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Is inflation taking a toll on the U.S. military budget?

BY **John Keller**
EDITOR IN CHIEF

U.S. Department of Defense (DOD) leaders are making a big deal of year-to-year increases in the proposed 2024 DOD budget compared to this year. DOD is asking Congress $842 billion next year — an increase of $26 billion from this year. Sounds good, right? After all, that represents a 3.1 percent increase, so the Pentagon budget seems to be headed in the right direction ...

... that is, until you consider the latest U.S. monthly inflation rate, which is 6.04 percent. That's enough to eat-up that apparent increase, and then some. Factor in inflation, and the DOD budget actually is decreasing. So much for the rosy predictions we're hearing about.

Inflation isn't the only thing eating away at the DOD budget. Consider the yearlong Ukraine war, which has no end in sight. According to the latest estimates, the U.S. has sent more than $75 billion to Ukraine over the past year which includes humanitarian, financial, and military support. That's a big chunk of money, a portion of which might otherwise have been spent on U.S. military preparedness.

Don't get me wrong, military spending is a benefit to the U.S. defense industry. It helps keep weapons assembly lines humming, spurs technology insertion and upgrades, bolsters technology innovations that in the future might help U.S. military capabilities, and gets military leaders thinking outside the box on how to capitalize on commercial off-the-shelf (COTS) technologies for future military use.

I'm just a little concerned with how the Pentagon spending picture stacks up against the increasing danger that the U.S. military faces throughout the world. We have Russian jet fighters forcing down an unmanned U.S. reconnaissance aircraft over the black sea, increasing tension China in the South China Sea overlooking the world's busiest commercial shipping lanes, and a still-volatile Middle East — all this with a functionally shrinking U.S. military budget.

The defense financial picture isn't all bleak, however. The proposed DOD budget next year is $842 billion; that's still a massive amount of money. The proposed 2024 DOD budget includes spending for air and missile defenses; hypersonic missiles; artificial intelligence (AI); unmanned systems; surface warships; and combat aircraft.

The budget includes $145 billion for research and development, as well as $170 billion for procurement — including modernizing U.S. nuclear forces on land, sea, and in the air. The 2024 budget was released in March. Fiscal 2024 begins next October 1.

Inside the budget is $61.1 billion for combat aircraft like the F-22, F-35, F-15EX; the B-21 bomber, KC-46A, and unmanned aircraft; construction of nine surface warships, as well as continued funding for Ford class nuclear powered aircraft carriers and Columbia-class ballistic missile submarines.

The budget has $13.9 billion for armored combat vehicles like the Armored Multi-Purpose Vehicle, Amphibious Combat Vehicle, and Optionally Manned Fighting Vehicle.

It has $37.7 billion for the B-21 next-generation bomber program; the second Columbia ballistic missile submarine; the LGM-35A Sentinel intercontinental ballistic missile. Missile defense has $29.8 billion for the Next Generation Interceptor for Ground-Based Midcourse Defense; regional missile defense network with Patriot Missiles, a Lower Tier Air and Missile Defense Sensor, additional ShortRange Air Defense Battalions, and hypersonic weaponry and defenses.

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2024 DOD budget would fund hypersonic missiles, artificial intelligence

BY John Keller

WASHINGTON – Leaders of the U.S. Department of Defense (DOD) propose spending $842 billion next year — an increase of $26 billion from this year. The proposed 2024 DOD budget includes spending for air and missile defenses; hypersonic missiles; artificial intelligence (AI); unmanned systems; surface warships; and combat aircraft.

▲ The proposed 2024 Pentagon budget would fund development of hypersonic munitions such as the one depicted above, as well as for artificial intelligence (AI) and machine learning research.

The budget includes $145 billion for research and development, as well as $170 billion for procurement — including modernizing U.S. nuclear forces on land, sea, and in the air. The 2024 budget was released last month. Fiscal 2024 begins next October 1.

Inside the budget is $61.1 billion for combat aircraft like the F-22, F-35, F-15EX; the B-21 bomber, KC-46A, and unmanned aircraft; construction of nine surface warships, as well as continued funding for Ford class nuclear powered aircraft carriers and Columbia-class ballistic missile submarines.

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Funding is included for reconnaissance satellites; the THAAD missile defense system; cyber security; and 24 new hypersonic strike missiles. Other DOD budget priorities include wideband and narrowband secure and jam-resistant capabilities; and $300 million for the Ukraine Security Assistance Initiative.

The DOD research and development budget includes $1.8 billion for AI; $1.4 billion for Joint All Domain Command and Control (JADC2); $17.3 billion for tactical missiles; $7.3 billion for strategic missiles; and $600 million for technology development of the Naval Strike Missile, RIM-174 Standard Missile, Advanced Medium Range Air-to-Air Missile, Long Range Anti-Ship Missile, and Joint Air-to-Surface Standoff Missile - Extended Range.

The DOD research budget also has $3.7 billion for cyber-secure microgrids with backup power, battery storage, and electrical transmission and distribution improvements; as well as $271 million for Army to modernize next-generation combat vehicles with silent watch and mobility, increased operational duration and more onboard electrical power.

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Boeing to design future E-7A radar surveillance aircraft for combat air traffic control

BY **John Keller**

HANSCOM AIR FORCE BASE, Mass. – U.S. Air Force aerial surveillance experts are looking to the Boeing Co. to build the E-7A airborne early warning and control (AEW&C) radar aircraft to replace the Air Force fleet of E-3 Sentry Airborne Warning and Control System (AWACS) aircraft.

Officials of the Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., announced a potential $1.2 billion contract in February to the Boeing Defense, Space & Security segment in Seattle for the E-7A Rapid Prototype program.

The E-7A is based on the Boeing 737-700ER long-range single-aisle passenger jetliner, and will be for simultaneous air and sea search, as well as combat air traffic control.

The E-7A will resemble the Australian E-7A Wedgetail aircraft, which is based on the Boeing 737-700ER long-range single-aisle passenger jetliner, and will be for simultaneous air and sea search, as well as combat air traffic control.

The E-7A will have the multi-role electronically scanned array (MESA) radar from the Northrop Grumman Corp. Electronic Systems segment in Linthicum, Md. The surveillance radar will look like a dorsal fin on top of the fuselage. Called top hat, the radar and is designed for minimal aerodynamic effect, and will be able to detect and monitor airborne objects as far away as 400 miles with look-up capability.

The dorsal-fin-like top hat radar will replace the E-3 Sentry AWACS radar system, which looks like a Frisbee flying disk mounted to the top of the plane's fuselage. The old E-3 is based on the Boeing 707 jetliner, which has been in service since the 1950s.

The E-7A aircraft's radar antenna will double as an electronic intelligence (ELINT) array, which can monitor RF signals as far away as 500 miles when the plane is flying at 30,000 feet altitude. The E-7A's radar signal processing and computers will be installed below the antenna array. The E-7A's cabin will have eight operator consoles with sufficient space for four more, if and when needed.

"The E-7A will be the department's principal airborne sensor for detecting, identifying, tracking, and reporting all airborne activity to Joint Force commanders," says Andrew Hunter, assistant secretary of the Air Force for Acquisition, Technology, and Logistics.

"The E-7A will enable greater airborne battlespace awareness through its precise, real-time air picture and will be able to control and direct individual aircraft under a wide range of environmental and operational conditions," Hunter said in an Air Force statement.

The Air Force is set to begin E-7A production in 2025, with the first E-7A to be fielded in 2027. Air Force leaders say they expect to buy 26 E-7As by 2032.

The E-7A will have a cabin crew of six to ten, with two pilots in the cockpit. The plane will be 100 feet long, with a 117-foot wingspan, and weigh 43,720 pounds. It will be 41 feet high, cruise at 530 miles per hour, have a 4,000-mile range, and will fly as high as 41,000 feet.

On this contract Boeing will do the work in Seattle, and should be finished by August 2024. For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

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Dynalec to design battle-hardened communications for Constellation-class frigate

BY John Keller

CHARLESTON, S.C. – U.S. Navy shipboard communications experts needed a battle-hardened telephone and announcing system for the next-generation Constellation class guided-missile frigate. They found their solution from Dynalec Corp. in Sodus, N.Y.

Officials of the Naval Information Warfare Center Atlantic in Charleston, S.C., announced a $23.9 million five-year contract to Dynalec to develop and build the Wired Voice Network (WVN) for the future Constellation-class frigate. The contract has options that could increase its value to $48 million.

The WVN will be a telephone and announcing system for vital and mission-critical end-to-end communications within the ship. The Constellation-class frigate will replace the Navy's now-retired Oliver Hazard Perry-class frigates — the last of which, the USS Ingraham (FFG 61), was removed from service in 2014.

The WVN will provide point-to-point telephone communications between various points on the ship, as well as one-way transmission of general orders, information, and alarm signals to various locations aboard the ship where personnel are stationed or normally will be located.

The shipboard communications systems also will provide interfaces to other shipboard systems, and to shipboard connection points to the Defense Switching Network (DSN) and the Public Switched Telephone Network (PSTN).

The future USS Constellation will be the lead ship of a class of at least 20 frigates. The hull of the frigate is be based on the Italian FREMM-class frigate. The first three ships of the class are under contract to Fincantieri Marinette Marine Corp. in Marinette, Wis.

The WVN telephone system will be a reliable and survivable network with built-in redundancy to eliminate single points of failure caused by battle damage or on-board accidents.

In addition, the system will have server and node failover redundancy in case of a controlling element failure. If any controlling element fails, all established calls must stay active. Failover capability allow new calls in 30 seconds or less. After failover, all interconnections will be available with no increase in blocking.

The announcing system will provide for one-way transmission of general orders, information, and alarm signals over loudspeakers to various locations where personnel are stationed or will normally be located. Such transmissions are made by means of microphones, alarm activators, and loudspeakers connected through central controlled amplifiers.

The reliable and survivable network announcing system will handle vital and mission-critical interior shipboard communications with built-in redundancy to eliminate single points of failure.

The Constellation-class frigate will be able to keep up with Navy aircraft carriers and will have sensors networked with the rest of the fleet. It normally will be part of Navy strike groups and large surface combatant-led surface action groups, but also will be able to operate and defend itself in independent operations.

Frigates typically are escort vessels that are lighter than destroyers, and help defend aircraft carrier battle groups or merchant convoys from submarine, aircraft, and cruise missile threats. They are intended to operate in the open ocean, unlike the Navy littoral combat ship, which is designed to operate in coastal waters and harbors.

The new frigates will have a minimum of 32 Mark 41 Vertical Launch System cells aboard for anti-air warfare. The ship will be designed to destroy surface ships over the horizon; detect enemy submarines; defend convoy ships; employ active and passive electronic warfare systems; and defend against swarming small boat attacks.

Dynalec Corp. is designing a rugged, fault-tolerant telephone and shipwide announcing system for the future U.S. Navy Constellation-class guided-missile frigate, shown above.

Shipboard electronics will include the Lockheed Martin COMBATSS-21 combat management system; AN/SPY-6(V)3 Enterprise Air Surveillance Radar (EASR); AN/SPS-73(V)18 surface search radar; AN/SLQ-61 lightweight towed array sonar; AN/SQS-62 variable-depth sonar; AN/SQQ-89F undersea warfare and anti-submarine warfare combat system; and Cooperative Engagement Capability (CEC).

The Constellation-class frigate will be able to fire RIM-162 ESSM Block 2 and/or RIM-174 Standard ERAM missiles; RIM-66 Standard SM-2 Block 3C; the Naval Strike Missile; RIM-116 Rolling Airframe Missile; Mk 110 57-millimeter gun; and machine guns. The ship will be able to carry one MH-60R Seahawk helicopter and the MQ-8C Firescout unmanned helicopter.

The Constellation and its first two sister ships, the USS Congress (FFG 63) and USS Chesapeake (FFG 64) are named for three of the Navy's six original frigates — USS Chesapeake; USS Constitution; USS President; USS United States; USS Congress; and USS Constellation — built between 1797 and 1800. Of these original ships, the USS Constitution still is a Navy commissioned warship and is based in Boston.

Dynalec designs and builds military-grade systems to withstand the rigors of the military shipboard environment that involves extremes in shock, vibration, temperature, humidity, and acoustic noise. The company designs equipment racks and cabinets, subassemblies, or complete systems for shipboard communication, navigation, and switching applications.

Dynalec specializes in EMI-resistant enclosures and cabinets; shock- and vibration-proof equipment; fire detection sensors and control systems; sound powered telephone systems; analog, digital, and IP-based voice systems, terminals, telephones, intercoms, and announcing systems; synchro and servo devices; and ship control and navigation systems.

On this contract Dynalec will do the work in Sodus, N.Y., and Marinette, Wis., and should be finished by March 2028. For more information contact Dynalec Corp. online at www.dynalec.com, Fincantieri Marinette Marine Corp. at https://fincantierimarinegroup.com, or the Naval Information Warfare Center Atlantic in Charleston, S.C. at www.niwcatlantic.navy.mil.

Johns Hopkins collaborates with NASA to send human heart 'tissue-on-a-chip' specimens into space

BY **Jamie Whitney**

KENNEDY SPACE CENTER, Fla., - Johns Hopkins Medicine researchers are collaborating with NASA to send human heart "tissue-on-a-chip" specimens into space as early as March. The project is designed to monitor the tissue for changes in heart muscle cells' mitochondria and ability to contract in low-gravity conditions.

The tissue samples will be launched into space aboard SpaceX CRS-27, a resupply mission to the International Space Station, which was slated for liftoff no earlier than Tuesday, March 14, at NASA's Kennedy Space Center in Florida.

To develop the microengineered human heart tissue-on-a-chip, researchers begin with human induced pluripotent stem cells grown in the laboratory.

To develop the microengineered human heart tissue-on-a-chip, researchers begin with human induced pluripotent stem cells grown in the laboratory. Such cells are able to develop into nearly any type of cell, and are coaxed biologically to develop into beating human cardiomyocytes, the muscle cells that make hearts contract.

Groups of cardiomyocytes form tissue that can be strung between two posts, one flexible and one stiff. The flexible post has an embedded magnet and, when placed over sensors, allows for collection of information on tissue contraction. The chamber enclosing the tissue is sealed so that liquid media feeding the tissue doesn't float away in space. These tissue chambers are then loaded into so-called plate habitats with the magnetic sensors located beneath the tissue. The experimental payload consists of two of these plate habitats, which measure about 7 inches long, 5 inches tall and 4 inches wide.

Astronauts on board during the mission will also introduce three FDA-approved medicines to the samples in efforts to prevent heart cell changes known or suspected to occur in those undertaking long-duration spaceflights.

"It's possible that what we learn from these experiments in space could also inform how we treat age-related cardiac problems," says Deok-Ho Kim, professor of biomedical engineering at the Johns Hopkins University School of Medicine, because many heart cellular changes already detected in space explorers mimic changes linked to heart muscle aging in general.

Kim, his previous postdoctoral researcher Jonathan Tsui, and his doctoral student Devin Mair previously sent heart tissue into space in March 2020. Those experiments, presented at the Tissue Engineering and Regenerative Medicine International Society-Americas 2022 Annual Meeting, showed that microgravity in space changed the cells' mitochondria and the tissues' ability to contract.

In the new experiments with their microengineered human heart tissues-on-a-chip, the scientists will focus on the proteins activated during tissue inflammation and mitochondrial dysfunction.

The astronauts aboard the space station will also test whether any of three medicines can stave off the problems anticipated in space-bound heart cells.

Companies eye RF signal-homing air-to-ground missile

Three U.S. defense systems integrators are moving forward on a project to build a next-generation air-launched RF signal-homing missile designed to attack missile and rocket launchers, artillery batteries surface warships, air bases, as well as radar and electronic warfare (EW) transmitters. Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., announced $18 million six-month contracts to Lockheed Martin Corp.; Northrop Grumman Corp.; and L3Harris Technologies Inc. for phase 1.3 of the Stand-in Attack Weapon (SiAW) program. SiAW is to be an Air Force air-to-ground weapon designed to hold at risk surface elements of the anti-access/area denial (A2/AD) environment. Details of SiAW phase 1.3 are classified. It's expected that the SiAW will have radio signal-homing guidance similar to the U.S. Army Lockheed Martin long-range Precision Strike Missile (PrSM), which seeks out enemy RF energy, but can remain difficult to detect by not emitting its own radar signal. Initial SiAW contracts were awarded in 2020 to the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla.; the Northrop Grumman Defense Systems segment in Northridge, Calif.; and the Mustang Technology subsidiary of L3Harris in Plano, Texas. The three companies won $15 million contracts in August 2022 for SiAW phase 1.2. SiAW will capitalize on enabling technologies developed for the U.S. Navy Advanced Anti-Radiation Guided Missile-Extended Range (AARGM-ER) anti-radar missile program.

