts user-generated software with third-party and supplier-provided software.

The DTP-N computer provides a gateway from existing F/A-18E/F and EA-18G avionics to new external radio frequency tactical networks. Connection to the Tactical Targeting Network Technology (TTNT) through MIDS-JTRS Ethernet interfaces helps increase bandwidth to collect and share time-critical information using streaming video and still imagery.

The DTP-N is an eight-slot 6U VPX avionics computer that can process information at speeds to 919 billion floating point operations per second. It has seven 10GBase-SR fiber-optic ports and 11 copper 10/100/1000Base-T Ethernet ports. The computer uses the VxWorks real-time operating system from Wind River Systems in Alameda, Calif.

On this contract Boeing will do the work in St. Louis, and should be finished by December 2026. For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds, or the Naval Supply Systems Command's Weapons Systems Support segment at www.navsup.navy.mil/NAVSUP-Enterprise/NAVSUP-Weapon-Systems-Support.

RF AND MICROWAVE

▼ Spectrum warfare to use light and RF energy for sensors and electronic warfare (EW)

U.S. Navy researchers needed an experimental deployable system able to help U.S. military forces manage and protect their use of RF, microwave, and light energy. They found their solution from Systems Engineering Associates Corp. (SEACORP), a KAPCO Defense company in Middletown, R.I.

Officials of the Office of Naval Research (ONR) in Arlington, Va., announced a $24.5 million contract to SEACORP to develop the Electromagnetic Maneuver Warfare Modular Suite (EMWMS).

The EMWMS spectrum warfare system will be a mobile configurable system designed to help Navy, U.S. Marine Corps., and other U.S. and allied military forces ensure their use of the electromagnetic spectrum for command, control, communications, and intelligence uses, and help deny its use to the enemy.

Electromagnetic maneuver warfare describes the ways the Navy and other military forces take advantage of RF and microwave and light energy for wireless communications, sensors, situational awareness, and reconnaissance, and help jam enemy uses of electromagnetic energy.

The EMWMS will take advanced of advanced sensors, digital signal processing, and other kinds of advanced

computing technologies and software to monitor the nearby electromagnetic spectrum, as well as to jam or spoof enemy communications, sensors, and surveillance systems.

The EMWMS is for long-term use in one location, or for roll-on/roll-off deployable missions aboard manned and unmanned aircraft, land vehicles, surface ships, and submarines.

On this contract, SEACORP will do the work in Middletown and Narragansett, R.I.; Norfolk and McLean, Va.; and Rochester, N.Y., and should be finished by May 2023. The contract has options that could extend work until September 2027, and the contract's value to $79 million. For more information contact SEACORP online at www.seacorp.com, or the Office of Naval Research at www.nre.navy.mil.

ELECTROMAGNETIC WARFARE

▲ Verus Research for high-power microwaves testing for future electromagnetic warfare

U.S. Air Force electromagnetic warfare experts needed a company to perform vulnerability testing on several electronic systems to help determine the effectiveness of potential high-power electromagnetic (HPEM) weapons. They found their solution from XL Scientific LLC, which is doing business as Verus Research, in Albuquerque, N.M.

Officials of the Air Force Research Laboratory Directed Energy Directorate at Kirtland Air Force Base, N.M., announced a $19.5 million five-year contract to Verus Research for the High Power Electromagnetics (HPEM) Empirical Effects project.

Verus experts will collect and analyze data from the empirical effects of high-power microwaves against a broad range of electronics, to capture HPEM effects at the device, circuit, and system levels.

The project is part of an effort that seeks to find a waveform for an effective electromagnetic weapon that is small size, weight, and power consumption (SWaP). This weapon is to help validate modeling tools and techniques.

This testing will involve a plan that describes appropriate instrumentation and sensors, best practices and industry standards, test and measurement approaches, cables, and sensors for the project.

