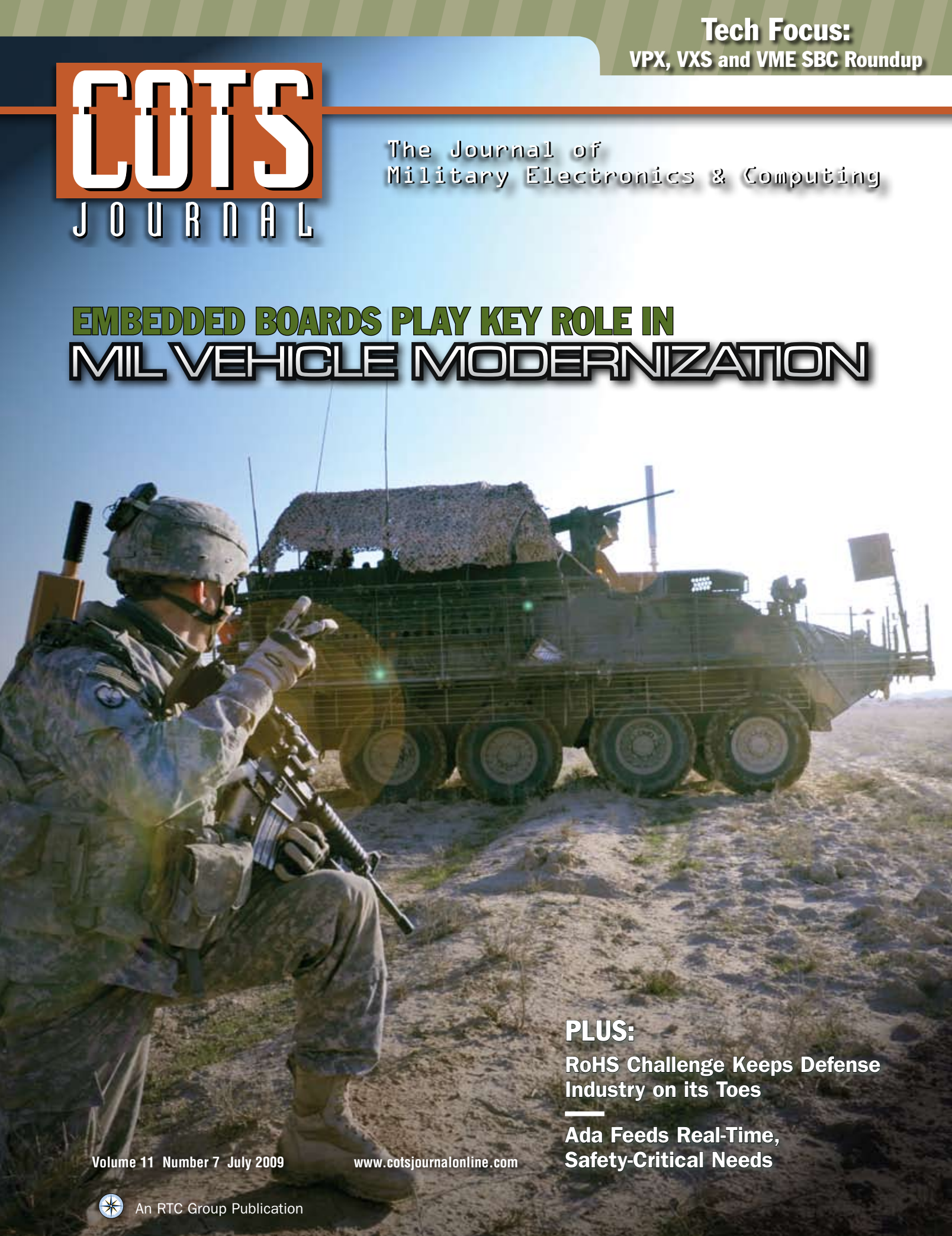
Tech Focus:
VPX, VXS and VME SBC Roundup

COTS JOURNAL

The Journal of Military Electronics & Computing

EMBEDDED BOARDS PLAY KEY ROLE IN MIL VEHICLE MODERNIZATION



PLUS:

RoHS Challenge Keeps Defense Industry on its Toes

Ada Feeds Real-Time, Safety-Critical Needs

Volume 11 Number 7 July 2009 www.cotsjournalonline.com

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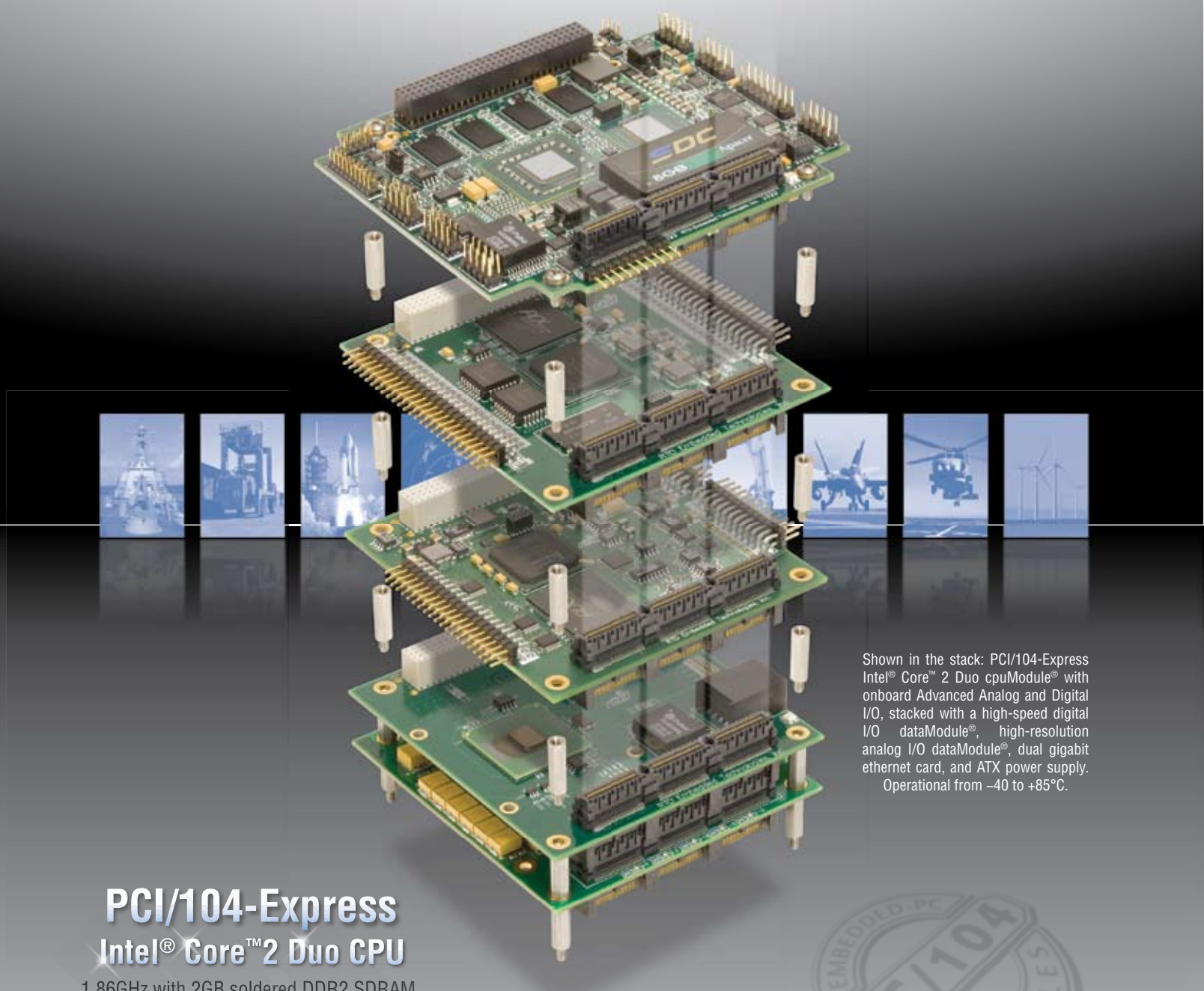

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COTS JOURNAL
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Features

July 2009 Volume 11 Number 7

Special Feature

Military Vehicle Electronics

Tech Recon

Impact of RoHS

System Development

Java and Ada in Real-Time Systems

Technology Focus

VPX, VXS and VME SBCs

COTS (kots), *n.* **1.** Commercial off-the-shelf. Terminology popularized in 1994 within U.S. DoD by SECDEF Wm. Perry's "Perry Memo" that changed military industry purchasing and design guidelines, making Mil-Specs acceptable only by waiver. COTS is generally defined for technology, goods and services as: a) using commercial business practices and specifications, b) not developed under government funding, c) offered for sale to the general market, d) still must meet the program ORD. 2. Commercial business practices include the accepted practice of customer-paid minor modification to standard COTS products to meet the customer's unique requirements.

——**Ant.** When applied to the procurement of electronics for the U.S. Military, COTS is a procurement philosophy and does not imply commercial, office environment or any other durability grade. *E.g., rad-hard components designed and offered for sale to the general market are COTS if they were developed by the company and not under government funding.*

Departments

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U.S. Army Cpl. David Tyrpin of 3rd Battalion, 21st Infantry Regiment, 1st Stryker Brigade Combat Team, 25th Infantry Division, signals a Stryker vehicle while on patrol. The Stryker BCTs are among the Current Force units expected to employ computing and networking technologies developed and spun out from what was formerely the FCS program. It's now called the Army Brigade Combat Team Modernization program.

(U.S. Army photo by Spc. Bobby L. Allen Jr.)

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The Journal of Military Electronics & Computing

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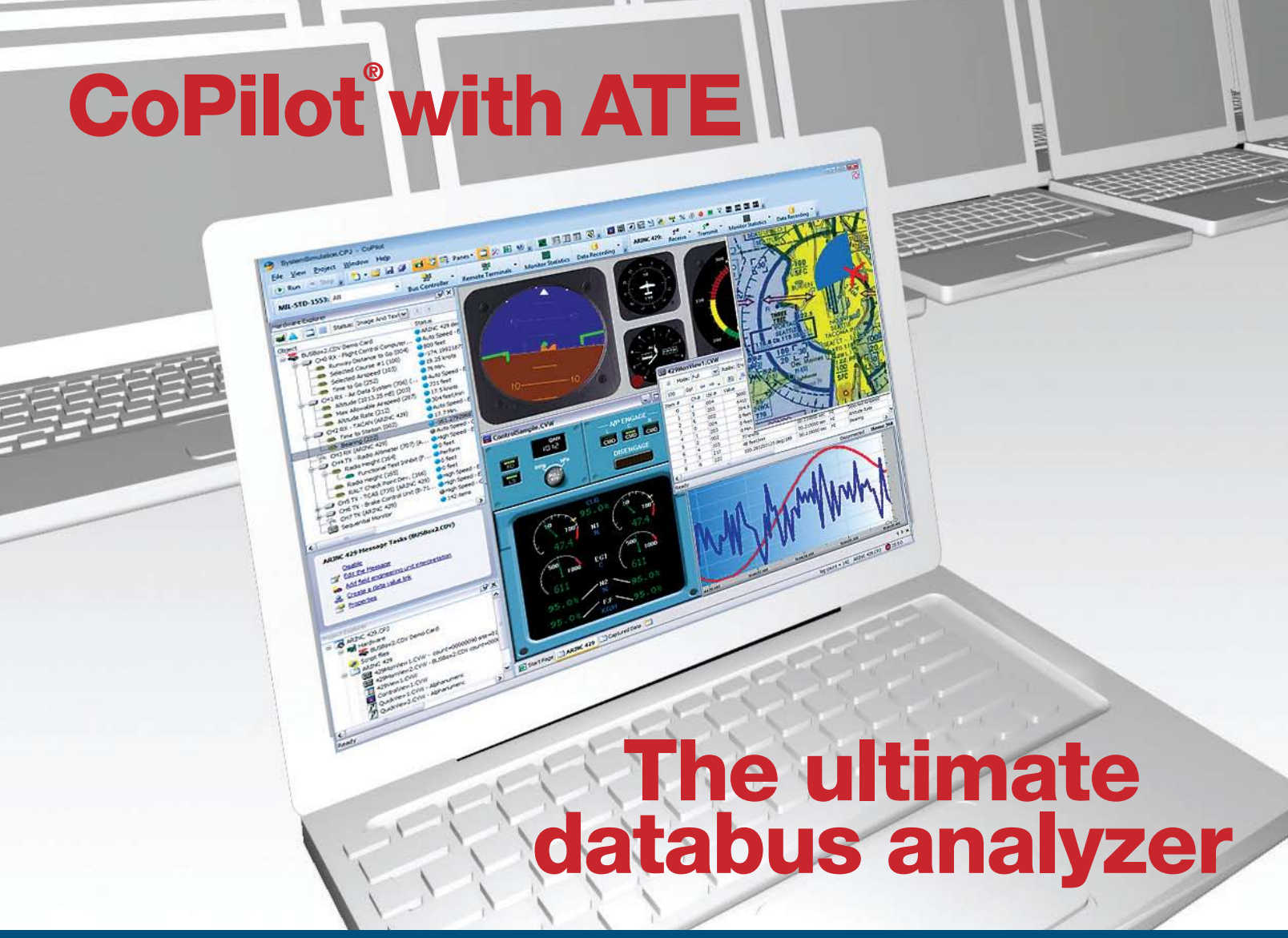

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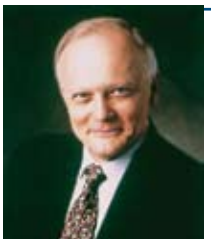

Publisher's Notebook

NASA in Transition

In May we were once again given the opportunity to go to the Kennedy Space Center to participate in the pre-launch and launch of the STS-125, the Shuttle mission to service the Hubble Telescope. Now before you start thinking this is just one big boondoggle, we really do go there to find out what embedded technologies are being employed in space programs and what opportunities there may be for our industry.

The NASA manned space program is in transition in more ways than one. Among the most significant is the move from the Shuttle program to the Constellation program. There are a number of people out there still wondering what support NASA will get or continue to get for this conversion.

NASA is close to having a new Director: retired Brigadier General, Charles Bolden Jr. In fact, his nomination hearing is happening as this issue goes to print. Mr. Bolden has flown four Shuttle missions and was a member of NASA's Aerospace Safety Advisory panel. It's easy to assume that he will have a positive view toward manned space flight; and his political ability may be tested this August. That's when it is expected that Norman Augustine will deliver his review of the manned spaceflight program.

Mr. Augustine was asked by the administration to resurrect the 1990 report "On the future of the U.S. Space Program" and update it. Not many people anticipate that the report will do anything to improve the current scheduled five-year absence of U.S. manned space flights between the Shuttle's last flight in 2010 and the Constellation's first mission in 2015 (at the earliest). So the U.S. participation in manned space flight is in jeopardy while Russian and Chinese participation is assured. In fact, all aspects of U.S. dominance in space are now being threatened and in some cases may even be overtaken by other nations.

NASA and space exploration continue to be a fertile embryonic source for developments that find their way into industry and the mainstream populous. That said, while NASA led the way for silicon and electronics development in the last century, they no longer play that role this century. COTS products have found their way into space through many suppliers such as Aitech, GE Fanuc and General Micro Systems, just to name a few. Clearly space applications all have a rather limited quantity requirement, and as a result it's not an area that companies seek out as their primary source of revenue. Products developed targeting stringent military applications can be modified slightly to meet requirements of spaceflight and provide them additional opportunities.

