JUNE 2013

Military & Aerospace Electronics

THE MAGAZINE OF TRANSFORMATION IN ELECTRONIC AND OPTICAL TECHNOLOGY

Rad-hard electronics

Radiation-hardened electronics advance with emerging standards and expanding markets. PAGE 18

Software-engineering tools

It's all about reliability and ensuring adherence to standards. PAGE 26

militaryaerospace.com

Avionics innovations

Civil and military aircraft benefit from the latest electronics.

PAGE 10

PennWell

The RIGHT FIT for Difficult to Outsource Projects

At Federal Electronics, we've built our business around projects our customers didn't think they could outsource. Typically, these projects are too technically or logistically complex for job shops, yet not large enough to be attractive to conventional contract manufacturers. We are AS9100 certified and our U.S. facility is ITAR-registered.

What makes us different? First, we've combined vertical integration with a core team of low volume custom component suppliers to provide high quality, low-to-medium volume solutions for PCBAs, cables, subassemblies and electromechanical systems in mission critical applications. Second, we've put together the right people, systems and processes to efficiently support and grow these projects over time.

We align our resources with customer needs. ***Our RIGHT FIT Toolbox*** service packages include:

- **Emerging Companies Assist –** A service cluster focused on helping start-up companies or those new to outsourcing eliminate project transition learning curve issues before they arise.
- **Mission Critical Assist –** Focused support for military/aerospace and other products with significant regulatory requirements which includes robust production qualification requirement support, traceability, configuration management and customized quality reporting.
- **Complex Low Volume System Support –**We have the team and supply base to support electromechanical projects with repetitive production requirements having lot sizes as low as one. We support the full product lifecycle from NPI through fulfillment and repair depot.
- **Cross-Border Cost Reduction Migration –** Our facilities in Cranston, RI and Hermosillo, Mexico work closely together. We can source high labor content components or the entire project in Mexico, providing the perfect mix of local support and low cost region savings.

Are we the RIGHT FIT for your difficult to outsource projects?
Give us a call at **401-944-6200 x25** or visit our website at **www.federalelec.com** to find out.

FEDERAL ELECTRONICS

kontron

» Fast-track the design to deployment of flight communications and server applications «

Flexible, reliable application-ready framework for high-speed networking requirements on aircraft

ACE Flight 600
General Purpose Airborne Servers

The Kontron ACE Flight 600 is a complete, highly integrated application-ready platform that is specifically designed to meet advanced communication application requirements for Ethernet-based network installations.

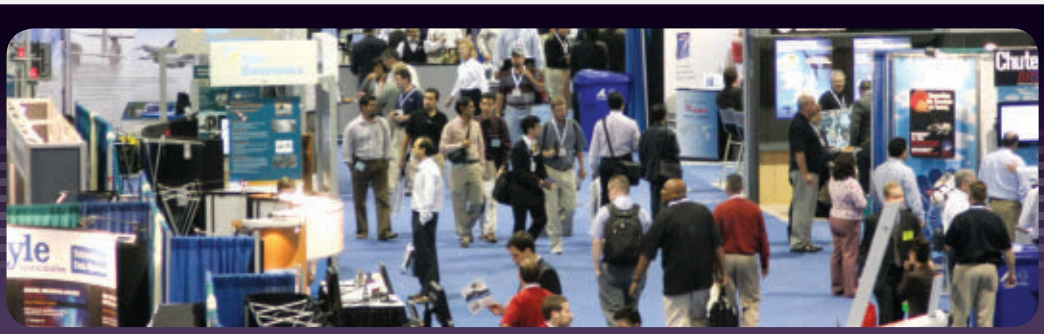
» Qualified to DO-160F
» ARINC 429 Interface
» ARINC 600 4MCU form factor, sealed unit
» Internal Gigabit L2/L3 Managed Ethernet Switch
» Latest Dual Core 1.5 GHz Intel® Core™ i7 processor
» Optimized for a full range of flight information systems

Call: 1-888-294-4558 • info@us.kontron.com • www.kontron.com/aceflight

12-15 August

Walter E. Washington Convention Center • Washington D.C.

AUVSI's Unmanned Systems 2013



REGISTER NOW

Conference from 12 - 15 August
Tradeshow from 13 - 15 August
550+ Exhibiting Companies
40+ Countries Represented
8,000+ Attendees

Promoting and Supporting ***Unmanned Systems*** *and* ***Robotics*** *Across the Globe*

AUVSI®
ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

auvsishow.org

JUNE 2013
VOL. 24, NO. 6

Military & Aerospace Electronics

COVER STORY

Image: Airbus S.A.S

MILITARY & AEROSPACE ELECTRONICS ©2013 (ISSN-1046-9079) is published monthly by PennWell Corp.,1421 S. Sheridan, Tulsa, OK 74112. Periodicals postage paid at Tulsa, OK 74101 and additional mailing offices. Editorial offices are located at 98 Spit Brook Road, Nashua, NH 03062-5737. Subscription Prices: Free to qualified subscribers in North America. Other subscribers in U.S.A: $175.00 one year; $309.00 two years; $440.00 three years. Other subscribers in Canada: $270.00 one year; $465.00 two years; $600.00 three years. All other international: $325.00 one year; $620.00 two years; $810.00 three years. Digital edition $70.00 yr. Call (847) 559-7500 for subscription information. We make portions of our subscriber list available to carefully screened companies that offer products and services that may be important for your work. If you do not want to receive those offers and/or information, please let us know by contacting us at List Services, Military & Aerospace Electronics, 98 Spit Brook Road, Nashua, NH 03062. **POSTMASTER:** Send change of address form to MILITARY & AEROSPACE ELECTRONICS, PO Box 3425, Northbrook, IL 60065-3425. All rights reserved. No material may be reprinted without permission from the publisher. Back issues of Military & Aerospace electronics may be purchased at a cost of $16.00 each in the U.S., $22.00 Canada, and $27.00 elsewhere. **RETURN UNDELIVERABLE CANADIAN ADDRESSES TO:** P.O. Box 122, Niagara Falls, ON L2E 6S4. **Printed in the USA / GST NO. 126813153 / Publications Mail Agreement No. 875376**

BY **JOHN KELLER**, EDITOR IN CHIEF

SWaP: how size, weight, and power are transforming the military electronics industry

It's ironic that one of the few growth areas in the U.S. defense industry these days involves making things smaller, but this is the world we live in now. While demand for military aircraft, tanks, and ships appears to be on a steady decline, small is where it's at.

I know you're dreading it, but I'll say it anyway: SWaP (you can uncover your ears now). It's that ubiquitous term you can't escape that refers to electronic systems that are small in size, weight, and power consumption. Why the obsession with small SWaP? A lot of it has to do with sophisticated electronics small enough for unmanned vehicles. Another is placing computer power, displays, communications, and sensors on an already overburdened infantryman. Overall, today's focus on small, lightweight electronic systems that don't use much power has to do with bringing as much capability to the forward edge of battle as possible.

That's at the heart of SWaP directives from the top, anyway. Industry has got the message loud and clear, and now it seems that every discussion of military technology is in the context of SWaP.

The topic of SWaP has become so pervasive that, let's face it, people are sick of hearing about it. I'm as guilty as anyone with other SWaP-related blog posts just this month alone. Still, the importance of SWaP, and the way SWaP issues are transforming the aerospace and defense electronics industry are profound and ought not to be ignored—even at the expense of inducing nausea at the mere thought of the term.

It's almost as if new military technology development has to involve SWaP even to be relevant. SWaP is a cornerstone of industry marketing campaigns and strategies. Don't take my word for it; just look at nearly any new product announcement in our industry these days.

Pretty soon, I predict, the term SWaP will be so much a part of the fabric of the aerospace and defense electronics industry that we no longer need to mention it; SWaP issues simply will be assumed as part of any new technology development.

Believe it or not, we've seen all this before with other all-consuming industry terms. Remember COTS?

That term, short for commercial off-the-shelf, came into fashion two decades ago in the first term of the Bill Clinton Administration. Clinton's secretary of defense, William Perry, essentially coined the term to describe military technologies borrowed from the commercial electronics industry and adapted to military applications. The idea then was for the U.S. military to quit re-inventing the wheel and draw from an ever-deepening well of commercially developed technology.

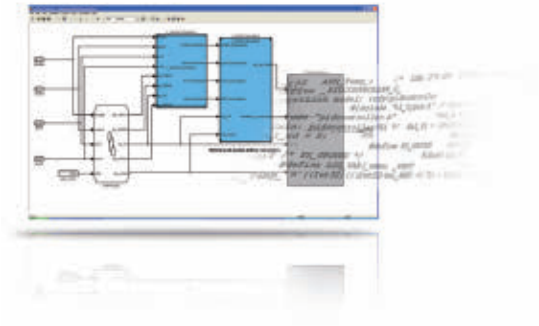
COTS described a revolutionary concept back in those days; today it's a no-brainer. Graphics processors adapted to massively parallel embedded computing, commercial flat-panel TV technology in combat information centers, radiation-hardened versions of PC microprocessors, and the list goes on.

SWaP news comes out at least weekly, sometimes even daily. One of the latest is government research concern for Common Data Link (CDL) radios small enough for hand-launched aerial drones. Technology is headed in the same direction for warfighters on the ground.

What might SWaP mean for tomorrow? Perhaps mechanical fleas designed not only to spy on the adversary, but also to render him combat-ineffective after he does mad with itching.

Perhaps then SWaP will become a verb, and we'll describe a defeated enemy as SWaPped.

Reliable and Efficient - TargetLink® for Automatic C Code Generation



dSPACE TargetLink generates high-quality production C code straight from Simulink / Stateflow and also from TargetLink's dedicated features for production controller development. Since TargetLink's launch in 1999, software development with TargetLink has been repeatedly approved according to DO178B during aircraft certification. TargetLink code has collected countless miles in production aircraft, from business jets to wide-body planes.

TargetLink - your direct and reliable route from model to production C code.

Embedded Success dSPACE

IN BRIEF

Lockheed Martin to provide Army with radar sensors for missile guidance

U.S. Army missile experts needed advanced radar missile seekers for air- and ground-based systems across several frequencies. They found their solution from the Lockheed Martin Corp. Missiles and Fire Control segment in Orlando, Fla. The Army Contracting Command at Redstone Arsenal, Ala., awarded Lockheed Martin an $8.2 million contract for Affordable Phased Array Sensor Systems (APASS) technology for a variety of applications. The APASS Ka-Band Medium Power Development program, sponsored by the Army Aviation and Missile Research, Development and Engineering Center (AMRDEC) at Redstone Arsenal, is developing phased-array radar technology for sensors guidance using RF and millimeter wave technologies. The program is developing affordable, solid-state, all-weather active electronically steered array (AESA) radar seekers to enable missiles to attack enemy ground targets, cruise missiles, unmanned aerial vehicles (UAVs), and helicopters, and to serve as a building block for future radar technologies for surveillance or fire control.

CONTINUED ON PAGE 28 ➔

Air Force asks industry for handheld Link-16 special operations networking radios

BY JOHN KELLER

WRIGHT-PATTERSON AFB, Ohio—U.S. Air Force special operations experts are surveying industry to find companies able to design and build a small handheld Link-16 secure, jam-resistant, high-speed digital data radio that is no larger than today's fielded AN/PRC-148 multiband inter/intra team radio (MBITR).

The Air Force is considering developing a Link 16 handheld radio no larger than the AN/PRC-148 multiband inter/intra team radio (MBITR), shown above.

The Air Force Life Cycle Management Center (AFLCMC) Battlefield Airmen Branch (WISN) at Wright-Patterson Air Force Base, Ohio, issued a request for information (FormFactor_Link-16_radio) last month for a very small form-factor Link-16 radio.

Link-16 is a NATO military tactical data exchange network that enables fighting forces to exchange their tactical pictures in near-real time, as well as send and receive text messages, imagery, and two channels of digital voice.

Link-16 radios typically are aboard aircraft, ships, and combat vehicles, but the Air Force wants to develop handheld Link-16 radios that are small enough for battlefield airmen to use while on foot.

Battlefield Airmen are the special operations force of the Air Force, and include combat controllers, para-rescuemen, tactical air control party members, and special operations weather technicians.

Battlefield Airmen are extensively trained and often operate far into hostile territory, and provide a key link between the air and ground. They perform surveillance, weather forecasting, airfield surveying, air traffic control, air strike direction, airdrop marking, trauma

care, and personnel recovery.

These special operations forces need a way to communicate with other Link-16 aircraft, ships, and combat vehicles without the need to carry excess bulk into the field.

Link-16 is a TDMA-based secure, jam-resistant high-speed digital data link which operates in frequencies from 960 to 1,215 MHz, which limits its use to line of sight, by tactical Internet, or by satellite communications (SATCOM) links.

The Air Force wants a Link-16 radio no larger than the MBITR, the 152/152A; it even could be as small as the RT-1922 microlight SADL radio.

This requirement calls for a small, lightweight, ruggedized tactical data link terminal to be worn by a battlefield airman for sending and receiving Link-16 messages and J voice communications while on foot or in a vehicle.

The radio should provide reliable, secure, Link-16 network connectivity and J-voice, as well as be NSA certified. The terminal should be ergonomically and functionally similar to the MBITR or AN/PRC-152 handheld radios, and use a 5.8-hour, lithium-ion battery and single-bay or six-bay charger.

The transceiver must connect to a computer or similar handheld device through an Ethernet connection and/or USB 2.0 connectors. The radio also should have a 6-pin multifunction connector, and be able to survive immersion in water as deep as six feet. ←

DARPA to create app store of military mobile apps that run on rugged smartphones and tablets

BY JOHN KELLER

ARLINGTON, Va.—U.S. military researchers have awarded the first of what may be several contracts aimed at placing the right mobile software applications into the hands of warfighters for use on rugged smartphones and tablet computers.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., awarded a $29.2 million contract to GXM Consulting LLC in Ashburn, Va., in the first of several contracts expected for the DARPA Transformative Apps program.