This work will include capturing effects and waveform data, identifying new targets, developing surrogate electronic systems for testing, purchasing representative electronic subsystems, developing fault trees, building probability of effect curves for the electronic subsystems, and planning outdoor effects testing to characterize electromagnetic weapon effectiveness.

Work will include performing effectiveness modeling, including developing, executing, and validating computational models, to assess the effectiveness and military utility of an HPEM weapon, characterizing collateral damage, developing recuperation time models, and performing trade studies to compare different HPEM weapons.

This work will provide information to develop, identify, and integrate new and existing software and hardware for battle damage assessment and recuperation time

On this contract Verus Research will do the work in Albuquerque, N.M., and should be finished by September 2027. For more information contact Verus Research online at https://verusresearch.net, or the Air Force Research Laboratory Directed Energy Directorate at www.afrl.af.mil/RD.

RADAR

▼ DRS Laurel to build missile-defense radar to protect Navy surface warships

U.S. Navy missile-defense experts are asking the DRS Laurel Technologies segment of Leonardo DRS in Johnstown, Pa., 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 $8.7 million order to DRS Laurel to build AN/SPQ-9B radar systems and support equipment.

DRS in April 2018 displaced Northrop Grumman Corp. as the Navy's AN/SPQ-9B shipboard radar contractor in a $64.3 million deal. That contract, which combined purchases for the Navy and the government of Japan, included options that could bring its cumulative value to $263 million.

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 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.

On this order DRS Laurel will do the work in Largo, Fla., and should be finished by May 2025. For more information contact DRS Laurel Technologies online at www.leonardodrs.com/locations/naval-electronics-laurel-technologies-johnstown-pa, or Naval Sea Systems Command at www.navsea.navy.mil.

CONNECTORS

▶ High-reliability micro-coax connectors introduced by Amphenol RF

Amphenol RF in Danbury, Conn., is introducing IP67 SubMiniature version A (SMA) connectors with waterproof options for designs with space constraints or that require a high degree of flexibility. These front-mount jacks are engineered for 1.32- and 1.37-millimeter micro-coax cable types, and are suited for industrial automation, kiosks, and smart meter applications. The high-reliability IP67 SMA panel mount jacks offer RF performance to 7 GHz and feature a threaded coupling mechanism for added vibration resistance. The front-mount bulkhead configuration offers extra protection when fastened to the inside of the panel or enclosure. The micro-coax cable can stabilize electrical characteristics even if bent while continuing to provide thermal resistance. For more information contact Amphenol RF online at www.amphenolrf.com.

DATA STORAGE

▼ Secure rugged networked-attached data storage introduced by Mercury

Mercury Systems Inc. in Andover, Mass., is introducing Rugged Data Storage (RDS) network-attached storage (NAS) system for mission-critical aerospace, defense, and commercial edge applications that require low-latency, scalability, and security. Developed with VAST Data Federal Inc. in Vienna, Va., RDS is a universal single-tier flash cloud for all types of data that can ease data bottlenecks, and offers complex storage tiering traditionally done with hard disk drives and other data storage media. The RDS universal data storage approach enables fast, secure access to big data, artificial intelligence (AI), and machine learning-powered exploitation at the edge, so users can make critical decisions quickly. RDS uses commercial flash technology and software algorithms from VAST Data to extend write endurance to more than years, and reduces disk space with data

reduction and compression. The RDS is optimized for size, weight, and power (SWaP)-constrained rugged environments such as aircraft, ships, ground radar stations, and industrial applications. The RDS uses high-speed NVMe data storage, offers DPU network acceleration, and has short-depth storage boxes (D-BOX), compute boxes (C-BOX), and network switch boxes to scale performance or storage capacity. It meets MIL-STD-810 for ruggedization and has integrated FIPS 140-2 security for trusted computing. For more information contact Mercury Systems online at www.mrcy.com, or VAST Data Federal at https://vastfederal.com.

