NOVEMBER 2016

Military & Aerospace Electronics

ENABLING TECHNOLOGIES FOR NATIONAL DEFENSE

2016 Technology Innovation Awards

Companies with the most innovative technology solutions of the year named from aerospace and defense electronics industries. PAGE 4

Test and measurement

Aerospace and defense looks to advanced test equipment for legacy and cutting-edge systems. PAGE 20

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Counter-drone systems

First they built drones; now they have to shoot them down. PAGE 12

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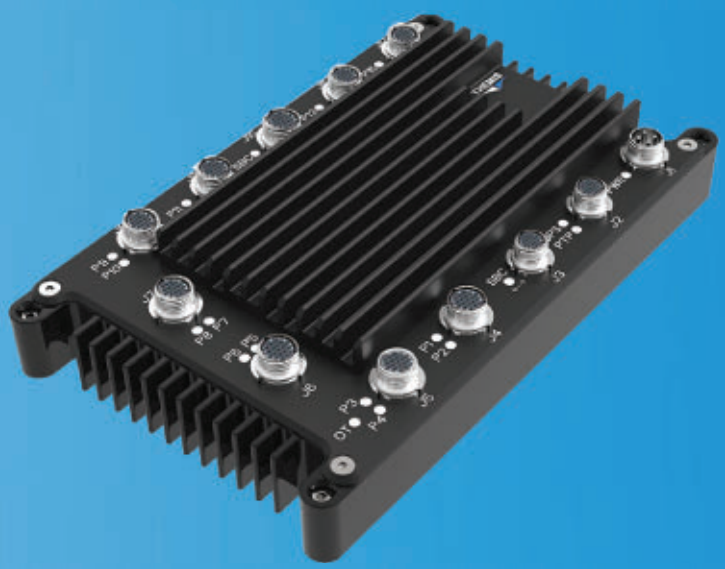

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- MIL-STD-810G - Environmental

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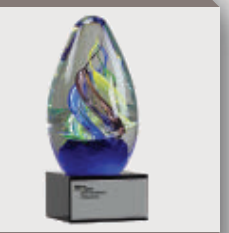

COVER STORY

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BY **JOHN KELLER**, EDITOR IN CHIEF

Consensus forms around cybersecurity as new industry takes shape

Cybersecurity goes by many names, and that's one of the reasons this emerging new industry remains so fragmented. It's time the industry reached consensus on an all-encompassing term that describes how to keep life- and mission-critical computers free from outside interference.

Unfortunately, cybersecurity has come to depict a range of nefarious computer break-ins by shadowy hackers with cryptic names that compromise the credit card accounts of retail store patrons, e-mails by notable politicians, and the control of cars and unmanned aircraft. Yet there's much more to cybersecurity than hackers and attempts to thwart their efforts. Moreover, there's billions of dollars pouring into the cybersecurity industry today, which represents opportunities for a wide variety of companies.

There's a plethora of descriptive terms in the cyber industry today, among them system security, system integrity, and trusted systems. Terms that were in vogue in previous years have fallen by the wayside, such as information assurance (IA), that authorities such as the U.S. Department of Defense (DOD) are abandoning. In fact, DOD officials issued an instruction last August to amend DOD Directive 5134.01, which establishes policy and assigns responsibilities to minimize the risk that DOD's warfighting mission capability will be impaired due to vulnerabilities in system design or sabotage or subversion of a system's mission-critical functions or critical components by foreign intelligence, terrorists, or other hostile elements.

The changes specifically substitute the word "cybersecurity" for information assurance. DOD leaders are setting on the term cybersecurity to describe outside interference to military computer systems and the embedded computing technology that underlies many of today's sophisticated weapon systems. That outside interference, described as vulnerabilities in system design or sabotage or subversion of a system's mission-critical functions could be intentional, such as the results of hackers, or also could include bits and pieces of computer programs, or bugs, that in certain circumstances could undermine or otherwise interfere with other parts of the program.

System security, system integrity, and trusted systems are describing aspects of the same thing: cybersecurity. Realizing this can help define what cybersecurity really means and can reveal a new perspective on the emerging industry. This became clear to me while talking with computer experts at the Association of the U.S. Army (AUSA) conference and trade show in Washington. Some of these people realize they're part of the cybersecurity industry, and some don't.

The computer scientist and companies involved with system security, system integrity, trusted systems, and perhaps even anti-tamper are working the same side of the street. These companies aren't involved in separate and distinct endeavors; they're all part of the cybersecurity industry.

So what does this mean? Well for one thing it places many embedded computing companies like Mercury Systems, Curtiss-Wright Defense Solutions, Extreme Engineering Solutions, and Abaco firmly in the cybersecurity camp. It's true, then, that not only the big prime contractors like Lockheed Martin, Boeing, Raytheon, and Lockheed Martin are doing cybersecurity. We're talking about an already-large and growing technology ecosystem that runs the gamut from software hypervisors all the way up to large, complex computer programs that run weapons platforms like jet fighters, main battle tanks, surface warships, and unmanned vehicles.

There are plenty of enabling technologies that come to bear on cybersecurity today, and plenty that will become part of this emerging ecosystem in the future. Perhaps the first step is to acknowledge that many of us are taking separate paths toward the same destination. ←

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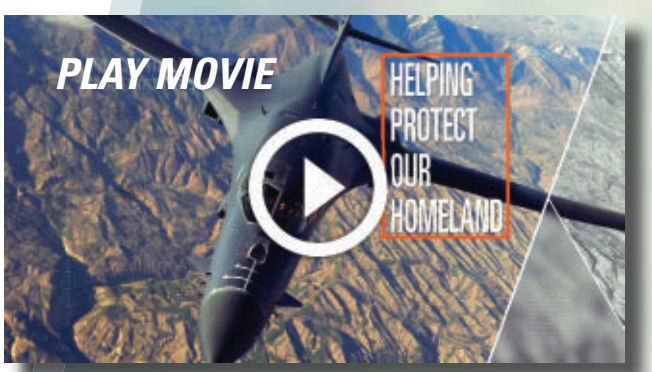

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news

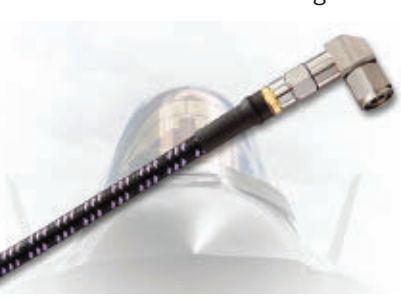
2016 Technology Innovation Awards announced for aerospace and defense industry

NASHUA, N.H. — *Military & Aerospace Electronics* and *Intelligent Aerospace* have announced their 2016 Technology Innovation Awards to recognize companies offering substantial military, aerospace, and avionics design solutions for 2016.

Awards are in three tiers, ranging from the highest platinum awards, to the gold awards, and finally to the silver awards, based on the recommendations of an independent panel of industry judges.

Here are the platinum award winners.

The OmniView eye-tracking system from ISCAN Inc. in Woburn, Mass., is a binocular, real-time, head-mounted, eye-tracking system for aircraft pilots or military ground vehicle drivers. It is an indicator for human factors assessment in military training to overcome limits to conventional eye trackers for military and avionics human factors and training applications. It tracks the user's eye position and overlays a point of gaze cursor that shows precisely where the user is looking. It is designed to work under real flight or vehicle operating conditions.



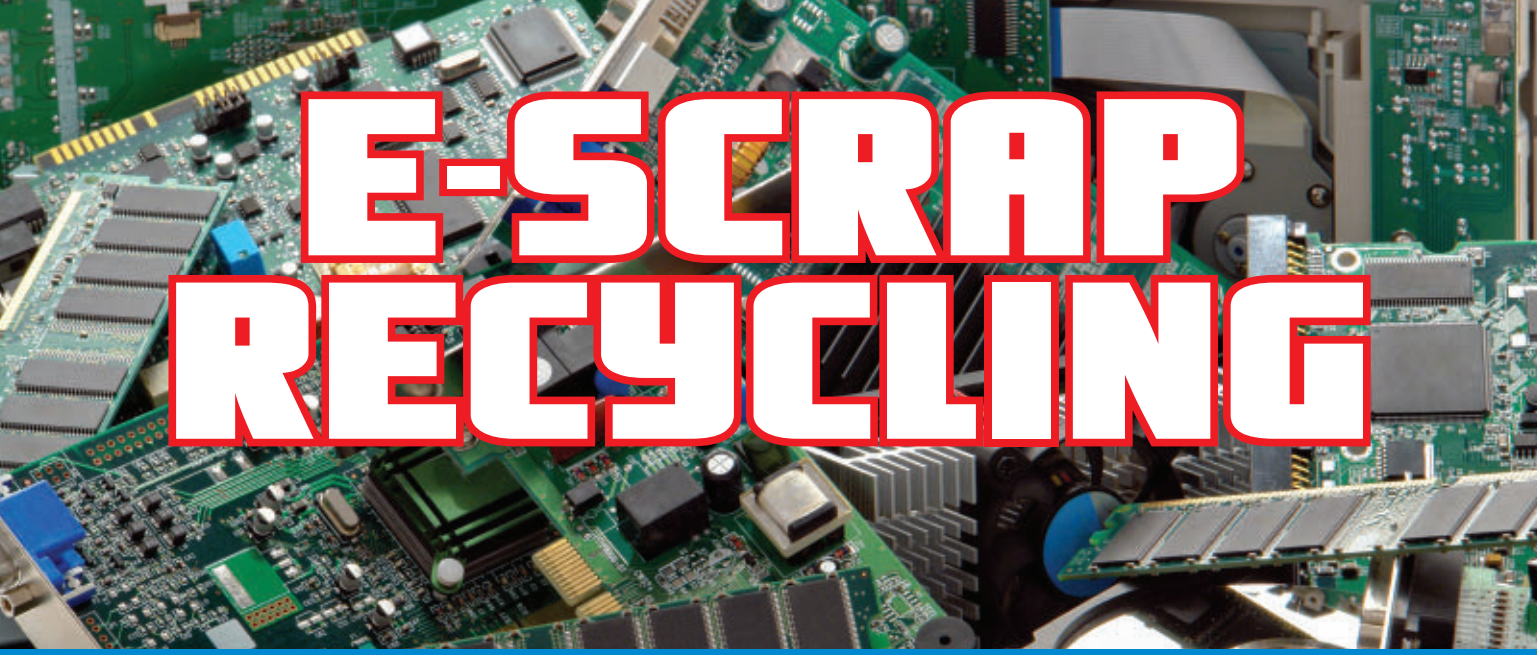
GORE-FLIGHT 6 series microwave cable assemblies from W.L. Gore & Associates Inc. in Newark, Del., which are lightweight cables that deliver low insertion loss before and after installation for reliable performance for the life of the system. More than 75 percent of microwave cables fail frequently — and about 36 percent have to be replaced every year. These cables are qualified to airframe assembly specifications to withstand the punishment of installation and operation in radar, surveillance, and signals intelligence applications.

VeroVision from ChemImage Sensor Systems in Pittsburgh is a portable shortwave infrared hyperspectral imaging sensor for real-time, standoff detection capability for military, public safety, ordnance disposal, and law enforcement to screen for chemicals, explosives, and illegal drugs. It gives users rapid access to visual

IN BRIEF

Pentagon pours $53.1 million into military supercomputer research

U.S. military researchers announced an investment of $53.1 million into a U.S. Department of Defense (DOD) program to enhance high-performance computing (HPC), or supercomputer technology, for advanced research work. Officials of the U.S. Army Corps of Engineers in Huntsville, Ala., announced three separate contracts to two supercomputer companies to acquire commercially available high-performance computing systems for the DOD's High Performance Computing Modernization program. Cray Inc. in Seattle won a $26.6 million contract, while Silicon Graphics Federal LLC in Annapolis Junction, Md., won separate $17.6 million and $8.9 million contracts — all for purchase of high-performance computing systems, administration, and maintenance. The DOD's High Performance Computing Modernization program operates five DOD Supercomputing Resource Centers (DSRCs), located at the Army Corps of Engineers Engineer Research and Development Center in Vicksburg, Miss.; the Army Research Laboratory in Aberdeen, Md.; the Naval Meteorology and Oceanography Command at Stennis Space Center, Miss.; and at Air Force Research Laboratory facilities in Maui, Hawaii and Dayton, Ohio.



