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Lockheed Martin developing high-power microwave weapons to destroy enemy drones. PAGE 4

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Commercially developed computer, display, and networking technology plays pivotal role simulation, training, and mission-rehearsal. PAGE 10

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COVER STORY

BY **JOHN KELLER**, EDITOR IN CHIEF

In a nick of time: military researchers get serious about Mach 5 hypersonic weapons

It's been apparent for a while now that Russia and China have stolen a march on U.S. military technology developers when it comes to the science of hypersonic weapons. Now the U.S. military has awakened from its slumber and is pursuing hypersonics with a vengeance.

The urgency with which military researchers are diving into hypersonic weapons technology indicates how much and for how long that military leaders have stood-by in hypersonics development — particularly in anti-ship missiles — while traditional adversaries have pushed forward quickly.

Hypersonic munitions are unlike any other weapon, in that they can move at Mach 5, or even faster. The central issue here is warning time. A missile traveling at five times the speed of sound is going about 3,800 miles per hour.

That's more than a mile per second. Target a ship at sea with such a hypersonic missile, that ship's crew has less than two minutes to detect, identify, and track the incoming missile, and then bring defensive weapons to bear and fire.

I first started to notice about two or three years ago when I read about reported Russian and Chinese test flights of hypersonic weapons. In March 2016 officials of the Russian navy announced they had begun testing the hypersonic Zircon anti-ship cruise missiles, which are expected to reach five or six times the speed of sound. These tests indicated that the Russian military was well along in developing hypersonic missiles.

A month later, in April 2016, China reportedly flight-tested a new high-speed maneuvering warhead just days after Russia carried out its own hypersonic glider test. Many of these maneuvering warheads essentially render ballistic missile — and traditional ballistic missile defenses — obsolete.

Around this time U.S. military officials were reporting progress on the Navy Lockheed Martin Long Range Anti-Ship Missile (LRASM), with barely a peep about hypersonics. But the LRASM is just no match for a hypersonic missile.

Viewed in these terms, hypersonic munitions are the weapons of the future, and it's clear that the U.S. military was caught with its pants down regarding this crucial future technology.

Now the Pentagon is making up for lost time, partnering with Lockheed Martin Corp. Earlier this month the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., awarded the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., a potential $480 million contract for Air-Launched Rapid Response Weapon (ARRW) critical design review and test and production readiness support.

Air Force officials say they want to achieve a capable weapon by 2021. The Air Force first awarded Lockheed Martin a contract last April to develop a prototype hypersonic cruise missile, the Hypersonic Conventional Strike Weapon (HCSW).

To be fair, U.S. military hypersonic weapons research didn't just start with the two contracts to Lockheed Martin this year. As far back as 2008 — perhaps even farther back — the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., and the U.S. Air Force were working on the Black Swift project to develop a hypersonic aircraft.

In early 2015 the Air Force Research Laboratory Munitions Directorate at Eglin Air Force Base announced the High-Speed Strike Weapon (HSSW) program to develop a hypersonic munition able to attack and destroy targets quickly over long distances, and pose lethal threats to many different targets in many different locations all at the same time.

In June 2016 DARPA launched the Advanced Full Range Engine (AFRE) project to develop a full-scale reusable propulsion system for future hypersonic aircraft and missiles that can fly at least five times the speed of sound. The AFRE project started bearing fruit in September 2017 with a $21.4 million DARPA contract to Orbital ATK Inc. in Elkton, Md.

All this comes in a nick of time. Some of the world's first hypersonic weapons are expected to deploy as early as 2021. ←

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news

BAE Systems starts moving Compass Call EW system to Gulfstream business jet

BAE Systems said it started work switching its Compass Call electronic warfare system from the Lockheed EC-130H to a modified Gulfstream G550, an EC-37B aircraft. Gulfstream Aerospace is in the process of removing unneeded commercial components from a G550 business jet in Savannah, Ga. Officials of the BAE Systems Electronics Systems segment in Nashua, N.H., say they anticipate the first two aircraft to be fielded with the new electronic warfare (EW) gear in 2023. BAE Systems has been keen to emphasize that the EC-37B aircraft will weigh 50 percent less and cost 50 percent less to operate. The aircraft also flies higher, faster, and further than its Cold War predecessor.

How the B-1 bomber could sink an aircraft carrier — and anything else at sea

The U.S. Air Force's 28th Bomb Wing at Ellsworth Air Force Base, S.D., could become the first Rockwell International B-1B jet bomber unit to receive the Lockheed Martin AGM-158C long range anti-ship missile (LRASM). Crews at the base started to train on the new weapon in July. The addition of the AGM-158C would give the venerable B-1B a new maritime strike mission. "It's designed to specifically to go against ships and it increases the B-1's lethality and the range at which we can employ this," says Col. John Edwards, commanding officer of the 28th Bomb Wing. The B-1B is entering the last stage of its service life. The Air Force expects to retire its 66 B-1B and its 20 Northrop Grumman B-2A Spirit bombers in favor of the new Northrop Grumman B-21 Raider stealth bomber. The last B-1B will likely leave service by 2036 when *[PAGE 8]*

Lockheed Martin continues building shipboard undersea warfare systems

BY **John Keller**

WASHINGTON — Anti-submarine warfare (ASW) experts at Lockheed Martin Corp. will continue developing, integrating, and building the U.S. Navy AN/SQQ-89A(V)15 shipboard undersea warfare systems for surface warships under terms of a $24.3 million order announced Friday.

Lockheed Martin Corp. continues to develop the U.S. Navy AN/SQQ-89A(V)15 shipboard undersea warfare systems for surface warships like the Arleigh Burke-class destroyer.

Officials of the Naval Sea Systems Command in Washington are asking the Lockheed Martin Rotary and Mission Systems segment in Manassas, Va., to support future advanced capability build and technical insertion baselines of the AN/SQQ-89A(V)15 undersea warfare combat systems.

The AN/SQQ-89A(V)15 is designed to search for, detect, classify, localize, and track underwater contacts, and to attack or avoid enemy submarines, floating, tethered, or bottom-attacked mines, and torpedoes.

The AN/SQQ-89A(V)15 uses active and passive sonar to enable Navy Arleigh Burke-class destroyers and Ticonderoga-class cruisers to detect, locate, track, and attack hostile submarines, mines, and torpedoes.

The system provides multi-sensor track correlation and target track management control, and forwards data to the ship's weapons and decision-support systems. The AN/SQQ-89A(V)15 works together with the ship's active and passive hull sonar, multi-function towed array, sonobuoy processing, torpedo alerts, fire-control system, sensor performance predictions, embedded operator, and team training systems.

The AN/SQQ-89A(V)15 has an open electronics architecture to accommodate system upgrades, and makes the most of data accessibility and system modules, Lockheed Martin officials say. Its software application programs are isolated from hardware with open middleware to render applications processor-independent.

The system today uses POSIX-compliant system calls and Motif and X-compliant display service calls. Symmetric multi-processors (SMPs) using Linux-based processing handle signal, data, display, and interface processing.

Virtual Network Computing (VNC) enables rapid re-allocation of operator console displays to suit the *[PAGE 6]*

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[FROM PAGE 4] tactical situation, Lockheed Martin officials say.

Recent and planned upgrades to the AN/SQQ-89A(V)15 include improved automated torpedo detection, sonar performance prediction, advanced active sonar processing, re-designed active displays to reduce operator loading, and integrated training and logistics.

The AN/SQQ-89 is integrated with the Aegis combat system, vertical launch anti-submarine rocket (ASROC) system. A variant of the AN/SQQ-89A(V)15 is integrated with late-version Aegis combat systems being installed onboard new Arleigh Burke-class destroyers. A back-fit program is in place to retrofit existing DDG-51 class ships and Ticonderoga-class cruisers.

On this contract modification Lockheed Martin will do the work in Lemont Furnace, Pa.; Syracuse, Owego, and Hauppauge, N.Y.; Manassas, Va.; Clearwater, Fla.; and Tewksbury, Mass., and should be finished by May 2019. ←

For more information contact ***Lockheed Martin Rotary and Mission Systems*** *online at* www.lockheedmartin.com, *or* ***Naval Sea Systems Command*** *at* www.navsea.navy.mil.

Lockheed Martin to develop high-power microwave weapons to destroy or disable enemy drones

BY **John Keller**

ADELPHI, Md. — U.S. Army unmanned weapons experts are negotiating with Lockheed Martin Corp. to develop high-power microwave (HPM) weapons payloads to enable new generations of unmanned aerial vehicles (UAVs) to destroy or disable enemy drones.

Officials of the Adelphi contracting division of the Army Contracting Command at Aberdeen Proving Ground, Md., announced plans in August to negotiate sole-source with the Lockheed Martin Missiles and Fire Control division in Grand Prairie, Texas, on an HPM UAV weapons project.

The Army is looking for unmanned aerial vehicle weapons payloads to help bring down enemy drones.

Lockheed Martin engineers will develop high-powered-microwave airborne counter-unmanned aircraft systems (CUAS), including the necessary development, integration, and support necessary to field HPM weapons-equipped UAVs.

Army leaders want Lockheed Martin to develop HPM weapons and similar kinds of UAV weapons payloads able to disable or destroy adversary UAVs. Weapons payloads for UAVs under consideration include explosives, nets, entanglers, streamers, and high-powered-microwave systems.

High-power microwaves represent a class of non-lethal weapons designed to destroy or disable enemy electronic systems with jolts of powerful electrical energy. It can fry electronics in much the same way as the electromagnetic pulse (EMP) from a nuclear detonation can disrupt electronics. [PAGE 8]

[FROM PAGE 4] Air Force strategic bomber fleet will consist of the B-21 and long-serving Boeing B-52.

New avionics in Tu-22 Backfire bomber make it a nightmare for U.S. aircraft carriers

Russia's long-awaited upgrade to the Tupolev Tu-22M Backfire jet bomber, the Tu-22M3M, rolled out last month and bring with it an anti-ship missile that's a nightmare for the U.S. Navy to defend against. A contemporary of the U.S. B-1B Lancer bomber, the Tu-22 M3M is a variable-sweep-wing supersonic bomber first introduced into service with the Soviet Air Force and Soviet Naval Aviation in the 1970s. Aircraft upgrades will include modern avionics, digital radio-navigation equipment, a new communications suite, and a new updated weapon-control system to enable the aircraft to launch precision-guided air-to-surface weapons including air-launched ballistic missiles and long-range anti-ship missiles.

Air Force eyes drone swarms, cloud computing, and artificial intelligence (AI)

Some of the most iconic weapons of the past 17 years are quickly becoming a relic. The Air Force is rushing toward a mix of almost-ready and yet-to-be-developed technologies, including artificial intelligence (AI), cloud computing, hypersonics, drone swarms, and clouds of tiny cubesats capable of sucking up data and beaming it back down to operators the ground in real time. After running red team exercises looking at what some of the biggest future challenges might be for the Air Force, leaders concluded that the Predator and Global Hawk unmanned aerial vehicles (UAVs) of today are not far away from becoming mere museum pieces. Not only does the Air Force want to get its people away from staring at computer screens to recognize, interpret, and identify what they're seeing, but also seeks to develop processing and exploitation at the sensor. ←

[FROM PAGE 6] High-power microwaves could destroy or disrupt an enemy UAV by destroying its antennas, data links, guidance, and communications subsystems, as well as blinding the enemy UAV's RF and electro-optical sensors.