With all the revenue-demanding issues the government has on its plate right now, it's easy to relegate NASA and the manned spaceflight program to a back burner, resulting in decades of delays. Space programs don't happen overnight even if you use COTS products. They have long gestation, development and test programs—plus there are the unforeseen issues. Just look at the development and launch of the Hubble Space Telescope. The project was conceived in 1969, development started in 1977—imagine what the state of technology was back then—scheduled to launch in 1986, and then put in storage until its 1990 launch because of the Challenger disaster. The Hubble is currently one of the most recognized products of NASA, providing a 120 Gbytes of data a week for use by scientists and school children, and should continue to do so until 2013. Exploration of space has to be a government funded project and needs to occur at a steady pace. It shouldn't be turned on and off like a light resulting in confusion rather than knowledge.

Charles Bolden, nominee for administrator of NASA, testifies at his confirmation hearing before the Senate Commerce, Science and Transportation Committee earlier this month.

Talking to the contractors involved in the Constellation program at the STS-125 launch not only allowed us to get better insight into the technology that the different elements of the program plan to use, but also allowed us to substantiate the legitimacy of COTS embedded electronic products. That's something we've been doing in our target markets since we started in 1998. The current mood in government is to promote greater emphasis on using available concepts and products rather than re-inventing them. And that brings the COTS concept into an even greater light. We want to help. ▮▮

Pete Yeatman, Publisher
COTS Journal

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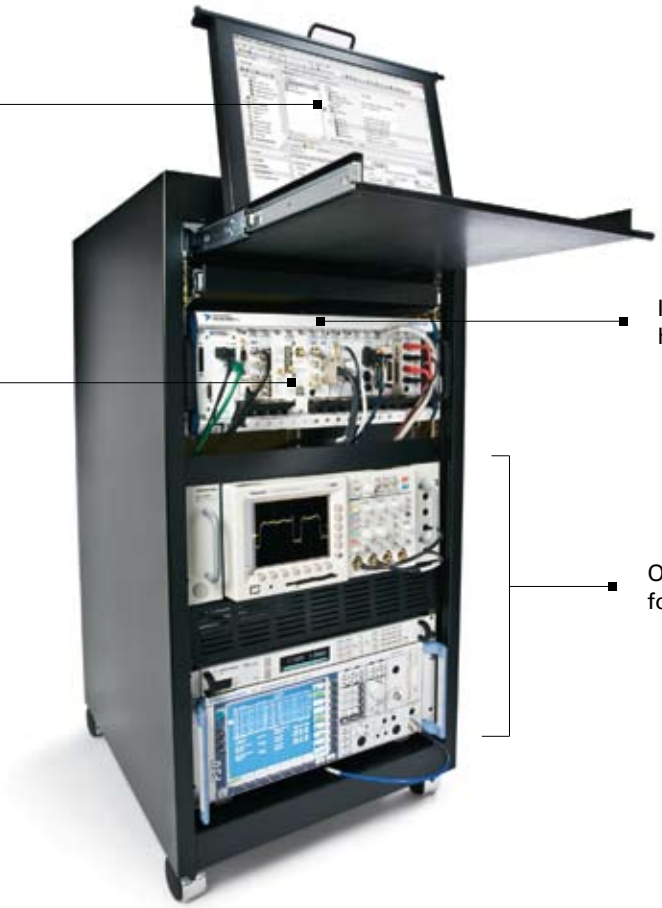

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NATIONAL INSTRUMENTS

The Inside Track

Mercury Delivers Aegis Weapon System Upgrade for Lockheed Martin

Mercury Computer Systems has delivered on an initial order and received a follow-on order from Lockheed Martin for the Aegis Weapon System upgrade. In February, Lockheed Martin was awarded a $78.6 million production contract from the U.S. Navy to provide the next evolution of hardware for the Aegis Modernization and Aegis Ballistic Missile Defense (BMD) programs. Developed by Lockheed Martin, the Aegis Weapon System is the only operational sea-based radar and weapon system capable of simultaneous warfare against air, surface, subsurface and land targets.

Mercury is delivering on an order for its next-generation

Figure 1

Lockheed Martin's Aegis Weapon System is the only operational sea-based radar and weapon system capable of simultaneous warfare against air, surface, subsurface and land targets.

Ensemble 7100 components and systems, which will be integrated on both land and ship sites for the Multi-Mission Signal Processor (MMSP) upgrade, which is a key component to provide ballistic missile defense capability to Aegis-equipped destroyers (Figure 1) undergoing modernization beginning in 2012. In addition, a recent follow-on order calls for Mercury to provide PowerStream 7000 production systems for the first two ships in the Aegis Ballistic Missile Defense Signal Processor (BSP) 4.0.1 upgrade, which is now undergoing testing for existing Aegis BMD-capable cruisers and destroyers.

Mercury Computer Systems
Chelmsford, MA.
(978) 256-1300.
[www.mc.com].

CSPI Provides Rugged Cluster Computers for Aegis Combat System

…and in other Aegis program news, CSPI, MultiComputer Division, announced it has provided Lockheed Martin's Surface/Sea-based Missile Defense Systems business with additional FastCluster systems valued at $1.6 million. FastCluster systems feature an open architecture environment and are easily integrated into a variety of radar applications. The clustered computer systems will support the deployment of a Radar Scene Generation program, which will provide a new test and evaluation resource for the Aegis Combat System at the U.S. Navy's Combat System Engineering Development Site in Moorestown, N.J.

The Aegis Combat System (ACS) is an advanced command and control (Command and Decision, or C&D, in Aegis parlance) and Weapon Control System (WCS) that uses powerful computers and radars to track and destroy enemy targets. It is the world's most advanced naval surface ship combat system and the first fully integrated combat system built to defend against air, surface and subsurface threats.

CSPI
Billerica, MA.
(978) 663-7598.
[www.cspi.com].

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Marines Contract General Dynamics to Develop Next-Gen Combat Operations Center

General Dynamics C4 Systems has been awarded $21 million to add Internet-like capabilities to the U.S. Marine Corps' Combat Operations Centers (COCs) (Figure 2). Through this effort, General Dynamics will upgrade the COCs' electronic systems to increase Marines' situational awareness and information sharing abilities, and improve network connectivity across the tactical battlespace. The contract being modified was awarded in 2002; the total value to date is $643 million.

Identified as the COC Model G, the new system will facilitate sharing of mission rehearsal and execution information among other Marine Corps Combat Operations Centers and joint forces partners. The system will enable services such as electronic "chat," email and VoIP communications. General Dynamics will also migrate existing hardware-based command and control, tactical data systems and other applications to software-driven services using the Marine Corps' service-oriented infrastructure. The COC Model G is also part of the Marine Corps' initiative to become compliant with the U.S. Department of Defense's Net-Enabled Command Capability (NECC). NECC enables Internet-like access to joint tactical networks and information that reaches across the battlespace and worldwide.

Figure 2

Combat Operations Centers house a network of workstations and servers supporting standard Tactical Data Systems and other mission-critical software, voice, data and Voice over Internet Protocol (VoIP) communications.

General Dynamics C4 Systems
Scottsdale, AZ.
(480) 441-3033.
[www.gdc4s.com].

DRS Technologies Awards Saft Contracts for Batteries on DDG 1000

Saft has signed two contracts totaling more than $1 million with DRS Technologies to

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Figure 3

The DDG 1000 destroyer is the first in a class of the U.S. Navy's multi-mission surface combatants tailored for littoral, air and sub-surface warfare.

supply its lithium-ion (Li-ion) energy storage systems for the Integrated Fight Through Power (IFTP) system for the U.S. Navy's DDG 1000 destroyers (Figure 3). The two rechargeable Li-ion batteries will support key functions within the IFTP system, which sustains the destroyers' Integrated Power Systems (IPS) and provides the means for conversion and distribution of the ships' service power to various shipboard weapons and sensor systems, as well as various auxiliary systems.

Saft will develop 12 batteries using VL 34P cells for each destroyer with custom electronics, housing and an integrated charger to support the IFTP's Load Center breakers, giving them the ability to shut down electronically, even when there is no power. Under the second contract, Saft will provide 22 batteries, also based on VL 34P cells, for each ship for the IFTP's Housekeeping Power Supply (HKPS). The batteries will supply onboard back-up power, carrying the destroyers' loads until they can be shut down. The DDG 1000 destroyer is the first in a class of the U.S. Navy's multi-mission surface combatants tailored for littoral, air and sub-surface warfare.

Saft America
Cockeysville, MD.
(410) 771-3200.
[www.saftbatteries.com].

Military Market Watch

System Designers Look to FPGAs as Processor Platform

To combat the always persistent processor obsolescence challenges encountered when using commercial silicon, embedded system designers and more specifically military/aerospace embedded system designers, are evaluating programmable logic platforms as alternatives to traditional commercial silicon. As part of VDC Research Group's 2009 market study on embedded processor platforms, we surveyed over 200 embedded processor users on their requirements and expectations for embedded processors. We asked them if they would consider replacing their current processor platform with an FPGA or other programmable logic device. The results are shown in Figure 4 broken out by the type of processor platform currently used by the respondents. This data, collected in Q4 2008, show that a significant percentage of all embedded processor user categories are at least considering programmable logic if not using it already.

Approximately one third of the total respondents to the questionnaire classified their primary vertical market focus as military/aerospace and an even greater proportion than that of all the respondents who answered that they were considering or already using FPGAs were military/aerospace respondents. The reason that military/aerospace embedded systems designers are on the leading edge of this trend of increasing usage of programmable logic is the unique set of requirements that embedded military systems face. With end product lifecycles that average 10 to 15 years and can be as long as 50 years, embedded military systems designers are most challenged by the problems of processor platform obsolescence. However, now in many applications commercial silicon can be replaced with an FPGA implementing a soft CPU core, which does not become obsolete because the CPU IP will exist forever and can be implemented easily in the successive releases of the FPGA even if the original FPGA model itself is discontinued. For more information please contact Eric Heikkila of VDC at: erich@vdcresearch.com

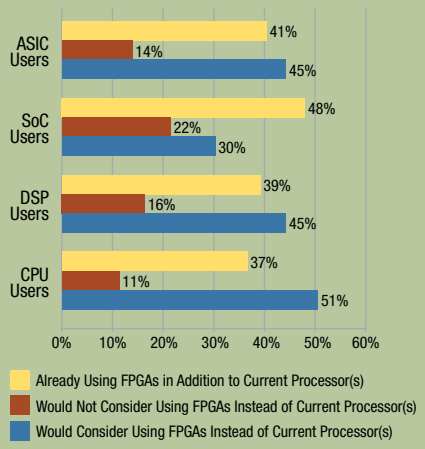

Figure 4

Respondents were asked if they would consider replacing their current processor platform with an FPGA or other programmable logic device. A significant percentage of all embedded processor user categories are at least considering programmable logic if not using it already.

VDC Research Group
Natick, MA.
(508) 653-9000.
[www.vdcresearch.com].

Figure 5

The RQ-4 Global Hawk Block 30 carries the Airborne Signals Intelligence Payload, which will increase battlefield signal collection capabilities.

SprayCool Enclosures Fly on Global Hawk ASIP Flight Test

SprayCool's liquid-cooled enclosures were included in the first test flight of Northrop Grumman Airborne Signals Intelligence Payload (ASIP) aboard a Block 30 Global Hawk UAV. One of the most significant new capabilities on Global Hawk is the addition of a Northrop Grumman-developed signals intelligence (SIGINT) sensor. SprayCool enables ASIP's critical electronics to be installed in the unpressurized compartments of the Global Hawk UAS.

The recently completed flight test of an ASIP sensor on the U-2 aircraft verified the successful application of SprayCool technology in a high altitude environment. Global Hawk testing further supports the use of this technology on a high altitude, long endurance platform. A series of flight tests are planned over the next few months to validate all aspects of ASIP performance on Global Hawk. An initial production contract on Global Hawk ASIP chassis was awarded to Spray-Cool in the summer of 2008. SprayCool is also on contract to provide SprayCool chassis for a scaled derivative of the baseline ASIP sensor, which will fly on another platform.

SprayCool
Liberty Lake, WA.
(509) 232-2600.
[www.spraycool.com].

Event Calendar

August 26
Real-Time & Embedded Computing Conference
Mt. Laurel, NJ
www.rtecc.com/moorestown2009

September 14-17
Autotestcon 2009
Anaheim, CA
www.autotestcon.com

September 15
Real-Time & Embedded Computing Conference
Toronto, ON
www.rtecc.com/toronto2009

September 21-24
Embedded Systems Conference
Boston, MA
www.esc-boston.techinsightevents.com

September 29
Real-Time & Embedded Computing Conference
Long Beach, CA
www.rtecc.com/longbeach2009

October 1
Real-Time & Embedded Computing Conference
San Diego, CA
www.rtecc.com/sandiego2009

October 5-7
AUSA
Washington, D.C.
www.ausa.org

October 19-21
MILCOM 2009
Boston, MA
www.milcom.org

October 27
Real-Time & Embedded Computing Conference
Vancouver, BC
www.rtecc.com/vancouver2009

October 29
Real-Time & Embedded Computing Conference
Seattle, WA
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Special Feature

Military Vehicle Electronics

Computing, Power and Networks Take Priority in Mil Vehicle Modernization

The FCS may be cancelled, but the embedded computing and networking progress it has made is sure to live on in the form of the Army's revamped and evolving strategy of vehicle modernization.

Jeff Child
Editor-in-Chief

For several years now, any discussion about the future of military vehicles revolved around the Army's massive Future Combat Systems program. All that officially changed late last month when the Under Secretary of Defense for Acquisition, Technology and Logistics issued an acquisition decision memorandum (ADM) implementing decisions regarding the Future Combat Systems Brigade Combat Team (FCS BCT) program announced by Secretary Robert M. Gates in April. The secretary expressed a specific concern that the portion of the FCS program to field new manned combat vehicles did not adequately reflect the lessons of counterinsurgency and close quarters combat in Iraq and Afghanistan.

While the ADM cancels the Future Combat Systems Brigade Combat Team (FCS BCT) program, it directs the Army to transition to a modernization plan—dubbed the Army Brigade Combat Team Modernization (ABCTM). Instead of a single, overarching program like FCS, the new plan will consist of several separate but integrated acquisition programs. Those integrated programs will be expected to leverage the "spin plans" of the FCS program to bring some of its technologies to Current Force infantry brigades and separate programs for information and communications networks, UAVs, UGVs and sensors. The memorandum terminates the manned ground vehicle portion of the previous FCS program and directs the Army to work with the Marine Corps to assess gaps for ground combat vehicles, leading to the launch of a new acquisition program in 2010. Meanwhile the status of the Non-Line-of-Sight Cannon (NLOS-C) that was part of FCS is unknown.

Role for Embedded Computing Remains Strong

On the surface these changes seem extreme—and for the upper levels of the development food chain they are. But the role of electronics and embedded computing in military vehicles remains stronger than ever. At this point it's too soon to know exactly what elements of computing elements from FCS will be

transferred to the new modernization efforts and how they may change. Speculation among many who are knowledgeable about the program is that, while manned ground vehicle designs may change radically in terms of mechanical shape, superstructure and configuration, it is likely that much of the networking and embedded computing developed for FCS thus far could easily transition over to whatever new vehicle designs emerge.

In keeping with that idea, the U.S. Army hasn't missed a beat in its work to evaluate networked-battlefield technology. Late last month the Army announced it is conducting a series of high-tech network and equipment verification tests at its massive White Sands test range as part of Brigade Combat Team modernization. The tests support the Army's efforts to modernize all Brigade Combat Teams with the latest networked intelligence, surveillance, reconnaissance and lethality capabilities, officials said.

Figure 1

In the recent Technical Field Test at White Sands, Army engineers and product developers are testing the performance of UGVs, UAVs, unattended sensors, an unattended munitions delivery system and the network that links them.