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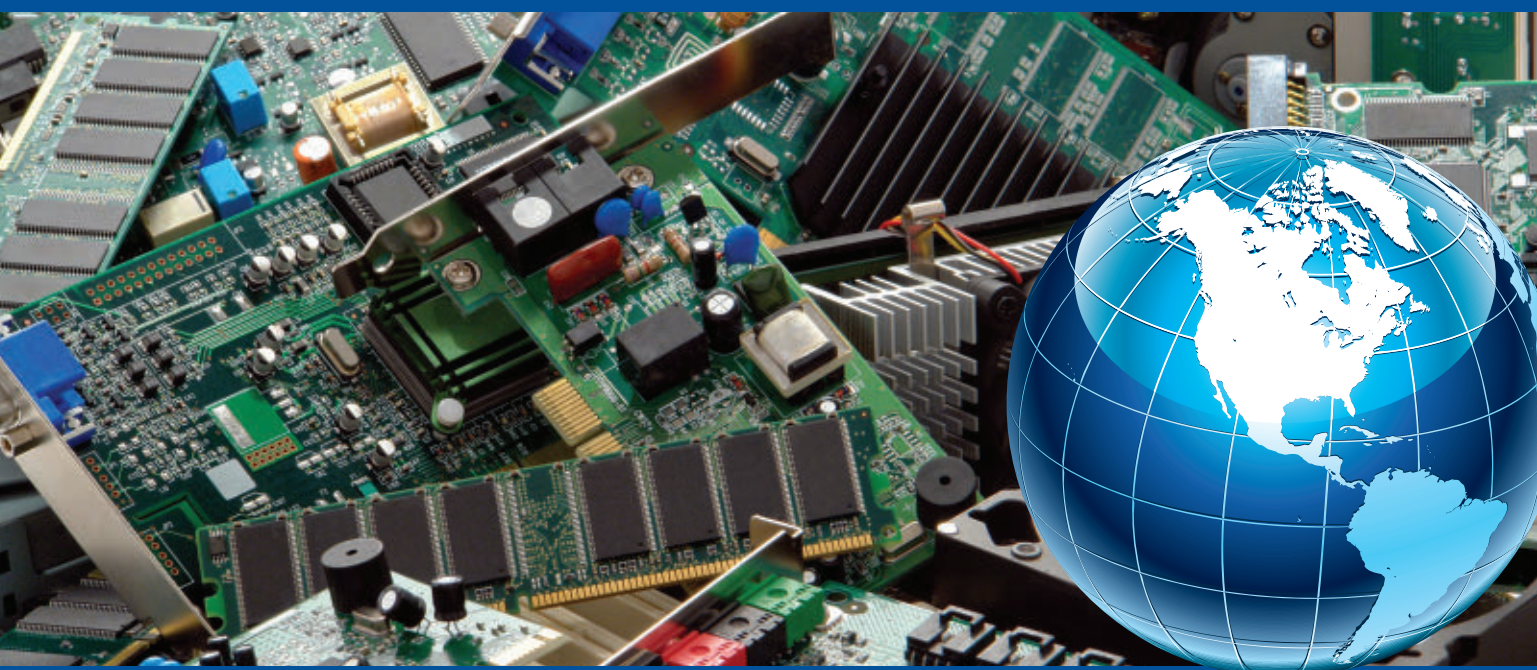

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information to improve situational awareness and reduce response time to threats packaged in bulk or in surface residues.

The NiCorAl coating for rugged circular push-pull connectors from LEMO SA in Ecublens, Switzerland, is a green alternative to cadmium and chrome VI coatings for aluminum-body connectors that must operate in harsh conditions such as salt spray. It satisfies guidelines of RoHS 2 and REACh 2017 without compromising corrosion resistance. Using reduced levels of chemicals, it offers 500 hours of corrosion resistance without using Chrome 6 in the process.

VXWORKS 653 3.0 safety-critical software from Wind River Systems in Alameda, Calif., is a commercial off-the-shelf (COTS) platform for delivering safety-critical integrated modular avionics. VxWorks 653 3.0 Multi-core Edition complies with ARINC specification 653, providing partitioning in time and space to ensure fault containment, and enabling reduced size, weight, and power (SWaP), as well as a reduced bill of materials (BOM) on advanced aircraft. It uses a certifiable hypervisor layer to take advantage of multicore hardware that until now has not been approved for safety-critical systems.

The AD9371 radio-frequency (RF) transceiver from Analog Devices Inc. in Norwood, Mass., is a wideband RF transceiver that helps reduce radio SWaP for military communications systems. It lends itself to improved spectral efficiency, range, and higher levels of RF performance to combat increasing signal interference. Applications include wide-bandwidth military satellite communication systems, long-range, high-definition video links in unmanned aerial vehicles (UAVs), spectrum monitoring, and small-form-factor multiband cellular base stations.

The V-SHIELD epoxy encapsulated packaging for rugged DC-DC converters from VPT Inc. in Bothell, Wash., features an epoxy encapsulated packaging design called V-SHIELD that resists chemical, solvent, and salt environments and is compatible with high-volume manufacturing processes, including wave solder, cleaning solvents, high-pressure sprays, and aqueous wash processes. V-SHIELD allows efficient thermal performance because it is encapsulated in a thermally conductive ep-

oxy that creates a heat path through either side of the package.

Here are the gold award winners.

The Masterclock Timing and Countdown System from Carl F Otto & Masterclock Inc. in Merritt Island, Fla., provides remote computer control of clocks and displays selection of event counts. It uses accurate real clocks instead of passive displays, as well as Ethernet and Masterclock software tools to provide switching, distribution, monitoring, and control of almost an unlimited number of clocks and event counts.

The M60 Upgrade Kit from the Curtiss-Wright Corp. Defense Solutions Division in Ashburn, Va., provides an innovative and affordable way to upgrade legacy M60 main battle tanks with modern electro-mechanical turret drive systems. It uses electro-mechanical technologies to enhance the performance of legacy hydraulic and hybrid turret-drive-based battle tanks.

The Abaco AXIS suite from Abaco Systems in Huntsville, Ala., is a collection of software development tools that enable users to accelerate the time-to-deployment of complex, multi-threaded applications based on embedded multi-core and single- and multi-processor platforms. AXIS can cut development time, reduce project costs and shorten time to market from initial stages of system design through later hardware and software changes.

The CertSAFE software engineering tool from CERTON in Melbourne, Fla., is a model-based development and verification tool that bridges the gap between systems and software teams by enabling rapid prototyping with validated requirements to ensure the correct systems are being built before the need to have hardware and target software. CertSAFE ensures cohesion between the system, software, and verification teams.

The ISL71840/41SEH radiation-hardened multiplexers from Intersil Corp. in Milpitas, Calif., are 30-volt, 16-channel multiplexers that act as drop-in replacements for Intersil's HS9-1840ARH, which has been aboard many satellite and space exploration missions, including NASA's recent Orion spacecraft flight test. The Intersil ISL71840/41SEH offers ESD protection and high signal chain accuracy and timing perfor-

SILVER

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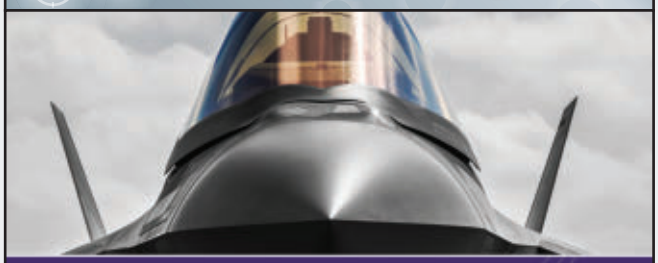

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The RPC24 Raid Array data storage system from Phoenix International Systems in Orange, Calif., supports TCG-compliant and FIPS 140-2-certified AES 256 encryption as well as instant secure erase when configured with solid-state disks and hard disk drives with these capabilities. Data security is a key component to any mass storage application and has been brought to the general public's awareness. For deployed military applications, data security has always been a concern and this data storage device helps make data-at-rest security more efficient and affordable.

The 760 series rugged electronic packaging for embedded computing from Atrenne Computing Solutions in Brockton, Mass., enables designers to deploy off-the-shelf Mini-ITX and PCI Express circuit cards in harsh environments that demand small SWaP. This series houses a processor board and three PCI Express cards in an 11.22-by-9.06-by-2.43-inch chassis that applies non-ruggedized commercial circuit boards to harsh environments like low-pressure and extreme temperatures of flight avionics.

The Intelligent Active Connector (IAC) from LEMO SA in Ecublens, Switzerland, helps maintain secure connections in military, aerospace, and other mission- and life-critical applications. It prevents unauthorized use, hazardous mismatching, and counterfeiting. A microchip can be featured in the plug connector to ensure it can be fitted only to a specific set of receptacles to guard against counterfeit.

The RES 3000 rugged Ethernet switches for military vetronics from Abaco Systems in Huntsville, Ala., features a modular design that provides as many as 24 ports of Gigabit Ethernet connectivity and four ports of 10 Gigabit Ethernet for vetronics and other rugged military applications. The RES3000 products are smaller, lighter, and less costly than other rugged layer 2/3 Ethernet switches, while offering a high port-count protocol, security, and compliance with the latest Ethernet standards and initiatives such as VICTORY.

Rounding out the awards, the silver winners are: the Ensemble LDS6526 Server Blade from Mercury Systems Inc. in Chelmsford, Mass.; Cobalt model 71664 200 MHz 16-bit A/D converter with programmable digital down converter based on the Xilinx Virtex-6 FPGA from Pentek Inc. in Upper Saddle River, N.J.; 3U CompactPCI SIU35 sensor interface unit with the Custom-on-Standard architecture from North Atlantic Industries in Bohemia, N.Y.; the Compact Rugged Avionics Interface Computer from Data Device Corp. (DDC) in Bohemia, N.Y.; the UMPIRE44 design and development tool form Foresite Inc. in Kokomo, Ind.; and the LOGIC Component Technology electronic switch guard and motor control from Applied Avionics in Fort Worth, Texas.

Army chooses rugged accelerometers from Meggitt for testing artillery shell

U.S. Army munitions researchers needed high-G rugged accelerometers to support test and measurement testing of the Raytheon M982 Excalibur satellite-gilded smart artillery shell. They found their solution from Meggitt Inc. in Irvine, Calif. Officials of the Army Contracting Command at Picatinny Arsenal, N.J., have announced a $7.1 million contract for high-gravity accelerometers for Excalibur and other telemetry programs. The Excalibur smart artillery shell has a ruggedized global positioning system (GPS) satellite navigation receiver and uses satellite signals to help guide itself to its intended targets. It first was fielded in Iraq in 2007 for urban or complex-terrain engagements in which collateral damage must be kept to a minimum. Meggitt designs and builds sensors that measure acceleration, speed, pressure, force, temperature, distance, position, vibration, and level in extreme environments like military weapons and civil power plants.

Surveillance and weapon unmanned aircraft are a growing threat to commercial infrastructure and heavy industry such as oil refineries, nuclear power plants, and airports.

The dawn of counter-drone technologies

The proliferation of relatively inexpensive unmanned aerial vehicles (UAVs) that can carry spy cameras or powerful explosives gives a sense of urgency to protecting airports, power plants, prisons, and military bases from the drone threat.

BY **J.R. Wilson**

One of the most frequently heard terms in the military and commercials worlds today is "disruptive technology" — something that so significantly changes the way things are done that entire industries and practices disappear as new ones arise. Small, cheap unmanned aerial vehicles (UAVs), easily available to anyone anywhere, are a major example of a disruptive technology.

While the U.S. military has dominated 21st century battle spaces with capable, sometimes armed, UAVs, nearly every nation and military on Earth is acquiring UAVs or building their own. That has led to the need for a counter-UAV (C-UAV) capability to defend U.S. and allied forces and critical infrastructure from enemy UAV surveillance, electronic warfare, and conventional attack.

Today's commercially available UAVs can carry surveillance cameras or a brick of powerful explosives. These miniature unmanned aircraft also are available to almost anyone over the Internet. This not only has created another level of threat for the military, but also has expanded the danger to power plants, sports arenas, ships, railroads, and pipelines.

While most small UAVs are operated legally, the threat from "bad actors" flying similar UAVs in the same airspace grows exponentially. This is creating a wide range of new industries, from legal practices specializing in UAV-based lawsuits or criminal charges to manufacturing and maintenance companies to a new generation of specialized small sensors to C-UAV systems.

Counter-UAV technologies are much like the armor/anti-armor developments prevalent in the last century: Build a stronger armor and someone will build a new way to pierce it. Build a better C-UAV capability and someone will create a new counter-C-UAV.

"All these C-UAV capabilities will lead to counter-counter — how do you make the drone unhackable. So it's a UAV/C-UAV arms race," says Michael Blades, senior aerospace and defense industry analyst at Frost & Sullivan in San Antonio, Texas.

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"While all these C-UAV companies are competing for this market, many are looking at a broad appeal that includes commercial requirements," Blades continues. "That has led to a search for synergies with other companies. Those same companies also are looking at hardening drones, something DARPA also is working on."

C-UAV is still in its infancy and many companies — large, small, and start-ups — only recently have begun looking at it as a prospective future high-growth market.

The Hitachi Visualization Suite (HVS) can correlate disparate data to cover everything from a college campus to very covert missions.

As with many others, experts at Hitachi Data Systems Federal in Reston, Va., began identifying the need about two years ago. A combination of in-house development and some technology acquisitions led to the marketing, about six months later, of the Hitachi Visualization Suite (HVS), which now has about two dozen active users.

