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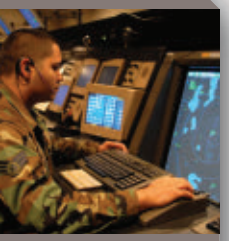

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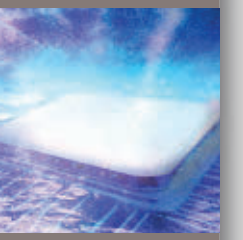

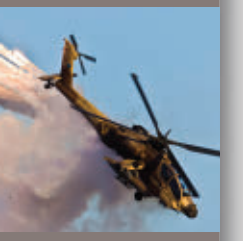

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BY **JOHN KELLER**, EDITOR IN CHIEF

Demand for shipboard power driving innovation in power electronics

The ability to generate, control, and channel electric power is crucial for today's military. Ground vehicles have become rolling networked data centers, aircraft are flying sensor platforms, and the infantry warfighter carries a variety of computers, radios, and wearable digital displays. Shipboard power might be in a category of its own.

Perhaps nowhere else, however, is power generation and control as important as it is aboard Navy surface warships. Future power demands aboard ship are staggering. Aircraft carriers, for example, are switching from steam power to electric power for aircraft catapults. Future cruisers, destroyers, frigates, and coastal combatants will carry laser weapons and electromagnetic guns to augment or replace missiles and deck cannon.

All-electric propulsion will be the norm on future Navy surface vessels, and with the growing number of wearable and deployable computers for sailors and Marines, surface ships also must become floating battery charging stations. None of this even touches on future needs for advanced shipboard radar, electro-optical sensors, tactical networking, and intra-ship communications.

With power demands like these, every naval ship afloat in the future also must become an underway power plant. There are power demands we'll see in the next couple of decades that no one's even dreamed of yet.

Fortunately, Navy researchers are doing their best to stay ahead of the power challenge. Just this month, for example, the Naval Sea Systems Command (NAVSEA) — the Navy's primary organization for ship design — inked a contract with the Florida State University Center for Advanced Power Systems (FSU CAPS) for advanced shipboard power research and development.

University researchers are focusing on modeling, simulation, and testing of Navy advanced shipboard electrical power systems and components. In addition, they'll create computer models of advanced shipboard electrical system components and entire shipboard power architectures.

Last month NAVSEA added money to a contract with the BAE Systems Platforms & Services segment to perfect an experimental containerized pulse power unit for the Navy's future power-hungry electromagnetic railgun — a long-range shipboard weapon that will fire projectiles using electricity instead of chemical propellants.

BAE systems experts also will work on integrating batteries and containers aboard surface warships that will host the electromagnetic railgun, and create computer models of shipboard pulsed power. BAE Systems Platforms & Services has been developing a pulse power unit for the Navy electromagnetic railgun since late 2011.

There's more Navy research and development into shipboard power systems and technology than that. Last year NAVSEA contracted with the RCT Systems Power Systems Division in Linthicum Heights, Md., to design experimental power-conversion modules and energy-storage components for shipboard power systems. RCT researchers are building and testing bi-directional power conversion modules to support a 4160-volt AC 60 Hz shipboard electrical architectures.

Future research into shipboard power generation and control is likely to continue ramping up to help accommodate power-intensive weapons, sensors, and communications systems aboard even surface warships as small as the Littoral Combat Ship (LCS) and a new LCS variant that will function as a frigate.

There's no end to demands for power aboard ship. It's a good thing the Navy seems to have the matter in hand.

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IN BRIEF

BAE Systems to build 11 recovery M88A2 armored combat vehicles

Armored combat vehicles experts at BAE Systems will provide the U.S. Army with 11 M88A2 Heavy Equipment Recovery Combat Utility Lift Evacuation System (HERCULES) vehicles and related vetronics under terms of a $28.2 million contract. Officials of the Army Contracting Command in Warren, Mich., are awarding the contract to the BAE Systems Platforms & Services segment in York, Pa., to provide the new battlefield armored recovery vehicles. This order is a modification to a $153.7 million contract announced originally in September 2014 for 53 M88A2 HERCULES armored combat vehicles. Since then BAE Systems has received four additional orders for these vehicles, raising the contract to 137 M88A2s at a total cost of $430.1 million. The armored vehicle's primary role is to repair or replace damaged parts in fighting vehicles while under fire, as well as free combat vehicles that have become bogged down or entangled. The main winch on the M88A2 is capable of a 70-ton, single line recovery, and a 140-ton 2:1 recovery when used with the 140-ton pulley.

Air Force researchers are looking for covert ways to track aircraft based only on the RF signals these aircraft emit.

Passive surveillance to track aircraft using only the RF signals they emit

BY JOHN KELLER

WRIGHT-PATTERSON AFB, Ohio — U.S. Air Force researchers are ready to ask industry for passive surveillance techniques to identify, pinpoint, and track aircraft, land vehicles, and surface ships using only the RF signals these targets emit.

Officials of the U.S. Air Force Research Laboratory (AFRL) at Wright-Patterson Air Force Base, Ohio, have issued a presolicitation (FA8650-17-S-1022) for the future Radio Identification (RID) program.

This initiative, which should begin in May or June, seeks to demonstrate and evaluate the benefits of identifying and geo-locating surface and air platforms via reception, processing, and display of their communications, navigation, and identification signals, as well as other signals of interest.

The ability to identify, locate, and track military and civil aircraft, ships, and vehicles in this way could enable covert surveillance and reconnaissance without the use of active sensors like radar. The result could be the ability to locate and track aircraft, ships, and vehicles without the targets knowing they are being tracked.

Such a project most likely will involve very sensitive RF receivers, directional and steerable antennas, and sophisticated power digital signal processing to pick targets of interest out of the staggering amount of RF noise and interference that exists from radio communications, cellphones, radio and television stations, and random RF noise.

The RID program will focus on non-cooperative target identification and geo-location via passive reception of RF signals of interest, AFRL officials say.

The project will mature technologies and develop techniques for detection, identification, and reporting of any spoofing attempts, and

demonstrate passive reception of at least one cooperative identification system. Automatic Dependent Surveillance-Broadcast (ADS-B) emitting signals at 1090 MHz is the planned capability.

Air Force researchers are looking for modular RID software architectures based on open-systems standards where practical to support upgrades to algorithms and incorporating additional signals of interest.

The system architecture must be able to support agile multifunction signal processing and fusion of sensor tracks. Researchers are interested in system architectures that could work on a variety of platforms and locations, and that could move to Air Force or U.S. military systems using multi-channel, multifunction apertures and receivers integrated with software-defined architectures and equipment.

A formal solicitation for the RID program is expected by late May or early June. The program should run for five years, and could be worth as much as $24.92 million to the contractor or contractors ultimately chosen to carry it out. Air Force researchers are not ready to accept proposals until the formal solicitation comes out in May or June.

For technical questions or concerns, contact the Air Force's John Bollinger by e-mail at john.bollinger@us.af.mil or by phone at 937-713-4304. For contracting questions, contact Cindy Brocker by e-mail at cynthia.brockert@us.af.mil or by phone at 937-713-9840.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/USAF/AFMC/AFRLWRS/FA8650-17-S-1022/listing.html.*

Trump Bump defense spending increase to add $54 billion to military budget

BY JOHN KELLER

WASHINGTON — Expect the 2018 Trump Bump military budget request for the U.S. Department of Defense (DOD) to contain additional defense spending for military cybersecurity, ships and submarines, munitions, and F-35 Joint Strike Fighters.

That's the word from the fiscal 2018 federal budget blueprint, released in mid-March. The blueprint is an outline of budget priorities that will be fleshed-out for the Trump Administration's formal budget request to Congress, which is expected in May.

The two-page blueprint for DOD calls for repeals of defense sequestration by restoring $52 billion to the DOD budget, as well as $2 billion to other national defense programs outside of DOD, for a $54 billion total increase in defense spending over current levels.

The blueprint promises more money to fight ISIS terrorism, and seeks to address urgent warfighting readiness needs. It addresses "pressing shortfalls, such as insufficient stocks of critical munitions, personnel gaps, deferred maintenance and modernization, cyber vulnerabilities, and degraded facilities."

The U.S. Army would see an end to strength personnel and materiel reductions, takes an "initial step toward restoring an Army that has been stressed by high operational demand and constrained funding levels in recent years."

As for the U.S. Navy, the 2018 budget will increase the total number of ships, and "reflects a down payment on the President's commitment to expanding the fleet."

The blueprint promises to accelerate U.S. Air Force efforts to improve tactical air fleet readiness, ensure technical superiority, and repair aging infrastructure. "Key investments in maintenance capacity, training systems, and additional F-35 Joint Strike Fighters would enable the Air Force, which is now the smallest it has been in history, to counter the growing number of complex threats from sophisticated state actors and transnational terrorist groups," the blueprint states.

A .pdf copy of the "America First: A Budget Blueprint to Make America Great Again" document is available online at https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/2018_blueprint.pdf.

Would a $54 billion increase in the U.S. defense budget have an influence on your business? Take the quick three-question poll online at www.militaryaerospace.com.

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DARPA rolls out molecular data storage project to handle flood of information

BY JOHN KELLER

ARLINGTON, Va. — U.S. military researchers have outlined a plan for industry to develop completely new kinds of data storage technologies that operate on the molecular and chemical level to handle vast streams of information from reconnaissance, electronic warfare (EW), signals intelligence (SIGINT), persistent surveillance, and other data-intensive military applications.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) briefed industry earlier this month on the Molecular Informatics project, which seeks to develop and test ways to store and process information with molecules.

Data storage and processing is central to U.S. Department of Defense (DOD) activities across areas like platform design and optimization, sensing, mission planning and logistics, and health care.

DARPA researchers are working with industry to develop information technologies that store data on the molecular level.

While current computational architectures remain essential, new complementary approaches are necessary to provide advanced capabilities as the complexity and volume of data grows, DARPA researchers explain.

Chemistry offers a yet-untapped source of molecular diversity that could be harnessed for scalable information storage and processing.

By manipulating properties such as structure, size, charge, and polarity, researchers may develop a vast design space enabling dense data representations and highly versatile computing concepts that operate outside of the traditional digital and logic-based approach.

