JUNE 2014

Military & Aerospace Electronics

ENABLING TECHNOLOGIES FOR NATIONAL DEFENSE

Rad-hard electronics

45-nanometer, radiation-hardened technology is just the beginning for space and military microelectronics. PAGE 18

Software tools

Today's design and development tools help systems integrators do more with less. PAGE 28

militaryaerospace.com

Aircraft cabin avionics

Wireless data access and in-flight entertainment demand cutting-edge technology.

PAGE 12

PennWell

POWER YOUR CRITICAL MISSION

A Full Range of Proven DC-DC Power Converters, EMI Filters and Accessories

Avionics & Military Features

- 1-120+ watts
- MIL-PRF-38534 Class H and Class K
- 100% hermetic
- -55°C to +125°C
- DLA SMDs available

Hi-Rel COTS Features

- 5-200+ watts
- Six-sided metal or potted packaging
- Rugged environmental screening
- -55°C to +100°C

Space Series

- 5-120+ watts
- Developed for TOR compliance
- TID: 100 krad (Si)
- SEE: 85 MeV
- -55°C to +125°C
- MIL-PRF-38534 Class H and Class K
- DLA SMDs available
- Engineering models typically ship from stock
- Other radiation levels and custom versions available

VPT

Power Your Critical Mission Today

www.vptpower.com

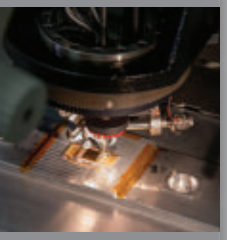
EFFICIENT & RELIABLE | 20 YEAR PROVEN HERITAGE | CERTIFIED QUALITY | SHIPS FROM STOCK

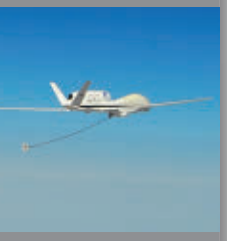
JUNE 2014
VOL. 25, NO. 6

Military & Aerospace Electronics

COVER STORY

Image: Rockwell Collins





MILITARY & AEROSPACE ELECTRONICS ©2014 (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) 763-9540 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 Subscription Services*, PO Box 3425, Northbrook, IL 60065. 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

Hypertemporal imaging: the next big challenge for high-performance embedded computing

It might be a fun exercise to sit with the leading practitioners of high-performance embedded computing (HPEC) to trade opinions about what are the toughest, gnarliest, most knee-buckling HPEC challenges in the foreseeable future.

We would hear the usual: bistatic radar, adaptive electronic warfare (EW), and wide-area communications intelligence. Well, I've got one that's a real beaut, and one that I think we're all going to be hearing a lot more about: hypertemporal imaging for persistent surveillance.

Yeah, it was a new one on me, too. Put simply, hypertemporal imaging involves multispectral or hyperspectral imaging over time. Where persistent surveillance is concerned, it's also a gigantic exercise in gathering gazillions of bits of data, and then throwing most of them away.

Multispectral and hyperspectral imaging involves slicing an image into a few or even many different spectral bands to uncover details that otherwise might be lost. This alone already presents a formidable digital signal processing challenge. Now add the dimension of time, and the problem grows by orders of magnitude.

Hypertemporal imaging is separating the wheat from the chaff, or more accurately encapsulates the challenge of finding the proverbial needle in the digital haystack. It's finding that little sliver of information that indicates even the tiniest changes of crucial importance to building a reliable intelligence picture.

Detecting and classifying tiny changes is what hypertemporal imaging is all about. It may be a bit of disturbed dirt that wasn't there before that could indicate the presence of an improvised explosive device (IED). It might be a fleeting spectral shadow under forest canopy that might be the passing of a military or terrorist vehicle. It also might indicate the transport of a dirty bomb through city streets.

Hypertemporal imaging might not be of much use unless intelligence analysts have a pretty good idea what they're looking for. To make this technology work will require the most powerful high-performance computing coupled with some of the most sophisticated computer algorithms that can detect and identify just a few bits of data—a pixel here and a pixel there—out of oceans of data.

Not a computing challenge for the faint of heart.

Military researchers are just getting started with hypertemporal imaging. Just last week the Air Force Research Lab asked Raytheon to develop a space-based hypertemporal sensor just to help them get a better understanding of what hypertemporal imaging might offer to intelligence analysts.

Once they start to understand the kinds of advantages this technology might bring to persistent surveillance, then look out. First, however, must come the computing capability. Hypertemporal sensors most likely will require vast amounts of computing resources at the sensor; the sheer amount of data could overwhelm data link and telemetry resources.

Then it will take the right kinds of algorithms that efficiently can latch on only to that information that is of interest, and throw out the rest of that fire hose of data.

Remember, only the imagery data that indicates change is of interest; the rest is just garbage. That means filtering complex streaming data down to that one-half of one percent that means something, and they have to do it in real time.

Module and System-Level Solutions from X-ES

Intel® and Freescale™ Single Board Computers

XPedite7570
4th Gen Intel® Core™ i7-based 3U VPX SBC with XMC/PMC

XCalibur1840
Freescale QorIQ T4240-based 6U VPX SBC with dual XMC/PMC

High-Performance FPGA and I/O Modules

XPedite2400
Xilinx Virtex-7 FPGA-based XMC with high-throughput DAC

Secure Ethernet Switches and IP Routers

XPedite5205
Secure Gigabit Ethernet router XMC utilizing **Cisco™ IOS®**

XChange3018
3U VPX 10 Gigabit Ethernet managed switch and router

High-Capacity Power Supplies

XPm2220
3U VPX 300W power supply with EMI filtering for MIL-STD-704 & 1275

Rugged, SWaP-Optimized, COTS-Based Systems

XPand4200
Sub-½ ATR, 6x 3U VPX slot system with removable SSDs

XPand6200
SFF 2x 3U VPX system with removable SSD and integrated power supply

XPand6000
SFF Intel® Core™ i7 or Freescale QorIQ-based system with XMC/PMC

X-ES

Extreme Engineering Solutions
608.833.1155 www.xes-inc.com

Designed, manufactured, and supported in the USA

Navy sets sights on new combat survivor evader locator survival radio for downed pilots

BY JOHN KELLER

PATUXENT RIVER NAS, Md.—U.S. Navy survival experts are reaching out to industry to find companies with the expertise to design a next-generation survival radio to help search-and-rescue teams find and rescue military pilots who have been shot down.

The Navy is asking industry to develop a new survival radio for downed combat aircraft pilots.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., released a request for information (242-14-082) for the Next Generation Survival Radio System-NGSR program.

Survival radios are for ships and aircraft for rescue in an emergency. These emergency radios generally transmit on international distress frequencies. Current U.S. aircrew survival radios are aging and require upgrades or replacement with new radios. To deal with this problem, Navy leaders are asking industry to start thinking about the Next-Generation Survival Radio (NGSR) to replace current versions such as PRC-112B1, PRC-112G, PRC-149/149A, and PRQ-7/7A radios as they expire over the next decade.

The Navy's request for information seeks to identify companies able to provide an off-the-shelf Next-Generation Survival Radio System with technologies to improve reliability, maintainability, and availability (RM&A) and enhance survivability. The new radio system may capitalize on existing survival radio technology to reduce manpower, training, and logistics requirements. Navy officials also want new survival radios that do not require modifications to the current air crew survival vest radio pocket, and that uses non-developmental item (NDI) technology to the maximum extent possible.

The new survival radio should be software-defined, with the ability to communicate using one of a variety of waveforms simply by reloading or reconfiguring the software for the necessary application.

The radio also must have combat survivor evader locator (CSEL) capability over the horizon, and should be compatible with planned military satellite communications (SATCOM) systems by software reprogramming. The radio must have a programmable auto activation capability for positive G and salt water immersion, should provide high reliability and availability, and use NSA Type I non CCI Suite B encryption.

IN BRIEF

Cobham to acquire Aeroflex in $1.46 billion deal

Defense systems integrator Cobham in Wimborne, England, will acquire microelectronics specialist Aeroflex in Plainview, N.Y., for $1.46 billion, boosting Cobham's capabilities in communications and digital connectivity. Aeroflex specializes in RF and microwave integrated circuits. Cobham has expertise in technologies and subsystems for harsh environments across commercial, defense, and security markets, from deep space to the depths of the ocean.

LynuxWorks changes name to Lynx Software Technologies

Software specialist LynuxWorks Inc. in San Jose, Calif., is changing its name to Lynx Software Technologies Inc. to reflect the company's evolution to real-time and secure software. Prior to 2000, the company had been named Lynx Real-Time Systems, and that year changed its name to LynuxWorks Inc. to reflect its involvement in the open-source Linux operating system. Fourteen years later the company apparently is moving closer to its original roots with Linux no longer emphasized in the company's name. The company's

CONTINUED ON PAGE 8 ➔

Military-developed technology to give synthetic vision to snowplow drivers

Military-developed synthetic vision technology in the future may enable snowplow drivers to see in blizzard and whiteout conditions.

BY JOHN KELLER

WASHINGTON—It might be a warm thought to those just emerging from a brutal winter that U.S. government transportation experts are ready to borrow from defense and aerospace synthetic vision technology to develop an enhanced vision system to enable snowplow drivers to see clearly in blizzard conditions.

Officials of the Federal Highway Administration (FHWA) in Washington are notifying industry of an upcoming project to develop a prototype visual guidance system to help snowplow operators see in low- and zero-visibility conditions like blizzards, rural nighttime operations, super-cooled fog, and other

CONTINUED ON PAGE 7 ➔

DRS and BAE Systems to integrate night-vision goggles with weapon sights

BY JOHN KELLER

ABERDEEN PROVING GROUND, Md.—U.S. Army night-vision experts are looking to two electro-optics companies to develop the next generation of military night-vision weapon sights to enable soldiers to fight effectively at night.

Officials of the Army Contracting Command at Aberdeen Proving Ground, Md., announced contracts to the BAE Systems Electronic Systems segment in Nashua, N.H., and the DRS Technologies Imaging and Targeting Solutions (ITS) segment in Dallas to build Individual and Enhanced Night Vision Goggle (ENVG) III weapon sights.

BAE Systems and DRS Technologies will develop integrated weapon sights and night-vision goggles as part of the Individual and Enhanced Night Vision Goggle (ENVG) III weapon sights program.

These weapon sights, which will be linked wirelessly to the head-worn displays in Enhanced Night Vision Goggles III, will enable solders to shoot their weapons with reasonable accuracy from behind cover without exposing their heads to enemy fire.

BAE Systems and DRS ITS also are expected to produce the head-worn goggle for the ENVG III system. The head-worn goggle and the weapon sight are tightly linked to enable the user to fight at night with the two components.

This capability also is expected to enable soldiers to shoot their rifles accurately over walls, around corners, and using other kinds of cover in difficult conditions such as urban warfare.

Compared with previous versions of the ENVG, the ENVG III weapon sights also will have improved resolution and a wider field of view. Exelis Night Vision Systems in Roanoke, Va., and L-3 Warrior Systems in Londonderry, N.H., are producing the ENVG II. The ENVG III acquisition combines the system's goggle with its Family of Weapon Sights-Individual (FWS-I). The ENVG III is a follow-on contract to previous ENVG I and ENVG II procurements.

The distinction of ENVG III from previous ENVGs is the added rapid target acquisition technology when used with the FWS-I, which is to be a weapon-mounted long-wave infrared sensor used for surveillance and aiming weapons during daylight, darkness, adverse weather, and dirty battlefield conditions, Army officials say.

When combined with the ENVG III, the FWS-I provides rapid target acquisition which wirelessly will send weapon imagery from the sight to the night-vision goggle eyepiece spatially aligned with the ENVG III image.

The rapid target acquisition capability is expected to cut in half the time a soldier typically takes to detect and shoot at a target. This will improve soldier lethality, enhance soldier effectiveness and improve soldier survivability by reducing soldier exposure to threat weapons, Army officials say.

For this contract, BAE Systems and DRS ITS will compete for separate Army orders over the next five years.

FOR MORE INFORMATION visit **BAE Systems Electronic Systems** online at *www.baesystems.com*, or **DRS ITS** at *www.drs.com*.

SNOW CONTINUED FROM PAGE 5

high-visual-impairment situations.