Vehicle Modernization Field Tests

As part of what is termed the Technical Field Test (Figure 1), Army engineers and product developers—supported by Soldiers of the Army Evaluation Task Force and a host of industry partners—are testing the performance of unmanned ground and air vehicles, unattended sensors, an unattended munitions delivery system and the network that supports them. The test is an important step toward spinning out networked equipment sets to the Brigade Combat Teams.

The equipment used in the test includes the Small Unmanned Ground Vehicle, or SUGV; the Class 1, Block 0 Unmanned Air System, known as UAS; the Unmanned Tactical and Ground Sensors, T-UGS and U-UGS; and the Non-Line of Sight Launch System, or NLOS-LS. Images and data from these assets were captured and sent in real time to a humvee containing a Network Integration Kit, a key component to ensuring battlefield sensor and target acquisition data can be transmitted across the brigade combat team. These networked humvees contain an Integrated Computer System consisting of multiband antennas, a ground mobile radio suite from the Joint Tactical Radio System family, Wideband Networking and Soldier Radio Waveforms. The waveforms allow for secure image transfer to the onboard integrated computer system.

Meanwhile, back in March, U.S. Soldiers of the U.S. Army's 4th Brigade - 2nd Infantry Division in Fort Lewis, WA., and 3rd Infantry Division in Fort Stewart,

Figure 2

The M2A3 and M3A3 Bradley Fighting Vehicle Systems include enhancements that provide increased situational awareness and digital command and control capabilities.

GA., completed a Limited User Test (LUT) of the Warfighter Information Network - Tactical (WIN-T) Increment 2, which for the first time delivers on-the-move Internet-like broadband networking capabilities to military units dispersed across wide geographic areas. The WIN-T program consists of four increments. Increment 1 is now in the hands of more than half of the U.S. Army worldwide, providing the Army's enterprise network for deployed forces in Iraq and Afghanistan.

The military exercises constitute the first time that actual soldiers used the WIN-T network across multiple geographic locations. During the LUT, soldiers carried out realistic mission scenarios that tested WIN-T's ability to support continuous command, control, communications and intelligence functions used by warfighters and commanders during an operation.

A Legacy of Modernization

Even though the terminology "Future Combat Systems" has now gone by the wayside, it's important to remember that vehicle modernization efforts have been a staple in the military for several decades with embedded computing technologies like VME playing a critical role. An example is General Dynamics' Continuous Electronic Enhancement Program (CEEP), part of the overall Abrams Tank Systems Enhancement Package (SEP) upgrade. CEEP integrates new technologies that will reduce future obsolescence issues and take advantage of improved processing and display capabilities. The SEP upgrade includes improved processors, color and high-resolution flat panel displays, increased memory capacity and an open operating system that will allow for future technology growth. The processor side of that involves GE Fanuc's rugged PowerPC processor, graphics and communications products. This processor board is designed to accept two onboard mezzanine modules all in a single VME slot and will allow for improved capabilities in both crew operations and vehicle diagnostics.

For both next-generation and Current Force military vehicles, demand is high for finding ways to meet the trickier

cooling, shock and vibration problems that emerge when more computing gear is packed into those vehicles. An added challenge for vetronics designers was introduced with the Army's directive to armor all tactical vehicles to protect our soldiers from weapons such as Rocket Propelled Grenades (RPGs) and Improvised Explosive Devices (IEDs). The added weight of that armor dramatically reduces the weight budget left over for the onboard electronics. As a result, many system designs had to go back to the drawing board and integrate into a much smaller volume.

The last twelve months have seen a wealth of contract wins involving electronics and embedded computing where the theme is either improving power efficiency or boosting compute-density, or both. Concurrent with that have been numerous contract awards centered around embedding sophisticated Satellite communications technology into military vehicles.

Figure 3

Power Accessory Distribution System (PADS) is a rugged, drop-in power source that delivers 110 VAC as well as 12 VDC and 5 VDC power outlets in 28 VDC power-based military vehicles.

Exemplifying the theme of increasing compute-density, BAE Ground Systems awarded CPU Technology a delivery order last summer for production kits containing an Acalis MultiCore System-on-a-Chip (SoC) for use in the Bradley Combat System (Figure 2). The Acalis family of Field Programmable MultiCore SoCs consists of highly integrated, low-power multicore devices that can be configured to meet the requirements for a particular system. The Acalis CPU420 contains numerous processors, memories, controllers, interfaces and several critical functions.

Leveraging Multicore Computing

According to CPU Tech, the system design was accomplished in less than half the normal industry time using industry-leading development tools available with Acalis. With high-fidelity, cycle-accurate models of the Acalis CPU420 and the other system components, the design team simulated the entire kit and its surrounding systems on SystemLab PS, a real-time platform simulator. The system-wide visibility enabled the kit to be debugged quickly and efficiently while completing the testing and system integration virtually.

Box-level computing meanwhile is playing a greater role in military vehicles. Last year DRS Technologies received an extension to its current JV5 production contract, to provide JV-5 ultra-rugged vehicle

computing and display systems for the U.S. Army's Force XXI Battle Command, Brigade and Below (FBCB2) program and Blue Force Tracking (BFT), and the United States Marine Corps situational awareness requirements. The JV-5 vehicle computing system includes new technologies such as multicore processors, increased memory, greater data storage and expansion capability to allow for future technology improvements. These enhancements provide the computer systems with better graphics processing, data handling and system networking capabilities. The JV-5 vehicle computing system includes new technologies such as multicore processors, increased memory, greater data storage and CompactPCI expansion capability.

Battery and Power Issues

Power distribution and battery issues are becoming ever more critical as a greater amount of electronics move onto military vehicle platforms. Serving the latter side of that, Saft late last year successfully completed the first part of development of a Lithium-ion cell claimed to be the world's most powerful electrochemical cell. Saft delivered the first 50 prototype VL-U cells under its contract with the U.S. Army Tank-Automotive and Armaments Command (TACOM). Saft's rechargeable VL-U Li-ion cells will enable greater capability for directed energy and other defense applications. Saft designed and developed the VL-U cell capable of producing continuous power of 10 kW/kg and pulse power as high as 30 kW/kg. The VL-U technology is an evolution of Saft's current VL-V and VL-A technology.

Offering a packaged solution specifically aimed at military vehicle power distribution, Curtiss Wright last summer rolled out its Power Accessory Distribution System (PADS) (Figure 3), a rugged, drop-in power source that delivers 110 VAC as well as 12 VDC and 5 VDC power outlets in 28 VDC power-based military vehicles. PADS enables soldiers to power a myriad of electronic devices that would otherwise not be supported by their vehicle's traditional 28 VDC power supply, without compromising the vehicle equipment. This compact accessory power system provides power conditioning and power outlets for 110/12/5 volt common plug items. The system is designed for use in harsh environments. It supports operation over a -30°C to +55°C temperature range. Power outlets provided by PADS include dual 12V "cigarette" receptacles, dual 110 VAC utility outlets, dual 5V USB ports and an 18-30V input connector. The main housing of PADS measures 14 x 6 x 3.1 inches.

Net-Centric Technologies

In keeping with the U.S. Military's efforts toward Net-Centric operations, research continues in developing the various pieces that make a networked-military work efficiently. Along those lines, late last year the U.S. Army Communications-Electronics Life Cycle Management Command (CE-LCMC) awarded Scalable Network Technologies a basic research contract to develop a prototype analysis and simulation tool for evaluating cross-layer wireless network designs. The U.S. Army has been studying cross-layer net-

Figure 4

MRAPs with MobiLink COTM systems are enabled with broadband connectivity while traveling at high speeds. In battle, the systems provide an unbroken satellite link on-the-move and operate without interference from military jammers.

work designs as a potential solution to the interference, capacity and latency limitations of current-generation on-the-move communication networks. A collaboration by SNT and Telcordia Technologies, the prototype of a cross-layer analysis and simulation system (CLASS) tool is to be developed using analytical and simulation-based approaches for evaluation and validation of different cross-layer network architectures.

More recently—earlier this month, in fact—SNT was awarded a grant, jointly sponsored by four DoD agencies (including the JTRS PEO) to create an enterprise solution for network communications simulation for JTRS Ground Mobile Radio (GMR) testing, training and experimentation. Tasks include leveraging the JTRS Modeling and Evaluation Environment (JMEE) that SNT developed under Phase I and II SBIRs to create a live-virtual-constructive test architecture that can accurately and realistically represent the operation of thousands of on-the-move radios, including verification and

validation. SNT has developed intellectual property for hardware-in-the-loop emulations that enables real physical networks to connect seamlessly with software virtual networks (SVNs).

More Satcom On-the-Move Systems Fielded

Once considered an exotic technology, Satellite communications "on-the-move" systems are becoming more prevalent in the field. For its part, DataPath is providing MobiLink Technologies communications on-the-move (COTM) systems to a deployed U.S. Army unit in support of battlefield operations. The MobiLink Technologies COTM system was successfully tested in Iraq in late 2008 and early 2009 and is now an operational system that quickly installs in Mine Resistant Ambush Protected (MRAP) vehicles (Figure 4). Eight additional COTM systems as well as field technical support and other services have been procured through exercised options under an existing delivery order. The COTM systems are expected to be deployed within weeks.

While on long convoys and operations in Iraq, MRAPs with MobiLink COTM systems are enabled with broadband connectivity while traveling at high speeds. In the battlefield environment, the systems provide an unbroken satellite link on-the-move and operate without interference from military jammers. Commanders on the battlefield use the COTM systems to simultaneously receive live UAV video feeds and use voice-over-IP, video teleconferencing, SIPRNet Web connectivity and other command and control applications. With these capabilities, forces in the field are able to create a robust local and over-the-horizon network that is reliable regardless of the terrain and the distance from a military base. The MobiLink, mSAT-C2V systems can be deployed on a variety of platforms such as MRAP, HMMWV, Stryker, Bradley and armored commercial SUV vehicles. ■■

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Special Feature

Military Vehicle Electronics

MIL-STD 461E: A Key Standard for Vehicle-Based Computing

Vehicles and other military platforms are challenging environments when it comes to EMI and EMC. The MIL-STD 461E set of standards provides a rich set of emissions and susceptibility requirements.

American Reliance

For the DoD, specifying a computer's electromagnetic interference (EMI) and its electromagnetic compatibility (EMC) is an important judge on how well the computer will operate within many "noisy" environments. MIL-STD 461 documents the EMI requirements for a wide range of applications, from trucks to ships to aircraft to fixed installations, not to mention the different requirements within an application—above deck and below deck on a Navy ship. There is also a trend to tailor the requirements to particular applications. Although the most modest EMC requirements are not much different from commercial requirements, most military applications are decidedly harsh.

Figure 1

The MIL-STD 461E EMC requirements serve a wide range of applications—everything from humvees to trucks to ships to aircraft to fixed installations. The standard provides the opportunity to tailor the requirements for each application without having to issue exceptions to the standard.

The Evolution of MIL-STD 461

The military's concern for EMI began as far back as the installation of the first radio in a vehicle before World War I. Because the application of radio technology and understanding its effects seem to parallel each other, it wasn't until 1934 that the U.S. Army Signal Corps published its first EMI standard: SCL-49, "Electrical Shielding and Radio Power Supply in Vehicles." This document "protected" radio receivers by requiring vehicle operations to not "disturb" radio reception through shielding the ignition system, regulator and generator.

From this simple beginning, military EMI evolved and changed as the complexity of the systems increased, frequencies jumped, and the threat from EMP (electromagnetic pulses) was documented and quantified. As the specifications evolved, each branch of the service defined requirements specifically for their depart-

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ments or platforms. This forced manufacturers to comply with significantly different specifications for each branch as well as different specifications for specific programs within each branch.

As a result, the DoD formed a working group to consolidate and replace approximately 20 requirements into the initial MIL-STD 461 (the requirements), MIL-STD 462 (the measurement methodology) and MIL-STD 463 (definitions and acronyms) that were published in 1967. As with any general standard, especially the initial standard, revisions were required resulting in MIL-STD 461A being issued in August 1968. Although mandated, many programs made revisions and exceptions to the standard (even as 461 went from revision A to C).

In 1993, the Tri-Service EMC Committee issued an updated MIL-STD 461 and MIL-STD 462, revision D. MIL-STD 463 was dropped and its definitions referenced to the American National Standards Institute (ANSI) C63.14 "Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP) and Electrostatic Discharge (ESD)." In 1999, 461 and 462 were combined, requirements updated and published in the currently enforced standard: MIL-STD 461E.

Applying MIL-STD 461E

MIL-STD 461E is a set of EMC requirements intended to serve a wide range of applications, from trucks to ships to aircraft to fixed installations (Figure 1). It specifically provides the opportunity to tailor the requirements for each application without having to issue exceptions to the standard. Although the more modest sections are not much different from the common IEC and FCC commercial requirements, most sections are decidedly harsh. Table 1 and Table 2 are adapted from the MIL-STD 461E standard and identify the emissions and susceptibility requirements. It is important

MIL-STD 461E Conducted Emissions and Conducted Susceptibility Tests

Requirement	Application	Frequency Range	Description	Changes due to MIL-STD 461E
Conducted Emissions				
CE101	Power & Interconnecting Leads	30 Hz - 10 kHz		No longer applicable to shipboard equip.
CE102	Power & Interconnecting Leads	10 kHz - 10 MHz		
CE106	Antenna Terminals	10 kHz - 40 GHz		
Conducted Susceptibility				
CS101		30 Hz - 150 kHz	The requirement is applicable to power input leads that obtain power from other sources not part of the computer including those that are rechargeable. There is no requirement on power output leads.	Applicability and limits extended to 150 kHz
CS103	Antenna Port, Intermodulation	15 kHz - 10 GHz	Not applicable to laptop, portable, or rack computers. (Applies only to receivers, transceivers, amplifiers and the like.)	
CS104	Antenna Port, Signal Rejection	30 Hz - 20 GHz	Not applicable to laptop, portable, or rack computers. (Applies only to receivers, transceivers, amplifiers and the like.)	
CS105	Antenna Port, Cross modulation	30 Hz - 20 GHz	Not applicable to laptop, portable, or rack computers. (Applies only to receivers, transceivers, amplifiers and the like, which extract information from the amplitude modulation of a carrier.)	
CS109	Structure current	60 Hz - 100 kHz	Not applicable to computers unless it is directly attached to very sensitive equipment (sensitive to 1μV or better) such as tuned receivers operating over the frequency range of the test.	Measurement procedures revised
CS114	Bulk Cable Injection	10 kHz - 200 MHz	The requirements are applicable to all electrical cables interfacing with the computer. It simulates currents that may be developed on the platform cabling from electromagnetic fields generated by antenna transmissions both on and off the platform.	Limits reduced to 200MHz
CS115	Bulk Cable Injection, Impulse Excitation	Transients - 2 nS x 30 nS	The requirements are applicable to all electrical cables interfacing with the computer. It simulates the fast rise and fall time transients that may be present due to platform switching operations and external transients such as lightning and electromagnetic pulses.	Applicability revised
CS116	Damped Sinusoid Transients - I/O & Power Cables	10 kHz - 100 MHz	The requirements are applicable to all electrical cables interfacing with the computer. It simulates electrical current and voltage waveforms occurring in platforms from excitation of natural resonance.	Measurement procedures & applicability revised

Table 1

Listed here are the conducted emissions and conducted susceptibility requirements for the MIL-STD 461E standard. The table also summarizes how the tests apply to computers. Major changes from revision D are also shown and summarized.

to remember that MIL-STD 461E doesn't directly cover a number of commercial EMI situations, including lightning and ESD. Thus, a number of related requirements are added to the list—some from commercial standards and some from DEFSTAN (UK) or STANAG (NATO) requirements.