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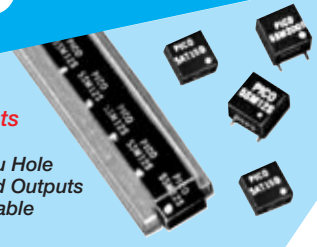

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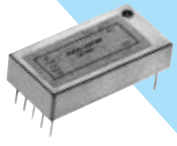

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IN BRIEF

Lockheed Martin to build missile defense rockets

Lockheed Martin will build 18 to 40 missile defense rocket interceptors under a $273.5 million contract. The U.S. Missile Defense Agency (MDA) in Huntsville, Ala., is asking the Lockheed Martin Missiles and Fire Control segment in Grand Prairie, Texas, to build Lot 9 of the MDA's Terminal High Altitude Area Defense (THAAD) ballistic missile defense system interceptor missiles, designed to shoot down ballistic missiles in their terminal phase using a hit-to-kill kinetic warhead.

Navy orders EW jammers to foil IEDs

U.S. military explosives-disposal experts are ordering electronic warfare (EW) jammers for deployed infantry warfighters to counter improvised explosive devices (IEDs). Officials of the Naval Surface Warfare Center in Indian Head, Md., placed a $31 million order to Sierra Nevada Corp. in Sparks, Nev., for the AN/PLT-5 IED electronic jammer to support explosive ordnance-disposal personnel. The Sierra Nevada AN/PLT-5 THOR II is a man-packable jammer designed to counter radio-controlled IEDs to protect EOD technicians from IEDs and other deliberate explosive devices by preventing their initiation, while working in close proximity to suspect devices.

The Molecular Informatics program seeks to answer questions such as:

- How and what can we encode in molecules?
- What types of operations can molecules execute?
- What are the representational abstractions, mathematical or computational primitives, that can describe these operations?
- What does 'computation' mean in a molecular context?
- What functions can be decided via molecular means and what equivalence might they have to traditional computing methods?
- Can we design approaches to compute directly on and with molecular data?

By addressing a series of mathematical and computational problems with molecule-based information encoding and processing, Molecular Informatics will discover and define future opportunities for molecules in information storage and processing.

A formal solicitation for the DARPA Molecular Informatics program was to be released sometime this month. DARPA Researchers are encouraging participation by non-traditional proposers such as small businesses, academic and research institutions, and first-time government contractors.

E-mail questions or concerns to DARPA's Anne Fischer, the Molecular Informatics program manager, at MolecularInformatics@darpa.mil.

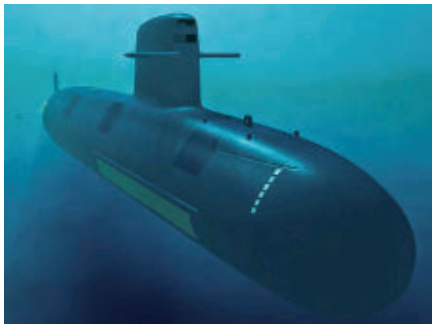
MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-SN-17-33/listing.html*.

Navy asks industry for optical communications between aircraft and submarines

BY JOHN KELLER

SAN DIEGO — U.S. Navy researchers are surveying industry for companies able to design and build a full-duplex optical communications system to enable manned and unmanned aircraft to communicate with submarines and unmanned underwater vehicles (UUVs).

Officials of the Space and Naval Warfare Systems Command (SPAWAR) in San Diego issued a sources-sought notice (SPAWAR_Headquarters_MKTSVY_131EDE) in March for the Modular Optical Communications (OCOMMS) Payloads project, which seeks to design a communications system to provide optimal connectivity between submarines and aircraft.



Navy researchers want to develop high-speed optical communications to enable aircraft and submarines to keep in touch.

Optical communications links would be better than radio waves for this application because optical

offers sufficient attenuation to penetrate water to undersea systems at useful depths, while RF systems require an above water antenna, officials say.

Communications through such an air-water-interface (AWI) have the potential for very high data rates and inherently low probability of intercept and low probability of detection (LPI/LPD). Navy researchers are looking for technology tradeoffs between bandwidth, availability, and vulnerability for such an optical communications payload.

Navy researchers have in mind an optical communications system that can communicate at speeds no slower than 1 kilobit per second between a submersible and an aircraft at ranges farther than 15 nautical miles through the air, and to depths greater than 100 feet through the water.

Of primary interest is an over-the-air and through-the-water optical communications system packaged as a gimbal mounted to the aircraft or in a pod that measures no larger than 16.5 inches long, 15.5 inches wide, and 13.25 inches high, and that weighs no more than 60 pounds.

Technologies of interest include compact pulsed lasers operating in the 450-to-550-nanometer region, large-aperture narrow-bandwidth and wide-field-of-view optical filters, communications modems able to modulate and demodulate optical signals using pulse position modulation (PPM), and sensitive large-aperture optical detectors.

The modem will use Reed-Solomon encoding to improve bit error rate (BER) performance, and should be able to monitor SNR and BER or Symbol Error Rate (SER) to adjust the modem parameters of the uplink and downlink to make the most of communications bandwidth while optimizing BER performance.

Companies interested should e-mail white papers or questions to SPAWAR's Kathleen McCoy at kate.mccoy@navy.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/DON/SPAWAR/SPAWARHQ/SPAWAR_Headquarters_MKTSVY_131EDE/listing.html*.

The challenge of controlling proliferating unmanned aircraft

BY **J.R. Wilson**

Unmanned aerial vehicles (UAVs) are in common usage in the U.S. military, yet systems designers struggle with developing universal UAV control systems that are simple and reliable to operate.

The technological revolution that began in the latter half of the 20th Century was largely hardware-based, from computers to communications to combat. That began to change as the 1990s drew to a close and software began taking on a greater role in providing upgraded capabilities on existing hardware.

The software-defined radio (SDR) generally is cited as the principle example of that, but in recent years it has expanded to include items such as software-defined radar, sonar, and software-defined unmanned vehicle (UXV) control systems.

Software-defined unmanned vehicle control is an adaptation that will better enable the long-sought goal of common controllers as the number and type of

PHOTO: NASA controllers use sophisticated display and software technology to control the organization's Global Hawk long-range surveillance UAVs.

unmanned aerial vehicles (UAVs) continues to grow across all four military services — and soon will include unmanned ground vehicles (UGVs) and unmanned underwater vehicles (UUVs). But the greater the reliance on software controls, onboard and remote, the greater the potential hazards.

"You can't assume anything is going to be the same from minute-to-minute," warns S. Tucker Taft, vice president and director of language research at software specialist AdaCore in New York.

Nevertheless, there is general agreement that the future of UXV control systems revolves around software.

"We're there today; SDR is a perfect analogy for just about any effort in the virtual space," says Todd Probert, vice president of mission support and modernization at Raytheon Intelligence, Information, and Services in Dulles, Va. "There will still be things that are physics-defined, but more and more capability is migrating to the software-defined space. The state of technology is very robust and evolving very quickly. It comes down to figuring out how to actually employ those CONOPs in the warfighting domain."

Cooperating unmanned vehicles

The ability to swarm UAVs is a major capability that software-defined control systems enable. "We have architecture controlling a swarm rather than each individual UAV," Probert says. "The Navy may want a number of different types of unmanned systems on the same ship, but because SWaP [size, weight and power] is a precious commodity, they don't want separate control systems for each. You can train a sailor on that architecture alone and it also is easier to maintain, so the economies of scale make a lot of sense."

There remain barriers to implementing common controls, especially across industry and between services. These barriers include the need to abandon proprietary elements; the need to trust others with software creation; concerns about security, at the manufacturing level and in the field; and the establishment and acceptance of standards.

"It's hard to gauge commitment on this," says Kingsley Fregene, group leader of robotics and intelligent systems at Lockheed Martin Advanced Technology Laboratories in Cherry Hill, N.J. "Almost everyone recognizes it is not ideal to have a separate controller for everything that is being fielded. It makes a lot of sense to have a common controller for a large category of systems, if not all systems. And that's where there are various opportunities going on."

Universal unmanned vehicle controllers still are in their infancy, experts say. "Developing a single controller for UAVs and UGVs is still in the early stages," Fregene says.

Botlink in Fargo, N.D. offers UAV control software that runs on tablet computers to keep users safe and in compliance with FAA regulations while operating drones.

"The technology operators recognize it is important to use a common controller across domains, but that effort is at a much earlier stage than the efforts to develop common controllers for specific types of UXVs — air vehicles or maritime or ground."

Leaders of the U.S. military services already are collaborating more broadly on a key element — the development open architectures and standards for UXV control systems, Raytheon's Probert says.

"From a CONOPs standpoint, I think we will see the ability to do that across services and domains in the near future," Probert continues. "It is very conceivable that as architecture collapses down, some general somewhere could have capability on his or her smartphone to handle a UAV."

Promising technologies for universal unmanned vehicle controllers could be closer than many people think. "If the state of technology is not there today, it is very near the tipping point," Probert says. "That's what is happening in this open-architecture environment and it's a key enabler because we only have to build the platform once. And we can build cyber resiliency into that open architecture as the threat evolves, as well."

The need for standards

While agreeing the future of UXV control systems lies with advanced software, Lockheed Martin's Fregene says cross-platform and inter-service systems won't happen without standardization.

"There is a lot of progress being made in trying to achieve unification, but we're not all the way there yet. It's a challenge because there are many different vendors and types of platforms and no agreed-upon standard everyone uses," Fregene explains. "There are committees meeting, from the STANAG [NATO Standardization Agreement] standards defining data flow to JAUS [Joint Architecture for Unmanned Systems], on how to allow systems to interact. Some are looking at air vehicles, some ground, some maritime. Those need to be brought together to have a truly unified standard in the future. Most recently, the Navy Science and Technology committee at NRL [the Naval Research Laboratory in Washington] has been trying to take the standards developed for air vehicles and customize them for maritime vehicles."

While software-defined controls are less expensive, easier to maintain and upgrade, require less user training, and can be adapted to changing mission requirements — perhaps literally on-the-fly — they also open the platforms involved to greater enemy threats. It requires physical access to compromise an electronic component, but in cyberspace, the hacker and her target can be on opposite sides of the world.

Researchers at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have begun looking into how to survive such an attack with the agency's High-Assurance Cyber Military Systems (HACMS) project to enable high-assurance military systems, including UXVs and command and control systems.

"Achieving this goal requires a fundamentally different approach from what the software community has taken to date," DARPA officials say. "Consequently, HACMS will adopt a clean-slate, formal methods-based approach to enable semi-automated code synthesis from executable, formal specifications.