Transformative Apps seeks to develop a military mobile apps marketplace to make new capabilities available for use in the field. Ultimately, the program seeks to move the resulting systems to the end users in the military services, and nurture a new model for acquiring, introducing, maintaining, and enhancing software.

Some DARPA Transformative Apps technology has been tested in the field in Afghanistan, and DARPA officials hope to make more widespread deployments and create a broader selection of apps.

Although today's military handheld computers and networks are robust and secure, they also are fairly inflexible and costly, DARPA officials explain. New applications, and modifications to existing applications, can take years to field.

Development is hampered by tight integration of hardware and software that often is generations behind commercial technology. Further complicating matters is the standard Pentagon practice to segregate users, requirements, and procurement in a process that does not respond quickly to rapidly changing user needs.

Transformative Apps builds on commercial practices to produce secure, affordable, and rapidly deployable solutions for warfighters, capitalizing on existing commercial smartphones and tablet computers for initial development and evaluations. Ultimately, DARPA officials want to help make handheld devices and apps broadly available to the lowest military echelons through a centralized marketplace for military apps that meet the evolving requirements of the battlefield.

DARPA researchers envision at least two apps repositories: one with beta apps for initial app evaluations, and another repository with apps that have been vetted, certified, and approved for use.

Part of the program's focus on creating a military apps marketplace involves exploring new business models that lower existing barriers to entry, such as long proposal writing and cumbersome military contracting procedures.

DARPA researchers want broad participation from many development teams, and are considering rewards for developers based on number of downloads, usage statistics, or other measures of value.

Apps will fill diverse needs of the tactical battlefield, including humanitarian missions, disaster recovery, command and control, reporting, mission planning, intelligence, surveillance, reconnaissance, real-time collaboration, geospatial visualization, analysis, language translation, training, and logistics tracking.

The program targets the Android operating system, with emphasis on user interfaces, usability, simplicity, and ease-of-use. Some apps will function without network access, while others may require more consistent network connectivity. For apps that rely heavily on network connectivity, DARPA is emphasizing minimal bandwidth consumption and application robustness in spite of frequent network disconnection.

The program will involve middleware and libraries to help share capabilities and accelerate app development. Example technologies include map viewing, time services, data synchronization, speech recognition, information assurance, peer-to-peer services, and apps management.

Of particular importance for the DARPA Transformative Apps program are middleware and tools to enable secure and reliable operation of apps on tactical networks in spite of limited backend computing and storage. The program also seeks to develop an affordable and secure mobile tactical network compatible with commercial smartphones. Also part of the program are vulnerability analysis and security architecture components.

GXM Consulting LLC will do the work in Ashburn, Va., and Afghanistan, and should be finished by April 2014.

X-47B combat drone launches from aircraft carrier in milestone maritime UAV demonstration

BY JOHN KELLER

ABOARD THE CARRIER USS BUSH—The X-47B unmanned combat aerial vehicle (UCAV) launched last month from the U.S. Navy aircraft carrier USS George H.W. Bush off the coast of Virginia in an important test to demonstrate the viability of future carrier-based unmanned fighter-bomber aircraft.

Launch of the combat drone occurred at 11:18 a.m. eastern time on 14 May while the carrier was underway off the coast of Virginia, say officials of X-47B designer Northrop Grumman Corp. The tailless, strike-fighter-sized aircraft flew autonomously back to Patuxent River Naval Air Station, Md., where it landed 65 minutes later, company officials say.

The X-47B catapult launch occurred just one day after the USS George H.W. Bush had departed from Naval Air Station Norfolk, Va.

The current at-sea period is the second such test period for the UCAS-D program. In December 2012, the program hoisted an X-47B aircraft aboard the USS Harry S. Truman (CVN-75), then demonstrated that the aircraft could be maneuvered safely and precisely on the ship's flight deck, in its elevators and in its hangar bay.

In preparation for the launch, the UCAS-D program completed a series of shore-based catapult shots at Patuxent River NAS between November and March. The air vehicle was transported by barge from Patuxent River to Naval Air Station Norfolk in early May, then hoisted aboard the ship.

"Today's catapult launch of the X-47B is a momentous feat for naval aviation," says Capt. Jaime Engdahl, Navy UCAS program manager for Naval Air Systems Command at Patuxent River NAS. "It proves that the Navy's goal of operating unmanned systems safely and from aircraft carriers is well on its way to becoming a reality."

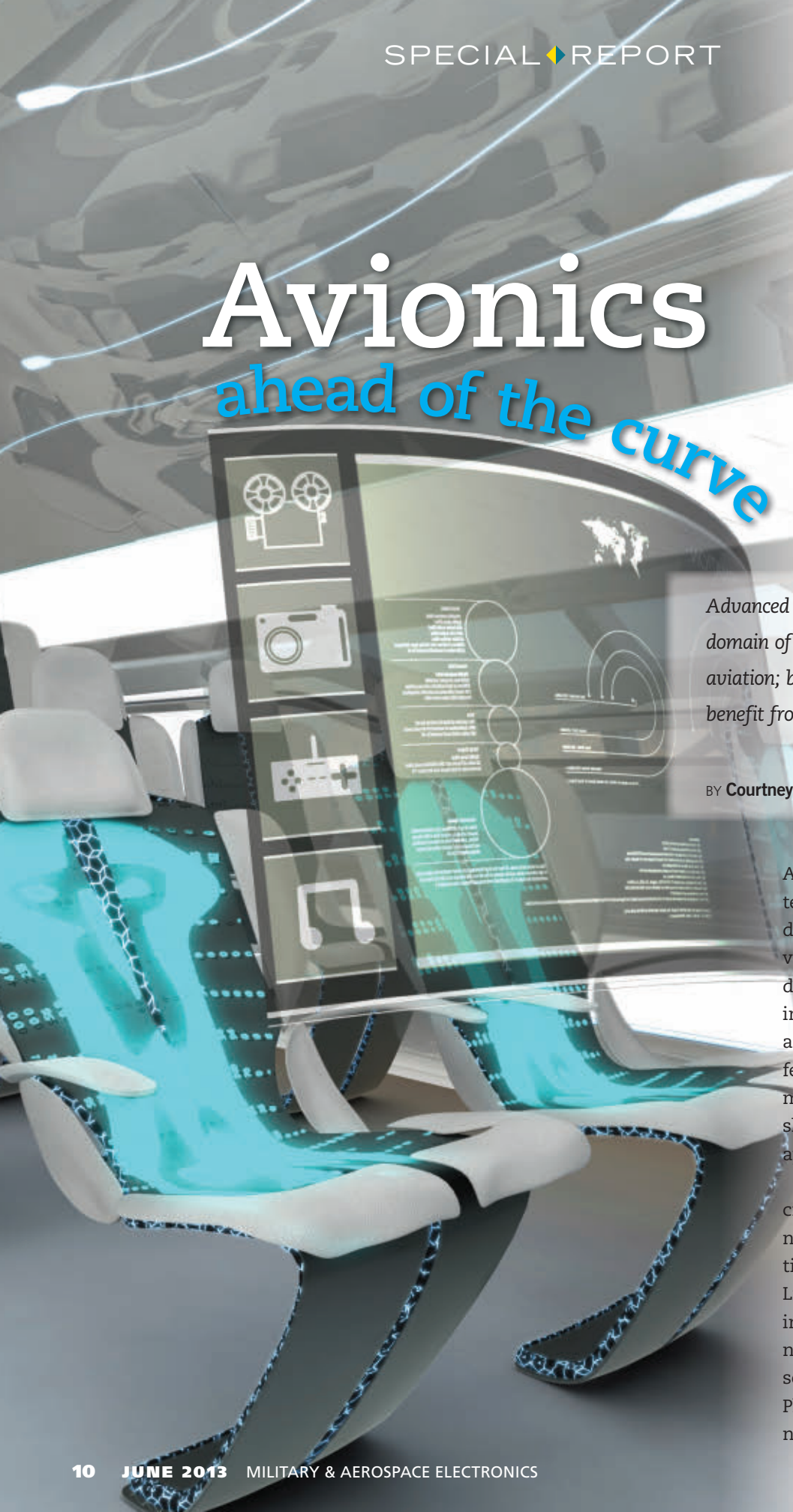
Northrop Grumman designed, produced, and is flight testing two X-47B air vehicles for the program. Air Vehicle 2 completed the catapult shot.

Northrop Grumman's UCAS-D industry team includes Pratt & Whitney, GKN Aerospace, Eaton, GE Aviation, UTC Aerospace Systems, Dell, Honeywell, Moog, Lockheed Martin, Wind River, Parker Aerospace, and Rockwell Collins.

The Northrop Grumman X-47B unmanned combat aircraft launches from the aircraft carrier USS George H.W. Bush in an at-sea demonstration last month.

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

Avionics
ahead of the curve



Advanced avionics is no longer the domain of either military or commercial aviation; both civil and defense aircraft benefit from the latest technologies.

BY **Courtney E. Howard**

A growing number of aerospace technology companies are introducing avionics technology innovations for the benefit of civil and defense projects. In many cases, industry firms are facilitating fast and seamless technology transfer between aviation sectors, and modifying commercial off-the-shelf (COTS) avionics for military applications and vice versa.

"When it comes to commercial and military avionics technologies, there is huge potential for overlap," explains Steven Lien, vice president of marketing and product management for navigation subsystems and sensors at Honeywell Aerospace in Phoenix. "Obviously, some things need to be different, but there is

a lot of commonality and many areas where both spaces, commercial and military, are moving forward together. We think about not 'either or' but really 'both together'—focusing on similar, sometimes common product roadmaps and common technology solutions that will serve both spaces, deliver the best of both worlds, and help customers be more efficient, safer, and accomplish their objectives."

Technology transfer

Many avionics technologies started in the military, were adopted and advanced in the commercial market, and moved back to the military. "GPS [global positioning system] technology started out with a military mission and was developed through the '60s, '70s, and '80s with that in mind, and migrated then to the commercial side," Lien says.

"Now it's ubiquitous and used everywhere from cars to cell phones to commercial aircraft, Lien continues." There are certain things the military has continued to evolve with GPS, and many others that commercial has continued to evolve, like augmentation, Wide Area Augmentation System (WAAS), and Localizer Performance with Vertical Guidance (WAAS LPV), and now rolling out Local Area Augmentation Systems (LAAS) with our SmartPath Ground Based Augmentation System (GBAS) product.

"It's interesting," Lien adds. "GPS innovations that commercial [vendors] have driven over the past decade are moving back into the military. In fact, many commercial aviation technologies are being taken back into the military. We are seeing more and more of that, including military [customers] asking for civil certifications on their navigation boxes so they can fly in civil airspace.

"A number of militaries internationally and in the U.S. are thinking about interoperability," Lien notes. "They are asking for DO-178B and DO-254 [certification], which will make their navigation boxes interoperable in commercial airspace; ultimately, they want to be certified to automatic dependent surveillance-broadcast (ADS-B) Out mandates."

Myriad civil and military aircraft take advantage of modern avionics from technology providers such as Honeywell. Honeywell's synthetic vision system is shown above in a Gulfstream cockpit.

Later in this decade, the commercial market will start to roll out more constellations. "International militaries will pick that up because they'll want to use their home constellation. Militaries broadly will move beyond GPS to multi-constellation satellite navigation," Lien says. "It's interesting when you think about this juxtaposition between military to commercial development and then back to military, and how the two exist in many cases in parallel and in many other cases as one depending on the specific need and use case."

Flash FPGAs

A wealth of military applications use field-programmable gate arrays (FPGAs); at the same time, avionics engineers working on commercial aircraft are increasingly adopting FPGA technologies.

Flash-based FPGAs are being employed in a variety of commercial aviation applications, including new passenger aircraft and retrofit projects. Ken O'Neill, space and aviation director of marketing at Microsemi Corp. in San Jose, Calif., sees design activity today on new, modern commercial airliners and retrofit equipment for recently introduced airliners.

"In the case of retrofit design and brand-new design," O'Neill says, "we see Flash FPGAs being adopted and some older antifuse FPGAs being used. Our new family of 65-nanometer, Flash-based FPGAs are also starting to get some good design traction in new aircraft." The company's FPGAs are involved in the design activity around the Airbus A350, Airbus A400, and Boeing 787, as well as retrofit design activity on Boeing 737, Boeing 777, and Airbus A340 aircraft, he says.

FPGAs are being adopted in a lot of flight-critical applications, categories of equipment considered either Design Assurance Level (DAL) A or B, such as the primary flight computer, navigation system, cockpit displays, braking systems, cabin pressure and temperature, lighting, actuator controls, or aircraft engine controls. "In those kinds of applications, very often there's a requirement for redundancy, so there will be at least two instances of the equipment on the aircraft," O'Neill explains. "There's often a requirement for those two pieces of equipment to have been designed independently by different design teams and to use different components, so that there's no common failure mode between the two types of equipment."

Engineers selecting FPGAs in these applications often will choose one particular kind of FPGA for the primary and a different type of FPGA for the redundant version of the system, O'Neill says. "That requirement for dissimilarity is one of the things driving adoption of new and not-so-new FPGAs. The fact that our Flash FPGAs and antifuse FPGAs are manufactured differently and have different architectures and different software means they are entirely dissimilar and, therefore, can participate in both sides of this redundant equipment."

Providing protection

Safety is a serious concern in civil and defense aviation applications; as a result, safety-related attributes can factor heavily in the adoption of certain avionics. Of particular interest are those avionics technologies that deliver protection from atmospheric

radiation, lightning, and the like.

"Even at 30 or 40 thousand feet in the atmosphere, where commercial aircraft fly, there are significant quantities of neutrons in the air and they're energetic. They can strike data circuits and cause data to change, upsets to occur," O'Neill explains. FPGAs configured with SRAM cells are susceptible to upsets; SRAM cells will upset in neutron radiation, causing the FPGA to change state and become nonfunctional, he says. "That is a major concern if you're using the FPGA for an application which is flight critical, and people's lives depend on the FPGA working correctly. The Flash-based FPGAs and antifuse FPGAs that we offer are immune to configuration upsets due to the neutron radiation that you get in atmospheric applications."