Applicable sections are summarized in Table 3 and cross-referenced as to how and where the equipment and subsystems are intended to be installed in, on, or launched from various military platforms or installations. If the equipment or subsystem may be installed on more than one platform, the standard requires that it comply with the more stringent requirement.

How stringent these requirements are enforced on laptop and other portable computers depends solely on the application and procurement office. Many DoD purchases require only commercial units; but if 461 is required, it is safe to say that most commercial-grade computers will fail without serious modifications. This is primarily due to the RS103 and RE102 requirements. RS103 requires that a computer maintain normal operation when exposed to a 20V per meter field (double the IEC 61000-4-3 requirements of 3 to 10V per meter).

On the emission side, RE102 requires compliance when measured at one meter, not the three meters specified in FCC Part 15, the most common commercial standard. This distance change alone means the RE102 is nine times more restrictive than the FCC, but RE102 also has tougher limits. In addition to these requirements, there are several tough conductive susceptibility tests—CS101, CS114 and CS116. These require injecting radio frequencies on the power lines as well as the printer, network, USB and other data ports.

Time-Consuming Tests

Combined, these five tests are the key to compliance with MIL-STD 461. If the product complies with these tests, it will pass the entire group of tests a notebook, handheld, laptop, or other portable computer must meet to be certified to MIL-STD 461. This testing is not inexpensive. The five core tests (RS103, RE102, CS101, CS114 and CS116) will require roughly two days of lab time; the entire standard, seven to 10 days. These estimates assume there are no major redesigns.

As mentioned earlier, MIL-STD 461E doesn't directly cover a number of commercial EMI situations, including ESD. For some military projects, a number of

MIL-STD 461E Radiated Emissions and Radiated Susceptibility Tests

Requirement	Application	Frequency Range	Description	Changes due to MIL-STD 461E
Radiated Emissions				
RE101	Magnetic Field	30 Hz - 100 kHz	This is applicable to computers and is intended primarily to control magnetic fields for applications where other equipment is sensitive to magnetic induction at lower frequencies. The most common example is a tuned receiver. (RS101 is a complementary requirement imposed on equipment to ensure compatibility with the anticipated magnetic fields.)	50 cm requirement deleted; limits more stringent
RE102	Electric Field	10 kHz - 18 GHz	The requirements are applicable to electric field emissions from the computer and associated cables. The intent is to protect sensitive receivers from interference radiated from the computer and coupled through the antennas associated with the receiver (many receivers have sensitivities on the order of one microvolt).	Limits revised for submarine equipment
RE103	Antenna Spurious & Harmonic Outputs	10 kHz - 40 GHz	Not applicable to computers, laptops and notebooks.	
Radiated Susceptibility				
RS101	Magnetic Field	30 Hz - 100 kHz	This requirement is applicable to computers and ensures that performance is not degraded when subjected to low frequency magnetic fields.	Limits revised for Navy applications; Added Helmholtz coil test
RS103	Electric Field	2 MHz - 40 GHz		Added use of mode-tuned reverberation chambers above 200 MHz
RS105	Electromagnetic Pulse Field Transient		This requirement is primarily intended for computers that could be subject to the fast rise time, free-field, transient environment of an electromagnetic pulse (EMP). It applies only to those computer equipments and enclosures that are directly exposed to the incident field outside of the platform structure, or for equipment inside poorly shielded or unshielded platforms.	Limits revised for consistency with IEC Standards

Table 2

Listed here are the radiated emissions and radiated susceptibility requirements for the MIL-STD 461E standard. The table also summarizes how the tests apply to computers. Major changes from revision D are also shown and summarized.

MIL-STD 461E Application Requirement Matrix Adapted from the Standard

	CE101	CE102	CE106	CS101	CS103	CS104	CS105	CS109	CS114	CS115	CS116	RE101	RE102	RE103	RS101	RS103	RS105
Submarines	A	A	L	A	S	S	S	L	A	L	A	A	A	L	A	A	L
Aircraft																	
Army (including flight line)	A	A	L	A	S	S	S		A	A	A	A	A	L	A	A	L
Navy	L	A	L	A	S	S	S		A	A	A	L	A	L	L	A	L
Air Force		A	L	A	S	S	S		A	A	A		A	L		A	
Space Systems (including launch vehicles)		A	L	A	S	S	S		A	A	A		A	L		A	
Ground																	
Army		A	L	A	S	S	S		A	A	A		A	L	L	A	
Navy		A	L	A	S	S	S		A	A	A		A	L	A	A	L
Air Force		A	L	A	S	S	S		A	A	A		A	L		A	

A = Applicable; L = Limited applicability; S = Specified in procurement; Blank = not applicable

Table 3

An "A" entry in the table indicates the requirement is applicable and must be followed; an "L" means the applicability of the requirement is limited, as specified in the appropriate requirement paragraphs of the standard; an "S" entry means the procuring activity or department must specify the applicability, limit and verification procedures in the procurement specification. A blank entry means the requirement is not applicable for that application.

related commercial requirements may be added to the list, such as IEC 61000-4-2 (ESD) and, occasionally, some DEFSTAN (UK) or STANAG (NATO) requirements.

Designing for MIL-STD 461 Tests

Many rugged computers fall well short of the ideal enclosure—a welded closed box. The display, access panels, drives, keyboards and I/O connections provide many openings and cracks that can potentially let radiation in and out. Because computer boards have densely packed layouts and run at high speeds, by their very nature, they radiate EMI. Add a plethora of antennas in the form of high-speed data connections to internal drives and external I/O ports and put these in a plastic case, and it's easy to see why an off-the-shelf laptop or notebook will need serious modifications to pass RS103 and RE102.

Certifying the Components

A first step in certifying to MIL-STD 461 involves examining the board and enclosure to find the potential leaks and areas of susceptibility. The easiest place to start is with the motherboard design. The fundamental source of all EMI is time varying currents. A motherboard has many sources, from the CPU to disk drives to read/write to memory to typing on the keyboard. Logic states change and produce these currents.

Designers reduce these effects through the use of large ground planes, shielded cables, short trace runs from the CPU to SDRAM, and adding common mode chokes. All these design strategies reduce the possibility of inadvertently creating tiny radar transmitters and receivers within the PCB that will leave the computer vulnerable to external radiation and from becoming a broadcaster of unwanted energy. How well this is done will reduce the shielding required in the case.

Unlike a rackmount computer that is surrounded by additional shielding, a portable laptop or wearable computer relies solely on its own case to mitigate the EMI effects. The case will need to suppress the remaining emissions that are impractical in the board design, absorb and reflect any external fields, and survive the rigors of the MIL-STD 810 environmental tests. They also must be lightweight.

As such, most MIL-STD enclosures are aluminum, magnesium, or a mixed-alloy material. Gaps or seams in the enclosures around the connectors, drive openings and keyboards allow EMI to radiate through the shield, unless the shield continuity can be preserved across these gaps. The function of an EMI gasket is to preserve continuity or current flow in the shield around these gaps. The gasket should be made of material identical to the walls of the enclosure, making the current flow in the gasket the same as the wall and approaching the ideal design: a welded seam.

EMI Display Issues

The display is another major gap where EMI can escape or affect the operation. All MIL-STD 461 tests require that the display of the information on the screen not flicker or be impaired during the test. Fortunately, there are several vendors that make a shielded glass that meet both the 461 and MIL-STD 810 requirements that can be mounted over the

LED or LCD displays. Though costly, this method saves money by allowing manufacturers to use industrial COTS screens, while still complying with the stringent MIL-STD 461 standards.

The last area to address is the attached antenna, better known as printer, USB, Firewire, RS-232 and network cables. Common mode currents turn these cables into antennas that can pick up and conduct radiation through computer ports and impact the operation. This is why the RS103 susceptibility test requires all cables be connected to the unit during the test.

Manufacturers can mitigate these common mode currents by using shielded cables and adding filters into the connector ports. They can also redesign these ports to incorporate fiber optics rather than the wired cables. Fiber optic cables are immune to the external EMI fields and, as such, could be extremely important for portable, laptop and wearable computers.

Coexisting with Other Gear

In many areas, the military standards, such as MIL-STD 461E/E, must be enforced since the computer must coexist with all other equipment including powerful transmitters and highly sensitive receivers. In many cases, commercial/consumer computers must be upgraded to meet these more rigorous military needs. This goes beyond just EMC and includes environmental requirements such as wider temperature ranges, higher shock and vibration, ability to withstand high humidity and salt spray, while also not growing mold, fungus, and others.

It is important to remember that the MIL-STD 461E (and earlier C and D versions) is really a set of EMC requirements intended to serve a wide range of platforms from trucks to ships to aircraft to fixed installations, and many different applications. Program managers also are allotted much leeway to tailor the requirements to their particular applications. Although the most modest of these EMC requirements is not much different from commercial, industrial and medical requirements, most applications are decidedly harsh and require modifications to the commercial/consumer computers. These modifications include additional shielding and gaskets as well as metal cases.

While more expensive, a unit that complies with both MIL-STD 461E/E and MIL-STD 810E uses many commercial components to keep the price difference to a minimum, while maintaining the mil-grade, reliability and performance needed for today's forces. This price difference between military and an off-the-shelf laptop and portable computer is not as great as it used to be, so there is a reasonable chance of finding the appropriate system within the budget. ▮▮

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Special Feature

Military Vehicle Electronics

Case Study: 24 GHz Short-Range Radar Chip for Mil Vehicles

A common core strategy enables an FMCW radar sensor solution to be applied to a variety of short-range radar applications on military vehicles and related systems.

Dave Saunders, Senior Systems Engineer
US Monolithics

Military vehicles use radar sensors to enable features such as all-weather operations, weapons control, altimeter measurements, reconnaissance and navigation. In all of these applications it is imperative that the radar sensor design meet a set of challenging goals. They must be reliable under all environmental conditions and entail little or no post installation alignment. At the same time they must occupy a very small volume of space, consume low amounts of power while keeping within reasonable cost constraints.

The cost part of that is sometimes the most difficult to meet, as the other goals all drive up the unit cost. One possible solution to meet these conflicting design goals and achieve lower production costs is to leverage commercial volumes of narrowband FMCW (frequency-modulated continuous wave) automotive radars. The consumer auto industry is in the early stages of deploying this technology, working to lower costs and improve reliability of radars to meet the demanding high-volume needs of automakers. The 24 GHz ISM band is ideal for these applications, having worldwide spectrum availability, little degradation from radome material, significantly lower cost compared to higher frequency devices, and smaller size compared to lower frequency devices.

Figure 1

Short-range radar sensor technology is useful in ground vehicle convoy operations. Shown here, security forces convoy assigned to the 407th Expeditionary Security Forces Squadron head across a desert in Iraq as part of an operation.

Taking Advantage of Commercial Trends

Sensor suppliers are working with system integrators to optimize the products and insert the latest technologies, such as silicon germanium integrated circuits, to accomplish these goals.

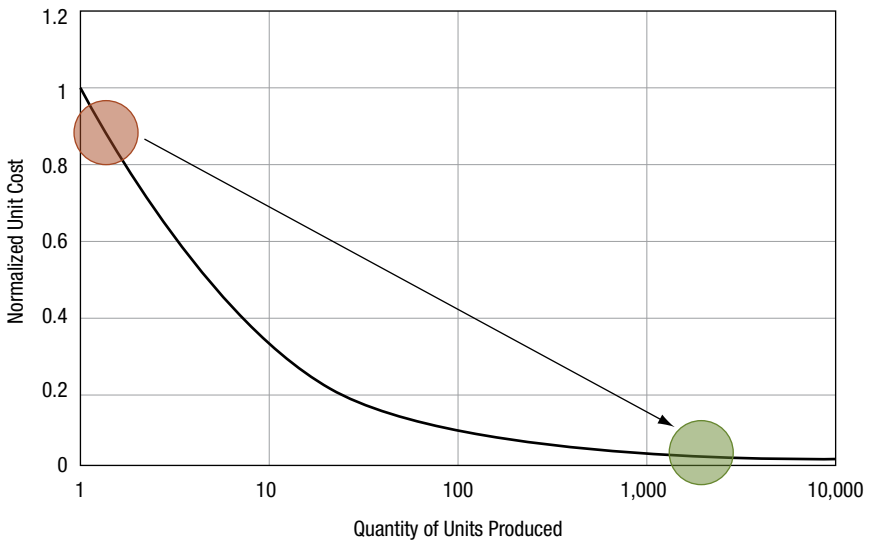

Figure 2

The differences in environment, range, speed and target radar cross section to very different radar sensors. But by integrating a core set of software-configurable functions, also used in high-volume commercial products, it's possible to achieve significant cost benefits for military applications.

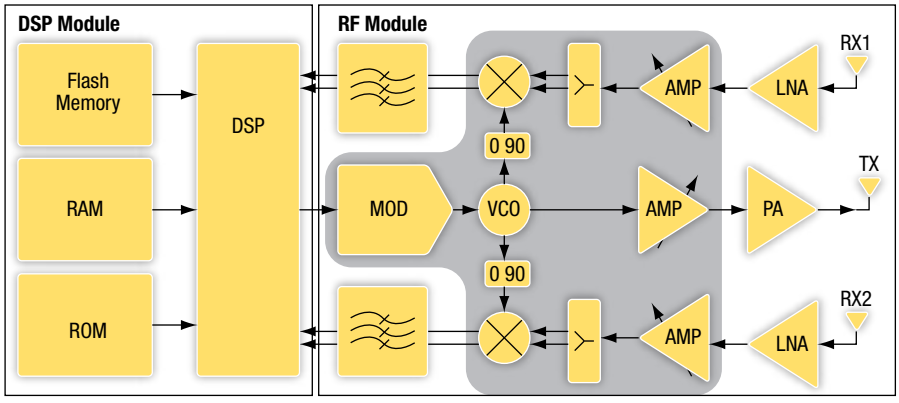

Figure 3

Shown here is a basic FMCW (frequency-modulated continuous wave) radar system, first developed for automotive adaptive cruise control.

With the trend in military procurement to using off-the-shelf components to lower development costs wherever possible, military system integrators can take advantage of progress by these automotive suppliers.

In looking at the seemingly disparate applications for radar sensors, it is easy to see why completely different designs could be envisaged. As an example, consider ground vehicle convoy operations (Figure 1), UAV navigation in close quarters, altimeters for weapons or flares or air deployment of supplies, and port security for small boat intruders. The environmental and physical requirements for installation are all different, from ruggedized ground equipment to lightweight aircraft.

The range of operation is different, from hundreds of yards to thousands of feet. The relative speed of the target to the sensor varies, with some cases using a stationary sensor while others use a sensor in complex and high-speed motion. The size and composition of the targets can also vary as much as the difference between people, vehicles, or the ground.

The differences in environment, range, speed, target radar cross section, etc. may lead to very different designs for each sensor, but all the applications transmit a signal with some form of modulation toward a target, receive energy scattered from the target, and process the received energy to determine position and/or speed. Which raises the question: would it be possible to integrate a core set of software-configurable functions, also used in high-volume commercial products, to potentially jump to a completely different part of the learning curve for significant cost benefit to military applications? Figure 2 shows the learning curve inherent in that leap.

Similarities and Differences

There are a number of similarities among the disparate applications for radar sensors. And those similarities could be increased by revamping the system architecture for a broader set of needs. Imagine if all the applications could be satisfied with radar that operated at the same carrier frequency and configurable radar waveform. Further imagine that the carrier frequency and radar waveform could be used worldwide without violating spectral emission requirements in any country.