FHWA officials released a presolicitation (DTFH6114R00035) for the Advanced, Low-Cost Snowplow Visual Guidance System. The FHWA is a bureau of the U.S. Department of Transportation.

The program will include gathering and synthesizing sensor data and displaying it on screens in the snowplow's cab to help drivers plow efficiently, drive safely along their designated routes, and avoid obstructions and other vehicles in zero-visibility winter conditions.

The project will involve digital imaging, digital multidimensional mapping, global positioning systems (GPS), sensing involving radar, light direction and ranging (LiDAR), forward-looking infrared-based (FLIR), and related emerging and existing technologies, FHWA officials say.

Federal transportation officials for this project will be looking for companies with experience in advanced digital imaging and displays, including augmented reality, virtual reality, synthetic vision, and advanced user displays such as head-up displays (HUDs), visors, and other wearable technology.

Officials want to develop a prototype snowplow vision system that can be tested and evaluated on the road in degraded-vision conditions that will be ready for further validation, enhancement and field use. It remains to be seen how this kind of technology might be received by state and municipal labor unions—especially if this system could track their movements via GPS.

IN BRIEF

products will continue to be designed to provide fail-safe reliability for successive generations of high-performance embedded computing devices for aerospace, defense, avionics, medical, industrial, consumer, office automation, transportation, and security applications.

BAE Systems U.S. operations to cut number of business sectors from four to three

BAE Systems in Arlington, Va., the U.S. subsidiary of BAE Systems, will reduce its number of primary business sectors from four to three amid a continuing downturn in U.S. defense spending and other difficulties in the military market. The prime defense contractor will eliminate the company's Support Solutions segment in Washington "to remain agile and best optimize its organizational effectiveness and efficiency." BAE Systems Support Solutions focuses on space and missile defense; radar tracking systems; optical tracking systems; ship repair; and military avionics. The reorganization, effective on 1 July 2014, will fold Support Solutions activities into the three remaining BAE Systems business sectors: Electronic Systems in Nashua, N.H.; Land & Armaments in Arlington, Va.; and Intelligence & Security in Arlington, Va.

Researchers eye linking artificial limbs with implantable devices for touch and muscle memory

Tomorrow's artificial limbs will have robotic technology for touch sense and muscle memory.

BY JOHN KELLER

ARLINGTON, Va.—U.S. military researchers are looking for technologies that could help provide injured warfighters with artificial limbs that feel and function like natural limbs.

Officials of the Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., are releasing a broad agency announcement (DARPA-BAA-14-30) for the Hand Proprioception and Touch Interfaces (HAPTIX) program that aims at developing touch-sensitive prosthetic arms and legs for warfighters who lose limbs in battle.

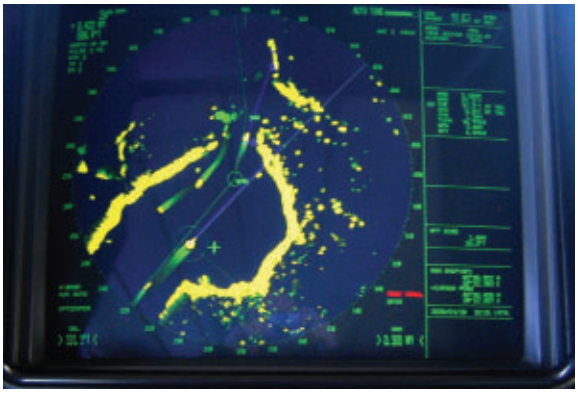
HAPTIX seeks to develop science and technology to achieve closed-loop control of dexterous mechatronic prostheses including implantable devices that provide artificial limbs with a sense of touch and muscle-memory movement that ease training and use of artificial arms and legs. The program will focus on implantable peripheral interfaces for volitional motor recording and sensory feedback signals; implantable electronic systems to transfer information between these interfaces and the prosthesis; and sophisticated encoding and decoding algorithms to transform recorded volitional motor control signals into limb movements and patterned stimulation into naturalistic touch and proprioceptive sensations.

Advances have been made in dexterous mechatronic prostheses, yet no clinical treatment exists to provide naturalistic control of prostheses or to convey tactile and proprioceptive feedback to the user.

The HAPTIX program has four thrusts: electrodes and algorithms; electronics and packaging; human use testing; and cutting-edge science and technology.

Matrix chosen for CERFER program to track targets amid RF jamming

WRIGHT-PATTERSON AFB, Ohio— U.S. Air Force researchers are moving ahead with a project to develop radar and electronic warfare (EW) technology that improves target detection, tracking, imaging, classification, and identification in the midst of enemy RF jamming, spoofing, and other challenging conditions.



Air Force researchers are asking Matrix to help them maintain track of important targets in the presence of electronic warfare jamming.

Officials of the Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio, announced a $36 million contract to Matrix Research Inc. in Dayton, Ohio, for the Contested Environment Radio Frequency Exploitation and Research (CERFER) program, which seeks to address problems of concurrent detection, tracking, imaging, classification, and identification of targets.

On the CERFER program, Matrix research sensor and signal processing experts will investigate advances in radar subsystems, particularly in hardware, software, and algorithm solutions to detect, track, image, and identify targets within contested areas. This includes exploiting passive and active signals.

Research that Matrix will perform includes developing models, hardware, software, algorithms, and techniques spanning basic, applied, and advanced research for active and passive sensing. Matrix was the contract winner among six bidders for the CERFER program.

Matrix's goal in the CERFER program is to advance RF sensing hardware, software, and algorithms using spatial diversity, waveform diversity, transmit and receive adaptivity, signals of opportunity, and similar resources to enhance sensor performance.

The idea is to address problems of concurrent detection, tracking, imaging, classification, and identification of targets within contested environments with single- and distributed-sensing architectures. The project will involve developing models, hardware, software, algorithms, and techniques for active and passive sensing.

Air Force researchers primarily are keen for Matrix to investigate distributed sensing architectures; distributed active detection; distributed active and passive tracking; distributed active and passive imaging; distributed active and passive identification and classification; synthetic aperture radar (SAR) detection, tracking, imaging, and identification; and fully adaptive radar (FAR) detection, tracking, imaging, and identification.

The CERFER program will last for seven years. Matrix Research will do the work in Dayton, Ohio, and should be finished by May 2021. ←

FOR MORE INFORMATION visit **Matrix Research** online at *www.matrixresearch.com*, or the **Air Force Research Laboratory** at *www.wpafb.af.mil/afrl*.

Flightline Test in Your Hand

NEXT-GENERATION ARMAMENT TEST IS HERE

The state-of-the-art MTS-3060 SmartCan™ is an advanced flightline armament test set that enables preload and weapons system testing of aircraft armament systems.

- Supports legacy and "smart" weapons systems
- Pre-load test modes for stray voltage and basic signals (such as SERD 75060)
- Enhanced weapons system test using weapon emulation
- Audio, video, and MIL-STD-1760 test capabilities for advanced troubleshooting
- Parametric test with automated test log storage

Learn more about the MTS-3060 at marvintest.com/smartcan.

MARVIN TEST SOLUTIONS | The Marvin Group

MARVINTEST.COM

Formerly Geotest - Marvin Test Systems

Fuselages filled with advanced electronics

Image courtesy Rockwell Collins.

Military and civil aircraft are increasingly outfitted with modern, networked electronics to meet demands for data.

BY **Courtney E. Howard**

Engineers who traditionally have concentrated on cockpit avionics are beginning to turn their attention to equipping aircraft cabins with advanced electronics.

Myriad reasons exist for outfitting fuselages with computers, networking switches, rugged cables and connectors, and additional technologies. Modern aircraft cabin electronics help to facilitate smooth air-to-ground operations and communications, inflight entertainment and connectivity (IFEC), and intelligence, surveillance, and reconnaissance (ISR) data acquisition and exploitation.

Air-to-ground communications

"Increased demand for modern, network electronics is being driven by the rapidly evolving mobile computing environment we live in today and the desire to deploy these mobile devices—including tablets, phablets (phone/tablets), and even smartphones—into aircraft cabins," explains Thomas "T.J." Horsager, business development manager, electronic flight bag systems at UTC Aerospace Systems in Eagan, Minn.

"Cabin solutions in which our customers have expressed interest are related to connecting operator assigned mobile devices to aircraft systems facilitating in-flight communications to ground systems," Horsager says. "This capability can support functionality ranging from inflight point-of-sale transaction validations and customized passenger experience based on individual preferences to electronic cabin logs and documentation."

In fact, Horsager adds, the UTC Aerospace Systems solutions and

Airbus A350 XWB inflight entertainment cabin electronics include fiber optics and high-definition displays.

product strategies are built on the notions that aircraft operators not only want to integrate mobile devices into their operations, but also require a connectivity solution to enable these devices.

"Operators utilizing mobile devices today are using them as electronic replacements for paper documents or as e-readers, yet significant value can be obtained thru connectivity. We enable connectivity with our solutions," Horsager says.

Info in the air

Crew members, including pilots, are not the only ones demanding greater access to information in flight. Passengers of all ages now fly with personal electronic devices (PEDs) and the expectation to connect to a wireless network throughout the flight, whether to increase productivity, exchange information, or simply pass the time.

"The hottest technology for the civilian aircraft market continues to be wireless inflight entertainment (IFE) systems," says R.J. McLaren, portfolio manager of commercial avionics & military products at Kontron in Poway, Calif.

"In the U.S., a wide range of aircraft [are] deployed with wireless IFE systems already, but in Europe and Asia, these deployments are just starting. Airlines now realize that a WiFi network on aircraft is possible and can be supported, so many are in the planning stages determining how and what to deploy on their fleets," McLaren says.

Installing an IFE system can be a lengthy process, especially given the need for certification from aviation authorities, such as the Federal Aviation Administration (FAA), European Aviation Safety Agency (EASA), and Civil Aviation Administration of China (CAAC). Defense contractors, too, are starting to select aircraft cabin electronics for

military programs based on their support of civil aviation regulations and requirements.

"The process can take time as they go through the evaluation process, FAA/EASA/CAAC approvals, flight trials, and then finally fleet installation," McLaren says. "A complete roll-out can take up to two years." In fact, given the investment of time and money, some customers opt to roll out IFEC in stages.

Kontron delivers its ACE Flight Server, a general-purpose airborne server, and Cab-n-Connect 802.11 wireless access point products. Kontron engineers designed ACE with next-generation Intel Core i7 processors based on a Kontron COM Express module.

The airborne server also includes several storage solid-state drives (SSDs), two of which are field-replaceable, at 160-, 600-, and 800-gigabyte capacities. Kontron plans to debut a 1.6-terabyte removable SSD later this year. Further, the company's own L2/L3 managed switch provides "a feature-rich platform of high-end networking options," McLaren says.

"Kontron provides the wireless network as one part of the system, while a connectivity solution such as over air-to-ground or to a satellite for the link back to the ground station and then to the Internet is another," McLaren says.

"Some airlines opt to deploy our equipment on the aircraft to provide a closed WiFi network on the plane and not provide a connectivity solution. This allows them to immediately start streaming movies from our server or other applications stored locally and generate additional revenue and an improved customer experience. They can always install a connectivity solution later, which can be then networked to a Kontron server to provide that Internet connection.

"This staged approach provides a compelling low-cost installation option for even smaller carriers to deploy, and sets the stage that very soon WiFi on aircraft will be commonplace—similar to consumer expectations for WiFi accessibility in most business environments they frequent today," McLaren says. "How the airlines will choose to leverage this WiFi connectivity to the client will be very interesting in terms of revenue models and customer experience applications that are developed in the near future."

Aerospace engineers continue to innovate in the area of aircraft cabin electronics. Above, Airbus engineers envision the passenger cabin of the future replete with advanced electronics.

SWaP savings

"Traditional IFE systems consist of a lot of avionics equipment that takes up precious space in the avionics bay along with the added weight, cost, and complexity of an integrated seatback solution," McLaren says. "The time spent to retrofit an aircraft with this approach and the time and revenue lost while the plane is out of service, ongoing maintenance costs associated with these types of integrated seatback systems, and the extra fuel costs tied to the additional weight add up quickly as recurring costs when deployed. Lastly, the electronic display technology integrated into the seatback is usually years behind the latest technology by the time it is installed on the aircraft."