"Within a geospatial format, with HVS you can see how disparate data correlates, not only geospatial but also time continuum. That covers everything from a college campus to very covert missions where you need to get real-time information out to the front line," explains Chris Jensen, director of HDS federal critical infrastructure, intelligence & investigative solutions at Hitachi Federal. "On the federal side, we added specific capabilities. We have our own design and development team to help us meet the need of a specific segment of the market."

He breaks down Hitachi's market segment into three parts: critical infrastructure, or anything from a sports stadium to a nuclear power plant; intelligence, or how to bring in information and create actionable intelligence out of it, then get that out to the end user; and investigative, or complex situations, such as conspiracies within the homeland or identifying and tracking terrorist cells internationally.

As with most high-tech areas today, the military is keeping a close watch on companies developing commercial products that the military could adapt for defense applications. Civilian markets also are benefitting from military developments, resulting in a complex and sometimes-contentious synergy.

"A lot of focus on the commercial side is being able to see the link between drone and operator and follow it back so the operator can be caught. It might not have been a malicious thing, but how do you know until you find the operator? So the commercial focus is detect and alert, then integrate into existing systems [for mitigation]," Blades says.

Countering drone swarms

"On the military side, a lot of top Army and Marine Corps brass are concerned about the potential for small, weaponized drone swarms. They don't think they really have a defense against that. So the military wants a multilayer detection capability and the option of either electronic or kinetic mitigation, depending on the area of operations, rules of engagement."

The potential threat from small UAVs in the hands of terrorists also has attracted the attention of regulatory agencies, such as the U.S. Federal Aviation Administration (FAA), which launched its Pathfinder Program in May 2015 as a partnership with industry to explore the next steps in unmanned aircraft operations beyond the type of operations the agency proposed in the draft small unmanned aircraft systems rule. The program began with three industry partners looking at possible UAV applications in different focus areas, all also vulnerable to potential UAV threats.

Cable News Network (CNN) in Atlanta is looking into visual

line-of-sight operations for the safe use of UAVs for news gathering in urban areas.

PrecisionHawk in Raleigh, N.C., is exploring extended visual line-of-sight operations in rural areas to enable UAV flights outside the pilot's direct vision for crop monitoring in precision agriculture.

The BNSF Railway Co. in Commerce, Calif., is exploring beyond line-of-sight command-and-control challenges to using UAVs to inspect rail system infrastructure in rural and isolated areas.

CACI International Inc. in Arlington, Va., is evaluating how the company's technology can help detect UAVs flying near airports.

In 2016, the FAA further expanded Pathfinder by signing co-operative research and development agreements (CRDAs) with Liteye Systems Inc. in Centennial, Colo.; Sensofusion USA in New York; and Gryphon Sensors LLC, an SRC company in North Syracuse, N.Y.

Liteye is the North American manufacturing and integration partner for three British developers working together on the Anti-UAV Defence System (AUDS) — Blighter Surveillance Systems in Great Chesterford, England; Chess Dynamics Ltd. in Horsham, England; and Enterprise Control Systems Ltd. in Wappenham, England. The CRDA calls for Liteye to test the AUDS integrated detect-track-disrupt-defeat C-UAV system at U.S. airports selected by the FAA.

AUDS integrates Blighter's A400 series Ku-band electronic scanning air security radar; Chess Dynamics' stabilized electro-optic director, infrared and daylight cameras, and target tracking software; and an Enterprise directional radio frequency (RF) inhibitor to detect, track, classify, disrupt, and defeat

The Sensofusion AIRFENCE system offers a smartphone app to warn users of drone intrusions around sensitive perimeters.

UAVs as far away as six miles. The team claims AUDS also is effective against Group 1 micro and mini UAVs at ranges of several miles.

UAV-aircraft near misses

More than 100 pilot reports occur every month about UAVs flying too closely to U.S. airports and commercial aircraft. This has created a major safety concern for the FAA, and a security issue for the U.S. Department of Homeland Security (DHS).

"AUDS is able to operate effectively in complex airport environments night and day, whatever the weather, and without disrupting other airport equipment. Using AUDS, the operator can effectively take control of a drone and force a safe landing inside or outside the airport perimeter," according to Mark Radford, speaking on behalf of the British/American team.

"The system can also assist airport authorities to track down the UAV pilots for prosecution by providing evidence — video footage or radar tracks — to the relevant authorities. We can also integrate 'friendly assets' into the AUDS platform — for example, a 'friendly' drone — to extend the threat detection and situational awareness capabilities of the system and to help capture rogue drone pilots," Radford says.

Sensofusion will test its AIRFENCE system, already being used in Europe to help secure high-profile government buildings, police and military sites, and prisons, as a C-UAV candidate to defend U.S. airports from hostile or intrusive UAVs.

"We first developed the technology to detect, locate, track, and gain control over UAS three years ago as a military project and operated it with three European armies under NATO," says Sensofusion CEO Tuomas Rasila.

DeDrone GmbH in Kassel, Germany, has developed the DroneTracker multi-sensor, counter-UAV system.

Gryphon will test a prototype UAV sensor detection system at FAA-selected airports. "Detecting these threats is challenging because most of them are very small, fly low to the ground, and can be pre-programed to fly autonomously," notes company president Tony Albanese.

"We anticipate receiving valuable data from each of these trials that could result in FAA-approved operations in the next few years. They will also give insight into how unmanned aircraft can be used to transform the way certain industries do business — whether that means making sure trains run on time, checking on the health of crops, or reporting on a natural disaster," FAA Administrator Michael Huerta says. "[Our industry partners] reached out to the FAA to work with us on exploring [unmanned operations and] have committed extensive resources to perform research that will help us determine if and how we can safely expand unmanned aircraft operations in the United States."

Many aerospace companies of all sizes — some with UAV backgrounds, some without — have joined the C-UAV effort.

Growing counter-UAV effort

Airbus Defence and Space in Toulouse, France, has developed a C-UAV System combining the company's radars, IR cameras, and direction finders with state-of-the-art data fusion and signals analysis. The system can identify an approaching drone and assess its threat potential at ranges between 3.1 and 6.2 miles, then offer electronic countermeasures like its Smart Responsive Jamming Technology, to minimize the risk of collateral damage.

"As a specialist in defense electronics, we have all the technologies in our portfolio and the integration knowledge needed to set up a quick-response protection system with extremely low false alarm rates," claimed Thomas Müller, head

of electronics and border security at Airbus Defence and Space.

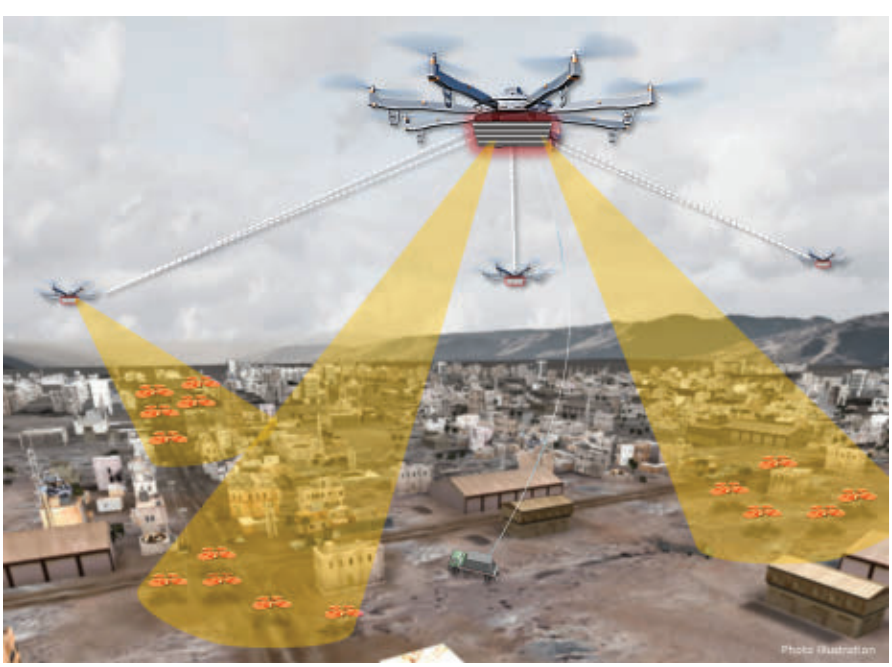
Another United Kingdom company — Drone Defence in Doncaster, England — recently announced what it calls Drone Defenders, former military and law enforcement personnel trained to use the Dedrone DroneTracker to detect and identify unauthorized UAVs, then employ either the company's man-portable Dynopis E1000MP to jam the UAV's controls or its Net Gun X1 C-UAV system to capture the aircraft. Operating from either a fixed location or as a mobile unit, DroneTracker uses acoustic, optical, and infrared sensors for real-time detection and identification.

In September, Van Cleve & Associates in Alexandria, Va., and Open Works Engineering in Riding Mill, England, bested six other international competitors to win the non-profit Mitre Corp. Countering Unmanned Aircraft Systems Challenge.

Van Cleve's DroneRanger was declared the best end-to-end system and best detection tool for interdicting small UAVs, while the Open Works SkyWall 100 won in the interdiction system category. The other finalists were:

— the DroneTracker from DeDrone GmbH in Kassel, Germany;
— the Mesmer platform Department 13 International in Columbia, Md.;
— the Icarus system from Lockheed Martin Corp.;
— the Knox platform from MyDefense Communications in Sundby, Denmark;
— the Dronebuster system from Radio Hill Technology in Portland, Ore.; and
— the DroneBlocker tool from TrustComs/Trifecta Global in Versailles, France.

MITRE C-UAS Challenge entrants from around the globe were asked for solutions that could detect drones smaller than five pounds during flight and determine which



U.S. military researchers are developing the Aerial Dragnet system for persistent wide-area surveillance of several small UAVs in urban terrain.

were threats, based on geographic location and flight trajectory, then interdict those perceived as threats by forcing them to land in a safe area for intact recovery.

Today's counter-drone systems must be able to work quickly, as terrorists and other criminals are weaponizing commercial UAVs with potentially disastrous results.

Counter-drone research

The U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., is investigating C-UAV, for future applications and more near-term use. Two of those are Aerial Dragnet and the Multi-Azimuth Defense Fast Intercept Round Engagement System (MAD-FIRES).

The 13 September 2016 Broad Area Announcement DARPA issued for Aerial Dragnet described the need and the goal for persistent wide-area surveillance of multiple small UAVs in urban terrain on a citywide scale. "Small UAS [unmanned aircraft systems] are rapidly becoming low-cost aerial platforms for hostile reconnaissance, targeting, and weapon delivery," DARPA officials say.

Unlike traditional air targets, small UAVs fly at altitudes lower than 400 feet above the ground, which make them easily hidden by complex terrain. These small unmanned aircraft also move more slowly than 90 knots, which makes them difficult to differentiate from other movers. These unmanned aircraft also are smaller than 55 pounds, making them difficult to sense.

"In future urban battlegrounds, U.S. forces will be placed at risk by small UAS that use buildings and naturally occurring motion of the clutter to make surveillance impractical using current approaches," DARPA officials say. "The rapid proliferation of commercial UAS with increasing endurance and payload capacity drives the need for a future urban aerial surveillance system that can detect, track, and classify many different UAS types at longer ranges in urban terrain."

Existing C-UAV approaches, the DARPA Aerial Dragnet solicitation continues, rely either on line-of-sight (LOS) target viewing not possible in urban terrain, or exploit fragile vulnerabilities of commercial UAVs.

"This program seeks to develop systems for threat-agnostic non-line-of-sight (NLOS) surveillance that exploit and adapt to the fundamental physics of the threat and the urban environment," the Aerial Dragnet solicitation says. "To achieve wide-area performance, proposals are solicited for a scalable network of surveillance nodes, each consisting of sensors mounted on a persistent unmanned aerial platform that can sense over and into complex terrain. The resulting system will produce real-time situational awareness of the airspace in urban areas below altitudes covered by conventional air surveillance systems."

Program Manager Jeff Krolik says real-time linkage of Aerial Dragnet's multiple UAVs and sensors can provide a comprehensive network for persistent wide-area surveillance of all low-flying UAVs in an urban setting. "Commercial websites currently exist that display in real-time the tracks of relatively high and fast aircraft — from small, general aviation planes to large airliners — all overlaid on geographical maps as they fly around the country and the world," Krolik says. "We want a similar capability for identifying and tracking slower, low-flying unmanned aerial systems, particularly in urban environments."

Counter-drone surveillance

The program office anticipates achieving that goal through innovative networking of surveillance nodes, perhaps mounted on tethered or long-endurance UAVs, to cover neighborhood-sized urban areas.

Using sensor technologies to look over and between buildings, the nodes could maintain UAV tracks even when the aircraft disappears around corners or behind objects.

Aerial Dragnet's sensor data would inform a continually updated common operational picture (COP) of the airspace at altitudes below where current aircraft surveillance systems can monitor, using secure data links to electronically disseminate it to authorized users. DARPA says the program also will focus on combining low-cost sensor hardware with software-defined signal processing hosted on existing UAVs, resulting in cost-effective, scalable urban coverage and rapid upgradeability as new, more capable and less expensive technologies become available.