Persistent Systems to provide perimeter security network for ICBM launch security

U.S. Air Force nuclear weapons authorities are taking the next step in perimeter security with a new initiative to implement wide-area networked intrusion detection at three intercontinental ballistic missile (ICBM) bases scattered over three U.S. states. Officials of the Air Force Global Strike Command at Barksdale Air Force Base, La., announced a $75.5 million contract to Persistent Systems LLC in New York for the Air Force Regional Operating Picture (ROP) program. Air Force experts will deploy the Persistent Systems Infrastructure-based Regional Operation Network (IRON) around remotely located ICBM fields at Minot Air Force Base, N.D.; Malmstrom Air Force Base, Mont.; and F.E. Warren Air Force Base, Wyo., for enhanced situational awareness over a 25,000-square-mile area — the largest mobile ad hoc networking (MANET) *Continued on page 13*

Sacramento Airport deploys facial biometric boarding for international flights

BY **Jamie Whitney**

SACRAMENTO, Calif., - The Sacramento International Airport (SMF) in Sacramento, Calif., sought a facial biometric recognition technology for screening its international passengers. They found their solution from Amadeus Facial Biometrics in Madrid, Spain.

▲ Biometric facial recognition matches the digital image of a human face to a database of faces to authenticate users through ID verification services.

Sacramento Airport officials will deploy the technology at select international boarding gates, which will changes the process of verifying traveler identities by comparing live photos to the traveler's existing passport or visa photo in secure U.S. Department of Homeland Security systems. The facial biometrics process is voluntary for U.S. citizens.

Biometric facial recognition matches the digital image of a human face to a database of faces to authenticate users through ID verification services. It works by pinpointing and measuring facial features from a given image.

The Amadeus Facial Biometrics technology only is for international flights, and is to make traveling more convenient for passengers. Biometric screening, Amadeus officials say, will save time and reduce stress for travelers, as well as provide a secure touchless departures for identity verification.

Travelers who wish to opt out of the new biometric process may notify an airline official or a U.S. Customs and Border Protection officer as they approach the departure gate.

These travelers must present a valid travel document for inspection by the gate agent and they will be processed consistent with existing requirements for departure from the United States.

To implement the technology at SMF, the airport's management will work closely with U.S. Customs and Border Protection under the U.S. Department of Homeland Security, and airlines.

The deployment of the biometric screening will be done in phases, with the first set of four gates already operational, and the remaining gates to be installed in the future.

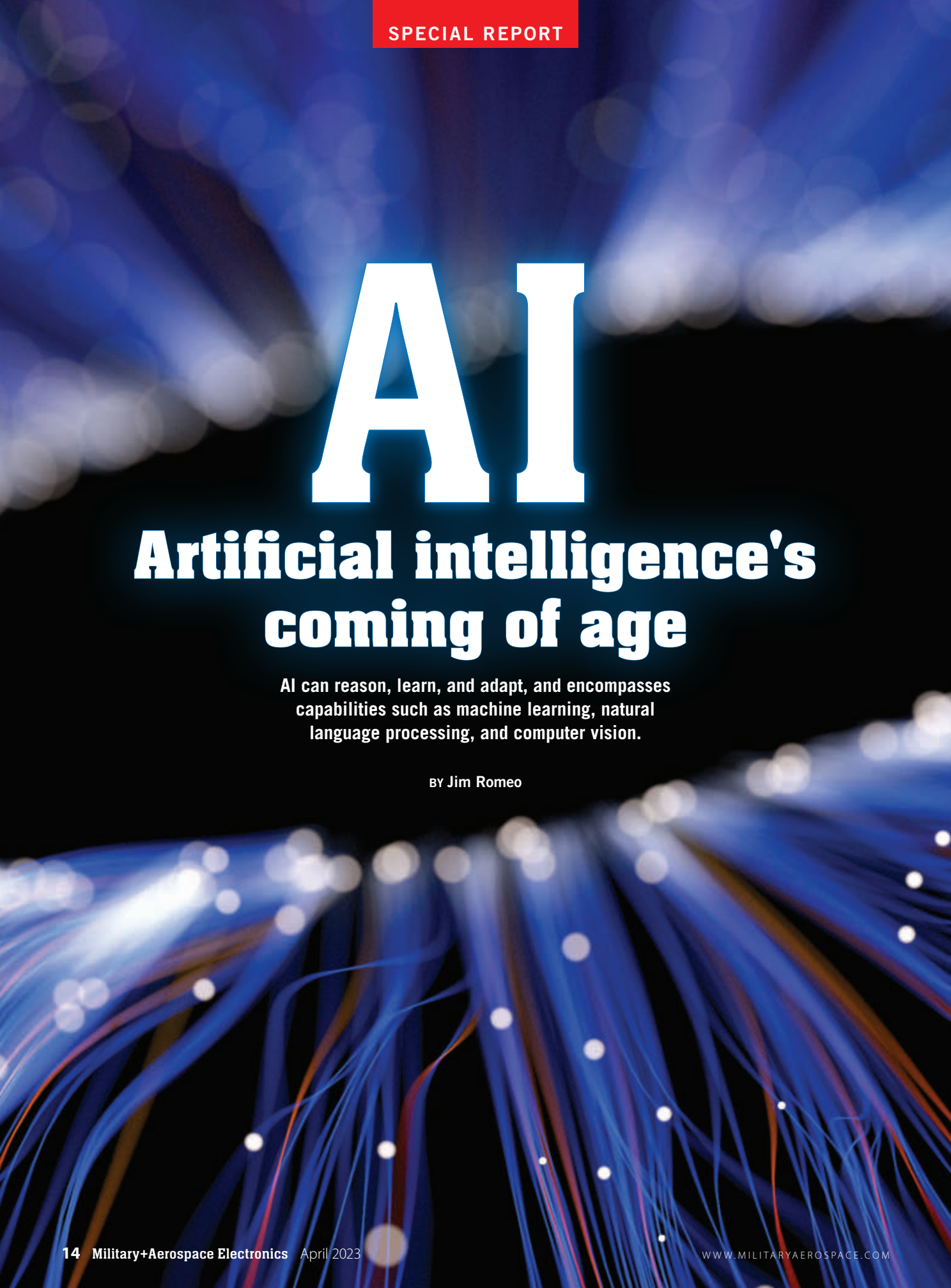
"Sacramento joins other leading airports in the US that are harnessing the unique qualities of facial biometric verification to enhance the passenger experience," says Betros Wakim, the Amadeus manager of airline operations in the Americas.

"We are working with a growing number of airports and airlines to build biometric identity technology into different stages of the airport experience, from check-in to bag drop and also boarding," Wakim says. "Where possible, we advocate for a cloud approach so different airlines can be easily integrated with an airport's biometric infrastructure. Biometrics is poised to be one of the defining aviation trends of 2023."

Continued from page 11 network in the world. ICBM launch facilities typically are located in large sparsely populated areas in the Great Plains region of the central U.S. The sheer size of these areas makes it difficult to track Air Force security teams investigating reports of unauthorized intrusions. The Persistent Systems IRON is an easy-to-deploy integrated MANET antenna system on fixed towers and poles to create a permanent Wave Relay MANET coverage area. With ROP in place, security personnel on a missile field now can maintain constant communications through the towers to an operations center. Likewise, security personnel at the operations center can follow the locations and movements of security forces on a digital map. Both parties can share critical tactical mission data seamlessly. For more information contact Persistent Systems online at www.persistentsystems.com, or Air Force Global Strike Command at www.afgsc.af.mil.

DARPA moves forward with project for secure radio communications

U.S. military researchers are continuing work with two U.S. companies to develop secure radio frequency (RF) transmitter and receiver technologies to enable the next generation of secure military tactical radio communications. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have awarded contracts to Peraton Labs Inc. in Basking Ridge, N.J., and to CACI Inc. Federal in Florham Park, N.J., for the next phase of the Wideband Secure and Protected Emitter and Receiver (WiSPER) project. WiSPER seeks to develop fundamentally disruptive wireless air interface transceiver technology to enable and sustain secure high-bandwidth RF communication links. The WiSPER wideband adaptive air interface also will mitigate impairment from dynamic harsh and contested environments to maintain a stable communication link. Peraton won a $7.9 million WiSPER phase-two contract on 25 Jan 2023, and CACI won a $10.6 million WiSPER phase-two contract on 23 Jan 2023. Now the companies move to the second phase of the project, which will improve the design, culminating in a transportable implementation and field test. The radio project's future third phase will further optimize the air interface to demonstrate adaptation to weather and other impairments in a portable prototype implementation. For more information contact CACI International online at www.caci.com, Peraton Labs at www.peratonlabs.com, or DARPA at www.darpa.mil.



AI

Artificial intelligence's coming of age

AI can reason, learn, and adapt, and encompasses capabilities such as machine learning, natural language processing, and computer vision.

BY Jim Romeo

It's been about a year since the stand-up of the Chief Digital and Artificial Intelligence Office (CDAO) in the U.S. Department of Defense (DOD). Since its genesis, momentum for AI technology has continued to build.

Military intelligence, once characterized by strategic decision making, paper maps, table-top exercises, and many legacy systems of hardware and software is becoming sophisticated and — well, artificial, in a very good sense. As artificial intelligence (AI) and machine learning pervades nearly every industry in the world we live in, and boosts innovation and technology in many ways, military and aviation electronic systems are no exception.

Its adoption, however, must be judiciously approached, paying attention to the return on investment and its practicality for so many use cases within military and aerospace environments.

As Hefty Conklin, technical director of department 22 at Raytheon Intelligence and Space in McKinney, Texas puts it: "AI/ML presents some game-changing capabilities, its integration can also drive challenging system requirements — cost, power and processing. It is not a panacea for every challenge in the contested threat environment. Some of the current capabilities that have been constructed with limited power and processing are highly effective for today's threat environment. We must use robust systems engineering of any system design to determine the balance, or where and how much AI/ML, combined with other approaches, provides the right amount of capability to manage that set of threats." Onward and upward, we move.

The steep upward slope of AI

AI is on a steep upward slope in its adoptions and utility to the modern warfighter across technology platforms in all service branches, as well as commercial and space aviation systems. Some are in early development, while others are in mid to late development.

The 2022 National Defense Strategy addresses technology priorities of the U.S. as it works to meet the rapidly evolving domains of war. That's prologue to the entire discussion of AI and machine learning and is part of an overarching new paradigm for quantum computing as it applies to all out integration of software and hardware that collectively act to enable AI in today's warfighter. That's how Austin Leach, associate director at TechLink in Bozeman, Mont., sees it.

"Central to these priorities are current and long-term investments in artificial intelligence, autonomy, integrated sensing, and systems, cyber, and quantum science," Leach says. "The NDS mentions further that the DOD has implemented "institutional reforms that integrate our data, software, and artificial intelligence efforts and speed their delivery to the warfighter." Within the field of defense electronics lies short term need fulfillment for AI driven data and image analysis tools and digital twinning for mission support and training, mid-term delivery of decision support capabilities and multi-domain intelligence synthesis, and long-term realization of a paradigm shift into quantum computing."

The bigger picture

DOD agencies continue to develop cognitive electronic warfare (EW) solutions, which use AI and machine learning technologies to modernize and enhance EW capabilities. Many of these projects have sponsorship from the Defense Advanced Research Projects Agency (DARPA), the U.S. Naval Research Laboratory, the Air Force Research Laboratory and the broader defense community. Roger Hill, a principal with Deloitte & Touche LLP, (Deloitte Defense), and security and justice sector leader in Arlington, Va., sees the big picture.

"In today's world of active electronic beamforming and steering, software defined radios and other advanced technologies, warfighters need EW systems that can help sense, reason, decide and act in near real time," Hill says. "By incorporating AI and machine learning technologies, cognitive electronic warfare capabilities can improve warfighters' ability to assess a given threat environment, accurately classify threats, design countermeasures against each threat and help implement an appropriate response."

The many faces of AI technology

So, what are some key technology trends? Hang on to your hats for the applications are many and the fruits of adoption are significant.

Ryan Tseng is the CEO and co-founder of Shield AI in San Diego. The firm develops AI to enable swarms of drones and aircraft to operate autonomously without GPS, communications, or a pilot.

He sees a trend that focuses on immunity, attack, computer power, and vertical integration. "As electronic warfare becomes increasingly sophisticated, there is a need for defense electronics to be immune to various types of attacks, including jamming, spoofing, and hacking," Tseng explains.

Conversely, he adds, that as systems become more immune to attack, there is a need to increase effectiveness of electronic attack systems. "We will see the continued advancement of high energy, directed energy systems RF systems," he says. "Additionally, we will see the advancement of weapons systems designed to disrupt destroy key nodes in electronic infrastructure for communication, position, and timing."

Even more specifically, however, he contends that the most disruptive technology for improving system level immunity to attack is edge artificial intelligence, and specifically AI pilots that can command and control aircraft with severely or entirely degraded communication and GNSS. But the journey towards AI pilots as conventional practice is in development.

It's important to capitalize on the autonomy that AI affords, without increasing vulnerability, says E. Egon Rinderer, chief technology officer at Shift5 in Arlington, Va. "With fully AI-enabled autonomy still a distant goal, the current trend is toward applying cutting-edge "race with" technology that enhances the human in the loop. We use technology to increase observability, lethality, and mission readiness while helping to preserve human life," he explains. "But the dichotomy is that these technologies intended to provide us the edge against an adversary also serve as a potential point of exploitation to be used against us. It's like the DOD's adoption of traditional information technology (IT) at the onset of Information Age and the over-wash of the second Information Age. It's critical that we apply the lessons learned over the decades in IT environments to OT environments."

One of the challenges of unfolding this new IT environment is to build technology that is dense. Big things should come in small packages in today's modern warfare. "We're focused on improving defense technologies to be more capable in smaller packages. We're designing technologies to pack more power, bandwidth, sensitivity and processing so they can operate at the tactical edge," says Hefty Conklin of Raytheon. "We're also developing our

DOD is working with industry in a wide-scale global experiment that seeks to employ data, analytics, and AI at scale to enhance mission goals and objectives.

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systems to perform multiple functions at the same time, such as radar, communications, and electronic warfare. While this can lead to some very complex systems, it also serves to reduce the number of subsystems, and therefore the total size, weight, and power consumption required, known as SWAP, on a platform."

Boosting warfighter capabilities

As AI and machine learning become ingrained in many defense technologies, they stand to improve warfare capabilities with new innovations. The implications of the many improvements which will provide greater capabilities are significant.

Will Keegan, chief technology officer of Lynx Software Technologies Inc. in San Jose, Calif., sees gains by focusing on AI and machine learning as crucial components in technology, as they help make better decisions, using data, for many scenarios. Subsequently, this helps protect human lives.

Specifically, he sees two themes: the use of AI and machine learning during development, and the use of AI and machine learning in deployed systems.

"In regard to AI and machine learning in deployment, these systems are becoming so complex, and automation can greatly improve our ability to correctly construct solutions and validate they are fit for use," explains Keegan. "In combination with model-based system engineering (MBSE) adaptive and learning algorithms can make quick work of robustness testing. We also see machine learning exceeding in the fine-tuning stages of system development and evaluation especially when it comes to controlling predictable timing and meeting performance thresholds. "

Combat aircraft are interacting with drones and ground forces for offense and defense on the next generation battlefield.

Source: iStock via Lynx Technologies

Data dependent

One shortcoming of leaning on AI and machine learning to drive decisions is to employ such robust modeling and learning algorithms, as sufficient data is not always available. Data needs not only to be available, but robust enough in acceptable formats so it may be useful for AI to compute.

Bryan Nousain is head of the signal research section at the U.S. Naval Research Laboratory in Washington.

Bryan Nousain is the head of signal research section for the U.S. Naval Research Laboratory (NRL) in Washington. He says that tactical military environments are dynamic and complex and may require the actuation of high-fidelity estimation and decision processes in the absence of behavioral and/or physics-based models.

"AI and machine learning approaches, such as deep neural networks, fill the gap when physics-based models are not available," Nousain says. "However, there may not be adequate data for training a deep neural network prior to its deployment. This is driving the development of generative models to augment training data for supervised and reinforcement learning applications."

One application where generative models are useful is for automatic target recognition (ATR), Nousain points out. "Generative models for ATR reproduce signal level effects due to the propagation channel and platform motion (e.g., turbulent conditions in the air or sea). These models are also useful to increase the robustness of algorithms by using multiple modalities as inputs to ATR algorithms. In electronic warfare (EW), generative models can also be used to replicate the behavior of a threat whose behavior is unknown and thus allow cognitive EW models to test their robustness to threats that have yet to be encountered."

It's not just the quality of data, but also the volume of data that must be computed. "AI and machine learning eases the burden of the warfighter having to make timely decisions based on an overwhelming volume of data generated by advanced multimodal sensors," says Joel Goodman, senior technical staff at NRL. This includes emerging applications such as providing decision support for combat identification using both passive and active sensors onboard surface, sub-surface, airborne, and spaceborne platforms.

"Unmanned autonomous systems that are powered by AI and machine learning are receiving significant technical investment, including developing advanced super swarm drone technology for command-and-control applications," NRL's Goodman says. "One new and innovative application of AI and machine learning is inferring the tactical relevance and/or lethality of platforms from RF spectrum transmissions. Making sense of spectrum emissions is an active area of investigation."

Data availability is somewhat connected to computing on the edge in scenarios where decisions are split-second and must not be vulnerable to cyber invasion. Kyle Adams is a strategy manager at SparkCognition Government Systems (SGS) in Austin, Texas. He notes that AI deployed at the "edge" is an important technology for warfare. He cites a few general examples where Edge AI will have an impact.