Kontron engineers set out to simplify all this with the company's wireless IFE system design. "We've been able to integrate the server, managed switch, and expandable storage system into one line-replaceable unit (LRU) that installs into 4MCU of space inside the avionics bay," McLaren says.

Kontron Cab-n-Connect wireless access points are installed in the cabin with typically three to four access points in a narrow-body aircraft. For wireless IFE systems, the Ace Flight Server is installed in the avionics bay of the aircraft and then networked to each of the Cab-n-Connect wireless access points along the ceiling of the cabin. The ACE Flight server is also connected to the receive channels of the ARINC-429 bus on the aircraft, which provides

Navy personnel take advantage of the Fully Integrated Tactical System (FITS) on an Airbus Military surveillance aircraft.

information such as longitude and latitude and then used to provide the passengers with a moving map application onto their devices.

McLaren says the wiring as minimal, consisting of power and Gigabit Ethernet network cable back to the server. "This, together with a simple control panel from the galley makes the aircraft wiring much less complex. All of this simplification has made it possible to install the system during an overnight shift, which eliminates the airlines' concern for taking an aircraft out of service. All of this addresses the major drawbacks of traditional IFE systems and at a fraction of the cost."

Kontron has systems deployed on more than 3,000 commercial aircraft, including Boeing and Airbus models, throughout the Americas, Europe, Middle East, and Asia. Kontron is the preferred provider of Airborne Servers and Cabin Wireless Access Points (CWAPs) for the Rockwell Collins new wireless inflight entertainment (IFE) systems.

The Kontron ACE Flight 600 general-purpose airborne server and the company's Cab-n-Connect CWAP are currently designed into the PAVES family of in-flight entertainment systems and the Skybox wireless cabin solutions from Rockwell Collins.

Row 44 engineers uses Kontron's Cab-n-Connect Wireless Access Point (CWAP) for the company's high-speed WiFi installations. Row 44, a subsidiary of Global Eagle Entertainment, is a leading provider of in-flight WiFi connectivity and device-based entertainment content for airlines around the world, including Southwest Airlines, Norwegian Air Shuttle, and Mango Airlines.

Cost calculations

As civil and military entities invest in aircraft cabin electronics systems, engineers are under pressure to install solutions with an eye toward reduced cost and future upgradability, cost is a concern.

U.S. Navy personnel employ advanced electronics onboard military aircraft to assist in the search for missing Malaysia Airlines flight MH370.

Customers, such as airlines and militaries, are keenly aware of the costs, complexity, weight and overall capabilities associated with making this type of investment, McLaren acknowledges. "The commercial airline environment for IFE will always be challenging as consumers push to see more advanced electronics on aircraft sooner to keep up with the technology customers have come to expect on the ground." However, FAA regulation compliance, testing, and approval constitute an expensive and time-consuming process, he says.

"The ability to leverage standards-based solutions, such as computing modules or even precertified systems from a hardware provider like Kontron, helps reduce the overall cost and time to launch the system on aircraft," McLaren says. "These types of open hardware platforms help ensure that there is a simplified and workable technology upgrade path that also helps protect system solutions from component obsolescence."

Kontron takes an open platform approach, supporting different operating systems and enabling customers to select the specific application software solution and features that suit their needs and customer goals best, McLaren explains.

Data in demand

ISR missions are increasing in depth, breadth, and number, requiring more capable electronics in military aircraft cabins. For ISR tasks, "aircraft typically need to have good endurance and range characteristics, comprehensive sensors and communications appropriate to the specific mission, and, crucially, an on-board mission system to process the sensor-derived data in a usable format," says an official of Airbus Military in Madrid.

Airbus Military surveillance aircraft are used for a variety of missions, ranging from anti-submarine and anti-surface warfare (ASW/AsuW) to such civic tasks as search and rescue (SAR), maritime patrol, or environmental protection—all of which employ the Fully Integrated Tactical System (FITS) from Airbus.

FITS includes an onboard suite of networked computers and displays with the intention of not only gathering data from several sensors, but also processing and presenting that information in an intelligent way to enable the crew to act on it. The system collects, classifies, and displays various types of sensor data gathered and provides it to the crew via an intuitive interface for increased operational effectiveness, enhanced information integration, and reduced workload onboard the aircraft, officials say.

FITS provides "the software glue that binds the aircraft's tactical systems together," officials explain. Airbus provides a number of different multifunction crew consoles and interfaces with aircraft navigation and communication systems, given that each FITS configuration depends on the specific missions, roles, and platform. A ground-based support center for mission analysis and training complements the airborne system.

FITS is designed to be modular, flexible, and adaptable to ensure applicability to a wide range of missions and aircraft. It uses commercial off-the-shelf (COTS) components, standard Microsoft Windows-based workstations, and

open architecture, as well as supports radar, electro-optic/infrared (EO/IR), acoustics, magnetic anomaly detector (MAD), automatic identification system (AIS), IFF interrogator, communications and electronic intelligence (COMINT/ELINT), and sea pollution detection systems. The system is integrated with the aircraft navigation systems and communications systems, such as VHF/UHF/HF radios, satellite communications (SATCOM), and high-frequency, Link 11, and Link 16 data links.

FITS is in service on the Airbus Military C212, CN235, and C295 special mission range of aircraft, and is included in the company's upgrade of the Lockheed P-3 Orion aircraft. FITS is in service with military and civil customers in Ireland, Chile, Mexico, Spain, and Brazil, among others. Typical configurations include: six consoles on the P-3, four on the C295, two on the CN235, and one on the lighter C212. In all cases, data can be shared with the pilots via a dedicated cockpit display.

Fuselages in the future

Civil and military organizations continue to integrate modern, multifunction, and networked electronics systems in new and existing aircraft, both in the cockpit and throughout the cabin.

"Future cabin electronics will enable and permit integration with mobile technology to perform tasks with increasing sophistication and value," says UTC Aerospace's Horsager. "Domain separation between aircraft operator resources and those potentially used for passenger/IFE in the cabin will continue to be of high importance to operators and regulators. "Engineering and certification aspects will need to clearly identify and segregate these domains to achieve successful product implementations.

"Wireless usage will continue to mature, as well, due to high dependence on this technology in mobile computing, and future aircraft products will need to have robust electronic emissions plans in place to support mobile device usage during all phases of flight," Horsager predicts.

Rad-hard moves into the submicron age

Radiation-hardened integrated circuits today are being fabricated on 45-nanometer processes, with promise for even smaller chip geometries in the future for high-reliability electronics in spacecraft, unmanned vehicles, and wearable devices.

BY **J.R. Wilson**

Semiconductor experts at BAE Systems are fabricating radiation-hardened ASICs on a 45-nanometer process.

In the early days of launching satellites into orbit, radiation hardening of electronic components was the norm, largely because scientists were not yet certain what types or levels of radiation might exist outside the protection of Earth's atmosphere—especially that resulting from nuclear weapons tests at high altitudes or in orbit.

The latter concerns went away through test ban treaties between the United States and then-Soviet Union and, barring a hit from solar radiation shot toward Earth by a coronal mass ejection (CME), normal radiation levels in low Earth orbit (LEO), where most satellites and manned spacecraft operate, were found to be less of a problem than originally feared. However, spacecraft operating in geosynchronous Earth orbit (GEO) or on missions to Luna or beyond still needed shielding for vulnerable electronic components.

Today, the threat of an orbital nuclear explosion has returned as the number of space launch-capable and nuclear-capable nations has increased. More than half a century of satellite and manned operations in LEO also has brought back concerns about that environment, especially for long-term exposure.

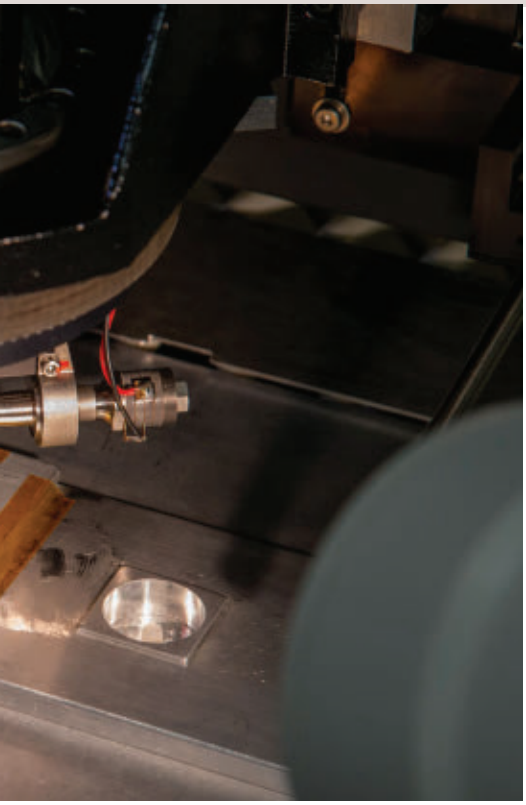
Space, however, is not the only environment where the military and many civil and commercial operations are looking to rad-harden vital electronics, from precision-guided weapons and the increasingly networked battlespace to electric power grids, financial computers, and GPS position, navigation, and timing (PNT).

The threats now include weapons designed to emit electromagnetic pulse (EMP) that fry unprotected electronics to predictions of a significant increase in solar activity; there is statistical probability of at least part of the planet being bathed in electronics-destroying radiation from major solar flares.

At terrestrial altitudes, the predominant sources of radiation include cosmic rays, but also alpha-particle radiation from radioisotopic impurities in component and system package and chip materials.

As a result, the demand for rad-hardened electronics has grown from space applications to include any critical system operating in the other three environmental regimes—air, land, and sea. The devices to be protected now include those carried into the field by individual warfighters—such as the new military-issue smartphones and tablets—to vehicles (military, commercial, and civil), bank ATMs, the Internet, personal and business computers, and hospital equipment.

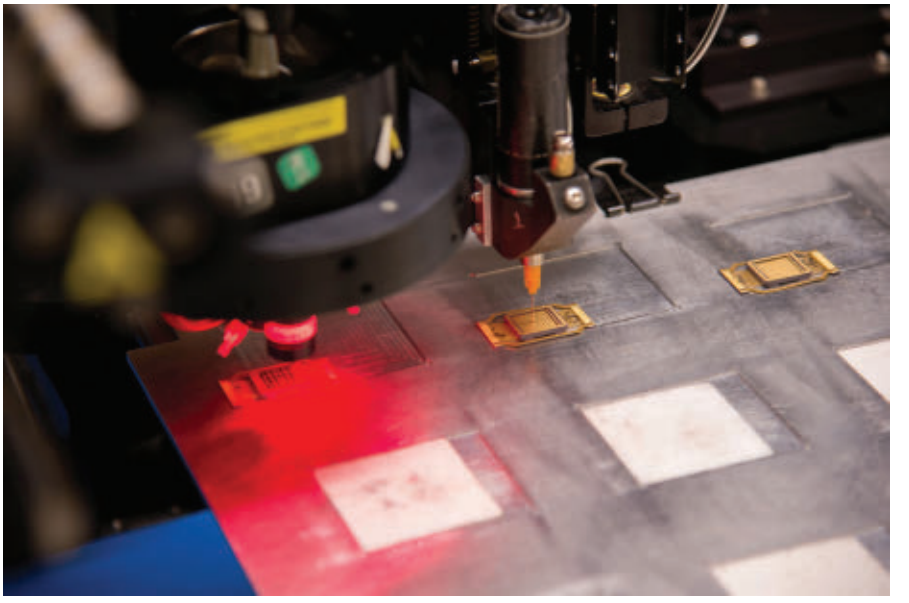
In short, every modern industrial society is at risk, from temporary outages to civilization being



thrown back to pre-industrial levels—but without the near-universal skills of that era needed to survive without electricity, motor vehicles, telephones, and other modern conveniences.

The Applied Physics Laboratory at Johns Hopkins University in Laurel, Md., has put considerable research into digital, analog, and mixed-signal application-specific integrated circuit (ASIC) development. APL's Space Department has focused on mixed-signal ASIC designs for spacecraft bus and instrument applications. While ASICs offer many advantages to spacecraft design, they also come with challenges, the most significant of which is the radiation environment in which they must operate.