DARPA's MAD-FIRES program is strictly for military use, although it may yield some commercially valuable anti-drone technologies. MAD-FIRES was created in response to an escalating rate of attacks by unmanned vehicles, missiles, small planes, fast attack craft, and other platforms posing "a perennial, evolving, and potentially lethal threat to ships and other maritime vessels." Those risks, combined with ever-morphing threats, make leading-edge defensive air and surface combat technologies critical. That is especially true for ships equipped with current close-range gun systems, enhancing their ability to rapidly and with high precision engage a swarm of diverse targets coming from a range of directions.

"The goal of the program is to design and develop technologies associated with a medium-caliber guided projectile that would combine the guidance, precision and accuracy generally afforded by missiles with the speed, rapid-fire capability, and large ammunition capacity afforded by bullets," explains MAD-FIRES Program Manager Jerome Dunn.

"MAD-FIRES aims to advance the state-of-the-art in defensive gun systems by creating a new, low-cost technological foundation for guided, gun-launched projectiles. Specifically, MAD-FIRES aims to incorporate enhanced ammunition rounds able to alter their flight path in real time to stay on target and a capacity to continuously target, track, and engage multiple fast-approaching targets simultaneously and re-engage any targets that survive initial engagement," Dunn says.

Rapidly evolving technologies

The future of small UAVs as a threat to military and civilian infrastructure — and human lives — and the level of success achieved through dozens of C-UAV efforts involving a host of different sensors and mitigation technologies remains murky, but rapidly evolving.

"On the defense side, you'll see more use at forward-deployed locations, integrating C-UAV into existing perimeter security systems, such as tethered aerostats, to cover more area. You'll see more deployable systems that can be easily transitioned to a mobile capability. Northrop Grumman recently demonstrated a system where an app on a soldier's smartphone can use its microphone to detect small drones. The range probably isn't great, but if every soldier is a sensor, that would help detect and triangulate," says Hitachi Federal's Jensen.

"On the commercial side, you'll see a lot more interest as proliferating small commercial drones get used for more and more applications. Companies won't want them flying over their test sites, the public won't want them flying over their homes. Stadiums, prisons, will show a much greater interest as people gain more ideas on what they can use drones for, including bad uses. So there will be lots of investment and attempts to defeat all kinds of drones and swarms, plus how to then defeat those. And that will just keep going back and forth," Jensen says.

While concern is growing about the kind of threats posed in a world filled with small, but increasingly versatile UAVs and hundreds of millions of dollars are being devoted worldwide to develop C-UAV technologies, reality may be lagging behind perception, at least for now, says Frost & Sullivan's Blades.

"It's a perceived threat. Whether that is real now is questionable. If it is a threat, why wasn't it one long ago with model airplanes? Granted, once you take off a fixed-wing model airplane, there's not a lot it can do between take-off and landing, while the more maneuverable UAV can get into smaller, more confined spaces," Blades says.

"C-UAV is almost all sensor-based, with the military spending millions on better sensors with better SWaP, which has driven a lot of innovation," Blades adds. "For now, the capability of inexpensive rotor-wing drones and autonomy is not yet to the point where a terrorist cell could get 20 or 30 drones and send them out in a swarm attack. It's probably not that far off." ←

Time to invest in test and measurement tools

Aerospace and defense organizations look to advanced test and measurement equipment to support both legacy and cutting-edge systems.

BY **Courtney E. Howard**

Innovation in aerospace and defense technologies happens at an exponential pace, as does development in test and measurement technologies, says Jeremy Haynes, electronic warfare (EW) business lead at Keysight Technologies Inc. in Englewood, Colo. "While companies are focused on developing the next generation of military [and aerospace] electronics, they must ensure their effectiveness prior to being used in an operational setting," driving demand for test equipment.

"Having innovative test and measurement solutions can allow an engineer to identify and fix problems early in the development of a new technology; oftentimes, waiting until the end of the product life cycle can prove to be cost prohibitive," Haynes says. "By investing in the correct [test] solutions, you can reduce cost and, most importantly, reduce risk to your projects."

Engineers use test and measurement solutions throughout the entire product life cycle, from modeling and simulation on a research and development (R&D) bench to flight testing and operational applications, Haynes explains. As an example, he says, Keysight's test and measurement technologies "are deployed in such diverse applications as measuring parametric values of power amplifiers to simulating advanced electronic warfare (EW) scenarios for next-generation warfighters."

Virtual Instrument Portable Equipment Repair/Test (VIPER/T) systems from Astronics Test Systems are used on the back of and also to support various military light armored vehicles.

Given the diversity of electronics and missions, aerospace and defense organizations increasingly are enticed by scalable, flexible test tools. With that in mind, Keysight engineers designed the N9952A FieldFox 50-gigahertz (GHz) handheld microwave analyzer as a tool to span the application space, whether a companion tool to an R&D bench or advanced measurement science deployed into an operational scenario, Haynes adds.

"Look for the increased utility in your test and measurement equipment rather than dedicated assets to serve a single function," says Darren

McCarthy, aerospace & defense technical marketing manager at Rohde & Schwarz America (R&S) in Beaverton, Ore. For example, he says, as a standalone product, the R&S FSW signal and spectrum analyzer can provide RF and microwave performance analysis for radar transmitters using optional software for pulse, chirp, continuous wave (CW), or frequency-agile signal analysis.

The R&S SMW200 vector signal generator can test radar receivers or, in a multichannel configuration, it can test and calibrate beam-steering antenna and direction finding systems. In combination, the FSW and SMW200 can perform power and flexible functional test of the radar itself; a radar echo generator can be used to calibrate a radar, validate functionality, and verify DSP and settings of the radar configurations.

Mitigating obsolescence

Obsolescence mitigation is driving increased investment in test equipment. "Most military and aerospace programs run for years, and companies must keep the technology fresh so that they can add new capabilities, plus address the obsolescence issues that always crop up," says Gary Tilley, director of sales and business development at Astronics Test Systems in Irvine, Calif.

"With the current budget restraints, weapons systems such as B-52 or A-10 [military aircraft] are commonly required to extend their anticipated lifetime," Tilley explains. "This shifts focus away from investing in test solutions for new weapons systems toward investments for maintaining the aging fleet by solving the obsolescence issues on a much more frequent rate."

Obsolescence is an important driver of test equipment updates, Tilley says. "Companies can come and go, and products can come and go, but end users need to stay current to keep the equipment running. Customers are continually looking for intelligent ways to accomplish this. Military and aerospace companies and programs also are continually refreshing the systems they have. Most customers would rather add a capability to an existing system rather than build a new system, if possible."

Capabilities and eCASS

Military and aerospace organizations worldwide are simultaneously maintaining current equipment and driving toward more complex, sophisticated systems — growing the need for more capable test and measurement equipment.

"As we put new technology in the field, we need to upgrade our test capability to stay ahead of that new technology," says Tilley, who commends U.S. Naval Air Systems Command (NAVAIR) engineers for their work on the Consolidated Automated Support System (CASS), and new electronic stations known as eCASS.

Keysight's N9952A FieldFox handheld microwave analyzer spans the application space, from an R&D bench to operational scenarios.

"NavAir refreshed the technology as they transitioned from the older system to the newer system for testing aircraft and weapons on carriers. The organization maintained backward compatibility as a requirement, enabling the eCASS stations to leverage the test program set from the older CASS program," Tilley explains.

Engineers at the Lockheed Martin Corp. Rotary and Mission Systems segment in Orlando, Fla., are assisting the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., with the upgrade, maintenance, and support of U.S. Navy combat avionics test equipment. Lockheed Martin engineers will provide performance-based logistics (PBL) maintenance and support for as many as 400 CASS avionics test stations and 150 Reconfigurable Transportable CASS (RTCASS) stations. CASS, the Navy's standard automatic test equipment (ATE) family supporting electronics on naval aircraft, is designed to help warfighters troubleshoot and repair aircraft assemblies at sea or ashore and return the avionics to service quickly.

A more modern version of CASS, eCASS test equipment includes: radio-frequency systems, self-maintenance and test calibration operational test program sets, calibration equipment kits, shore installation kits, ship installation kits, test program sets development suites, high-power mission equipment kits, and electro-optic mission equipment kits. Lockheed Martin delivered the first modernized eCASS station in late 2014 to support all the aircraft in the Navy's fleet, including the F-35 Lightning II joint strike fighter (JSF).

"New technology is required to fully test any new systems, such as the JSF," Tilley says. "New weapons, aircraft, and other systems are coming online all the time, and they bring new and growing demands." As an example, he says, the Federal Aviation Administration's (FAA's) Next Generation Air Transportation System (NextGen) will require all new test capabilities for aircraft avionics systems as the world moves from analog, ground-based aircraft communications to satellite-based, digital aircraft communications. "The test requirements will change, requiring more digital instrumentation than analog instrumentation. In essence, it will flip the switch on test requirements to a new set of completely different parameters."

NextGen testing

Test and verification of avionics hardware and software systems are integral to ensuring the safety and efficiency of aircraft in U.S. National Airspace System (NAS), as well as virtually all air traffic management/air traffic control (ATM/ATC) infrastructures worldwide. Aerospace and defense firms rely on modern software analysis, test, and verification tools to ensure the safety and help speed the availability, certification, and deployment of myriad safety- and mission-critical airborne systems and platforms.

Atlantic Inertial Systems Limited, part of aerospace system and component manufacturer UTC Aerospace Systems, in Plymouth, England, adopted the CodePeer static analysis tool from AdaCore, with headquarters in New York and Paris, to perform a software test of its TERPROM digital terrain system for military transport aircraft. AdaCore products have helped to field and maintain a range of critical space, commercial avionics, military, and ATM/ATC systems, officials say.

Atlantic Inertial Systems engineers will use CodePeer to facilitate the certification, by authorities such as the FAA and European Aviation Safety Agency (EASA), of UTC Aerospace Systems' TERPROM terrain referenced navigation software, which enables the TERPROM system to provide precise, reliable, and predictive ground proximity warnings.

CodePeer automates the review and validation of Ada source code, helps detect potential errors early in product development, and automates several verification activities. The availability and functionality of such software test tools are credited with saving both time and money, especially compared to manual code review procedures, as well as providing "deep insight into potential issues and automating parts of the DO-178B verification process for the certification of software in airborne systems," officials say.

"Sound static analyzers allow code reviews to be significantly more effective and less time consuming than traditional manual methods," says Cyrille Comar, AdaCore president and a member of the SC205 (DO-178C) Working Group. "This automation is a major new trend in the verification of critical software."

AdaCore officials are seeing growth in the use of advanced static verification solutions, such as the company's CodePeer and SPARK Pro, says Martyn Pike, technical account manager at AdaCore in the United Kingdom. "Model-based design is clearly having an impact in the embedded systems development world, particularly through products like Simulink and Stateflow. AdaCore's QGen qualifiable code generator for [MathWorks] Simulink and Stateflow models brings software test technology such as coverage testing and testing through processor emulation to the model verification arena. The use of model-based design will hopefully continue and allow system-level verification technologies to flow down into software verification and vice versa.

"Test solutions are not always about dynamically testing the software and many properties of the software can be verified statically, allowing for early detection and removal of bugs and vulnerabilities, even before a single line of code is executed. Strive for automation and put in place a continuous integration process so bugs and vulnerabilities can be detected as early as possible," Pike recommends.

Astronics' CTS-6000 radio test set delivers several test instruments in a single unit.

Safe, accurate air navigation

Engineers at prime contractor Moog in East Aurora, N.Y., used test and measurement equipment from Rohde & Schwarz (R&S) to help solve important measurement challenges, explains McCarthy of Rohde & Schwarz America.

Moog engineers selected the R&S EDS300 distance measurement equipment (DME)/pulse analyzer as a standard test solution for research & development, manufacturing, and field deployment of the company's MM-7000 series navigation aids, including the Moog MM-7000 advanced, full-service Tactical Air Navigation System (TACAN) and DME Beacon-Transponder, which are designed to provide the precise, reliable civil and military aircraft navigation vital to ensure international aviation safety.

The R&S EDS300 remote-controlled level and modulation analyzer can be deployed for the continuous monitoring, recording, and analysis of pulsed terrestrial navigation signals, while R&S EDS300 TACAN software includes measurement functions for analyzing signals from TACAN stations.

"The R&S EDS300 has the performance and sensitivity we need in the lab and manufacturing environment, plus it offers a robust and compact design for field testing the air interface of the MM-7000," says Moog Director of Engineering Achim Soelter. "The R&S EDS300 is an integrated test solution that enables Moog to have a standardized test process for verifying the performance of our TACAN and DME products at all stages."

Flight test and FAA requirements

Oregon-based aviation service providers Erickson Inc. and Helicopter Transport Services (HTS) are conducting flight tests of their jointly designed and developed advanced composite main rotor blades (CMRB) for the S-64 Aircrane and CH-54 Skycrane heavy-lift helicopters used globally for fire suppression and emergency response.