Engineers have employed Microsemi FPGA technology in various military fighter, bomber, transport, tanker, and support aircraft and myriad programs, including modern U.S. fighter programs like the F-35 and F-22, upgrades on the F-16 and F-18; internationally, the Eurofighter Typhoon has a significant number of Microsemi FPGAs on board, O'Neill says.

Microsemi's patented plastic large area device (PLAD) package technology, used in the company's transient voltage suppressor (TVS) diodes, help protect aircraft from multi-stroke lightning. "TVS diodes protect various electronic systems—such as those used in power management, actuation, flight control,

Curtiss-Wright Controls Avionics & Electronics provides rackmounted data concentrators.

and engine management—from transient voltage surges," says Durga Peddireddy, director of marketing and applications at the Microsemi Hi-Rel Group in Lawrence, Mass.

"The single-component solution meets aircraft lightning standard RTCA DO-160, saves board space, lowers weight, and improves reliability over the multi-device designs often used to provide these high levels of protection," Peddireddy adds. "It has dual usage because any aircraft, either military or commercial, need protection from lightning strikes." It brings value to all aircraft modules and subsystems from manufacturers such as BAE Systems, UTC, and Rolls Royce, Peddireddy adds.

The "Black Box" Flight Recorder with an internal Recorder Independent Power Supply above is but one avionics solution available from Curtiss-Wright Controls Avionics & Electronics.

Upgrades and integration

Commercial and military pilots are anxious to gain access to the latest cockpit avionics; yet, the current economic environment is oftentimes preventing the acquisition of new aircraft and glass cockpit upgrades on commercial and military aircraft.

"The military space is really interesting right now," says Larisa Parks, vice president of marketing and product management for crew interface products at Honeywell Aerospace. "Certainly, the current economic and budget situation for the defense sector in the U.S. is limiting the new cockpit opportunities, but there is a desire and need to upgrade, for a couple reasons: to incorporate some of the NextGen [Next Generation Air Transportation System] functionality as they plan to mix airspace, and also reliability and performance. They're looking for those types of upgrades in the pilot experience without swapping out the entire cockpit." Avionics engineers are implementing solutions such as Honeywell's IPM (image processing module) to improve the processing power in existing cockpits.

Mandate-driven modifications

Some avionics upgrades are driven by mandates, such as NextGen in the U.S. "It's usually collections of mandates that tip the scales as to when it is time to replace an analog cockpit or legacy CRT display, and how far modifications go or the point at which it's no longer economic to retain a legacy system," says Paul Hart, director of avionics engineering at Curtiss-Wright Controls Avionics & Electronics (CWC-AE) in Christchurch, England.

US Airways reportedly is the first commercial airline to receive FAA certification on the full suite of SafeRoute NextGen ADS-B avionics, in which military avionics engineers are becoming increasingly interested. US Airways engineers selected SafeRoute, a set of four flight deck applications from ACSS, an L-3 Communications and Thales Company in Phoenix, for its wide-body Airbus A330 aircraft to enhance operational safety and efficiency in all phases of flight under the FAA's NextGen implementation program.

"The recent certification of ACSS NextGen avionics for US Airways is an important advancement in cockpit avionics," notes Steve Henden, senior manager, communications for L-3 Aviation Products in Phoenix. "The higher level of situational awareness and information enables our SafeRoute ADS-B In avionics to deliver efficiency and safety benefits, resulting in less fuel burn and fewer deviations during approach."

The certified SafeRoute suite of applications on US Airways A330 aircraft uses Automatic Dependent Surveillance-Broadcast (ADS-B) technology to provide pilots with more precise position information of the operating aircraft and surrounding airplane traffic. ADS-B is a cornerstone technology for the FAA's NextGen airspace redesign program.

"US Airways and our other airline partners understand and embrace the opportunities and savings ADS-B provides for operators," says Terry Flaishans, president of ACSS. "Our investment in SafeRoute avionics is helping airlines operate more safely and fly the most efficient routes to their destinations."

Modular avionics

Modification centers and original equipment manufacturers (OEMs) are installing glass cockpits under a growing number of aircraft upgrade programs, says CWC-AE's Hart. Yet, the industry trend toward glass cockpits creates a lot of design and integration issues.

"The interfacing on a lot of the avionics, such as the electronics flight instrument system (EFIS), is ARINC 429, Ethernet, or sometimes video buses. They don't normally have the analog connections needed to interface to legacy aircraft, and that's really where we come in," Hart explains. "A lot of EFIS have a generic multifunction display but the digital receiver ports won't be compatible with a lot of sensors—for position, airspeed, altitude, pressure, etc.—around the aircraft. It would be a very expensive retrofit to replace and recertify all those sensors; we provide the translation box that cleans up those interfaces, does all the signal conditioning and scaling, and sends a clean output by ARINC 429 or Ethernet into the glass cockpit EFIS."

Avionics upgrades often happen in stages. "There are a lot of existing systems on the aircraft—many of which will not necessarily be upgraded at the same time—that they will want to reuse from program to program," says John Fallon, marketing manager at Curtiss-Wright Controls Avionics & Electronics in Dublin. "The data concentrator can be the glue and remove the complexity for the core avionics supplier. They can continue to develop new systems and hand off the custom integration with other systems to data concentrators. A data concentrator solves this integration challenge by collecting, combining, and reformatting data from a variety of existing subsystems into the required avionics bus format."

"What we have is a scalable DCU approach; people can do a basic cockpit upgrade, gaining navigation and primary flight display information, and still retain a mix—hybrid cockpits that maintain a mixture of glass cockpit and old analog displays," Hart says. "With a DCU architecture, you add capability to a bus so you can then go into higher levels of integration and start phasing out some of the old analog systems. There are ways and means that cockpit upgrades can be phased in conjunction to mandates and aircraft owners' budgets."

"Our Data Concentrator Unit (DCU), has been described by some in the industry as a 'Happy Box' because it solves many integration issues and lowers certification risk to the program," Fallon says. "A DCU converts input data from one form to another before outputting to one or more locations. Honeywell engineers chose Curtiss-Wright's Advanced Data Acquisition Units (ADAUs) to convert analog and digital sensor inputs into digital outputs on its Primus Apex Integrated Flight Deck.

"It's about taking an existing product, the standard data acquisition unit; making it more powerful; and enabling growth features that increase efficiency, capacity, and most importantly, enhance aviation safety. There's a solid trend throughout the industry toward making integrated avionics systems more aircraft-independent and Honeywell's ADAU concept makes this a reality," says John Todd, vice president of business and general aviation at Honeywell Aerospace.

"The ADAU approach plays a critical role in enabling Primus Apex to reduce the time and costs associated with adopting and certifying highly integrated, custom avionics suites," Todd continues. "By having the aircraft-specific data conversion done separately from the flight deck, OEMs and operators benefit from an easier and more straightforward path toward incorporating highly-desirable features such as low RNP (required navigation performance), ADS-B, or SmartView enabled by software upgrades."

Military aircraft already are benefiting from existing data concentrator technology to solve integration challenges as part of major upgrade programs, Fallon says. Curtiss-Wright has provided data concentrators to the CH-47 and CH-53 military helicopter upgrade programs.

"The latest generation of the data concentrator is also being provided to the U.S. Air Force and NATO

Microsemi FPGAs are employed on a variety of civil and military platforms.

Airborne Warning and Control System (AWACS) upgrade programs," Fallon says. "Rockwell Collins is providing the navigation and control avionics upgrade and is using CWC-AE DCU technology." Curtiss-Wright's DCUs provide the conversion of analog and digital sensor inputs into digital outputs to support the upgrade of the AWACS aircraft's vital navigation control avionics.

The popular Dassault Falcon sports Honeywell's EASy II flight deck as its man-machine interface.

Design to delivery

To help avionics systems developers fast-track the design-to-deployment process of flight communication and wireless server applications, Kontron in Poway, Calif., launched the next generation of its ACE Flight 600 general-purpose airborne servers.

The Kontron ACE Flight 600 integrated, application-ready platform is designed to meet advanced communication application requirements for Ethernet-based network installations on linefit and retrofit aircraft.

"Although the primary applications for Kontron's ACE Flight Server and Cab-n-Connect wireless access point equipment have been for commercial airlines and general aviation, some deployments are in progress for government and military aircraft," says R.J. McLaren, product marketing manager at Kontron. "A general-purpose networking server can be used for many applications and provides up to 1.8 terabytes of solid-state disk (SSD) storage. In combination with the wireless access point, it allows for an enterprise-class wireless networking solution on a plane that has been tested and approved by the FAA (PMA)."

A majority of engineers use this combination of Kontron avionics equipment for passenger in-flight entertainment or Internet connectivity; yet, it is also used for crew connectivity and aircraft operations.

"Militaries and governments continue to use personnel electronic devices that need to be continuously connected. Our products can help to provide secure wireless on the plane and ensure that they continue to get high data rates for video or other types of media streamed to their portable wireless devices," McLaren adds.

"The challenges for both civil and military continue to be savings in weight, power, size, cost, and time-to-market with new technologies. The process and cost required to get new equipment approved and certified for airworthiness, not to mention the down time to install onto an aircraft, makes it difficult to keep ever changing and evolving technology for the consumer current on the aircraft," McLaren says.

"To help solve some of these issues, Kontron develops computer on modules and boards that can be used for avionics and provide compatibility both backward and forward within the deployed equipment," McLaren notes. "By packaging cutting-edge processor boards in pre-certified solutions, Kontron makes it even easier for the avionics industry to adapt and deploy new technology onto the plane, saving significant time and costs by doing it themselves."

Future functionality

Avionics technology continues to advance rapidly, to the benefit of commercial, general, and military aviation communities and applications.

"I see a bright future in spite of various challenges such as reducing weight, higher reliability, increasing efficiency, high power requirements, and lowering costs the civil and military avionics is facing," says Microsemi's Peddireddy.

"New architectures, such as distributed control systems, all-electric systems, modular approaches, lighter body materials, and next-generation semiconductor technologies, are a few approaches to address these challenges," Peddireddy explains. "Engineers play a vital role in meeting these demands by being more innovative and agile."

DSEI

10 – 13 September 2013

ExCeL, London **www.DSEI.co.uk**

Register now for early bird discount

THE WORLD LEADING DEFENCE & SECURITY EVENT

+ **1,400 international exhibitors** - an unrivalled range of suppliers from more than 50 countries
+ **Specialised Air, Naval, Land, Security, Medical and Unmanned Zones**
+ **Visiting naval ships** available to tour
+ **Live Waterborne and Unmanned Ground Systems Demonstrations**
+ **Unbeatable networking** - the entire defence and security supply chain in one place
+ **NEW medical seminars and exhibitors**
+ **6 free seminar theatres** offering educational sessions and showcases
+ **Static vehicle displays** for land, air and naval sectors - our biggest offering yet
+ **Unmanned focus** - UAS Conference and Unmanned Systems Showcase

REGISTER NOW FOR EARLY BIRD DISCOUNT **www.DSEI.co.uk/early1at**

IN ASSOCIATION WITH

MINISTRY OF DEFENCE

UK TRADE & INVESTMENT

aerospace defence security space ADS

PLATINUM SPONSORS

BAE SYSTEMS

GENERAL DYNAMICS United Kingdom Limited

CLARION EVENTS

Rad-hard space electronics hit the mainstream

Radiation-hardened electronics advance with emerging standards and expanding markets.

BY **Skyler Frink**

Older satellite constellations, such as the Boeing 601 MEASAT satellite, are currently being replaced.

Space is one of the most difficult environments for electronics, and the systems that contain these electronics must last for years without any maintenance. Unlike an aircraft or underwater vehicle, which enters harsh environments as well, radiation-hardened electronics often are placed on satellites where, once the system is launched and operating, it will not receive any maintenance at all.

This means radiation-hardened electronics need to be completely fail-proof for their inclusion on systems on which lives often depend. These space systems are becoming more and more common for defense and consumer purposes, from military imaging satellites to consumer communication satellites. Highlighting the importance of space systems is the number of countries that are attempting to gain a presence in space.

Even with the shrinking U.S. defense budget, the radiation-hardened electronics industry is seeing a larger market than ever and systems designers that are requesting equipment to fit systems both new and old.

Legacy systems

There are satellites in orbit that have been up for dozens of years; these systems, while functioning, are not expected to last forever. While new systems ideally would replace them, some systems designers are simply looking for products that match legacy systems for form and performance. "Right now, systems designers are not doing a lot of research and development, but they are keeping legacy systems alive," says Peter Millike, semicustom product manager at Aeroflex Inc. in Plainview, N.Y. "They are looking for parts for systems that were designed up to 10 or 15 years ago. The time it takes to requalify systems can take years. In legacy systems, they want form for function equivalents; which saves months, if not years, and millions of dollars."

With the recent defense budget cuts, keeping legacy systems up and running has been an effective alternative to designing entirely new systems. Many older systems that have begun to fail are being replaced, such as the Landsat remote-sensing satellite. Landsat 8 was launched this year for the sole purpose of keeping the Landsat system from falling into disrepair, and a new launch, Landsat 9, is already being

Power Your **Space** Mission Today

TOR Compliant • Rad Hard • Power Modules

VPT offers an entire system of SVR Series power conversion products to satisfy today's standards and power tomorrow's space systems.