Army officials say Lockheed Martin is the only responsible source able to develop HPM-based UAV weapons payloads to the Army's specifications. ←

More information is online at https://www.fbo.gov/notices/38c66baa9b53a9d12eb840eaebe56955. *Also contact* ***Lockheed Martin Missiles and Fire Control*** *at* https://www.lockheedmartin.com/en-us/who-we-are/business-areas/missiles-and-fire-control.html.

General Dynamics names nine suppliers for $3.9 billion CHS-5 COTS rugged computers project

BY **John Keller**

FAIRFAX, Va. — General Dynamics Missions Systems in Fairfax, Va., has named nine rugged computer companies as partners in the U.S. Army-General Dynamics $3.9 billion five-year Common Hardware Systems 5th Generation (CHS-5) project to provide U.S. warfighters with rugged commercial off-the-shelf (COTS) computers and networking equipment modified for military operations.

Officials of the U.S. Army Contracting Command at Aberdeen Proving Ground, Md., announced a $3.9 billion

General Dynamics is working with nine suppliers to provide the U.S. Army with rugged commercial off-the-shelf (COTS) computers and networking equipment modified for military operations.

five-year contract to General Dynamics in early August for the CHS-5 project to provide the U.S. military with rapid and affordable access to COTS computers and network equipment modified for military operations.

General Dynamics partners will supply a variety of ruggedized portable computers, laptop computers, tablet computers, printers, networking equipment, and other ruggedized electronics to help fulfill General Dynamics contractual obligations to the Army.

There are nine rugged computer equipment manufacturers considered to be most important for the General Dynamics CHS-5 program. More companies may be named later. The General Dynamics CHS-5 partner contractors are:

- Cisco Systems in San Jose, Calif.;
- Dell in Round Rock, Texas;
- DRS Land Electronics in Melbourne, Fla.;
- Hewlett Packard Enterprise (HPE) in Palo Alto, Calif.;
- Hewlett Packard Inc. in Palo Alto, Calif.;
- Intellipower Inc. in Orange, Calif.;
- Miltope Corp. in Hope Hull, Ala.;
- NetApp in Sunnyvale, Calif.; and
- RITEC Inc. in Simi Valley, Calif.

CHS is to be a one-stop-shop for tactical information technology (IT) hardware solutions supporting more than 120 Army and U.S. Department of Defense (DOD) program offices, including the Navy and the Marine Corps.

The program involves the rapid acquisition and delivery of COTS IT hardware and services. About 75,000 to 100,000 pieces of hardware are acquired through the contract from General Dynamics and its partners, which includes dozens of small and large businesses, General Dynamics officials say.

The project seeks to put the most advanced and up-to-date COTS computer hardware and software into the hands of U.S. warfighters and other government computer users. The idea is to buy in quantity to keep costs as low as possible, while acquiring the most advanced technologies.

CHS is to provide state-of-the-art computing and networking equipment that improves connectivity, interoperability, logistics, and maintenance support to Soldiers. The goal is to reduce procurement and fielding time without compromising quality. ←

For more information on the CHS-5 contract contact ***General Dynamics Mission Systems*** *online at* https://gdmissionsystems.com, *or the* ***Army Contracting Command at Aberdeen Proving Ground*** *at* http://acc.army.mil/contractingcenters/acc-apg.

THE INCREASING ROLE OF COTS IN HIGH-FIDELITY SIMULATION

The best commercial off-the-shelf (COTS) computer, display, and networking technology that industry has to offer is playing a pivotal role in today's cutting-edge simulation, training, and mission-rehearsal systems.

BY **J.R. Wilson**

Each new generation of warfighter grows up with the latest commercial technology, which the military increasingly adopts to enhance mission readiness, capabilities, and even lethality.

The first military personnel to use mechanical, non-fieldable devices for training were aircraft pilots. From crude, stationary and often not especially realistic small boxes in which pilot trainees learned the location and function of primary controls, dials, and gauges to the full-motion, high-fidelity flight trainers of the 1990s took about half a century, and had to overcome contentions of veteran pilots that the only way to learn to fly aircraft was to fly the actual aircraft.

As fighters, bombers, helicopters, and other military aircraft became more complex, however, the aviation elements of the armed services came to rely ever-more on huge computer- and power-hungry flight simulators. But they were too large, complex and expensive to send forward for mission rehearsal, which still relied on limited numbers of expensive real aircraft flying in controlled airspace that rarely bore much resemblance to where the mission would be flown.

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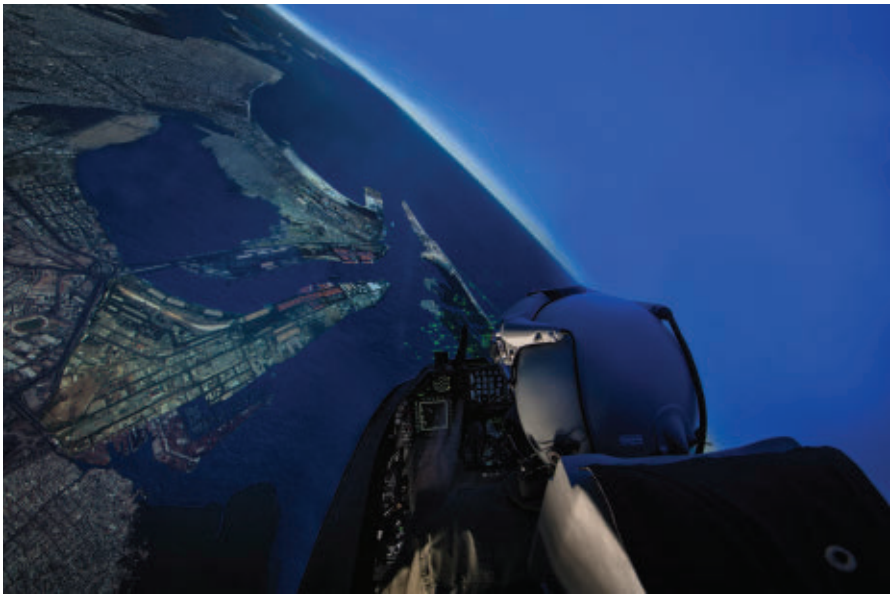
In the 21st Century, civilian gaming industry advances in virtual and augmented reality (VR and AR), increasingly smaller and more powerful computers, highly advanced displays and graphics (including helmet-mounted displays and goggles) are making it possible to conduct very realistic mission rehearsal and training aboard ships or at military bases anywhere in the world. The same is becoming true for operating and maintaining battle tanks, surface warships and other military platforms.



An unidentified L3 Link customer trains using an F-16 in a high-fidelity tactical environment.

Generational resistance also has dropped sharply, as today's senior officers and noncoms were the first generation of tech-savvy junior officers and enlisted personnel in the 1990s and early 2000s.

Simulation, training, and mission rehearsal "all are all threads of the same thing — building proficiency in people. My team provides ready forces for the fleet, men and women who can do the jobs. We utilize various simulation technologies to create environments for training that are a collection

of activities that allow them to gain skills," says Capt. Erik Etz, commanding officer of the U.S. Naval Air Warfare Center Training Systems Division (NAWCTSD) in Orlando, Fla.

Regimen of instruction

"It's usually not just one device that satisfies that need, but a regimen from classroom instruction to full mission simulators. Most of our Navy and Marine aviators need far more complex skills to operate our aircraft and weapons systems than they did just a few years ago. We can't fly more to train on those, based on funding or life of the airframe, so the game-changer is to provide more capability in the simulator to rehearse those skills over and over, so when you do get flight time, you aren't fumbling with the basics but dealing at the high end."

That also is true for the U.S. Army, notes Matt Clarke, Director of the Army Simulation & Training Technology Center (STTC) in Orlando, Fla.

"Internally, we have worked on the Augmented Reality Sandtable (AReS) ... [which] is more mission command, the ability to project. We have interactive terrain projected onto sand, which students can shape based on digital inputs from

The CAE 700MR series flight training device is designed for military helicopter flight and mission training, and features an extreme field-of-view visual system to provide a realistic and immersive training environment.

the terrain program for height, vegetation, etc. They can manipulate it to represent a lake or river. You can emulate forces or tactical units via symbols or actual model tanks, in a 2D or 3D rendering," Clarke says.

"We are integrating the AR part of that and looking at future capabilities to get the 3D representation and the immersion piece and make it even more distributed than it is today. 3D is critical to visually represent autonomous vehicles — ground or air — and their field-of-view or give a 3D representation of what an artillery fire solution might be, along with the electromagnetic [EM] spectrum."

Among the military contractors working to advance the technologies, capabilities and size, weight and power (SWaP) aspects of current and future simulators are CAE Defense & Security in Tampa, Fla., and L-3 Link Training and Simulation in Arlington, Texas.

CAE is a global training systems integrator whose programs include the Medium Support Helicopter Aircrew Training Facility (MSHATF) in the United Kingdom; the Brunei Multi-Purpose Training Centre (MPTC); the Operational Training Systems Provider (OTSP) for Canada's fleets of CC-130J and CH-147 aircraft; a simulation-based Naval Warfare Training System for the Swedish navy; Helicopter Flight Training Services for Germany's NH90 helicopter program; synthetic training for AgustaWestland helicopters, including the AW109, AW139, AW169, AW189 and naval variant of the NH90; a Tampa-based training center for U.S. Coast Guard and Reserve (and 20 international militaries) C-130H pilots, flight engineers, load masters, and maintenance technicians; Royal Australian Air Force (RAAF) C-130J aircrew training and the world's largest civil pilot training network, with more than 65 centers around the globe training more than 120,000 crew members annually.

Lt. Col. Jason Turner, 80th Operations Support commander, looks up during a maneuver in a mixed reality flight simulator at Sheppard Air Force Base, Texas

"Our programs are almost all integrated, with elements of live, virtual, and constructive training ... that leverage simulation-based technologies to be more effective and efficient," says CAE Group President Gene Colabatistto. "There are two sides to this — provision of the systems and actually running the training, which is what is becoming what the company is all about.

Enabling technologies

"There are three classes of enabling technologies involved, the first of which is a surprise we would not have predicted just five years ago. Defense organizations around the world want to invest more in the immersive nature of the simulator itself, with more and more visual acuity, which is both a hardware issue, with screens delivering higher and higher resolution, and to make sure the visual databases have both natural and manmade features at increasing levels of fidelity. Our customers continue to demand higher levels of fidelity in the visual part of the system – they want it to feel immersive. The second is end-things, like cockpit geometry and the functioning of the simulator itself. Five years ago, there was no switch, knob or control in the simulator that did not do what it actually does in the aircraft. Today, that has become a requirement," Calabatistto says.

"What's new is in this environment military aircraft do not fly alone, so when we build simulation systems, realistic training demands we have a lot of training entities in that sim, so you see other planes out the window. Those may be a pilot flying a real plane generated on the simulator screen or another simulator or a computer-generated aircraft. That is a requirement — more than 98 percent of all our simulators around the world are on networks and sharing data with other simulators. Distributed mission operations are no longer nice to have, but very much part of the training baseline."