Even if there could be a common carrier frequency and software-definable radar waveform, there are still differences in the applications that drive requirements for transmit power, transmit antenna gain/directivity, receive antenna gain/directivity, receive sensitivity, and so on. How can the system architecture leverage the similarities and still accommodate the differences among applications? The key is to take a system design approach that works from the core outward.

Engineers at U.S. Monolithics started by choosing a common carrier frequency and radar waveform type designed for high-volume automotive sensors: a 24 GHz FMCW radar. Compared to 77 GHz radar, used in luxury cars for years, a 24

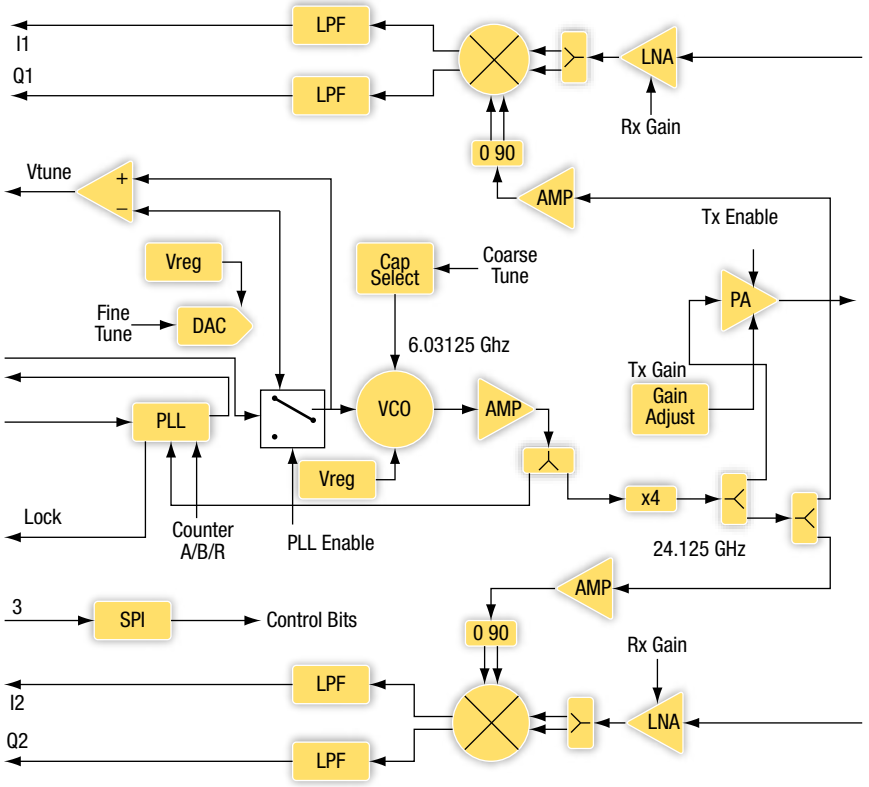

Figure 4

A more detailed view of the core architecture. Included are a transmitter with adjustable output power, dual direct conversion receivers with adjustable gain, as well as an on-chip voltage controlled oscillator.

GHz device is less expensive to produce, suffers less attenuation through the radome, has less path loss, has lower phase noise, and consumes less DC power. And compared to 24 GHz ultra-wideband radar, FMCW has longer range, shorter measurement cycles and wider regulatory acceptance. Thus any common core of a radar sensor must be able to generate frequencies in the 24 GHz ISM band and must have a radar waveform that is software defined. With this common core, such a sensor could be a low-cost alternative to radars deployed in many military applications.

Putting it all Together

A basic FMCW radar system, first developed for automotive adaptive cruise control, is shown in Figure 3. The system is comprised of two modules, a DSP module and an RF module. The DSP module includes a commercially available DSP chip and the software required to calibrate the RF module frequency, generate the commands to form the radar waveform, acquire baseband data, perform object detection and object tracking, and communicate the target or position lists to the outside world. The RF module accepts commands from the DSP module to generate a specific carrier frequency and convert the reflected energy from targets to baseband. In applications other than automotive adaptive cruise control, some parts of the system change, while other core parts remain the same.

The changeable, non-core parts of the system include software, filter bandwidths and RF elements that affect gain. The DSP module software can adjust to shift the carrier frequency within the 24 GHz ISM band to cause operation within a specific spectral region allowed by local gov-

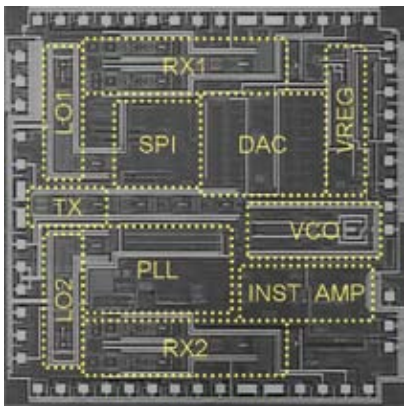

Figure 5

A die shot of the fully functional radar sensor core die including all pads. It can fit within a standard 5 mm x 5 mm plastic 32-pin QFN package.

ernment authorities. It can also be adjusted to optimize the radar waveform for a given application.

The tracking algorithms can look for moving targets, stationary targets, or targets within a particular range and angle. Similarly, the RF module baseband filtering can be adjusted to optimize performance when the sensor platform is undergoing vibration or to accommodate the Doppler shifts due to relative motion involved in a given application. Also, the selection of LNAs and PAs can enhance long-range applications or accommodate different antenna directivity for different applications. Each non-core part can be optimized for a specific application.

Same Core, Different Applications

The core parts of the system stay the same with each application. The core of the RF module is shaded in gray in Figure 3. A more detailed view of the core architecture is shown in Figure 4. It includes a transmitter with adjustable output power, dual direct conversion receivers with adjustable gain, an on-chip voltage controlled oscillator, an internal DAC for frequency control, a PLL with instrumentation amplifier for frequency calibration, a serial programming interface, low drop-out DC voltage regulators and ESD protection—all designed to operate over a temperature range of -40° to +125°C. Shown in Figure 5, the fully functional core die including all pads, can fit within a standard 5 mm x 5 mm plastic 32-pin QFN package.

Prior to the integration of all these functions onto a single chip, the core of the system used discrete gallium arsenide components for the high-frequency functions. Each discrete component could be assembled using standard surface mount technology, but part-to-part variation requires post-assembly alignment and calibration. Because each part was in a separate package, the total cost and size was large. Additionally, the bond wires connecting the die with the package for each component acted as antennas, each radiating or receiving electromagnetic energy.

Overcoming Cost Issues

Because of the size of the collection of discrete components, the cavities used to contain the electromagnetic energy and isolate transmit and receive functions were large enough that cavity resonance near the operating frequency was possible. That required additional post-assembly application of absorber material. The cost, size and assembly issues associated with the non-integrated core functions were deemed unacceptable for high-volume production.

The best way to reduce cost and achieve higher reliability than discrete designs is to integrate all of the core RF module functions into a single chip, though it may seem impossible to place all the functions on a single chip and still maintain sufficient isolation between the transmitter output and the receiver inputs.

This seemingly impossible task was overcome by first creating usage cases of possible applications to understand the requirements for transmit power, receiver compression, etc. A close working relationship with DSP module designers and antenna designers completely defined the interfaces. After 13 months of simulations, optimizations, thermal modeling, 3D

electromagnetic modeling, package definition and interface iterations, the first silicon was delivered.

Extensive RF Module Testing Ensures Reliability

The first silicon functioned well at the sensor level, achieving a range of over 90 meters on the first road tests, even with moisture intrusion caused by a rain storm. First silicon testing at the wafer and package level showed two minor mistakes in the inductor layouts. These errors may seem minor, but they most likely would lead to lower yields in production, so a solution using focused ion beam cuts took care of the problem. With modifications to the top metal masks layers, testing of the B silicon matched the simulated results, achieving a higher range of functionality at 24 GHz than ever before.

Since the initial testing, the chip has completed additional RF performance testing over a temperature range of -40° to +105°C in a controlled environment. Some key results:

- Transmitter EIRP of 23 to 24 dBm over the full 24 GHz ISM band at 25°C with less than 2.5 dB variation over temperature
- Transmitter phase noise spectral density of -80 to -83 dBm at 100 KHz offset over temperature
- Receiver sensitivity at maximum gain of less than -100 dBm room temperature and less than -94 dBm over the full temperature range
- Receiver sensitivity at minimum gain of less than -90 dBm room temperature and less than -84 dBm over the full temperature range

Further reliability testing has also resulted in no failures. Thermal shock testing was performed to accelerate failure mechanisms such as die cracking, bond lifting, package cracking and solder joint cracking. High-temperature operating life testing was also done to accelerate time dependent dielectric breakdown (TDDB), electromigration, hot carrier effects, charge effects and mobile ionic contamination. The length of both tests were set to simulate the average lifetime of a car, which is roughly 6,000 operating hours and 17 years of standby. The performance of the RF module samples met all specified parameters over the duration of the testing and showed no abnormal degradation.

A Team Effort

A highly focused, cross-functional team composed of system, circuit, mechanical and manufacturing engineers has developed a low-cost, high-volume radar sensor that has shown its ability to meet the stringent environmental requirements of the commercial automotive industry. Using commercially available components and, most importantly, integrating the core RF functions on a single chip for automated assembly, produces a low-cost product. The processor hardware and the integrated RF chip can be common building blocks for multiple radar sensor applications by changing the non-core functions, namely the software, baseband filtering, transmit and receive gain elements, and antenna.

This strategy will significantly reduce the time and cost to develop and deploy military radar sensor systems. Initial military applications for this technology are radar used in weapons or air drops that require disposable, inexpensive components, or temporary perimeter security. Others include ground vehicles and UAVs that have quantities and program costs that do not justify a large or expensive radar system.

With this flexible, advanced technology in a packaged MMIC, an RF front-end, or a complete sensor with integrated signal processing, military system integrators can take advantage of commercial volumes to reduce system cost and deployment times for military radar application. ■■

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		CMA22MVD1860HR	CMA22MVD1200HR	CMA157886PX1400HR	CMX158886PX1400HR	CMX158886PX1400HR-ECC	CMD158886PX1400HR	CMX158886PX1400HR-BRG	CMD158886PX1400HR-BRG	CME146786CX650HR	CME147786CX650HR	CML147786CX650HR	CMX147786CX650HR	CME136686LX500HR	CME137686LX500HR
Expansion Bus	PC/104 ISA Bus			✓						✓	✓	✓	✓	✓	✓
	PCI-104 PCI Bus	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓
	PCIe/104 Express Bus	✓	✓												
CPU and BIOS	CPU Max Clock Rate (MHz)	1860	1200	1400	1400	1400	1400	1400	1400	650	650	650	650	500	500
	Intel SpeedStep Technology	✓	✓	✓	✓	✓	✓	✓	✓						
	ACPI Power Management	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	2.0	2.0
	Max Onboard DRAM (MB)	2GB	2GB	512	1GB	512	1GB	1GB	1GB	256	256	256	256	256	256
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RTD Quick Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Legacy (Keyboard & Boot)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	Watchdog Timer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Solid State Hard Drive Disk Chip	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB
	Audio				✓	✓	✓	✓	✓		✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS	LVDS	LVDS	LVDS			TTL	LVDS	LVDS	
	PS2 Mouse/Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	RS-232/422/485 Ports	4	4	4	4	4	2	4	2	2	2	2	2	2	2
	SATA	2	2												
	USB 2.0	6	6	4	2	2	4	2	4	2	2	2	2	2	2
	Gigabit Ethernet	1	1												
	10/100Base-T Ethernet			1	1	1	1	1	1	1	1	1	1	2	1
	Parallel Port				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO (Advanced Digital I/O)	14	14	14	18	18	18	36	36	18	18	18	18	18	18
	aAI (12-bit Advanced Analog Input)	8	8												
	multiPort (aDIO, ECP, FDC)				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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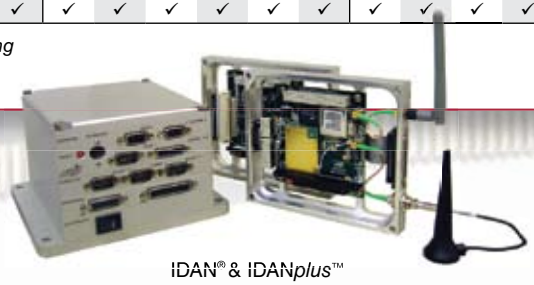

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Bus	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA				ISA	ISA		PCI				ISA		PCI	ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
Analog Input	Single-Ended Inputs	16	16	16	16	16	16	16	16							
	Differential Inputs	8	8	8	8	8	8	8	8							
	Max Throughput (KHz)	1250	1250	500	100	1250	500	500	500							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Input Ranges/Gains	3/7	3/7	3/4	1/4	3/6	3/3	3/3	3/3							
	Autonomous Calibration	✓	✓													
	Data Marker Inputs	3	3	3		3										
Conversions	Channel-Gain Table	1K	1K	1K	1K	1K	1K	1K	1K							
	Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓	✓	✓							
	A/D FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Sample Counter	✓	✓	✓	✓	✓	✓	✓	✓							
	SyncBus	✓	✓			✓	✓	✓	✓							
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	16	48	18/9	64	48	48	48	48
	Bit Programmable I/O	8	8	8	8	8	8	8	8	24	6/0		48	48	48	✓†
	Advanced Interrupts	2	2	2	2	2	2	2	2	2			2	2	2	✓†
	Input FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Versatile Memory Buffer												4M	4M	4M	8MB
	Opto-Isolated Inputs											48				
	Opto-Isolated Outputs											16				
	User Timer/Counters	3	3	2	2	3	3	3	3	3	3		10	10	10	6
	External Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓†
	Incr. Encoders/PWMs										3/9		4/8	4/8	4/8	✓†
Analog Out	Analog Outputs	2	2	2	2	2	2	2	2							
	Max Throughput (KHz)	200	200	200	100	200	100	100	100							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Output Ranges	4	4	3	1	4	5	5	5							
	D/A FIFO Buffer	8K	8K			8K	8K	8K	8K							

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Tech Recon

Impact of RoHS

Military Market Struggles with RoHS

The EU directive RoHS opened up a host of challenges for the military market. The industry is becoming more savvy about dealing with the problem, but there's a lot of room for improvement.

Jeff Child
Editor-in-Chief

In contrast to the military market, the general commercial electronics industry woke up on the morning of July 1, 2006 with little or no anxiety about the European Union's Restriction of Hazardous Substances (RoHS) directive. The major semiconductor vendors took little time to shift over to RoHS compliance. They had no issues to face like that of the military market: such as long-term reliability or mixing leaded and lead-free components in the same system. That's because in the biggest chip markets like consumer electronics, boards and even end-user devices are now always disposed of rather than repaired.

Ironically, the defense industry, while one of the industries that's exempt from the RoHS initiative, was (and is) much more affected by it than other industries. Makers of board-level products for the military are far from off the hook, because in this age of COTS most companies craft board designs targeted for both military and non-military markets. Even companies purely in the military market can't escape RoHS's effects, because these days it would be extremely costly and inefficient not to use the chips and components designed for the commercial market. The only alternative would be boards populated with completely customized silicon—a strategy that is far too costly for all except the most niche military electronics. The sidebar "Coping with RoHS: A Contract Manufacturer's Point of View" looks at one company's experience dealing with RoHS.