Max Output Power	Model Series	Output Voltages (VDC)	Total Dose with ELDRS	SEE	TOR Compliant	DLA SMD Number or Drawing
DC-DC Power Converters—Isolated						
15 W	SVRHF2800S/D	Single 3.3, 5, 12, 15 Dual ±5, ±12, ±15	100 krad(Si)	85 MeV-cm²/mg	Yes	In DLA review
40 W	SVRTR2800S/D	Single 3.3, 5, 12, 15 Dual ±12, ±15	100 krad(Si)	85 MeV-cm²/mg	Yes	5962R13209 5962R13210
100 W	SVRFL2800S/D	Single 3.3, 5, 12, 15 Dual ±5, ±12, ±15	100 krad(Si)	85 MeV-cm²/mg	Yes	In DLA review
Point of Load DC-DC Power Converters—Non-Isolated						
8 A	SVRGA0508S	-1.5% to 1.5% of Vout	100 krad(Si)	85 MeV-cm²/mg	Yes	5962R13217
EMI Filters						
2 A	SVRMH28	Single 28	Immune	Immune	Yes	In Qualification
4 A	SVRMC28	Single 28	Immune	Immune	Yes	13010
10 A	SVRME28	Single 28	Immune	Immune	Yes	13009

- **Complete distributed system**: Isolated DC-DC converters, point of load converters, EMI filters
- **Qualified**: MIL-PRF-38534 Class K, on DLA SMDs
- **Heritage**: Designs proven in 20 years of space flight
- **Delivery**: Engineering models typically ship from stock

View the datasheets and download a catalog today.
www.vptpower.com/SpaceDCDC

VPT
Power Your Critical Mission Today

planned to keep the system running beyond Landsat 8's design life.

Commercial and military

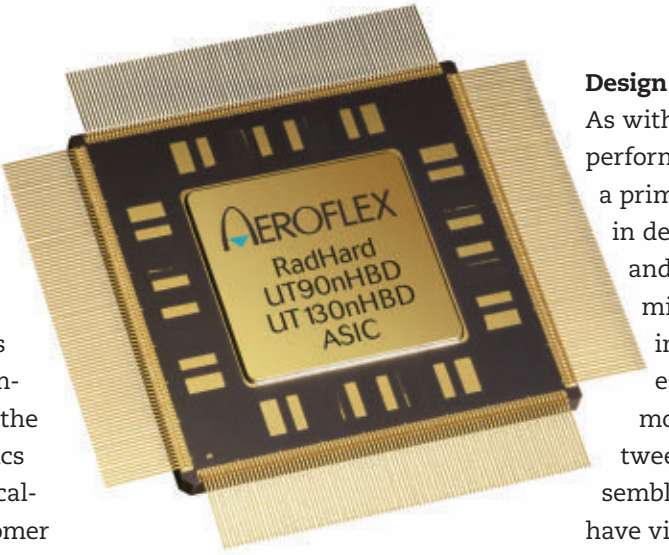
The consumer market has a major effect on the military market, with electronics that often are higher performing but less reliable. "I think the radiation-hardened electronics market is in two bands, typically based on the type of customer and the orbit they're in," says Simon Wainwright, vice president and general manager of the Hi-Rel Group in Aliso Viejo, Calif. "The commercial guys with communication satellites and stuff like that, they tend to be closer to the Earth. Then you have the military guys who tend to be the Geostationary orbits (GEO)."

Because of their use of low-Earth orbits, most consumer electronics can afford to be less tolerant of radiation, as they are exposed to far less radiation than satellites in Geostationary orbits.

Still, the military is looking at commercial products whenever possible. "Customers are looking at commercial solutions and products and looking at what they can get away with," says Microsemi's Wainwright. "Is it possible to use it in an aerospace or defense application?" Less rugged electronics can be used in launch gear, in particular, where the system only needs to last for a matter of minutes or hours before falling away from the primary system.

Risk and reward

With shrinking budgets, aerospace and defense systems designers have been watching the commercial market more closely for possible innovations. "There used to be higher reliability across the board," says Microsemi's Wainwright. "Now we're seeing it split up into different levels of risk. The commercial guys take more risks; they place fewer demands on electronics. They may have a radiation-level requirement that is slightly lower than the military guys. The military has much more stringent qualification levels. Iridium is considering plastic products; GPS 3 will not be using plastic products."



The UT90 hardened-by-design standard cell uses 90-nanometer transistors and features 30,000,000 usable equivalent gates with a 1.0-volt Core using standard cell architecture.

The major risky move the consumer market has made is the consideration of plastic products in communication satellites. If the products are a success, they may end up making their way on temporary, or less important, military systems.

Wainwright says the idea of using plastic parts is simply part of a cycle. "Every 10 to 15 years, people start toying with the idea of using non-hermetics and plastics in space," he says. "They have failures in their programs when they do it."

Design trends

As with all electronics, superior performance and faster speeds are a primary concern. "The trends in designing have been smaller and better," explains Microsemi's Wainwright. "We're seeing more high-speed interfaces. Customers are trying to move a lot more data faster between boxes or between subassemblers in the electronics. If you have video, imagine a satellite taking the picture and having to process and stream that information. Compressing it, managing it, and transmitting it is where the direction is headed." Data processing is so important because of the increasing sensitivity of sensor payloads on satellites.

"The changes have been driven primarily by the sensor," says Aeroflex's Millike. "We're trying to penetrate to the ground, use radar, take images. The sensor is responsible for collecting a lot of data. What we're seeing over the years is that the sensor's ability to collect more data improves.

"What we end up with is more data that needs to be moved from one satellite to another or back down to the ground, or it needs to be processed by the satellite itself," Millike explains. "We need more powerful algorithms, more logic, in a smaller space. We are also concerned about power, because a satellite has to generate its power with solar cells. We've got power issues, thermal issues, and a payload that needs to crunch a lot of data and make a decision or send it to the ground. What we have seen is just an increase in the amount of data."

As the volume of data a satellite

can gather increases, so too does the necessity of having the processing power to make that raw data useful. Not only is there more to process, but there is a need to process this information while using as little power as possible.

One response to the demand for superior electronics with greater efficiency has been shrinking the size of transistors. "Ninety-nanometer technology is a response to the requirement of more gates per unit area. The 90-nanometer refers to the size of the base transistors; we're building circuits with transistors that are, at a minimum, 90 nanometers," says Aeroflex's Millike.

"Our systems designers require a particular logic density, and then our systems designers also require specific operating frequency, and they request a certain power. Those things result in physically smaller size transistors," Millike mentions.

Nintey-nanometer technology may not be new to electronics, but the ability to have transistors of that size and still survive the space environment is. This results in not only superior processing, but also power savings. It does bring up new problems with how the electronics survive radiation, as lower voltages are more susceptible to radiation interference.

"Shrinking tech means you're lowering the voltage," says Millike, "so the signal-to-noise ratio has gotten worse. The challenge is how do I get smaller and lower voltage and still get the same radiation tolerance."

The challenge of developing electronics that can not only ignore radiation, but also survive in an environment where they are exposed to it is what causes the radiation-hardened market to lag behind other electronics.

New Techniques

While radiation-hardened electronics typically rely on mature technologies, the industry has been branching out to meet systems designers' demands for efficient and faster computing. One way this has manifested itself is in the industry's consideration of wide-bandgap technologies. Wide bandgap semiconductors

feature electronic band gaps that are significantly larger than one electron volt, which gives them an advantage in higher temperature environments as well as higher efficiency. “The wide bandgap technologies provide improvement in terms of switching,” explains Microsemi’s Wainwright. “They lend themselves to much better efficiencies in, say, power supplies. When you use wide bandgap technologies in converters you can get between 3 and 10 percent increases in efficiencies.”

Wide bandgap technologies are not a mature technology for the radiation-hardened industry, where products need to be extremely well tested and reliable to pass muster. “The military tends to be a lot more cautious when it comes to wide band gap technology,” says Wainwright. “These technologies are in their infancy at this point and we still have a lot of work to do to say that they’re reliable. We feel that they have potential and that we can get there. We just need to do the testing.”

Wide bandgap technologies show promise for radiation-hardened electronics, and as the technology matures, it will likely become widespread in the industry with its higher efficiency and possible operating temperature.

The SVR series DC-DC converters and EMI filters from VPT are TOR qualified and designed for the harshest radiation environments.

Increased resilience

As space becomes more important, the aerospace and defense industry has begun to test more and more frequently and design products based on the new testing. Effective testing for radiation effects is still relatively new and as research is done, testing changes. “I think the challenges are in trying to understand the different types of radiation effects that there are to withstand,” says Microsemi’s Wainwright. “The effects we’re trying to characterize are total dose, a constant bombardment of radiation, and low dose rate effects that actually can have different effects on semiconductors. The difference there is that we expose the products to lower rates of radiation and we’re finding out that even though the radiation is the same, there’s actually a different performance when you lower the rate. We have to try to understand the effects as we go forward. We’re always looking to do experimentation to understand where the worst effects occur.”

With more information being uncovered all the time, the design of certain products has seen itself changing to become more rugged in high-radiation environments. “At the moment, we’ve been highly active in redesigning bipolar transistors to enhance the survivability over the low dose and high dose radiation spectrums,” says Microsemi’s Wainwright. “You can have different dose

rates or a total dose, and a bipolar is more susceptible to a low dose rate that you'd see in space. We're designing some of our parts to make sure we have a higher resistance to the low dose environments."

The redesign of bipolar transistors comes after the discovery that consistent, low doses of radiation cause existing components issues. Different components react differently to dosage rates and total dose levels.

The emerging TOR standard

Previously, MIL-PRF-38534 Class K was considered the most stringent standard for radiation-hardened electronics. Anything above Class K was simply called Class K+ and was not standardized. This changed with Aerospace TOR, which refers to reports developed by the Aerospace Corp. and flowed down as requirements on space asset procurements that cover technical requirements on electronic parts, mechanical parts, materials, and processes involved in the manufacture of components used on space-based systems. The requirements include guidance on analysis, part deratings, prohibited part types, and part element evaluation and screening that exceeds the requirements of MIL-PRF-38534 Class K.

"TOR is a new requirement that has been growing with the industry," says Monty Pyle, vice president of sales and marketing for VPT Inc. in Everett, Wash. "Even in the tight-knit space industry, everyone is aware of it but nobody can define it unless you're knee deep in it. This continuing, growing requirement is constantly in a state of flux."

The TOR requirements are meant to give military and aerospace systems designers a better idea of requirements for programs that would have previously been Class K+, and companies have already begun designing electronics that fit the current requirements.

"The TOR standard has actually been reviewed and discussed for the past 5 years, and it has gone through many revisions," explains Microsemi's Wainwright. "They're trying to develop a standard that makes sense.

"Over the last couple years, they are trying to be more cost effective; they seem to be making changes that are less expensive for us to meet. We're actually looking at designing our products with the TOR requirements," Wainwright adds.

The TOR requirements take into account not only the needs of defense and aerospace systems designers, but also the needs of the industry. TOR requirements have made it easier for military and aerospace systems designers to communicate with the companies that produce radiation-hardened electronics by providing a common ground.

"As painful as it is, TOR has helped [high-reliability] programs kind of migrate in a general direction to a general point," says VPT's Pyle. "Instead of having various systems designers come in and talk about Class K+ in different ways—there's almost this feeling out and learning process every time—TOR has brought that vagueness more into a gray circle; it helps bring people to the point faster on what's really realistic and available. We can point to a spec now. There's a commonality there; it's not a start from ground zero."

COMPANY INFO

Aeroflex Inc.
Plainview, N.Y.
516-694-6700
www.aeroflex.com

Aeroflex RAD
Colorado Springs, Colo.
719-531-0800
www.aeroflex.com/ams/pagesproduct/prods-radinc-services.cfm

Aitech
Chatsworth, Calif.
818-700-2000
www.rugged.com

Atmel
San Jose, Calif.
408-441-0311
www.atmel.com

BAE Systems Electronic Solutions
Nashua, N.H.
603-885-4321
www.baesystems.com

Crane Interpoint
Redmond, Wash.
425-882-3100
www.interpoint.com

Curtiss-Wright Controls Embedded Computing
Ashburn, Va.
703-779-7800
www.cwcembedded.com

Honeywell Microelectronics
Plymouth, Minn.
877-841-2840
www.honeywellmicroelectronics.com

International Rectifier
El Segundo, Calif.
310-726-8000
www.irf.com

Intersil Corp.
Milpitas, Calif.
408-432-8888
www.intersil.com

Linear Technology Corp.
Milpitas, Calif.
408-432-1900
www.linear.com

Maxwell Technologies
San Diego, Calif.
858-503-3300
www.maxwell.com

Microelectronics Research Development Corp.
Colorado Springs, Colo.
719-531.0805
www.micro-rdc.com

Micropac Industries
Garland, Texas
972-272-3571
www.micropac.com

Microsemi SoC
Mountain View, Calif.
800-713-4113
www.microsemi.com

Modular Devices Inc.
Shirley, N.Y.
631-345-3100
www.mdipower.com

MS Kennedy Corp.
Liverpool, N.Y.
315-701-6751
www.mskennedy.com

Peregrine Semiconductor Corp.
San Diego, Calif.
858-731-9400
www.psemi.com

Semicoa Corp.
Costa Mesa, Calif.
714-979-1900
www.semicoa.com

STMicroelectronics
Geneva, Switzerland
+41 22 929 29 29
www.st.com

Synova Inc.
Melbourne, Fla.
321-728-8889
www.synova.com

Teledyne Microelectronic Technologies
Los Angeles, Calif.
310-822-8229
www.teledynemicro.com

Texas Instruments
Dallas, Texas
972-995-2011
www.ti.com

3D-Plus
McKinney, Texas
214-733-8505
www.3d-plus.com

TRAD
Lebarge, France
+33 (0)5 61 00 95 60
www.trad.fr

Triad Semiconductor
Winston-Salem, N.C.
336-774-2150
www.triadsemi.com

Ultra Communications Inc.
Vista, Calif.
760-652-0011
www.ultracomm-inc.com

VPT Inc.
Everett, Wash.
425-353-3010
www.vpt-inc.com

Xilinx Inc.
San Jose, Calif.
408-559-7778
www.xilinx.com

Rad-hard market

Space has become more open than ever, with governments and their militaries jumping on the chance to get satellites into orbit. "The space market is definitely growing," says Microsemi's Wainwright. "Every time we turn around, there is a different country going into space. It used to be the U.S. was dominant, and then Europe jumped in; now countries all over the world are getting involved. Everybody wants to put a satellite in orbit."