POWER ELECTRONICS

▼ Double-insulated single-phase EMC filter introduced by SCHURTER

SCHURTER Inc. in Santa Rosa, Calif., is introducing the IEC protection class II FMAB NEO single-phase electromagnetic compatibility (EMC) power filter for applications such as critical medical systems and in-home medical devices that provide user protection from electric shock through two levels of insulation without the need for earthing. This double-insulated filter with no protective ground offers insulation safety testing, low leakage current, and high

attenuation performance of electromagnetic interferences — particularly symmetrical attenuation. According to IEC 61140, the term IEC protection class II is also referred to as protective insulation. It is further defined as protection by doubling or reinforcing insulation of live parts. All clearances and creepage distances must be doubled, requiring that the inside of the filter also has double or reinforced insulation. The FMAB NEO for Class II meets all these requirements, with reinforced insulation inside of the filter and large plastic collars around the terminals. Additionally, the filters are hi-pot tested with four-kilovolt AC (kVAC) between L or N against the metal housing for a dielectric strength of more than 5.6 kilovolts DC (kVDC), according to IEC 60601-1. The FMAB NEO for IEC protection class II is rated 1-20 amps at 250 volts AC according to IEC and 125 and 250 volts AC according to UL. SCHURTER Inc. is the exclusive North America sales and distribution office for the SCHURTER Group in Lucerne, Switzerland. For more information contact SCHURTER Inc. online at www.schurter.com.

INTERCONNECTS

▼ Connectors with L-coding and dip contacts introduced by Binder-USA

Binder-USA in Camarillo, Calif., is introducing M12 panel-mount connectors with L-coding and dip solder contacts for hand soldering, wave soldering, and reflow soldering on printed circuit boards. As part of Binder's 823 series, this compact connector is a space-saving alternative to the 7/8-inch connectors typically used in power supplies for Industrial Ethernet applications in the PROFINET environment. When mated, the connector offers IP68-level protection, and is suitable for front and rear panel mounting. Binder's 823 series is suited to the assembly and disassembly of circuit boards. Two-piece male and female connectors with separate mounting body and socket housing enables technicians to solder without the housing, significantly reducing the stress load on both components and helping to eliminate this as a source of failure. For more information contact Binder-USA online at www.binder-usa.com/us-en.

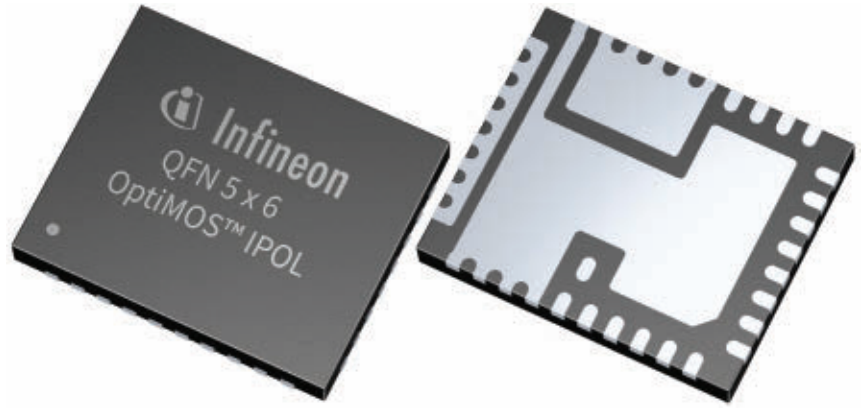
TABLET COMPUTERS

▲ 5G-capable rugged tablet computer for mobile field workers introduced by Handheld