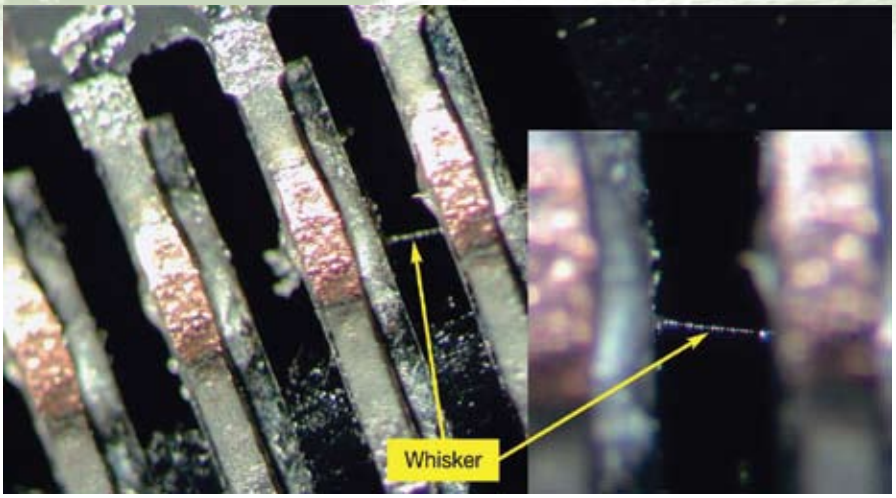

Figure 1

Shown here is a tin whisker that has spontaneously grown between two pure tin IC pads, creating a short circuit. Fortunately strategies to deal with those issues are starting to mature. Source: Fischer Instrumentation.

Clearly military and aerospace markets face some unique requirements. Much higher reliability requirements, extremely long service lifetimes (decades) and extended temperature ranges top the list. Add to that the fact that the DoD is among the few segments that actually repairs embedded computer boards, rather than just disposing of them when a component goes bad. Meanwhile, lead-free components face solder issues and tin whisker failures that aren't acceptable. The link between using pure tin solders and component lead finishes and the resulting occurrence of tin whiskers is well known and thoroughly documented. Figure 1 shows a tin whisker that has spontaneously grown between two pure tin IC pads, creating a short circuit. Fortunately strategies to deal with those issues are starting to mature.

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Coping with RoHS: A Contract Manufacturer's Point of View

RoHS is an issue that any maker of electronic equipment or subsystem must wrestle with. *COTS Journal* recently sat down with a representative from Columbia Tech, a small U.S.-based turnkey contract manufacturer, about how they deal with RoHS and its impact on military design projects. Richard Schulman is VP quality and ITAR technology control officer at Columbia Tech.

COTS Journal: *Although the defense industry is technically exempt from the European Union's RoHS directive, obviously any electronic system these days relies on the same pool of semiconductors that have mostly shifted over to lead-free. Many defense systems require leaded parts because they can't risk the problems of tin-based chips. What sort of challenges does this impose on you as provider of engineering and manufacturing services for military customers?*

Richard Schulman: Certainly tin whiskers have been an industry concern. Coming from the semiconductor field, I know this all too well. The challenge the providers of engineering and manufacturing services face today is based on the bill of materials we are provided by the customer. Since we are not at liberty to digress from that BOM, when we attempt to procure those "older, leaded" devices on the BOM we are often times unsuccessful or only find these devices available from distributors. Where a distributor obtained the parts could be another mystery. Ultimately, all that might be available is the lead-free and not the required leaded device.

CJ: *Explain the component obsolescence problems that you see caused by RoHS and how they can be managed for military customers.*

RS: Because we're not at liberty to stray from that customer BOM, all that might be available is the lead-free and not the called out leaded device. We've found that in some cases, the customer has made last time buys and can provide that leaded device to us. In other cases we've been successful at obtaining a waiver to substitute an equivalent leaded device. This route, however, takes time and is not always available. The procurement challenge of once plentiful leaded devices is not limited to the semiconductor industry. Interconnects, connectors as well as other active and passive devices can be difficult to find in their old leaded configuration. That said, the tin whisker issue is predominantly a semiconductor design/packaging issue. I'm sure Columbia Tech is not alone in strongly urging the DoD and the military to review their older designs for alternatives.

CJ: *In the early days before the July 1, 2006 RoHS deadline, the DoD seemed very late to the game as far as providing a lot of leadership in explaining to the defense industry what they could do to deal with the looming problem of RoHS. Do you see much progress there since that time? In other words, are there useful DoD directives or protocols that you or your military customers follow to ensure that the use of lead-free IC packaging and solder material can either be avoided or that their problems can be mitigated?*

RS: The DoD had plenty of time to deal with this looming issue. From my perspective they were late to provide guidelines. In my opinion lead-free is not going away and a solution needs to be found. If there is a DoD directive or protocol that addresses how to mitigate the issue, it hasn't been well publicized.

In the year or so leading up to the July 1, 2006 RoHS deadline, the DoD and other major defense industry institutions had given little direction to the industry on what to do about the RoHS problem. That said, there were efforts underway by the Lead-Free Electronics in Aerospace Project Working Group (LEAP-WG) of the AIA. Formed in 2004, the group was tasked to develop and implement documents describing best practices and technical guidelines to enable the aerospace industry and the military to accommodate the global transition to lead-free electronics. ▮▮

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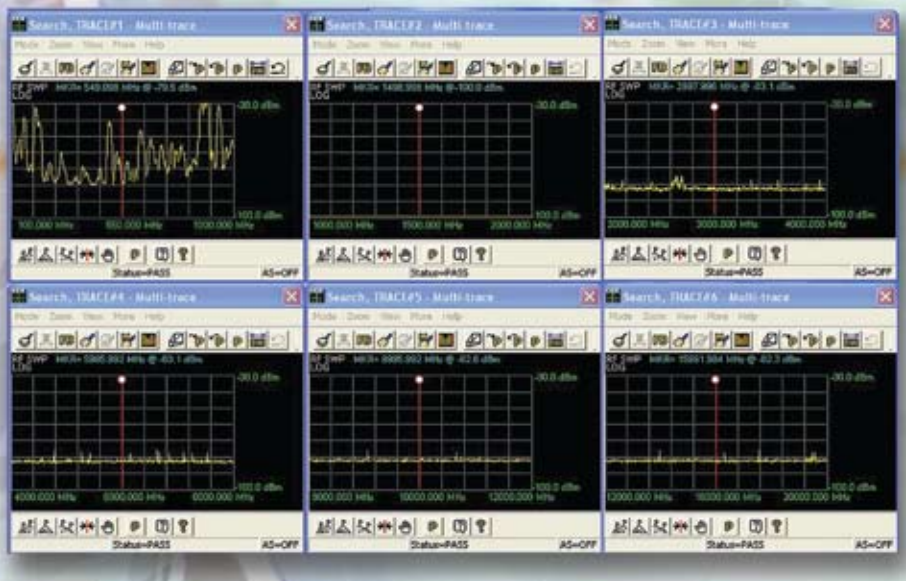

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System Development

Java and Ada in Real-Time Systems

Ada Language Suits Real-Time Safety-Critical Needs

Unlike other programming languages, Ada was developed from the ground up with capabilities that serve real-time and safety-critical needs.

Benjamin M. Brosgol, Senior Technical Staff
AdaCore

Developing real-time software for military systems is difficult. In such systems correctness means not only computing the right results but doing so within specified time intervals. When the system is safety-critical, things are even harder. To satisfy standards such as DO-178B, military system developers need to convincingly demonstrate to certification authorities that the system does what it is supposed to, and does not do what it is not supposed to. The programming language, as the medium in which the system is expressed, directly affects the ease or difficulty of carrying out this task.

Ada was designed from its inception for developing real-time and safety-critical systems. As it has evolved it has continued to meet this goal, both in the features that it supplies and, equally important, in the features that it allows users to omit. Ada has a strong track record in real-time and safety-critical applications in the defense industry and offers the language technology that most closely meets the needs of these communities.

The Real-Time Problem

A system is real-time if its correctness involves meeting temporal constraints—or, more simply, meeting deadlines. A real-time system is connected to the outside world and performs some mission such as device monitoring/control. It is hard real-time if missing a deadline implies complete loss of the mission. It is soft real-time if missing a deadline compromises some objectives but allows the mission to continue. Deadlines for real-time programs typically range from milliseconds to seconds. A real-time system is safety-critical if its failure can directly cause loss of human life or severe environmental damage.

Concurrent and Asynchronous Activities

Real-time safety-critical software is significantly more difficult to develop than other kinds of systems. First, it generally has to deal with concurrent and asynchronous activities; this is much more complex than programming a purely sequential application. Second, safety-critical industries impose certification requirements that developers must satisfy through convincing demonstrations of a system's assurance: evidence of a sound development process, of the correctness and safety of the resulting product, or both. For example, the highest safety level of DO-178B requires showing traceability—from requirements to code and vice versa—and thorough coverage analysis of the software including a demonstration of the absence of "dead code"—code that is present in the application but that does not correspond to any requirement.

For real-time and safety-critical systems, the choice of programming language affects the effort, and therefore the cost, to develop and certify the software. The language has to meet several kinds of requirements:

Reliability: The language should have features that prevent the introduction of errors and that help detect errors that have managed to slip in. This means an absence of "traps and pitfalls" (features whose effects are unintuitive), the presence of checks that catch errors such as type mismatches early in the development process, and, more generally, support for sound software engineering principles such as encapsulation.

Analyzability: It should be possible to deduce correctness and safety properties of the program from an inspection (manual or automated) of the program's source text. Properties relevant here include predictability of time and space, data flow constraints, control flow constraints and assurance of unambiguous behavior.

Expressability: The language should contain features for composing reliable, long-lived real-time programs, through a combination of built-in features and standard libraries. Concurrency support, exception handling, time management, low-level facilities to access hardware-specific functions, and perhaps specialized features such as fixed-point arithmetic should be supplied. General-purpose features for large system construction and maintenance, such as Object-Oriented Programming and flexible namespace management, are also useful.

An immediate issue is that these requirements conflict. Features that add

generality and expressive power also make programs more difficult to analyze, because of semantic complexity, additional library code that is implicitly included, or lack of traceability from source code to object code. In practice, language subsets, and run-time libraries specially tailored to be certifiable, are chosen to avoid these problems.

The question then is how the programming language navigates this tradeoff: providing sufficient generality for expressing real-time programs in a natural fashion, while enforcing sufficient restrictions on feature/library usage so that the resulting code can be analyzed for compliance with safety-critical standards. Ada offers a unique solution to this dilemma, allowing the program to decide the tradeoff in an application-specific fashion.

Real-Time from the Ground Up

Ada was designed from the start to support real-time and safety-critical systems and use a traditional and conservative run-time model. In brief, Ada is a strongly typed block-structured language with features that include exception handling, concurrency (tasks), modularization (packages), hierarchical namespaces, Object-Oriented Programming, generic templates and low-level mechanisms. It also includes a standard facility for interfacing with other languages such as C, an extensive set of predefined libraries, and specialized annexes supporting Systems Programming, Real-Time Systems, Distributed Systems, Information Systems, Numerics and High-Integrity Systems. The Ada language was originally standardized by ISO in the 1980s and has undergone two subsequent revisions. The current version of the Ada language standard is known as Ada 2005.

An Ada program generally consists of a main procedure together with the packages that it depends on, directly or indirectly. When the program starts up, the data initialization and other executable constructs in the packages are performed ("elaborated") and then the main procedure is invoked. An example of Ada program structure is shown in Figure 1.

The program may contain one or more threads of control (tasks). There is a "static" area containing data declared in top-level packages, stacks (one per task) and a heap. Data objects declared in procedures and functions go on the stack; unlike Java, it is not necessary to use dynamic allocation for aggregate data such as arrays and records. The heap is only used when dynamic allocation is explicitly performed by the program. Thus, if there is no dynamic allocation after the main program starts, heap management and storage reclamation are non-issues.

Ada was designed to avoid the traps that are typical in languages that have C-based syntax. For example, an octal literal such as 1778 is written as 8#177# rather than 0177. As another example, the ability to use underscores in numeric literals makes the value obvious to a human reader. And Ada's syntax for compound statements avoids the "dangling else" pitfall and the various problems with C's switch statement.

One of the most useful features in Ada is the ability for a programmer to specify a range of values for a scalar variable, with Ada semantics ensuring that an attempt to assign an out-of-range value will be detected. Specifying scalar ranges is an invaluable aid to the human reader to convey the program's intent, and the information can be used by compilers and static analysis tools for purposes of optimization and error analysis. Ada semantics ensure that the notorious "buffer overflow" vulnerability—for example assigning past the end of an array—is detected at run time.

Managing Concurrency

Typical real-time programs involve concurrency, since it is natural to define separate threads of control for the software compo-

Ada Program Structure

```
package Point_Pkg is
   procedure Assign(X, Y : in Float);
   -- Assigns X and Y as the new coordinates

   procedure Fetch(X, Y : out Float);
   -- Copies the current coordinates to X and Y
end Point_Pkg;
```

```
package body Point_Pkg is

   X, Y : Float;  -- Coordinates

   procedure Assign(X, Y : in Float) is
   begin
      Point_Pkg.X := X;
      Point_Pkg.Y := Y;
   end Assign;

   procedure Fetch(X, Y : out Float) is
   begin
      X := Point_Pkg.X;
      Y := Point_Pkg.Y;
   end Fetch;
end Point_Pkg;
```

```
with Point_Pkg;
procedure Prog is
  X, Y : Float;
begin
   Point_Pkg.Assign(1.0, 2.0);
   Point_Pkg.Fetch(X, Y);
end Prog;
```

Figure 1

Shown here is an example of Ada program structure.

nents that monitor or control the various external devices or processes. That raises the immediate issue of how concurrency is to be modeled in the programming language. Some languages, such as C and C++, ignore the issue, regarding concurrency as a service that can be supplied in an external library. The language standard is simpler, but programmers need to realize that semantics that apply in a sequential application might be different when concurrency is introduced. For example, a non-reentrant library that is safe for sequential programs may result in corrupted data structures when invoked from concurrent threads.

In contrast, a number of languages (including Ada, Java and C#) offer specific features for concurrency. Ada's concurrency model is distinctive, grounded in a foundation that is both reliable and efficient. The unit of concurrency in Ada is the task, and tasks generally interact with each other through encapsulated data (protected objects) or via direct communication (rendezvous). Protected objects enforce encapsulated state-based mutual exclusion but avoid the race conditions that can come up in Java and other languages. An example of Ada tasking with a protected object is shown in Figure 2. Note that the interface (the specification of package Point_Pkg) is the same as in Figure 1, but here the implementation is safe for usage in a tasking program. The Ada tasking model scales up to multicore architectures; when AdaCore implemented its GNAT Pro Ada environment on a multicore system, no changes to the run-time libraries were required.

Beyond supplying a general concurrency model, a language for real-time systems needs features for dealing with time, deadlines, scheduling, and also low-level processing (interrupt handling, accessing "raw storage," and so on). Ada directly meets all these requirements. For example, in the scheduling area Ada defines the semantics for task priorities, specifies a mechanism for priority inheritance and an object locking scheme based on the priority ceiling protocol, and provides a variety of task dispatching policies in-

Structure of a Concurrent Program

```
package Point_Pkg is
   procedure Assign(X, Y : in Float);
   -- Assigns X and Y as the new coordinates

   procedure Fetch(X, Y : out Float);
   -- Copies the current coordinates to X and Y
end Point_Pkg;
```

```
with Point_Pkg;
procedure Tasking_Prog is
  task T1;
  task body T1 is
  begin
   Point_Pkg.Assign(1.0, 2.0);
  end T1;

  task T2;
  task body T2 is
     X, Y : Float;
  begin
   Point_Pkg.Fetch(X, Y);
  end T2;
begin
  -- T1, T2 activated here
  -- Assign, Fetch executed with
  --  mutual exclusion
end Tasking_Prog;
```

```
package body Point_Pkg is
   -- Implementation for tasking programs

   protected Point is
      procedure Assign(X, Y : in Float);
      procedure Fetch(X, Y : out Float);
   private
      X, Y : Float;
   end Point;
   -- Invoking Point.Assign or Point.Fetch involves
   --  obtaining a "lock" on the Point object
   -- These operations are thus performed
   --  under mutual exclusion

   protected body Point is
      procedure Assign(X, Y : in Float) is
      begin
         Point.X := X;
         Point.Y := Y;
      end Assign;

      procedure Fetch(X, Y : out Float) is
      begin
         X := Point.X;
         Y := Point.Y;
      end Fetch;
   end Point;

   procedure Assign(X, Y : in Float) is
   begin
      Point.Assign(X, Y);
   end Assign;

   procedure Fetch(X, Y : out Float) is
   begin
      Point.Fetch(X, Y);
   end Fetch;
end Point_Pkg;
```

Figure 2

This shows an example of Ada tasking with a protected object. Notice that the interface (the specification of package Point_Pkg) is the same as in Figure 1, but here the implementation is safe for usage in a tasking program.