Networking, in turn, has increased cyber security requirements, which are now key on all new systems.

"The third thing is we still train military pilots much as we have for many years, with a student pilot receiving instruction from a more experienced pilot, which will differ from student to

student. One of the challenges is to enforce standards so the instructor pilot has tools to help the student," Colabatistto continues.

The integration of big data analytics, using artificial intelligence (AI), into the training domain will take all the data coming off the simulator or live aircraft and give the instructor better information to evaluate the student pilot. The Air Force is talking about its new training paradigm that will result in a much more tailored training system that should move students through more quickly and reduce attrition.

With its acquisition of Link Simulation & Training and Thales Training & Simulation's civil aircraft simulation and training business, both in 2012, and Raytheon Training Devices and Training Services in 2000 (among numerous other acquisitions since the turn of the century), L-3 Link can trace its role in military simulators to before World War II. Today its systems include the F-22 Full Mission Trainer, B-2 Aircrew Training System, F/A-18 Tactical Operational Flight Trainers, F-16 Simulators, the U.S. Army's Aviation Combined Arms Tactical Trainer (AVCATT) and Predator Mission Aircrew Training System (PMATS) ground control station simulation units.

"The desire is to be able to train anywhere, anytime," says Lenny Genna, President of L-3 Technologies Defense Training Solutions. "When our warfighters go into the field, they want to do training and they need the equipment to allow that. They may not be able to take a full system, but we can provide a subset that comes close to the full system. Using the technologies we have today, we can do training in the field with other components in a secure fashion When you really want to mission rehearse, you're doing that with a large package; live virtual constructive — using real aircraft and VR simulators — allows you to do that.

High-fidelity displays

One of the biggest improvements in recent years involves high-fidelity, realistic displays. "Before, the computational power did not exist, the visual systems were very archaic, where today it is very high fidelity, so the realism and capability of the models is significantly higher," Genna says. "Another change is from what I call safety aflight, which is a valuable piece, but today only a small percentage of the training, which

predominantly is how to use the system most efficiently and incorporate changes reported from the field so those going in next will be much safer and more accurate in what they do."

The enabling technologies, for the current state of the art and next-generation systems, have seen tremendous advancement in this century — especially the last decade — with even greater changes anticipated in the decade to come.

"AI is certainly an enabling technology for visuals, which also can give you virtual humans and intelligent tutors. Cloud-based architecture supporting the point-of-need is critical, as are haptics and greater computer power," Genna says. "We're not brand specific, but want to swap out and integrate quickly. We need to reduce lags and latency, to give entity representation — not just individuals and where they are located, but also the number of entities required for a realistic training event. Today's first-person games are very closed scenarios, where the military training scenario can involve thousands of entities."

High-performance computers are essential for rendering convincing imagery in simulation and training devices. "You need the computing power to make them look and act the way they should," Genna continues. "Basically, what we need is a warehouse of computer power packed into a cigarette-case sized pack, which goes to SWaP. Each device has a different power requirement you can measure by the mission scenario. An average mission event of say 48 hours requires that much uninterrupted power during the mission, but you also have to do the follow-on piece and regenerate the next 48 without a significant lag or drop in performance.

Deployable simulation

"Weight is critical," Genna points out. "The average soldier today has potentially 400 pieces of kit that can be configured for him to carry, depending on the mission. So every time you add something, you are adding the proverbial last straw. Our systems could be helmet-mounted. The key to it all is balance. If you have weight without proper balance, you have a problem. More power, less size and less weight is where you want to go, but packaging is critical to get optimum performance — and it also has integrated to the soldier so it is usable over a long period of time."

Today's state-of-the-art flight simulators can send pilots into combat fully trained in and ready to respond to a wide range of mission scenarios. In reality, however, once deployed they tend to fly a limited number of mission types over and over for weeks or months at a time, during which their skills on those missions they are not flying — but may be called upon to begin at a moment's notice — deteriorate.

"Training occurs wherever you are, including operational environments, sometimes utilizing the operational platforms. But we need to train in a simulated environment, even in forward deployments, to improve skills," says NAWCTSD's Etz. "Once deployed, skills in a range of mission proficiencies may decrease without the ability to execute those using deployable trainers with low-cost tech — from computer-based, multiple screen platforms to advanced VR or AR.

Two U.S. Army Rotary-wing aviators conduct mission training in an L3 UH-60M.

COTS information technology

A wide variety of commercial off-the-shelf (COTS) computers and other information technology are available for today's leading-edge simulation and training systems. "The current state of the art for flight training utilizes the best-of-breed of commercially available IT systems, allowing us replicate aircraft functions in a virtual environment, including accurate representation of aerodynamic models and mission systems capabilities and the environments in which those aircraft operate," Etz says. "That has been one of the biggest improvements in the past 10 or 15 years. Visual and sensor

representations are far more capable today, with pilots not just seeing high-def versions of geography and clouds, sunlight, darkness, etc., but the EM spectrum that goes along with that to represent radar environments, for example, which are far more robust and more accurately represent the real world."

The ability to do highly realistic mission rehearsal in the field, altering aspects of the simulation in real time as new information becomes available, is considered critical to the U.S. military maintaining the technology and operational edge it has enjoyed for more than three decades — an edge that is now facing serious challenges from potential peer and near-peer adversaries.

"We're learning more and more that powerful simulation benefits training and MR," says the Army Simulation & Training Technology Center's Clarke. "Cost alone is one reason. The operating cost of driving a real tank a mile down the road is significant; you can get that kind of training in a simulator at a fraction of the cost. And you can recycle sims over and over again. High quality, AR-immersive simulation allows a commander to subject a soldier or a team to a scenario where the risk is much higher than they would ever do with live fire. You can simulate casualty care, noise and confusion, and visual impacts. You also can alter content, change the scenario."

One of the most high-level counter-terrorism operations in decades is a stark example. "Look at the raid on Osama bin Laden," Clarke says. "We knew very little about the interior of that building and they had a short time to train — and had to do it in the dark. Simulation would allow you to change the wall structure, add additional guards, so they know what to do under differing circumstances and broaden the training scenario in ways you couldn't do live. The virtual or AR environment will become more mainstream in our training — not just mission rehearsal, but a continuum from the institutional base to home station to deployed. Eventually, we will have intelligent tutors or avatars to train the soldier in the field on something they have not seen before in real-time."

Intelligent tutors

Intelligent AI tutors will be a key element of next-generation systems, observing a wider range of student actions and reactions than a human

instructor can handle in real time and reducing the assessment of a student's performance from a lengthy after-action analysis and report to real-time feedback while the training is still underway.

"Currently, when evaluating individual soldier or group performance in training, you have a team of people who spend a huge amount of time to understand if the trainee is meeting certain objectives," says Army STTC Deputy Director Ivan M. Martinez. "So there is a lot of effort on how to automate those so it can be done in real-time by the training system."

Those will be integrated into future systems that will replace the Army's current Close Combat Tactical Trainer (CCTT) and Aviation Combined Arms Tactical Trainer (AVCATT).

"CCTT and AVCATT are expensive, and maintenance and upgrade are costly," Martinez explains. "So the Army is moving away from heavy infrastructure, large simulation facilities, to a more streamlined, software-based capability where simulation is provided over the network to where the soldier is so he doesn't have to go to a fixed facility. And it is a more immersive, virtual system with some haptic components. We're currently in the transition period of moving into new technology to enable that vision, which includes the future of ground, air and dismounted soldier simulations and the integration of them all into a new training capability."

Psychological aspects

What is now considered a vital piece of training — and especially mission rehearsal — is stress. If the pilot knows nothing bad can happen in the simulator, the stress inherent is real-world combat will not be there to influence his or her reaction speeds and thought processes. That also applies to other platform and weapons training, from tanks and mortars to ships and submarines.

"There is a team of psychologists here at the Center looking at those issues. When we take a new technology out, we have a number of metrics we collect while doing that experiment — including how the stress affects the soldiers, from heart rate to pupil size, even saliva production," Martinez explains. "That group is trying to figure out when and how to put cues into the training to bring those responses from the soldier to ensure the training outcomes are met and the system

is optimized to trigger the types of responses we want when we need it to meet the training goals."

Thus creating immersive environments where those who fly or work on or maintain aircraft, ships, tanks, etc., can rehearse and optimize their skills, wherever they may be, is a major goal of next-generation simulation, training and mission rehearsal.

"We want to create a scenario that replicates the pressures of mission operations," he says. "That may include motion-based simulators with hi-fidelity visuals and accurate representations of cockpits. In others, we may not have full motion, but bladders that inflate or deflate to replicate G-forces. In others, wrap-around VR screens can create a sense of motion. And accurately creating a simulated X X X X helps bring up the stress level," Etz concludes.

"It is always a balance between technical solutions and the requirements of the humans in the loop, those being trained and the instructors. There is usually not just one answer to solve a training requirement and at each point in a spectrum of solutions there are people involved in the loop. We provide solutions that improve human performance through simulation, but where we really want to meet the needs of the fleet is to provide trained sailors to meet the requirements of their mission." ←

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The ASTA Group
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CAE Defense & Security
Tampa, Fla.
www.cae.com/defence-security/

Cubic Global Defense, a business division of Cubic Corp.
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www.cubic.com/solutions/training

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Meggitt Training Systems
Suwanee, Ga.
https://meggitttrainingsystems.com

Science Applications International Corp. (SAIC)
McLean, Va.
www.saic.com

Tru Simulation + Training, a Textron company
Tampa, Fla.
www.trusimulation.com

Data and networking push advances in embedded computing

An ever-increasing demand for intelligent, actionable data, combined with a boom in connected devices, is shaping how developers design the next generation of embedded computing systems.

BY **Michael Harris**

As the aerospace and defense systems employed across the land, sea and air become increasingly more sophisticated, it should come as no surprise that demands for data are growing at an exponential rate.

This data must be secure, reliable, and perhaps above all else, actionable — and as a result, technology developers must balance customer needs constantly with infrastructure constraints, safety certifiability and, increasingly, adherence to new standards set by the industry itself.

Mercury Systems says its "Air Flow-By" system provides more efficient cooling through carefully engineered air management.

The cockpit of tomorrow

Though the aircraft cockpits in many aircraft historically have relied on a hodgepodge of mechanical gauges to display information, flight decks quickly are transforming into sleek workstations filled with digital flat screens.

This "glass cockpit" approach enables operators to consolidate systems and access robust information in near real-time conditions, though it requires ample computing and data transfer capabilities.

"Whether it's a cockpit gauge, radar display, map, or some other thing that stood on its own and was its own self-contained system, all of those things are now being pulled over to one single pane of glass in the front of the cockpit," says Andrew McCoubrey, senior product manager for networking at Curtis-Wright Defense Solutions in Ashburn, Va.

The convergence of systems largely has relied on Gigabit Ethernet connections to this point, though the demands of processing and displaying data-intensive information like advanced radar and intelligence, surveillance and reconnaissance (ISR) applications is forcing developers to look toward even bigger avenues.