"The first is scenarios where units are operating in a tactical environment with limited data availability and decisions must be made in seconds," explains Adams. "In this situation, the warfighter is limited in time and capacity to make the best use of whatever limited data does exist and is at risk of drawing poor conclusions under the tactical threat environment. Edge AI can empower the unit to draw insights and conclusions at the necessary tactical speed. In tactical scenarios at the Edge, these seemingly minor advantages have life-and-death consequences and overall mission effectiveness. With respect to EW, signals intelligence (SIGINT) is commonly occurring at the Edge, and AI is a powerful capability to unlock this data and convert it into a tactical advantage."

Adams cites a second example that mixes AI with cyber security at the edge. "In today's battlefield, the warfighter and the devices they carry represent an endpoint that is susceptible to cyber-attack. This exponential growth in endpoints on the battlefield network means that the endpoint is the frontline in network resiliency," says Adams. "AI-powered endpoint protection leverages machine learning to provide continuous protection for an evolving threat environment. It does not require regular signature updates for effectiveness, maintaining high efficacy and resilience to zero-day attacks."

AI and machine learning: the road ahead

In the next three to five years, we can expect even more AI and machine learning developments. Their applications are vast and deep and stand to elevate the capabilities of technology platforms to new heights.

Chris Ciufo is the chief technology officer and chief commercial officer at General Micro Systems (GMS) in Rancho Cucamonga, Calif. He foresees great strides in how vendors combine the need for more AI and machine learning processing power with less size, power, and heat over the next five years.

"The future battlefield will be won by digital means, so that means supporting our troops with clear and comprehensive data without squeezing them between racks of computers or noisy fans," Ciufo says. "Smaller conduction-cooled (passive) AI and machine learning computers are needed to embed AI into/onto less sophisticated systems—the 'at the edge' term that's pervasive lately. This seems a given. What's less obvious? Knowing how AI capabilities can be easily and cheaply added to not-so-obvious platforms like mortars, shoulder munitions, SATNAV/SATCOM gear, and workhorse platforms like 6x6 transport trucks or aged M113 personnel carriers. The promise of AI and machine learning is so great that all vehicles, weapons, processes, and piece of equipment should be considered for some add-on intelligence."

Alternatively, Neil Sampson the director of aerospace and defense for GSI Technology Inc. in Sunnyvale, Calif., believes the greatest leaps may occur in satellites, drones, and unmanned materiel capabilities in the next three to five years. "Having satellites be able to do more data processing on-prem increases capability by transmitting pre-processed information rather than raw data,"Sampson says. "Similarly, drones having autonomous capabilities can increase the operational effectiveness of handlers: allowing both increased control of numbers, and better attention for hot situations."

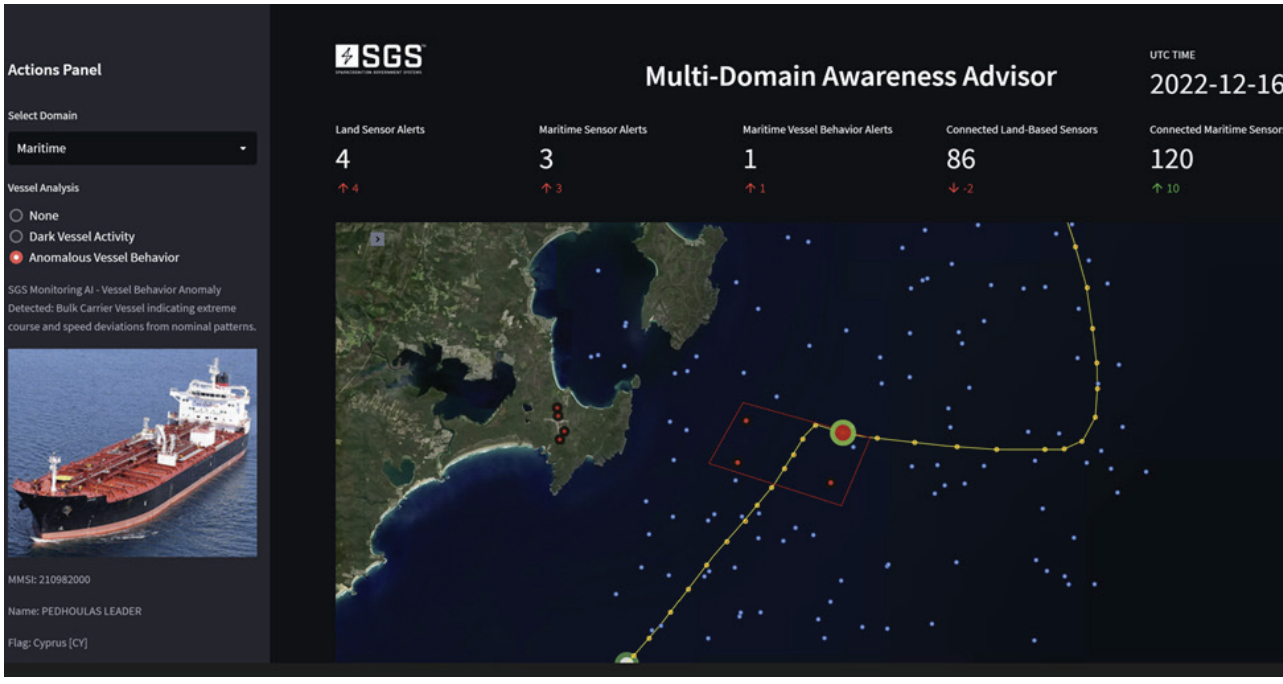
Lockheed Martin officials say they expect to see the aerospace and defense community continue to leverage state-of-the-art technology from the commercial sector, but we also expect to see defense sharing innovations we've developed with commercial and other open-source communities.

"Some technologies we see flowing from commercial to defense include use of large language models and explainable AI methods which aid use of AI in critical commercial and defense use cases alike, e.g., for medical diagnosis," says Mauro J. Sanchirico III, engineering manager at the Lockheed Martin AI Center (LAIC) in Orlando, Fla. "Finally large architectures comprised of multiple AI systems in larger systems-of-systems will be a new frontier for both commercial and defense research communities."

Sanchirico adds that as the commercial and defense communities face these new frontiers together, some technology will flow back from the aerospace and defense sector to the commercial. This will be especially true for edge signal processing.

"As the electromagnetic spectrum continues to crowd with commercial and defense use by communications, radar, and consumer electronics, the need to remove interference more effectively and adaptively will continue to be a common need," says Sanchirico.

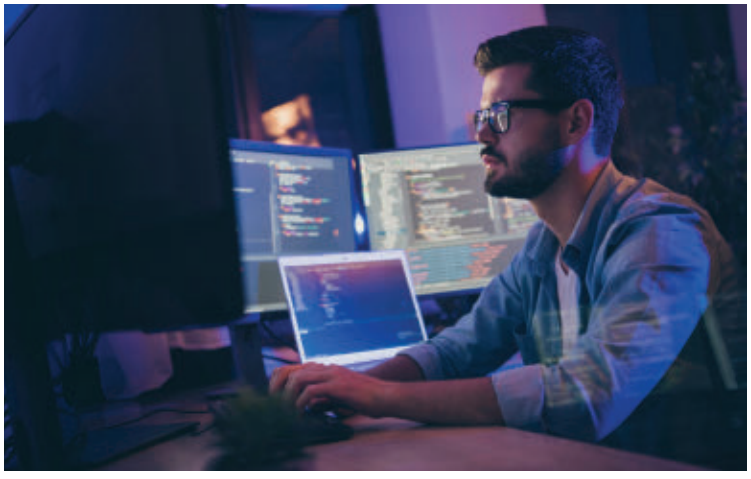
"As Lockheed Martin moves toward connecting multiple AI nodes together in large collaborative networks, reliable sensing and communications will continue to be the key fabric we build on in defense applications, and use of AI to intelligently deconflict will be key to doing so reliably. To facilitate these developments, Lockheed Martin expects to see a continued strong



AI is an overarching system that can reason, learn, and adapt, and includes fundamental capabilities such as machine learning, natural language processing, and computer vision. Source: iStock via Lynx Technologies

demand for AI talent in the aerospace and defense industry, and career opportunities for those who are already establishing AI careers in the electromagnetic spectrum operations (EMSO) community.

"Within the Lockheed Martin AI Center, we've established a Cognitive Signals and Systems team dedicated to applying AI in EMSO, consisting of specialists in AI, signal processing, and software engineering, several of whom conceived of and invented the technologies and applications we've mentioned here," Sanchirico says.



Military AI researchers need to find the right places where they can leverage value that can drive a cycle of change. Source: iStock via Lynx Technologies

Staying vigilant of AI applications

The NRL's Goodman advises keeping a watchful eye on unmanned aerial vehicles (UAVs) among other technologies. Specifically, he says that in the next three to five years, expect to see a greater reliance on autonomous multi-platform coordinated operation of forwardly deployed UAVs, unmanned surface vessels and unmanned underwater vehicles (UUVs) when engaged in intelligence, surveillance and reconnaissance (ISR), EW, or time-tactical targeting.

"There has been some reticence in adopting AI and machine learning given the black-box nature of its operation, so the DOD has invested in research to better explain the rationale used by autonomous systems in their decision-making process, especially when they encounter patterns and/or scenarios that were not a part of training," says Goodman.

In addition to autonomy though, investments will continue in hardware and software to harness data that enhances AI across different applications.

"Breakthroughs in areas such as natural language processing for text and sequence-to-sequence prediction, such as Explainable AI's ChatGPT3, have relied on a huge volume of labeled data to train massive AI and machine learning models," Goodman notes.

"The DOD generally does not have access to a large corpus of labeled data, so instead it is investing in techniques that are capable of training on datasets captured in the field with incomplete labels," Goodman continues.

"It is also expected that specialized hardware, developed under the CHIPS Act, will deliver AI and machine learning-enabled payloads that would otherwise be unable to meet tight SWaP constraints onboard smaller platforms such as Class 2 UAVs and CubeSat-size satellites," Goodman says. "Finally, some AI and machine learning architectures — particularly those based on a deep learning framework — could be vulnerable to adversarial exploitation using systems such as generative adversarial and diffusion networks. Ensuring that deep learning systems are resistant to adversarial attack and whose decisions are explainable are critical considerations."

SGS's Adams, however, posits that the merits of AI are on the cusp of penetrating a wide range of products throughout the military aviation and electronic landscape. AI is beginning to stand well on its own two feet, helped along by efficiency, cost savings, and some uncanny strategic benefits that can't help catching the attention of world leaders.

"With usable AI reaching an inflection point, we will start to see every product and operation designed around extracting the benefits that AI will bring," says SGS's Adams. "Efficiencies, cost savings, resiliency, awareness, decision dominance, confidence, and speed—-these are crucial components of a successful defense industry and a ready and lethal military—AI is poised to take a far more prominent and entrenched role across the entire spectrum of warfare in the middle to late stages of this decade."Summarily, AI remains on an upward trajectory. That steep upward slope should proceed for some time. AI is still in early adoption, as the costs and benefits are weighted and measured, while its benefits are slowly, but surely, recognized as a boon to our definition of military intelligence in our modern world. We have much reason to wait with anticipatory optimism as AI continues to be built out in military technology where, perhaps, the best is yet to come.

PLATFORM SYSTEMS

More information on AI systems and suppliers is online at https://www.militaryaerospace.com/directory/platform-systems-subsystems

Power electronics designers strive for high efficiency, and low SWaP

Trends in power supplies include efficiency, new device materials, rugged and radiation-hardened packaging, and high-voltage designs.

BY **John Keller**

Electric power control and conditioning for ever-more-powerful and -complex embedded computing processors, sensors, RF transceivers, and other advanced components poses challenges today that involve size, weight, and power consumption (SWaP); efficiency; thermal management; new materials; ruggedized packaging; and the growing influence of open-systems industry standards.

It's one thing to design microprocessors that are smaller and more powerful with each passing year, but it's quite another to design the kinds of DC-DC converters and other power supplies that can feed these processors just the amount of power they need, when they need it. Furthermore, today's power components must be small and lightweight enough to fit into complex electronic architectures, make the right balance of voltage and current, keep levels of waste heat down, and capitalize on the latest semiconductor materials for the best efficiencies possible.

Systems integrators are looking for power electronics technologies that can help them enhance efficiencies to help them reduce size and weight; meet the guidelines of open-systems standards when they're specified; manage internal heat, accommodate advanced materials, and design for harsh environments that involve shock, vibration, and temperature extremes in next-generation radar, electronic warfare (EW), rugged computers, and similar systems.

Power electronics designers like VPT specialize in radiation-hardened power devices for demanding space environments like geosynchronous orbits.

Shrinking size and weight

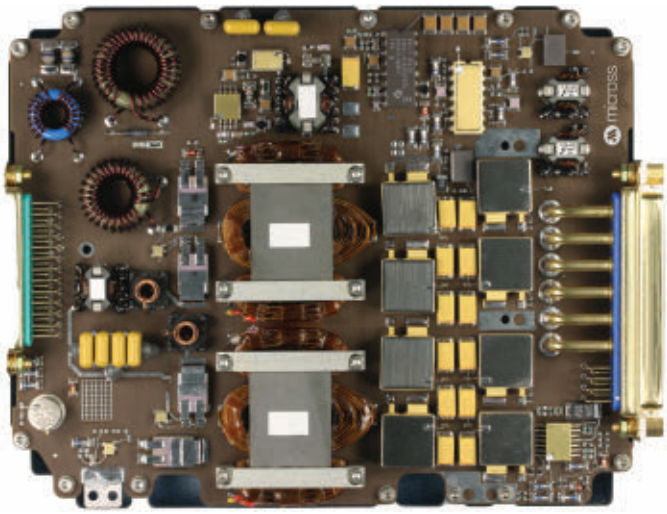
Trends in the power electronics market mirror those of many other segments in the electronics industry: everything's getting smaller. This shrinkage of electronic components is fueling aerospace and defense electronics trends in unmanned vehicles, surveillance and reconnaissance, avionics, communications, and many other applications.

"Everything is shrinking in size," says John Santini, chief technology officer of Micross Components Inc. in Melville, N.Y. "Everybody is looking to do point-of-load regulation closer to the ICs — especially ASICs and processors. It gives you much better transient response, and you don't have conductive losses in the traces, and you save board real estate."

Some power electronics companies are shrinking device size by increasing the level of integration of their products. One such company is Gaia Converter in Bordeaux, France. "We offer a complete range of products that are 8 millimeters tall for use in VPX systems where you don't have a lot of space," says Christian Jonglas, Gaia's technical support manager.

"This year we started to compress functions into one module," Jonglas continues. "This is a trend today at Gaia Converter to embed all power functions on one device. We are developing the FLHG 60 DC-DC converter, which includes all front-end functions you need to place in front of the DC-DC converter."

Gaia's power integration efforts continue. "In the future we will put a complete power supply in one COTS [commercial off-the-shelf] case," Jonglas says. Gaia's PSDG 40 — a 40 watt power supply — will be introduced later this year, which will be a complete power supply in one COTS module, with four to five different power outputs, Jonglas says. This product should be compliant with DL 160 and MIL STD 461.



▲ **Micross offers integrated power control and conditioning devices to help designers avoid power systems made from many discrete components.**

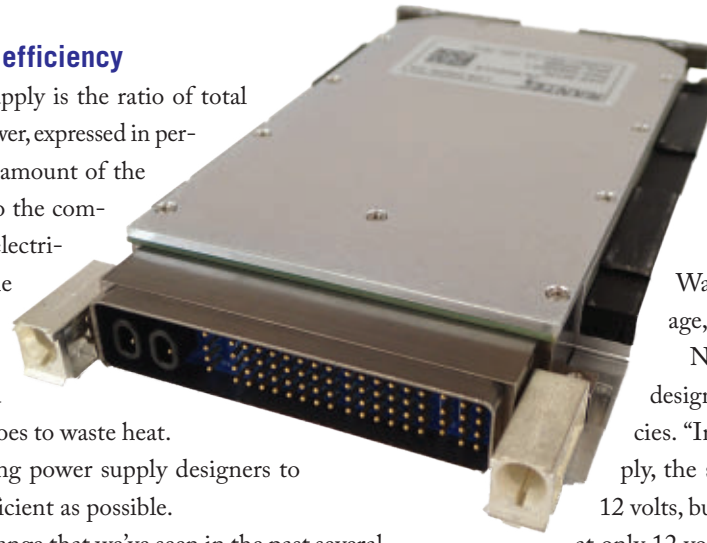
This trend in power systems integration has been a long time in coming. "In 2005 we were doing 150 Watts in a half-brick module, and today it is 500 Watts," Jonglas explains. "We will be at more than one kilowatt in one-half brick, and this should be ready very soon."

Keeping up this trend have its challenges, though. "To build a wide input range of high power with as much as 90 percent efficiency will need new technologies, but we could see that in the next five years," Jonglas says. ""Integration is difficult for many reasons. You can get very wide input range DC-DC converters with sustained transient voltage, but it is difficult to make the choices necessary to get the best optimization."