"In addition to generating code, HACMS seeks a synthesizer capable of producing a machine-checkable proof that the generated code satisfies functional specifications as well as security and safety policies," DARPA officials continue. "A key technical challenge is the development of techniques to ensure that such proofs are composable, allowing the construction of high-assurance systems out of high-assurance components."

Reliable software

One of those working on that concept is AdaCore, where Taft says intelligent control systems for autonomous vehicles is where the software becomes extremely important.

"And the biggest challenge is not so much the control system, which typically has a human operator, but in security of transmission and the reliability of remote sensors and the connection between the remote

pilot and the vehicle," Taft explains, adding another rapidly developing element, artificial intelligence, expected to play a role in future UXVs creates issues more basic than fears of "Terminators" taking to the battlefield.

Indeed, those working on artificial intelligence (AI)-based control systems believe AI will have the opposite effect — creating greater human control.

"AI is great, but has to be paired with a system that has simple controls," Taft says. "By itself, it is too hard to feel confident about it at this time. I think we will start understanding what AI can and cannot do — and it won't be as helpful as hoped in some areas. It will augment, not replace, human input; it will deal with the details and the human with the higher-level decisions."

Lockheed Martin also is working on systems that will improve the integration of man and machine.

"Traditionally, we've had a mix of in-house command stations and those from other sources. Right

The L-3 Link PMATS is a flight simulator that reproduces the aircrew ground stations of MQ-1 Predator and Predator B/MQ-9 Reaper combat drone pilots and sensor operators.

now, there is a trend to put together a command and control [C2] station especially for UAVs, pulling in different capabilities and unifying the way you interact with these vehicles," Fregene says. "On the research and development side, there is a strong interest in developing C2 stations with the ability for humans and machines to interact — human and robot teaming. So control stations that require the human to be head-down, looking at the screen almost all the time, are being replaced by devices that can be worn on the body, head-up displays, etc., to make these interactions a lot easier."

Fregene agrees, saying human operators will remain important to all future UXV control systems, no matter the level of autonomy involved.

Human-machine teams

"There is a big emphasis on determining the best way for humans and robots to form teams, which presuppose some type of interaction, from having enough onboard autonomy that the functionality required on the control station is minimal to something similar to what we have today with many systems remotely controlled," Fregene explains. "As we increase the level of autonomy we put on these systems, it won't remove the need to have a human. The goal is not to have systems that operate with no human involvement at all. What needs to happen is to understand how team dynamics work. Increasing autonomy will help with how we do control stations by reducing the need to put in a lot of functionality for total human control."

From a control systems standpoint, then, AI is an important component in expanding the abilities of human operators to control UXVs in the future.

"Right now, it takes 10 people to control one drone," says Jim Crowder, chief engineer at Raytheon Intelligence, Information, and Services, who is helping to pioneer AI technologies. "What we'd like to get to is one guy controlling 10 drones."

The U.S. Air Force already is moving forward with that concept with a new UAV Block 50 ground

control station that enables one operator to perform functions now done by multiple operators. The Block 50 also will incorporate open architecture, allowing it to integrate new software as technologies continue to evolve.

One operator using these advanced control systems could be a submariner, an infantryman or a fighter pilot, each controlling multiple UUVs, UGVs, or UAVs — and, eventually, combinations of those platforms, regardless of service ownership. Such unified control would speed the delivery of information from the UXV directly to the human controller, without going through a dedicated ground control system first, and new orders from that human to individual UXVs or even a swarm.

Having a human controller in the same battlespace also makes the UXVs more agile, eliminating the up to two-second delay in commands sent from a control station half the world away. The key is to make the unmanned platform and its onboard controller sufficiently autonomous and able to process and fuse data onboard that the human controller only receives what is absolutely necessary to his or her decision-making, without being overwhelmed.

> "There are many autonomous systems and the goal is to have systems with their own ability to make decisions in response to what they encounter in the field."

The role of hardware

Although the future of UXV control systems commonality is tightly bound to software developments, that does not mean advances in hardware are no longer needed or relevant — especially if some remote systems are worn by warfighters. As those systems become

AdaCore is pursuing advanced safety elements in UAV control systems as unmanned platforms become more autonomous.

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smaller and proliferate, they raise new problems — and potential software solutions — of their own.

"Power has emerged as an important aspect, in some ways impacting Moore's Law because if you want twice the speed, you need more power. At some point, you need to concentrate on low-power systems, especially during those times when you don't need the highest levels of performance," says AdaCore's Taft. "We have smartphones today that can do a lot of tasks and can be ruggedized and given to soldiers. Or the soldier could wear a tracker and the UGV would simply follow. But what happens when controls worn or carried by a soldier get captured by the enemy? You have to be able to detect quickly when that happens, which means a monitor on every soldier that can shut the system down if things go off the rails."

A growing reliance on software-defined systems also means a growing reliance on having the best programmers available — far more skilled at creating error-free software than ever before.

That is an area that greatly concerns Taft. "The actual process of creating software is still pretty primitive. There is a push toward so-called model-based development, which we're trying to support among our customers, but in my own view, that is still pretty low-level. I'm in the programming language research business and I don't think we've reached the end of that road.

"It's not just a question of how quickly you can produce a program that does the right thing, but creating a program that does it with safety and security. In almost every engineering classification, you have to get certified — but not in the software field. And as more and more of our systems become software-centric, it is alarming that so many parts of these systems are being built by people who have no real certified background."

As research organizations such as AdaCore, Lockheed Martin, Raytheon, DARPA, and NRL enhance and expand their efforts on future UXV control systems, technologies will need to move forward. Fregene addressed some of those:

■ Displays

"There are some very interesting technologies that are leading to displays that are conformal, meaning they can change shape to fit. Those are in the early stages, but will be critical to meeting the need for control stations that are less burdensome than what we have today."

■ Batteries (or alternative power sources)

"There is a lot of work being done there, including early research into embedding some materials in the boots of operators so they can generate some quantity of power just by their usual movements and walking around."

■ Power electronics

"Many systems will have power electronic components that are built-in, to manage consumption or channel power directly to device sub-elements, for example. There is no one way to address the broad subject of power, including finding ways to control it. But ways will be found to be more efficient with the processes already being used as we tackle them from all directions."

■ Wireless networking

"Wireless networks are pretty well understood in terms of the protocols we have today. New questions include how much can we package into these channels and how well can we secure them. Operators will almost be like nodes on a wireless network. So there will need to be some new foundational technologies developed to address the issues surrounding wireless."

■ Microprocessors

"There are different processing techniques being developed that have very little power consumption; neuromorphic processors meant to in some sense imitate how the human neural system works and reduce power consumption."

■ Nanotech

"Nanotech is another enabling technology; using nanotech fabrication techniques, for example, can enable new processors to become more viable."

■ SWaP-C

"SWaP is important in onboard and remote control systems. If you have something flying, weight impacts how long and far it can fly. So managing SWaP-C is critical to what you put out there. There is a finite amount of power available and the longer time-on-station you can have for your system, the better.

"For remote controllers on the ground, SWaP-C is still important because they take up space and resources, especially in

expeditionary applications. So it will continue to be an important consideration for any future systems."

■ Artificial intelligence

"A lot of good work has happened in AI in the last five years or so, a lot enabled by so-called deep learning. There are many autonomous systems and the goal is to have systems with their own ability to make decisions in response to what they encounter in the field. Deep learning, which is driving AI today, is being developed directly in the processing architecture. Today we write algorithms that run on a processor, but if we can run those algorithms directly, using a deep learning architecture, we will see the promise of AI. Deep learning, enabled by the ability to do direct onboard implementation, will go a long way toward accomplishing that."

"Once we close down an avenue of attack, the persistent threat out there finds two or three new ways to attack, so you have to build your architecture with that in mind."

Autonomous activity

In February 2017, the U.S. Navy underwent a massive reorganization of its unmanned underwater platform programs structure, disbanding the year-old Unmanned Warfare Systems Directorate and moving all its unmanned systems into technology development or domain-based warfare directorates.

The Navy said no current programs of record will be cut, slowed, or otherwise affected, but will be more completely integrated across domains. Among those affected are the Common Control System (CCS) and Common System Interface, which enables CCS communication with existing system interfaces.

In 2016, tests of the CCS with a Large Displacement Unmanned Undersea Vehicle demonstrated it could provide command, control, planning, and monitoring from one global operations center to UUVs on missions anywhere in the world and is adaptable to UUV and UAV missions, according to program officials at Patuxent River, Md. The Navy's ultimate goal is to field the CCS across all domains and platforms — air, land, sea, and undersea — simultaneously.

"I think there will be more and more autonomy, but paired with high-level control. You give it a mission and it does its best to achieve that, but fundamentally it is trying to control a system at a much higher level than we've been used to. But even if fully autonomous, UXVs will depend on external connections of some sort, to know where other units are, to receive information. That is the big challenge," Taft says. "You have a very noisy space and people trying to make it even noisier. So you have to come up with algorithms to compensate; the systems have to be very adaptive and can't assume one level of communication and connection. They also must be able to validate the data they are receiving, because the inputs may be misleading, intentionally or otherwise. Safety and security are no longer as separate as they used to be."

As new UXV control systems technologies evolve, changing military CONOPs and expanding capabilities, potential adversaries are working hard on ways to disrupt and defeat what, until now, has been total U.S. dominance in the field of unmanned platforms.

"The biggest space is cyber, not just for unmanned but for all C2 and ISR systems. Cyber is a key element we need to contend with going forward and make sure we can manage alongside the functionality and capability of these systems," Probert concludes. "We are building foundational open architecture that includes the ability to evolve from a cyber resilience standpoint. But once we close down an avenue of attack, the persistent threat out there finds two or three new ways to attack, so you have to build your architecture with that in mind.