According to APL documents, "prolonged exposure to radiation can change the electrical properties of ASIC transistors; long-term radiation exposure has been successfully dealt with at APL by using a specialized radiation-hardened manufacturing process. For example, the temperature remote input/output (TRIO) ASIC has found widespread use in many APL spacecraft.



BAE Systems is releasing two next-generation ASICs for space environments. The chips are made in the miniature scale of 45-nanometer processing technology.

"The TRIO's simple interface and multichannel capacity simplify the acquisition of temperatures across a spacecraft. APL has also developed a multi-channel instrument front-end and an innovative time-to-digital converter. Both these ASICs have allowed the development of advanced spacecraft instruments for missions such as MESSENGER [Mercury, Surface, Space Environment, Geochemistry and Ranging, which recently completed its 3000th orbit of Mercury] and New Horizons [launched in 2006 to explore the outer reaches of the Solar system]."

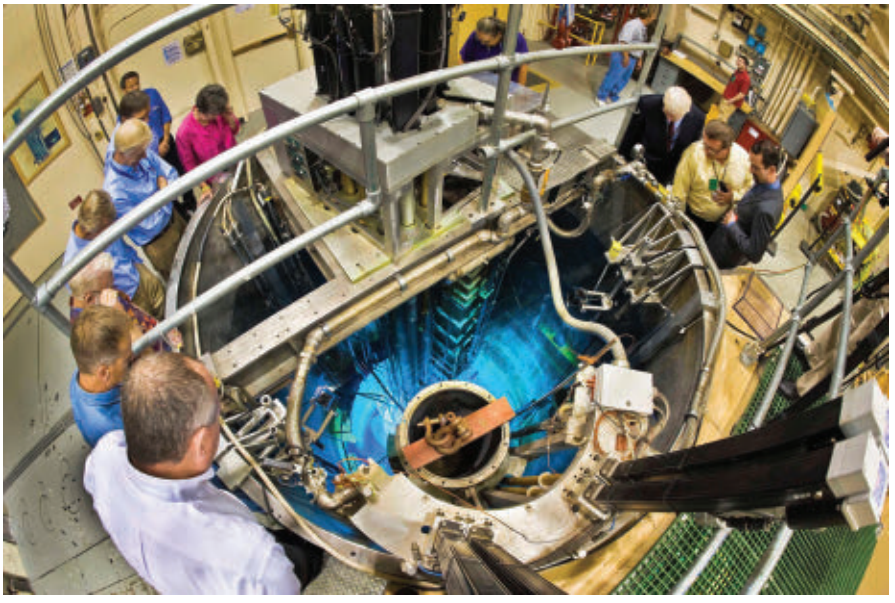
Dealing with that falls into two categories: radiation-tolerant and radiation-hardened.

Prof. John F. Meyer, at the University of Michigan Computing Research Laboratory in Ann Arbor, Mich., defines R-T—or fault-tolerant—as "systems, predominantly computing systems, communication systems and other computer-based systems, which tolerate undesired changes in their internal structure, internal state or external environment. Such changes...may occur at various times during the lifetime of a system, beginning with its specification and proceeding through its use. Faults can be classified in a variety of ways according to when, where, why and how they occur."

Rad-hard, on the other hand, means electronic components or systems have been made resistant to damage or malfunction caused by ionizing radiation (particle radiation and high-energy EM radiation) from natural phenomenon in space or at high altitude, in the proximity of nuclear reactors or particle accelerators, during nuclear accidents or nuclear warfare or from man-made EMP weapons. When interacting with an atom, ionizing radiation has enough energy to force tightly bound electrons from their orbits, causing the atom to become charged or ionized. Examples are gamma rays, protons, and neutrons.

Semiconductors, circuit boards and integrated chips are especially susceptible to radiation, leading the commercial world to spend millions of dollars on research leading to radiation-tolerant microchips. Higher level rad-hard components are based on their non-hardened, but rad-tolerant, equivalents. Due to the extensive work going into the rad-tolerant

The BAE Systems 45-nanometer rad-hard technology provides 10 times more mission capability within the same size, weight and power of its predecessor.



A group of spectators gathers at the Sandia National Laboratories Annular Core Research Reactor, which has been a valuable resource for a wide variety of experiments in nearly every branch of nuclear science, especially the testing of radiation-hardened electronic components.

The largest of the Gamma Irradiation Facility's three test cells at Sandia National Laboratories is spacious enough to irradiate large objects like tanks and satellites.

designs, that means rad-hardened electronics tend to lag behind.

A single charged particle of ionizing radiation can wreak havoc with digital circuits, knocking loose thousands of electrons and causing signal spikes that render anything coming from them inaccurate or just gibberish. To deal with the rad-hard requirements of military and aerospace systems, in particular, ICs, sensors, etc., have been subjected to various approaches to radiation hardening, sometimes in tandem, from the microchip out.

According to the authors of an IEEE paper—"Using Charge Accumulation to Improve the Radiation

The influences of radiation on end-user devices

- Neutron Effects: When a neutron interacts with the semiconductor lattice, it displaces the lattice atoms, increasing the count of recombination centers and deep-level defects, reducing minority carrier lifespans, affecting bipolar devices more than CMOS.
- Total Ionizing Dose Effects: Cumulative ionizing radiation damage of lattice displacement, measured in rads and causing gradual device performance degradation. A total dose greater than 5000 rads delivered to silicon-based devices in seconds to minutes will cause long-term degradation.
- Transient Dose Effects: Short-term, high-intensity radiation pulse typical during a nuclear explosion. The high radiation flux creates photocurrents in the entire body of the semiconductor, causing transistors to randomly open, changing logical states of flip-flops and memory cells.
- Systems-Generated EMP (SGEMP): Effects caused by the radiation flash traveling through the equipment and causing local ionization and electric currents in the material of the chips, circuit boards, cables and cases.
- Single-Event Effects (SEE): Phenomena affecting mostly digital devices that only recently have received extensive study. A high-energy particle traveling through a semiconductor leaves an ionized track that may cause a highly localized effect similar to a transient dose. Single Event Effects are especially critical to satellites, aircraft and other civilian and military aerospace applications.
- Single-Event Upsets (SEU): Transient radiation effects in electronics—memory state changes or register bits caused by a single ion interacting with the chip. While not causing lasting damage to the device, SEUs may cause lasting problems to a system that cannot recover from such an error.
- Single-Event Latchup: A SEL can occur in any chip with a parasitic Positive-Negative-Positive-Negative (PNPN) structure. A heavy ion or a high-energy proton passing through one of two inner-transistor junctions can turn on the thyristor-like structure, which then stays "shorted" (latchup) until the device is power-cycled. Bulk CMOS devices are most susceptible.
- Single-Event Transient (SET): When the charge collected from an ionization event discharges in the form of a spurious signal traveling through the circuit, creating a de facto electrostatic discharge.
- Single-Event Snapback: Similar to SEL but not requiring the PNPN structure, induced in N-channel MOS transistors switching large currents. When an ion hits near the drain junction and causes avalanche multiplication of the charge carriers, the transistor opens and stays opened.
- Single-Event induced Burnout: SEB may occur in power MOSFETs (Metal-Oxide Semiconductor Field-Effect Transistors) when the substrate immediately below the source region gets forward-biased and the drain-source voltage is higher than the breakdown voltage of the parasitic structures. The resulting high current and local overheating then may destroy the device.
- Single-Event Gate Rupture (SEGR): Observed in power MOSFETs when a heavy ion hits the gate region while a high voltage is applied to the gate. A local breakdown in the insulating layer of silicon dioxide causes local overheat and destruction of the gate region.

Tolerance of Multi-Gb NAND Flash Memories"—their research indicates "a path forward to the development of a multi-gigabit, rad-hard, non-volatile memory."

"Consecutive write operations on 42- and 60-nanometer single-level cell (SLC) Samsung NAND flash memories are shown to significantly improve the total ionizing dose response and the single event upset tolerance of the memory. By writing these SLC flash memories multiple times, more charge is placed on the floating gate. This accumulated charge leads to a larger amount of radiation needed to corrupt the data," they wrote in the December 2013 issue of IEEE Transactions on Nuclear Science.

"When I started in space 27 years ago, defense drove commercial developments. Today, commercial is well ahead of space usage and we're looking to leverage what's out there for space. Commercial technologies are not rad-hardened, but can

be evaluated for use in a rad-hard environment," says Joe Marshall, senior principle systems engineer at BAE Systems Electronic Systems in Manassas, Va. "Technologies today are starting to push down below 100 nanometers, licensing 45- or 90-nanometer commercially qualified for space. That's kind of where the state-of-the-art is.

"The big thing we're seeing is a look to more onboard processing. And with that the ability to interconnect data from elements within the systems and a need for high-speed fabrics rather than the old low-speed bus. And affordability, which often means more-for-less—so we can't afford for everybody to go off and do their own thing. The enabling technologies [to date] include commercial below 100 nanometers, electronic silicon, point-of-load devices to provide power, interconnects like RapidIO, Ethernet, and PCI Express, plus high-speed memories, such as DDRs, all on the commercial side that are enabling and will help provide solutions needed for space applications."

A key element in new technologies for space and military air-land-sea operations involves reducing size, weight, and power consumption (SWaP). That also applies to rad-hardening of electronic components and systems. In space systems, size and weight are critical during the launch phase, and power once a system is in orbit or on its way elsewhere.

"As an engineer, I'm trying to apply what's coming out of the commercial world and labs to achieve actual solutions, but with the lowest SWaP technology we can get," Marshall says.

Part of that involves SpaceVPX, a new standard development that enables very flexible advanced electronics to create interoperable systems and products for the space electronics community.

"Preparing VPX for use into space will be a revolution in space computing power and is a large driver for rad-hard technology," says Gregory Powers, business development manager at TE Connectivity in Berwyn, Pa. "TE is providing interconnects for the VPX gear, but that already is pretty rad-tolerant."

Another standard related to rad-hardening was the October 2013 release of the "Test Standard for the Measurement of Proton Radiation Single Event Effects in Electronic Devices" by the JEDEC Solid State Technology Association in Arlington, Va.,, a global leader in standards development for the microelectronics industry.

"The radiation effects test and programmatic community has requested a proton SEE test standard for many years," says Reed Lawrence, Chairman of the JC-13.4 Subcommittee for Radiation Hardness: Assurance and Characterization. "JEDEC believes this new standard will meet the community's needs for a test able to simulate the harsh environment of outer space."

The test standard defines the requirements and procedures for 40 to 500 mega-electron volt (MeV) proton irradiation of electronic devices

for single event effects (SEE). Protons are capable of causing SEE by direct and indirect ionization, but in this energy range, indirect ionization will be the dominant cause of SEE. Indirect ionization is produced from secondary particles of proton/material nuclear reactions, where the material is any element present in the semiconductor.

The effects of radiation on electronics manifest in two fundamental damage mechanisms:

1. Lattice Displacement—Caused by neutrons, protons, alpha particles, heavy ions and very high energy gamma photons, it changes the arrangement of atoms in the crystal lattice, creating lasting damage, increasing the number of recombination centers, depleting the minority carriers and worsening the analog properties of the affected semiconductor junctions.
2. Ionization Effects—Caused by charged particles, including those with energy too low to cause lattice effects. Ionization effects typically are transient, creating glitches and soft errors, but can lead to destruction of the device if they trigger other damage mechanisms, such as a latchup—commonly caused by a nuclear explosion's X-rays and gamma radiation flash, which may prevent crystal oscillators from oscillating for the duration of the flash.

Anthony Jordan, vice president of product marketing & applications engineering for the HiRel Division of Aeroflex Microelectronic Solutions in Colorado Springs, Colo., says there has been a concerted effort to close some of the gaps between commercial and military development.

"Commercially, you're talking 14- and 28-nanometer technology — 14-nanometer on the leading edge. When you look at our industry, the leading edge guys are at 90-nanometer and we're seeing development at 50 and 45 nanometers. We continue to be one to two generations behind, from a rad-hard space viewpoint, which has been the case for a couple of decades now," he says. "That's due to a combination of the need to have mature technology and then leveraging that in a way to demonstrate reliability for upwards of 18 to 20 years.