Handheld Group in Lidköping, Sweden, is introducing the Algiz RT10 ultra-rugged 10-inch Android tablet computer for mobile field workers. The Algiz RT10 offers an IP67 rating and the ability to withstand the effects of water, dust, shock, and extreme temperatures, and offers a high-resolution 10-inch touchscreen and a weight of 2.2 pounds. With a Qualcomm Snapdragon 5G platform and Android 11 operating system (OS), it allows live video streaming in the field, and has enhanced security features including fingerprint ID, and the MaxGo mobile device management (MDM) software that enables custom settings across all devices in a field network. Other pertinent features of this rugged tablet compute include Google GMS for Play Store and Google Maps access.; 5G, 4G/LTE high-speed data, Wi-Fi, BT and NFC; built-in u-blox NEO M8U chipset for GNSS location data using GPS, GLONASS, Galileo, QZSS and BeiDou; 13-megapixel rear-facing and 5-megapixel front-facing cameras; daylong user-replaceable battery; optional scanner and integrated UHF; and carrying cases and vehicle docks with GPS and Wi-Fi antenna pass-through. For more information contact the Handheld Group online at www.handheldgroup.com.

POWER ELECTRONICS

▶ IPOL buck regulators for data storage and distributed power offered by Infineon



Infineon Technologies AG in Munich is introducing a family of OptiMOS 5 integrated point of load (IPOL) buck regulators for next-generation server, data storage, telecommunications, data communications, and distributed-power applications. These buck regulators offer VR14-compliant SVID standard and I²C/PMBus digital interfaces for Intel and AMD server CPUs and network application-specific integrated circuits (ASICs) and field-programmable gate arrays (FPGAs). A buck step-down switch-mode voltage regulator has a lower output voltage than its input voltage. It is a DC-to-DC power converter that steps down voltage while stepping up current from its input to its output. It is housed in a 5-by-6-cubic-millimeter PQFN package. The OptiMOS IPOL single-voltage synchronous buck regulator TDA38640 supports an output current as strong as 40 amps. The device comes with Intel SVID and I²C/PMBus digital interfaces and can be used for Intel VR12, VR12.5, VR13, VR14, IMPVP8 designs, and DDR memory without significant changes to the bill of materials (BOM). The TDA38740 and TDA38725 digital IPOL buck regulators support output currents as strong as 40 and 25 amps respectively, and come with a PMBus interface. All three devices use Infineon's proprietary fast constant on time (COT) pulse width modulation (PWM) engine to deliver transient performance while simplifying the design development. For more information contact Infineon online at www.infineon.com.

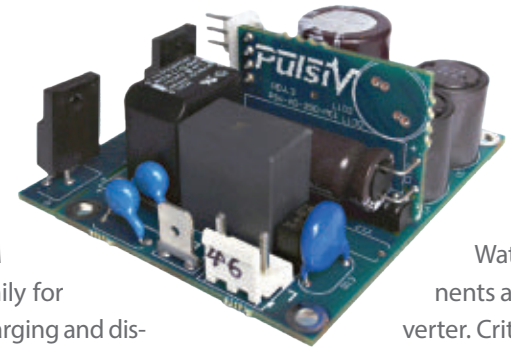
DATA STORAGE

▼ Secure solid-state data storage with cryptographic modules offered by DIGISTOR

DIGISTOR, a CRU Data Security Group (CDSG) company in VANCOUVER, Wash., is introducing pre-boot authentication (PBA) to the company's line of secure DIGISTOR Citadel self-encrypting data (SED) storage drives. The secure data storage drives are for developing secure data at rest (DAR) storage solutions in commercial and other government applications must protect against ransomware and other cyber threats. In addition, DIGISTOR is announcing that the Citadel C series Advanced version has been listed by NIST as a FIPS 140-2 L2-certified data storage device with National Institute of Standards and Technology (NIST) certificate #4294. This certification is an additional assurance that DIGISTOR C series Advanced SEDs have been tested and validated by the U.S. government for information security in the devices' cryptographic modules. Pre-boot authentication requires that a computer user provide trusted credentials to the drive before the laptop or desktop computer can detect and boot. This prevents unauthorized users from gaining access to the encrypted drive and its sensitive data. Citadel C series solid-state drives (SSDs) offer additional cyber security functions such as multi-factor authentication (MFA), zero-trust file access, unreadable storage partitions protected by non-recoverable keys, automated threat response that renders data invisible if Cigent Data Defense is disabled, and secure access logs that capture all insider threat activity. For more information contact DIGISTOR online at https://digistor.com.