Another way to reduce SWaP is to move to advanced materials like gallium nitride and silicon carbide, instead of traditional silicon MOSFETs. "The size of a GaN FET, compared to a silicon MOSFET, is about an eight times reduction in volume," says Brian Paul, general manager at Milpower Source Inc. in Belmont, N.H.

Couple that reduction in SWaP to the increased performance of GaN and SiC FET. "Designers get the temperature range they need, and we are pushing beyond 800 Watts in a 3U VPX power supply now," Paul says. "We started building 3U VPX power supplies in 2015, and since then we have moved from about 250 Watts to beyond 800 Watts, due to the materials and the innovation of what you can do in that volume. we also do discrete component designs, which enables you to stuff more in the same volume."

Designing for power efficiency



Open-systems standards like 3U VPX have a growing influence on embedded power electronics like this embedded power module from Rantec.

Efficiency in a power supply is the ratio of total output power to input power, expressed in percent, and represents the amount of the actual power delivered to the components divided by the electrical power drawn from the supply socket. The better the efficiency, the more power goes to good use, and the less power goes to waste heat. It's a primary goal among power supply designers to make their devices as efficient as possible.

"The number-one change that we've seen in the past several years is efficiency," says Jeremy Ferrell, director of engineering at VPT Inc. in Blacksburg, Va. "People are changing what their efficiencies are, and are pushing that down to the power converter. Every little bit of power they can save is a big reduction in weight from solar panels and batteries. Our customers are demanding more efficiencies."

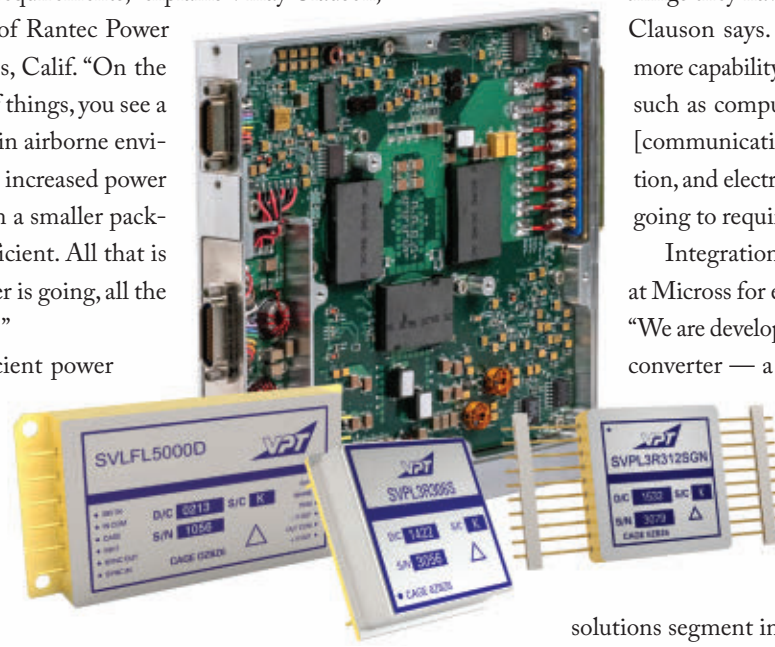
Advanced applications like military avionics are helping to drive developments in power electronics. "The technology fundamentally is driven by the requirements," explains Vinay Clauson, executive vice president of Rantec Power Systems Inc. in Los Osos, Calif. "On the military aerospace side of things, you see a lot of demand for power in airborne environment, and that means increased power density — more power in a smaller package, lighter, and more efficient. All that is driven by where the power is going, all the way down to the devices."

The demand for efficient power never seems to end. "Customers always want more efficiencies," Clauson says. "Our customers will do things like drive higher voltages; they are looking for more, and more power at the same voltages. The way to go is to higher voltages to make up for higher copper loss."

For Rantec and other power electronics designers, the trend is clear. In 3U VPX power supplies, for example, in recent years were able to supply 500 Watts, and that has grown to 750 Watts — all in the same-sized package, Clauson says.

New industry-standard power designs are pushing for higher efficiencies. "In our VPX VITA 62 power supply, the standards accommodate 3.3 and 12 volts, but now they just want more power at only 12 volts," Clauson says. "For customers that simplifiers their design; they don't have to deal with three different voltages, and can route more power on the backplane because they have a higher voltage. There is not as much current flowing through a backplane."

Increasing voltages "allows the system-level designer to have more power available, and from a power supply perspective he can get higher system level efficiencies by not using those 3.3 power voltages; the whole push for going in that direction, is doing things they haven't been able to do before, Clauson says. "They can add more and more capability to these military platforms, such as computing, radar, and CNI/EW [communications, navigation, identification, and electronic warfare]. Everything is going to require more power electronics."



VPT offers a variety of power supplies for space applications, ranging from low-Earth orbit commercial satellites to geosynchronous communications and reconnaissance satellites.

Integration also is the name of game at Micross for enhancing power efficiency. "We are developing solutions for the down-converter — a large centralized architecture — and at developing points of load sitting next to the processors," explains Lass Pedersen, vice president of the Micross high-rel power solutions segment in San Jose, Calif.

"With higher voltage, you get better efficiency in the whole system," Pedersen continues. "The higher voltage drives a need for less losses in output stage. As the transmitter is often the mission, and the mission always get most of the power, so the customer looks at the best efficiency he can get."

New device materials

Increasing voltages isn't the only way to enhance power efficiencies. Another way is to move beyond traditional silicon-based metal oxide semiconductor field-effect transistors (MOSFETs) and gallium arsenide (GaAs) to gallium nitride-based FETs or to silicon carbide (SiC). "We are using gallium nitride FETs, which represent a game changer," says VPT's Ferrell. "GaN can switch a lot faster than silicon. A lot of research is going into GaN, which is naturally radiation hardened, produces less losses, and we can make it smaller."

GaN represents a major trend for many power electronics applications. "At VPT we think GaN is the future as far as performance is concerned. There always will be a place for MOSFETs. We have spent the past eight years to make sure the circuits work reliably. There is a learning curve, and we are over that learning curve, but there is a pretty large boundary to enter that market."

Silicon carbide also is making inroads to power electronics technologies. "We see a lot of use of silicon carbide and gallium nitride to drive efficiencies," says VPT's Clauson. "These new ICs support addition efficiencies, and smaller dies."

Sometimes the application helps determine the choice of materials for power electronics devices. "Already now gallium arsenide is a niche for lower frequencies, while GaN is more popular for higher frequencies," says Pedersen of Micross. "Most likely GaAs will remain for niche applications."

The move to GaN should be a major boost to the power electronics industry, says adds Santini of Micross. The move to GaN also has helped the power conversion industry because now the buzz word in power conversion is to go to GaN and to silicon carbide. Those new technologies allow smaller and more efficient devices. GaN is really doing that on the low-voltage devices of less than 100 volts, and for devices of more than 100 volts silicon carbide is more popular."

Next-generation DC-DC converter power supplies also should benefit from GaN, which "is being optimized for switching power applications and for next-generation DC-DC converters," Santini says. "GaN lets you switch efficiently at high frequencies, and by moving the frequencies up, all the magnetics shrink, and you get better efficiencies."

Yet as new technologies come online, systems designers often face a new set of issues. "GaN opens up the box to a new set

of tradeoffs," Santini says. "It decreases switching losses, and they allow the magnetics and capacitors to shrink as well, which drives smaller package sizes."

Flexibility in design is another advantage of switching to new materials like GaN and SiC. We have implemented GaN FETs, and use a lot of silicon carbide," says Milpower Source's Paul. "Silicon carbide is good at some of the higher voltages, and GaN can give you advantages in the lower voltages."

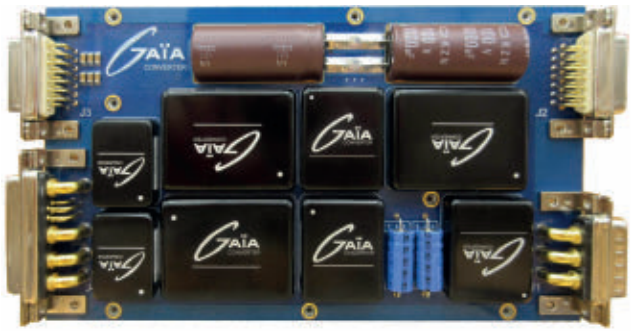
Rantec specializes in custom-design power supplies for use in extremely harsh aerospace, defense and orbital space applications.

Power electronics applications

There are many aerospace and defense applications that are helping to push power electronics technologies forward. "At the end of the day the power electronics is driven by the application," points out Pedersen of Micross. "We do power because it is needed for different applications; wherever the applications are going, the power goes with them."

Pedersen says he sees four major trends driving developments in power electronics. "One is the increased need for processors. We see processors all over the place, and you need low-voltage high-current solution that sits next to the processor, and the downconverter that provides small points of load with a certain voltage. We are developing solutions for the downconverter, a large centralized architecture, and at developing points of load sitting next to the processors.

The second trend involves RF and microwave communications. "We are seeing increased bandwidth for communications," Pedersen continues. "One way to get that is apply higher frequencies in your communications systems, and there gallium nitride pushes things to higher frequencies. GaN is coming into the market as preferred technology. Pushing a need for instead of gallium arsenide transmitters that operate in 6 to 10 volts, but GaN transmitters are operating at 30 to 50 volts."



Gaia Converter specializes in integrated systems and commercial off-the-shelf (COTS) components to produce power supplies that are rugged and affordable.

The third trend involves moving to higher voltages. "Higher voltage gets you better efficiency in the whole system," he says. "The higher voltage drives a need for less losses in output stage. The transmitter is often the mission, and the mission always gets most of the power, so the customer looks at the best efficiency he can get." The fourth trend involves applications in orbiting satellites, which requires some level of radiation hardness or radiation tolerance in power devices.

Other applications driving power electronics technology forward include unmanned vehicles with multisensor payloads, says Gaia's Jonglas. "You need power for all electronics inside — cameras, sensors, all the systems of different voltages and power." Echoes VPT's Ferrell, "Target applications are any kind of transmitter, many with high-voltage output, but in any geo-synchronous satellite."

Vast increases in the use of microprocessors in aerospace and defense systems across the board is a huge driver in power electronics innovation, says Milpower Source's Paul. "The amount of data they are crunching requires more and more power," he says.More information on data storage manufacturers and suppliers is online at https://www.militaryaerospace.com/directory/components-power-electronics-sensors.

MORE INFORMATION

More information on data storage manufacturers and suppliers is online at https://www.militaryaerospace.com/directory/ components-power-electronics-sensors.

Northrop Grumman to provide 42 AESA radar systems for F-16 fighters in $99.4 million order

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio – U.S. Air Force aerial warfare experts are ordering additional modern active electronically scanned array (AESA) radar for F-16 jet fighter aircraft under terms of an $99.4 million order.

Officials of the Air Force Life Cycle Management Center, Fighter Bomber Directorate, F-16 Division, at Wright Patterson Air Force Base, Ohio, are asking the Northrop Grumman Corp. Mission Systems segment in Linthicum Heights, Md., for 42 production radars and spare parts.

The APG-83 AESA fire-control scalable agile-beam radar (SABR) integrates within the F-16's structural, power, and cooling constraints without Group A aircraft modification, Northrop Grumman officials say. The company leverages technology developed for the APG-77 and APG-81 radar systems on the U.S. F-22 and F-35 combat aircraft.

In a 2013 competition, Lockheed Martin Corp., the F-16 manufacturer, selected the APG-83 as the AESA radar avionics for the F-16 modernization and update programs of the U.S. Air Force and Taiwan air force.

▲ The bandwidth, speed, and agility of AESA radars enable legacy fighter aircraft like the F-16 to detect, track, and identify many targets quickly and at long ranges.

The bandwidth, speed, and agility of AESA radars enable legacy fighter aircraft like the F-16 to detect, track, and identify many targets quickly and at long ranges, and to operate in hostile electronic warfare (EW) environments.

Northrop Grumman is building APG-83 radar systems for global F-16 upgrades and new aircraft production, as well as for the U.S. Air National Guard. Northrop Grumman also has installed a production APG-83 SABR on a U.S. Marine Corps F/A-18C Hornet jet fighters, company officials say.

On this order Northrop Grumman will do the work in Linthicum Heights, Md., and should be finished by July 2025. For more information contact Northrop Grumman Mission Systems online at www.northropgrumman.com, or the Air Force Life Cycle Management Center at www.aflcmc.af.mil.

Raytheon taps North Atlantic for communications for LTAMDS missile-defense radar

BY **John Keller**

ANDOVER, Mass. – Missile-defense experts at Raytheon Technologies Corp. needed high-density I/O, communications, Ethernet switching, and embedded computing capability for the Lower Tier Air and Missile Defense Sensor (LTAMDS). They found their solution from North Atlantic Industries Inc. in Bohemia, N.Y.

▲ **The North Atlantic SIU35 3U CompactPCI sensor interface unit is being integrated into the Raytheon for the Raytheon Lower Tier Air and Missile Defense Sensor (LTAMDS).**

Officials of the Raytheon Missiles & Defense segment in Andover, Mass., are choosing the North Atlantic SIU35 3U CompactPCI sensor interface unit for the LTAMDS, which is to replace the U.S. Army Phased Array Tracking Radar to Intercept on Target (PATRIOT) missile system.

LTAMDS is the next generation, 360-degree missile-defense radar that ultimately will replace the current U.S. Army's PATRIOT missile radars. The radar has gallium nitride components, and was scheduled to reach initial operational capability with the Army in 2022.

The North Atlantic SIU35 is a configurable rugged subsystem with five 3U CompactPCI slots, and accommodates as many as 15 I/O and communications modules. the SIU35 supports stand-alone operation via Ethernet connection to mission computers.

For LTAMDS, Raytheon is taking advantage of the flexibility and modularity of North Atlantic's Configurable Open System Architecture (COSA) to consolidate several interface functions into two off-the-shelf chassis.

To meet platform requirements, Raytheon configured the pair of North Atlantic SIU35 rugged boxes to serve as a programmable logic controller and a cooling system controller aboard the next generation GhostEye radar system.

Raytheon designers sought to improve efficiencies in LTAMDS size, weight, and power consumption (SWaP) by combining many channels and dissimilar functions into dense multi-purpose solutions. LTAMDS relies on Ethernet-based communications to monitor, manage, and control several I/O and communications interfaces without the need for custom electronics, says Lino Massafra, vice president of sales and marketing at North Atlantic.

The SIU35 uses the NXP PowerPC QorIQ P2041, Intel Core i7, and ARM Cortex-A9 microprocessors; meets MIL-STD-461F, MIL-STD-810G, MIL-STD-1275, and MIL-STD-704A standards for high reliability; has a 28-volt DC input, and measures 7.13 by 4.78 by 8.71 inches.

The I/O subsystem offers software support that includes Wind River Linux and VxWorks, Xilinx PetaLinux, and Windows Embedded Standard 7 OS support; offers built-in test, and operates in temperatures from -40 to 71 degrees Celsius.

LTAMDS consists of a primary antenna array on the front of the radar, and two secondary arrays on the rear. The radar antennas work together to enable operators to detect and engage several threats simultaneously from any direction, ensuring there are no blind spots on the battlefield.

The LTAMDS primary array is roughly the same size as the PATRIOT radar array, but provides more than twice PATRIOT's performance. While it is designed for the U.S. Army's Integrated Air and Missile Defense system, LTAMDS will also be able to preserve previous PATRIOT investments.

Raytheon is working with hundreds of suppliers across 42 states. In addition to North Atlantic, Raytheon LTAMDS suppliers include Orolia USA in Rochester, N.Y., which is providing the company's rugged SecureSync time and frequency system to supply positioning, navigation, and timing (PNT) capability; and Crane Aerospace and Electronics in Lynnwood, Wash., which is providing defense power systems for power control and conditioning for LTAMDS. Mercury Systems Inc. in Andover, Mass., is providing high-performance digital signal processing and RF solutions for LTAMDS.

For more information contact North Atlantic Industries online at www.naii.com/model/SIU35, or Raytheon Missiles & Defense at www.raytheonmissilesanddefense.com.