"What happens with UXV control systems, onboard and remote, in the next 5 to 10 years is very much about analytics, automation, and cyber. The world is quickly going to a virtualized environment, where it doesn't really matter where the UXV control system resides. Technology has increased almost exponentially in the last five years — and that will continue. The battlespace is becoming digitized and that digitization is driving the speed of war in ways we can't even imagine." ←

Power control and thermal management at the platform level

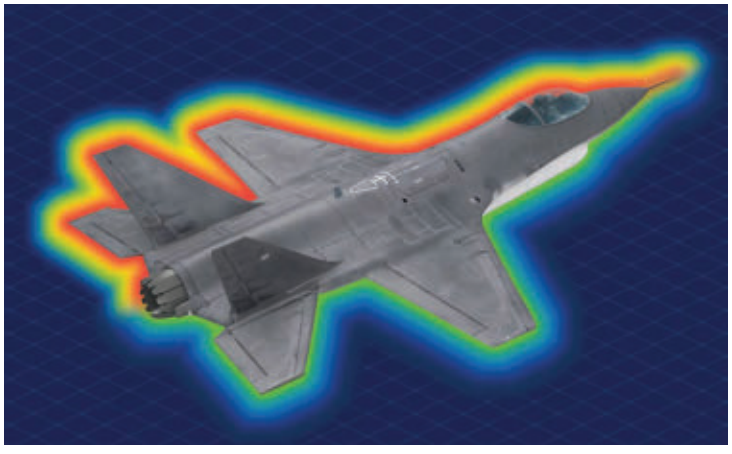
Demands are increasing for high-performance embedded computing in small packages, which creates a huge amount of waste heat. Designers look at sharing responsibilities for electronics cooling from chips to entire systems.

BY **John Keller**

Aerospace and defense systems designers today face an overwhelming task when it comes to electric power control and thermal management. Systems integrators are demanding increased capabilities and ever-smaller packing, and yet these converging forces are conspiring to create staggering amounts of waste heat; there's no end in sight to this trend.

On a subsystem level, controlling power and managing waste heat is relatively straightforward. Embedded computing and electronics subsystem designers today look at making components and board products as small and as power-efficient as possible, and remove waste heat with conduction, convection, or liquid cooling.

Conduction cooling moves heat away from hot components like data and graphics processors by channeling heat along card edges or through heat pipes to cooler surrounding surfaces. Conduction cooling uses fans to blow heat away from hot components. Liquid cooling, meanwhile, uses a system of pumps and plumbing to move heat away from the electronic components that produce it.



Trends in more-electric aircraft are increasing power loads while reducing fluid available for system cooling.

These approaches often work just fine within an electronics box, but the real sticky problems come at the so-called platform level — on an aircraft, ground vehicle, surface ship, or submarine. The core issue is where does the heat go when it moves away from chips, boards, and electronics boxes?

Waste heat from electronics boxes has to go somewhere, and places to dump heat on the platform are decreasing in number as technology advances. Moreover, the number of electronics subsystems producing waste heat on modern military platforms is growing, which compounds the problem — a growing amount of heat, and fewer places to dump it.

"Just to take the heat away from electronic components is just the first step," says Gerald Janicki, vice president of thermal systems at Meggitt Defense Systems Inc. in Irvine, Calif. The box-level electronics designers

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"are smart enough to get the heat from the board to something that will conduct the heat, and then their job is done. You really have to have a global and local optimization approach. You can't just cool at the component, board, or box level. Nothing has gotten cooler; everything has gotten hotter."

Where to get rid of the heat

Consider an aircraft. One possibility for dumping heat is into the ambient air. At altitudes where temperatures are cold, that can be the best solution, but what about when the aircraft is idling on a desert runway with its electronics on? In those cases, using just ambient air as a primary heat sink isn't adequate.

One place where systems engineers can consider dumping waste heat is liquid, and on aircraft that means fuel or hydraulic fluid. While aircraft fuel systems still provide abundant opportunity to move heat away from electronics, using hydraulic fluid to absorb heat just isn't what it used to be. Modern avionics designs are making many hydraulic systems a thing of the past. In fact, the option of using aircraft hydraulic fluid for heat management is shrinking or going away entirely.

Modern aircraft are being designed as all-electric, or at least "more-electric." That means using electric power to move control surfaces, brakes, and other mechanical systems rather than hydraulics. While this might be an advantage for improving overall platform

Revolutionary designs in power efficiency for high-performance embedded computing

There are two ways to control potentially damaging heat from high-performance embedded computing systems: move the heat away with conduction, convection, or liquid cooling, or create vast enhancements in the power efficiency of digital processors to reduce the amount of heat they generate.

It's the latter option, enhancing power efficiency, that drives a U.S. military research program that seeks to create enabling technologies leading to the design of high-performance processors with power efficiencies of 75 billion floating point operations per second with a single watt of electricity.

Seventy-five gigaflops per watt is the lofty goal of the Power Efficiency Revolution for Embedded Computing Technologies (PERFECT) program of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

Beginning in 2012, the PERFECT program set out on an approach that includes near-threshold voltage operation and massive heterogeneous processing concurrency, combined with ways to use the resulting concurrency and tolerate the resulting increased rate of soft errors — all seeking to improve the power efficiency of embedded computing components.

"We could trade the thermals, but that's really solving the problem, because if you can reduce the overall power of the processing, you can make thermal management better," says Trung Tran, who manages the PERFECT program for the DARPA Microsystems Technology Office (MTO). "Thermals are something you have to look at, but PERFECT is looking reducing overall power, and then thermal management on the platform is less of a problem."

The PERFECT program was originally focused on seven program elements: architecture, concurrency, resilience, locality, algorithms, simulation, and test and verification.

As the program stands today, several contractors have been involved, and its benefits revolve around three technology areas: power design, reducing the voltage of electronic components, and advanced algorithms that use low power, Tran explains.

One of the most promising successes of the PERFECT program was at the University of California at Berkeley: the Strober tool, which enables processor manufacturers to gauge the power usage of their components in real time during the design phase. Strober "gives you within 3 percent of the power of the chip for workload, and that gives you a lot of control over the design," Tran says. "Now we can start doing power tradeoffs in real time, and make power an integral part of the design."

Separately, chip experts at IBM Corp. created a suite of design tools called CLEAR that help engineers ensure the reliability of processor designs that increase power efficiencies by using relatively low voltages.

"With CLEAR we can design-in reliability in the circuit so we could run at lower voltages and correct the errors of running at those lower voltages," Tran says. "Instead of going from a 1-volt power supply we can go all the way to 0.6 or 0.4 volts in the operation of the chip. We're looking at 60 percent of the voltage being gone and still have the same reliability and functionality. We get five orders of magnitude increase in the reliability of the chip."

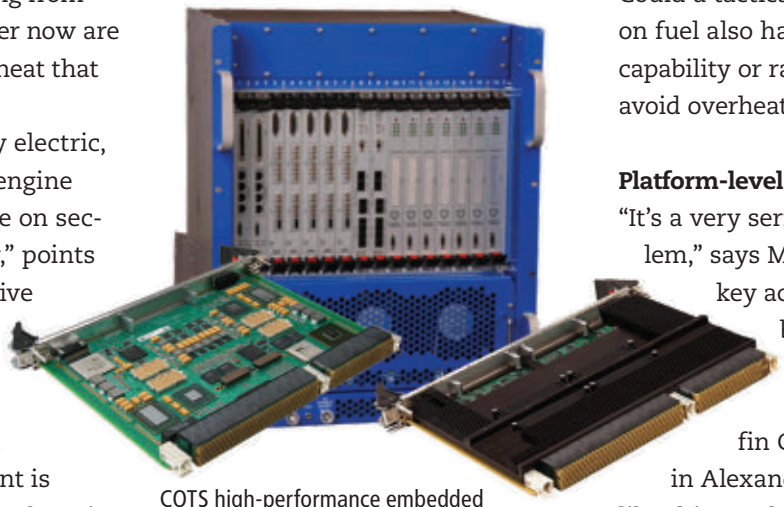
Finally, the PERFECT program has led to efficiency increases in software algorithms that advanced processors run. "If we are more intelligent about how we structure the program, we can lower the power," Tran says. "We look at how we map information into memory to reduce the number of idle cycles."

With substantial research work already completed, Tran is working to switch lessons learned over to industry. Anyone interested in learning more or gaining access to the PERFECT research, should e-mail outreach@darpa.mil.

maintenance, it can be a nightmare for the thermal engineer. Not only do electric aircraft have fewer places to dump waste heat, but the subsystems that are converting from hydraulics to electric power now are generating electric waste heat that wasn't there before.

"Aircraft today are very electric, and rely less and less on engine power and more and more on secondarily generated power," points out Meggitt's Janicki. "Active cooling needs to dump the heat into the fuel. That's fine until you start running low on fuel. Good thermal management is very benign; nobody cares about it until something breaks down. It can ruin your whole mission."

An aircraft fuel system also is a viable option for dumping waste heat, and this practice is common. Still, what happens when the aircraft starts to run low on fuel? Not only is the aircraft's range severely cut back, but its ability to cool electronics also is diminished. Could a tactical aircraft running low on fuel also have to compromise the capability or range of its sensors to avoid overheating its electronics?



COTS high-performance embedded computing systems typically use conduction and convection cooling, but systems designers must have places for the heat to go.

Platform-level considerations

"It's a very serious system problem," says Michael Humphrey, key account manager for business development and global support at the Parker Hannifin Corp. Aerospace Group in Alexandria, Va. "All systems like this need to look hard at the capacity of the system, and what if you are putting a thermal on your

fuel system that might impact your range or effectiveness."

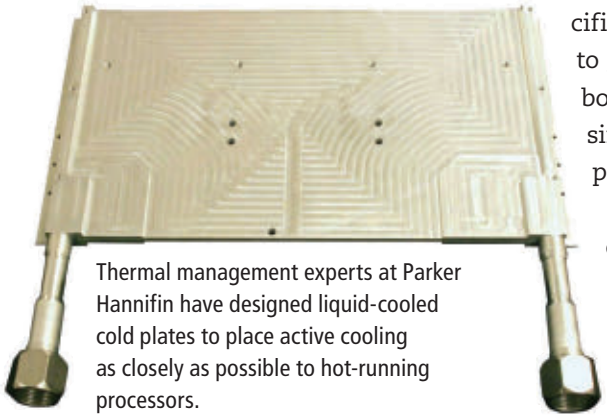
Some industry sources suggest that the Lockheed Martin F-35 Joint Strike Fighter is facing just this issue as platform designers scramble to balance the ability to manage waste heat with the aircraft's onboard, high-performance computing, sensors, high-speed data networking, and other electronic subsystems.

"The F-22 and F-35 are moving to more-electric aircraft, generating a lot of waste heat. What are you going to do with that?" asks Jim McCormick, product line director for solid-state power controllers at Data Device Corp. (DDC) in Bohemia, N.Y.

It can be awkward to discuss electronics thermal management on a platform level. Electronic subsystems designers continue to develop innovative box-level cooling techniques to handle modern processors like the Intel Xeon D and a variety of general-purpose graphics processing units (GPGPUs). As long as they can cool a box, their job is done.