The new rotor blades are designed to increase aircraft perfor-

mance at high elevations and temperatures, as well as increase fuel efficiency and reduce manufacturing and maintenance costs. Erickson engineers are conducting helicopter flight tests with the goals of perfecting the rotor blade design and achieving airworthiness certification and operation approvals. Flight testing is expected to span several months and certification is expected by the end of 2016.

"We use a suite of National Instruments data acquisition and recording equipment that utilizes a hybrid [Microsoft] Windows XP operating system and LabVIEW [system design] software," says Ian Gibson, chief engineer and FAA Powerplant Designated Engineering Representative (DER) at Erickson Inc. in Medford, Ore. "All our flight test parameters are fed into this equipment."

A custom-built data gathering and telemetry system, designed and manufactured to Erickson's specifications by Advanced Telemetrics International (ATI) of Spring Valley, Ohio, facilitates the transmission of flight test data from the rotating sensors affixed to the blade, rotor heads, and both main and tail and drive shafts. VGO engineers in Portland, Ore., instrumented the composite main rotor blade.

"We have over 100 recorded data channels, 45 of which are wireless telemetered by the ATI equipment," Gibson says. "With the exception of the instrumented main rotor blade, Erickson has designed and installed all the various data channel sensors which include strain gages, linear and rotary potentiometers, accelerometers, and ARINC 429 data stream pick-offs.

Gulfstream Aerospace engineers use Moog Aerospace Test Controller systems to analyze wear and tear on business aircraft wings, fuselage, empennage, and components such as flaps, elevators, and horizontal stabilizers.

"For calibration purposes, the instrumentation package including the ATI telemetry was built up in our lab space and used to ensure accurate readings from the strain gages. Calibration loads were typically applied using Erickson-designed and -manufactured custom fixtures and load cells; but, where the instrumented hardware was small enough, we utilized a calibrated Instron tensile test machine to apply the required loads," Gibson continues.

Erickson engineers are working closely with the FAA's Fort Worth, Texas, Rotorcraft Directorate to capture test data to ensure the safety and enhanced performance of the new blade, and enable the successful certification of the composite main rotor blades. Flight testing ranges from the initial hover flight (collecting blade, rotor head, tail rotor, and other levels of strain) to company flight envelope expansion (to prove handling qualities are appropriate and as expected), FAA-sanctioned flight strain survey (the data from which will in part be used to specify loadings for the full-scale fatigue test article) through to performance testing at low- and high-density altitudes that will provide the data to publish flight manual performance limitations.

The plethora of rotating instrumentation required for these tests proved challenging, despite Erickson's extensive experience with flight tests. ATI provided the bespoke equipment to bridge the dynamic-to-static interface.

"For all the sensors installed, the environment is extremely challenging. The levels of vibration, while significantly reduced by the new blade, and exposure to dynamic environments were and still are a challenge," Gibson says. "Where strain gages are in areas only accessible by significant disassembly — for example, the gearbox main shaft — we installed and calibrated redundant sensors to account for any possible loss during the test program. Up to this point in time, we have had very few sensor failures, and none in areas requiring disassembly. The CMRB strain gages that are exposed to sunlight, high-g loading, and intense aerodynamic forces have been extremely robust."

Incorporating this equipment onto the airframe and, in particular, installing the data acquisition unit into the cockpit has turned the S-64 aft piloting station into a flight test engineer's (FTE's) office, Gibson says. The FTE runs the equipment, monitors test parameter alarms, and coordinates with the flight crew to navigate through each flight test card.

"The use of reliable and easy-to-use instrumentation is the key to successful flight test," Gibson says. "Loss of a test card's worth of data

results in re-flight that is expensive and inefficient. If the FTE can run the system easily in the challenging environment of a helicopter cockpit, your data is that much more reliable and in need of far less re-testing." (For more on Erickson Inc.'s composite main rotor blade and flight testing, visit *Intelligent-Aerospace.com*.)

NAVAIR needs

The Naval Air Warfare Center Aircraft Division (NAWCAD) at Patuxent River Naval Air Station, Md., is opening a new operations center for NAWCAD's Atlantic Test Ranges (ATR) to support simultaneous test operations for current and future naval aviation programs, including unmanned systems and live, virtual, constructive (LVC) battle space environments.

"The new operations center will help us meet the requirements of future major Navy programs, reduce scheduling conflicts, and provide more secure information-processing capability for our test ranges. That, in turn, supports delivering new systems to the fleet faster," says Rear Adm. Shane Gahagan, NAWCAD commander.

NAWCAD's Atlantic Test Ranges provide full-service support of testing and training for naval aviation aircraft and aircraft systems throughout their service life. The 17,000-square-foot addition to the existing ATR facilities at Patuxent River Naval Air Station will include secure, multipurpose mission test cells built to support current and future flight test programs, such as the MQ-25A Stingray, Next-Generation Jammer, Next-Generation Air Dominance platform(s), and the Unmanned Aircraft Common Control Station, along with system-of-systems interoperability efforts, officials say.

"ATR is always pushing to remove constraints and provide the capabilities that naval aviation test programs need," says Robert Vargo, ATR director. "I'm excited because this facility will provide well into the future the capacity and capability to get the mission accomplished on time. In short, this addition allows us to support the future now."

In July 2016, Rohde & Schwarz won a potential $1.56 million NAVAIR contract for as many as 338 Model R&S RTE1054 digital oscilloscopes. Digital oscilloscopes acquired through the five-year, indefinite-delivery/indefinite-quantity contract will support the Department of the Navy Metrology and Calibration (METCAL) program, fulfilling NAWCAD's oscilloscope requirements.

The Naval Air Warfare Center Aircraft Division supports the research and development, engineering, test, and evaluation of all Navy and Marine Corps air vehicle systems and trainers, as well as manages test ranges, test facilities, laboratories, and aircraft necessary to support the fleet's acquisition requirements.

NAVAIR METCAL equipment funding is used to procure Calibration Standards (CALSTDs) and ancillary equipment for aviation fleet intermediate calibration activities, fleet training activities, and Aviation Navy Calibration Laboratories (NCLs) to support aviation organizational- and intermediate-level maintenance assets.

Warfighters in the field rely on portable, capable test systems to verify the operation, effectiveness, and reliability of myriad electronics systems, including mission-critical communications.

Electronic warfare

Investment in test and measurement is growing at a modest rate for the aerospace and defense sector, says Keysight's Haynes. "However, certain segments are seeing much larger growth than others. With the military's focus on dominating the electromagnetic spectrum, we

Erickson Inc. flight test data is fed into National Instruments hardware with LabVIEW software.

see significant growth in the electronic warfare and signal intelligence segments."

Giga-tronics Inc. EW and Radar Test Solutions Director Armand Pantalone in San Ramon, Calif., is seeing an uptick in advanced signal generator (ASG) adoption, and a rapidly growing need for advanced signal analyzers in aerospace and defense. Multiple radar and EW defense contractors are using Giga-tronics' line of agile, coherent, wideband RF synthesizer/RF upconverter products to generate complex radar and jammer signals for radar and EW system stimulation, integration and test, and evaluation, he says.

"NAVAIR, Raytheon Integrated Defense Systems (IDS), and Lockheed Martin Aerospace use our product line extensively," Pantalone says. "Raytheon IDS uses a set of eight signal generators with our coherent system architecture to generate simulated radar targets, plus sending RF uplinks and processing RF downlinks in a sophisticated real-time, closed-loop hardware in the loop (HWIL) test facility dedicated to the integration and test of a well-known air defense system utilizing a missile interceptor with a radar seeker."

At the same time, "Lockheed Martin Aerospace uses the signal generator as an RF upconverter and the signal analyzers as an RF downconverter in its Modular Adaptable Radar Simulator (MARS) to do completely closed-loop testing of EW systems," Pantalone adds. "Raytheon IDS also chose both the signal generator and signal analyzers as the heart of its new EW simulator upgrade to the long-established Radar RF Target Generator and HWIL facility for testing surveillance and tracking functions of an air and missile defense radar system."

Giga-tronics' product engineers are developing an integrated test suite, called the Threat Emulation System (TEmS), for NAVAIR in Point Mugu, Calif. The TEmS presents a multichannel, independent, and programmable "multi-ship" dense radar environment threat emulator to stimulate the systems under test, Pantalone explains. "For this program, we partnered with Lockheed Martin's Aerospace group to develop the ability for the client and end user to script some dense target and threat environments that are tactically realistic with a very user-friendly software interface. That integrated system and solution is on track to ship before the end of 2016."

RF test

System complexity continues to grow and drive the need for more sophisticated test equipment. Aerospace and defense organizations have a need for "more and more sophistication and complexity in creating more tactically realistic test environments for radar and EW systems," Pantalone says. It is no longer enough, he says, for an engineer to compare test and measurement equipment solely based on figures such as performance specifications on a data sheet or price.

"Performance parameters like frequency coverage, spectral purity, phase noise, etc. are all well-known and have to be considered no matter what you're looking at or for," Pantalone admits. Yet, in RF test today, "there is a new paradigm, where the operational and program concerns reach way beyond just mere technical parameters and they all must be considered."

In fact, Pantalone recommends considering all major concerns, including operational and technical characteristics, as well as taking a holistic view of test. "Mil/aero engineers and engineering managers shouldn't just think of selecting test and measurement equipment as parts, but to think of the big picture now that fully designed and fully integrated test solutions and test environments exist and are commercially available."

One wideband solution that works across several programs or the company's product line makes a lot of sense versus "narrow-banded" and purely custom designs that support only one program, each having their own design costs, risks, and delivery/time-to-capability schedules/timelines, Pantalone says.

Measuring performance

Engineers at RF-Lambda, a manufacturer of passive and active RF and microwave components and subsystems in San Diego needed test and measurement instruments capable of delivering a high degree of accuracy and repeatability to help solve real-world measurement challenges.

They selected Rohde & Schwarz to provide the R&S ZVA vector network analyzer and R&S FSW signal and spectrum analyzer after an in-depth analysis. The measurements evaluated performance parameters that are essential for optimizing the performance of RF-Lambda's components and modules for end users.

RF-Lambda's product testing faces tough measurement challenges on a daily basis due to performance requirements such as high dynamic range and linearity, low noise floor, high peak to average ratios, and ultra-wide frequency bandwidth. Engineers selected several of the company's components for comparative tests: Model RFDAT0118G8A and RFDAT0040G5A digital control step attenuators, Model RFPSHT450M1D8 digital step phase shifter, RLNA00M50GA high-gain low-noise amplifier (LNA), and a custom transmit/receive module for an airborne application at 67 GHz.

RF-Lambda engineers were having difficulty achieving repeatable measurements of phase continuity over the full bandwidth of the attenuator and phase shifter components. They worked with Rohde & Schwarz engineers who made the same measurements using the R&S ZVA vector network analyzer, which was able to make measurements that represented the true performance of the components across the measurement band.

With the R&S ZVA, RF-Lambda engineers were able to adjust phase and amplitude in very fine increments, which is important when testing digital controllable step attenuators and phase shifters widely used in orthogonal frequency division multiplexing (OFDM) and phased array radar systems. At the same time, the very low noise floor of the R&S FSW signal and spectrum analyzer enabled the design team to measure phase noise performance of the transmit/receive module directly and at frequencies up to 67 GHz, eliminating the need for corrective noise cancellation techniques, external mixers, and a separate, dedicated phase noise test system, officials say.

"By evaluating [the Rohde & Schwarz instruments] using measurement challenges we were actually facing, their superior characteristics became all the more evident," explains RF-Lambda Director of Engineering Michael Liu. "In addition, the Rohde & Schwarz technical support team was very responsive and helped us optimize our test results."

Military personnel harness Astronics Test Systems equipment to test jet engines on an aircraft carrier.

Radio communications

As military radios evolve into more complex systems, the need escalates for sophisticated portable testing solutions, affirms Tilley of Astronics Test Systems. Field testing is an area of growth in aerospace and defense, as is at-platform testing for communications systems on aircraft, he says.

The Australian Department of Defense invested in a new tactical radio system; yet, they did not have a solution to test the radios in the field and shipping radios back to a depot for testing is time consuming and expensive, Tilley says.

Seeking a faster turnaround, they purchased the Astronics CTS-6000 radio test sets. "These portable devices provide more than 12 synthetic test instruments in a single tablet-sized device, making it easy to perform tactical radio testing at the operational level. Today, more than 100 units are deployed, and their technicians are being trained on the devices both in the classroom and in the field," Tilley adds. "By bringing the test system to the point of use, the Australian DOD expects to save time, cost, and reduce frustrating 'no fault found' errors."

U.S. Marines pack test systems on trucks for portability. Astronics' VIPER/T test system is used in the field to test anything from laser sights on weapons to Javelin missile electronics. Astronics Test Sys-

tems assisted the Marines in modernizing this legacy system, Tilley explains. "After a trade study and analysis, Astronics provided an updated configuration for the test equipment, which included upgrading the digital test capability, a modernized controller, some analog instruments such as a digitizer, and other equipment. The Marines will be rolling out a fresh, updated solution in the coming year for a Foreign Military Sales (FMS) requirement."