"What's going on under the hood in a lot of cases is that lots of discrete boxes are being pulled together into bigger boxes, or in some cases those boxes are just getting connected together and it's all, generally speaking, with networking technology," McCoubrey says. "We're able to use Gigabit Ethernet for the standard avionics stuff, but then 10-, 40- and 100-Gigabit Ethernet for big, bad radars and ISR-type systems."

Life in the cloud

The ability of an aircraft to provide its own computing likely will never change, though the complexity of the tasks being performed has, in some cases, outgrown the capabilities of on-board systems. This, coupled with the prospect of easily sharing data across an entire fleet, is driving development toward network-based systems.

"Everything is going toward the cloud," says John Bratton, product marketing director for sensor and mission processing at Mercury Systems in Andover, Mass. "It's the same thing for the defense industry. Everything is going to move to the cloud, including all battle and defense systems."

As Bratton describes it, the military

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would do well to emulate the commercial sector as it shifts toward cloud-based computing.

"We go back to when we were growing up, and all the cool stuff came out of defense spending," Bratton says. "If it was new and exciting, it probably came out of Department of Defense (DOD) spending or something like that. Over the past 20 years, that's completely changed. The DOD is using commercial technology because there's so much investment and it's moving so quickly.

"So, if the DOD wants to stay up-to-date with current and modern threats, it's got to be on the same roadmap. Since the commercial sector is going toward data centers and cloud processing, they've got to use the same technology to stay up-to-date and in front," Bratton says.

Such connectivity comes with risks to security, however, though they are those that engineers are working to address.

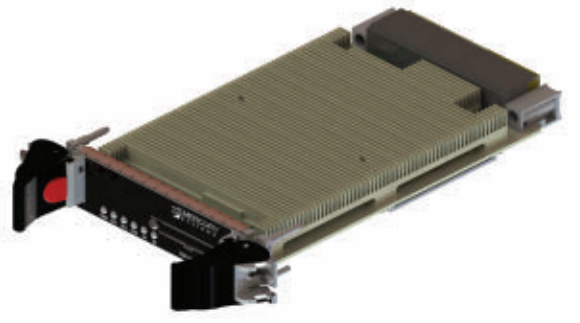
"The big theme in all of this is that as more stuff gets connected, the need for security is higher than it was when every electronic system on the aircraft was a stand-alone box with its own display that wasn't connected to anything," says Curtiss-Wright's McCoubrey. "But, safety critical practices are coming to the network as well, and that's driving our features and designs."

Let's get physical

Just as important as data handling and processing are the physical attributes related to bus, board and embedded computing design, generally defined in terms of size, weight and power, or SWaP.

Sometimes overlooked, however, is cooling, which has a direct impact on all other aspects of a unit's design.

"One thing that never seems to go away is thermal management," says Bratton. " As we get better and more efficient at making these devices, they get more and more powerful, which presents opportunities to make them more thermally efficient. So going forward, cooling remains a paramount concern. Good cooling means you burn less power, good cooling means that it weighs less because you've got less infrastructure to keep it cool, and good cooling generally means that the size is smaller as well."



Mercury Systems' EnssembleSeries LDS3517 is built on the 3U OpenVPX form factor, equipped Intel's Xeon D server-class processor and Xilinx UltraScale FPGA.

The VPX-150 is a COTS board manufactured by Curtis-Wright to meet DO-254 and DO-178 safety-certifiable requirements.

SWaP isn't the only concern related to cooling with an electrical unit's performance depending heavily on its ability to stay within given temperature parameters.

"If a device is rated for X-degrees and you can keep it X-degrees below that, you get magnitudes of increases in reliability," Bratton says. "If devices get too warm, they start throttling back, and as they start throttling back, they're not processing at the same number of Hz. When it's hot, they're also less of a conductor, so it's getting even hotter due to increased resistance."

Meeting military standards with commercial products

DO-254 and DO-178 standards, covering airborne electronic hardware and aircraft systems software, respectively, recently have found favor within the military as commercial-off-the-shelf (COTS) products become more prevalent.

The military's adoption of DO-254 and DO-178 standards has been advantageous for a number of manufacturers given they were already providing components for both military and civilian aerospace systems.

"Those two standards are all about making sure that the equipment doesn't do anything you don't want it to do," says Rick Hearn, senior product manager for Curtis-Wright's Safety Certifiable Solutions group. "So we've started to put together building blocks, with those being safety-certifiable processing cards. Using those building blocks, increasingly, customers are coming to us asking us to put those together into systems."

Commercial systems also are expected to meet international standards for safety certifiability, which has also become important for the military. A given unit's service history is also key, forcing developers to be

diligent in building products with reliable technologies.

"In our traditional COTS space, usually bigger, badder, and faster is where we want to go with the newest and greatest things," Hearn says. "But it's important to the Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA) that they need to see some level of service history, and having seen it in previous safety-certifiable systems gives them some sort of comfort level. So, what we're doing with our safety-certifiable building blocks is making sure that we're using tried and trusted parts."

COTS components offer several advantages to proprietary systems, with perhaps none so resonant amongst decision makers as cost reductions.

"There's been a directive amongst the service branches to take COTS more seriously," says Valerie Andrew, marketing manager at Elma Electronic Inc. in Fremont, Calif. "We need to figure out how to be able to use common

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www.acromag.com

ADL Embedded Solutions
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www.adl-usa.com

Aitech Defense Systems Inc.
Chatsworth, Calif.
http://www.rugged.com

Alligator Designs Pvt. Ltd
Bangalore, India
http://alligatordesigns.com

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Elma Electronic
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www.elma.com

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

General Micro Systems Inc. (GMS)
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www.gms4sbc.com

Gichner Shelter Systems
Dallastown, Pa.
www.gichner.us/index.html

Global Technical Systems (GTS)
Virginia Beach, Va.
http://gts.us.com

Kontron
Mira Mesa, Calif.
www.kontron.com

LCR Embedded Systems Inc.
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www.lcrembeddedsystems.com

Meggitt Defense Systems Inc.
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www.meggittdefense.com

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PCI Systems Ltd.
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Themis Computer
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United Electronic Industries (UEI)
Walpole, Mass.
www.ueidaq.com

Vadatech Inc.
Henderson, Nev.
www.vadatech.com

computing platforms across all three branches because they were all doing their separate things and therefore, the cost of doing this was staggering. It's not just cost savings, but also time savings, because if they're putting together their heads for development efforts, then everybody benefits from working together and driving the technology improvements that they can get from that, rather than each one doing their individual thing."

In addition to removing developmental redundancies, COTS systems also can help eliminate much of the process associated with safety certification.

"Until a couple of years ago when COTS vendors like us were offering safety-certifiable electronics, the customer had to build his own custom boards and then collect what they call 'data artifact packages' from scratch," says John Wranovics, director of public relations at Curtis-Wright. "These are thousands and thousands of pages long and take millions of dollars and years to assemble to meet the aviation agencies' requirements to prove that they're safe. But now, you can buy them as standard products with the data artifacts already provided."

Elma Electric's 12-slot 3U OpenVPX backplane addresses the Department of Defense's C4ISR Modular Open Suite of Standards (CMOSS).stilwell

Further cooperation through VPX

The growing importance of COTS products, coupled with an emerging reliance on cloud-based platforms, made the time ripe for a wide-ranging interoperability standard, giving rise to the OpenVPX framework.

The VPX community, composed of companies from around the aerospace and defense sector, advocates for several standardized technical parameters, including the adoption of 3U and 6U formats; 7-row high speed connectors rated to 6.25 gigabits per second; serial fabrics; PMC and XMC mezzanines; and hybrid backplanes capable of accommodating VME64, VXS, and VPX boards.

"OpenVPX is the de facto way of doing things — particularly in the defense industry," says Mercury's Bratton. "The reason being that it's a very small form factor architecture, and it's very rugged. And it's the ruggedness that's a big deal."

OpenVPX — like DO-254, DO-178 and safety certifiability — also is interest to the military. "It's something that's been picked up by all three branches of the military," says Elma's Andrew. "They realized they were doing parallel work, and would benefit from just combining their efforts and combining their efforts and doing it under one umbrella."

The growing role of UAVs

The technologies required to fly unmanned aerial vehicles (UAVs) follow many of the same trends seen elsewhere, though their ability to be piloted autonomously or remotely does add some difficulties.

"There's a large amount of sensing and processing," says Mercury's Bratton. "A lot of it is going to be done on the platform, but a lot of it is going to be fed to the cloud to manage the volume of data. They've also got to have two things intrinsically built into them. One of them is security, for the obvious reasons, and the other is safety. Most nations around the world won't allow anything to fly or operate on its own unless it can be flight- or battle-certified."

The volume of data required also adds challenges, given that it must be streamed from the craft for the purposes of monitoring and operation.

"If you've got someone piloting that aircraft who's piloting that over satellite link and they're streaming video or cockpit displays over that radio or satellite, then the wide-area network link that connects that UAV to the pilot becomes even more critical," says Curtiss-Wright's McCoubrey. "So, as you try and give that operator visibility through more cameras or more sensors or lower latency or whatever, the demands placed on your network inside that vehicle to get all those different data sources reliably onto that satellite link means your network's a lot more complicated than it used to be. In the unmanned space, getting a router that manages those data sources and fits them into a skinny satellite pipe with all the quality of service management is pretty important." ←

Northrop Grumman radar could mean big things for Marine Corps F/A-18C/D jets

The U.S. Marines hope to upgrade and retrofit roughly 100 F/A-18C/D aircraft with active electronically scanned array (AESA) radar systems as the service extends the operational life of its Hornet fleet before those jets are eventually replaced by Lockheed Martin's F-35 Joint Strike Fighter. Northrop Grumman has performed a fit check of its new AN/APG-83 Scalable Agile Beam Radar (SABR) on a Boeing F/A-18C Hornet strike fighter at the request of the U.S. Marine Corps on 2 Aug. The Marine Corps, which is the sole remaining operator of the classic Hornet in active U.S. military service, hopes to replace the mechanically-scanned Raytheon AN/AGP-73 radar with a new AESA radar. Northrop Grumman is competing with incumbent Raytheon, which is offering its AN/APG-79(V)X Raytheon Advanced Combat Radar (RACR). Both radars would offer improved performance, reliability, and sustainability.

GATR Technologies lands $522 million Army contract for inflatable satellite antennas

ATR Technologies Inc. in Huntsville, Ala., won a $522 million U.S. Army order on Friday for inflatable satellite antenna systems. These antennas are mobile, lightweight, and quick to set up in the field for on-the-spot satellite communications (SATCOM) the antennas look like giant rubber balls, and can survive and operate through several hits from small-arms fire. GATR's ground-mounted antennas have tiedowns to point them in the right direction. The antenna inside is reflective fabric. Fans keep the air pressure in the top half slightly higher than in the bottom half, pushing the fabric down into the right shape. ←

Lockheed Martin to upgrade electronic warfare (EW) systems on E-2D carrier aircraft

BY **John Keller**

PATUXENT RIVER NAS, Md. — Avionics experts at Lockheed Martin Corp. will upgrade electronic warfare (EW) systems aboard the U.S. Navy E-2D Advanced Hawkeye carrier-based airborne early warning aircraft under terms of a $64.7 million five-year contract.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Lockheed Martin Rotary and Mission Systems segment in Owego, N.Y., to upgrade the advanced digital receiver and processor (ADRP) and active front end (AFE) in the E-2D's AN/ALQ-217 electronic support measures (ESM) systems. Lockheed Martin will deliver 16 ESM ADRP upgrade kits.