Not only has space become more accessible, but legacy systems are growing obsolete, and some are even failing. "Satellites are not forever things," says Aeroflex's Millike. "You have a lot of satellite capacity up there that's aging." Legacy systems are already being replaced, and many companies are looking to maintain the status quo, creating a large market for legacy parts.

These factors have made radiation-hardened electronics providers optimistic about the future of the industry, even after the past few years of relatively small growth.

"We believe that this is a market that we want to be in," says Microsemi's Wainwright. "We believe that we see growth in this specific market. We are completely dedicated to investing in it."

Air Force researchers look to keep satellite networks up in the presence of cyber attacks

U.S. Air Force space electronics specialists are considering a research program on cyber security for orbiting satellites and satellite ground-control equipment, and trying to determine the level of expertise and capability in defense companies and universities. Officials at the Air Force Research Laboratory Space Vehicles Directorate at Kirtland Air Force Base, N.M., issued a request for information for the Space Systems Cyber Resiliency program, which involves cyber security for satellites, satellite subsystems, and satellite ground-control systems. Researchers are interested in spacecraft as a platform, the systems that constitute the spacecraft, computers and software, buses and networks, and elements that interface to the spacecraft throughout its acquisition lifecycle. Interest extends to analytic tools to determine spacecraft vulnerability to cyber-attacks; technologies to keep spacecraft and networks functioning in the presence of cyber-attacks; ways to distinguish between anomalies from system failures, cyber-attacks, and radiation-induced upsets; self-healing systems; cyber defense-in-depth; and mission survival with graceful degradation under cyber-attack. ←

Air Force looks to Northrop Grumman for Global Hawk UAV maintenance through late 2014

BY **John Keller**

ROBINS AIR FORCE BASE, Ga.—Contractor logistics support—or the lifetime maintenance of weapons systems by defense contractors instead of military maintenance personnel—has become big business in recent years, and Northrop Grumman Corp. is cashing-in with a U.S. Air Force contract worth nearly half a billion dollars to maintain the RQ-4 Global Hawk long-endurance unmanned aerial vehicle (UAV).

The Northrop Grumman Aerospace Systems sector in San Diego won a $434 million contract to perform contractor logistics support for the Global Hawk. The contract was awarded by the Air Force Life Cycle Management Center (AFLCMC) at Robins Air Force Base, Ga.

Northrop Grumman Aerospace designed and built the Global Hawk, a surveillance UAV larger than an F-16 jet fighter, and will handle contractor logistics support for the unmanned aircraft through September 2014 under terms of the Air Force contract.

Global Hawk was designed by Ryan Aeronautical, which Northrop Grumman acquired in 1999. The UAV has a role similar to the U-2 high-altitude surveillance aircraft.

The RQ-4 UAV provides broad-area surveillance using high-resolution synthetic aperture radar (SAR) and long-range infrared sensors. The aircraft can remain aloft for days and can survey as much as 40,000 square miles a day.

Northrop Grumman will handle maintenance, upgrades, and technology insertion for the Global Hawk UAV, shown above.

A Navy version of the Global Hawk called the Broad Area Maritime Surveillance (BAMS) UAV assists the Navy's Boeing P-8 surveillance jet with anti-submarine warfare (ASW) and maritime patrol duties.

Contractor logistics support, although an expensive line item in the Pentagon budget, often makes sense in the modern era of complex military technology—especially as military personnel are taking a hit due to sequestration and other U.S. Department of Defense budget cuts.

Maintaining large and complex weapon systems such as the Global Hawk, often referred to as organic repair, is a massive undertaking, according to a 2009 study by Rand Corp., a think tank in Santa Monica, Calif.

Managing organic repair efficiently has been a challenge for the Air Force throughout its existence, according to the Rand Corp. study, entitled Contractor Logistics Support in the U.S. Air Force. The Air Force

CONTINUED ON PAGE 39 ➔

Software development tools today are about reliability and ensuring adherence to standards

BY **John Keller**

Application software for a growing majority of aerospace and defense systems is complex, and is becoming more so all the time. Requirements for broad capability, precise reliability, security, networking, real-time performance, and interoperability make writing software for military systems more difficult and crucial than ever before.

These are the reasons for the growing sophistication and demand for software design and development tools that seek not only to automate and streamline the software-development process, but also to impose rigor in software engineering and help developers meet safety-critical software standards, such as DO-178B and DO-178C.

"There are two things that are interrelated," explains Chris Rommel, vice president for machine-to-machine and embedded technology at market research VDC Corp. in Natick, Mass. "Reliability is key, and the mission-critical requirements associated with it. Then compliance drives purchasing decisions."

By compliance, Rommel is referring to software development tools that help enforce compliance with reliability and safety-critical standards. "Artifacts can be produced and automated if possible, to ease process standard adherence, such as DO-178B and C, which are the big ones."

Software engineering tools often attempt to automate many of the steps involved in software product lifecycle management, or PLM, as the industry knows it. This means software engineering tools that automate tasks from initial requirements through writing the actual lines of code.

"It starts with requirements," explains Jim McElroy, vice president of marketing at software engineering specialist LDRA Technology Inc. in San Bruno, Calif. "Then the tool hands off those requirements to the software- and hardware-development teams. That requirement gets implemented in software, and the engineer needs to develop a behavior design and the actual code—whether automatically generated or hand-written code."

Software engineering tools must help the developer trace each line of code back to the specific requirement that spawned it, McElroy explains. Likewise, software tools must be able

COMPANY INFO

AdaCore
New York
www.adacore.com

Atego
San Diego
www.atego.com

CIMdata
Ann Arbor, Mich.
www.cimdata.com

Coverity Inc.
San Francisco, Calif.
www.coverity.com

Dassault Systemes
Auburn Hills, Mich.
www.3ds.com

DDC-I Inc.
Phoenix
www.ddci.com

ENSCO Avionics
Endicott, N.Y.
www.ensco.com/avionics

GrammaTech Inc.
Ithaca, N.Y.
www.grammatech.com/

Green Hills Software
Santa Barbara, Calif.
www.ghs.com

Integrated Systems Inc. (ISI)
Tysons Corner, Va.
www.global-isi.com

LDRA Technology Inc.
San Bruno, Calif.
www.ldra.com

LynuxWorks Inc.
San Jose, Calif.
www.lynuxworks.com

The MathWorks Inc.
Natick, Mass.
www.mathworks.com

Mentor Graphics
Wilsonville, Ore.
www.mentor.com

Omnify Software
Andover, Mass.
www.omnifysoft.com

Oracle
Redwood Shores, Calif.
www.oracle.com

Parasoft Embedded, a division of Parasoft Corp.
Monrovia, Calif.
www.parasoft-embedded.com

Real-Time Innovations
Sunnyvale, Calif.
www.rti.com

SAP Labs U.S.
Palo Alto, Calif.
www.sap.com

SofTech Inc.
Lowell, Mass.
www.softech.com

Wind River
Alameda, Calif.
www.windriver.com

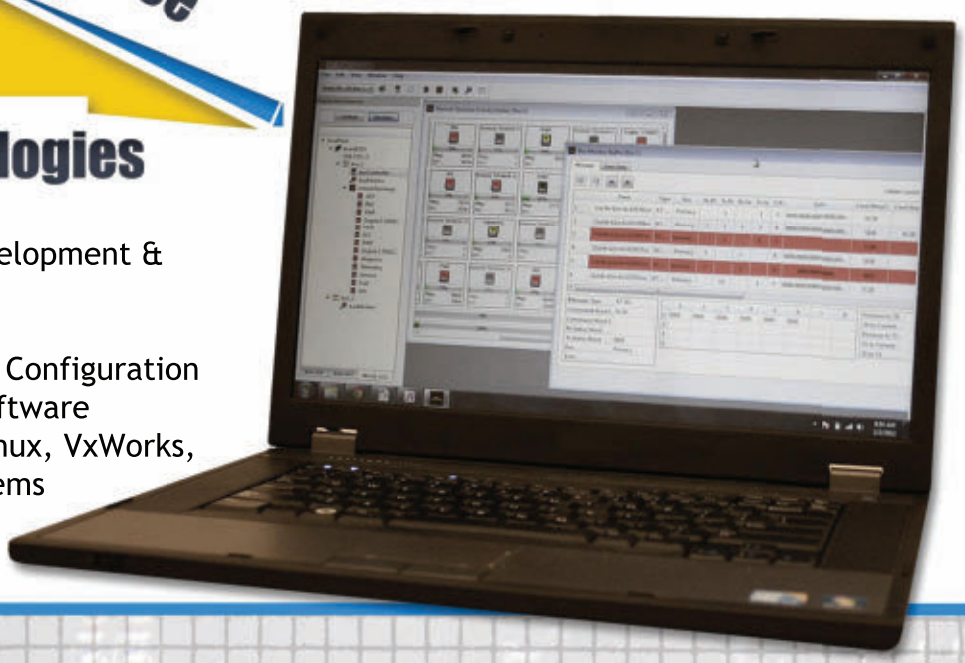
www.aviftech.com/software

TODAY'S SOLUTIONS
FOR TOMORROW'S DEMANDS

Avionics Interface Technologies

Complete Software Development & Test Tools

Software Development, Configuration Manager, & Analyzer software supporting Windows, Linux, VxWorks, QNX, and LabVIEW systems



SOFTWARE TOOLS
Simple, Intuitive, & Effective

Flight Simulyzer™ Analyzer/Simulator software for Windows & Linux applications supporting MIL-STD-1553, ARINC 429, & ARINC 664

fcXplorer™ Analyzer/Simulator software for Fibre Channel & HS1760/MIL-STD-1760E

TEST INSTRUMENTATION

CUSTOM IP SOLUTIONS

RUGGED COTS MODULES

sales@aviftech.com

+1 402.763.9644

to trace requirements forward to help determine if resulting lines of code actually are logical outgrowths of the initial requirements.

"The drive for standards today is the full lifecycle requirements—from requirements all the way through verifications in a bi-directional workflow," McElroy says.

To ensure compliance to standards like DO-178B and C, software development tools offer a formal automated approach to make sure each requirement corresponds with specific lines of code, and each line of code corresponds with its initial requirement. "If I need to make a change in a line of code, what requirement is that line of code part of?" McElroy explains.

Ensuring rigor in software development, as well as compliance to standards, has taken many different approaches over the years. Back in the 1980s, for example, the U.S. Department of Defense (DOD) mandated use of the Ada programming language for writing real-time mission-critical software applications.

Ada is a disciplined language with built-in traceability and other features that enforce a structured software-development process. DOD eventually dropped its requirement for Ada because of industry pushback. Preferred programming languages, such as C and C++, however, do not enforce software rigor like Ada, so today's software development tools are attempting to add Ada-like software-development methodologies and standards compliance on languages like C and C++.

"Ada was put in place because it is a strong, structured language," McElroy says. "In reality, it wasn't attractive to the commercial base of developers. It was not as flexible as the more-marketable C++ and Java languages." Today, it is the role of software-development tools to "see that developers are implementing C in a safe manner, because it is a very flexible language," he says.

While many of the mature software-development companies have developed formal workflows with guidelines for using C and C++ in real-time, mission-critical embedded systems, LDRA and other companies offer tools to help other developers write software to a specific set of coding standards, address safety and security requirements, and help customers check code against those limitations, McElroy says.

IN BRIEF

CONTINUED FROM PAGE 6

Argon ST picks up where it left off in sensor-fusion program to reduce military GPS use

Navigation and guidance experts at Argon ST Inc. in Fairfax, Va., are building on previous company research to develop a prototype sensor fusion system for land, sea, and airborne applications that can accept inputs from several kinds of navigation sensors so that warfighters can maintain navigation capability with or without global positioning system (GPS) satellite navigation. Argon ST won a $2 million contract for the U.S. Defense Advanced Research Projects Agency (DARPA) All Source Positioning and Navigation (ASPN) Phase 2 program, designed to develop algorithms and a prototype sensor-fusion system to enable low-cost navigation for military users on any operational platform and in any environment, with or without GPS. Argon ST won a $1.9 million first-phase ASPN contract early last year, and focused on developing navigation algorithms and a navigation software architecture.

Also participating in the first phase of the ASPN program was the Charles Stark Draper Laboratory Inc. in Cambridge, Mass. With the addition of Argon ST, the number of ASPN Phase 2 contractors grows to six. SAIC Inc. in McLean, Va., won the initial contract in late January, and other ASPN Phase 2 contractors are Vesperix Corp. in Arlington, Va.; SRI International in Menlo Park, Calif.; Systems & Technology Research in Woburn, Mass.; and the Northrop Grumman Corp. Navigation and Maritime Systems Division in Woodland Hills, Calif.

Army taps DRS and BAE Systems to develop electro-optical, one-man targeting systems

BY **John Keller**

ABERDEEN PROVING GROUND, Md.—The U.S. Army has chosen two companies for a one-year program to develop, prototype, and test a next-generation handheld electro-optical system to enable infantry soldiers, Marines, and joint terminal attack controllers to acquire, locate, identify, and designate targets quickly for air strikes or artillery attacks.

The next-generation JETS will enable infantry to acquire, locate, identify, and designate targets quickly for air strikes or artillery attacks.

The Army Contracting Command at Aberdeen Proving Ground, Md., awarded contracts to the BAE Systems Electronic Systems segment in Nashua, N.H., and DRS RSTA Technologies Inc. in Dallas to develop prototypes for the Joint Effects Targeting Systems (JETS) Target Location Designation System (TLDS).

The JETS TLDS is a one-man targeting system to enable Army and Marine Corps forward observers and Air Force tactical air controllers to call for fire from indirect munitions like JDAM and Excaliber, as well as to call for close air support from all joint forces.

The two companies should be finished with this portion of the engineering and manufacturing (EMD) phase of JETS TLDS development in March 2014. DRS RSTA won a $15.6 million contract and BAE Systems won a $15.3 million contract. Northrop Grumman Corp. Electronic Systems in Apopka, Fla., also has been involved in JETS TLDS development.