The N-GEN Test System from Astronics Test Systems is a turnkey solution designed to provide a complete test environment for any type of engine testing, at any location.

Mission-critical systems test

Military personnel understand well the importance of reliable, capable communications. It is not surprising, then, that defense departments worldwide insist on accurate test solutions to ensure communications equipment is functioning as intended.

An undisclosed international military organization has selected the GENASYS mixed-signal test system platform from Marvin Test Solutions in Irvine, Calif., to assure the mission readiness of audio, video, and communications systems and other critical electronics on state-of-the-art armored infantry vehicles. Marvin Test won a contract to deliver multiple TS-321 test stations, as well as test programs, spares, and training.

The GENASYS platform is designed for mission-critical electronics applications — at the board, box, or system level — such as satellite payloads, platform management systems, armament electronics and subsystems, and flight management and control systems, officials say.

"GENASYS offers a compact, flexible, scalable system designed to address the complex current and future test requirements of military and aerospace applications," says Stephen Sargeant, CEO of Marvin Test Solutions and a retired U.S. Air Force major general. "Designing a system with future upgradeability in mind provides the ideal solution for customers whose test requirements evolve with every new advance in technology."

The future of military radio likely lies in long-term evolution (LTE), the commercial cellular market's 4G mobile communications standard. U.S. Department of Defense (DOD) officials are investigating the feasibility of LTE and LTE-Advanced technologies to modernize military communications. "As the U.S. DOD begins to research and adopt commercial LTE technologies for tactical radio purposes, our R&S CMW500 has been readily adopted for many of these advanced research needs," says McCarthy of Rohde & Schwarz.

Forward momentum

Aerospace and defense organizations are increasingly replacing test systems that have gone obsolete, after being fielded for decades, with modern, expandable test solutions — and doing so to save money, says Marvin Test Systems' Sargeant.

"At some point, the cost of sustaining older, obsolete equipment gets to be a number that's too large to continue to fund," Sargeant explains. Aerospace and defense organizations, especially prime contractors, are hitting that threshold and are looking for a test solution that can meet current specs, capture a decade or more of requirements, and offer the modularity, scalability, and flexibility to support future applications and requirements.

Aerospace and defense officials are looking for a test platform that can "overcome the legacy problems of cost, time, and less-than-efficient use of engineers to keep the system running," Sargeant says. Two defense primes have moved to Marvin's GENASYS platform, using its software tools to transition their test plan sets (TPSs).

"TPSs are extremely expensive to create from scratch; [our software] enables engineers to clean up those TPSs to make them more efficient. They are using their engineering talents to refine and build TPSs rather

than putting money and effort into maintaining [a legacy] platform," Sargeant says. "Especially in a time of fiscal constraint, companies need a test solution to meet requirements, grow with them as their requirements grow, and overcome issues with obsolescence they've had for decades."

Portability and future proof

Tilley and his colleagues at Astronics Test Systems advise customers "to 'design with headroom,' which is to design so that your test technology can evolve as your system technology grows in the future," he says. "We also suggest customers keep in mind the value of synthetic test instruments.

"Synthetic instruments can form a block of technology to provide many different functions without buying say, up to 12 cards with 12 different functions. So, consider synthetic first as a way to save technical complexity, size, weight, and cost," Tilley suggests.

Astronics, in collaboration with National Instruments, introduced several new PXI test instruments this year, including a rubidium, a pulse generator, and a new digital test instrument — designed to provide familiar, fast development paths for legacy and new military and aerospace programs. The new releases "carry backward-compatible test sets so that they can be used to upgrade older VXI systems with fresh, new, PXI-based technology," Tilley says.

"The challenge of lowering cost and preserving legacy investment in the face of rapid technology change requires industry collaborations for success and attention to software compatibility," says Luke Schreier, director of automated test product marketing at National Instruments (NI) in Austin, Texas. "The NI and Astronics collaboration preserves technology investment for our mutual customers and fosters innovation."

Digital subsystems continue to play a crucial role in most aerospace and defense test platforms, adds Brian Price, executive vice president and general manager at Astronics Test Systems. "With the introduction of these new Astronics PXI Express products, engineers can now expand on today's test platforms to support tomorrow's military and aerospace requirements and maintain their original TPS investments."

The new digital subsystem includes the latest parallel digital, serial, and bus protocols, while also taking advantage of the PXI platform's high speed, small size, and lower cost. "These PXI instruments round out our line of VXI instruments so that we can continue supporting the aerospace and defense automated test systems of yesterday, today, and tomorrow," Price says.

Future functionality

Aerospace and defense professionals will need far more sophistication, complexity, and capability to fulfill far more test needs and requirements in much smaller, more affordable, off-the-shelf, integrated solutions and individual products, Giga-tronics' Pantalone predicts.

Customers are always looking to make testing equipment smaller, more functional, and more cost-effective, says Astronics' Tilley of the future of test and measurement. Astronics Test System engineers put portability and connectivity at the forefront of everything they design, he says, and deliver features like over-the-air-testing and synthetic instrumentation in new systems.

"Much like the fact that today you can hold a spectrum analyzer in one hand and buy that unit for $10,000 or less is just what we will have and are driving to for the future for more applications in the RF test space. We already have and will continue to develop incredibly capable and integrated, agile, coherent, wideband RF radar and EW system test and measurement suites that fit in single racks and even in man-portable carry cases," Pantalone explains.

"These commercial off-the-shelf (COTS) solutions operate in real time and in closed-loop fashion and can support multiple programs across multiple radar bands in a single product," Pantone adds. "These products are already modular and scalable, with their capability only limited today by the processing power controlling the units, and at a fraction of the cost of the far less capable and larger test instruments and behemoth test suites of days gone by."

Too often engineers and engineering managers get focused on a single key attribute when selecting test and measurement equipment, admits Keysight's Haynes. "It used to be a key specification, but today it is more often price. I encourage the companies that we work with to evaluate the total cost of ownership and view it as an investment to reduce risk and cost to the project. A good evaluation should take into consideration the entire life of the solution with respect to not only capital cost, but support and reliability." ←

British military chooses data radios from L-3 for UAV surveillance system

British military experts needed data radios for full-motion video distribution from unmanned surveillance aircraft to military forces on land and at sea. They found their solution at L-3 Communication Systems-West in Salt Lake City. The United Kingdom Ministry of Defence in London has awarded L-3 a $23.2 million contract for the company's Tactical Network ROVER handheld transceivers and ROVER 6i transceivers for the United Kingdom Joint Common Remote Viewing Terminal (JCRVT) program. The JCRVT distributes full-motion video data from unmanned aerial vehicles (UAVs). It displays data, saves video and images, and transmits video and imagery to British military forces on land and at sea. The JCRVT will use L-3 ROVER transceivers to integrate key United Kingdom intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) aircraft with land- and sea-based weapons platforms such as surface warships, artillery, and missile launchers.

FOR MORE INFORMATION visit **L-3 Communications Systems-West** online at *www2.l-3com.com/csw*, or the **United Kingdom Ministry of Defence** at *www.gov.uk/government/organisations/ministry-of-defence.*

Thales developing deployable instrument landing system for Air Force

BY **John Keller**

Thales is developing a deployable aircraft instrument landing system to help aircraft land in bad weather and in difficult terrain.

HANSCOM AIR FORCE BASE, Mass. — Military air traffic control experts at Thales Defense & Security Inc. in Clarksburg, Md., are moving forward with developing a deployable aircraft instrument landing system (ILS) for precision aircraft approach and air traffic control worldwide in difficult conditions.

Officials of the Air Force Life Cycle Management Center at Hanscom Air Force Base, Mass., announced a $14.1 million order to Thales to build three Deployable Instrument Landing System (D-ILS) production-representative units as part of a risk-reduction effort.

The D-ILS is to provide a system of equal performance to existing Category I fixed-based systems that provide aircraft guidance on final approach in low-visibility and low-ceiling weather conditions.

The order is a modification to an $18.4 million contract the Air Force awarded to Thales in July 2015 to build two D-ILS prototypes for operational test and evaluation.

Air Force air traffic control experts used the original two D-ILS prototypes for operational test and evaluation of a fixed-based instrument landing system at tactical airfields and at airfields where permanent ILS capability has been disrupted by events such as natural disaster.

Thales will provide deployable glide slopes, deployable localizers, and containers for the electrical gear.

While a fixed-base ILS is large and requires several aircraft to deliver all the equipment, the D-ILS will fit onto one C-130 aircraft, Air Force officials say. Thales is to finish development and provide ready-to-deploy D-ILS capability by mid-2017.

The Thales D-ILS will provide precision guidance to fixed-wing aircraft and helicopters in separate environmentally diverse regions. Each system will provide guidance based on the aircraft's position in relation to the final approach course glide path from the touchdown point on the runway or landing surface.

The goal is to provide the Air Force with supportable, adaptable, resilient, enduring, and persistent precision-approach capabil-

ity that all joint, coalition, and civil ILS-equipped aircraft will be able to use worldwide.

The D-ILS will provide significantly improved reliability, maintainability, and supportability over legacy deployable Precision Approach Radar (PAR) systems, Air Force officials say.

The Thales D-ILS will offer remote monitoring and maintenance that allows for maintenance configuration from remote locations. It would involve setting up a remote maintenance center in theater for central depot storage of all maintenance items to sustain D-ILS installations at several different airfields.

On this order, Thales will do the work in Clarksburg, Md., and should be finished by January 2019.

FOR MORE INFORMATION visit **Thales Defense & Security** online at *www.thalescomminc.com*, or the **Air Force Life Cycle Management Center** at *www.wpafb.af.mil/aflcmc*.

Navy to develop dual microwave and millimeter-wave shipboard antennas

BY **John Keller**

WASHINGTON — U.S. Navy RF and microwave radio communications experts are kicking-off a research program to develop dual microwave and millimeter-wave shipboard antennas capable of transmitting in the 4- to 40-GHz frequency range.

Officials of the Naval Research Laboratory (NRL) in Washington announced a plan to issue a formal solicitation (N00173-17-R-GB01) for the Dual Microwave and Millimeter Wave Antennas project.

This project will ask one industry contractor to design, test, and deliver dual microwave and millimeter-wave antennas that transmit in the 4- to 40-GHz frequency range. The effort has three parts:

- design and installation of 10 preliminary antennas within three months of the contract award;
- delivery of one pair (forward and aft) prototype antennas within six months of contract award; and
- delivery of three pairs (forward and aft) antennas within one year of contract award.

Navy experts are looking for new dual-band shipboard antennas for communications and electromagnetic compatibility.

To be eligible for submitting a bid, companies must be registered in the System for Award Management (SAM) database, which is online at https://www.sam.gov/portal/SAM/##11#1#1. E-mail questions or concerns to the NRL's Bruce Gunther at bruce.gunther@nrl.navy.mil, or Leigh Kellstrom at Leigh.Kellstrom@nrl.navy.mil.

MORE INFORMATION IS online at *https://www.fbo.gov/spg/DON/ONR/N00173/N00173-17-R-GB01/listing.html*.

Raytheon to enhance gallium nitride technologies for radar and RF

Microelectronics experts at the Raytheon Co. are enhancing their company's process for producing gallium nitride (GaN)-based semiconductors for advanced military radar systems, electronic warfare (EW), and other RF and microwave technologies. Officials of the U.S. Air Force Research Laboratory and the Office of the Secretary of Defense have awarded a $14.9 million contract for the Raytheon Integrated Defense Systems segment in Tewksbury, Mass., to enhance GaN semiconductor manufacturing. The pact follows a previous GaN Title III contract, which Raytheon completed in 2013, and aims to increase the performance, yield, and reliability of Raytheon GaN-based, wideband, monolithic, microwave-integrated circuits (MMICs) and circulator components. GaN is a semiconductor material that can amplify high power radio frequency signals efficiently at microwave frequencies to enhance a system's range. GaN technology takes part in military radars and defense systems, including the U.S. Navy's Air and Missile Defense Radar and Next Generation Jammer.

FOR MORE INFORMATION visit **Raytheon Integrated Defense Systems** online at *www.raytheon.com*, or the **Air Force Research Laboratory** at *www.wpafb.af.mil/afrl*.

DARPA seeks to protect convoys from swarms of attacking small UAVs

U.S. military researchers are asking for industry's help in developing an agile and mobile drone-defense system that can defeat a raid of self-guided, small unmanned aerial vehicles (UAVs) that are attacking important targets like high-value moving convoys. Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., released an industry solicitation (DARPA-PS-17-01) for the Mobile Force Protection (MFP) program. The potential $63 million project seeks ways to defend against today's radio-controlled and GPS-guided weaponized UAVs, and also future UAVs that navigate by visual means in large groups to gather intelligence and coordinate attacks against one or more high-value moving targets. Of interest is the ability to counter small fixed-wing or helicopter UAVs that weigh less than 200 pounds apiece, officials say. An MFP system must be able to integrate new approaches and technologies quickly, and work on ground vehicles, surface vessels, and aircraft. E-mail questions to DARPA-PS-17-01@darpa.mil. ←

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-PS-17-01/listing.html*.