Electronic support measures represent one branch of EW that detects, intercepts, identifies, locates, records, and analyzes radio signals for threat recognition and EW planning.

Electronic Support data can support signals intelligence (SIGINT), communications intelligence (COMINT) and electronics intelligence (ELINT) by passive listening to electromagnetic radiations of military interest.

The Navy Northrop Grumman E-2D is a tactical airborne early warning (AEW) aircraft designed to operate from aircraft carriers. The twin-engine turboprop aircraft has a distinctive saucer-like antenna, and provides the carrier battle group with wide-area radar surveillance for enemy monitoring and combat air traffic control.

The Lockheed Martin AN/ALQ-217 ESM system functions as the ears of the E-2D and other advanced tactical aircraft. As a passive sensor system, the AN/ALQ-217 identifies and locates sources of radio frequency (RF) emission.

Lockheed Martin is upgrading the advanced digital receiver and processor (ADRP) and active front end (AFE) in the U.S. Navy E-2D's AN/ALQ-217 electronic support measures (ESM) systems.

The AN/ALQ-217 uses an open-systems architecture and commercial off-the-shelf (COTS) processing. The system has four antennas, four active front ends, and a combined receiver and processor.

The AN/ALQ-217 is designed to perform in dense littoral and open-ocean environments; has adaptable system performance; has tailorable hardware and software to new platforms; and fast reaction time, Lockheed Martin officials say. The system provides fast angle of arrival information and weapon system identification; identifies the type, function, and mode of the intercepted emitters; and can pinpoint emitter position quickly.

Lockheed Martin will do the work in Owego, N.Y., and Clearwater, Fla., and should be finished by June 2022. ←

For more information contact ***Lockheed Martin Rotary and Mission Systems*** *online at* www.lockheedmartin.com, *or* ***Naval Air Systems Command*** *at* www.navair.navy.mil.

Navy asks Rockwell Collins to provide AN/ARC-210 avionics radios in $288.5 million order

BY **John Keller**

PATUXENT RIVER NAS, Md. — Military radio communications experts at Rockwell Collins in Cedar Rapids, Iowa, have landed their second multi-million-dollar order in as many months for AN/ARC-210 avionics radios and related equipment for U.S. and foreign military aircraft.

Officials of the Naval Air Warfare Center Aircraft Division at Patuxent River Naval Air Station, Md., announced a $288.5 million order to Rockwell Collins on Monday for the AN/ARC-210 family of radio equipment for the U.S. Navy, Air Force, Marine Corps, and allied military forces.

The AN/ARC-210 radio operates over frequencies from 30 to 512 MHz, covering UHF and VHF bands with AM, FM, and satellite communications. It includes embedded anti-jam waveforms like 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.

Rockwell Collins won an $82.6 million Navy order last month for AN/ARC-210 radios.

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.

Rockwell Collins has been building the AN/ARC-210 radio since 1990; it is installed on more than 180 platforms and is operating in more than 40 countries. As of 2010, 30,000 had been produced and by October 2016, 40,000 had been delivered.

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.

Rockwell Collins will provide AN/ARC-210 military avionics radios to help aircraft pilots stay in touch.

The AN/ARC-210 also has a connector in the back of the radio for an Ethernet input for network-centric warfare. It also provides embedded programmable information security per the U.S. National Security Agency (NSA) Cryptographic Modernization Initiative.

On this order Rockwell Collins will do the work in Cedar Rapids, Iowa, and should be finished by September 2021. ←

For more information contact ***Rockwell Collins*** *online at* www.rockwellcollins.com, *or the* ***Naval Air Warfare Center Aircraft Division*** *at* www.navair.navy.mil/nawcad.

Radiation-tolerant COTS atomic clock for commercial space introduced by Microsemi

Microsemi Corp. in Aliso Viejo, Calif., is introducing the commercial off-the-shelf (COTS) radiation-tolerant SA.45s commercial space chip scale atomic clock (CSAC) for low-Earth-orbit (LEO) space applications. The device provides the accuracy and stability of atomic clock technology with reduced size, weight, and power consumption (SWaP), and is for satellite timing and frequency control; satellite cross linking; assured position, navigation and timing; and Earth observation. The CSAC provides drift performance and built-in 1-pulse-per-second input for working together with the global positioning system (GPS). The timing module is a s a stand-alone atomic clock with a 10 MHz CMOS-compatible output. For more information contact **Microsemi** online at www.microsemi.com.

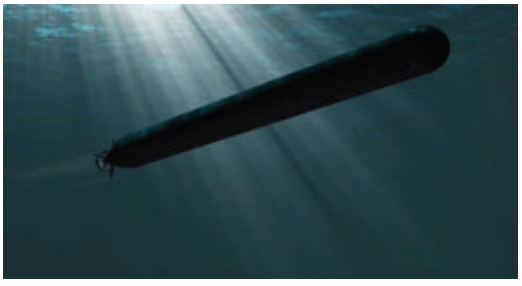
Australia reconnaissance drones to boost surveillance over South China Sea

Australia is spending billions on unmanned American reconnaissance drones that will be able to fly higher and further than its manned aircraft, to beef up its surveillance operations in areas that include the disputed South China Sea. The Triton unmanned aerial vehicles (UAVs) would complement the current surveillance aircraft Australia already uses to survey its maritime borders, conduct search and rescue, and carry out Freedom of Navigation exercises in the contested South China Sea. From Australia, the Triton UAVs will be able to fly as far north as the South China Sea, as far west as the Indian Ocean, and as far south as Antarctica, where the Australian military monitors activity over the country's Exclusive Economic Zone, a marine area of around 4 million square miles. ←

Navy taps 24 companies for enabling technologies in next-generation UUVs

BY **John Keller**

NEWPORT, R.I. — Twenty-four U.S. defense companies will share more than half a billion dollars over the next five years to help the U.S. Navy develop and test enabling technologies for future generations of unmanned undersea vehicles (UUVs).



Twenty-four U.S. defense companies will develop enabling technologies for next-generation unmanned underwater vehicles (UUVs)

Officials of the Naval Undersea Warfare Center Division in Newport, R.I., announced a collective contract award Monday for $561.2 million — with options that could bring the amount to $794.5 million — to develop and test of UUV technologies and systems by capitalizing on Navy and industry research.

The aim is to find suitable enabling technologies necessary to develop, build, and support the future Navy Unmanned Undersea Vehicle (UUV) Family of Systems (FoS). This project will involve developing core technologies in UUV launch, communications, command and control, navigation, endurance, recovery, payload feasibility, and mission planning.

The list of 24 companies that the Navy selected for this program reads like a Who's Who of undersea warfare specialists. The companies are:

- Aerojet Rocketdyne in Canoga Park, Calif.;
- Alion Science and Technology Corp. in Burr Ridge, Ill.;
- American Systems Corp. in Chantilly, Va.;
- BAE Systems Electronic Systems in Nashua, N.H.;
- The Charles Stark Draper Laboratory Inc. in Cambridge, Mass.;
- DRS Naval Power Systems in Fitchburg, Mass.;
- General Atomics in San Diego;
- General Dynamics One Source in Fairfax, Va.;
- UTC Aerospace Systems in Windsor Locks, Conn.;
- Huntington-Ingalls AMSEC in Virginia Beach, Va.;
- Hydroid Inc. in Pocasset, Mass.;
- L-3 KEO in Northampton, Mass.;
- Lockheed Martin Rotary and Mission Systems in Riviera Beach, Fla.;
- MOOG Inc. in Elma, N.Y.;
- Northrop Grumman Corp. in Annapolis, Md.;
- Oceaneering in Hanover, Md.;
- Raytheon Co. in Tewksbury, Mass.;
- Rite Solutions Inc. in Pawcatuck, Conn.;
- Science Applications International Corp. (SAIC) in Reston, Va.;
- SEA Corp. in Middletown, R.I.;
- Southwest Research Institute in San Antonio, Texas;

- Teledyne Brown Engineering in Huntsville, Ala.; and
- Woods Hole Oceanographic Institution in Woods Hole, Mass.

Initially these technologies are for the Navy's future extra-large unmanned undersea vehicles (XLUUVs), and later for other kinds of UUVs, Navy officials say. The project also will customize UUV sensor and weapons payloads.

The energy prototyping portion of the project will capitalize on existing independent research and development in energy-dense technology that could meet power requirements for future UUV missions that are limited by the amount of power currently available.

Power efforts will include research, development, test, and evaluation of advanced development model energy solutions initially applicable to XLUUVs for increased energy endurance and efficiency to extend the reach of all unmanned undersea systems.

The common control and autonomy portion of the project will include risk reduction and developmental efforts of autonomy systems and architectures for common standards, interfaces, and systems to support cross-domain applications. The payloads portion of the project focuses on lethal and non-lethal payloads.

These 24 companies will compete for task orders over the next five years, based on their expertise and core technologies. The companies will do the work at various locations, and should be finished by July 2023. ←

For more information contact the ***Naval Undersea Warfare Center Division-Newport*** *online at* www.navsea.navy.mil/Home/Warfare-Centers/NUWC-Newport.

Scientists rely on unmanned surface boats for long-term research

When it comes to acquiring knowledge, scientists often are constrained by human limitations. But when people expand their thinking to consider options that may seem beyond what is humanly possible, new doors to understanding open. That's what happened when marine biologists enlisted robots to study obscure regions of the sea. White sharks aren't supposed to be social, yet researchers have used unmanned surface vessels (USVs) to find that the notoriously solitary predators regularly gather together at one particular spot in the Pacific Ocean. There they perform a mysterious ritual: diving down almost 500 yards and then resurfacing, hundreds of times a day. In hopes of gaining some insight into this puzzling behavior, researchers have deployed two autonomous robots called Saildrones to gather crucial data to build a better picture of the region's ecosystem. Saildrones aren't the first autonomous devices to be employed in marine science, but since their 2014 release they have been lauded for their utility. These boats are much less expensive to operate than ships, and because they're wind- and solar-powered they can travel uninterrupted for months. ←

Fixed-focal-length lenses for space-limited applications introduced by Edmund

Edmund Optics Inc. in Barrington, N.J., is introducing the TECHSPEC UCi series fixed-focal-length lenses for OEM electro-optics applications requiring small, robust, and lightweight imaging tools. Designed for space-limited applications, these lenses are ultra-compact instrumentation (UCi) versions of Edmund Optics's UC series fixed-focal-length lenses, using the same optics. TECHSPEC UCi lenses have 4K resolution, and are for small pixels less than 2.2 micron and are offered in several fixed apertures for a wide variety of applications. TECHSPEC UCi are optimized for 1/2.5" sensors, however, many of the focal length options may be used on sensors up to 1/1.8". They also are for use with M12 x 0.5 S-mount cameras. TECHSPEC UCi lenses are available in 21 models with focal lengths of 4, 6, or 12 millimeters, with working distances that are short or zero. Each lens is coated with an MgF2 anti-reflective coating, which offers maximum transmission from 400 to 700 nanometers. RoHS-compliant TECHSPEC UCi lenses are available. For more information contact **Edmund Optics** online at www.edmundoptics.com.