Among the goals of JETS is reducing friendly fire and collateral damage by helping soldiers differentiate between enemies, friendly forces, and civilians while working with satellite positioning and surveillance data.

Military forces need a lightweight handheld system for reconnaissance, surveillance, target acquisition, target engagement, and fires coordination for infantry forces. Current systems are far too heavy or lack necessary capability for accurate fire support during the day and at night, and do not work well with digital communications necessary to receive, transmit, store, display, plan, and coordinate targeting data.

DRS RSTA and BAE Systems will design and build JETS prototypes as part of the program's full-scale development phase, which should last for about 2½ years. The companies will deliver between five and 20 prototype JETS systems. ←

FOR MORE INFORMATION
visit **DRS RSTA** online at *www.drs.com/Products/RSTA*.

Air Force STAMPEDE program to develop sensor chips for satellites

U.S. Air Force researchers are asking industry to develop high-performance, radiation-hardened medium wavelength infrared (MWIR) sensor chip arrays (SCA) that can operate at high operating temperatures for persistent-surveillance satellites. The initiative, of the Air Force Research Laboratory at Kirtland Air Force Base, N.M., is the Superlattice Technology Arrays for Midwave Photon Excited Detector Enhancement (STAMPEDE) program, which seeks to develop rad-hard infrared sensor chip arrays suitable for space intelligence, surveillance, and reconnaissance (ISR) applications. The goal is to demonstrate high-temperature MWIR sensor chips capable of operating at 130 Kelvin or higher to detect low to moderate photon irradiances.

Leupold and Aimpoint win Navy ECOS-O combat infantry rifle sight contract

Two military optics companies are combining their expertise in rifle scope and sighting technologies for a U.S. Navy program to provide Marine Corps warfighters and other combat infantry personnel with an advanced rifle sighting system for a variety of battlefield weapons. The Naval Surface Warfare Center Crane Division in Crane, Ind., is awarding five-year contracts to Leupold & Stevens Inc. in Beaverton, Ore., and Aimpoint in Chantilly, Va., for the Enhanced Combat Optical

CONTINUED ON PAGE 35 →

Navy to develop UAV-killing laser for fast-moving tactical vehicles

BY **John Keller**

ARLINGTON, Va.—U.S. Navy researchers are taking the first steps toward a tactical laser weapon mounted on a humvee-like maneuverable combat vehicle to protect moving U.S. Marine Corps task forces from unmanned aerial vehicles (UAVs), cruise missiles, and other weapons that are difficult to pick up on radar.

The Office of Naval Research (ONR) in Arlington, Va., released a formal industry solicitation (13-SN-0014) for the Ground–Based Air Defense Directed Energy On-The-Move program (G-BAD DE OTM), which seeks novel subsystems and components for a future UAV-killing laser vehicle that can fire on the move.

The U.S. Army, in a separate program, is investigating laser vehicles such as the Boeing truck-mounted High Energy Laser Technology Demonstrator (HEL TD) to defend Army troops against UAVs, rockets, artillery shells, mortars, and similar threats. The big difference, however, is firing on the move. The HEL TD, which has been demonstrated at White Sands Missile Range in New Mexico, is designed to move to deployed Army sites and engage targets from fixed sites. The future Marine Corps G-BAD is envisioned to fire laser weapons while maneuvering with moving Marine Corps air-ground task forces.

While the Army HEL-TD program seeks to mount a 10-kilowatt laser weapon on a 10-ton eight-wheel truck to engage targets from a distance, the G-BAD initiative seeks to mount a short-range air-defense laser at least as strong as 25 kilowatts on a four-wheel platform like the future Joint Light Tactical Vehicle (JLTV), which the Army, Marines, and Special Operations forces are developing to replace the Humvee.

Navy researchers are looking at a G-BAD laser weapon that can fire at full power for as long as two minutes, followed by a 20-minute recharge to 80 percent of total capacity. The laser weapon should not weigh more than 2,500 pounds, and needs to fit in the JLTV's cargo area.

Marine Corps officials say current low-altitude air-defense systems have weaknesses against UAVs, which are becoming armed threats, and say they need something like the G-BAD concept as a new expeditionary mobile air-defense weapon. The G-BAD concept will be developed from the ground up to prevent reconnaissance, surveillance, targeting, and engagement of expeditionary forces by UAVs.

The Navy is trying to develop a UAV-killing laser mounted on fast-moving vehicles like the future JLTV, shown above.

The G-BAD system will consist of three subsystems a volume-surveillance radar, command and control (C2), and a high-energy laser weapon. Navy researchers envision the G-BAD laser weapon ultimately for the JLTV, but the first demonstrations most likely will be on a M1152A1 humvee.

For now, the G-BAD program aims to identify, develop, and mature novel key components and subsystems that not only improve Marine Corps air-defense capability, but also offer reductions in size, weight, and power consumption, and that can operate effectively on-the-move.

Navy researchers primarily are interested in high-energy laser sources of at least 25 kilowatts that are small, rugged, high-efficiency, and with good beam quality. Eventually researchers want a JLTV-mounted 50-kilowatt laser weapon.

Other laser weapon technological areas of interest include a rugged, lightweight beam director; improved beam control; adaptive optics; an atmospheric characterization and tactical decision aid; thermal storage and management; power generation, storage, and conditioning; weapon station controls and displays; and long-range optics. For now, Navy researchers are not trying to procure a high-energy laser weapon. Instead, they are focusing on developing technologies and components for such a future system.

Companies interested in participating in the G-BAD program should respond with full proposals no later than 7 June 2013. ONR scientists say they plan to award several contracts worth as much as $400,000 each for this solicitation, although they will consider proposals outside of this cost range. Projects may last for as long as four years. ←

MORE INFORMATION ON the solicitation is online at *https://www.fbo.gov/spg/DON/ONR/ONR/13-SN-0014/listing.htm*.

PRODUCT applications

BATTERY CHARGERS

Marines look to QinetiQ to provide portable power for battery charging in the field

U.S. Marine Corps leaders have selected the Q-Gen 2.0 1-kilowatt, JP-8 fuel compatible, one-man portable military power generator from QinetiQ North America in Reston, Va., for further evaluation in the low-rate initial production (LRIP) phase of the Marine Corps One Man-Portable Generator (1MPG) program.

Q-Gen 2.0 is a portable power generator that one person can carry in support of military missions in remote, hostile, or austere environments. It operates on heavy fuels such as JP-8 and Jet A in a wide variety of operational conditions and ambient environments, QinetiQ officials say.

Q-Gen 2.0 does not require an accelerant to start or operate on heavy fuels, and it automatically adjusts air flow and engine temperature in response to fluctuations in the environment or applied load.

Q-Gen 2.0 features improved batteries and efficient vaporizer to enhance reliability and performance. The system can provide 900 watts of electrical power for more than three hours to a military team operating in the field on one tank of fuel. The generator also can connect to other Q-Gen units to provide more power.

"Our warfighters can't afford delays in their power-supplied systems on the battlefield or in remote, hostile environments," explains J.D. Crouch, president of the QinetiQ Technology Solutions Group. "Q-Gen provides a reliable source of portable power that weighs less than 40 pounds."

The Marine Corps 1MPG program is developing a power source that operates on common military fuels, is highly transportable, and can be remotely started.

FOR MORE INFORMATION visit **QinetiQ North America** online at *www.qinetiq-na.com*.

RUGGED COMPUTERS

Navy chooses rugged embedded computers from Ballard Technology for LCS ship modules

U.S. Navy electronics designers needed rugged embedded computers for mission module packages aboard the Navy's Littoral Combat Ship (LCS). They found their solution from Ballard Technology Inc. in Everett, Wash.

Officials of the Naval Surface Warfare Center Panama City Division in Panama City, Fla., have announced their intention to award a sole-source contract to Ballard for nine AB3100H embedded computers for the LCS Multiple Vehicle Communications System (MVCS) shipboard electronics.

The MVCS is for communications between the LCS surface ship and different mission packages involving mine countermeasures, anti-submarine warfare, and surface warfare.

The MVCS supports communications between the surface mother ship and mission package vehicles that are part of the Remote Multi-Mission Vehicle (RMMV) unmanned vehicle, and the LCS's Unmanned Influence Sweep System (UISS), which provides stand-off, long-endurance, semi-autonomous minesweeping capability to counter

acoustic and magnetic influence sea mines in shallow waters along coasts and harbors.

Ballard Technology, an Astronics company, provides the AB3100H rugged computer, which is part of the company's AB3000 line of small, lightweight embedded computers designed for integration into aircraft, unmanned aerial vehicles (UAVs), and ground vehicles.

The Ballard AB3000 rugged embedded computers come with the Intel E680T processor, MIL-STD-1553 and ARINC 429/708/717 interfaces, Ethernet, USB, video, audio, and PMC expansion. The AB3100H computer that the Navy is buying for the LCS MVCS comes without the avionics I/O that comes standard with the AB3000.

The AB3000 series from Ballard comes with factory-installed PCI mezzanine card (PMC) modules that enable designers to add an Ethernet switch, synchronous and asynchronous serial interfaces, and isolated double-throw relays.

The Navy is buying the rugged computers sole-source from Ballard because the purchase is unsuitable for full and open competition.

The Ballard AB3100H rugged computer was tested specifically as part of the MVCS and is the only item that has been certified through interoperability certification, Navy officials say. Today, no other source meets the certification requirements for interoperability with the MVCS.

To buy other slightly modified COTS items would require extensive engineering testing and certification, which would result in late deliveries, Navy officials say.

FOR MORE INFORMATION visit **Ballard Technology** at *www.ballardtech.com*.

RADAR AND SENSORS

Coast Guard looks to ITT Exelis for long-range surveillance radar for HC-130J aircraft

U.S. Coast Guard leaders needed a long-range surveillance radar for the service's fleet of HC-130J Super Hercules long-range surveillance aircraft. They found their solution from the ITT Exelis Electronic Systems segment in Clifton, N.J.

The Coast Guard awarded Exelis a $6.5 million contract to supply the AN/APY-11 multimode radar system to support the service's maritime reconnaissance mission on the Lockheed Martin HC-130J four-engine turboprop aircraft.

The AN/APY-11 multimode radar is designed to support Coast Guard missions such as long-range surveillance, drug interdiction, and counter-terrorism, Exelis officials explain.

First provided to the Coast Guard under a 2005 contract, the AN/APY-11 multimode radar is produced by Exelis and partner the ELTA Systems Ltd. segment of Israel Aerospace Industries in Ashdod, Israel.

The AN/APY-11 maritime, littoral, and surveillance radar on the Coast Guard HC-130J helps air crews intercept drug smugglers, locate stranded boats, and track ice in the North Atlantic. The radar also can help map oil spills.

This radar has been installed for 360-degree coverage in the aircraft belly and nose, and can detect and track ships, aircraft, ground moving vehicles, and search and rescue transponders at ranges as far as 200 nautical miles. The system's high-resolution synthetic aperture radar also can provide imaging of ships, terrain, and coastal features.

The radar system can display more than 1,000 targets in search and moving-target modes, and works together with an integrated cue to electro-optical forward-looking infrared sensor systems.

The AN/APY-11's imaging capability can provide range signature for instant view of ship size and features; inverse synthetic aperture radar detailed imaging of ships at sea for classification; circular synthetic aperture radar detailed imaging of ships in harbors and coastal waters for classification; spot synthetic aperture radar for high resolution imaging and large area imaging of land and sea; and strip synthetic aperture radar for continuous imaging for strip maps as wide as 35 nautical miles.

The system also can provide a six-color navigation and weather picture—including turbulence—as well as real beam mapping. Software tools can help create ship libraries for target and type identification in real time, and the system can provide several combinations of its radar modes simultaneously.

The HC-130J aircraft performs maritime surveillance in areas that cannot be patrolled efficiently by medium-range surveillance aircraft or Coast Guard surface ships. The aircraft also provides heavy air transport for maritime safety and security teams, port security units

and National Strike Force personnel and equipment.

FOR MORE INFORMATION visit **ITT Exelis Electronic Systems** online at *www.exelisinc.com/business/electronicsys*, or the **U.S. Coast Guard** at *www.uscg.mil*.

SIGNAL PROCESSING

NATO minehunting UUV relies on GPU-based embedded processor from GE for imaging sonar

NATO military technology researchers needed real-time digital signal processing (DSP) capability for demonstration of a synthetic aperture sonar data for adaptive track spacing and target detection on an autonomous vehicle. They found their solution from GE Intelligent Platforms in Huntsville, Ala.

The Centre for Maritime Research and Experimentation (CMRE) segment of the NATO Science & Technology Organization in La Spezia, Italy, used the GE MAGIC1 rugged display computer for the synthetic aperture sonar demonstration, GE officials announced at the GPU Technology Conference (GTC) in San Jose, Calif.

The CMRE Autonomous Mine Search Using High-Frequency Synthetic Aperture Sonar project focuses on enhancing NATO mine detection and neutralization capability with unmanned underwater vehicles (UUVs). The GE MAGIC1 embedded computer is based on graphics processing unit (GPU) technology.

The GE MAGIC1 rugged display computer improves the processing and decision-making capabilities on-board the Minehunting UUV for Shallow water Covert Littoral Expeditions UUV, otherwise known as MUSCLE. The MUSCLE UUV uses multi-resolution, multi-aspect synthetic aperture sonar to create detailed images of the seafloor.

CMRE experts say GPU technology and associated development tools like the CUDA libraries were a key component in the recent sea trials in which the computer executed the sonar processing chain on the MUSCLE UUV.

The CMRE project uses techniques from machine intelligence to develop UUV behaviors that can help with mine hunting. The project also is developing automatic target recognition algorithms to help identify ocean mines.

Moving the algorithms and behaviors on-board the UUV has the potential to significantly increase the speed of operation for mine countermeasure missions, CMRE officials say.

"The key to fulfilling these two objectives is the capability to process the sonar data on-board the vehicle in near real-time, producing detailed acoustic images of the sea bed," says Rod Rice, general manager of military & aerospace products at GE Intelligent Platforms.