SPARK: A Supercharged Ada Subset for High-Integrity Systems

Standards such as DO-178B focus on gaining assurance about the development process, with an emphasis on testing as the technique for demonstrating correctness. DO-178B has become a critical requirement in aerospace and defense system designs. However, as the noted computer scientist Edsger Dijkstra once famously said, "Testing can show the presence of bugs but never their absence." For systems requiring high levels of assurance—safety, security, or both—the usage of mathematically rigorous static analysis techniques can provide confidence in correctness well beyond what can be achieved through testing.

One such approach is found in the SPARK language and toolset. Designed by Praxis High Integrity Systems, SPARK is an Ada subset augmented with specialized comments (annotations) that convey a software component's "contract." SPARK includes most of Ada's "static" facilities, along with the Ravenscar tasking profile. It omits features such as exceptions, dynamic allocation and recursion because they complicate analyzability and predictability. SPARK has been successfully used in safety- and security-critical applications ranging from a smartcard operating system kernel and an NSA-sponsored research project (Tokeneer) to avionics and air traffic control.

The SPARK language is unambiguous. Features whose semantics are not completely specified in Ada are either excluded from SPARK or else the implementation's choice (for example the order of evaluation of expressions) does not influence the program's effect.

SPARK's annotations document data flow, information flow (couplings between variables), pre- and post-conditions, loop invariants and other program properties. SPARK tools analyze a program and check that the annotations are consistent with the code. The tools can also generate verification conditions and automate the proofs of these conditions. They are sound (all errors are detected) and precise (low rate of "false alarms"), and scale up to large systems.

Although in principle other languages could have been used as the basis for a rigorous proof-based analysis technology, Ada was the appropriate choice. In addition to its broad support for sound software engineering (packages, subprograms, strong type checking), Ada allows the programmer to specify ranges for scalar variables, as noted earlier. This feature, missing from C, C++ and Java, provides information that tools can use to ensure absence of run-time exceptions.

cluding "run until blocked or preempted" and "earliest deadline first." With object locking governed by the priority ceiling protocol, an implementation can optimize protected objects on a uniprocessor to avoid mutexes and queuing overhead.

Ada Keeps Things Safe

Fielding safety-critical software raises the bar for quality assurance, with analyzability a key requirement. In order to ensure, for example, that data storage constraints are met, the developer needs to guarantee that there is sufficient stack space. This means either no recursion, or showing that the recursion is bounded. Dynamic allocation needs to be eliminated or carefully managed (automatic garbage collection in a safety-critical system remains a research topic). Depending on the analysis techniques employed, other features likewise need to be eliminated or restricted in their usage. There is no "one size fits all" subset; the kinds of restrictions depend on the safety level and the specific analysis techniques that are used.

Ada has a unique approach to this problem: through a mechanism known as pragma Restrictions, a program can specify which features are banned. An attempt to use any of these features will cause compilation to fail. The implementation can omit run-time support libraries for such features so there is no need for the developer to provide certification material for such libraries. This à la carte

Figure 3

Lockheed Martin Aeronautics will be using AdaCore's GNAT Pro to develop the Flight Management System Interface Manager and Radio Control software on the C-130J Super Hercules aircraft.

approach offers maximum flexibility. Features whose usage can be eliminated or restricted include tasking, exception handling, dynamic allocation and Object-Oriented Programming. AdaCore's GNAT Pro is an example of a technology that performs this optimization. Lockheed Martin Aeronautics will be using AdaCore's GNAT Pro to develop the Flight Management System Interface Manager and Radio Control software on the C-130J Super Hercules aircraft (Figure 3).

Ravenscar Profile

A set of related restrictions can be bundled into a profile, and the Ada 2005 standard includes the definition of the so-called Ravenscar Profile, which comprises a simple set of tasking features whose usage and run-time libraries are amenable to safety certification. A program using the Ravenscar Profile consists of a set of tasks, each of which loops forever on either a simple event or a time-out. Despite its simplicity, the Ravenscar Profile is rich enough to express the kinds of concurrent programs that come up in practice.

A variety of languages are available for real-time and safety-critical systems, but Ada stands out as the one that was specifically designed for that purpose. Its underpinnings are based on reliability and early error detection, and it navigates the trade-off between expressibility and analyzability by providing a flexible mechanism that developers can use to tailor their own language subsets. With a traditional stack-based run-time model, Ada avoids the problems that would arise in languages such as Java that rely heavily on dynamic allocation. Ada is also the basis for the SPARK language and toolset—a SPARK program is a legal Ada program and can be compiled with any standard Ada compiler—which has a successful track record in safety- critical and high-security applications. For more details see the sidebar "SPARK: A Supercharged Ada Subset for High-Integrity Systems." Ada has evolved over the years to increase its support in the high-integrity area, and it remains the closest technical fit to this community's demanding requirements. ▮▮

AdaCore
New York, NY.
(212) 620-7300.
[www.adacore.com].

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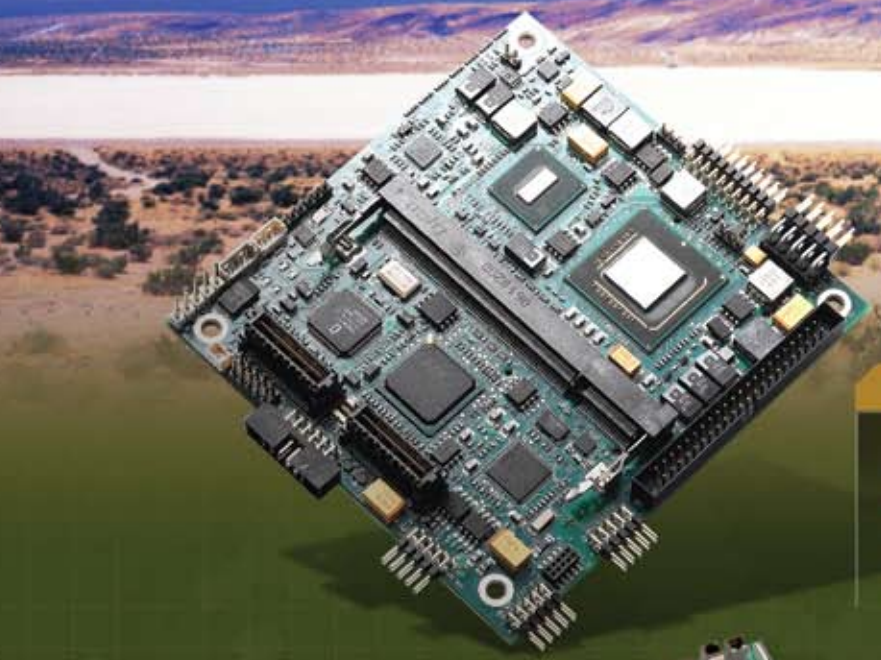

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(866) 4-ADLINK email: info@adlinktech.com

Technology Focus

VPX, VXS and VME SBCs

Systems Issues Drive VME, VXS and VPX SBC Trends

As the VPX community works through interoperability challenges, VXS and VME SBCs satisfy legacy upgrade needs.

Jeff Child
Editor-in-Chief

The military is hungry to put VPX to work in both new and legacy/upgrade programs. System developers are attracted to the increased potential bandwidth, level-2 maintenance features, I/O options and ruggedness of VPX. That said, VME/VME64x remains the dominant choice in deployed systems. And many shipboard, submarine and aircraft applications are more than happy with legacy VME performance. Meanwhile, VXS's share of the market is growing in niche applications. It offers a significant performance boost over VME64x, and its backward-compatibility is particularly attractive in many systems.

For its part, VPX is aimed specifically at defense applications and brings the performance of switched fabric interconnects such as PCI Express, RapidIO, InfiniBand and 10 Gbit Ethernet into a rugged slot-card architecture similar to legacy VME. The VITA 46.0 VPX Base Standard and VITA 46.1 VMEbus Signal Mapping on VPX were ratified a few years ago and have seen some design wins in major programs, with some programs even mandating the use of VPX. A problem that's hindered VPX's progress is that, with the large number of open pins and the variety of fabric options available to it, it's difficult to ensure any compatibility between VPX products of different vendors.

Aiming to address just that problem, earlier this year an initiative was formed called OpenVPX Industry Working Group. OpenVPX is an independent association whose members include nearly all the major military VME vendors. The group also includes a number of leading defense prime contractors. OpenVPX's ultimate goal is to craft a System Design Guide that will include predefined system profiles for 3U and 6U VPX-based systems, and they're hoping to accomplish this by October 2009. OpenVPX is an effort outside VITA and its standards body, the VITA Standards Organization (VSO), but it's using the same rules and procedures. And OpenVPX plans to turn the design guide over to VITA control upon completion.

Meanwhile, ordinary VME continues to thrive in slot-card technology upgrade programs. VME's ability to insert new processing, memory and I/O functionality on legacy platforms is exactly why the military has favored modular slot-card form factors like VME in the first place. Feeding that need, board vendors are rolling out new VME SBC products that sport the latest multicore processors, while supporting fabric-based mezzanines in the form of XMC.

Figure 1

The Continuous Electronic Enhancement Program (CEEP) for the Abrams tank relies on VME technology as a means to upgrade processor capabilities that serve both crew operations and vehicle diagnostics.

An example of VME's ability to serve long deployment cycles is General Dynamics' Continuous Electronic Enhancement Program (CEEP), part of the overall Abrams Tank Systems Enhancement Package (SEP) upgrade (Figure 1). CEEP integrates new technologies that will reduce future obsolescence issues and take advantage of improved processing and display capabilities.

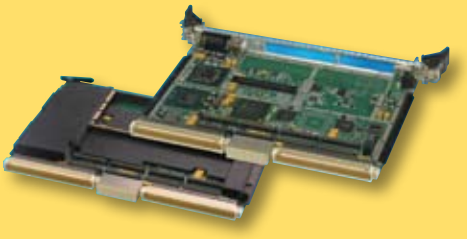
The SEP upgrade includes improved processors, color and high-resolution flat panel displays, increased memory capacity, and an open operating system that will allow for future technology growth. The processor side of that involves GE Fanuc's rugged PowerPC processor, graphics and communications products. This processor board is designed to accept two onboard mezzanine modules all in a single VME slot and will allow for improved capabilities in both crew operations and vehicle diagnostics. ■■

Technology Focus:

VPX, VXS and VME SBCs Roundup

VME SBC Boasts Latest Low-Power Core2 Duo Processor

Perhaps the greatest triumph of VME is its capability to maintain backward compatibility while remaining suited to incorporating new computing elements as they evolve. Exemplifying this trend is Aitech Defense Systems' new 6U VME SBC using Intel's latest T7500 low-power, high-performance Merom Core 2 Duo dual core processors. The new C160 is designed for rugged, mission-critical mobile applications requiring exceptionally low power and high processing throughput.

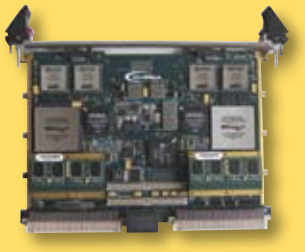


The new single-slot C160 now offers clock frequencies up to 2.2 GHz for the high-performance version and 1.67 GHz for the low-power version, which draws only 25W. The new board also uses Intel's Virtualization Technology (VT), enabling the board to run different applications simultaneously using multiple virtual partitions. The fully featured C160 incorporates a custom metal thermal management frame supporting an array of integral stiffeners for increased resistance against high shock and vibration. The board offers large memory arrays providing extensive volatile and nonvolatile memory resources. These include up to 2 Gbytes fast DDR2 SDRAM operating at 667 MHz and up to 8 Gbytes of onboard flash disk (NAND Flash), with IDE controller eliminating the need for externally attached mass-storage media. OEM pricing for the C160 6U VME SBC starts at $6,050.

Aitech Defense Systems
Chatsworth, CA.
(888) 248-3248.
[www.rugged.com].

Conduction-Cooled DSP/FPGA-Based VXS Card

VXS has found a solid niche as a "here and now" solution for marrying switched fabric performance with legacy VME backward compatibility. BittWare's latest VXS offering is the GT-6U-VME (GTV6), which features two Altera Stratix II GX FPGAs (2SGX90 or 130), two processing clusters consisting of two ADSP-TS201S TigerSHARC DSPs from Analog Devices, and up to 3 Gbytes of DDR2 SDRAM memory. This conduction-cooled board is optimized for high-end, multiprocessing applications, while also providing complete flexibility for future adaptability, ideal for existing and future military applications requiring embedded signal processing in a VXS/VITA 41 form factor.



The GTV6 implements a dual BittWare ATLANTiS framework to interface between the FPGAs and DSPs. The GTV6 also features two clusters of two ADSP-TS201S TigerSHARC DSPs, which are interconnected by a 64-bit cluster bus running at 83.3 MHz.

BittWare
Concord, NH.
(603) 226-0404.
[www.bittware.com].

1.6 GHz Atom N270 Processor Powers VME SBC

With a power consumption of under 20W, a new ultra-low-power VME single board computer is based on the Intel Atom processor. The VP A45/01x from Concurrent Technologies uses the 1.6 GHz Intel Atom processor N270 and the Intel 945GSE Express chipset both from the Intel embedded roadmap, ensuring long-term availability. With 2 Gbyte DDR2-533 SDRAM, this ultra-low-power board also supports a variety of peripheral I/O ports, flash drive, CompactFlash site and PMC/XMC modules.

Commercial and extended temperature versions are now available, and ruggedized, conduction-cooled or air-cooled (to VITA 47) versions will be available shortly. With a wide range of flexible I/O, the VP A45/01x supports a PMC/XMC site with front I/O and P2 rear I/O (VITA35 P4V2-64ac) plus a second 33 MHz PMC site with front I/O and rear I/O via the optional P0. A range of onboard I/O is available to the user: two Ethernet interfaces, a USB 2.0 port and an RS-232 interface via the front panel, whilst the rear panel I/O includes digital 3D graphics (2048 x 1536), keyboard, mouse, four GPIO signals, two USB 2.0 ports, an RS--232/RS422/RS-485 port and two SATA150 interfaces. The optional P0 also supports two Gigabit Ethernet interfaces.

Concurrent Technologies
Woburn, MA.
(781) 933 5900.
[www.gocct.com].

VPX SBC Serves 8-Core Freescale QorIQ CPU

Compute-density has become the watchword in many of today's military applications, and multicore processors help to feed that need. Along just those lines, Curtiss-Wright Controls Embedded Computing has introduced the VPX6-187, its first single board computer based on Freescale's latest eight-core QorIQ P4080 Communications Processor. This rugged, high-performance 6U VPX general-purpose SBC supports its eight 1.5 GHz Power Architecture processor cores with high-performance datapath acceleration logic, network and peripheral bus interfaces.