POWER MICROCONTROLLERS

▶ Microcontroller family to boost power efficiency introduced by Pulsiv



Pulsiv Limited in Cambridge, England, is introducing the OSMIUM Pulsiv OSMIUM microcontroller family for converting AC to DC that involves charging and discharging a small storage capacitor without the need for a power factor correction (PFC) inductor. This solution delivers high power and efficiency in an compact system design that can help improve overall system efficiency, optimize cost, and reduce energy consumption. The Pulsiv OSMIUM microcontroller family and supporting components can combine with commodity flyback DC-DC converters to displace LLC solutions. Pulsiv has demonstrated a universal-input single-switch 150-Watt flyback power supply design that delivers 97.5 percent average front-end efficiency while maintaining 90 percent at 2 Watts. A 240-Watt interleaved flyback is being developed. The PSV-AD-150 and PSV-AD-250 OSMIUM microcontrollers do not determine output power directly and can be used for applications that require 1 Watt to 10,000 Watts, by adjusting three system components and connecting a suitable DC-DC converter. Critical components in a Pulsiv OSMIUM circuit operate at low temperatures to extend their expected operating life, even under convection cooling. By regulating the flow of mains through a charging capacitor, Pulsiv has completely eliminated inrush current, meaning that manufacturers of industrial power supplies and LED lighting products can simplify their designs and reduce the cost of system installation. Pulsiv OSMIUM technology supports active bridge control, configurable hold-up, X-cap discharge, HVDC output selection, a power consumption indicator and grid failure detection. For more information contact Pulsiv online at https://pulsiv.co.uk.

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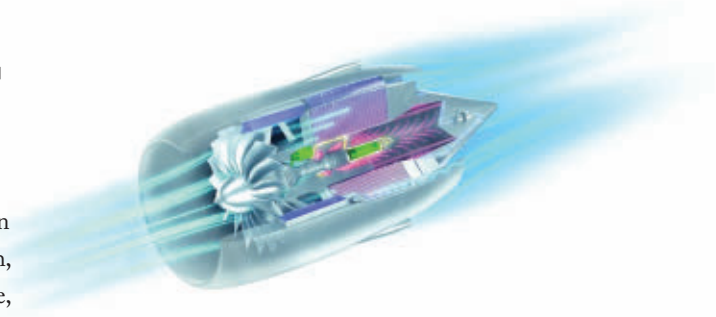
SWITCH project aims to advance hybrid electric and water enhanced turbofan tech

BY **Jamie Whitney**



The Sustainable Water-Injecting Turbofan Comprising Hybrid-Electrics (SWITCH) project seeks to develop hybrid-electric and water-enhanced turbofan aircraft propulsion technology.

TOULOUSE, France - Supported by the European Union Clean Aviation Joint Undertaking, MTU Aero Engines AG in Munich, Raytheon Technologies' Pratt & Whitney and Collins Aerospace, GKN Aerospace in Redditch, England, plus Airbus and other companies have announced the formation of a consortium to develop hybrid-electric and water-enhanced turbofan technology for future aircraft propulsion systems.

With the Sustainable Water-Injecting Turbofan Comprising Hybrid-Electrics (SWITCH) project, the aerospace companies aim to demonstrate the potential of these technologies to improve fuel efficiency and reduce aircraft CO2 emissions by as much as 25 percent compared to today's state-of-the-art propulsion systems for short- and medium-range aircraft.

The SWITCH project is focused on developing a novel propulsion concept built from two technologies: Water Enhanced Turbofan (WET) and hybrid-electric propulsion. By combining these technologies with Pratt & Whitney's GTF engine architecture, the SWITCH concept aims to enhance efficiency and reduce emissions across the full operating envelope of an aircraft. Technologies developed as part of SWITCH will be fully compatible with cleaner alternative fuels – such as Sustainable Aviation Fuel (SAF) — and will be evaluated for future use with hydrogen.