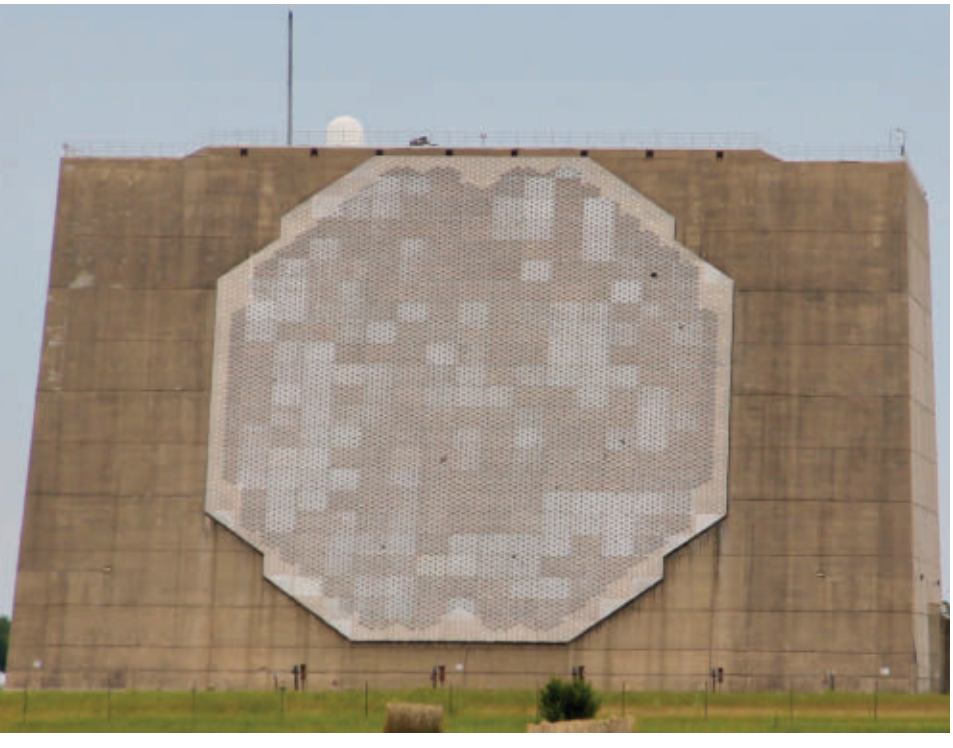
InDyne to maintain and upgrade early warning radar for ballistic missile defense

BY **John Keller**

PETERSON SPACE FORCE BASE, Colo. – U.S. Air Force needed a company to operate, maintain, and upgrade a ground-based early warning radar system to help protect the U.S. and its allies from enemy ballistic missile attack. They found their solution from InDyne Inc. in Lexington Park, Md.

Officials of the Space Acquisition, and Integration Office of the Space Force's Space Operations Command at Peterson Space Force Base, Colo., have announced a $63 million contract to InDyne for the operations and maintenance support of the Perimeter Acquisition Radar Attack Characterization System (PARCS) mission system.

PARCS is a large radar installation that provides ballistic missile warning and attack assessment, as well as space surveillance data to the North American Aerospace Defense Command (NORAD) at Peterson Space Force Base, Colo., as well as to USSTRATCOM and regional combatant commanders.



U.S. Space Force is choosing InDyne Inc. in Lexington Park, Md., to operate, maintain, and upgrade the Perimeter Acquisition Radar Attack Characterization System (PARCS) ground-based early warning missile-defense radar system.

The PARCS ballistic missile defense radar monitors and tracks more than half of all Earth-orbiting objects with its AN/FPQ-16 phased-array radar system pointed northward over Hudson Bay, and analyzes more than 20,000 tracks per day, from giant satellites to space debris.

The PARCS signal processing group (SPG) consists of 10 cabinets of equipment with hundreds of unique parts. The SPG generates frequency-modulated pulses for transmission, spectrum inversion, and pulse compression; performs side lobe reduction; as well as compares and processes track signals, multiplexing, and signal conversion.

Extensive alignment and maintenance are necessary to maintain proper signal reception and analog digital conversion of the radar system, experts say.

PARCS is a sister ballistic-missile-defense system to the Precision Acquisition Vehicle Entry Phased Array Warning System (PAVE PAWS), and the Ballistic Missile Early Warning System (BMEWS).

PAVE PAWS is a ground-based radar system that provides U.S. Strategic Command (USSTRATCOM) at Offutt Space Force Base near Omaha, Neb., with warning and attack-assessment information on all intercontinental ballistic missiles (ICBMs) launched throughout the world that might be headed for U.S. territory.

BMEWS, meanwhile, is a ground-based radar system that helps warn USSTRATCOM and NATO authorities of submarine- and sea-launched ballistic missile (SLBM) attacks and provides data to help evaluate the severity of ballistic missile attacks.

On this contract InDyne will do the work at Cavalier Space Force Station, N.D., and should be finished by August 2029. For more information contact InDyne online at www.indyneinc.com, or Space Force Space Operations Command at www.spoc.spaceforce.mil.

Lockheed Martin eyes inertial navigation and radar guidance for PAC-3 missiles

Air- and missile-defense experts at Lockheed Martin Corp. will provide hardware, manufacturing, and testing to produce MIM-104 Patriot Advanced Capability-3 (PAC-3) missiles under terms of a $273 million order. Officials of the U.S. Army Contracting Command at Redstone Arsenal, Ala., are asking the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, to provide services, hardware, facilities, equipment, and all technical, planning, management, manufacturing, and testing efforts to produce PAC-3 missiles. Patriot PAC-3 is a hit-to-kill missile designed to defeat tactical ballistic missiles, cruise missiles, and aircraft. It is a high- to medium-altitude long-range air-defense missile that defends ground combat forces and high-value military equipment. The PAC-3 missile is a high velocity interceptor that defeats incoming targets by body-to-body direct impact. PAC-3 missiles, when deployed in a Patriot battery, provide 16 PAC-3s on a Patriot launcher. Lockheed Martin also handles the PAC-3 missile segment upgrade, which consists of the PAC-3 missile, PAC-3 missile canisters in four packs, a fire solution computer, and an Enhanced Launcher Electronics System. The missile flies to an intercept point specified prior to launch by its ground-based fire solution computer, which is embedded in the system's engagement control station. The PAC-3 system can update target trajectory data during missile flyout with a radio frequency uplink and downlink. On this order Lockheed Martin will do the work in Dallas, and should be finished by January 2023. 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 Arsenal at https://acc.army.mil/contractingcenters/acc-rsa/.

Northrop Grumman to build 42 AN/APG-83 AESA jet fighter radar systems

U.S. Air Force aerial radar experts are ordering 42 modern active electronically scanned array (AESA) radar systems for Air Force F-16 jet fighters under terms of a $99.4 million order. Officials of the Air Force Life Cycle Management Center, Fighter Bomber Directorate, F-16 Division, at Wright Patterson Air Force Base, Ohio, are asking the Northrop Grumman Corp. Mission Systems segment in Linthicum Heights, Md., to build 42 AN/APG-83 AESA radar systems and spare parts for the F-16. The APG-83 AESA fire-control scalable agile-beam radar (SABR) integrates within the F-16's structural, power, and cooling constraints without Group A aircraft modification, Northrop Grumman officials say. The company capitalizes on technology developed for the APG-77 and APG-81 radar systems on the U.S. F-22 and F-35 combat aircraft. In a 2013 competition, Lockheed Martin Corp., the F-16 manufacturer, selected the APG-83 as the AESA radar for the F-16 modernization and update programs of the U.S. Air Force and Taiwan air force. The bandwidth, speed, and agility of AESA radar systems enable legacy fighter aircraft like the F-16 to detect, track, and identify many targets quickly and at long ranges, and to operate in hostile electronic warfare (EW) environments. Northrop Grumman is building APG-83 radar systems for global F-16 upgrades and new aircraft production, as well as for the U.S. Air National Guard. Northrop Grumman also has installed a production APG-83 SABR on a U.S. Marine Corps F/A-18C Hornet jet fighter-bomber, company officials say.

General Dynamics to upgrade SIGINT sensors to keep up with evolving threats

BY **John Keller**

ABERDEEN PROVING GROUND, Md. – Military signals intelligence (SIGINT) experts at General Dynamics Corp. will maintain and upgrade combat vehicle SIGINT vetronics system to detect, identify, locate and deter a wide range of signal emissions on the battlefield.

Officials of the U.S. Army Contracting Command at Aberdeen Proving Ground, Md., announced $481.6 million contract to the General Dynamics Mission Systems segment in Scottsdale, Ariz., to sustain the AN/MLQ-44 Prophet-Enhanced SIGINT vetronics systems.

General Dynamics also will continue development and integration of technology insertion capabilities for the Prophet-Enhanced system to keep the systems up to date against an evolving threat.

The Prophet system is vehicle-mounted or soldier-transportable. Prophet offers a near-real-time picture of the battlespace through SIGINT sensors and high-performance computing.

The program is structured with the ability to incorporate new technologies as they become available. For example General Dynamics has used the RS112 1U rugged server from Crystal Group Inc. in Hiawatha, Iowa.

Prophet is the Army division and armored cavalry regiment commander's principal SIGINT and electronic warfare (EW) system. It also enhances the tactical commander's capabilities in electronic intelligence battlespace visualization, target development, and force protection. Prophet offers electronic attack and navigation attack capability.

The Prophet system also provides near-real-time digital information to the Army division's common operating picture (COP), and is integrated with battlefield sensors such as the Joint Surveillance Target Attack Radar System (Joint STARS), the Guardrail Common Sensor, Artillery Counter Mortar/Battery radars, and Forward Area Air Defense Command and Control/FAADC2.

▲ The Prophet system is vehicle-mounted or soldier-transportable, and offers a near-real-time picture of the battlespace through SIGINT sensors and high-performance computing.

Prophet's primary mission is to map radio frequency (RF) emitters on the battlefield electronically from 20 MHz HF frequencies to 2000 MHz SHF frequencies.

Electronic mapping detects, identifies, locates, and tracks all RF emitters operating within range, and helps coordinate these RF signatures with other battlefield surveillance and reconnaissance systems.

Prophet helps protect Global Positioning System (GPS) satellite navigation, helps detect intrusion or false GPS signals, and helps attack the enemy's ability to use the GPS or other satellite navigation and timing systems. The system also can intercept, disrupt, or eavesdrop on enemy radio communications.

On this contract General Dynamics will do the work at locations to be determined with each order, and should be finished by January 2028. For more information contact General Dynamics Mission Systems online at https://gdmissionsystems.com, or the Army Contracting Command at Aberdeen Proving Ground at https://acc.army.mil/contractingcenters/acc-apg.

Lockheed Martin eyes EW aboard helicopters to defend against anti-ship missiles

BY **John Keller**

LIVERPOOL, N.Y. – U.S. Navy surface warfare and missile defense experts are asking Lockheed Martin Corp. for help in building and fielding helicopter-based long-range electronic warfare (EW) systems to protect Navy surface ships from existing and future advanced anti-ship missiles.

Officials of the Naval Sea Systems Command in Washington announced a $14.8 million order to the Lockheed Martin Rotary and Mission Systems segment in Liverpool, N.Y., for systems engineering for the AN/ALQ-248 Advanced Off-Board Electronic Warfare (AOEW) Active Mission Payload (AMP) system for the MH-60R and MH-60S ship-based maritime helicopters. Lockheed Martin will deliver two AOEW AN/ALQ-249 pods with spares and support.

AOEW will provide electronic countermeasures against anti-ship missiles with an EW active mission payload for the MH-60R and MH-60S ship-based maritime helicopters.

AOEW will provide long-endurance, off-board electronic countermeasures against current and future anti-ship missiles with a long-duration EW active mission payload for the MH-60R and MH-60S ship-based maritime helicopters.

The AOEW AMP AN/ALQ-248 can work independently or together with the ship's onboard AN/SLQ-32(V)6 Surface Electronic Warfare Improvement Program (SEWIP) Block 2 to detect an incoming missile and then evaluate where it is going, Lockheed Martin officials say. AOEW then uses radio frequency countermeasure techniques to deter the missile.

One of the goals of the AOEW program is to detect and counter threats to provide enterprise electronic warfare to protect for the Navy Fleet. Lockheed Martin won the industry competition to develop and build the AOEW system in early 2016.

Lockheed Martin won a $17.8 million order in October 2021 to build low-rate initial production units of AOEW AMP system. The company was asked to deliver two AOEW AN/ALQ-249 pods with spares and support.

Although initial AOEW prototypes are to be installed on MH-60R and MH-60S helicopters, future deployable versions may be intended for long-range, long-endurance fixed-wing or helicopter unmanned aerial vehicles (UAVs), experts say.

Lockheed Martin will develop a modular open-systems architecture (MOSA) to enable the EW payload to adapt to evolving threats, hasten deployment, reduce development time and costs, and facilitate future system upgrades and technology insertion.

The AOEW program capitalizes on Lockheed Martin expertise across the corporation. The Lockheed Martin facility in Owego, N.Y., will integrate the system onto the MH-60 helicopters, which are built by Sikorsky, a Lockheed Martin company in Stratford, Conn.

On this order Lockheed Martin will do the work in Syracuse, N.Y., and should be finished by November 2023. For more information contact Lockheed Martin Rotary and Mission Systems online at www.lockheedmartin.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Penn State to develop enabling technologies in unmanned undersea vehicles

BY **John Keller**

WASHINGTON – U.S. Navy undersea warfare experts have awarded contracts collectively worth more than $1.8 billion to Penn State University to investigate guidance, navigation, propulsion, and materials for future unmanned underwater vehicles (UUVs) for a variety of reconnaissance and attack missions.

Officials of the Naval Sea Systems Command in Washington announced a $735 million order in December to the Applied Research Laboratory at The Pennsylvania State University (ARL/PSU) in University Park, Pa., for UUV work throughout the U.S. Department of Defense (DOD).

That order for unmanned undersea enabling technologies is on top of a $1.1 billion 10-year contract announced in February 2018 for the same kinds of work, which involves:

- guidance, navigation, and control of undersea systems;
- advanced thermal propulsion concepts and systems for undersea vehicles;
- advanced propulsors and other fluid machinery for marine systems;

▲ Penn State researchers will investigate guidance, navigation, propulsion, and materials for future unmanned underwater vehicles (UUVs) for a variety of reconnaissance and attack missions.

- materials technology and manufacturing technology for naval systems and components;
- atmosphere and defense communications systems research; and
- mission- and public service-related research, technology developments, test evaluation, and systems analysis. This work is to help provide a quick response to rapidly evolving DOD and other government agency requirements. ←

Work on these contract and order awards will be in University Park, Pa., and should be finished by February 2028. For more information contact the Penn State Applied Research Lab online at www.esm.psu.edu/research/centers-and-institutes/applied-research-lab.aspx, or Naval Sea Systems Command at www.navsea.navy.mil.

Army asks industry for robotic manipulator arms for unmanned bomb disposal

BY **John Keller**

PICATINNY ARSENAL, N.J. – U.S. Army bomb disposal experts are reaching out to industry to find companies able to design a robotic manipulator arm to help explosive ordnance disposal (EOD) experts detect, identify, disable, and dispose of chemical, biological, radiological, and nuclear (CBRN) explosives.

Officials of the Army Contracting Command - New Jersey Close Combat, on behalf of the Army Program Manager for Close Combat Systems at Picatinny Arsenal, N.J., have issued a request for information (W15QKN-23-Z-0U7W) for the Highly Dexterous Manipulation-Robotic Arms project.

This project seeks to gain information on mature enabling technologies available for designing robotic arms with dexterous fingers with near-human flexibility and greater-than-human strength.

These robotic arms should be able to grasp an object with an end-effector and manipulate it with another end-effector with intuitive systems controllers that include force feedback and haptic feedback. Information from this notice will help the Army shape future requirements and acquisition programs for robotic payloads.

Concerning technologies for the manipulator arms, Army researchers want information about:

- six degrees-of-freedom to include shoulder roll and pitch, elbow roll and pitch, and wrist roll and pitch per manipulator;
- forward reach of at least 50 inches, an upward reach of at least 36 inches, and downward reach of at least six inches below the platform's ground plane;
- weight of no more than 60 pounds;
- lift capability of at least 55 pounds with one manipulator, and at least 65 pounds with more than one manipulator;
- full extension lift capability of at least 30 pounds with one manipulator, and at least 50 pounds with more than one manipulator at full extension;
- dexterity sufficient to manipulate small wires, zipper fasteners, screws, door handles, push buttons, and similar objects;
- ability to manipulate large bombs and artillery shells like 155-millimeter artillery projectiles; and
- have a multi-shot disruptor tool that provides accurate and precise liquid and solid-shot explosive hazard disruption.

The Army is surveying industry for information about manipulator arms for unmanned vehicles that disarm roadside bombs and other explosives.

The robotic manipulator arm should be:

- compatible with Army percussion actuated non-electric (PAN) disruptor ammunition;
- capable of remotely loading and unloading multiple disruptor ammunition and projectile options in most orientations;
- able to aim the disruptor; and
- accurate enough to hit a 9-volt battery from 30 feet away.

The program's precision aiming manipulator should be capable of fine adjustments for positioning and aiming the multi-shot disruptor, and should be able to perform post disruption procedures of explosive hazards.

The robotic manipulator arm should have a maximum aiming resolution pan and tilt movement of 0.625 inches horizontally and vertically at 10 feet of aiming resolution; forward reach of at least 55 inches; weigh no more than 69 pounds; be able to lift at least 65 pounds; be able to lift at least 12 pounds at full extension; and be able to go 300 shots before maintenance.

Video should provide operators with situational awareness around the robotic platform as well as close-up views of manipulated items. The arm should be able to work in a chemical, biological, and radiological environment.

Companies interested were asked to respond by March to the Army's Yolie Marie Davila at yolie.m.davila.civ@army.mil and Carolina Ayala at carolina.j.ayala.civ@army.mil. More information is online at https://sam.gov/opp/5af691db075449348e7d0bade71a2c1e/view.