Navy orders unmanned ground vehicle

BY **John Keller**

INDIAN HEAD, Md. — U.S. Navy bomb disposal experts are beefing-up their inventory of unmanned ground vehicle (UGV) robots that are designed to detect, pinpoint, and neutralize improvised explosive devices (IEDs) and other roadside bomb threats.

The QinetiQ TALON unmanned ground vehicle will help U.S. and allied warfighters detect, locate, and neutralized improvised explosive devices (IEDs).

Officials of the Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division in Indian Head, Md., has announced a $10.2 million order to QinetiQ North America in Waltham, Mass., for continued production of the MK2 Man Transportable Robotic System (MTRS).

The MK2 MTRS from QinetiQ is one of several MTRS designs that provides stand-off capability to detect, identify, and dispose of IEDs and related hazards using an unmanned ground vehicle equipped with special IED-disposal payloads.

The MTRS provides the ability to locate, identify, and clear land mines, unexploded ordnance, and IEDs in the path of maneuvering Army or Joint forces.

The QinetiQ version of the MTRS is based on the company's TALON tracked unmanned ground vehicle. These lightweight vehicles are designed for IED and explosive ordnance disposal, reconnaissance, communications, countering chemical, biological, radiological, nuclear, and explosive (CBRNE) threats, security, heavy lift, defense, and rescue missions.

Talons can move as fast as six miles per hour, are transportable by one person, work in bad weather and rugged terrain, and have high payload capacity and payload-to-weight ratios. The TALON V provides 16 I/O ports including Interoperability Profile (IOP) A and B connectors; has JAUS AS4-compliant software; supports plug and play discovery of IOP devices; offers a variety of high-definition and standard-definition camera options in addition to an optional, dual-purpose thermal/daytime zoom camera; has a heavy-lift multiple-degree-of-freedom arm manipulator; and supports a variety of third-party and legacy TALON manipulators.

This order to QinetiQ is to exercise option two of MK2 MTRS production, as well as for depot-level repair parts, spare kits, approved

accessories, consumable parts, reconditioning, conversions, engineering enhancements, and configuration management in support of the Joint Service Explosive Ordnance Division program.

QinetiQ won the company's original $9.4 million MTRS contract in September 2014. The company won a separate $9.9 million MTRS order in September 2015.

QinetiQ will do the work in Waltham, Mass., and should be finished by September 2016.

FOR MORE INFORMATION visit **QinetiQ North America** online at *www.qinetiq-na.com*, and the **Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division** at *www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Indian-Head-EOD-Technology*.

Hydronalix to develop unmanned boat technology for underwater communications

BY **John Keller**

LAKEHURST, N.J. — U.S. Navy researchers needed an unmanned surface vessel (USV) to monitor the safety of Navy boats operating in the Persian Gulf, as well as to maintain underwater communications. They found their solution from Hydronalix Inc. in Green Valley, Ariz.

Officials of the Naval Air Warfare Center Aircraft Division in Lakehurst, N.J., announced plans to award a phase-3 small business innovative research (SBIR) to Hydronalix to upgrade micro USV technology and integrate it with existing underwater acoustic communications technology.

The Naval Air Warfare Center is negotiating the SBIR phase-3 contract with Hydronalix on behalf of the Office of Naval Research Science Advisor for the Commander Fifth Fleet in Bahrain.

Hydronalix engineers will adapt a small unmanned surface boat to function as a mobile gateway buoy to support Fifth Fleet operations. The unmanned boat will act as a communications node in an underwater communications network to help protect Navy manned rigid-hull inflatable boats operating in the Persian Gulf.

These manned Navy boats monitor port operations, perform vehicle inspections, and carry out similar operations. Navy experts say the unmanned mobile gateway buoy will enable Navy boat crews to carry out missions when other assets are not available because of bad weather, engagement limitations, and treaty agreements. Navy officials say using the unmanned surface vessel acting as a mobile gateway buoy to monitor the operations may reduce the need to use other Navy boats, ships, and aircraft to protect the inflatable boat crews.

The unmanned surface vessel acting as a mobile gateway buoy will be capable of situational awareness, transmitting and receiving data, and being stationed aboard Navy ships and boats. Without such a system, Navy boat crews may continue to be used inefficiently and inadvertently face danger by operating in or near mine fields or unknown vessels, Navy officials say.

Hydronalix will develop unmanned surface vessel technologies for underwater safety monitoring and communications.

Ultimately, Navy researchers want to create a field-deployable system that enables Fifth Fleet explosive ordnance disposal forces to communicate remotely and track unmanned underwater vehicles (UUVs) that are involved with locating and destroying enemy sea mines.

This project could add levels of intelligence, surveillance, and reconnaissance (ISR) capability not available in existing Micro-USV systems, Navy officials say. More information on this project is online at *http://bit.ly/2fxgOfd*.

FOR ADDITIONAL INFORMATION visit **Hydronalix** online at *https://hydronalix.com/*, and the **Naval Air Warfare Center Aircraft Division-Lakehurst** at *www.navair.navy.mil*.

ELECTRO OPTICS watch

High-speed digital camera for production fault-finding introduced by Photron

Photron Inc. in San Diego is introducing the electro-optical PhotoCam SpeederV2 digital high-speed camera for production fault-finding to enable workers to view and identify production errors quickly on the integrated 7-inch LCD remote touch screen, without the need for a computer or network infrastructure. The SpeederV2 system is available with one or two miniature remote camera heads that are tethered to a compact camera control unit. The new production line imaging system provides as many as 2,000 frames per second at full pixel resolution (512 x 512) and higher frame rates at reduced resolutions. There are two video recording modes — speed priority mode for high-frame-rate, full-resolution video capture to the onboard internal memory; and time priority mode for extended duration video capture (i.e., very long recording times at reduced frame rates and/or resolutions) which can be streamed to an integrated solid-state drive (SSD).

Simulation and training experts Lockheed Martin and CAE to upgrade C-130J flight simulators

BY **John Keller**

WRIGHT-PATTERSON AFB, Ohio — Simulation and training experts at Lockheed Martin Corp. are working with their subcontractors to upgrade flight simulators for the Italian air force C-130J utility turboprop aircraft fleet.

Officials of the U.S. Air Force Life Cycle Management Center at Wright-Patterson Air Force Base, Ohio, announced a $20.1 million order to the Lockheed Martin Rotary and Mission Systems segment in Orlando, Fla., to upgrade the Aeronautica Militare C-130J operational flight trainer and cockpit avionics part task trainer.

Lockheed Martin partners with flight simulation specialist CAE Inc. in Montreal to design and build simulation and training systems for the C-130-series aircraft for the U.S. military and for international military forces like the Italian air force.

Lockheed Martin and CAE are upgrading C-130J aircraft flight simulators for the Italian air force.

An operational flight trainer, or OFT, is a flight simulator for general flight training as opposed to specialist tactics and weapons training. The flight simulator has a motion

FLIR Systems adds machine vision to infrared know-how with acquisition of Point Grey Research

WILSONVILLE, Ore. — Executives of electro-optics and infrared sensors specialist FLIR Systems Inc. in Wilsonville, Ore., are boosting their company's expertise in machine vision cameras with their upcoming acquisition of Point Grey Research Inc. in Richmond, British Columbia.

FLIR officials have agreed to acquire Point Grey Research for $253 million in cash. Point Grey Research develops machine vision cameras for use in industrial, retail, scientific, traffic, mapping, and other advanced imaging applications.

The addition of the Point Grey business will augment FLIR's existing OEM cores and components

platform that enables realistic instrument flying (IF) and other procedural training.

A part task trainer, meanwhile, is a flight simulator designed to train a member of the aircrew or maintenance staff on a particular aircraft task. Although less elaborate than an operational flight trainer, the part task trainer helps flight crew members train in avionics systems, weapons delivery, aerial refueling, and a variety of complex tasks specific to a particular aircraft.

CAE designed the Italian air force's C-130J operational flight trainer and cockpit avionics part task trainer located at Italy's National Training Center (NTC) in Pisa, Italy. The NTC primarily conducts C-130J aircrew and maintenance training, as well as classroom. Lockheed Martin, as the C-130J aircraft designer, acts as prime contractor on C-130J flight simulation programs with CAE serving as Lockheed Martin's teammate and major supplier.

Lockheed Martin provides overall program management and operations as well as engineering services. CAE is responsible for the design and manufacture of the majority of C-130J training devices, including high-fidelity weapon systems trainers.

CAE operates a C-130J systems integration lab at CAE USA in Tampa, Fla., which the company uses to develop and test C-130J operational flight program block upgrades and modifications.

CAE performs C-130J simulator upgrades, training device maintenance, software engineering, configuration management, data management, and program management support. The company also performs obsolescence and technology refresh updates.

On this order for the Italian air force, Lockheed Martin and CAE will do the work in Marietta, Ga., and should be finished by July 2019. ←

FOR MORE INFORMATION visit **Lockheed Martin Rotary and Mission Systems** online at *www.lockheedmartin.com/us/rms.html*, **CAE Inc.** at *www.cae.com*, the **Italian air force** at *www.aeronautica.difesa.it/Pagine*, and the **Air Force Life Cycle Management Center** at *www.wpafb.af.mil/aflcmc*.

Northrop Grumman to build beam control for laser weapons

Laser weapons experts at Northrop Grumman Corp. are helping the U.S. Air Force with beam control technology to protect current and future fighter aircraft with directed-energy systems. A contract from the Air Force Research Laboratory at Kirtland Air Force Base, N.M., calls for the Northrop Grumman Aerospace Systems segment in Redondo Beach, Calif., to build the beam-control portion of an airborne laser weapon demonstrator. This part of the Air Force Self-Protect High Energy Laser Demonstrator (SHiELD) advanced technology demonstration (ATD) program. The laser weapon will be housed in a pod attached to a fighter-sized aircraft, and tested at speeds to supersonic. AFRL expects to begin flight testing the integrated system by 2019. Northrop Grumman is developing the SHiELD beam control system under a segment of the ATD program known as SHiELD Turret Research in Aero Effects, or STRAFE. ←

business by adding visible spectrum machine vision cameras and solutions. FLIR officials say.

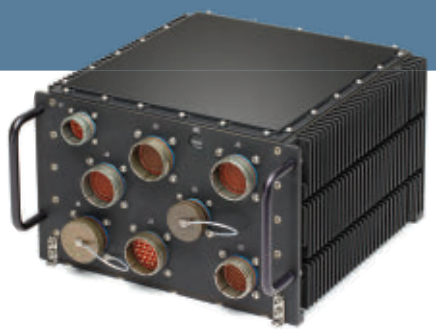
Point Grey develops advanced visible imaging cameras for military and defense products, industrial automation systems, medical diagnostic equipment, people-counting systems, intelligent traffic systems, and advanced mapping systems. The company designs cameras and related software.

FLIR's thermal sensor technology also will extend Point Grey's product range into new application spaces. The business will become FLIR's Integrated Imaging Solutions line of business operating within the FLIR Systems OEM and Emerging segment.

"Thermal imaging technology provides vision systems customers an alternative imaging spectrum that offers a rich, largely untapped layer of information that can be further leveraged," says Andy Teich, FLIR's president and CEO. The transaction should close by the end of this year. ←

FOR MORE INFORMATION visit **Point Grey Research** online at *www.ptgrey.com*, and **FLIR Systems** at *www.flir.com*.

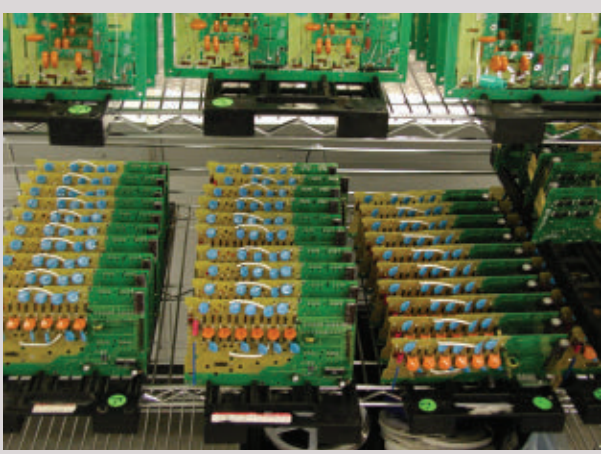
PRODUCT applications



BOARD MANUFACTURING

Colonial to provide contract manufacturing for circuit boards and RF components

U.S. Navy surface warfare experts needed contract manufacturing for electronic circuit boards, RF distribution assemblies, and related military and aerospace electronics items. They found their solution at Colonial Assembly and Design LLC in Fredericksburg, Va.



Officials of the Naval Surface Warfare Center (NSWC) in Dahlgren, Va., announced a $37.2 million contract to Colonial Assembly for a variety of contract manufacturing jobs. Those jobs include design, fabrication, rapid prototyping, and technology integration for circuit board design; radio-frequency (RF) distribution assemblies; synthetic rope assemblies; mechanical fabrication; and fabric assemblies.