MAGIC1 is a rugged, small-form-factor subsystem with an NVIDIA GPU. This kind of graphics processing capability increasingly is being applied in the aerospace and defense industry for complex digital signal processing. The GPU acts as a massively parallel embedded processor.

"GPU technology is being applied to the most challenging problems by military customers because of the ability it provides to process significant amounts of data collected by growing numbers of sensors," Rice says. "These solutions are increasingly being deployed on autonomous vehicles, where size, weight and power—together with the ability to withstand the harshest environments—are critical."

The NATO MUSCLE UUV is based on the commercial off-the-shelf (COTS) Bluefin-21 UUV from Bluefin Robotics Corp. in Quincy, Mass. The Bluefin-21 is rated to depths of nearly 5,000 feet, upgradeable to nearly 15,000 feet.

The MUSCLE UUV uses a navigation and control system from Bluefin, and a synthetic aperture sonar sensor from Thales Underwater Systems in Brest, France. For surface navigation, the MUSCLE UUV uses a global positioning system (GPS) sensor, and for underwater navigation it uses a combination of a Doppler velocity log and an inertial measurement unit.

Various synthetic aperture sonar processing algorithms had been developed over several years at CMRE, existing in various implementations, although none of them were ideally suited for an embedded and near real-time application, officials say.

GPUs and the CUDA libraries were considered an ideal candidate for the minehunting UUV task. With support of the Istituto Italiano di Tecnologia (IIT), the entire processing chain was re-designed and implemented in C++ and CUDA.

Tests were conducted on mid- to high-end workstations equipped

with different generations of TESLA GPUs, exhibiting speed-ups in excess of 70X from the original un-optimized scientific code. In parallel with that effort, the Engineering Division at CMRE started the integration of a new payload section for the MUSCLE UUV containing a ruggedized CPU from GE and a ruggedized version of a TESLA GT240 GPU.

The new version of the CMRE SAS processing algorithms can run in near real-time on the NVIDIA GPU in the GE embedded computer installed into the MUSCLE UUV. The UUV performs missions following pre-programmed paths collecting raw sensor data to be analyzed at the end of the survey, which results in no capability to adapt to unexpected environmental conditions and/or sonar performance.

The CMRE tests involved a multinational team of scientists and engineers aimed at finding the best technologies that could be used by Nations in joint NATO mine countermeasures missions.

FOR MORE INFORMATION
visit **GE Intelligent Platforms** online at *www.ge.com*, **CMRE** at *www.cmre.nato.int*, or **Bluefin Robotics** at *www.bluefinrobotics.com*

VETRONICS

Curtiss-Wright to supply vetronics computers and network switches in GCV competition

Vetronics designers at Northrop Grumman Corp. Information Systems sector in McLean, Va., needed an open-architecture embedded computer and network switch subsystems for the company's version of the U.S. Army Ground Combat Vehicle (GCV). They found their solution from Curtiss-Wright Controls Defense Solutions in Santa Clarita, Calif.

Northrop Grumman awarded a $2.5 million contract to Curtiss-Wright for the mission computer and network switch. The contract has a potential value of more than $250 million over the life of the GCV production phase, which is expected to begin in 2018.

Northrop Grumman is teaming with BAE Systems in a competition to build the Army a next-generation armored personnel carrier. The Northrop Grumman-BAE Systems team is entering a 70-ton armored combat vehicle in the GCV competition. The tracked vehicle can carry infantry squad and three crewmen, and is air-transportable by C-17 and C-5 cargo jets.

The Curtiss-Wright mission computer going onto the BAE Systems-Northrop Grumman entry in the GCV competition uses four commercial off-the-shelf (COTS) single-board computers in a rugged chassis.

The chassis is able to cool more than 250 watts of heat without the use of fans, liquid cooling, or conditioned base plate, company officials say. The company's rugged network switch provides a network for communications between the mission computer and other devices within the vehicle.

Two teams are competing to build the GCV: a team of BAE Systems, Northrop Grumman, QinetiQ North America, Saft Group, and iRobot; a team of General Dynamics Land Systems, Lockheed Martin, and Raytheon. The program has entered engineering and manufacturing development.

The Army plans to buy more than 1,874 GCVs to replace Bradley

Fighting Vehicles. The vehicle will have mature technologies, and will be able to accommodate future growth.

Under the terms of the Northrop Grumman contract to Curtiss-Wright, shipments began in the first quarter of 2012 and are scheduled to continue throughout the remainder of this year. Curtiss-Wright is delivering products to Northrop Grumman in Huntsville, Ala.

The BAE Systems–Northrop Grumman GCV Infantry Fighting Vehicle design modernizes the U.S. Army's ground combat vehicle fleet with a new hybrid electric drive propulsion system that enables force protection and mobility, while allowing for future growth in power requirements and new technologies, Curtiss-Wright officials say.

The vehicle employs customizable combinations of armor packages on a tough, space efficient steel core hull and features improved fuel efficiency, agility, and acceleration due to the electric drive.

The GCV accommodates up-to-date network capability via an open-architecture command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) and infrastructure system.

FOR MORE INFORMATION visit **Curtiss-Wright Controls Defense Solutions** at *www.cwcdefense.com*, or **Northrop Grumman Information Systems** at *www.northropgrumman.com*.

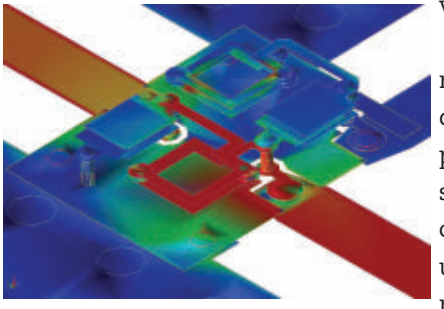
SOFTWARE

Plextek RFIC designers choose simulation software from Agilent to fine-tune circuit designs

Designers at RF and microwave integrated circuit specialist Plextek RF Integration in Great Chesterford, England, needed simulation software for their high-frequency circuit and monolithic microwave integrated circuit (MMIC) designs. They found their solution from test and measurement expert Agilent Technologies Inc. in Santa Clara, Calif.

After an evaluation of available 3D planar electromagnetic software tools, Plextek experts chose Agilent's Momentum simulator for its performance and flexibility, Agilent officials say.

Plextek designs and develops radio-frequency integrated circuits (RFICs), MMICs, and microwave/millimeter-wave modules.



Accurate electromagnetic simulation enables designers to improve the performance of their designs, while increasing confidence that the manufactured product will meet specifications, Agilent officials say. Momentum is integrated with Agilent's Advanced Design System and Genesys RF and microwave design software.

In their evaluation, Plextek designers used Momentum to simulate the performance of a 57- to 64-GHz amplifier integrated circuit. They also used Momentum to develop several Ka-band ICs.

"Designing advanced, high-frequency circuits and MMICs requires access to the industry's most advanced modeling and simulation tools," describes Liam Devlin, chief executive officer at Plextek RFI. "The performance and flexible features of Agilent's Momentum software provides us the functionality we need to maintain a leading edge in the highly competitive wireless, microwave, and millimeter-wave markets in which we compete. Because of this, we plan to leverage this solution on future design projects, including our current development of an LNA covering the full 71- to 86-GHz range of E-band." ←

FOR MORE INFORMATION visit **Agilent** online at *www.agilent.com*.

CONTINUED FROM PAGE 29

Sight-Optimized (ECOS-O) program. Leupold & Stevens won a $42.8 million contract; Aimpoint won an $8.7 million contract to provide ECOS-O equipment. The ECOS-O advanced rifle sighting system combines the Leupold & Stevens Mark 6 3-18x44mm Riflescope with the Aimpoint Micro T-1 red-dot aiming system to enable combat infantrymen to engage targets with standard infantry rifles at distances of more than half a mile, and can be used with night-vision goggles.

Northrop Grumman doubles resolution of Hawk missile sensor

Electro-optics engineers at the Northrop Grumman Corp. Electronic Systems segment in Rolling Meadows, Ill., developed a new-generation infrared sensor to improve resolution in export versions of the MIM-23 Hawk medium range surface-to-air missile. Northrop Grumman is introducing its Fourth Generation Tracking Adjunct Sensor (4G TAS), an upgrade to the company's high-resolution electro-optical and infrared sensors for the Hawk air defense system. The missile, built by Raytheon, was designed to shoot down aircraft, and later was adapted to destroy other missiles in flight.

Military laser bar packs 300 watts into 300-gram package

DILAS in Mainz, Germany, developed a fiber-coupled laser diode module that meets a critical military-application goal: less than 1 kilogram of weight per kilowatt of power while maintaining nearly 50 percent efficiency. Actual specifications for the 976-nanometer laser are greater than 300 watts output power in a 200-micron-diameter/0.22-numerical-aperture fiber-coupled package with a weight of roughly 300 grams. The small, lightweight package includes a low-thermal-impedance heat sink on which the laser diode bar is mounted to remove waste heat. The micro-optics attachment process is automated to improve beam quality from the laser diode bar through high-efficiency fiber coupling. ←

new PRODUCTS

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

THERMAL MANAGEMENT

Military-grade thermoelectric air conditioner for cooling electronics introduced by EIC Solutions

EIC Solutions Inc. in Warminster, Pa., is introducing the ThermoTEC 145 series 1500 BTU military-grade air conditioner to cool electronics operating in harsh aerospace and defense environments. The lightweight thermoelectric cooling unit features auto ranging chip circuitry that enables the units to run on 24/28-volt DC or 120/240 AC power. The auto ranging feature automatically tracks and optimizes available voltage to provide unimpeded

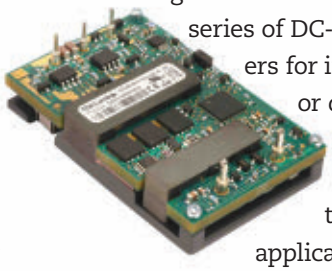
cooling at the rated 1500 BTUs, even when the units are installed in areas where voltage flow may vary such as remote military installations. ThermoTEC units are built for 19-inch, rackmount installation in transit cases. Operating at temperatures to 160 degrees Fahrenheit, the 145 series military-grade model also is available with higher ambient temperature tolerances. ThermoTEC units are manufactured to NEMA 4X standards, have solid-state construction, and use corrosion-resistant, powder-coated aluminum.

FOR MORE INFORMATION visit **EIC Solutions** online at *www.eicsolutions.com*.

POWER ELECTRONICS

DC-DC converters for robotics and test introduced by TDK Lambda

TDK-Lambda Americas Inc. in San Diego is introducing the iQG series of DC-DC converters for intermediate or distributed bus power architectures in



applications such as robotics, industrial controls, test and measurement, data communications/telecom, and wireless/broadcast. The power electronics device is 0.52 inch high, designed for use in confined space and demanding thermal environments, and provides a regulated 12-volt DC output with a high-isolation of 1500 volts DC, input to output. In addition, they operate with inputs from 36 to 75 volts DC. The user can select from models rated at 300 or 400 watts. The converter's efficiencies of as much as 95 percent substantially minimize wasted heat and system cooling issues. The device is compatible with conduction, convection, and forced-air cooling, and has a baseplate temperature range of -40 to 125 degrees Celsius.

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

RUGGED COMPUTERS

Rugged embedded computer for unmanned vehicles, industrial control introduced by X-ES

Extreme Engineering Solutions Inc. (X-ES) in Middleton, Wis., is introducing the XPand6103 fanless embedded rugged box computer using the Intel Core i7 processor for small, rugged applications like unmanned vehicles. The XPand6103 is a maintenance-free, high-performance embedded computer also is suited for environmentally challenging and space-constrained applications like industrial,

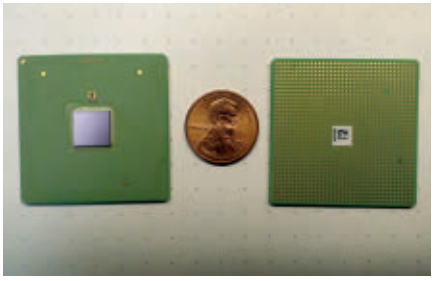
vehicle, and rail transportation. The XPand6103 support X-ES's line of rugged COM Express modules that integrate the most Intel Core i7 and Freescale QorIQ processors in a small and thermally efficient design. The computer has an internal 64 gigabytes Slim SATA SSD memory module. The XPand6103 is equipped with several I/O interfaces through its rugged and environmentally sealed M12 connectors. The standard configuration includes DisplayPort++ video, two Gigabit Ethernet, USB, four CAN Bus, and RS-232/RS-422 ports.

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

INTEGRATED CIRCUITS

D/A converter fast enough for advanced electronic warfare introduced by Tektronix

Tektronix Component Solutions in Beaverton, Ore., is introducing the TDAC-25 10-bit commercial digital-to-analog converter (D/A converter), which at 25 gigasamples per second is what company officials claim is the world's fastest D/A converter. The TDAC-25 is of particular interest in



defense applications because of its low latency where it can deliver the fast response needed for electronic warfare (EW) systems. The TDAC-25, a 25-gigasample-per-second application-specific integrated circuit (ASIC) is for use in next-generation embedded systems in such areas as defense, commercial aerospace, medical, and coherent optical communications. The TDAC-25 D/A converter offers dynamic ranges to -80 dBc narrowband and -60 dBc wideband. In RF-based applications, it supports direct-generation of wideband signals to enable systems designers to eliminate D/A converter arrays and frequency conversion blocks.

FOR MORE INFORMATION visit **Tektronix Component Solutions** at *http://component-solutions.tek.com*.