Platform-level systems integrators, meanwhile, have so many design priorities to worry about that system-wide thermal management rarely comes up. "We have been talking about this system-level thermal management for a long time, and it's falling on deaf ears," laments Parker's Humphrey.

Experts are urging subsystems designers to think more broadly about thermal-management solutions that can benefit the entire platform, rather than just the electronics box. "We shouldn't waste our time on technologies that don't really affect the overall system," says Meggitt's Janicki. "You have to understand how these smaller technologies like passive cooling affect the whole system. There are a lot of good solutions out there, but scaling them up is another matter."



Thermal management experts at Parker Hannifin have designed liquid-cooled cold plates to place active cooling as closely as possible to hot-running processors.

Electronic subsystems designers and platform integrators shouldn't just think about how to cool boards and boxes; they should consider early in the design process the environment in which a platform will operate and the opportunities that environment offers for cooling. "It's really not even just about what the platform is; it's about where the platform is, and what is the place you have to get rid of the heat into," says Parker's Humphrey.

"We've never really coupled power and cooling together, and think we have to," adds Meggitt's Janicki.

Thermal management and power efficiency

One of the most straightforward approaches to managing waste heat in an electronics system or on a platform is to do everything possible to improve the efficiency of electronic components and subsystems so they function with high performance, yet generate a minimum of waste heat.

"We are now working on power density — or how little real estate you can allow, vs. how much space do you have allocated in the platform for power switching," says DDC's McCormick. "We do some custom ASIC [application-specific integrated circuit] designs to get some advantages, reduce board space, add more heat sinking, and have a more compact design."

Another approach to enhancing power efficiency involves so-called "smart power," or using microprocessors instead of electro-mechanical circuit breakers to route and control electric power. "We have seen a huge conversion from electro-mechanical circuit breakers to solid-state power controllers [SSPCs]," McCormick says.

Inserting digital control of power also offers new ways to look at power management on a system and platform level. "People have been looking at intelligent load management," McCormick says. "If I only have so much power available, how do I manage this load from a power-management and power-dissipation perspective. We could think segregating non-essential things like commercial aircraft galleys, and then power-up the galleys when there's less load on the entire system."

Parker Hannifin offers a onboard controller that manages thermal control in a chassis. In this case thermal management involves not only removing waste heat from electronics, but also providing heat for powering-up electronics in cold environments.

"Using COTS [commercial off-the-shelf] or modified COTS, a lot of those circuit cards in embedded systems can go down to zero or minus 40 degrees Celsius," says Jason Dundas, engineering manager in the Parker Hannifin Gas Turbine Fuel Systems Division in Mentor, Ohio. "We can manage all that: the power quality with system-level monitoring, intermediate voltage rails, and backplane voltages. Monitoring gives us the ability to send messages to a customer's payload that make decisions based on that information."

Parker thermal-management experts also are working on concepts involving two-phase cooling to enhance heat removal in small packages. Two-phase cooling

Some thermal management approaches spray cooling liquid directly onto heat-producing components to keep them in safe operating ranges. The liquid is recovered and recirculated.

involves liquid brought to the boiling point that cools with the liquid itself, as well as with the latent vaporization of the boiling liquid.

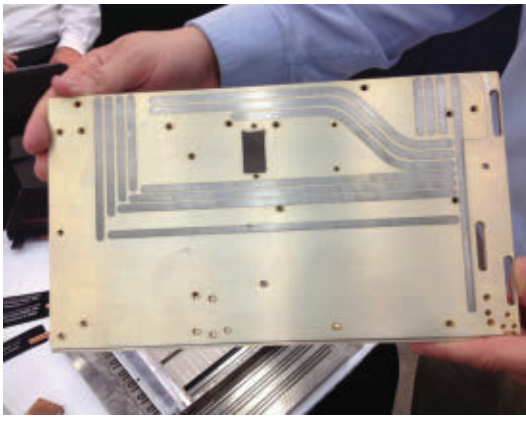
"Think about boiling water on your stove top," Dundas says. "Heated water stays at that same temperature, even though you continue to apply heat energy. You can acquire heat while keeping your substrate at a relatively isothermal temperature, which is very good and promotes efficient heat transfer."

The trick is to transport the cooling liquid and steam to a condenser. "Until that heat condenses, you still use that vaporization to reject that same amount of heat," Dundas says. This process can enable users to maintain temperatures while transferring vast amounts of heat. "You end up with something that has a much smaller volume of liquid for coolant," says Parker's Humphrey. "then you can think about creative ways to save weight."

Cooling hot custom boards

Parker experts are capitalizing on their company's expertise in liquid cooling to create a thin metal cold plate containing a small amount of liquid to cool custom-designed high-performance circuit boards for radar, electronic warfare (EW), signals intelligence (SIGINT), and other demanding applications.

"We want to get the heat-acquiring substance, liquid, as close as possible to the heat source so we can pick up the heat," Dundas says. "It allows such nice integration of your cooling with your electronics." Some of these specialized boards, custom-designed by the prime contractors, can generate as much as 200 watts of waste heat per board. "Sensors are driving thermal densities up, and heat pipes can't transfer the heat fast enough."



Advanced Cooling Technologies has devised cooling techniques for high-power VPX embedded computing cards using heat pipes to enhance heat removal from computer boards.

If power-control and thermal-management trends continue as they have been, a growing number of embedded computing designers will be forced into using liquid cooling, simply because conduction and convection cooling will be inadequate to handle such intense thermal loads, Parker's Humphrey says.

"At the board level, it is still a COTS market, but the box level and sensor level are very application-specific," Humphrey says. Applications like that most likely will require custom and application-specific cooling solutions for now, but COTS high-performance embedded computing designers are likely to become involved in liquid cooling as well. "It will evolve down to the COTS box guys," he says. "These guys will get pulled into the liquid-cooled world kicking and fighting."

Navy contracts Raytheon for communication and engagement network

Raytheon won an $11.8 million U.S. Office of Naval Research contract to develop an advanced, cross-domain communication and engagement network for the U.S. Navy. Raytheon will research and develop weapons networking technologies to enable greater sensor interconnectivity and improve integrated fires capabilities for naval operations. Raytheon's communications and interoperability for integrated fires (CIIF) will offer situational awareness for force-wide integrated air and missile defense and allow naval vessels, aircraft, and expeditionary forces to communicate and share information across data links.

Thales and SES select Hughes for aviation connectivity network

Thales, SES S.A., and Hughes Network Systems entered agreements whereby SES contracts capacity on Hughes EchoStar XVII and EchoStar XIX high throughput Ka-band satellites giving Thales FlytLIVE the only redundant coverage network in North America. SES will purchase multiple JUPITER System gateways to qualify Thales to deploy FlytLIVE service on the Hughes JUPITER Aeronautical platform so Thales can initiate its next-generation connected inflight experience in North America this year.

Navy orders more SEWIP Block 2 shipboard EW systems from Lockheed Martin

BY **John Keller**

WASHINGTON — U.S. Navy surface warfare experts are ordering additional advanced shipboard electronic warfare (EW) systems for surface warships like aircraft carriers, amphibious assault ships, cruisers, and destroyers under terms of a $98.5 million contract announced in March.

The U.S. Navy is expanding the reach of the shipboard AN/SLQ-32(V)6 Surface Electronic Warfare Improvement Program (SEWIP) Block 2.

Officials of the Naval Sea Systems Command in Washington are exercising options with the Lockheed Martin Corp. Rotary and Mission Systems segment in Liverpool, N.Y., for full-rate production of Surface Electronic Warfare Improvement Program (SEWIP) Block 2 subsystems (AN/SLQ-32(V)6).

SEWIP Block 2 is an evolutionary acquisition and incremental development program to upgrade the existing AN/SLQ-32(V) electronic warfare system.

SEWIP provides enhanced shipboard EW for early detection, analysis, threat warning, and protection from anti-ship missiles. SEWIP Block 2 will enhance the shipboard EW system's receiver and antenna group to meet the latest threats.

Lockheed Martin won a $148.9 million contract last October for full-rate production of AN/SLQ-32A(V)6) and AN/SLQ-32C(V)6 SEWIP shipboard EW systems. Before that, Lockheed Martin won a Navy award for SEWIP Block 2 in late 2009, leading a team of ITT Electronic Systems (now Harris Corp.), Cobham Defence Electronic Systems, Research Associates Syracuse, and Azure Summit Technology of Fairfax, Va.

Since the SEWIP program started in 2002, General Dynamics Advanced Information Systems (AIS) in Fairfax, Va., acted as prime contractor for SEWIP blocks 1A, 1B1, 1B2, and 1B3.

The Lockheed Martin Block 2 SEWIP design is based on its integrated common electronics warfare system (ICEWS), which enables

rapid reconfiguring of the system with commercial technology.

Developed by Raytheon in the 1970s, the original AN/SLQ-32 systems employed passive radar technology for early warning, identification, and tracking of enemy threats. Subsequent upgrades provided an additional active capability for simultaneous jamming of several different threats.

On this contract Lockheed Martin will do the work in Liverpool, N.Y.; Lansdale, Pa.; Chelmsford, Mass.; Frankfort, N.Y.; Hamilton, N.J.; Hauppauge, N.Y.; Brockton, Mass.; West Yorkshire, England; Minneapolis; Huntsville, Ala.; and Lancaster, Pa., and will be finished by July 2019. ←

FOR MORE INFORMATION visit **Lockheed Martin Rotary and Mission Systems** online at *www.lockheedmartin.com/us/rms*, or **Naval Sea Systems Command** at *www.navsea.navy.mil*.

Rockwell Collins to provide additional AN/ARC-210 aircraft radios

BY **John Keller**

PATUXENT RIVER NAS, Md. — Military radio communications experts at Rockwell Collins in Cedar Rapids, Iowa, will provide additional AN/ARC-210 avionics radios and related equipment for U.S. and foreign military aircraft under terms of a $10.5 million order announced in March.

The AN/ARC-210 Gen V programmable digital aircraft radio from Rockwell Collins provides two-way, multi-mode voice and data communications over frequencies from 30 to 512 MHz, covering UHF and VHF bands with AM, FM, and satellite communications capabilities.

The ARC-210 radio also includes embedded anti-jam waveforms, including Have Quick and SINCGARS, and other data link and secure communications features for battlefield interoperability and transfer of data, voice, and imagery. The radios communicate with other avionics over a MIL-STD-1553 data bus.