"So we need reliability and the ability to withstand a nasty environment—galactic charged particles, solar particles, X-rays, gamma rays, trapped electrons and protons. You can't just jump to the best-in-class commercial, although it is actually, in performance outside the atmosphere, improving through better technology—increasingly smaller transistors, thinner gates, changes in materials."

The requirements coming from the military are for total ionizing dose greater than 100 kilorads, with 18-to-20 years of reliable life, Jordan adds, but higher requirements also are now being seen for avionics, vetronics and other non-space electronics. And those, too, have to consider the SWaP effects of rad-hardening on system electronics.

"We're having those discussions now, especially as we pack more electronics—gates and

Physical techniques for rad-hardening

- Hardened chips, often built on insulating substrates instead of traditional semiconductor wafers; Silicon on Insulator (SOI) and sapphire (SOS) are commonly used. While normal commercial-grade chips can withstand between 5 and 10 kilorads, space-grade SOI and SOS chips can survive doses many orders of magnitude greater.
- Bipolar integrated circuits, typically with higher rad-tolerance than CMOS circuits. These can withstand 1000 kilorads on low-power systems to 10,000 kilorads on many ECL (emitter-coupled logic) devices.
- Magnetoresistive RAM (MRAM)—promoted by some as a "universal" memory to replace DRAM, SRAM, EEPROM and flash—is considered a likely candidate for radiation-hardened, rewritable, non-volatile conductor memory. Physical principles and early tests suggest MRAM is not susceptible to ionization-induced data loss.
- Shielding the package to reduce exposure of vulnerable components to radioactivity.
- SRAM as a more rugged—but also larger and more expensive—replacement for capacitor-based DRAM.
- Choice of substrate with wide band gap, which gives it higher tolerance to deep-level defects; e.g. silicon carbide or gallium nitride.
- Using depleted boron (with only the Boron-11 isotope) to shield the chips themselves in the borophosphosilicate glass passivation layer.

memory—into a unit area. The power goes up and management becomes an issue, especially in satellites," he says. "We have renewable batteries on satellites, but we're still concerned about power, which we know we can trade off versus rad-hard performance.

"If I choose to use redundancy—dual or triple—that adds to my power number, which also adds to size. Our customers are pushing for lower power, smaller size ICs, but we have to trade that off with respect to rad performance."

A number of plans for future rad-hardening rely heavily on moving to VPX embedded computing for space applications.

"SpaceVPX was founded as a next-generation space interconnect standard in 2011 and it quickly became apparent we needed to work on the physical boards, that we didn't have interoperable space electronics without physical form factors people could use. So in 2012 we created a study group and had our first working draft of the SpaceVPX standard in 2013," says BAE Systems's Marshall, who serves as primary editor on the working group, which also includes representatives from Boeing, Honeywell, Northrop Grumman, Seakr, TE Connectivity, Smith Connectors, L3-Comm, Lockheed Martin, Harris, Hypertronics, Elma, Amphenol, IEH Corp, Curtiss Wright, Aerospace, AFRL, JPL, NASA Goddard, and NRL.

"We have enough yes votes and corrective no votes to pass and are now working on getting the best consensus from a very large group, made up of most of the U.S. companies involved in space systems—payload providers, user agencies, etc. And that has been one of the strengths—it's not just a couple of engineers in a corner, but a broad, industry-wide group that has been working on it for two years. We hope to have a clean draft by June at the latest."

The biggest problem with adapting VPX for space was waiting for it to become possible.

"We had to wait for the technology. There had been efforts, such as the Advanced Spaceborne Computer Module, which attempted to define an interoperability standard. It was somewhat successful and got

Logic Techniques

- Error correcting memory uses additional parity bits to check for and possibly correct corrupted data. Since radiation effects damage memory content even when RAM is not being accessed, a "scrubber" circuit continuously sweeps the RAM, reading out data, checking parity for data errors, then writing any corrections back to RAM.
- Multiple separate, redundant microprocessor boards may independently compute and then compare answer calculations; if a minority result is produced, it will be recalculated. Repeated errors from the same system may lead adds logic to shut down that board.
- Circuit level redundancy also may be used, replacing a single bit with three bits, each with separate "voting logic" to continuously determine results. Although that increases chip design area by a factor of 5, it also has the secondary advantage of being "fail-safe" in real-time.
- Hardened latches may be used.
- A watchdog timer can be employed to do a hard system reset unless it detects evidence indicating the system is alive, such as a write operation from an onboard processor. During normal operation, software schedules a write to the watchdog timer at regular intervals to prevent the timer from running out. If radiation causes processor errors, it also is likely to fail to clear the watchdog timer, which eventually will time out and force a hard reset. This is considered a last resort to other methods of radiation hardening.

some use, but was not widespread. And not being a fabric, it was a huge number of signals. Buses are a lot harder to standardize than fabric," Marshall says. "VCI [virtual card interface] became the de-facto standard for space in the 1990s and early 2000s. A lot of electronic boards talk Compact VCI, but no one really tried to standardize as a group.

"I think we've learned by supplying products into those uses—as have other companies—what needs to happen to make a standard usable. With earlier technologies, functions often had to split across boards. Now much more dense technologies are becoming available to put more stuff on a board. If we can establish a boundary around it, that allows people to still do unique things inside the board, but the board becomes the interface and, with enough speed and data capability, it seems to match what people need. We're also trying to make sure there is some growth capacity built in for the next technologies that come along."

Jay H. Johnson, principle product marketing engineer at Aeroflex, says most avionics applications are rad-tolerant rather than rad-hard, but the demand for rad-hard for terrestrial applications is growing.

"One of the programs we're

excited about now is UAVs [unmanned aerial vehicles] for battlefield surveillance. They don't require the level of rad-hardness our satellites do, but we're seeing a need for hardness beyond just the typical levels achieved with a commercial product, so we're taking that to the next level with our radiation testing reports," he says. "That's typically around 30 to 50 kilorads for battlefield drones.

"Every integrated device is intrinsically hard to some level, but to qualify to a specific rad-hardness, from a design standpoint, you start with a rad-hard library. About 10 years ago, we did more rad-hard process-related efforts in building the IC rather than how you design it. But when we move to 350-nanometer processes, that is rad-hard by design. You can test any semiconductor to a level of rad-tolerance, but to ensure it works above 100 kilorads, it needs to be designed to be rad-hard."

Aeroflex Product Marketing Engineer Michelle Mundie says industry has been working with several enabling technologies in seeking to meet the new level of radiation hardening requirements coming from the military and civil/commercial customers.

"A good example is our MRAM [magneto-resistant RAM] product, which is truly bullet-proof for customers who need true mega-rad performance. With a total ionizing dose at 1 megarad per second, it is truly a rad-hard device and excellent candidate for space applications," she says. "MRAM is based on a magnetic tunnel junction, with two mag layers, which is inherently immune to single event upsets.

"Synchronous SRAM is in development and we expect qualification by the end of this year. It is a rad-hard device, targeting 300 kilorads total ionizing dose and based on one transistor/one capacitor technology for the memory cell, a commercial technology that enables us to achieve a higher density. We're also developing a line of bus-switch products that can be used for isolation, power management, and redundancy to aid system designers in reducing power. These devices are hardened to 300 kilorads. Our NOR flash device, through power cycling, can achieve a greater rad level. And the bus switch can be used to power down the NOR flash to achieve even higher levels."

As technologies continue to shrink, the demand for rad-tolerant and rad-hardened electronics will continue to increase. While design will remain imperative to achieve high rad-hard levels, in five to ten years, the basic component technologies themselves will have better intrinsic radiation performance.

At the same time, however, threats will continue to grow, as will the range of efforts to deal with them.

"There's nothing we're doing that would preclude board replacement in space, but that was not a focus," Marshall says of the proposed SpaceVPX standard. "As we look to the future and things we might do with the standard, LRUs [line-replaceable units] are typically part of the commercial/military use of open VPX.

"Our hope is when we get this out and people start using it, where we go from here will become evident as people take advantage of it to move forward. So I'm looking forward to completing this and getting the standard into use in the space industry."

Software design and development tools help systems integrators do more with less

BY **John Keller**

Software design and development tools are helping systems designers come to grips with that age-old problem: how to do more with less. Shrinking military budgets and growing pressures to get reliable software code into applications quickly are among today's most prominent market drivers.

"There is an awareness that you have to do more with less," points out Jon Friedman, aerospace and defense industry marketing manager at The MathWorks Inc. in Natick, Mass. "The way you do more results with less resources is by using modern tools and modern technology."

Under these conditions one of the most urgent requests that software tools vendors receive from their customers is how to help comply with industry standards for safety-critical systems like commercial and military aircraft.

The chief requirement in the safety-critical realm these days is adhering to the DO-178C standard and its predecessor, DO-178B. Where in the past the use of DO-178 was a strong recommendation from government authorities like the U.S. Federal Aviation Administration (FAA), today it's a solid requirement, Friedman says.

Moreover, other government authorities like the U.S. Department of Defense also are starting to recommend or require DO-178 for life- and mission-critical systems. This standard also is having an influence on other industries like medical and automotive, and eventually may have a significant influence in other industries, experts believe.

While DO-178B still is the controlling standard today, DO-178C has introduced new guidelines to software development. Today's software design and development tools can help companies write software code that adheres to the provisions of DO-178 from beginning to end.

"Now the trend is looking at the overall software development life cycle, from requirements, through verification, and deployment," says Jim McElroy, vice president of marketing at LDRA Software Technology in Atlanta.

The newest standard has provisions for the use and qualification of software tools that automate much of the actual coding process based

COMPANY INFO

AdaCore
New York
www.adacore.com

Altera
San Jose, Calif.
www.altera.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

Lynx Software
San Jose, Calif.
www.lynx.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

Sparx Systems
Creswick, Australia
www.sparxsystems.com

Trideum Corp.
Huntsville, Ala.
www.trideum.com

Wind River
Alameda, Calif.
www.windriver.com

Xilinx Inc.
San Jose, Calif.
www.xilinx.com

on high-level models that map abstract requirements into executable lines of code.

Adherence to DO-178 is only a part of today's requirements for writing complex software. Software engineers need to write reliable code quickly, document the code with bidirectional traceability from requirements to deployment, as well as comply with standards. "How do we make software development more productive, reduce the software-development life cycle, and meet the standards," LDRA's McElroy says.

One tactic that many companies are considering to meet these objectives is standardizing on how they develop software, with a goal of setting a process in place to help engineers write high-quality software quickly, McElroy says.

Data code analysis tools, for example, can help developers understand software complexity, and ensure that members of software-development teams adhere to the same software-development process to write code that is maintainable, readable, clear, concise, and understandable.

"Anyone else on the team should be able to pick up my code and understand it," McElroy says. "Static analysis helps them do this, and adhere to a particular coding procedure and style."

Structural coverage analysis can help engineers measure the effectiveness of their testing process and ensure that their systems are adequately tested—on the host and on the target. Without this kind of testing on host and target, designers risk having compilers inserting errors into executable code. Object verification helps ensure that those errors are not inserted, McElroy says.

Not only are today's software design and development tools helping engineers write error-free efficient code, but also are helping systems integrators understand the overall complexity of their systems through extensive modeling.

"In naval ships, for example, there is an evolution to understanding power requirements, because modern ships essentially are floating power grids," Friedman says. "They all run electro-mechanically, and you need to understand how much load you can put on those things. With more and more C4ISR on these ships, they need to generate enough power and balance the loads."

Software tools are available from companies like The MathWorks that enable designers to model the power load on the ship. Rarely will every system be running at maximum power, so engineers are designing shipboard power systems to enable the vessels to run at peak efficiency.

System modeling through software also is helping designers make efficient use of so-called "big data," that typically gathers more data than systems can use.

Model-based design can capitalize on big data to create maintenance schedules based not just on conditions that actually cause system wear and failures, but also to look at correlating events that based on their patterns and past experience may indicate that maintenance and component replacement may need to happen soon.