Colonial Assembly is doing the contract manufacturing work for the Weapons Control and Integration Department at NSWC Dahlgren. Government agencies and private companies use contract manufacturing for economy and speed in procuring important components and subsystems.

Agencies and companies often use contract manufacturing to avoid the costs of creating and maintaining complex assembly lines, and to help them concentrate on their core technological expertise.

Colonial Manufacturing is part of Zentech Manufacturing Inc. in Baltimore, which acquired Colonial Manufacturing in April 2015.

On this contract, Colonial Manufacturing will do the work in Fredericksburg, Va., and should be finished in September 2021. ←

FOR MORE INFORMATION visit **Colonial Assembly and Design** online at *www.colonialassembly.com*, or **NSWC Dahlgren** at *www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Dahlgren*.

AVIONICS COMPUTERS

Northrop Grumman to provide mission computers for Marine Corps helicopters

Military avionics designers at Northrop Grumman Corp. will provide mission computers for new U.S. Marine Corps UH-1Y and AH-1Z helicopter avionics under terms of an $18.3 million order.

Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking the Northrop Grumman Mission Systems segment in Woodland Hills, Calif., for tech refresh mission computers and trays in support of Lot 13 AH-1Z Super Cobra and UH-1Y Super Huey attack and utility helicopters.

The mission computer purchases are for the U.S. Navy and the government of Pakistan under the Foreign Military Sales program. The UH-1Y and AH-1Z helicopters are in full production by Bell Helicopter Textron Inc. in Fort Worth, Texas.

Northrop Grumman Gen III mission computers are the heart of the company's Integrated Avionics System that powers the glass cockpit avionics of the UH-1Y and AH-1Z helicopters. The conduction-cooled Gen III Technical Refresh mission computer incorporates a ruggedized 6U VME PowerPC-based single-board computer. Interfaces include Fast Ethernet, four serial ports, parallel I/O, and built-in-test. FlightPro has a standard, partitioned real-time operating system with ARINC 653 and POSIX support.

Northrop Grumman is providing identical Gen II mission computers for the UH-1Y and AH-1Z aircraft that make up the Marine light attack helicopter squadrons to help save money and simplify logistics.

The mission computer's standard configuration also includes a quad-channel 1553 mezzanine card, high-speed serial card, digital I/O module with eight channels of opto-coupled discrete inputs, eight channels of opto-coupled discrete outputs, and 16 channels of general-purpose, bi-directional discretes that can be programmed individually as outputs or inputs.

The FlightPro mission computer is capable of Required Navigation Performance/Area Navigation (RNP/RNAV) in all flight regimes, including departure, en route, terminal, and non-precision approach using GPS as the sole navigation source. The flight computers use 28-volt DC or 115-volt AC three-phase 400-Hz input power, measure 13.61 by 11.5 by 7.55 inches, and weigh 30.4 pounds. The computers have rated 3,200 hours mean time between failures.

FOR MORE INFORMATION visit **Northrop Grumman Mission Systems** online at *www.northropgrumman.com*.

RUGGED COMPUTERS

Lockheed Martin selects Ampex airborne server/recorder for advanced mission system

Engineers at Lockheed Martin Mission Systems and Training (MST) in Owego, New York, needed a data storage and compute platform for the company's new advanced mission system. They found their solution at Ampex Data Systems, a Delta Information Systems Company, in Hayward, California.

Ampex Data Systems won a Lockheed Martin contract to provide the Ampex TuffServ 640 (TS640) Airborne NAS 10 Gigabit Ethernet Server/Recorders. The first systems will be used under a Foreign Military Sales contract for the P-3 aircraft platform. The P-3 Orion is a four-engine, turboprop, anti-submarine and maritime surveillance aircraft developed by Lockheed Martin for the U.S. Navy.

Under this contract, Ampex will provide TS640 file servers and support. The TS640 is a high-data-rate, multi-terabyte storage and compute platform. The TS 640 uses the common architecture found throughout the TuffServ series, and advances performance and scalability in a standard half-ATR package. Read/write speeds as fast as 1 gigabyte per second, 12.8 terabytes of removable solid-state memory, and standard dual 10-gigabit optical Ethernet ports are suitable for a wide variety of airborne and mobile applications.

FOR MORE INFORMATION visit **Ampex Data Systems** at *www.ampex.com*.

COMMUNICATIONS

Navy chooses Continental Electric to upgrade electronics at submarine communications sites

RF and microwave experts at Continental Electronics Corp. in Dallas will maintain and upgrade electronic components of a U.S. Navy high-power communications system that sends one-way text messages to submerged nuclear ballistic missile submarine forces.

Officials of the Space and Naval Warfare (SPAWAR) Systems Center Atlantic in Charleston, S.C., announced an $11.4 million contract to Continental Electronics to replace several electronic components in the high-power Fixed Submarine Broadcast System (FSBS). Continental Electronics will replace the helic coils that make up part of the antenna matching network, as well as the system's pure water cooling loop system, two grid variometers that make up part of the AN/FRT-64 VLF transmitter, and a power supply in the FSBS very-low-frequency and low-frequency (VLF/LF) transmitter equipment.

The FSBS consists of 10 land sites worldwide that transmit data streams at a slow 50-baud pace to submerged Ohio-class nuclear ballistic missile submarines. The low frequency and high power of the signal can penetrate seawater to enable submarines to remain submerged while receiving messages from national command authorities. ←

FOR MORE INFORMATION visit **Continental Electronics** online at *www.contelec.com*.

new PRODUCTS

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

VISION PROCESSING

Rugged embedded vision system for video capture introduced by Elma

Elma Electronic Inc. in Fremont, Calif., is introducing its OptiSys-5101 rugged, high-performance, embedded vision system for optical inspection and video capture. The OptiSys-5101 has four configurable Camera Link ports and a front-removable, multi-terabyte storage bay

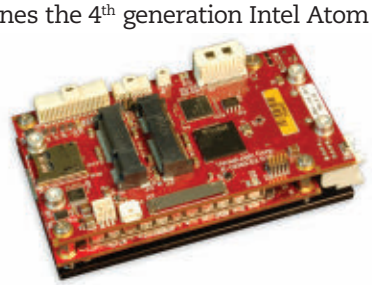
with SATA III interface for high-speed imaging data offload and transfer. Powered by an Intel Quad Core i7 processor, the vision system features a high-definition image frame grabber and a mini PCI Express expansion site for I/O customization. Designed to withstand severe environments, the compact system is for harsh-environment applications that require high-speed image inspection, analysis, and measurement such as security and surveillance; transportation security systems; vehicular traffic monitoring and management; manufacturing inspection and monitoring; and health care imaging. The four Camera Link ports are configurable as four base ports, two full ports, or two base ports and one full port for data processing in excess of 5 gigabits per second.

FOR MORE INFORMATION visit **Elma** online at *www.elma.com*.

EMBEDDED COMPUTING

Small-form-factor rugged embedded computer introduced by VersaLogic

VersaLogic Corp. in Tualatin, Ore., is introducing the small-form-factor VL-EPU-3311 Osprey rugged, embedded computer for military and avionics applications. This next generation of the VersaLogic embedded processing unit (EPU) format combines processor, memory, video, and system I/O into an extremely compact full-function embedded computer just slightly larger than a credit card. The VL-EPU-3311 was engineered to meet the military and avionics industries' evolving requirements for smaller, lighter, and more powerful embedded systems. Less than 1.1 inches thick, the Osprey embedded compute combines the 4th generation Intel Atom



Bay Trail processor, with newer system interfaces, in a form factor designed to withstand extreme temperature and vibration.

FOR MORE INFORMATION visit **VersaLogic** online at *www.versalogic.com*.

RUGGED COMPUTERS

Rugged servers for radar signal processing introduced by Crystal

Crystal Group Inc. in Hiawatha, Iowa, is introducing the RS4104 and RS4198L24 high-performance and configurable rugged servers for use in harsh-environment applications

that require storage, removal, and instantaneous processing of critical data. Crystal Group has designed these units to accept GPGPU engines such as the Xeon Phi, AMD FirePro, or the Nvidia Tesla to make these devices for data-intensive applications including digital signal processing (DSP), intelligence, surveillance, reconnaissance (ISR), radar signal processing, training, and oil & gas exploration. The rack-mounted servers are designed to have dual Intel Haswell or Broadwell E5 Xeon processors paired with coprocessors like the Xeon PHI or Nvidia Tesla products fast compute processing. The RS4104 also supports as many as 10 PCI Express 3.0 x8 or 5 PCI Express 3.0 x16 expansion slots for add-in cards, and is powered by a 1780-watt power supply. The RS4104 and RS4198L24 4U are compatible with industry standard operating systems such as Windows 7, Windows 10, Windows Server 2008, Windows Server 2012, VMware, and Linux.

FOR MORE INFORMATION
contact **Crystal Group** online at *www.crystalrugged.com*.

VETRONICS NETWORKING

Rugged vetronics network switch with embedded positioning and timing introduced by Curtiss-Wright

The Curtiss-Wright Corp. Defense Solutions division in Ashburn, Va., is introducing the DuraDBH-672 Digital Beachhead rugged vetronics network switch with Mounted

Assured-PNT (MAPS) functionality to provide military vehicles with precise positioning and timing, even in GPS-denied environments. The DuraDBH-672 has a built-in, military ground-based global positioning system (GPS) receiver application module (GB-GRAM), chip-scale atomic clock (CSAC), and inertial measurement unit (IMU). The switch and shared services processor com-

plies with standards outlined in the Vehicular Integration for Command, Control, Communication, Computers, Intelligence, Surveillance, Reconnaissance (C4ISR)/Electronic Warfare (EW) Interoperability (VICTORY) program.

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

RUGGED COMPUTERS

Lightweight server-class rugged computer for military applications introduced by GMS

General Micro Systems Inc. (GMS) in Rancho Cucamonga, Calif., is introducing the SB2002-MD Golden-Eyes II small lightweight server-class ultra-rugged computer for military and aerospace applications that operate in harsh operating conditions. The multi-domain server has two isolated and separate Red

(non-secure) and Black (classified) network and server domains, and separate power supplies. The unit is for isolated processing, virtual machines, MILS-targeted red/black separated networks, redundant host processors, or any system requiring separated or dual-class CPU configurations. The Golden-Eyes II SB2002-MD supports a multi-domain, NSA-secure architecture, and has two independent Intel Xeon D-based servers each with as many as 16 cores, and as much as 64 gigabytes of DDR4 memory with Error Correcting Code (ECC). The computer is designed to withstand harsh outdoor environments where it may be exposed to rain, sun, dirt, and battlefield shock and vibration.

FOR MORE INFORMATION visit **General Micro Systems** online at *www.gms4sbc.com*.

POWER ELECTRONICS

DC-DC converters for power electronics applications introduced by TDK

TDK-Lambda Americas Inc. in San Diego is introducing the TDK-Lambda 15-watt CCG15S series of DC-DC

converters for power electronics applications that include test and measurement, telecommunications, process control, and broadcast. Operating over a 4:1 input range, these products are enclosed in a 1 inch by 1 inch six-sided shielded metal case. The CCG15S is available with 3.3-, 5-, 12-, or 15-volt outputs

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and can operate from either a 9-to-36-volt DC or 18-to-76-volt DC input. With operating efficiencies up to 88 percent, TDK-Lambda's new CCG15S series will operate in ambient temperatures from -40 to 85 degrees Celsius. All models have a +/-10 percent output trim function, remote on/off, and over-voltage and over-current protection. The isolated CCG series has an input to output isolation of 1,500 volts DC and 1,000 volts DC input or output to case. Safety certifications include: IEC/EN 60950-1 and UL/CSA 60950-1 with CE marking for the Low Voltage and RoHS2 Directives.

FOR MORE INFORMATION visit **TDK-Lambda Americas** online at *www.us.tdk-lambda.com*.

SECURE SERVERS

1U dual secure server for developing secure information sharing applications introduced by DDC

Data Device Corp. (DDC) in Bohemia, N.Y., is introducing the BU-67127W 1U dual secure server to enable system integrators to develop secure information sharing applications. Applications include streaming intelligence, surveillance, and reconnaissance (ISR) data, transferring vehicle health management data, and sharing data with coalition partners. The BU-67127W combines with secure filtering software from Tresys in Columbia, Md., to help with cross-domain information transfer, and red/black hardware separation. The BU-67127W

offers dual 2.4-GHz Intel i7 Quad Core Haswell processors; USB key secure boot; dual 10/100/1000 Ethernet networking ports; security-enhanced (SE) Linux operating system; and hardware isolation between red and black sides. The system requires minimal administration and is suitable for remote or isolated environments. It offers secure transfer rates of 700 megabits per second and latency as low as 3 milliseconds.

FOR MORE INFORMATION visit **DDC** online at *www.ddc-web.com*, or **Tresys** at *www.tresys.com*.

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