This avionics radio order from Naval Air Systems Command at Patuxent River Naval Air Station, Md., is a modification to a $101.1 million contract announced in October 2014. Since then Rockwell Collins has received seven additional orders on the original contract worth $364 million.

The Rockwell Collins AN/ARC-210 aircraft radio, shown above, is one of the most widely used pieces of avionics in the U.S. military inventory.

The ARC-210 aircraft radio provides VHF close air support radio communications on 30–88 MHz frequencies; navigation on 108–118 MHz; air traffic control on 118–137 MHz; land mobile communications on 137–156 MHz; and maritime communications on 156–174 MHz.

The radios also provide aircraft with UHF military and homeland defense communications on 225–512 MHz frequencies; and public-safety communications on 806–824, 851–869, 869–902, and 935–941 frequencies.

The AN/ARC-210 Gen V programmable digital communication system conforms to software-defined radio (SDR) tenets and architectures, and transfers networked or point-to-point data, voice, and imagery.

Rockwell Collins engineers also have added a connector in the back of the radio to allow an Ethernet input for network-centric warfare. Rockwell Collins has supplied more than 30,000 AN/ARC-210 radios worldwide on more than 180 different kinds of aircraft for multiband, multi-mode communications.

The ARC-210 provides embedded, programmable information security per the U.S. National Security Agency Cryptographic Modernization Initiative.

Rockwell Collins will do the work in Cedar Rapids, Iowa, and should be finished by September 2018. ←

FOR MORE INFORMATION visit **Rockwell Collins** online at *www.rockwellcollins.com*.

DARPA asks industry for unmanned undersea vehicle payload delivery system

U.S. military researchers are working with industry to develop an advanced undersea payload delivery system for extra-large unmanned underwater vehicles (XLUUVs). Payloads could involve persistent-surveillance sensors, weapons, or other unmanned underwater vehicles (UUVs) and unmanned aerial vehicles (UAVs). Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., have issued a broad agency announcement (HR001117S0022) for the Hunter program to develop a payload-delivery system from a large UUV. The Hunter program involves only the payload-delivery system and not the extra-large UUV itself. The Hunter Program is a 45-month program in three phases: the first to design and build the payload delivery device to fit inside a government-provided payload module; and the second and third phases to support integration of the payload delivery device into the big UUV for testing. E-mail questions or concerns to HR001117S0022@darpa.mil. ←

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/HR001117S0022/listing.html*.

Navy orders additional unmanned boats from Textron to provide LCS minesweeping capability

BY **John Keller**

WASHINGTON — Textron Systems Corp. will build fast unmanned boats to provide the U.S. Navy's Littoral Combat Ship (LCS) with unmanned minesweeping capability to detect, pinpoint, and destroy ocean mines.

Officials of the Naval Sea Systems Command announced a $14.8 million order to the Textron Unmanned Systems segment in Hunt Valley, Md., to provide additional units for the Unmanned Influence Sweep System (UISS) program.

The UISS is an unmanned surface vessel (USV) with integrated magnetic and acoustic minesweeping capability that will be part of the LCS mine warfare module. It will provide magnetic and acoustic influence minesweeping capability when deployed from the LCS.

The UISS, which uses the Textron Common Unmanned Surface Vessel (CUSV), will target acoustic, magnetic, and magnetic and acoustic combination mine types, and provide the LCS with a rapid, wide-area coverage mine-clearance capability to neutralize magnetic and acoustic influence mines.

UISS seeks to provide a high area coverage rate in a small, lightweight package with minimal impact on the LCS. The UISS surface vehicle will travel aboard the LCS and will be deployed as necessary to detect, pinpoint, and trigger explosive sea mines hidden under the surface to damage or destroy surface warships or commercial shipping.

The Textron Common Unmanned Surface Vehicle (CUSV), shown above, is the basis for the U.S. Navy Unmanned Influence Sweep System (UISS).

The system consists of the CUSV unmanned power boat that tows an acoustic and magnetic minesweeping system that emits acoustic and magnetic signals that provide a false signature that triggers mines. The surface vessel while operating will be far enough away so that it will not be damaged by a detonating mine, Navy officials say.

The UISS will use the Navy's Multiple Vehicle Communications System (MVCS) aboard the LCS, which handles communications between the LCS surface ship and different mission packages — including the UISS — that involve mine countermeasures, anti-submarine warfare, and surface warfare.

For the MVCS the Navy is using the AB3100H embedded computer from Astronics Ballard Technology in Everett, Wash. The AB3100H rugged

computer is part of the company's AB3000 line of small, lightweight embedded computers with the Intel E680T processor, MIL-STD-1553 and ARINC 429/708/717 interfaces, Ethernet, USB, video, audio, and PMC expansion. The AB3000 series from Astronics Ballard Technology comes with factory-installed PCI mezzanine card (PMC) modules that enable designers to add an Ethernet switch, synchronous and asynchronous serial interfaces, and isolated double-throw relays.

The Textron CUSV and its unmanned maritime command and control station use a modular architecture that accommodates platform reconfiguration and interchangeable payloads. The CUSV unmanned boat is capable of executing mine warfare; anti-submarine warfare; communications relay; intelligence, surveillance and reconnaissance; anti-surface warfare; and UAS/UUV launch and recovery missions.

Textron will do the work in Hunt Valley and Columbia, Md.; Slidell, La.; Hauppauge, N.Y.; and Lemont Furnace, Pa., and should be finished by September 2018.

FOR MORE INFORMATION visit **Textron Unmanned Systems** at *www.textronsystems.com* and **Astronics Ballard Technology** at *www.astronics.com*.

Boeing to convert 18 F-16 jet fighters into unmanned target drones

BY **John Keller**

EGLIN AIR FORCE BASE, Fla. — Boeing military avionics experts will convert 18 retired U.S. Air Force Lockheed Martin F-16 jet fighters into sophisticated manned and unmanned target drones under terms of a $24.7 million order.

Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., are awarding a contract modification to Boeing Defense, Space & Security in St. Louis to handle the conversion of 30 F-16 fighters into unmanned full-scale aerial targets (FSATs).

Boeing won a $28.5 million contract in March 2015 to convert 25 retired F-16 fighters in QF-16 target drones. This order exercises an option on that contract. The transaction involves Lot 5A production of the QF-16 FSAT program. The Air Force has used converted jet fighters as target drones for decades, beginning in the 1960s when the Air Force converted 24 Lockheed F-104 Starfighter jets into target drones.

Although some of these retired jet fighter target drones are destroyed during weapons tests, often the drones rely on onboard sensors to calculate the point of missile detonations to record "kills" without destroying the target aircraft.

Boeing is converting retired F-16 jet fighters into unmanned target drones to help train combat pilots in advanced tactics.

These aircraft are replacing the Air Force's fleet of QF-4 target drones, which are converted McDonnell Douglas F-4 Phantom jet fighters phased out of active service in the 1980s.

The newer QF-16s are bringing a new level of sophistication to U.S. supersonic target drone capability. The F-16 is a fourth-generation fighter, and brings new challenges for weapons testing over the third-generation F-4.

Boeing started converting F-16s into the first QF-16 drones in 2010. Company experts strip down retired F-16 fighters to remove unnecessary parts like the jet's 20-millimeter cannon and APG-66/68 radar. Boeing alters the aircraft to fly unmanned or with human pilots.

Boeing also installs a flight termination system that can destroy the drone if it goes out of control, command telemetry systems so operators can control the drone can be controlled from the ground, a scoring system to gauge the accuracy of air-to-air missiles fired at the drone, as well as avionics packages to enable these plans to fly unmanned.

Air Force leaders are expected to buy a total of 120 QF-16 target drones through 2019. Optionally Air Force leaders are considering buying a total of 210 QF-16 through 2022. The fleet should last until 2025.

On this contract, Boeing will do the work in St. Louis and should be finished by April 2021.

FOR MORE INFORMATION visit **Boeing Defense, Space & Security** at *www.boeing.com/defense*.

Lockheed Martin moves forward on sophisticated missile defense sensor seeker

BY **John Keller**

HUNTSVILLE, Ala. — U.S. ballistic missile defense experts are asking Lockheed Martin Corp. to refine the electro-optical sensor and seeker design of an advanced missile interceptor able to destroy several incoming ballistic missile warheads and decoys using just one missile.

Officials of the U.S. Missile Defense Agency (MDA) in Huntsville, Ala., announced a $53.1 million contract to the Lockheed Space Systems segment in Sunnyvale, Calif., for the Multi-Object Kill Vehicle MOKV technology risk reduction (TRR) effort.

As many as six MOKVs will launch on one booster rocket, deploy at the edge of space, steer toward, and destroy several incoming ballistic missile warheads and decoys using separate kinetic hit-to-kill weapons.

This contract calls for Lockheed Martin experts to refine their design for the MOKV gimbaled seeker assembly, integrated avionics assembly, and advanced seeker, as well as carry out component integration and testing.

The MDA's design approach for the MOKV consists of concept definition, risk reduction, and proof of concept before MDA officials decide on pursuing a full development program. This contract represents part of the Missile Defense Agency's technology risk reduction strategy.

The Raytheon Co. Missile Systems segment in Tucson, Ariz., and the Boeing Defense, Space & Security segment in Huntsville, Ala. also have been involved in MOKV development. Lockheed Martin, Raytheon, and Boeing all won MOKV concept definition contracts in August 2015.

Lockheed Martin is developing a spacecraft able to destroy several incoming enemy ballistic warheads.

When put to use, military forces will load several MOKVs on one missile-defense rocket, such as the three-stage Ground-Based Interceptor. After launch, each MOKV will steer toward an incoming ballistic missile warhead or decoy to destroy it.

Each interceptor rocket will have an advanced sensor and divert, attitude-control, and communications technologies, to enable each MOKV to home-in on its target. Each MOKV will have its own sensor and diverting thrusters.

If MDA officials and other senior military leaders decide to proceed with MOKV development, production of these missile-defense warheads could begin in 2022.

On this contract Lockheed Martin will do the work in Sunnyvale and Goleta, Calif., and in Bethesda, Md., and should be finished by March 2020.

FOR MORE INFORMATION contact **Lockheed Martin Space Systems** online at *www.lockheedmartin.com/us/ssc.html*, or the **Missile Defense Agency** at *www.mda.mil*.