The hybrid-electric GTF powertrain will enable greater efficiency across all phases of flight by leveraging megawatt class electric motor generators, power electronics, and batteries to optimize the performance of the fuel-burning gas turbine. The WET concept recovers water vapor from the engine exhaust and re-injects it into the combustion chamber to significantly improve fuel efficiency, reduce NOx emissions, and lessen contrail forming emissions. These revolutionary technologies are designed to work together to deliver a step change reduction in emissions and energy use across the full operating system, while maintaining world class reliability and operability.

Airbus in Toulouse, France, will provide key expertise relating to the future integration of SWITCH technologies at the aircraft-level and will support the evaluation of performance benefits including aircraft design and integration of battery and energy management systems. Collins Aerospace in Charlotte, N.C., will provide megawatt-class electric motor generators and power electronics, high-voltage DC distribution and protection, thermal management components and nacelle architectures for the project.

GKN Aerospace will develop various engine structures with all-new functionalities, such as integrated electric machines and heat exchangers.

In addition to aerospace companies, the project is also seeing participation from the DLR German Aerospace Center, plus higher learning institutions Aristotle University of Thessaloniki in Greece; Chalmers University of Technology in Sweden, and the University of Stuttgart in Germany.

"This project will enable us to advance several key technologies on our roadmap to further extend the efficiency of the GTF engine architecture," said Geoff Hunt, senior vice president, Engineering and Technology, at Pratt & Whitney, which is headquartered in East Hartford, Conn. "Given the challenge of reducing the environmental impact of aviation, cross-industry collaboration and public-private partnerships like Clean Aviation will play a vital role in delivering the technology breakthroughs needed to make net zero emissions aviation a reality."

Pratt & Whitney and NASA collaboration drives 'green' engine development

BY **Jamie Whitney**

WASHINGTON - The National Aeronautics and Space Administration (NASA) announced plans to work with industry, academia, and others to work towards the aviation community's goal of reaching net-zero carbon emissions by 2050.

In that aim, NASA selected Pratt & Whitney in Hartford, Conn., as a partner to explore new propulsion technologies to reduce emissions in single-aisle aircraft.

Pratt & Whitney, a Raytheon Technologies company, was tapped to participate in the Hybrid Thermally Efficient Core (HyTEC) portion of the Sustainable Flight National Partnership (SFNP) with an eye on utilizing sustainable aviation fuels (SAFs). The project includes developing and testing the fuel and air mixers for optimal efficiency and then measuring the emissions and noise emitted using Jet A fuel and high blends of SAF.

In October 2021, NASA awarded Pratt & Whitney two contracts under the HyTEC project to develop technologies for a high-pressure turbine that will include next generation ceramic matrix composites (CMC) materials capable of operating at higher temperatures than current CMCs, environmental barrier coatings, and advanced cooling and aerodynamic approaches that will enable new component designs and efficiencies.

In the first phase, Pratt & Whitney will utilize its recently opened ceramic matrix composites (CMC) center of excellence in Carlsbad, California, and collaborate with Raytheon Technologies Research Center on the project. The technologies targeted by HyTEC include next generation CMC materials capable of operating at higher temperatures than current CMCs, environmental barrier coatings, and advanced cooling and aerodynamic approaches that will enable new component designs and efficiencies. By increasing the thermal efficiency of the high-pressure turbine, these technologies will contribute to greater fuel efficiency in future gas turbine propulsion systems.

In the second phase of the HyTEC project, Pratt & Whitney plans to demonstrate a technology-infused core comprised of a high-pressure compressor, high-pressure turbine, and combustor leveraging successes from the first generation GTF core. This phase is planned for 2024 through 2027 and will provide critical learning and increased maturation of the core prior to the next program launch.

Pratt & Whitney officials say that collaboration between NASA and the company has already led to several key advances in sustainable propulsion technologies in recent decades, including low-pressure-ratio fans, low-emissions combustors, and high-performance hot section. These collaborations have a vital role to play towards developing and maturing technologies that will ultimately help make aviation more sustainable environmentally and economically.