Kratos moves to full-rate production of BQM-177A unmanned target drones

BY **John Keller**

PATUXENT RIVER NAS, Md. – High-performance target drones experts at Kratos Defense & Security Solutions Inc. are moving on to full-rate production of a new subsonic aerial target designed to help Navy aircraft and surface warship crews learn to defeat enemy cruise missiles.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $49.6 million contract in late January to the Kratos Unmanned Systems segment in Sacramento, Calif. (formerly Composite Engineering Inc.), for 55 full-rate-production lot-4 BQM-177A surface-launched aerial targets.

The BQM-177A is the Navy's next-generation subsonic aerial target (SSAT), which is designed to mimic the behaviors and radar cross sections of dynamic, high-subsonic, sea-skimming anti-ship cruise missiles to help naval personnel practice air-to-air engagements.

The contract includes 55 rocket-assisted takeoff attachment kits, 277 mission kits, and data for the U.S. Navy and the militaries of Canada and Australia.

The BQM-177A unmanned aerial vehicle (UAV) program is designed to meet the U.S. Navy's requirements for a high fidelity target to replicate subsonic anti-cruise missile threats in direct support of fleet training and weapon system testing and evaluation.

In November 2016 Kratos Unmanned Systems officials announced they had achieved the final development program milestone for the BQM-177A target drone leading up to low-rate initial production (LRIP). In June 2018 Kratos began LRIP on the BQM-177A with a Navy order for 45 of the high-performance target drones.

▲ The BQM-177A is the Navy's next-generation subsonic aerial target (SSAT), which is designed to mimic the behaviors and radar cross sections of sea-skimming anti-ship cruise missiles.

Capable of speeds in excess of 0.95 Mach and a sea-skimming altitude as low as 10 feet above the surface of the water, the BQM-177A carries internal and external payloads including proximity scoring, identification friend or foe (IFF), passive and active RF augmentation, electronic countermeasures, infrared plume pods, chaff and flare dispensers, and towed targets.

The BQM-177A is based on the Kratos BQM-167X aircraft, a derivative of the U.S. Air Force BQM-167A Skeeter target. The BQM-177A introduces a new fuselage with area ruling, high-mounted wings, and an internally integrated MicroTurbo TR-60-5+ turbo jet engine for reduced transonic drag.

The BQM-177A will augment and later replace existing BQM-74E aerial targets, and will deliver longer range, lower cruise altitudes, and greater maneuverability than previous-generation target drones.

The BQM-177A is 17 feet long, has a 7 -foot wingspan, and weighs 620 pounds with fuel or payloads. It can fly at altitudes as low as 6.6 feet above the ground or water, and as high as 40,000 feet above sea level. ←

On this contract Kratos will do the work Sacramento, Santa Ana, Concord, and Chatsworth, Calif.; Dallas; Fort Walton Beach, Fla.; Blacksburg, Va.; Newton, Kan.; and Milwaukie, Ore., and should be finished by April 2024. For more information contact Kratos Unmanned Systems online at https://www.kratosdefense.com/about/divisions/unmanned-systems, or Naval Air Systems Command at www.navair.navy.mil.

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Howard University to establish research center for applications in machine autonomy

BY **John Keller**

ARLINGTON, Va. – U.S. Air Force researchers are asking Howard University, a historically black college in Washington, to establish a state-of-the-art facility to perform tactical machine autonomy research for future military applications.

Officials of the Air Force Office of Scientific Research in Arlington, Va., announced a $90 million contract to Howard University to establish a Historically Black Colleges and Universities-led University Affiliated Research Center consortium to execute research in tactical autonomy that will help move research into practical applications.

Howard will form and lead a consortium of historically black colleges with engineering and technology capabilities essential to military tactical autonomy research.

Toward this goal, Howard will establish a state-of-the-art research facility; assemble a world-leading team of autonomy faculty and researchers; increase the quality and quantity of job candidates military machine autonomy; and support an ecosystem of business and government partnerships to move autonomous technologies to weapon systems such as manned and unmanned platforms.

For decades, Congress has recognized the need to develop a diverse national science, technology, engineering, and mathematics (STEM) workforce. As the largest federal research funding agency and the largest employer of federal STEM professionals, the U.S. Department of Defense (DOD) plays an essential role in the U.S. science and technology ecosystem and can expand opportunities to diversify the STEM workforce, Air Force researchers say.

The Howard-led machine autonomy research consortium will focus on trust in mission autonomy; collaboration between platforms; and human-machine teaming.

Goals include fostering creative autonomy research in science and engineering; enhancing early career development of outstanding STEM professionals to increase and diversify the pool of STEM talent; and increasing opportunities for universities to work with the Air Force, Space Force and DOD in science and engineering.

Howard University will establish specialized facilities for autonomy research in enhancement of multi-domain situational awareness; reduction of cognitive workload; enabling force protection; and projecting solutions at-scale and in general for decision aids, cyber security, and teams of humans and autonomous machines.

Howard will form and lead a consortium of historically black colleges with engineering and technology capabilities essential to military tactical autonomy research. Watson College photo by Jonathan Cohen

On this contract, Howard University and its consortium will do the work on their college campuses, and should be finished by January 2028. For more information contact Howard University online at https://research.howard.edu, or the Air Force Office of Scientific Research at www.afrl.af.mil/AFOSR.

Boeing to make final procurements of airborne infrared sensors for stealthy Super Hornet jet

BY **John Keller**

PATUXENT RIVER NAS, Md. – U.S. Navy air combat experts are asking electro-optics engineers at the Boeing Co. to procure 19 airborne infrared search and track (IRST) systems to help Navy combat jets detect enemy aircraft without using radar.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $43.5 million order to the Boeing Defense, Space & Security segment in St. Louis to procure the 19 IRST pods, 15 supply IRST pod spare parts, 34 fuel tank assemblies, 34 sensor assembly structures, and special tooling, non-recurring engineering, sustainment support, and data.

These infrared sensor avionics will go aboard Navy aircraft like the Boeing F/A-18E/F Super Hornet carrier-based jet fighter-bomber. The Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., designs the IRST, which enables the F/A-18E/F to detect, track, and attack enemy aircraft without making its presence known.

▲ The infrared sensor for the Super Hornet's IRST system is on the leading edge of the auxiliary fuel tank on the bottom of the aircraft.

The Super Hornet combat aircraft IRST is a long-wave infrared detection sensors system that targets enemy aircraft in conditions where the Super Hornet cannot use its radar.

The system uses infrared search and track technology to detect and provide weapons-quality track solutions on potentially hostile aircraft. The Navy and Boeing first flew the IRST Block II pod on an F/A-18E/F Super Hornet in late 2019. IRST is a passive, long-range sensor incorporating infrared and other sensor technologies for accurate targeting.

This order represents the final IRST pod assemblies for the U.S. Navy, officials say.

The IRST Block II gives the F/A-18 improved optics and processing power, significantly improving pilot situational awareness, Boeing officials say. The Block II variant will be delivered to the US Navy in 2021, reaching initial operational capability shortly thereafter.

The IRST Block II is part of the Super Hornet Block III upgrades to keep the F/A-18 in active service for decades to come. Block III upgrades also include enhanced network capability, longer range with conformal fuel tanks, an advanced cockpit system, signature improvements, and an enhanced communications system.

The IRST fits on the front of the Super Hornet's centerline fuel tank. Three years ago Navy leaders approved a restructured program that foregoes full-rate production of Block I sensors and proceeds directly to the Block II system.

The IRST passive search system consists of a passive longwave infrared receiver, a processor, inertial measurement unit, and environmental control unit. The infrared receiver, processor, and inertial measurement unit fit inside the sensor, which attaches to the front of the fuel tank mounted to the aircraft on the BRU-32 bomb rack.

The Navy developed the IRST Block I using components from the F-15K/SG aircraft's infrared receiver, which is based on the IRST design of the now-retired Navy F-14 Tomcat jet fighter. IRST Block II includes improvements to the infrared receiver and updated processors. The Navy intends to produce 170 IRST systems.

Even amid electronic attack or heavy RF and infrared countermeasures, IRST provides autonomous, tracking data that increases pilot reaction time, and enhances survivability by enabling first-look, first-shoot capability, Lockheed Martin officials say.

Infrared sensors like the IRST detect the heat from an aircraft's engine exhaust or even the heat generated by the friction of an aircraft as it passes through the atmosphere. Unlike radar, infrared sensors do not emit electronic signals, and do not give away their presence to adversaries.

This ability can enable Super Hornet pilots to identify enemy aircraft at long ranges, and enable them to fire their air-to-air missiles at their maximum ranges.

Data from the IRST system can stand alone or fuse with the Super Hornet's other on-board sensor data situational awareness. Lockheed Martin also is developing an IRST pod that can be fitted to the F-15C and F-16 jet fighters.

On this order Boeing will do the work in St. Louis, and should be finished by April 2026. For more information contact Boeing Defense, Space & Security online at www.boeing.com/company/about-bds, Lockheed Martin Missiles and Fire Control at www.lockheedmartin.com, or Naval Air Systems Command at www.navair.navy.mil.

Army wants new electro-optical means to merge targeting for laser and conventional weapons

BY **John Keller**

FORT BELVOIR, Va. – U.S. Army targeting experts are reaching out to industry for new ways of designing electro-optical beam director gimbals that merge conventional and high-energy laser targeting.

Officials of the Army Rapid Capabilities and Critical Technologies Office (RCCTO) at Fort Belvoir, Va., released a request for information (W50RAJ-23-RFI-NBD) for the Novel Beam Directors project.

Merging conventional and high-energy laser targeting could enable combat aircraft, armored vehicles, surface warships, and artillery emplacements to combine effects from conventional kinetic weapons like bombs, missiles, and mortar shells with laser weapons as circumstances and targets dictate.

As high-energy laser weapons evolve, their deployment and use with conventional kinetic weapons is likely to increase, which will require military fire-control systems to handle all these kinds of weapons.

Army researchers want to expand their knowledge of these kinds of capabilities in the defense industry, non-traditional defense contractors,

Merging conventional and high-energy laser targeting could enable weapons to combine effects from bombs, missiles, and mortar shells with laser weapons.

as well as colleges and universities. Army researchers will use this knowledge to develop acquisition strategies, statements of work, and statements of objectives.

Researchers are interested in ways to combine high-energy laser weapons and conventional weapons targeting in two assembly levels: beam director targeting gimbal systems with embedded processing and sensors; and targeting sensors and camera electronics only. Systems should not include cockpit displays and controls.

Industry responses may concern design concepts that describe optical layout, mechanical, electrical, and processing, as well as estimates with key milestones showing how long it would take to design a prototype equipment set; and rough estimates of costs.

Submissions should indicate key enabling technologies that require advance development, and describe any internal investments necessary for a successful effort. Submissions also should provide any additional recommendations the government should consider.

Companies interested were asked to email 10-page capabilities statements by March to the Army's Hillary Roy at hillary.s.roy.civ@army.mil and Paul Kemp at paul.a.kemp5.civ@army.mil. More information is online at https://sam.gov/opp/dc550ebb85404766bb25cc903936d139/view.

Silicon and InGaAs photodetectors introduced by Advanced Photonix

Advanced Photonix Inc. in Camarillo, Calif., is introducing silicon (Si) and indium gallium arsenide (InGaAs) surface-mount technology (SMT) photodetectors for security, medical, and communications imaging, industrial controls, opto switches, opto counters, industrial sensing, light management, and handheld devices. The family of electro-optical surface-mount devices (SMDs) are assembled in compact, water-clear P-I-N, APD, PSD, and 1206 packaging and are available in cut tape, tape box, tape & reel or custom reel quantities. The optical sensors and photodiodes are specially designed for automated SMT/SMD assembly and solder reflow mounts on printed circuit boards and ceramic substrates. Advanced Photonix's silicon and InGaAs SMT detectors come in wavelengths ranging from ultraviolet (UV) to near infrared (300 nanometers to 1700 nanometers). The photodetectors range in varying active area sizes from 0.185 square millimeters to 8.07 square millimeters. The company's SMT optical sensors also feature small footprints, low dark current and capacitance, and high sensitivity. For more information contact Advanced Photonix online at www.advancedphotonix.com, or distributor Digi-Key Electronics at www.digikey.com.

Sapphire windows to protect lenses from contaminants introduced by Meller Optics

Meller Optics Inc. in Providence, R.I., is introducing custom fabricated sapphire windows for gimbaled optical systems that protect lenses from chemicals, dirt, saltwater, sand, and other fast-moving particulates. Meller sapphire windows provide front surface protection for optics used in gimbaled systems and are available with multispectral anti-reflective coatings that can meet salt fog requirements. Second only to diamond in terms of hardness, sapphire windows can be manufactured to specification in sizes from 0.25-inch to 10-inch diameter with varying thicknesses, and can include stepped edges and elliptical edge shaping, holes, slots, and wedges. Surface finishes for these sapphire windows can range from 60 to 40 to 40 to 20 scratch-dig, depending on configuration. Meller sapphire windows for gimbaled systems are priced according to configuration and quantity. For more information contact Meller Optics online at https://melleroptics.com.

High-resolution XY alignment stages for research introduced by OES

Optimal Engineering Systems Inc. (OES) in Van Nuys, Calif., is introducing the AU200-120x120 high-resolution high-repeatability XY alignment stages for industrial, medical and research applications. Easy integration *Continued on page 42*

L3Harris to provide shipboard electro-optical targeting sensors

BY **John Keller**

▲ **The EOSS is a check sight and targeting sensor for anti-surface and anti-air warfare and naval gun fire support missions.**

WASHINGTON – Military electro-optics experts at L3Harris Technologies Inc. will provide shipboard sensors for the fire-control necessary for U.S. Navy and Coast Guard warships to hit enemy ships and aircraft with naval gun fire under terms of a $13.7 million order.

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 sections kits, shock ring kits, and spare parts for the Navy and Coast Guard.

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

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

L-3 KEO has been building the EOSS since 2005. That year L3-KEO 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, L-3 officials say.

On this contract modification L-3 will do the work in Northampton, Mass., and should be finished by April 2027. For more information contact L3Harris KEO online at www.l3harris.com, or Naval Sea Systems Command at www.navsea.navy.mil.

Continued from page 41 of tooling and fixtures comes through a precision series of threaded mounting holes. Applications include alignment, inspection, test and measurement, scanning, laser drilling, machining, semiconductor handling, sampling, assembly, and optical applications. The AU200-120x120 alignment stages feature 120 millimeters of travel in the X and Y axes. These low-profile 87-millimeter high XY stages, have a 188-millimeter x 188-millimeter (7.401 in. x 7.401 in.) open aperture. The AU200-120x120-01 XY Stage is stepper motor-driven, featuring a resolution of two microns when using a 10 micro-steps-per-step micro-stepper motor driver and one micron repeatability. The AU200-120x120-02 Stage comes with three-phase brushless servo motors and quadrature incremental encoders, and AU200-120x120-03 has DC servo motors with quadrature incremental encoders. The two closed-loop servo motor options offer great resolution, repeatability, positional accuracy, high travel speeds, and great throughput. The AU200-120x120-04 has the knobs on the stepper motors replaced with quadrature incremental encoders for position verification. The AU200-120x120 alignment stages can be ordered as a complete plug-and-play system with compatible motion controllers with PC interface, joystick and keypad from OES.

TACTICAL NETWORKING

▲ L3Harris to build tactical networking for E-2D aircraft to blend sensors and weapons

U.S. Navy anti-air warfare experts needed an electronics manufacturer to build sensors and weapons tactical networking terminals for the carrier-based E-2C and E-2D airborne early warning aircraft. They found their solution from the L3Harris Technologies C5 Integrated Systems segment in Camden, N.J.

Officials of the Naval Sea Systems Command in Washington announced an $41 million order to L3Harris to build AN/USG-3B Cooperative Engagement Capability (CEC) avionics sets for E-2C and E-2D military aircraft.

The CEC is a tactical sensor and weapons network for anti-air warfare that combines information from sensors operating over broadly distributed geographic areas in a common tactical picture for battle groups at sea. It improves overall situational awareness, and enables fleet commanders to work closely together to attack enemy forces from long ranges.

The order includes CEC spare parts, signal data processors, AN/USG-3B systems, stock point operation and program support, engineering studies and analyses, configuration, obsolescence, and technical data management, and technical data package.

The AN/USG-3 is the airborne designation of CEC deployed in E-2C and E-2D aircraft. Other CEC terminals are aboard Navy surface warships; U.S. Marine Corps command posts, aviation command-and-control centers, and surveillance aerostats.

CEC blends sensors and weapons into an integrated real-time network that expands the battlespace; enhances situational awareness; increases depth of fire; enables long intercept ranges; and improves decision and reaction times.

It extracts and distributes sensor information such that the superset of this data is available to all participating CEC-equipped units by fusing the distributed data from shipboard, airborne, composite tracking network ground-mobile units, Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS), and coalition partners into one fire-control-quality air track picture.

The system uses line-of-sight data distribution to share radar-measurement data among sensors and weapons to create one distributed integrated air picture. It combines surveillance and targeting information such that the combined system is greater than the sum of its parts.