Raytheon to upgrade UAV control system

Unmanned aerial vehicle (UAV) control experts at the Raytheon Co. Technical Services segment in Dulles, Va., will switch a major unmanned helicopter control system from Solaris to Linux software, and upgrade the system with universal UAV control qualities under a $15.8 million contract. Officials of the U.S. Naval Air Systems Command at Patuxent River Naval Air Station, Md., are asking Raytheon to upgrade the company's Vertical Takeoff and Landing Unmanned Air Vehicle (VTUAV) Tactical Control System (TCS), designed to help operators fly the Northrop Grumman MQ-8 Fire Scout unmanned helicopter. Raytheon will switch the VTUAV TCS block II from the Solaris to the Linux version B2VL software, and continue evolving the system to the military's new Unmanned Aerial System Control Segment architecture.

Spending for U.S. military UAVs to grow

Spending for U.S. military unmanned aerial vehicles (UAVs) will rise from $4.97 billion in 2013 to $6.53 billion in 2018—a five-year increase of 24 percent—predict Frost & Sullivan analysts in Mountain View, Calif. UAVs remain essential for conducting intelligence, surveillance, reconnaissance and strike operations. ←

DARPA launches CODE program for UAVs to share information and work together

BY **John Keller**

ARLINGTON, Va.—U.S. military researchers are trying to enable surveillance and attack unmanned aerial vehicles (UAVs) to work together on missions involving electronic jamming, degraded communications, and other difficult operating conditions.

Military researchers are looking for ways to enable unmanned aircraft to work together in difficult conditions.

Officials of the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., released a solicitation (DARPA-BAA-14-33) for the Collaborative Operations in Denied Environment (CODE) program to enable UAVs to work together in teams and take advantage of the relative strengths of each participating unmanned aircraft. The CODE program is to expand the mission capabilities of existing UAVs through increased autonomy and inter-platform collaboration. Collaborative autonomy has the potential to increase capabilities and reduce costs of today's UAVs by composing heterogeneous teams of UAVs that can capitalize on the capabilities of each unmanned aircraft without the need to duplicate or integrate capabilities into one UAV.

Although today's UAVs have proven themselves in a wide range of missions, most current UAVs are not well matched to the needs of future conflicts, DARPA officials say. Compared to today, future conflicts will be much less permissive, very dynamic, confront U.S. and allied forces with more dangerous threats, and involve contested electromagnetic spectrum and relocatable targets. In these future conflicts, UAVs could use collaboration algorithms to help each other with tasks like geo-locating targets with long-distance sensors, as well as guiding less-capable UAVs to within their sensor ranges.

Collaboration algorithms could help UAVs work together to provide multi-modal sensors and diverse observation angles to improve target identification, transmit important information through the network, provide navigational aide to low-tech or damaged UAVs, and protect each other by overwhelming defenses. Goals are to develop and demonstrate the value of collaborative UAV autonomy in tactical situations; rapidly bring that capability to the warfighter; develop ways to expand the range of collaborative UAV missions; and help researchers contribute to collaborative autonomy technologies.

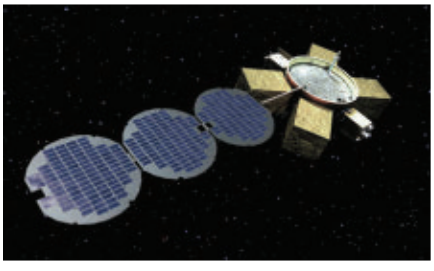
The program has three phases. The first phase starts later this year and extends through early 2016. ←

MORE INFORMATION IS online at *https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-BAA-14-33/listing.html*.

Air Force Research Lab taps Raytheon to build hypertemporal multispectral space sensor

BY **John Keller**

KIRTLAND AIR FORCE BASE, N.M.—U.S. Air Force space surveillance experts are looking to the Raytheon Co. Space and Airborne Systems segment in El Segundo, Calif., to blend multispectral images of the Earth taken over time to extract important reconnaissance information. Officials of the Space Vehicles Directorate of the Air Force Research Laboratory's Space Experiments and Programs Branch (AFRL/RVEP) at Kirtland Air Force Base, N.M., announced a $33.7 million five-year contract to Raytheon for the hypertemporal imaging space experiment payload.



The future EAGLE spacecraft, depicted above, will have the hypertemporal imaging space experiment payload from Raytheon.

The electro-optical space instrument that Raytheon will build is to help Air Force researchers improve their understanding of hypertemporal imaging, which involves blending images taken of different spots on the Earth in several different spectral wavelengths at regular intervals over time. Hypertemporal images give intelligence analysts a look at how light interacts with the scene over many different wavelengths—infrared, ultraviolet, and visible light—and how the scene changes over time.

The Air Force Hypertemporal Imaging Space Experiment (HTI SpX), for which Raytheon is designing this space instrument, may be using advanced hypertemporal techniques such as principal components analysis and Fourier analysis to help researchers better understand how they can use persistent-surveillance space imagery taken over time.

Air Force researchers are asking Raytheon to build a space sensor to collect data that consists of a range of target signatures in varied background environments. The flight instrument will be compatible with and fly on the Air Force Research Laboratory's Evolved Expendable Launch Vehicle (EELV) Secondary Adapter (ESPA) Augmented Geostationary Laboratory Experiment (EAGLE). Spacecraft designers at Orbital Sciences Corp. in Dulles, Va., won a $32 million contract from the Air Force in 2012 to develop the experimental maneuverable EAGLE spacecraft to host several payloads in low- and geosynchronous orbits.

Raytheon will design a stabilized hypertemporal imaging space sensor that is optimized for thermal control of its optics. Work should be finished by January 2017.

FOR MORE INFORMATION visit **Raytheon** at *www.raytheon.com*.

Hoffman Engineering to provide night-vision test gear to Air Force

Night-vision test & measurement experts at Hoffman Engineering Corp. in Stamford, Conn., will provide the U.S. Air Force with test equipment for night-vision goggles under terms of a $6.7 million contract. Hoffman will manufacture as many as 80 night-vision goggle infrared test sets and as many as 300 test set upgrade kits. Awarding the contract were officials of the Air Force Life Cycle Management Center at Robins Air Force Base, Ga. Among the latest electro-optical device test sets that Hoffman offers for night-vision devices is the ANV-126A, which offers field of view night-vision device testing as wide as 40 degrees and enhanced resolution levels over previous ANV-126 models.

CMOS X-Ray camera for non-destructive testing introduced by Teledyne

Teledyne DALSA in Waterloo, Ontario, is introducing the Rad-icon 1520 CMOS X-Ray camera for industrial X-ray inspection, scientific imaging, and non-destructive testing, including weld inspection, wire bond and printed circuit board (PCB) inspection, microfocus, computed tomography (CT) and other demanding industrial imaging applications. The Rad-icon 1520 electro-optical detector features 1548-by-2064-pixel resolution, an active area of 15.3 by 20.4 centimeters, and 99 micron pixel size. Rad-icon detectors deliver real-time frame rates to 30 frames per second.

PRODUCT applications

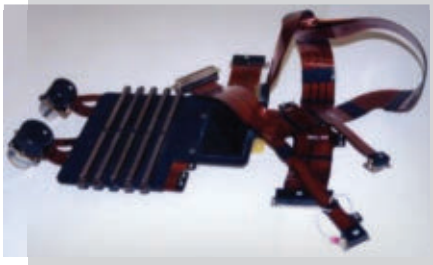
CABLE AND CONNECTORS

Military looks to Disan Engineering to provide backplane interconnect for C-130 aircraft

U.S. military logistics experts needed an electronic backplane interconnect system for the Lockheed Martin C-130 four-engine turboprop utility aircraft. They found their solution from Disan Engineering Corp., a military electronics manufacturer in Nowata, Okla.

Officials of the Defense Logistics Agency Land & Maritime segment in Columbus, Ohio, are soliciting a long-term contract with Disan Engineering for a multi-layer rigid and flex interconnect assembly that connects about 1,500 circuits for the navigation system in the C-130 aircraft.

The Disan 11250 design provides the interconnections internally, as well as provides shielded paths for many of the circuits. Some shielded circuits consist of several leads encased in a flexible shield, which is subsequently encased in a flexible master layer shield.



The interconnect product is for the Teledyne AN/APN-218 Doppler radar navigation system on the C-130 aircraft. The system also is for the Boeing B-1B bomber, Boeing B-52G/H bomber, and Boeing KC-135 mid-air refueling aircraft.

The terminations of the flex circuits are done on a rigid multi-layer printed circuit board to alleviate the normal separation problems typically found in flex circuitry.

Disan is the Defense Logistics Agency's approved source for this item, and to ensure some level of competition, agency officials are asking industry if any companies other than Disan would like to become approved sources for the interconnect product. The agency does not have any drawings or specifications for the Disan 11250 backplane interconnect, officials say.

Companies interested in becoming approved sources for the interconnect should respond no later than today, 17 Feb. 2014. Defense Logistics Agency officials say they need about 34 of these interconnect products each year.

FOR MORE INFORMATION visit **Disan Engineering Corp.** online at *www.disancorp.com*.

APPLICATION SOFTWARE

NASA chooses Tietronix to perform software research and maintenance at mission control

Mission control specialists at the U.S. National Aeronautics and Space Administration (NASA) in Houston needed advanced software programming to support the agency's Mission Operations Directorate (MOD) and human spaceflight programs at the NASA Johnson Space Center in Houston. They found their solution from Tietronix Software in Houston.

Officials NASA Johnson awarded a potential $35 million contract to Tietronix for the Advanced Technology and Integration Contract (ATIC) to design advanced technologies and custom software applications for NASA mission operations. Tietronix software engineers will explore new technologies for improving the effectiveness of NASA mission operations, including situational awareness displays, Web-based workflow systems, computer simulations, virtual reality, intelligent systems, and flight crew operations applications.

Among the goals of the NASA ATIC program is to integrate complex data sources for NASA's existing manual workflow process for mission control operations. The contract is worth as much as $35 million over the next five years.

Company software engineers

will write, maintain, and upgrade software applications in the C, C++, C#, JAVA, JAVA Script, Bash, PERL, TCL/TK, and GTK programming languages, as well as develop Web-based applications with database backend, installation, configuration, programming, and administration using Oracle, Structured Query Language (SQL), and Multi-Tiered Architectures.

Tietronix experts also will use open-source software tools for advanced technology projects involving .Net, Active Server Pages (ASP), Winchill, and Extensive Markup Language (XML), as well as carry out Linux system administration of Unix and Windows computers to include Red Hat Enterprise Linux (RHEL), Community ENTerprise Operating System (CentOS), Scientific Linux, Windows XP, Windows 7, and Windows server 2003 and 2008.

FOR MORE INFORMATION visit **Tietronix** online at *http://tietronix.com*.

CIRCUIT CARDS

Elbit to provide spare circuit cards for Apache helicopter helmet-mounted targeting system

U.S. military aviation experts needed spare electronic circuit cards for the Integrated Helmet and Display Sighting System (IHADSS) of the U.S. Army Boeing AH-64 Apache attack helicopter. They found their solution from Elbit Systems of America LLC in Fort Worth, Texas.

Officials of the Defense Logistics Agency (DLA) detachment in Warren, Mich., plan to award a contract to Elbit worth about $685,000 for 68 embedded computing circuit cards for the AH-64's Sight Electronic Unit (SEU), an electronics box in the helicopter's IHADSS. The IHADSS provides a visually coupled interface between the AH-64 pilot and the helicopter. It has a helmet-mounted display monocular with a 40-by-30-degree field of view with symbology and video overlays.

Electro-optical sensors on the nose of the Apache helicopter are slaved IHADSS monocular on the pilot's helmet, which match the sensor's view with the pilot's head.

The SEU and circuit cards are critical for the safe operation of the AH-640 helicopter during nighttime nap-of-the-Earth (NOE) flight.

The SEU controls the night sensor line of sight (LOS) by monitoring and reporting the pilot's head position, assuring that the night sensors correctly point where the pilot looks. SEU or circuit card malfunction during nighttime NOE flight could risk a helicopter crash.

The circuit card is proprietary to Elbit, and no other suitable sources for the part are available, officials say. There are no other applications, military or commercial for the part.

Elbit acquired the Apache IHADSS product line, as well as technical and data rights, in about 2000, and has the facilities, personnel, and technology established to manufacture the parts, DLA officials say. No other contractors are being qualified to provide these parts.

FOR MORE INFORMATION visit **Elbit Systems of America** online at *www.elbitsystems-us.com*.