"Aviation is moving toward a greener, cleaner future. Our partnership with NASA on HyTEC will allow Pratt & Whitney engineers to explore new technologies that will help make future aircraft propulsion systems even more sustainable," said Geoff Hunt, senior vice president, Engineering and Technology, at Pratt & Whitney. "The use of SAF blends is increasing today to 50% and will reach 100% within a few years. This is a key pathway to achieving the industry's goal of net zero carbon emissions by 2050. Our engine technology continues to improve in efficiency – flying further, with more power and on less fuel. This award helps Pratt & Whitney continue to ensure we develop advanced propulsion technologies that will be ready for the next-generation aircraft in the next decade."

Aircraft engine designer Pratt & Whitney will help explore new propulsion technologies to reduce emissions in single-aisle passenger jet aircraft.

Boeing delivers novel MEO communications satellite to SES

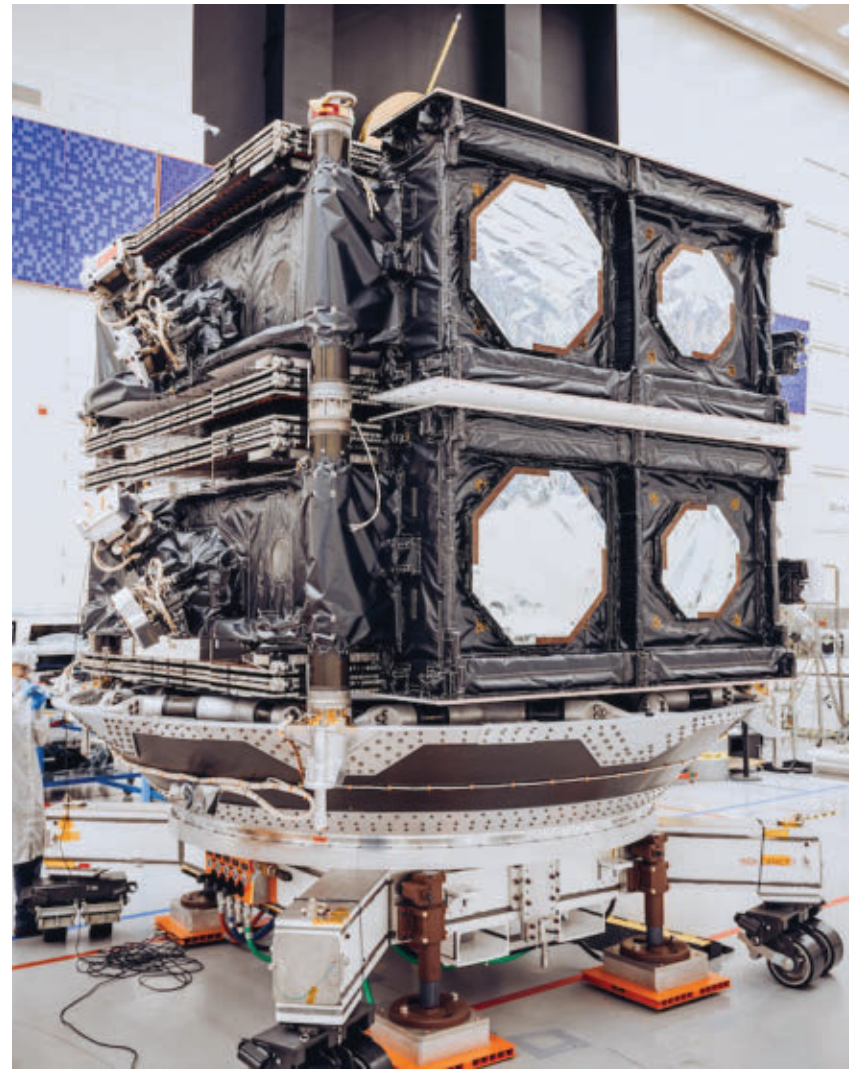
BY **Jamie Whitney**

EL SEGUNDO, Calif., - Boeing has delivered the first two Orb mPOWER satellites to SES, a global content connectivity solutions provider in Betzdorf, Luxembourg.