U.S. Army demonstrates integration of laser weapon on combat vehicle

The U.S. Army Space and Missile Defense Command/ Army Forces Strategic Command (USASMDC/ARSTRAT) Technical Center's Air and Missile Defense Directorate participated in the Joint Improvised-Threat Defeat Organization (JIDO) UAS Hard-Kill Challenge for laser weapons and vetronics at White Sands Missile Range, N.M. During the challenge, the Mobile Expeditionary high-energy Laser (MEHEL) 2.0 demonstrated its counter-unmanned aircraft system (C-UAS) capability. MEHEL, a laser test bed on a Stryker-armored fighting vehicle chassis, serves as a platform for research and development. MEHEL 2.0 is an improved version of the original with a laser upgraded from 2 to 5 kilowatts and other added C-UAS capabilities.

Raytheon to establish dedicated software team for multi-spectral targeting sensors

Unmanned aerial vehicle (UAV) avionics experts at the Raytheon Co. are establishing a dedicated software team to support multi-spectral targeting sensors on the MQ-1 Predator and MQ-9 Reaper medium-range attack UAVs. Officials of the U.S. Air Force Lifecycle Management Center at Wright-Patterson Air Force Base, Ohio, announced a $12.6 million contract last month to the Raytheon Space and Airborne Systems segment in

Army wants dual-use aircraft infrared sensor for missile warning and situational awareness

BY **John Keller**

FORT BELVOIR, Va. — Officials of the Army Contracting Command at Fort Belvoir, Va., approached industry last month for the Digital Dual Use Sensor (DDUS) project, which is to be a high-pixel-count dual-band infrared sensor module capable of providing high-quality imagery for threat warning and for pilotage and situational awareness applications on future Army helicopters and fixed-wing aircraft.

The goal is to combine into one compact sensor module the imaging ability to detect and locate threats such as ground-to-air and air-to-air missiles via passive thermal imaging, as well as to help pilots navigate in bad weather, at night, and in other degraded-visibility conditions.

This single dual-use, electro-optical sensor will require large-format, dual-band infrared imaging sensors and high-frame rate, high dynamic range, multifunction readout integrated circuits (ROICs).

The Army Contracting Command issued a sources-sought notice on behalf of the Army Research Development and Engineering Command (RDECOM), Communications and Electronics Research and Development Engineering Center (CERDEC), Night Vision Electronics Sensors Directorate (NVESD) at Fort Belvoir, Va.

Army researchers point out that integrating these sensor components and image-processing algorithms will require careful management of the engineering design trades for each sensor component.

The Army wants to develop an electro-optical, dual-use sensor to protect aircraft from missile attacks, as well as to provide situational awareness.

Specifically, Army researchers are looking for 2,048-by-2,048-pixel medium-wave and long-wave infrared focal plane arrays with pixels smaller than 12 microns. These sensors should have high quantum efficiency, low dark current, and low spatial and spectral pixel crosstalk.

The readout circuit is to match the focal plane array format, with high injection efficiency, low noise, low power dissipation, true full well capacity greater than 8e7 electrons, 18 bits of dynamic range, and non-linearity smaller than 0.1 percent. The ROIC should be linear through the whole dynamic range, and not involve logarithmic compression.

Researchers are considering only off-the-shelf solutions, as no development funding is available.

McKinney, Texas, for MQ-1 and MQ-9 support. The job involves establishing a dedicated software team to develop, field, and sustain the Medium Altitude Long Endurance Tactical Multi-Spectral Targeting Systems software line.

L-3 to provide electro-optical submarine sensor systems

U.S. Navy undersea warfare experts are ordering additional non-penetrating, electro-optical sensor submarine masts from L-3 KEO in Northampton, Mass., for Virginia-class fast-attack submarines, and for other kinds of modern submarines without traditional periscope wells. Officials of the Naval Sea Systems Command in Washington announced a $14.5 million order to L-3 KEO (formerly Kollmorgen) to provide an undisclosed number Universal Modular Mast (UMM) systems for Navy submarines. L-3 acquired Kollmorgen in 2012. The Virginia-class is one of the first submarines without a traditional optical periscope that penetrates the vessel's pressure hull and extends upward to enable commanders of submerged submarines to view the scene on the surface. The UMM serves as a lifting mechanism for five different sensors, including the photonics mast program, high-data-rate mast, multifunctional mast, multifunctional modular mast, and integrated electronics support measures mast.

PRODUCT applications

SHIPBOARD NETWORKING

Navy chooses rugged shipboard networking and communications gear from RuggedCom

U.S. Navy shipboard electronics experts needed spare parts to support shipboard networking, communications, and land-based test sites. They found their solution from Siemens RuggedCom in Concord, Ontario.

Officials of the Naval Surface Warfare Center Philadelphia division in Philadelphia have announced plans to award a one-year contract to Siemens RuggedCom in Concord, Ontario, for various parts to support hull, mechanical & electrical (HM&E) networks and land-based test sites (LBTS).

Only RuggedCom parts meet Navy requirements, officials say, and Navy shipboard electronics experts need the RuggedCom parts to ensure compatibility and conformity with existing systems and programs. The value of the upcoming contract to RuggedCom has yet to be negotiated, and it will include options for two additional years. Siemens acquired RuggedCom in 2012.

RuggedCom offers a variety of communications subsystems suitable for shipboard electronics, including rugged Layer 2 and Layer 3 Ethernet switches; routers; media converters; secure products to extend IP networks over long distances to fixed and mobile users; serial-to-Ethernet servers; modems; power over Ethernet injectors; and support software.

The company's Ethernet switches are suitable for mission-critical, real-time control applications, while the RuggedCom M-Line family of rugged Ethernet switches is suited for Navy, Army, and Air Force applications.

RuggedCom products offer extreme temperature range, zero-packet-loss technology for immunity to high levels of electromagnetic interference, and enhanced rapid spanning tree protocol for high-speed network fault recovery.

The company provides products for mission-critical networks used in substation automation, self-healing power grids or smart grid systems, intelligent transportation systems for traffic management and railway control systems, as well as in industrial process control and manufacturing automation systems. ←

MACHINE INTELLIGENCE

ASSETT to apply machine autonomy to Navy submarine combat systems

U.S. Navy shipboard electronics experts need machine autonomy and artificial intelligence technology to improve effectiveness and reduce personnel requirements of surface ship and submarine combat systems. They found their solution from ASSETT Inc. in Manassas, Va.

Officials of the Naval Sea Systems Command in Washington announced plans to award a follow-on research contract to ASSETT for the Navy's Combat Systems of the Future (CSoF) project. The value of the contract has yet to be negotiated.

ASSETT engineers will develop an improved combat system that incorporates autonomous and remote vehicle command and control for to Navy submarines, surface ships, and aircraft.

ASSETT will provide cognitive engineering, systems engineering, modeling, simulation, software development, as well as hardware engineering, manufacturing, and support. The upcoming Small Business Innovative Research (SBIR) phase-3 contract has one base year and four one-year options.

ASSETT will capitalize on service-oriented architecture software design and artificial intelligence to design, test, and deploy technologies for the Navy's AN/BYG-1 submarine tactical control system.

The AN/BYG-1 handles weapons control aboard Navy Los Angeles-, Seawolf-, and Virginia-class fast-attack submarines, Ohio-class cruise missile submarines, the Australian Collins-class attack submarine, and the future Columbia-class ballistic missile submarine, which will replace existing Ohio-class ballistic missile submarines.

AN/BYG-1 improvements should help these submarines respond to new and emerging threats and use evolving technology for enhancements to Seal Delivery Vehicle (SDV) control displays; integrated bridge technology; command and control; and decision aids.

ASSETT, which is short for Advanced Systems/Supportability Engineering Technologies & Tools, won its original $14.6 million CSoF SBIR phase-3 contract in July 2010, and won an $11.4 million modification to that contract in December 2011.

The company's original CSoF work involved reduced shipboard manning requirements without compromising vessel safety and performance. Subsequent CSoF work involved operator cognition, automation, data fusion, processing, technology evolution, and combat systems technologies for Navy submarines, surface ships, and aircraft.

FOR MORE INFORMATION visit **ASSETT** online at *http://assett.net*, or **Naval Sea Systems Command** at *www.navsea.navy.mil*.

SOFTWARE TOOLS

Mercury chooses software tool from Jama to track system requirements

Software designers at embedded computing expert Mercury Systems in Chelmsford, Mass., needed an updated software engineering tool for tracking system requirements. They found their solution from Jama Software in Portland, Ore.

Mercury Systems, which designs and manufactures high-performance digital signal and image processing systems for defense and commercial applications, chose the

Jama 8.10 software-development tool to replace the IBM Rational DOORS project that Mercury had been using.

Mercury experts found the IBM Rational DOORS software tool to be costly to manage and did not deliver necessary reporting capabilities, particularly as the company prepares to comply with AS9100, a new aerospace quality standard that requires complete traceability of product requirements, Jama officials say.

Mercury explored several options to upgrade its product development process and ultimately chose the Jama solution because of its reporting capabilities, its ease of use, and its clean Web-based interface, Jama officials say.

A typical Mercury product involves 1,200 to 1,500 requirements, and Mercury manages all of them in Jama. As many as 300 engineers use the Jama Review Center regularly to share product requirements, iterate on specifications and confirm mutually agreed-upon requirements.

"You can attach comments to reviews and this makes for a quick, dynamic review cycle," says Joe Plunkett, Mercury's director of systems engineering. "We can collect feedback earlier, and this allows more people to add value."

Jama has made Mercury's development process more efficient, and engineers no longer sit in marathon sessions going over documents line by line, then frantically merging changes, Jama officials say. Now they can easily manage all revisions, even if the project scope is modified daily.

"We're working with a defense contractor on a multibillion-dollar project," Plunkett says. "They needed to generate reports and show traceability, so I sat down with the client and showed him how easy it is with Jama. He was stunned that something that took him hours to do could be accomplished in a few seconds with Jama." ←

FOR MORE INFORMATION visit **Jama Software** online at *www.jamasoftware.com*, or **Mercury Systems** at *www.mrcy.com*.

new PRODUCTS

To submit new products for consideration, contact John Keller at jkeller@pennwell.com.