The jam-resistant CEC obtains target track information to form one real-time composite track to help coordinate theater air and missile defense to engage incoming cruise missiles.

On this order L3Harris will do the work in Largo, Fla.; Menlo Park, Calif.; Lititz, Pa.; and Salt Lake City, and should be finished by October 2024. For more information contact L3Harris Technologies online at www.l3harris.com, or Naval Sea Systems Command at www.navsea.navy.mil.

COMPUTERS

▼ Lockheed Martin to provide mission planning computers for F-35 combat aircraft

U.S. Navy combat aircraft experts needed logistics and mission-planning computer hardware for the F-35 Lightning II joint strike fighter. They found their solution from Lockheed Martin Corp. Aeronautics segment in Fort Worth, Texas.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $152.3 million contract to provide F-35 logistics information systems to include Autonomic Logistics Information System (ALIS), Operational Data Integrated Network (ODIN), and Mission Planning Environment (MPE) hardware.

ODIN is a cloud-native computer logistics sustainment system with an integrated data environment and user applications that improve F-35 sustainment and readiness.

This contract includes contract management, planning and readiness reviews, and non-recurring introduction to help field the F-35 ODIN, MPE, and components of any future ODIN and MPE retrofits for the F-35A, F-35B, and F-35C combat aircraft.

ODIN is to supersede Lockheed Martin's ALIS by the end of this year when all F-35 units are scheduled to have ODIN computers and software. The F-35 MPE consists of developed applications built from a framework, common components, and unique planning components.

F-35 pilots, maintainers, and support personnel have been using ALIS to track and order spare parts, conduct repairs, support mission planning and training, and store technical data. Still, ALIS was designed with the jet in the early 2000s, and some of its technology has become outdated; today it creates a system that is slow and difficult to use.

ODIN is being designed to decrease F-35 administrator and maintainer workload, increase mission capability all F-35 variants, and enable engineers to develop and deploy software updates rapidly.

ODIN will combine Lockheed Martin computer and networking hardware with software coded by the government to enable military experts to retain control over the system.

The new ODIN hardware is much smaller than the servers and the computers that support ALIS. Existing ALIS servers can weigh more than 800 pounds require a six-foot rack of electronics and backup power modules, which makes it difficult to deploy ALIS in austere environments near the front lines.

ODIN hardware, on the other hand, has two transportable cases about the size of two pieces of carry-on luggage that collectively weigh about 140 pounds. ALIS software also runs about twice as fast on the ODIN computers than it did on the old hardware.

The F-35 is the first tactical aircraft with sustainment tools designed together with the aircraft to help control the costs of maintaining a fleet of 5th generation jet fighters.

On this order Lockheed Martin will do the work in Orlando, Fla., and Fort Worth, Texas, and should be finished by December 2024. For more information contact Lockheed Martin Aeronautics online at www.lockheedmartin.com/en-us/who-we-are/business-areas/aeronautics.html, or Naval Air Systems Command at www.navair.navy.mil.

SATELLITE CONTROL

◀ Mangata Networks selects Honeywell to provide control systems for its 5G SATCOM network

Satellite designers at Mangata Networks in Phoenix needed a control system for the company's 5G satellite telecommunications constellations. They found their solution from Honeywell Aerospace, also in Phoenix.

Mangata's new highly elliptical orbit (HEO) and medium-Earth orbit (MEO) satellite constellations — made up of 32 satellites — provide communications and weather monitoring in areas that typically lack quality internet connectivity.

The Honeywell Integrated Attitude Control System (IACS) helps control and steer satellites to ensure the proper altitude and position of space vehicles, which is essential for effective signal communication and solar power generation to keep the satellites operating efficiently.

Honeywell's space IACS platform enables continuous connectivity for users of Mangata's network of telecommunications satellites. The partnership aims to build secure high-speed connectivity for businesses and individuals in remote areas without adequate internet access.

"The traditional geostationary equatorial orbit (GEO) constellations already provide broadband and other connectivity solutions for consumers and commercial applications, but the existing technology has become too slow by today's standards," says Ricky Freeman, president of defense and space at Honeywell Aerospace.

DATA RECORDERS

▼ Mercury to provide data recorders and data storage for F/A-18 jet avionics

U.S. Navy combat aircraft avionics experts needed advanced data recorders for F/A-18C/F and EA-18G carrier-based jet fighter-bombers and electronic warfare jets. They found their solution from Mercury Mission Systems LLC in Torrance, Calif.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., have announced a $35.7 million contract to Mercury for data transfer units and avionics data recorders, as part of the Automatic Real-Time, Reconfigurable Interface Generalization Hardware Multiprotocol Data Recorder project.

Mercury Mission Systems (formerly Physical Optics Corp.) will provide 104 1553 data-transfer units — 68 for retrofit on F/A-18C-F aircraft and 36 for EA-18G production aircraft; and 144 high-definition video recorders for retrofit on F/A-18C-F aircraft.

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

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

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

A plug-and-play self-sealing environmentally protected removable memory unit (RMU) enables rapid upgrades to avert obsolescence by capitalizing on commercial solid-state memories.

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

On this contract Mercury will do the work in Torrance, Calif., and should be finished by July 2024. For more information contact Mercury Mission Systems online at www.mrcy.com/products/data-storage-and-transfer, or Naval Air Systems Command at www.navair.navy.mil.

POWER ELECTRONICS

▲ Aviation Ground Equipment and PD Power to provide aviation ground power units

U.S. Air Force aviation ground equipment experts needed aircraft ground power units to provide electric power to aircraft on the ground. They found their solutions from Aviation Ground Equipment Corp. in Melville, N.Y., and from PD Power Systems LLC in Springfield, Va.

Officials of the Air Force Life Cycle Management Center at Robins Air Force Base, Ga., announced contracts to the two companies potentially and collectively worth nearly a billion dollars on Friday for aviation ground power units.

The companies each won 10-year contracts potentially worth $482 million. PD Power will provide 72-kilowatt ground power units, while Aviation Ground Equipment will provide 72-kilowatt ground power units, 144-kilowatt ground power units, and 144-kilowatt universal load banks.

Ground power units, used at airports and military air bases, connect to the electrical systems of aircraft while on the ground to provide either 120-volt AC or 28-volt DC power.

Aviation Ground Power offers the AGEC 6021 Air Force-specified 72-kilowatt Multi-Output Diesel Cart for all military applications from land-based theaters to shipboard environments. The unit offers integrated power frequency converter with three modes of operation: 400 Hz Output, 28 volts DC output, and 270 volts DC output.

PD Power offers the MEP-PU-810C/D units for U.S. military applications future users. The unit is mounted on a two-axle wagon-style chassis equipped with surge actuated hydraulic brakes, a lunette-ring hitch tow bar, and is designed for low speed mobility, towed by vehicles without trailer brake controllers.

PD Power's MEP-PU-810D model power unit is mounted on a two-axle chassis, equipped with air actuated brakes, a 5th wheel kingpin hitch, and is compliant for U.S. Department of Transportation (DOT) transport .

For more information contact PD Power Systems online at www.aviationgroundequip.com, Aviation Ground Equipment Corp. at https://pdpowersystems.com, or the Air Force Life Cycle Management Center-Robins at www.robins.af.mil/Units/AFLCMC. ←

AVIONICS

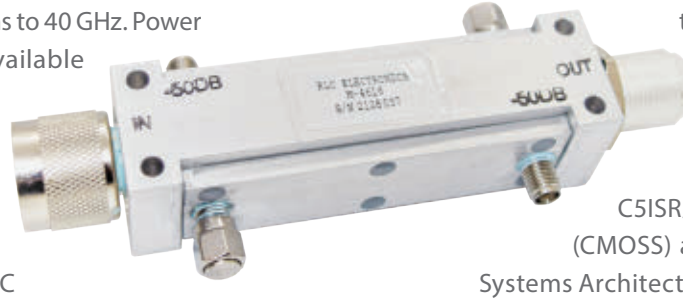
▶ ARINC 429 databus line receivers for commercial aviation introduced by Holt

Holt Integrated Circuits in Mission Viejo, Calif., is introducing an enhanced version of the company's HI-35980 family of 8-channel ARINC 429 line receivers for commercial aviation avionics applications. Holt has expanded the user-programmable label filtering capability of the avionics databus interface from 16 labels to all 256 labels, and increased the 4-word deep receive FIFO to 32 words deep. In addition, Holt has added a 32-word deep transmit FIFO to increase the transmit capability from the single-word buffer on the existing device. The avionics databus device is available in an industrial temperature range of -40 to 85 degrees Celsius, and an extended temperature range of -55 to 125 C., with optional burn-in at the higher temperature. Samples are available from Holt on request. For more information contact Holt Integrated Circuits online at www.holtic.com.

POWER ELECTRONICS

▼ High-power directional couplers for power amplifier test beds introduced by RLC

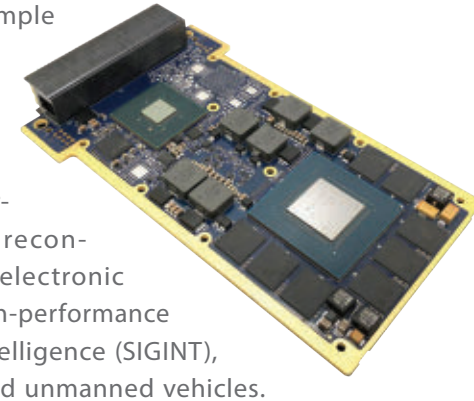
RLC Electronics Inc. in Mount Kisco, N.Y., is introducing high-power, high-directivity directional couplers for power electronics applications in high-power sampling and signal leveling; traveling wave tube amplifier; high-power amplifier test beds; calibration labs; power monitoring; and voltage standing wave ratio measurements. RLC offers power coupling as accurate as +/-1.0dB, insertion loss as low as 0.1 to 0.35dB max, and less than 35dB directivity in both directions. These high-power couplers come with 500 to 1000 Watts average power handling to 18 GHz, as well as 100-Watt versions to 40 GHz. Power couplers are available in single- and dual-directional construction, typically over a 2 octave bandwidth or less. RLC can use SC or 7/16 connectors on the main line, should this be needed to meet customer designs. For more information contact RLC Electronics online at https://rlcelectronics.com.



EMBEDDED COMPUTING

▼ SOSA-aligned processor for artificial intelligence (AI) introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the VPX3-4936 3U OpenVPX GPGPU processor module for deep learning, neural networks, artificial intelligence (AI), and machine learning. The processor features the combination of the NVIDIA Ampere graphics processing unit (GPU) and a configurable Gen4 PCI Express switch. The NVIDIA Ampere architecture boosts performance and efficiency over the previous NVIDIA Turing generation, including more flexible concurrent execution of floating point and integer streams. Example applications for the embedded computing processor include intelligence, surveillance, and reconnaissance (ISR); electronic warfare (EW), high-performance radar; signals intelligence (SIGINT), sensor fusion, and unmanned vehicles.

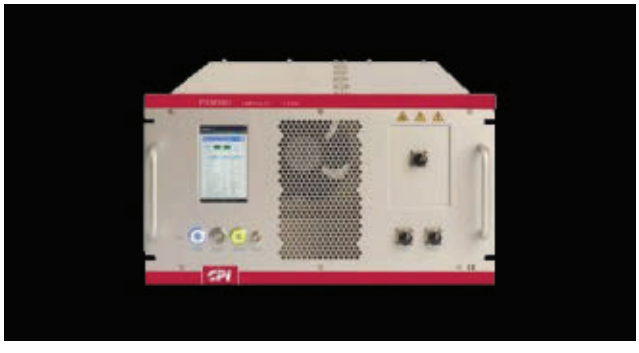


The Ampere device's third-generation Tensor cores deliver as much as four times the acceleration of AI and machine-learning algorithms, and its -RT cores and CUDA core architecture provide twice the performance compared to the previous generation. While delivering close to 18 TFLOPS FP32 peak performance and 68 dense/136 sparse Tensor TOPS, the NVIDIA Ampere also improves power efficiency, yielding 154 GFLOPS per Watt. The module's PCI Express Gen4 architecture also doubles the host interface bandwidth, eliminating data throughput bottlenecks. The rugged VPX-4936 module is designed in compliance with the U.S. Army's C5ISR/EW Modular Open Suite of Standards (CMOSS) and is aligned with the Sensor Open Systems Architecture (SOSA) technical standard to support compute-intensive ISR and EW systems. For more information contact Curtiss-Wright Defense Solutions online at www.curtisswrightds.com.

RF AND MICROWAVE

▼ Travelling wave tube (TWT) amplifiers for test and measurement introduced by CPI

Communications and Power Industries (CPI) International Inc. in Palo Alto, Calif., is introducing two K- and Ka-band travelling wave tube (TWT)-based instrumentation amplifiers for test and measurement, communications, electronic warfare (EW), and radar. The PTCM1017 and PTCM1027 feature higher gain and efficiency performance than solid-state amplifiers. Other applications include RF component testing, electromagnetic compatibility (EMC) testing, and radiated immunity testing. With a frequency coverage of 18 to 26.5 GHz (K-band, PTCM1017) and 26.5 to 40 GHz (Ka-band, PTCM1027), the amplifiers offer a power output exceeding 100 Watts continuous wave, and can also be pulsed using an internal grid modulator. Operating features include self-test, comprehensive fault diagnosis, Ethernet remote control and monitoring, and modular plug-and-play field replaceable printed circuit boards. The amplifiers also include TWT and power supply protection. An Ethernet graphic user interface enables connection to any PC or laptop with a standard browser. This functionality enables CPI to offer customers on-demand support by remotely connecting to the amplifier to provide in-depth diagnosis and care, should it be needed. The protection systems monitor critical performance parameters to ensure the product is not damaged in the event of incorrect operation. The TWT heater, grid and cathode voltage are continuously monitored and voltage standing wave ratio (VSWR) protection is provided. Designed and built to ISO9001 quality certification, the construction of the PTCM1017 and PTCM1027 is based on a modular 6U system that offers different configurations. For more information contact CPI online at www.cpii.com.



CHASSIS AND ENCLOSURES

▲ OpenVPX- and SOSA-aligned 10U embedded computing chassis introduced by Pixus

Pixus Technologies in Waterloo, Ontario, is introducing the OpenVPX- and SOSA-aligned 10U RiCool embedded computing chassis for aerospace and defense applications. The 10U RiCool embedded computing chassis supports single, dual, or N+1 redundant power suppliers that plug in from the rear of the enclosure. The 10U RiCool embedded computing enclosure features a 6U OpenVPX or SOSA aligned backplane in up to 16 slots at 1-inch pitch and speeds to 100 Gigabit Ethernet. The enclosure is extra deep to enable rear pluggable power supplies. This additional space also enables RF devices or other modules to fit within the rear of the chassis. The enclosure also supports a pluggable SOSA aligned chassis manager or a rear mezzanine approach that fits behind the backplane without taking up any slot space. Each of the two reverse impeller blowers support 191 cubic feet per minute of airflow for powerful cooling in a front-to-rear airflow configuration. The efficient and hot-swappable fans typically run more quietly than 59 decibels. Various I/O and power options are available, along with optical or RF interfaces through the backplane. Pixus offers chassis in commercial grade and MIL rugged formats. The company also has options for other VITA and PICMG based standards such as VME, CompactPCI Serial, SpaceVPX, and xTCA. For more information contact Pixus Technologies online at https://pixustechnologies.com.

CONNECTORS

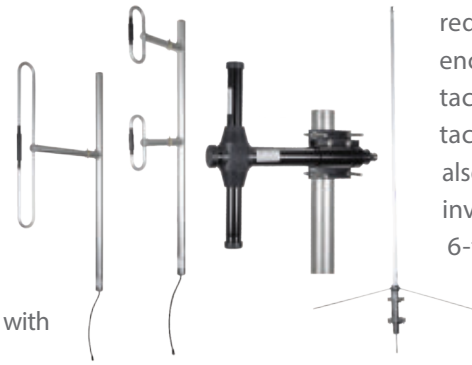
▶ High-reliability Glenair Micro-D aerospace and defense connectors introduced by Powell

Electronics distributor Powell Electronics in Swedensboro, N.J., is introducing TwistPin equipped Micro-D subminiature connectors from Glenair in Glendale, Calif. The Glenair's Micro-D subminiature connectors are for high-reliability defense, aerospace, and industrial applications, and offer mating performance, high durability, and minimal contact resistance. These QPL 83513 Micro-D and COTS connectors offer high current ratings, low circuit resistance, and EMI/RFI shielding. TwistPin contacts set on 0.050 centers in arrangements from 9 to 130 contacts. Material selection, fabrication, and heat-treating techniques resist high temperature stress relaxation for as long as 1000 hours at 125 degrees Celsius. Available with insulated and uninsulated wire, printed circuit board,, solder cup, and flex terminations as QPL or commercial variations, the Micro-D devices help meet high-performance interconnect requirements including high temperature and hermetic applications. Space-grade Micro-D connectors with NASA and ESA screening options also are available. The products are manufactured in the U.S., and in the United Kingdom. For more information contact Powell Electronics online at www.powell.com/content/Glenair-Micro-D-Connector-3100017707, or Glenair at www.glenair.com.