Raytheon to provide laser-guided Paveway smart munitions in $110 million 10-year contract

U.S. Air Force smart munitions experts are asking the Raytheon Co. to build Paveway GPS- and laser-guided aerial weapons under terms of a $110 million 10-year contract. Officials of the Air Force Life Cycle Management Center at Eglin Air Force Base, Fla., are asking the Raytheon Missile Systems segment in Tucson, Ariz., to produce the Paveway family of [PAGE 32]

Boeing and Lockheed Martin to build advanced infrared search and track (IRST) for Navy Super Hornet

BY **John Keller**

PATUXENT RIVER NAS, Md. — U.S. Navy air combat experts are asking electro-optics engineers at the Boeing Co. and Lockheed Martin Corp. to design and build improved infrared search and track (IRST) sensors for the F/A-18E/F Super Hornet jet fighter-bomber to enable the aircraft to detect, track, and attack enemy aircraft in a stealthy way without making its presence known.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., announced a $152.5 million contract Friday to the Boeing Co. Defense, Space & Security segment in St. Louis to design and build the IRST Block II, Phase II engineering change as a replacement to the IRST Block I system on F/A-18E/F carrier-based combat jets.

The Super Hornet's IRST is a long-wave infrared detection system that targets airborne vehicles in a radar-denied environment. The system, which Boeing is buying from the Lockheed Martin Missiles and Fire Control segment in Orlando, Fla., uses infrared search and track technology to detect and provide weapon-quality track solutions on potentially hostile aircraft.

The IRST Block I, also called the IRST21 Sensor System, fits on the front of the Super Hornet's centerline fuel tank. Two years ago Navy leaders approved a restructured program that foregoes full-rate production of Block I sensors and proceeds directly to the Block II system.

A new IRST will enable the Navy F/A-18E/F Super Hornet to search for targets in a stealthy way.

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

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

At this stage, existing IRST Block I systems will support testing and tactics development. Navy leaders say they will begin the Block II operational [PAGE 32]

Companies develop ballistic missile defense against decoys and maneuvering warheads

BY John Keller

HUNTSVILLE, Ala. — Three U.S. prime defense contractors will share as much as $4.1 billion to help develop enabling technologies to enable U.S. ballistic missile defense systems to defeat advanced missile threats like decoys and maneuvering warheads.

Officials of the U.S. Missile Defense Agency (MDA) in Huntsville, Ala., announced five-year contracts to the Raytheon Co., Lockheed Martin Corp., and Northrop Grumman Corp. to develop advanced ballistic missile defense techniques.

The three companies will provide autonomous acquisition and persistent precision tracking and discrimination to optimize the defensive capability of the Ballistic Missile Defense system and counter evolving threats.

Contracts went out to Raytheon Integrated Defense Systems in Woburn, Mass.; Lockheed Martin Rotary and Mission Systems in Moorestown, N.J.; and Northrop Grumman Missile Defense and Protective Systems Division in Huntsville, Ala. Each company will receive at least $10,000, and will compete for orders collectively worth as much as $4.1 billion.

Raytheon, Lockheed Martin, and Northrop Grumman are pursuing research to help missile defenses defeat incoming decoys and maneuvering warheads.

Raytheon, Lockheed Martin, and Northrop Grumman will develop sensor and digital signal processing techniques necessary to defeat these missile-spoofing technologies and defense U.S. and allied territories from ballistic missile attacks.

These three companies will do the work primarily at their own facilities, and should be finished by July 2023. ←

For more information contact ***Raytheon Integrated Defense Systems*** *online at* www.raytheon.com/capabilities/missiledefense, ***Lockheed Martin Rotary and Mission Systems*** *at* www.lockheedmartin.com, *or* ***Northrop Grumman Missile Defense and Protective Systems*** *at* www.northropgrumman.com, *or the* ***Missile Defense Agency*** *at* www.mda.mil.

L3 WESCAM delivers first electro-optical system for Canada's fixed-wing search-and-rescue program

L3 WESCAM in Burlington, Ontario, has delivered its first MX-15 electro-optical and infrared (EO/IR) system to Airbus Defence and Space in support of Canada's Fixed-Wing search-and-rescue (FWSAR) aircraft replacement program. The MX-15 electro-optical sensor for the Canadian search-and-rescue aircraft is a replacement system for those aboard Canada's legacy search-and-rescue aircraft, the CC-115 Buffalo and CC-130H Hercules. Canada's FWSAR aircraft is an Airbus C295W, a variant of the C295 military transport aircraft, which is being manufactured by Airbus Defence and Space in Toulouse, France. Canada has a search area of 18 million square kilometers. The high-sensitivity sensors will provide SAR operators with day and night visual capabilities, despite atmospheric interference, and will operate with detection and identification ranges that will help to shorten search grid patterns and on-scene search times. ←

[FROM PAGE 30] weapons, which are conventional gravity bombs that are converted to precision-guided smart munitions with guidance and tail kits. Paveway munitions use laser guidance, as well as GPS satellite navigation and inertial guidance to glide Paveway bombs precisely to their targets. Paveway kits can attach to 250-, 500-, 1,000-, and 2,000-pound bombs. The contract involves a total-package approach for Paveway-specific activities including studies, production, certification, integration, and sustainment. Paveway munitions with multi-guidance systems can decreases the required sortie count and weapon inventory while simultaneously increasing the mission success rate, Raytheon officials say.

Dynetics and Lockheed Martin chosen for work on 100-kilowatt laser weapons

Dynetics, Lockheed Martin, and other partner laser weapons companies have received a $10 million contract for further development of the 100-kilowatt High Energy Laser Tactical Vehicle Demonstrator (HELTVD) program. Officials of the Lockheed Martin Space Systems segment in Sunnyvale, Calif., announced the contract Monday. A preliminary design review for the program is expected to start in January 2019. The companies recently completed a system requirements review and technical baseline update. The laser will be mounted on the Family of Medium Tactical Vehicles, a series of military trucks produced by Oshkosh. The laser is a derivative of the U.S. Army's Robust Electric Laser Initiative program. Team Dynetics is one of two competitors seeking to build to build a laser system will be tested in 2022 at White Sands Missile Range in New Mexico. The other team, led by Raytheon, received a $10 million contract from the Army at the beginning of July for development of the system. ←

[FROM PAGE 30] tests in 2020. The Navy intends to produce 170 IRST systems.

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

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

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

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

On this contract Boeing and Lockheed Martin will do the work in Orlando, Fla., and in St. Louis, and should be finished by December 2021. ←

For more information contact ***Boeing Defense, Space & Security*** *online at* www.boeing.com/company/about-bds, www.lockheedmartin.com, *or* ***Naval Air Systems Command*** *at* www.navair.navy.mil.

Precious invisibility: scientists use gold to make thermal camouflage

How do you become invisible to a device that doesn't need visible light to see you? Thermal imaging cameras, which can be useful in daylight as well night, work by detecting infrared radiation. An effective thermal camouflage requires an engineering hat-trick. You need a material that is flexible, can adapt to different temperatures, and can do so extremely quickly.

Some of the difficulties encountered in the development of thermal camouflage so far include poor temperature variability, slow response times, and the requirement for rigid materials, to name a few. Now Coskun Kocabas at University of Manchester in Manchester, England, along with colleagues at the Massachusetts Institute of Technology (MIT) in Cambridge, Mass., as well as Bilkent University and the Izmir Institute of Technology in Turkey, have developed a flexible camouflage system that blends with background temperatures within seconds. To achieve this, they needed graphene, a few ions, some nylon and a little gold. The system involves two flexible electrodes: the top electrode is made up of layers of graphene while the bottom electrode is made of heat-resistant nylon coated with gold. Between them sits a liquid of positively and negatively charged ions. In the presence of a small voltage, the ions travel into the graphene, which is then able to absorb infrared radiation being emitted by the wearer. ←

PRODUCT applications

AVIONICS

Rockwell Collins-ESA to provide 120 head-up helmet-mounted displays for jet fighter-bombers

Combat avionics experts at Rockwell Collins-ESA Vision Systems in Fort Worth, Texas, will provide the U.S. Navy with 120 head-up helmet-mounted displays for high-performance jet fighter-bombers under terms of a $20.9 million order.

Officials of the U.S. Naval Air Warfare Center Aircraft Division at Patuxent River Naval Air Station, Md., are asking Rockwell Collins-ESA Vision Systems to provide 140 Joint Helmet Mounted Cueing system, Night Vision Cueing and Display systems for U.S. Navy and Marine Corps F/A-18 jet fighter-bomber squadrons.

The NVCD is part of the Joint Helmet Mounted Cueing System (JHMCS), which projects symbology and imagery onto the pilot's helmet-mounted visor to help meet the workload of operating the aircraft; detecting, tracking, and engaging targets; and dealing with emergency situations. It enables high-performance jet fighter and bomber pilots to cue weapons and sensors at night.

The system is designed to enable pilots to fly near-daytime tactics at night, while also providing the system's head-up display data over the eye in addition to camera video recording of the pilot's viewpoint. Rockwell Collins-ESA Vision Systems is a partnership of Rockwell Collins in Cedar Rapids, Iowa, and Elbit Systems of America in Fort Worth, Texas.

The NVCD enables aircrews simultaneously to display radar and navigation symbology on the helmet's display and cue short-range air-to-air missiles. It helps pilots identify terrain, targets, and other aircraft at night.

The JHMCS and NVCD are mounted on a lightweight HGU 55/P helmet shell that can accommodate the day or night modules. The system offers a 100-by-40-degree field of view or 40 degrees circular, with symbology or video inserted into the night-vision scene.

On this contract Rockwell Collins-ESA Vision Systems will do the work in Merrimack, N.H.; Wilsonville, Ore.; Atlanta; and Fort Worth, Texas, and should be finished by July 2020.

For more information contact **Rockwell Collins** online at *www.rockwellcollins.com*, **Elbit Systems of America** at *www.elbitsystems-us.com*, or the **Naval Air Warfare Center Aircraft Division** at *www.navair.navy.mil/nawcad*.

MISSION COMPUTING

Physical Optics to provide military distributed processing mission computer

Aircraft mission computer experts at Physical Optics Corp. in Torrance, Calif. are developing a deployable military avionics subsystem to decentralize mission data processing across several distributed processing nodes under terms of a $32.8 million five-year order.

Officials of the U.S. Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., are asking Physical Optics experts to enhance the experimental Joint Avionics Reconfigurable Visual Information System (JARVIS) so it is ready for military test and demonstration.

The JARVIS project seeks to increase avionics mission processing interface speeds and lower costs compared to today's monolithic systems by decentralizing mission data processing across several distributed processing nodes.

Physical Optics developed a prototype JARVIS system under a small business innovation research (SBIR) phase-one contract. The system seeks to address the Navy's need for a miniaturized, fault-tolerant, decentralized mission processing.

JARVIS incorporates Physical Optics-developed components and existing commercial- and modified off-the-shelf components to offer superior fault tolerance and decentralized aircraft mission processing, Navy officials say.