RUGGED DISPLAYS

Rugged 17-inch sunlight-readable display for aircraft and ships introduced by TRU-Vu

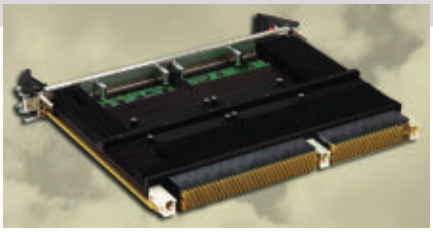
TRU-Vu Monitors Inc. in Arlington Heights, Ill., is introducing the ARM-17S 17-inch industrial-grade sunlight-readable display for applications such as aircraft, ships, and surveillance equipment where video image visibility in direct sunlight is crucial. The monitor has 1,000 nits of brightness; it will produce vivid color images even with bright sunlight falling directly onto the screen, company officials say. The ARM-17S sunlight-readable monitors offer 1280-by-1024-pixel resolution; VGA, S-Video and Composite (BNC) video inputs; NTSC/PAL auto-recognition; 1,000:1 contrast ratio; and 3-millisecond response time. The monitors also have internal speakers, an AC power adapter, rear VESA mount hole pattern, and a tabletop base. Applications include aircraft and helicopters, boats and ships, navigation equipment, and portable surveillance systems.

FOR MORE INFORMATION visit **TRU-Vu Monitors** at *www.tru-vumonitors.com*.

SIGNAL PROCESSING

Embedded computers with fast D/A converters for SIGINT and EW offered by Curtiss-Wright

Curtiss-Wright Controls Defense Solutions in Ashburn, Va., is introducing versions of the company's CHAMP-WB rugged 6U OpenVPX embedded computers with the TDAC-25 10-bit, 25-gigabit-per-second, digital-to-analog converter from Tektronix Component Solutions in Beaverton, Ore. Curtiss-Wright first will deliver the TDAC-25 on the CHAMP-WB-DRFM card featuring the Tektronix 12.5-gigasample A/D converter and D/A converter-based TADF-4300 module. Curtiss-Wright and Tektronix designed the TADF-4300 together for use with the CHAMP-WB Xilinx Virtex-7 field-programmable gate array (FPGA)-based 6U VPX card. The TDAC-25 D/A converter is an application-specific



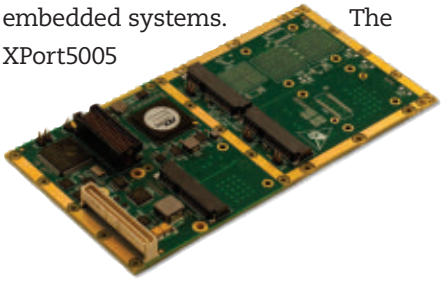
integrated circuit (ASIC) designed with defense, aerospace, telecom, commercial, and medical applications in mind. The device delivers as much as -60 dBc of dynamic range and enables direct-generation of wideband signals.

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

RUGGED DISPLAYS

Rugged XMC for military, aerospace, vehicle, and rail applications introduced by X-ES

Extreme Engineering Solutions Inc. (X-ES) in Middleton, Wis., is introducing the rugged XPort5005 express mezzanine card (XMC) for military, aerospace and land vehicle embedded computing applications. Users can configure the module to support a platform's specific I/O or storage needs in a wide variety of military embedded systems. The XPort5005



enables systems integrators to support varying I/O and storage requirements of different platforms. The XPort5005 supports operational temperatures from -40 to 85 degrees Celsius for conduction-cooled applications and -40 to 70 C for convection-cooled applications.

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

PRODUCT & LITERATURE SHOWCASE

ST-9020 rugged computer system with 20" display, MIL STD shock & vibration qualified

DU-19/U rugged monitor

For full line of rugged systems contact:

IBI SYSTEMS, INC.
6842 NW 20TH AVE, FORT LAUDERDALE, FL 33309
PHONE; 954-978-9225, WEB: www.ibi-systems.com

introducing **RPC24**

Rugged, Deployable, Mission Oriented Data Storage

Drive Magazine Based High Performance Multi-Protocol RAID System

- ***24 Solid State or Hard Disk Drives*** in only 2U of panel height
- ***Two Quickly Removable Storage Magazine*** - each containing up to 12 HDDs or SSDs each
- ***Fault Tolerant, Hot Swap Components*** - no single point of failure
- ***Sustained Read and Write Data Transfer Rates*** - of over 5000 MB/sec and 3000 MB/sec respectively
- ***MIL-STD-810G , MIL-STD-461E Certified***

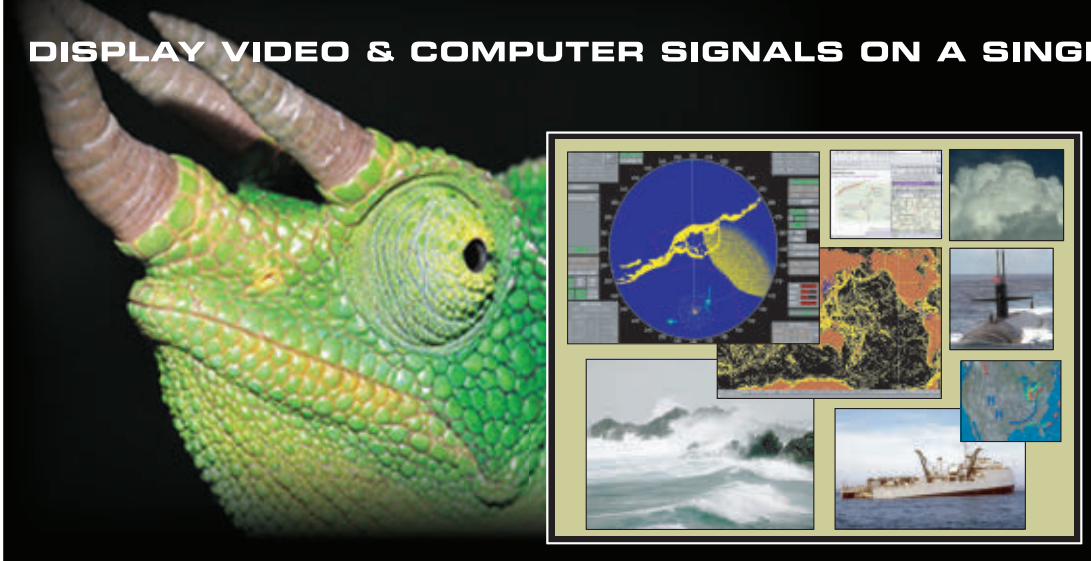
PHOENIX INTERNATIONAL

AS9100 Rev C/ISO 9001: 2008 Certified

www.phenxint.com 714-283-4800

SITUATIONAL AWARENESS

DISPLAY VIDEO & COMPUTER SIGNALS ON A SINGLE SCREEN



Combine up to 12 real-time visuals on a single screen

Display any signal type, including graphics, HD and video

Position and scale images any size, anywhere

Pan and zoom within images

SUPERVIEW® - ALWAYS THE BEST...NOW EVEN BETTER

RGB SPECTRUM®
decision support systems™

(510) 814-7000 www.rgb.com

GLOBAL HAWK UAV CONTINUED FROM PAGE 25

spent $5.1 billion on organic depot maintenance and an additional $4.6 billion for private depot maintenance in 2005.

Organic repair typically happens at government depots, intermediate repair facilities, and at flight lines on military bases. Contractor logistics support, meanwhile, is defined as contractor sustainment of a weapon system that is intended to cover the total life cycle of the weapon system.

The Air Force increasingly has chosen contractor logistics support as an alternative to organic support of weapon systems since the last decade, particularly for depot maintenance for airframes and engines, as well as for parts repair and replacement.

Contractor logistics support normally involves several sustainment tasks, usually for the life of the weapon system. Examples of common contractor logistics support tasks are aircraft and engine overhaul, repair and replenishment of parts, sustaining engineering, and supply chain management.

Northrop Grumman will do the work involved in this contract in San Diego.

FOR MORE INFORMATION visit **Northrop Grumman Aerospace** online at *www.northropgrumman.com*, and the **Air Force Life Cycle Management Center** at *www.robins.af.mil/units/aflcmc*.

ADVERTISERS INDEX

Military & Aerospace Electronics

PUBLISHER **Ernesto Burden**
603 891-9137 / ernestob@pennwell.com

EDITOR-IN-CHIEF **John Keller**
603 891-9117 / jkeller@pennwell.com

EXECUTIVE EDITOR **Courtney E. Howard**
509 413-1522 / courtney@pennwell.com

CONTRIBUTING EDITOR
WESTERN BUREAU **J. R. Wilson**
702 434-3903 / jrwilson@pennwell.com

EDITORIAL GRAPHIC DESIGNER **Cindy Chamberlin**

PRODUCTION MANAGER **Sheila Ward**

SENIOR ILLUSTRATOR **Chris Hipp**

AUDIENCE DEVELOPMENT MANAGER **Debbie Bouley**
603 891-9372 / debbieb@pennwell.com

AD SERVICES MANAGER **Glenda Van Duyne**
918 831-9473 / glendav@pennwell.com

MARKETING MANAGER **Justine Beauregard**
603 891-9410 / justineb@pennwell.com

PennWell

Editorial offices
PennWell Corporation,
Military & Aerospace Electronics
98 Spit Brook Road LL-1, Nashua, NH 03062-5737
603 891-0123 • FAX 603 891-0514 • www.milaero.com

Sales offices
EASTERN US & CANADA & UK **Bob Collopy, Sales Manager**
603 891-9398 / Cell 603 233-7698
FAX 603 686-7580 / bobc@pennwell.com

WEST OF MISSISSIPPI **Jay Mendelson, Sales Manager**
4957 Chiles Drive, San Jose, CA 95136
408 221-2828 / FAX 650 941-5120 / jaym@pennwell.com

REPRINTS **Jeanine Pranses**
717 505-9701 x344 / jeanine.pranses@theygsgroup.com

DIRECTOR LIST RENTAL **Kelli Berry**
918 831-9782 / kellib@pennwell.com

Corporate Officers
CHAIRMAN **Frank T. Lauinger**

PRESIDENT AND CEO **Robert F. Biolchini**

CHIEF FINANCIAL OFFICER **Mark Wilmoth**

Technology Group
SENIOR VICE PRESIDENT/PUBLISHING DIRECTOR
Christine Shaw

Subscription Inquiries
847 559-7500 • FAX 847 291-4816
e-mail: mae@omeda.com / web: mae-subscribe.com

BPA WORLDWIDE

AMERICAN BUSINESS MEDIA
The Association of Business Media Companies

Q+A

BIO:

NAME: Dan Kinney

TITLE: Business Development Manager, Parker Aerospace, Thermal Management Systems

CO.: Parker Hannifin Corp.

ROLE: Combining products, services, and experience to help solve tough thermal management challenges

CONTACT: *www.parker.com*

Dan Kinney

A thermal management specialist discusses the cooling requirements unique to smart munitions.

How are the cooling requirements of smart ordnance unique?

For platforms such as the Joint Strike Missile (JSM), size, weight, and power (SWaP) are critical. Volume and weight are at a premium, and anything you can do to reduce these factors helps enable the ability to carry more fuel, which helps increase range. SWaP is important with aircraft and ground vehicles, as well, but is amplified with missile applications. It gets down to grams, not pounds and ounces. Volume is just as important. Even if thermal management hardware weighs little, you still have to fit it in a confined space, and packaging is tight, as you can imagine. We work to keep the size of products to an absolute minimum. Forces from shock, vibration, and especially gravity are big drivers in the design; our products must be robust.

How were engineers able to meet demands for a compact, cost-effective, "disposable" system?

Our Thermal Management Systems (TMS) organization is much more than SprayCool. Parker's acquisition of SprayCool in 2010 helped us broaden market awareness of our technology, but this JSM system is not a SprayCool solution like you see on unmanned aerial vehicles (UAVs) like the Global Hawk or Triton, or other airborne and ground platforms.

JSM is a single-phase liquid design where we take fuel and pump it through a series of cold plates to cool (and even heat) the vehicle's electronics. We have other cold-plate solutions for ground mobile and shipboard applications as well as airborne uses, such as on the Boeing 787. We really want to be able to support any type of thermal management need that involves liquid, whether single-phase or two-phase solutions that include both liquid and vapor.

Is there a concern over reverse-engineering thermal-management technology on recovered missiles?

Reverse engineering is always a possibility with any product we deliver. However, customers usually take the lead on dealing with it, and to be honest, their systems are usually a lot more sensitive. For the JSM, our manufacturing techniques are just as important, and would be hard to reverse engineer.

What advice would you offer engineers wrestling with thermal-management issues?

Please don't wait to start thinking about your thermal management approach. To be able to deliver an efficient solution to a customer, it needs to be dealt with as a key part of the development process up front; don't just kick the can down the road.

The other thing I would add is: Don't be afraid of liquid. It is used all the time in military and aerospace applications. In fact, it is used every day in cars and in homes, and it is pretty darn reliable. Using liquids are a good way to reduce overall system SWaP compared to air, and there are lots of different fluids that are available and approaches to using them. ←

Don't miss a word

Access the rest of this conversation by visiting *www.militaryaerospace.com/LastWord* or scanning the QR code at left.

Military & Aerospace Electronics

Mobile Your Way

Read it Anytime
Take it Anywhere
Share with Anyone

Take *Military & Aerospace Electronics* on the go and stay connected. From breaking news to videos to the mobile web, there's a way to connect from your mobile device.

Now Available

- iPhone
- iPad
- Mobile Site
- RSS
- Android

Scan the QR code at the right with a barcode-scanning app on your phone.

Download and go mobile with *Military & Aerospace Electronics* today.

http://www.militaryaerospace.com/mobile.html

YOUR OFFICE. OUR ROUTER.

Utilizing the same Cisco IOS software that IT staffs are already trained on, our rugged, SWaP optimized routers are battlefield-ready. The X-ES XPedite5205 PMC router module and the SFFR small form factor router platform, working in conjunction with UHF, VHF, Wi-Fi and other radio platforms create mobile ad hoc networks to provide highly secure data, voice and video communications to stationary and mobile network nodes across both wired and wireless links. **Call us today to learn more.**

Connected everywhere. That's Extreme.

X-ES

Extreme Engineering Solutions

608.833.1155 www.xes-inc.com