CONNECTORS

TE introduces mil-spec circular composite connectors for military and commercial avionics

TE Connectivity in Harrisburg, Pa., is introducing the company's next-generation ACT mil-spec circular composite connectors for military and commercial avionics applications. The ACT series circular connectors, which are part of the

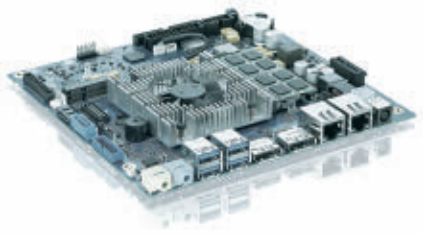
TE DEUTSCH MIL-DTL-38999 series, offer composite shells providing as much as 40 percent weight savings over aluminum connectors. The ACT series composite shells are light weight, resist corrosion, and offer 1,500 mating cycles. The ACT series composite connectors offer 3 shell styles, 6 shell clockings, 2 platings and more than 50 different insert arrangements supporting size 22, 20, 16, and 12 contacts for power and signal systems, as well as coax and twinax contacts.

FOR MORE INFORMATION visit **TE Connectivity** online at *www.te.com*.

POWER ELECTRONICS

SSPC power devices for military vehicles and harsh environments introduced by DDC

Data Device Corp. (DDC) in Bohemia, N.Y., is introducing the RP-20011601S0 35-amp, 28-volt, single-channel remote solid-state power controller (SSPC) module



for military vehicles and other harsh-environment applications. The power electronics device offers advanced programmability, power optimization, and system health diagnostic and prognostic data in a compact and reliable module. The programmable remote power controller can be configured for a wide range of power requirements for advanced electrical management systems, as demonstrated by its selection for use on the Joint Light Tactical Vehicle (JLTV). These SSPC modules help extend mission range and longevity, minimize inventory requirements, and enable system designers to efficiently add additional power controllers in support of evolving load requirements, DDC officials say. Benefits of DDC's SSPCs include smart power control; reduced size, weight, power consumption, and cost (SWaP-C); and increased reliability.

FOR MORE INFORMATION visit **DDC** online at *www.ddc-web.com*.

EMBEDDED COMPUTING

Rugged Mini-ITX motherboard for industrial automation applications introduced by Kontron

Kontron in Poway, Calif., is introducing the rugged mITX-APL thin Mini-ITX motherboard with Intel Atom E39xx and Celeron N3350 microprocessors based on the Intel Apollo Lake processor for industrial automation, medical technology, digital signage, and similar harsh-environment applications. The efficient mITX-APL boards deliver improved performance and extended functionality, and offer low power consumption and low installation height of 2.5 centimeters. The Kontron mITX-APL embedded motherboard offers improved graphics and processing performance, with power consumption of 6 to 12 watts. The mITX-APL includes LVDS 24-Bit Dual Channel and two Display Port 1.2 interfaces, a SO-DIMM DDR3L-1867 socket for as much as 8 gigabytes memory, a full-size mPCI Express slot, CAN

Bus, and eMMC support. To protect applications and licenses, the embedded board is equipped with a TPM 2.0 chip. It is available in two versions with an Intel Atom E39xx processor as well as a Celeron N3350 CPU. The mITX-APL board is part of the Kontron Security Solution Line. Applications are protected against unwanted access and make possible creating, managing, and tracking licenses. At the same time, privileges can be assigned and access levels defined.

FOR MORE INFORMATION visit **Kontron** online at *www.kontron.com*.

FPGAS

Low-power FPGA for military and commercial aviation introduced by Microsemi

Microsemi Corp. in Aliso Viejo, Calif., is introducing the PolarFire field programmable gate array (FPGA) product family for military and commercial aviation, industrial automation, cellular infrastructure, and Internet of Things (IoT) applications. The cost-optimized PolarFire

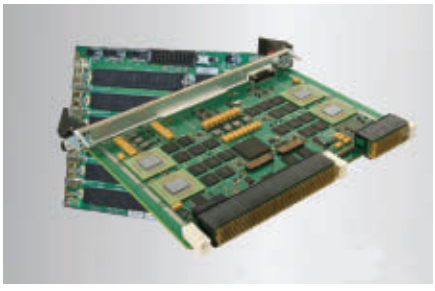
FPGAs delivering low power at mid-range densities with 12.7 gigabits per second serializer/deserializer (SerDes) transceivers as well as security and reliability. The devices are for defense and aerospace applications like encryption and root of trust, secure wireless communications, radar and electronic warfare (EW), aircraft networking, actuation, and control. The FPGA product family also addresses concerns over cybersecurity threats as well as reliability concerns that face deep submicron SRAM-based FPGAs as they relate to single event upsets in their configuration memory.

FOR MORE INFORMATION visit **Microsemi** online at *www.microsemi.com/products/fpga-soc/fpga/polarfire-fpga*.

BOARD PRODUCTS

Curtiss-Wright introduces Gen 4 PCI Express board with MultiGig RT2 VPX connectors

The Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va., is introducing the ability to meet the



increased bandwidth requirements of Gen 4 PCI Express embedded computing with standard MultiGig RT2 VPX connectors. This uses a new optimized design approach, extends the ability of the VPX and OpenVPX (VITA 65) standards to support the full bandwidth and signal integrity required when transferring 16-gigabaud PCI Express 4.0 data communications signals over the backplane. Curtiss-Wright plans to support Gen 4 PCI Express using standard VPX connectors on its Fabric64 family of modules and systems.

FOR MORE INFORMATION visit **Curtiss-Wright Defense Solutions** online at *www.curtisswrightds.com*.

SINGLE-BOARD COMPUTERS

Rugged 3U OpenVPX single-board computer introduced by Abaco

Abaco Systems in Huntsville, Ala., is introducing the SBC329 rugged 3U OpenVPX single-board computer as a drop-in replacement for existing users of Abaco's mission-ready embedded computing systems for demanding applications to be deployed in harsh constrained environments. The SBC329 offers a 10 percent performance improvement over its predecessors. It is based on the latest 7th generation Intel Core technology (codenamed "Kaby Lake"). The SBC329 is available in two variants that are pin-compatible with previous versions. For applications prioritizing throughput and performance, the SBC329 is configurable with the Intel Xeon E3-1505M V6 processor operating at 3 GHz. For applications prioritizing minimal

power consumption and heat dissipation, the Intel Xeon E3-1505L operating at 2.2 GHz is available.

FOR MORE INFORMATION visit **Abaco Systems** online at *www.abaco.com*.

SAFETY-CRITICAL COMPUTING

Safety-critical embedded computing for avionics and mission computers introduced by Mercury

Mercury Systems Inc. in Chelmsford, Mass., is introducing the Mercury Mission Systems (MMS) safety-qualified embedded computing product line for safety-critical solutions for mission computers, avionics, and platform management in defense and commercial aerospace applications. MMS products feature design assurance and supporting software designed to reduce integration time and effort. The product line includes solutions from the former Creative Electronic Systems, S.A. (CES) in Geneva, acquired by Mercury last November. MMS products are designed to the DAL-A, DO-254, and DO-178 safety-critical standards and

are for primary flight control units, flight test computers, mission computers, command and control processors, graphics and video processing, and avionics-certified Ethernet and I/O. MMS products includes a DAL-certifiable bootloader and test and health monitoring software. Mercury also provides equipment configuration software tools to help designers assemble complex multi-

processor and multi-FPGA systems where a fast-loading mechanism and reliable version control of all software elements are required.

FOR MORE INFORMATION visit **Mercury Systems** online at *www.mrcy.com*.

RF AND MICROWAVE

RF and microwave Schottky detector diodes introduced by SemiGen

RF and microwave specialist SemiGen Inc. in Manchester, N.H., is introducing the SZB900 series of zero bias Schottky detector diodes for video detectors and power monitors. These Schottky detector diodes can eliminate the need for external DC biasing. They feature low junction capacitances, high voltage sensitivity, uniform video resistances, and high sensitivity, all without external bias circuitry. With forward voltage drops of 0.3 volts and superior tangential signal sensitivity

(TSS), these diodes are for use in waveguide, coaxial, and stripline RF and microwave applications through K-band. With an operating temperature from -55 to 150 degrees Celsius and power dissipation of 100 milliwatts, these diodes come in chip, glass, ceramic, and beam lead packages.

FOR MORE INFORMATION visit **SemiGen** online at *www.semigen.net*.

MEZZANIN E BOARDS

NXP QorIQ T2081-based mezzanine board for security introduced by X-ES

Extreme Engineering Solutions (X-ES) in Middleton, Wis., is introducing the XPedite6101 NXP QorIQ T2081 processor-based embedded computing mezzanine board to support secure booting for military and avionics applications requiring enhanced levels of security. The XPedite6101 comes with the Wind River VxWorks 653 3.0 multi-core edition certification-ready

multi-core operating system environment. In addition to being ARINC 653-compliant, this solution is integrated with Wind River's Information Assurance Framework (IAF). The Wind River VxWorks 653 software enables avionics vendors and hosted-function suppliers to develop and deploy several applications independently on one multi-core hardware system to support avionics safety standards, X-ES officials say.

FOR MORE INFORMATION visit **X-ES** online at *www.xes-inc.com*.

GRAPHICS PROCESSING

Rugged 3U VPX H.265 video encoder for harsh environments introduced by EIZO

EIZO Rugged Solutions Inc. in Altamonte, Springs, Fla., is introducing the Condor VPX-H265-SDI rugged 3U VPX H.265 high-efficiency video encoding (HEVC) audio and video encoder for harsh environments such as manned

and unmanned airborne applications where low-latency encoding, streaming and low power consumption are essential. The Condor VPX-H265-SDI from EIZO Rugged Solutions (formerly Tech Source Inc.) features dual 3G-SDI inputs and support for cursor on target (CoT), key length value (KLV), and vertical ancillary data (VANC) metadata insertion. The Condor VPX-H265-SDI is a 3U VPX (1-inch pitch) H.265

(HEVC) or H.264 video encoding and streaming solution designed that encodes and streams two 3G-SDI, HD-SDI, or SD-SDI inputs simultaneously using the video coding standard H.265 (HEVC) which provides increased video quality and a 50 percent reduction in bitrate compared to H.264.

FOR MORE INFORMATION visit **EIZO Rugged Solutions** online at *www.eizorugged.com*.

CONNECTORS

Connectors for high-risk applications like fuel systems introduced by TE Connectivity

TE Connectivity in Harrisburg, Pa., is introducing the DEUTSCH autosport hermetic fuel tank connector range for very high-risk applications like fuel and pressure systems.

The connectors come with an aluminum shell designed to go into the wall of a fuel cell with a glass seal to stop any fuel escaping up the wiring loom. It replaces standard stainless steel materials with aluminum to achieve a 60 percent weight savings. The DEUTSCH autosport hermetic fuel tank connector was designed originally for the professional auto racing industry.

FOR MORE INFORMATION visit **TE Connectivity** online at *www.te.com*.

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