In the first phase of the JARVIS project, Physical Optics demonstrated the feasibility of a miniaturized virtually and physically reconfigurable system to enable military aircraft crews to maintain situational awareness even when more than 50 percent of the processing nodes fail.

In this second phase, Physical Optics will demonstrate a prototype aircraft mission processing system that will comply with Future Airborne Capability Environment (FACE) and Modular Open Systems Approach (MOSA) industry standards such that it will be capable of being certified for flight.

Physical Optics will mature the JARVIS prototype through engineering manufacturing and development (EMD) to technical readiness level 8, which means the actual system will have been completed and qualified through test and demonstration.

Physical Optics will mature JARVIS technology such that it will operate in conformance with the FACE standard, incorporate software re-configurability, leverage distributed processing, and address cyber security requirements.

On this order Physical Optics will do the work in Torrance, Calif., Indianapolis, and Atlanta, and should be finished by July 2023. For more information contact **Physical Optics Corp.** online at *www.poc.com*, or the **Naval Air Warfare Center Aircraft Division-Lakehurst** at *www.navair.navy.mil*.

ELECTRONIC WARFARE

Northrop Grumman to provide electronic warfare (EW) jammers to foil radio-controlled IEDs

Electronic warfare (EW) experts at Northrop Grumman Corp. are building additional open-architecture RF jammers for infantry, land vehicles, and fixed sites to protect U.S. and allied warfighters from radio-controlled improvised explosive devices (IEDs).

Officials of the U.S. Naval Sea Systems Command in Washington announced a $96.5 million order to the Northrop Grumman Mission Systems segment in Herndon, Va., for Joint Counter-Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) increment one block one (I1B1) systems full-rate production.

The JCREW I1B1, formerly known as JCREW 3.3, is the first-generation system that develops a common open architecture across all three capabilities and provides protection for worldwide military operations, officials say.

This integrated design makes the most of commonality across all capabilities, reduces life cycle costs, and provides increased protection against worldwide threats, Navy officials say. It is for the U.S. Marine Corps, Navy, and Air Force, and is under supervision of Naval Sea Systems Command.

Friday's order is a modification to a $57.7 million contract announced in July 2017 for JCREW I1B1 full-rate production. Northrop Grumman also won a $23.2 million order JCREW I1B1 full-rate production order last December, as well as a $267.7 million JCREW I1B1 order last September. The original contract has options that could increase its value to $505.3 million.

CREW systems provide combat troops protection against radio-controlled IEDs, and are designed to provide protection for foot soldiers, vehicles, and permanent structures, Navy officials say.

Among the JCREW I1B1 systems is the Northrop Grumman Freedom 240 for Counter Radio-controlled IED Electronic Warfare Marine Expeditionary Unit Special Operation Capable (SOC), or CREW MEU.

The system jams a wide range of IEDs and creates a protective barrier around Marine Corps infantry and their equipment while minimizing disruption to friendly communications systems. On this contract Northrop Grumman will do the work in San Diego and in Sierra Vista, Ariz., and should be finished by August 2022. For more information contact **Northrop Grumman Mission Systems** online at *www.northropgrumman.com*, or **Naval Sea Systems Command** at *www.navsea.navy.mil*.

EMBEDDED COMPUTING

Navy looks to Progeny Systems to stave-off obsolescence in undersea warfare embedded computing

U.S. Navy undersea warfare experts needed open-architecture embedded computing hardware and software to help mitigate obsolescence issues in submarine and undersea warfare weapons systems. They found their solution from Progeny Systems Corp. in Manassas, Va.

Officials of the Naval Sea Systems Command in Washington announced a potential $92 million contract to Progeny Systems on Friday for software development, commercial off-the-shelf (COTS) hardware and software, and systems integration for submarine and undersea warfare weapons systems.

Progeny Systems engineers will provide these goods and services as necessary to resolve COTS obsolescence and technical issues that influence physical or electronic interfaces on Navy submarines and undersea warfare systems.

Hardware and software obsolescence can threaten to invalidate a variety of existing technical certifications, Navy officials say. These certifications involve weapon systems safety, ship control safety of flight, live fire shock, and information assurance accreditation.

Many of today's weapons systems are obsolete and cannot support changes necessary to adapt to new threats, Progeny officials say. Solutions to obsolescence typically involve replacing rather than modifying the existing system, which is an expensive option.

Yet modern high-density systems can migrate reasonably to higher-performance like-technology components, as long as the base architectures have not changed. Systems designers can

minimize this migration effort by applying discipline to development — even for systems that differ architecturally.

Progeny Systems has developed a prototype environment for integrating COTS hardware and software into embedded computing systems by providing open-architecture infrastructure components, infusion assessment and management tools, strategies, and methodologies for creating resilient system designs, company officials say.

Progeny has applied this approach to several Navy systems and architectures, such as non-tactical data processing and system automation software to support reduced manning onboard submarines; upgraded torpedo electronics for improved performance and reduced cost; submarine weapon simulators; and information-assurance products for managing classified data, officials say.

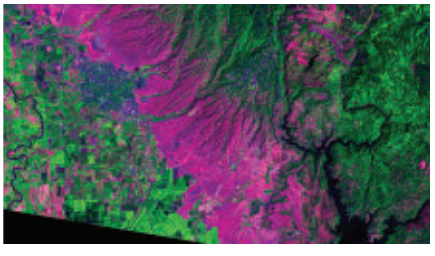
This contract involves Small Business Innovation Research (SBIR) topic N96-278 called Technology Infusion Methodology for Commercial Off-the-Shelf (COTS) Based Systems. Progeny will receive $17.2 million up-front, and will fulfill for follow-on orders as necessary.

Progeny Systems will do the work on this contract in Manassas, Va.; Middletown, R.I.; and San Diego, and should be finished by June 2019. For more information contact **Progeny Systems** online at *www.progeny.net*, or **Naval Sea Systems** at *www.navsea.navy.mil*.

IMAGE ANALYSIS

BAE Systems to help DARPA provide intelligence analysts with satellite imagery using cloud computing

U.S. military researchers needed a way for intelligence analysts quickly to access and analyze a growing amount of satellite imagery using cloud computing. They found their solution from the BAE Systems Electronic Systems segment in San Diego.



Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., announced a $2 million contract to BAE Systems last week for the Geospatial Cloud Analytics (GCA) project.

GCA seeks to create scalable computer cloud-based repository of global satellite data, make it accessible via common interfaces, and start developing analytics-as-a-service for U.S. military users.

The rapid pace of new commercial satellite constellation launches has led to a significant increase in the amount and availability of geospatial imagery, DARPA researchers point out.

Until now, however, there has been no straightforward way for analysts to access and analyze all that imagery. Instead, today's ad-hoc, time-intensive approach requires gathering and curating data from many sources, downloading it to specific locations, and running it through separate suites of analytics tools.

The GCA program seeks to enable instant access to the most up-to-date images anywhere in the world, as well as cutting-edge analysis tools by aggregating vast amounts of commercial and open-source satellite data from optical and RF sensors, as well as from synthetic aperture radar (SAR).

BAE Systems experts will try to do this virtually in a common cloud-based repository with automated curation tools that would provide global situational awareness, event detection, monitoring, and tracking capabilities. The project also aims to create analytical applications to enable analysts to draw specific information from the aggregated data.

The idea is to enable commercial analytics providers to use the common data platform to develop and offer their services in a competitive market that would provide image analysis to the U.S. military at an affordable price.

In this project, BAE Systems experts will look at problems at a variety of time scales, such as food shortages over a period of weeks or months; locating oil fracking sites or days and weeks; detecting illegal fishing over minutes to days; and an open-call scenario where proposers may suggest other problems of military relevance.

For more information contact **BAE Systems Electronic Systems** online at *www.baesystems.com*, or **DARPA** at *www.darpa.mil*. ←

POWER ELECTRONICS

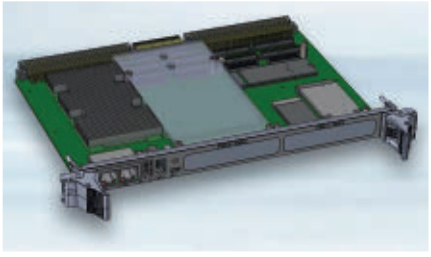
Radiation-hardened DC-DC converter power supplies for space introduced by VPT

VPT Inc. in Blacksburg, Va., is introducing the SVPL series space-qualified point-of-load DC-DC converter power supplies for radiation-hardened space applications facing harsh radiation environments while requiring low voltages and tight regulation for high-performance processors. These power electronics devices cover an input voltage range of 3.1 to 13.2 volts and are available in 6-, 9-, and 12-amp output surface-mount options. The SVPL series use the Renesas ISL7000x family of rad-hard synchronous buck regulators to provide high power density, fast transient response, and as much as 94 percent efficiency. The ISL7000x bare-die integrated circuits (ICs) are characterized for total ionizing dose (TID) of 100 kilorads, including enhanced low dose rate sensitivity (ELDRS), and they are immune to destructive single event effects (SEE) with linear energy transfer (LET) of 86.4 MeV-cm2/mg. The SVPL series of converters are characterized for TID of 100 kilorads, including ELDRS, and SEE performance to 85 MeV-cm2/mg, per VPT's DLA-approved radiation hardness assurance (RHA) plan. For more information contact **VPT**, a HEICO company, online at *www.vptpower.com.*

SINGLE-BOARD COMPUTING

Rugged 6U VME single-board computer for military and transportation introduced by Kontron

Embedded computing specialist Kontron in Augsburg, Germany, is introducing the rugged VM6062 6U VME single-board computer for size weight-, power- and cost-constrained (SWaP-C) systems and general-purpose mission computers, ranging from industrial to extreme rugged transportation and defense applications.