The all-digital satellites are being prepared in Florida for launch to Medium Earth Orbit (MEO), 8,000 kilometers from Earth, where they will provide low-latency, high-throughput connectivity to users around the world.

The satellites combine Boeing's 702 platform, Boeing subsidiary Spectrolab's custom-designed solar arrays built to withstand harsh medium-Earth orbit (MEO) radiation, and the 702X software-defined payload providing more than 5,000 steerable beams per satellite.

"SES's Orb mPOWER system is a true game changer and will transform the way people think about connectivity," says Ruy Pinto, chief technology officer at SES. "Delivering performance above all, Orb mPOWER will offer connectivity services to government organizations and enterprises based in the most remote regions. In times of natural disasters, when networks are disrupted, Orb mPOWER's low-latency services can quickly restore critical communications networks."



Boeing is under contract to deliver 11 Orb mPOWER satellites to SES, and will continue production, integration and testing of the remaining nine spacecraft.

Instead of relying on few large fixed beams or a proliferated low-Earth orbit (LEO) constellation covering vast regions – systems that struggle to fulfill high-density demand – the software-driven Orb mPOWER system is equipped with shapable beams that can be repositioned based on real-time data from SES customers' terminals, delivering a superior end-user experience.

Boeing is under contract to deliver 11 Orb mPOWER satellites to SES, and will continue production, integration, and testing of the remaining nine spacecraft.

"SES approached us with a vision to create global equity, by providing people with high-speed connectivity where it wasn't economically or physically feasible to build fiber infrastructure," said Jim Chilton, senior vice president of Space and Launch at Boeing Defense, Space & Security. "We partnered to create a super computer constellation in space to meet that goal, and we can't wait to see what SES does as the 702X platform's first user."

NASA selects Phantom Space Corp. for commercial CubeSat launch

BY **Jamie Whitney**

TUCSON, Ariz. - The U.S. National Aeronautics and Space Administration (NASA) needed a partner to launch small CubeSats into orbit. They found their solution from Phantom Space Corp. in Tucson, Ariz.

▲ NASA will rely on Phantom Space Corp. in Tucson, Ariz., to launch small CubeSats into orbit.

The CubeSats will be ferried into space by Phantom's two-stage Daytona rocket, which stands 18.7 meters tall (61 feet) and can transport satellites up to 450 kg (990 pounds) into low-earth orbit.

The Daytona is being designed, built, and tested at Phantom's base in Tucson. It is powered by ten Hadley engines supplied by Ursa Major of Colorado.

The rocket's first stage utilizes 9 Hadley engines to power the first part of the journey into space. Hadley is powered by liquid oxygen (LOX) and rocket propellant (RP-1).

Shortly after first stage separation, the second stage ignites to bring Daytona into orbit. The second stage uses a single vacuum-optimized Hadley engine, and contains the avionics and all necessary computing required to travel to, through, and back from space.

The Hadley engine, which is developed by Ursa Major, is a pump-fed, high-efficiency, 3D-printed rocket engine fueled by liquid oxygen (LOX) and rocket propellant (RP-1).

NASA's Venture-class Acquisition of Dedicated and Rideshare (VADR) missions intend to meet the agency's needs for NASA payloads while also fostering the development of new launch vehicles from both emerging and established launch providers. VADR increases access to space by significantly reducing costs using less NASA oversight to achieve lower launch costs with payloads that can accept a higher risk tolerance.

"The new contracts will help us launch a Golden Age of commercial space, and it's an honor to have NASA onboard—their leadership is invaluable to the space industry, and we are proud to help their programs expand humanity's knowledge of our planet, solar system, and beyond," says Mark Lester, Phantom Space COO and VADR Program Manager for the company.