SENSORS

Rockwell Collins to provide weather radar for future Coast Guard MH-65E utility helicopters

U.S. Coast Guard aviation experts needed a weather radar system for the service's future MH-65E Dolphin helicopter. They found their solution from Rockwell Collins in Cedar Rapids, Iowa.

Coast Guard officials are choosing Rockwell Collins to provide the company's RTA-4114 multiscan weather radar with enhanced ground and shoreline mapping, as well as new maritime surface search mode, as the MH-65E radar sensor system (RSS) for 102 MH-65E helicopter avionics systems. The MH-65E is to join the Coast Guard fleet in 2017.

The Rockwell Collins RTA-4114 will provide the Coast Guard's future MH-65E with a lightweight, flexible, and supportable radar, company officials say. The RTA-4114 automatically scans ahead of the helicopter and combines the returns through advanced digital processing and analysis algorithms to display precipitation rates and weather threats.

The MH-65E Dolphin helicopter is to be the latest version of the MH-65, the Coast Guard's most ubiquitous helicopter, and will feature an all-glass cockpit with advanced navigation capabilities to meet emerging FAA requirements. The MH-65 is the Coast Guard's version of the French-built Airbus Helicopter (formerly Eurocopter) AS365 Dauphin.

The MH-65 helicopter is designed to operate in all-weather conditions except in icing conditions,

as well as at night, and is the primary Coast Guard helicopter used aboard Coast Guard cutters during deployments.

The helicopter has a forward-looking infrared (FLIR) sensor, a heads-up display (HUD), and other avionics upgrades are being installed aboard the H-65 as part of the conversion-sustainment initiative to sustain the airframe for the foreseeable future.

The Rockwell Collins RTA-4114 weather radar features automated tilt, clutter removal and gain management, as well as automatic compensation for many predictable atmospheric and climatic conditions.

Under the Coast Guard contract, Rockwell Collins will provide an enhanced RTA-4114 radar with a new maritime surface search mode and advanced ground clutter-rejection algorithms expanding the radar's ground mapping capability for shoreline and over water use.

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

CLOUD COMPUTING

C3 Systems chooses Deltek First software tool to help move management projects to the cloud

Consummate Computer Consultants Systems (C3 Systems) in Herndon, Va., needed cloud-computing software to help manage various government contracting projects. They found their solution from Deltek Inc. in Herndon, Va.

C3 Systems is choosing the Deltek First cloud computing software from Deltek as the C3 enterprise resource planning (ERP) system. Deltek First uses project management and project accounting software to help companies move applications to the cloud.

Deltek First is a software-as-a-service (SaaS) ERP product for companies like management consultants and government contractors that enables users to unite projects on one cloud computing ERP system. C3 Systems supports federal, state, and local government customers with help in software requirements, process reengineering, enterprise architecture, independent verification and validation (IV&V), and testing. C3 leaders recognized they had significant challenges with their former time-management and accounting systems that did not meet the needs of its growing business.

Not only was C3 unable to integrate the two systems, but it also experienced significant issues getting a clear picture of the business as its company grew and had too many manual processes in place for effective control of its mission-critical data. C3 needed an expedited implementation because the firm is taking on several new contracts.

FOR MORE INFORMATION visit **Deltek** online at *www.deltek.com*.

UAV CONTROL

Navy chooses shipboard data link from L3 Communications-West to communicate with UAVs

The U.S. Navy needed a digital data link to control the MQ-8B and MQ-8C unmanned helicopters operating from the Littoral Combat Ship. They found the solution at L3 Communications-West in Salt Lake City.

Officials of the Naval Air Systems Command at Patuxent River Naval Air Station, Md., awarded $17.6 million contract modification to L3 for surface terminal equipment for Hawklink Tactical Common Data Link (TCDL) and the Littoral Combat Ship, as well as for the Vortex Mini-TCDL Shipset components, to support the Fire Scout shipboard UAV.

The L2 T-series model-S surface terminal is a ruggedized communications terminal that has been integrated into the Littoral Combat ship and the Coast Guard National Security Cutter. The terminal is software configurable and supports standard CDL waveforms.

The system enables naval personnel aboard the Littoral Combat Ship to fly the Fire Scout unmanned helicopter remotely, and receive sensor information from the aircraft.

FOR MORE INFORMATION visit **L3 Communications-West** online at *www2.l-3com.com/csw*.

new PRODUCTS

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

POWER ELECTRONICS

Rugged power converters in encapsulated modules from Pico Electronics

Pico Electronics Inc. in Pelham, N.Y., is introducing the rugged DC-1 series of power converters, which come in encapsulated modules for a ruggedized applications. The power electronics devices are designed to combine high input voltage capabilities of 120 to 370 volts DC and high power ratings of to 300 watts with regulated output voltages from 5 volts DC to 300 volts DC standard. Pico's DC-1 high input voltage series of modules, in one brick package, enables users to input a DC voltage range of 120 to 370 volts DC and provide isolated output voltages from 5 volts DC to 300 volts DC, and output power to 300 watts. Sixteen models will provide an isolated, regulated DC output voltage at a fixed 100 kHz operating frequency.

FOR MORE INFORMATION contact **Pico** online at *www.picoelectronics.com*.

CABLING

Low-loss test cables introduced by Fairview Microwave

Fairview Microwave Inc. in Allen, Texas, is introducing a line of low-loss test cables for test environments where a rugged, phase stable cable assembly is required. The test & measurement cables use LL335i and LL142 coax, and are rated to 18 GHz. LL335i and LL142 cables allow for relatively high power transmission because the resulting higher temperatures do not have a negative effect on the cable due to the thermal stability of the PTFE tape dielectric. Where phase stability requirements are critical, Fairview's low-loss cables allow for a 75 percent lower phase shift due to the precise construction of these cables. This cable configuration offers attenuation levels 20 to 35 percent lower than comparable mil-spec cables. Fairview's RF cable assemblies offer a choice of stainless steel TNC, SMA, and N-Type connectors and a heavy-duty booting to improve strain relief.

FOR MORE INFORMATION contact **Fairview Microwave** online at *www.fairviewmicrowave.com*.

TEST AND MEASUREMENT

Oscilloscopes able to measure 40 channels at once from Agilent

Agilent Technologies Inc. in Santa Clara, Calif., is introducing the Infiniium Z-series oscilloscopes, which can be synchronized for test & measurement of as many as 40 channels simultaneously with a maximum 63-GHz real-time oscilloscope bandwidth on as many as 10 oscilloscopes. With noise and jitter measurement floors, the oscilloscopes enable engineers to test devices that incorporate new technologies. The Z-series includes 10 models ranging from 20 to 63 GHz, all of which are bandwidth-upgradable to 63 GHz. The Z-series also has fast processing and a next-generation user interface. Capabilities include bandwidth to capture the third harmonic on 28-, 32-, and 40-gigabit-per-second digital signals; user interface to analyze emerging technologies, including spatial modulation; optional synchronization port to measure as many as 40 channels simultaneously; capacitive touch screen; and USB 3.0 offload speeds.

FOR MORE INFORMATION contact **Agilent** online at *www.home.agilent.com*.

RF AND MICROWAVE

Coaxial resonator oscillator for digital radio from Crystek

Crystek Corp. in Fort Myers, Fla., is introducing the CVCO55CXT-6000-6075 coaxial resonator oscillator (CRO) for digital radio equipment, fixed wireless access, satellite communications systems, base stations,

and other RF and microwave equipment. The CVCO55CXT-6000-6075 is a coaxial-based voltage-controlled oscillator (VCO) with an internal proprietary frequency doubler. The CVCO55CXT family's frequency doubling, 2X fundamental technology offers low phase noise and low harmonics while achieving low current consumption. The CVCO55CXT-6000-6075 operates from 6000 to 6075 MHz with a tuning voltage range of 0.5 to 4.5 volts DC. This coaxial VCO features a typical phase noise of -100 dBc/Hz at 10 KHz offset and has good linearity.

FOR MORE INFORMATION contact **Crystek** online at *www.crystek.com*.

SWITCHES

Rugged switches for harsh environments from C&K

C&K Components in Newton, Mass., is expanding the K12S series harsh-environment surface mount key switch family with improved illumination, environmental sealing, and actuation options. By employing an advanced material for transparency while withstanding high reflow temperatures, C&K has enhanced the luminosity of the K12S series rugged switches, with a choice of six standard LED colors. The K12S series key switches now include a version sealed to IP67 standards for use in outdoor applications such as automotive door locks, trunk openers, motorbike handles and other environments likely to encounter harsh conditions. An IP40 version of the switch is available for less demanding environments.

FOR MORE INFORMATION contact **C&K Components** online at *www.ck-components.com*.

RUGGED COMPUTERS

Rugged notebook computers from GammaTech

GammaTech Computer Corp. in Fremont, Calif., is introducing the DURABOOK R8300 rugged notebook computer for harsh environments in military, public safety, and utility applications. The DURABOOK R8300 notebook comes with an Intel 3rd Generation i-Core LV /ULV CPU i-Core i7-3555LE or i-Core i5-3437U mobile processor, and includes a mobile Intel QM77 Express Chipset that provides integrated USB 3.0, Intel AMT 8.0 with enhanced manageability and security, Intel Rapid Storage Technology with RAID support for enhanced performance, power management, and data protection, Intel Smart Response Technology, and Intel Anti-Theft Technology that can disable a lost or stolen PC and reactivate it without compromise to the system or data. The R8300 notebook's 13.3-inch TFT touchscreen LCD display has direct-sunlight readability. The unit is certified to MIL-STD-810G and IP65 specifications for shock, drop, vibration, temperature, water and dust resistance, as well as operation in hazardous locations.

FOR MORE INFORMATION contact **GammaTech** online at *www.gammatechusa.com*.

DATA RECORDERS

Extreme-environment data recorders introduced by Pentek

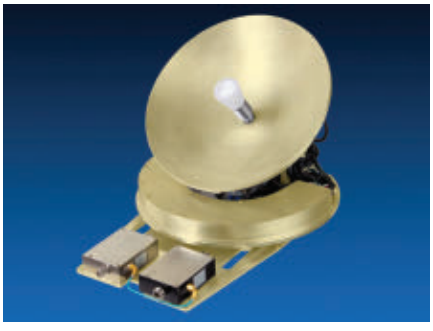
Pentek Inc. in Upper Saddle River, N.J., is introducing a line of extreme-environment data recorders for aerospace and defense applications in the field. The Talon RTX Rackmount series rugged data storage devices are designed to provide a combination of high performance and large storage capacity in a military-specified rackmount chassis. The RTX Rackmount series provides to 30 terabytes of solid-state data storage with aggregate recording rates as fast as 5 gigabytes per second. The RTX Rackmount series has a chassis designed in collaboration with Nova Integration Solutions in Saint Cloud, Fla. A major innovation for the RTX Rackmount systems is the QuickPac canister that allows operators to quickly remove and replace storage drives in the field.

FOR MORE INFORMATION contact **Pentek** online at *www.pentek.com*.

ANTENNAS

Ka-band VSAT SATCOM antenna for in-flight connectivity from TECOM

TECOM Industries in Thousand Oaks, Calif., is introducing the KaStream 5000 satellite communications (SATCOM) antenna for mounting in the tail of aircraft for airborne in-flight connectivity. The Ka-band VSAT solution offers effective isotropic radiated power (EIRP) in a small form factor to enable high data rates off the aircraft; two line replaceable units (LRUs), an antenna control unit (ACU), and 11.5-inch Ka band satellite tracking antenna assembly (STAA); multi-modem capability supporting dif-



ferent satellite and ground systems worldwide; and swappable Ku- or Ka-band antenna platforms. The product is designed to be form and fit swappable with either Ka-band or Ku-band STAA. TECOM will debutintroduce its new Ku-band VSAT tail mount SATCOM product and swappable STAA later this year.

FOR MORE INFORMATION contact **TECOM** online at *www.tecom-ind.com*.