The VM6062 has the Intel D1508 processor, a high-performance, low-power two-core and four-tread processor soldered on the board to increase its resilience against shock and vibration, as well as 8 gigabytes of DDR4 memory, extendible to 32 gigabytes, with ECC. The VM6062 has two Gigabit Ethernet interfaces, one USB 3.0 port, two serial links and one HDMI digital graphics interface as standard connectors on the front panel. Equipped with a solid-state drive on one of the two standard M.2 slots, the VM6062 can be used as a Rugged Blade PC. The board has modular extension with I/O mezzanines to enable designers to tailor systems from open standard components. It has two PMCs, one VITA 42 XMC or VITA 61 XMC 2.0, one Mini-PCI-Express, and two M.2 mezzanine slots. For more information contact **Kontron** online at *www.kontron.com.*

DATA CONVERSION

16-bit A/D channelizer for military software radio receivers introduced by Pentek

Pentek Inc. in Upper Saddle River, N.J., is introducing the 2-channel Jade model 71865 200 MHz 16-bit A/D channelizer for commercial, military and government high-channel count software radio receiver applications. The Jade 71865 high-speed data converter Switched Mezzanine Card (XMC) field-programmable gate array (FPGA) module has 762 narrowband digital down converters (DDCs), four wideband DDCs, and is based on the Xilinx Kintex UltraScale FPGA. The model 71865 functions include two A/D acquisition IP modules for simplifying data capture and transfer. Each acquisition IP module has a controller for all data clocking, triggering, and synchronization functions. From each of the two acquisition modules, A/D sample data flows into identical IP modules consisting of banks of

wideband and narrowband DDCs. Finally, data is delivered to four direct memory access (DMA) controllers linked to the PCI Express Gen.3 x8 interface for transfer to a signal processor. Users can set the four wideband DDCs for decimation values between eight and 128 in steps of four, providing usable output bandwidths from 1.25 MHz to 20 MHz. The wideband DDCs can help locate signals of interest. For more information contact **Pentek** online at *www.pentek.com.*

LED PRODUCTS

Long M6 thread LED helps designers build thick panels without changing to larger LEDs

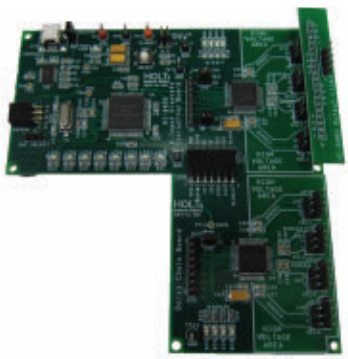
Wilbrecht LEDCO Inc. in St. Paul, Minn., is introducing the CDLB series long M6 thread 3-millimeter panel light-emitting diode (LED) to enable designers to build panels with 3-millimeter LEDs to their own specifications, eliminating the need to change to larger LEDs to fit thick panels. The

CDLB series mounts in panels as thick as 8 millimeters, even when supplied with the optional washer for IP67 sealing. The front-mount nickel-plated housing has a prominent bezel shape with a protruded LED. The potted housing with additional gasket offers front and rear IP67 sealing and provides environmental protection for outdoor applications. The LED indicator is available in a broad range of colors and intensities, including daylight readable, bicolor, and blinking. Optional internal resistors allow operation to 60 volts DC and custom AC voltage assemblies also are available. Manufactured in the U.S., the LED can be adapted to meet custom needs for special wire, connectors, or marking. For more information contact **Wilbrecht LEDCO** online at *www.wilbrechtledco.com*.

AVIONICS

Quad galvanically isolated discrete-to-digital sensor introduced by Holt

Holt Integrated Circuits in Mission Viejo, Calif., is introducing the HI-8400 quad galvanically isolated discrete-to-digital sensor for avionics applications. The device exceeds Airbus ABD0100 specification requirements by providing 800-volt galvanic isolation between individual sensors and the logic interface. Sensor input thresholds comply to Airbus ABD0100H and MIL-STD-704 specifications and sensor outputs may be read from a serial peripheral interface (SPI) or parallel bus. A sensor output interrupt pin alerts the system to a change in sensor input, avoiding constant polling via SPI to check status. Each discrete input is configurable as a GND/open or supply/open (28-volt/open) sensor, making this device suitable for systems that tolerate different grounds or excessive voltage transients. The HI-8400 also is suitable for relay switching detection, providing a 1 milliamp wetting current to prevent dry contacts. For more information contact **Hold Integrated Circuits** online at *www.holtic.com*.



POWER CONTROL

16-channel solid-state power controller for military and aerospace applications introduced by DDC

Data Device Corp. (DDC) is introducing the RP-2016371X 16-channel 48-volt DC, 238-amp solid-state power controller (SSPC) for military and aerospace applications. The power distribution unit offers programmability, system health diagnostic and prognostic data, and high power density in a compact and ruggedized military-grade form factor. It distributes and controls power to as many as 16 independent 48-volt DC loads, with 8-, 10-, and 25-amp maximum capacities, and provides significant size,

Newport Gimbal Systems

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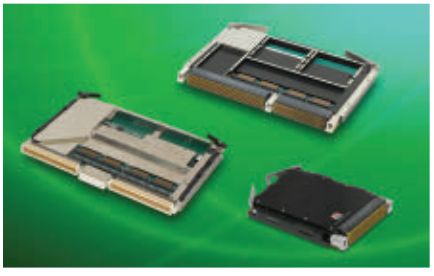
SINGLE-BOARD COMPUTERS

NXP-based single-board computers for trusted computing in rugged environments introduced by Aitech

Aitech Defense Systems Inc. in Chatsworth, Calif., is introducing four single-board computers with the ultra-low power T4xx1 processor family from NXP for size-, weight-, power-, and cost



(SWaP-C)-optimized trusted computing applications in rugged and mobile environments. Aitech has implemented NXP's low-power T4241, T4161, and T4081 PowerPC variants on the company's QorIQ-based computer boards. The low-power series is available on the Aitech C912 3U VPX, C111 6U VME, and C112 6U VPX computer boards. The C912 3U VPX boards offers as many as 12 e6500 PowerPC cores. All of Aitech's boards in this series have NXP's Trust Architecture 2.0, which provides a high-trust cyber security processing environment for sensitive data security and supervisory control — a typical requirement for manned and unmanned space, air and ground vehicles. For those looking for an integrated hardware- and software-bundled platform that offers exceptional graphics computing, the CB912 VideoPaC also comes with the option of using a processor from the low-power T4xx1 Series. For more information contact **Aitech** online at *www.rugged.com*.

EMBEDDED COMPUTING

Industrial-temperature Mini PCI Express Ethernet embedded computing board introduced by VersaLogic

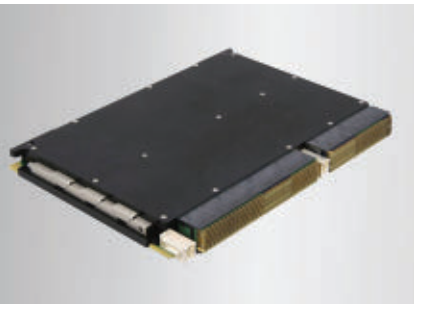
VersaLogic Corp. in Tualatin, Ore., is introducing the E5 VL-MPEe-E5E industrial-temperature rugged Mini PCI Express dual Gigabit Ethernet expansion board to add additional Ethernet ports

to embedded computing systems that operate in harsh environments. These boards operate in temperatures from -40 to 85 degrees Celsius, and add two additional Ethernet ports to embedded systems. The E5 is self-contained with on-board magnetic isolation. There is no need for off-board magnetics or special cabling. The E5's extremely small form factor format makes it suitable for size-and weight-optimized applications. Latching connectors and Mil Standard 202 shock and vibration testing ensure performance in demanding environments. The E5 is customizable, even in low OEM quantities, with conformal coating, revision locks, custom labeling, customized testing, and screening. It is compatible with Linux and Windows. For more information contact **VersaLogic** online at *www.versalogic.com*.

ETHERNET SWITCHING

6U OpenVPX Gigabit Ethernet switch for C4ISR and embedded computing introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the VPX6-688 24-Port 6U OpenVPX Gigabit Ethernet switch module for demanding applications in command, control, communications computers, intelligence, surveillance, and reconnaissance (C4ISR).



The switch simplifies the integration of a networking solution into open-architecture VPX systems, and enables embedded systems to share data safely on intra-platform and wide-area networks. The rugged module offers network security by disabling non-essential services, and provides secured management interfaces for administration. To protect against emerging cyber security threats, Curtiss-Wright provides regular network software updates to ensure that the VPX6-688's network security posture stays up to date. If the application requires secure WAN connections, Curtiss-Wright offers an optional services mezzanine module that provides a-featured Cisco IOS router. The VPX6-688 supports the high-precision IEEE 1588 Precision Time Protocol (PTP) synchronization required by real-time and signal processing applications. For more information contact **Curtiss-Wright Defense Solutions** online at *www.curtiss-wrightds.com*.

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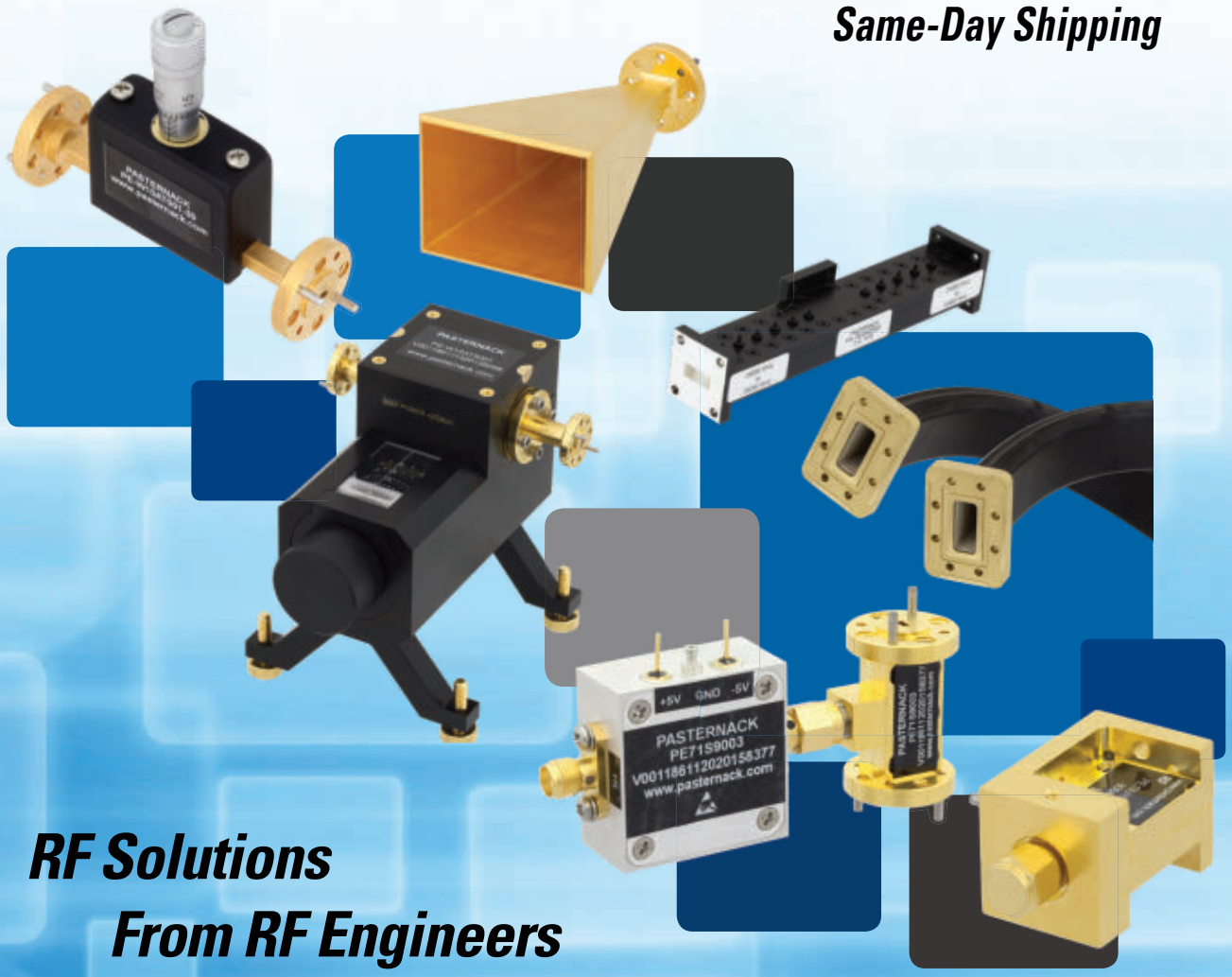

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