ANTENNAS

▼ VHF and UHF antennas for military communications and public safety introduced by KP

KP Performance Antennas in Edmonton, Alberta, is introducing a series of VHF and UHF dipole, collinear, and Yagi antennas for military communications, public safety, land mobile radio, trunking, and amateur radio applications. The VHF and UHF exposed dipole arrays, omnidirectional collinear, and Yagi antennas cover frequencies of 135 MHz to 512 MHz and feature high-power handling of more than 200 Watts. The rugged outdoor designs of these VHF and UHF antennas ensure performance in all environmental conditions. The individual folded and straight dipole antennas allow for minimal storage and efficient transportation. KP also offers pre-configured dipole arrays with internalized cabling, making for quick and simple deployments. The VHF and UHF antennas feature multiple-gain options with fixed and adjustable dipole configurations. All components are DC grounded for lightning protection and come in optional prefabricated arrays with fixed quarter-wave or half-wave spacing from the mast. For more information contact KP Performance Antennas online at www.kpperformance.com.



INTERCONNECT PRODUCTS

▶ Rugged Amphenol Nexus mil-spec audio connectors offered by CDM

Electronics distributor CDM Electronics Inc. in Turnersville, N.J., is offering the Amphenol Nexus Technologies AJ and AP series of mil-spec audio connectors for military command-and-control applications. The AJ and AP series QPL MIL-DTL-55116 and M55116-Type connectors are widely specified for mission-critical military, tactical, aerospace, industrial, and public safety applications, and are made in the United States. Product groups include the high-performance 5- and 6-contact QPL MIL-DTL-55116/1 through M55116/14 interconnects and accessories in standard and lightweight versions to support military radios, tactical intercom networks, and rugged-environment communications requirements. The panel- and cable-mount series encompass waterproof, polarized plugs and receptacles with either crimp sleeve or solder cup contacts. Right-angle M55116-Type shielded plugs are also available for space-limited designs. Additionally inventoried is the 50 percent smaller TAC series of 6-to-10 pin M55116-Type connectors optimized to meet the small-format specifications of soldier-worn applications ←

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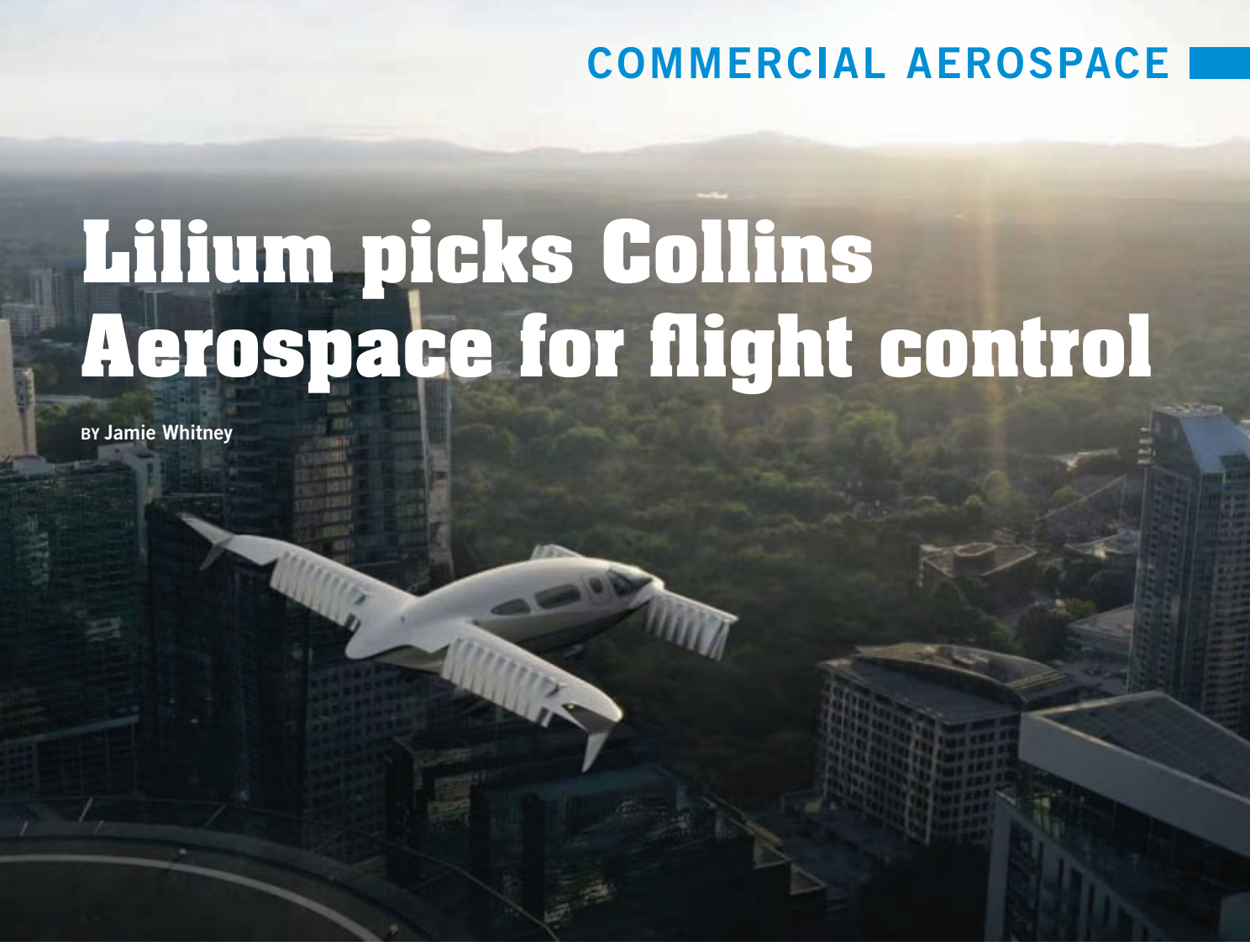
Lilium picks Collins Aerospace for flight control

BY Jamie Whitney



MUNICH - Lilium N.V. in Munich needed flight controls for its all-electric vertical take-off and landing (eVTOL) jet. They found their solution from Collins Aerospace in Cedar Rapids, Iowa.

▲ Lilium N.V. in Munich is choosing Collins Aerospace to provide flight controls for the company's all-electric vertical take-off and landing (eVTOL) jet.

Collins, a Raytheon Technologies company, will design, develop, and build the Lilium Jet's inceptors – the sidestick system used by the pilot to control the aircraft.

The Lilium Jet inceptors, Lilium says, will provide safe and intuitive handling qualities, easy access to functionalities, and an aesthetic, ergonomic design. While integrating all conventional mechanical and electrical flight controls into two sidesticks, the Collins system brings a new piloting philosophy for single pilot operations in the eVTOL realm. The system will also be designed to bring space and weight savings compared to conventional sidesticks.

As part of the supplier agreement, Collins will certify the Lilium Jet's inceptors to commercial aviation standards.

The Lilium Jet utilizes Ducted Electric Vectored Thrust (DEVT) where electric jet engines integrated into the wing flaps provide advantages in payload, aerodynamic efficiency and a lower noise profile. The engines rely on just a single "stage" rotor/stator system driven by an electric motor with zero emissions

"Our partnership with Collins Aerospace allows us to reap the benefit of five decades of experience in flight deck controls. Our two companies' collaborative development approach allows us to re-imagine the cockpit and pilot experience, and further strengthens our path towards certification and commercialization," Yves Yemsi, Chief Operating Officer at Lilium, said.

"Our extensive experience innovating sidestick design is key when tackling the challenges of redefining the entire flight control philosophy for single-pilot aircraft in this new market of advanced regional air mobility," said Jean-François Chanut, vice president and general manager of Collins Aerospace Propeller Systems. "This innovating and exciting partnership with Lilium is a first step in defining the right solutions toward more automated, sustainable and safe operations for the future of flight."

FAA seeks industry input on 'extended-reality' simulation software

By Jamie Whitney

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WASHINGTON - The U.S. Federal Aviation Administration (FAA) in Washington has a need for extended-reality software to support training and technical research and is looking for industry input. Extended reality (XR) encapsulates augmented-, virtual-, and mixed-reality technologies (AR, VR, MR respectively).

AR is the combination of digital and real objects where the digital information is overlaid on the real-world environment. MR also combines digital information with real-world objects, but enables additional interactions between the user, physical objects, and virtual objects. VR is a fully artificial environment that simulates a user's presences within a virtual setting. These levels of virtuality can be described as existing along a continuum with each serving a different purpose and function for workforce solutions.

The FAA's Civil Aerospace Medical Institute (CAMI) aims to establish an XR laboratory to use these enabling technologies to enhance training, performance, and safety. This laboratory will support research being conducted within the National Airspace System (NAS) Human Factors Safety Research Laboratory (AAM-520) on the use of XR technologies within the NAS.

Currently, CAMI performs research using a variety of traditional simulators and physical equipment. Most of these require an associated structure that are expensive and difficult to modify. The XR Lab will leverage the power of augmented, virtual, and mixed reality technologies to create research scenarios and simulation environments without the associated structural constraints – enabling "simulation without structures".

This technology will allow CAMI to rapidly update its simulation environments to reflect the frequent changes and advances in NAS technologies and aviation systems. CAMI says that rather than building a physical mock-up of a simulated environment, which must be rebuilt and/or modified with each change in the NAS, the institute could update their simulation with an update to the software. Furthermore, XR technology has the potential to facilitate collection of human performance data that have previously been beyond our capabilities. This laboratory will allow CAMI and the FAA to research the myriad uses of XR for different aviation work environments, thereby providing human factors input on the correct use of these technologies to interested parties throughout the agency.

▲ The FAA's Civil Aerospace Medical Institute (CAMI) aims to establish an XR laboratory to use these enabling technologies to enhance training, performance, and safety.

The required delivery includes the software and initial scenario development to stand up a fully functional XR Laboratory to support training and technical research. The XR Laboratory will be used by CAMI researchers to collect human in the loop (HITL) data in a variety of test environments. The Lab must be able to support a variety of research with the ability to add additional scenarios as needed. Although laboratory solutions are not required to support the collection of wearer eye-movement data, additional consideration will be given to solutions that can be shown to support the collection of these types of data.

CAMI anticipates the XR software solution will include professional 3D software; data collection software; and two initial scenarios – one using VR and one using AR

In addition, CAMI says it expects support to include operation/functionality of the software; scenario development and modifications; and exporting performance data from software. The results of this market survey will be used to determine the acquisition strategy in support of an award.

Companies were asked to respond by March. More information is online at https://sam.gov/opp/d0901b02b91a496785fe7e3aa66e5034/view. Email questions or concerns to the FAA's Nia Glover at nia.glover@faa.gov.

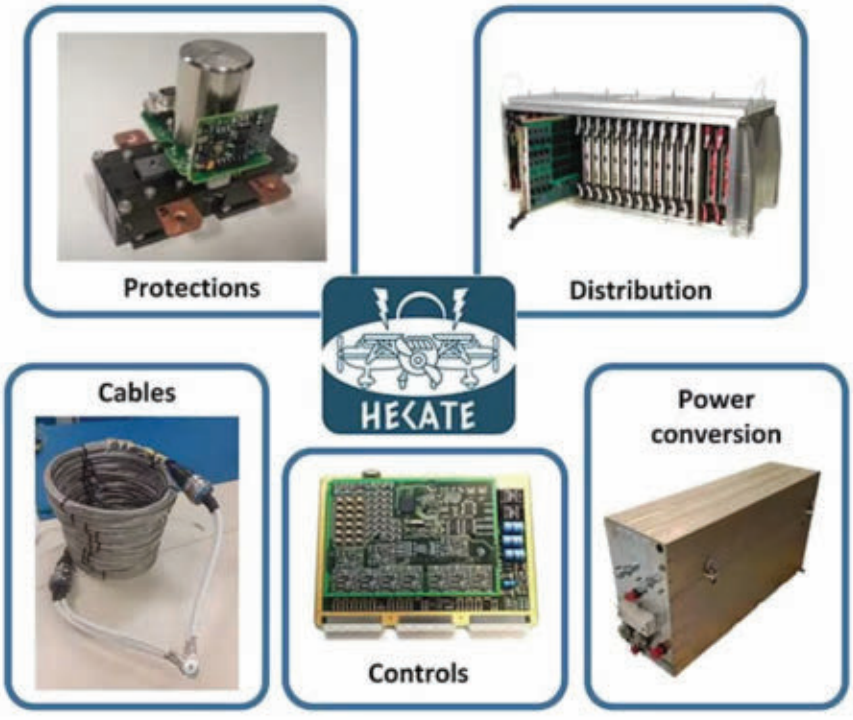
EU taps Collins to coordinate development of aviation high-voltage distribution

BY **Jamie Whitney**

CORK, Ireland - Collins Aerospace in Charlotte, N.C., has been selected by the European Union's clean aviation HECATE project to coordinate the development of new high-voltage electric power distribution technologies for aerospace.

For HECATE, which stands for Hybrid-ElectriC regional Aircraft distribution TEchnologies, Collins will lead the project's steering committee, while Safran in Paris will serve as technical coordinator. The two companies will work with a consortium of 37 European aerospace industry partners across 10 countries, including Thales, Diehl Aerospace, Airbus Defense and Space, Leonardo, and multiple universities.

The global aviation industry is targeting a date of 2050 to remove all carbon emissions from aircraft. The development of hybrid-electric aircraft is seen as one of the key ingredients to zero carbon. To support hybrid-electric propulsion systems, new high-voltage distribution technologies are necessary as electric power levels increase from hundreds of kilowatts in today's aircraft, to megawatt levels in the aircraft of the future. The HECATE consortium will work to address this challenge for regional platforms, with a goal of demonstrating a more than 500 kilowatts hybrid-electric architecture in ground tests by 2025.



Collins Aerospace will coordinate development of high-voltage electric power distribution technologies for aerospace as part of the EU clean aviation HECATE project.

Collins' Applied Research and Technology (ART) organization in Cork, Ireland, will lead the company's coordination of HECATE, while its facilities in Solihull, England, and Nördlingen, Germany, will develop power conversion and secondary distribution technologies for the project. Safran will supply primary distribution and cabling. Thales in Paris and Diehl Aerospace in Überlingen, Germany, will contribute specialized power electronics, system control, and energy management. Airbus Defence and Space in Taufkirchen, Germany, and Leonardo in Rome will provide the airframer perspective, and support requirements and validation activities.

"With decades of experience supplying electric power systems for the world's most advanced aircraft, Collins is bringing that expertise to bear in the development of multiple next-gen electric technologies that are integral to sustainable flight," said Mauro Atalla, Senior Vice President, Engineering & Technology for Collins. "Key among them are high-voltage distribution systems—a critical enabler for hybrid-electric propulsion. In collaboration with the HECATE consortium, we will develop new high-voltage technologies to help pave the way for future hybrid-electric platforms and reduced carbon emissions."

"We're proud to be selected as technical coordinator and supply primary distribution and cabling for the HECATE consortium. This project is in line with our strategic aims: it features breakthrough high-voltage electrical technologies, with a low carbon footprint. This agreement bolsters our position as a key player in innovative, competitive electrical systems," says Bruno Bellanger, Executive Vice President and General Manager, Power Division, Safran Electrical & Power.

NASA seeks expert input in efforts to improve its procurement framework

BY **Jamie Whitney**

WASHINGTON - The National Aeronautics and Space Administration (NASA) in Washington is seeking procurement ideas and solutions to "encourage innovation from diverse perspectives, improve reach, reduce barriers, and ultimately meet and exceed agency goals."

▲ NASA is seeking to improve its procurement procedures by eliminating bottlenecks in the agency's processes that slow down or block procurements.

The NASA Acquisition Innovation Launchpad (NAIL), managed by the agency's Office of Procurement, is online, and submissions of inquiries and ideas will be accepted on a rolling basis.

Whether experts want to point out bottlenecks in the agency's processes that slow down or block procurements, recommend tools that increase quality or speed, provide ideas to reduce the burden on industry or barriers to entry, or want to offer outside-the-box thinking to optimize activities within procurement work, NASA says they want to hear from you.

"The NASA Acquisition Innovation Launchpad will serve as a dynamic catalyst for innovation in both procurement and program management processes, tools, and techniques," said Deputy Chief Acquisition Officer and Assistant Administrator for the Office of Procurement at NASA Karla Smith Jackson. "The NAIL will apply NASA's culture of exploration and innovation to the acquisition life cycle and empower our acquisition workforce to meet objectives and challenges such as NASA's Moon to Mars exploration approach."

The NAIL framework is designed to facilitate acquisition techniques and smart program management tools. It provides avenues for managed risk-taking through the submission, review, prioritization, approval, and measurement of agency testbed efforts submitted by innovation champions across the agency. NASA spends approximately $21 billion or 85% of its budget on acquiring goods and services. The agency aims to use NAIL to further establish a bridge for industry input through public focus groups and industry feedback.

NASA seeks to provide open and transparent communication through integrated groups and councils across the enterprise with voices from each of its centers and industry partners.

If you are interested in being a part of future NAIL focus groups, please visit https://www.nasa.gov/office/procurement/nail-industry-interest.