ADHESIVES

Electrically insulating epoxy adhesive from Master Bond

Master Bond Inc. in Hackensack, N.J., is introducing the EP21SC-1 epoxy adhesive engineered with a silicon carbide filler material that delivers abrasion resistance in chemical and mechanical processing applications. This electrically insulating epoxy has a smooth paste consistency and a non-critical one-to-one mix ratio by weight or volume. As a two part system, it cures at room temperature or more quickly at elevated temperatures. With a Shore D hardness ex-

ceeding 95, EP21SC-1 is a rigid compound that adheres well to treated metals, ceramics, and many plastics. Its physical strength profile includes a tensile strength greater than 6,000 psi and a compressive strength of over 15,000 psi at room temperature.

FOR MORE INFORMATION contact **Master Bond** at *www.masterbond.com*.

RUGGED TELECOMMUNICATIONS

Secure telephone for military weapon systems communications introduced by TACTICALIVE

TACTICALIVE in Colorado Springs, Colo., is introducing the PW-14 secure tactical data link telephone for military communications of weapons systems. The type-1 auto-protocol switching redundant secure telephone for monitoring real-time capability over data-link tracks of concern, providing the capability to lock-on tracks, forwarding it's client side data, back to main tactical data-link devices for further processing. With an IP-to-serial auto-alternate connection, as well as manual configuration, the communications device makes the most of uptime

rates with redundancy in secure and non-secure settings. It is type 1 encryption compliant, for VOIP, analog, and certified to support Link-22. For Coalition Guard, it supports classified and sensitive data sharing of NATO and multinational interoperability.

FOR MORE INFORMATION contact **TACTICALIVE** at *www.tacticalive.com*.

RUGGED COMPUTERS

Rugged Intel-based embedded computer from Crystal Group

Crystal Group in Hiawatha, Iowa, presents its RE0814 rugged embedded computer for operations in

harsh environments. The RE0814 rugged embedded computer has no moving parts and is fanless. It operates in temperatures as hot as 85 degrees Celsius, offers the Intel Core i3, i5, or i7 microprocessors, and is packaged in 11-by-14-inch 1U short chassis.

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

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 **Adrienne Adler**
603 891-9420/ aadler@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 & EASTERN CANADA & UK
Bob Collopy, Sales Manager
603 891-9398 / Cell 603 233-7698
FAX 603 686-7580 / bobc@pennwell.com

WESTERN CANADA & WEST OF MISSISSIPPI
Jay Mendelson, Sales Manager
4957 Chiles Drive, San Jose, CA 95136
408 221-2828 / 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
847 763-9540 • FAX 847 763-9607
e-mail: mae@halldata.com
web: https://pennwell.sub-forms.com/PNW20_MFcontact

BPA WORLDWIDE

AMERICAN BUSINESS MEDIA
The Association of Business Media Companies

Q+A

BIO:
NAME: Dr. Michael Griffin
TITLE: Chairman and CEO
CO.: Schafer Corp.
ROLE: provider of technology services and solutions for customers with missions of national significance in aerospace and national security
CONTACT: *www.schafercorp.com*

Dr. Michael Griffin

A former NASA administrator discusses aerospace opportunities.

What is happening in aerospace?

When you talk about aerospace, people generally think about two commercial markets: aviation and communication satellites. It was, literally, the only commercial space market 40 years ago. While civil aviation was important, they were doing so much Department of Defense (DOD) work that most of the civil transportation was derived from Defense Department designs. At that time, aerospace across the board was dominated by what the government did; now there's commercial imaging, commercial rockets, and people working on commercial crew vehicles.

In civil aviation, the Boeing 787 doesn't come from any DOD airplane. Boeing developed [the Dreamliner] as a commercial product. The commercial market today is much different and stronger. That is one of the real opportunities.

There is so much commercial satellite traffic, or rather commercial imaging traffic, that it is not unreasonable for the DOD to consider flying some of its payloads as passengers on what would be a commercial flight—and do so for a fraction of the cost. Once the hosted payload capabilities are in place, it is reasonable to [populate payloads with] sensors; there are endless possibilities.

What challenges exist?

We need better definition of what the government aerospace sector intends. We have a rather poorly defined set of space policies, civil and military. They're not what they were in previous years but, at the same time, are not clearly defined. What [Congress expects] NASA to be doing is not that clear, nor is a long-term commitment to space programs.

In the U.S., the aerospace community is in the midst of a study on engines to power Atlas rockets given difficulties with Russia over the Ukraine situation. We buy engines for the Atlas rocket from Russia. Most of Congress was not aware of that until recently. A study on alternatives is ongoing. It is late to be thinking about that. What the U.S. wants to do in the aerospace arena is more than a little uncertain. It would be helpful if that were clarified. Government constitutes the largest portion of what this nation does in aerospace; yet, it is difficult for commercial aerospace entities to know where they should be investing.

What do you predict for the future?

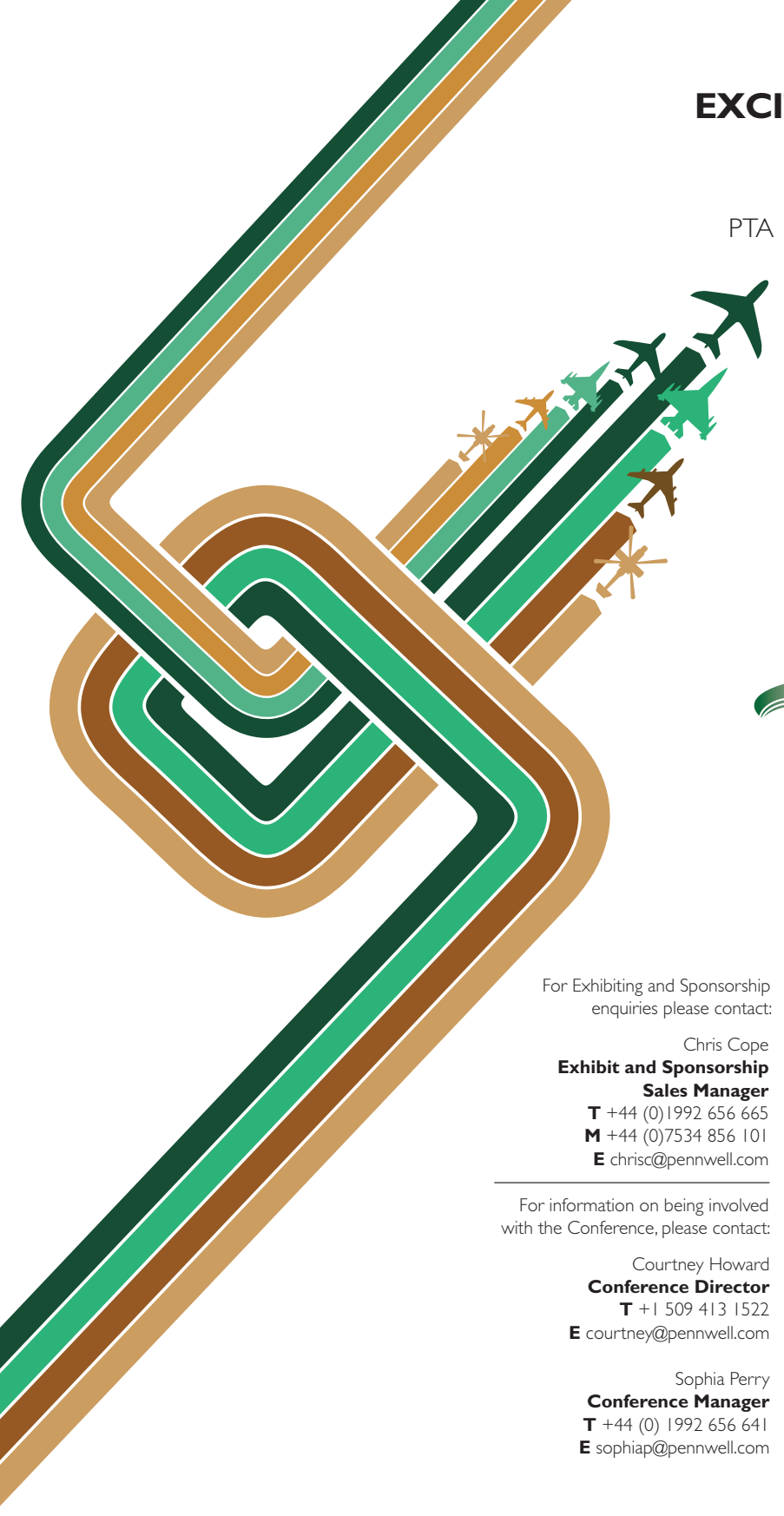
In the short term, not much will change. The government sector will be hard-pressed to make reductions in discretionary spending. The U.S. has been at war for more than 10 years. Money has gone into that and less into new capabilities, and that is not going to change right away. Longer term, when we look at the world situation, with more societies that are now near-peers in capabilities, and at the potential for adversarial actions, the U.S. is not going to want to fall behind. I predict a five- to ten-year period of reinvestment in government aerospace across the board; otherwise, the U.S. will be accepting a secondary status as a nation. ←

Don't miss a word

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

EXCITING NEW EVENT IN 2015

CONFERENCE AND EXHIBITION
6 – 8 OCTOBER 2015
PTA • AMSTERDAM • THE NETHERLANDS
www.intelligent-aerospace-event.com



INTELLIGENT AEROSPACE™

IMAGINATION **INNOVATION** INTEGRATION

For Exhibiting and Sponsorship enquiries please contact:

Chris Cope
Exhibit and Sponsorship Sales Manager
T +44 (0)1992 656 665
M +44 (0)7534 856 101
E chrisc@pennwell.com

For information on being involved with the Conference, please contact:

Courtney Howard
Conference Director
T +1 509 413 1522
E courtney@pennwell.com

Sophia Perry
Conference Manager
T +44 (0) 1992 656 641
E sophiap@pennwell.com

INVITATION TO PARTICIPATE

Intelligent Aerospace is a unique conference and exhibition, designed from the ground up to offer an exciting perspective on the ever-changing needs of the global aerospace electronics technology community.

The conference focuses on the cutting-edge electronics hardware and software technology required for:

- Airport Operations
- Air Traffic Management
- Satellite Communications and Meteorological Imaging
- Unmanned Aircraft Systems
- Fixed-wing and Rotorcraft Avionics

The conference will ultimately look at how these technology elements are transferable, complimentary and integrate with one another.

With these technologies transforming virtually all phases of air travel and transport, Intelligent Aerospace provides a new and vital platform for the most senior key decision makers to view products, network, and be part of an exciting conference program, all under one roof.

SWaP THIS!

TWO FULLY INDEPENDENT SYSTEMS IN ONE ULTRA-RUGGED BOX

NSA APPROVED SECURE ARCHITECTURE

SB1002-MD "GOLDEN EYES" FEATURES

TWO FULLY INDEPENDENT SYSTEMS (RED/BLACK) EACH WITH:

- *Up to 2.4GHz Intel® Quad Core™ i7 Haswell processor w/ 6MB of L2 Cache*
- *Up to 32GB of 1600MHz DDR-3 memory with ECC*
- *Up to 512GB of sealed removable SSD drives*
- *Up to 512GB of fixed SSD for OS boot*
- *Two SAM™ sites for custom I/O (Wi-Fi/BT and GPS)*
- *Seven Gigabit Ethernet ports with TCP/IP Offloading Engine (TOE)*
- *Six USB 2.0 ports and two Serial Ports with RS-232/422/485 options*
- *Trusted Platform Module (TPM) and Trusted Execution Technology (TXT)*
- *Supports Intel Virtualization Technology (VT-x/VT-D2) for best performance*
- *Tamper proof hardware w/optional Secure Erase monitoring w/ status LED indicators*

• *Ultra-low SWaP only 5.4" x 6.5" x 2.75" @ 3.5 lbs. and as low as 60W total*

• *Operates from -40° C to +85° C without throttling CPU speed*

Many other standard configurations as well as custom builds available.

AS9100 REGISTERED FIRM

TRUSTED COMPUTING GROUP

PICMG

MEMBER VITA

All Rugged products are fully-sealed and Extended temp -40°C to +85°C. Compliant to MIL-STD-810F, 1275, 202, 901D, DO-160D and IP67.
All GMS products are proudly designed and manufactured in the U.S.A. and are fully ITAR compliant. © 2014, General Micro Systems, Inc.

GMS COMPUTING ENGINES

GENERAL MICRO SYSTEMS, INC.

Powering the Embedded Market Since 1979

800-307-4863 gms4sbc.com