Offered in both air-and conduction-cooled rugged configurations, the VPX6-187 is also optionally available in a VPX-REDI (VITA 48) configuration to support applications that require Line-Replaceable Modules (LRMs). The VPX6-187's high-speed VPX backplane supports connectivity via Gen 2 PCIe and SRIO for multi-Gbyte/s board-to-board data communications. The VPX6-187 also supports a rich I/O complement including four Gbit Ethernet ports, USB, options for multi-function RS-232/422/485 serial ports, MIL-STD-1553, Serial ATA, and TTL and differential discrete I/O to provide connectivity integration with other system elements independent of its two PMC/XMC sites. The board's dual mezzanine sites are ideal for the acquisition, processing and distribution of high-speed sensor data such as video, radar and sonar.

Curtiss-Wright Controls
Embedded Computing
Leesburg, VA.
(703) 779-7800.
[www.cwcembedded.com].

Ruggedness, Low Power Combine on VME SBC

Packing the most performance possible into a single VME slot, at low power, is now an easy feat. Dynatem has accomplished that with its Core-Duo-based DPD VME SBC. The DPD is a single-slot VMEbus (and VME64)-compatible platform based on the Intel low-power Core-Duo (Yonah) processor. The DPD takes advantage of the Core-Duo's low 15W power consumption as a rugged SBC. The DPD requires only 5V from the backplane. This enables full functionality in legacy VMEbus backplane systems.

Shock and vibration immunity were major goals in the DPD design. All major components including processor, chipset and memory are BGA-based. The only socketed devices on board are the optional CompactFlash and optional battery, both of which are securely fastened when required. The DPD is available as an IEEE 1101.2-compliant, conduction-cooled VMEbus module with wedge locks and a full-board heat sink for high shock/vibration environments and temperature extremes. The DPD comes installed with 2 Gbyte ECC-compatible DDR2-400 memory. Memory is BGA for the best shock/vibration spec. Two SATA ports, VGA video, two Gbit Ethernet ports, four RS-232 ports, one RS-422 port, an IDE interface, PS/2 mouse and keyboard, and two more USB 2.0 ports are routed to the backplane. Conventional PC I/O is accessible with industry-standard connectors on optional rear I/O modules. The two onboard mezzanine card interfaces include one PMC site based upon the 64-bit PCI-X bus. Pricing for the DPD starts at $4,738 in single quantity.

Dynatem
Mission Viejo, CA.
(949) 855-3235.
[www.dynatem.com].

VME SBC Features 1.3 GHz PowerPC and Rich I/O

VME remains the most widely installed slot-card embedded computer form factor in the military, and it's living up to its promise as a valuable path for military technology refresh and technology insertion. Feeding just those needs, Emerson Network Power has announced the MVME4100, its fastest single-core, next-gen VMEbus processing blade.

Equipped with expanded processing power for I/O and data-intensive applications, the MVME4100's 1.3 GHz 8548E system-on-chip PowerPC processor features a double-precision embedded scalar and vector floating-point APU that delivers next-generation, floating-point processing performance for today's demanding high-precision applications. The board offers a range of storage capabilities including 4 Gbytes of fully programmable NAND flash memory, 2 Gbytes of onboard DDR2 SDRAM and 512 Kbytes of nonvolatile MVRAM memory. The blade's I/O capabilities include advanced 2eSST protocol availability capable of bandwidth up to 320 Mbytes/s, 4 GigE ports, 3 serial ports, USB 2.0 compatibility and PCI-E expansion options for maximum performance and flexibility. In addition, the board's I/O and firmware are fully backward compatible with existing MVME3100 and 7100 models to ensure easy interoperability with legacy hardware.

Emerson Network Power
Tempe, AZ.
(800) 759-1107.
[www.emersonnetworkpower.com].

3U VPX SBC Sports Freescale MPC 8640D Processor

There have been only a handful of SBC vendors so far that have rolled out VPX products. The ones that jumped on board have already got several out. Extreme Engineering Solutions' latest VPX offering is the XPedite5170, a feature-rich 3U VPX (VITA 46) solution targeting Freescale Semiconductor's dual-core MPC8640D processor. The XPedite5170 delivers enhanced PowerPC performance with AltiVec technology and power efficiency for today's military customers requiring high performance in small form factors.

The board runs at up to 1.25 GHz and includes two channels of 1 to 4 Gbytes of DDR2-533 SDRAM and up to 4 Gbytes of NAND flash and 256 Mbytes of NOR flash. Interconnects included dual Gigabit Ethernet ports, PCI Express or Serial RapidIO Fat Pipe P1 interconnect. The P2 interconnect includes GPIO, two RS-232/RS-422/RS-485 serial ports, I²C and PMC I/O. XPedite5170 is shipping today with XPand1000 development chassis. Pricing varies from $6,000-$8,000 depending on ruggedization level, memory configuration and quantity purchased.

Extreme Engineering Solutions
Middleton, WI.
(608) 833-1155.
[www.xes-inc.com].

VPX SBC Serves Up 1.86 GHz Core2 Duo

VPX is shaping up to be the favorite next-gen embedded computer architecture for the military. GE Fanuc Intelligent Platforms's latest VPX offering is the SBC620 rugged 6U VPX single board computer. The SBC620 features an Intel 1.86 GHz Core2 Duo (Penryn) processor with 6 Mbytes of L2 cache memory and up to 4 Gbytes of DDR2 SDRAM. The SBC620 is characterized by the flexibility and performance of its I/O subsystem. The onboard Intel 5100 chipset provides four x4 PCI Express lanes to the VPX backplane, with one XMC site supported by x8 PCI Express and a second site supported by x4 PCI Express. I/O flexibility is further enhanced by the provision of six USB 2.0 ports, two Gbit Ethernet ports, two SATA (3 Gbit/s) ports and two RS-232/422 ports.

The SBC620 also features an XGI Volari Z11 graphics processor, enabling the SBC620 to support dual VGA or VGA/DVI output. Available in five ruggedization levels from convection-cooled for development to conduction-cooled extended temperature operation for deployment, and providing optimum performance per watt, the SBC620 can be optionally configured with covers to allow for 2-level maintenance in line with the VITA-48 (REDI) standard.

GE Fanuc Intelligent Platforms
Charlottesville, VA.
(800) 368-2738.
[www.gefanucembedded.com].

VME SBC Provides Versatile 2.16 GHz Core 2 Duo Solution

For a lot of military programs—in the Navy in particular—reducing cost is a high priority. Often that means choosing an embedded computing solution that can be applied to multiple systems. Along just such lines, General Micro Systems has introduced the "Maritime" (VS275), a new VMEbus CPU that defies obsolescence by enabling seamless upgrades and complete flexibility with the addition of five different expansion modules. The supreme versatility offered by the Maritime enabled the U.S. Navy to use the VS275 as the common platform in three programs.

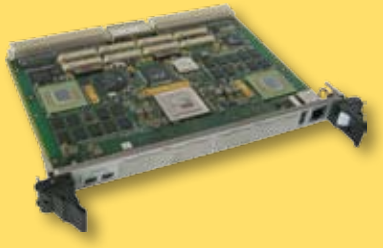
Maritime uses the GMS P70 "Nucleus" processor module, a module that supports either the ultra-low-power Core 2 Duo operating at 1.5 GHz or the Core 2 Duo at 2.16 GHz with 4 Mbytes of L2 Cache and 667 MHz FSB. Custom configurations are made possible through one PMC-X and/or 16-Lane XMC-compliant site with rear I/O and an optional workstation I/O module (second VME Site). Other features include two Gbit Ethernet ports with TCP/IP offloading engine and dedicated interrupt; ten USB 2.0 ports; four serial ports with RS232/422/485 options; two PATA ports, one to the rear, one for onboard HDD/SSD/CF; 16 individually programmable buffered user I/O lines, and custom I/O functions such as FireWire or octal SIO via a SAM-III module. Pricing for the standard version of Maritime (VS275) starts at $3,200, in quantities of a 1 unit.

General Micro Systems
Rancho Cucamonga, CA.
(909) 980-4863.
[www.gms4sbc.com].

VME 2eSST Card Provides PMC8640 CPU and XMC

VME's ability to marry legacy compatibility with new technologies has set it apart from other computing form factors. Along those lines, Interface Concept offers the IC-De6-VMEb, a 2eSST VME board powered either by one or two PMC8640 (or MPC8641), both available in single or dual core version. IC-De6-VMEb is a VME64x board based on the Freescale e600 processor.

Designed for applications requiring a very high level of performance, the IC-De6-VMEb board also provides a very flexible



combination of interfaces offering thus the ideal open platform for demanding customers. Its embedded Ethernet switch enlarges the communication skills normally found on such a board, while the two PMC XMC slots enable it to increase the computing power and the range of available I/Os. The 2eSST capabilities of the IC-De6-VMEb provide up to 300 Mbyte/s burst transfer rate across the VMEbus. Moreover, the backward compatibility protects existing investments. The board also features two banks of DDRII DRAM, each up to 1 Gbyte, 256 Mbytes of soldered Mirror Flash and 256 Kbytes of MRAM (non-volatile memory). Also provided is a PPC 64-bit Real Time clock and 32 bit-timers, calendar clock with supercap backup along with a temperature sensor and monitoring.

Interface Concept
Briec de l'Odet, France.
+33 (0)2 98 57 30 30.
[www.interfaceconcept.com].

3U VPU Features Core2 Duo Processor

The ranks of VPX vendors continue to grow. Kontron's latest offering is the VX3020 based on the Intel Core 2 Duo processor. VPX, a proposed ANSI standard, breaks out from the traditional connector scheme of VMEbus to merge the latest in connector and packaging technology with the latest in bus and serial

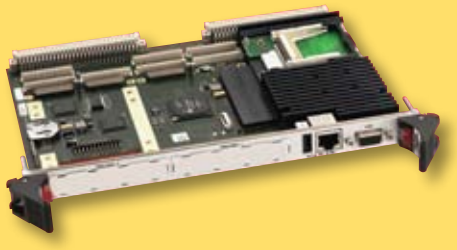
fabric technology. The boards are available in Rugged Conduction-Cooled (RC) versions that support operational temperatures ranging from -40° to +85°C according to VITA 47 recommendations.

Based on the latest dual core 1.5 GHz Intel Core2 Duo LV processor, the Kontron VX3020 VPX CPU board offers high-end processing performance to meet a wide range of demanding signal and data processing requirements. With the Intel 3100 chipset the Kontron VX3020 supports up to 2 Gbytes of DDR2 SDRAM and features all the high-performance I/Os that are available on the latest laptop PCs such as the UXGA graphics controller with PCI Express, two Gigabit Ethernet network interfaces configurable by software either on the front RJ45 connector or the rear VPX backplane connector, 3 x SATA-150 interfaces and multiple USB 2.0 ports. An onboard USB connector is able to support a standard USB flash disk module. The Kontron VX3020 can also easily run high-demanding PCI-based applications with support for high-performance and PCI software backward-compatible PCI Express, which is configurable either as x4 or quad x1 over the backplane.

Kontron America
Poway, CA.
(858) 677-0877.
[www.kontron.com].

Core2 Duo VME Card Supports Deal PMC/XMC Sites

Combing ruggedness with advanced computing capability is what VME does best. Exemplifying that trend is the new VMEbus SBC from MEN Mikro Elektronik, which supports a multitude of Intel Core 2 types and pairs outstanding reliability in computing with fast data transmission. The A20 single board computer is the latest 6U VMEbus board of MEN's product range. This SBC was specially designed for industrial applications with the highest reliability in computing and graphics, and is used in the world's largest particle accelerator of the Swiss research organization, CERN. Being open for any user requirements, the robust card supports a multitude of Intel processors—from the Core Duo or Core 2 Duo with 1.5 GHz down to single-core Celeron M versions.



Due to the Tundra TSI148 bridge controller, the SBC supports fast and reliable data throughput using 2eSST. This protocol doubles the theoretical VMEbus transaction bandwidth to up to 320 Mbytes/s. The A20 is one of only a few 6U computers that provide space for 2 PMC or 2 XMC modules. Its fast 64-bit/66 MHz PMCs give the single board computer particular communication strength. Users with a need for even more speed can make use of four of a total of six PCI Express lanes to connect XMC modules. Standard I/O at the front of the A20 includes graphics via VGA, one Gigabit Ethernet, one USB 2.0 or optionally a COM interface on RJ45. The rear side gives access to the I/O functions of the PMC modules, and also to seven USB interfaces and one SATA port. With a size of up to 4 Gbytes of DDR2 RAM main memory is firmly soldered against shock and vibration.

MEN Micro
Ambler, PA.
(215) 542-9575.
[www.men.de].

VXS Board Serves Up Dual Freescale 8641Ds

VXS has established itself as a "here and now" technology for bringing switched fabric performance into the infrastructure of VME. Mercury Computer Systems offers the Ensemble 5000 Series VXS HCD5220 Dual 8641D Dual-Core Processing Module. The HCD5220 is the first of several new products from the VXS Ensemble 5000 Series product family designed to extend embedded, high-performance computing to a sensor-networked environment, enabling rapid access to critical information from distributed sensors via the Converged Sensor Network (CSN) Architecture.

The Ensemble VXS HCD5220 is rich with architectural innovations and industry firsts. The HCD5220 combines the high-performance computing power of two Freescale 8641D PowerPC processors with dual PMC/XMC mezzanine sites, creating the ultimate balance of I/O and processing per slot. The HCD5220 includes key architectural elements from Mercury's CSN Architecture. Each PowerPC processor in a large multi-board system is paired with several internal and external Gbit Ethernet interfaces, allowing any processor to communicate with any other processor for system control, as well as with customer-configured external networked resources. The Ethernet network is in addition to the 3.125 Gbaud Serial RapidIO switch topology for application data. The VXS HCD5220 module is available now. Entry-level versions in volume start at under $10,000.

Mercury Computer Systems
Chelmsford, MA.
(978) 256-1300.
[www.mc.com].

Quad-Core Intel Xeon-Based VME SBC

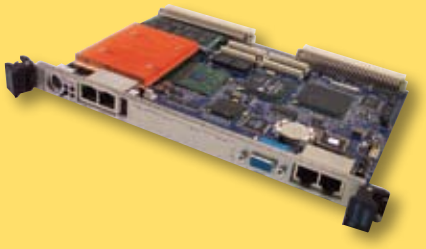
The multicore trend has swept through the military embedded computing industry, and military system developers are embracing it with open arms. Along just such lines, Themis Computer's XV1 is a VME SBC designed to meet the needs of customers who require quad-core performance for their demanding applications. The Quad-Core Intel Xeon Processor on the board using Intel's new 45nm process brings workstation and server performance to the VME market.

Themis' XV1 is based on the low-power Quad-Core Xeon L5408 processor clocked at 2.13 GHz, and Intel's 5100 chipset used in high-performance Xeon servers. The 5100 chipset memory controller supports ECC to maintain the highest system integrity, and provides the bandwidth necessary to support high-performance I/O. XV1 memory is expandable to 8 Gbytes of DDRII memory. The XV1 base configuration includes two Gbytes of DDR II memory, three Gbit Ethernet ports, two SATA II ports, four USB 2.0 ports and two XMC/PMC slots. An onboard ATI ES1000 video controller is provided with either front or rear panel VGA access.

Themis Computer
Fremont, CA.
(510) 252-0870.
[www.themis.com].

VME Card Is 1 GHz Drop-In Replacement for Predecessor

The longevity of VME in the military is partly thanks to technology updates to legacy slots. Feeding exactly such needs, Xembedded has announced a drop-in replacement for the End of Life SBS VR7, but with much more processor power. The XVME-689-VR7 is a powerful, very low-power single slot 6U single board computer with the same VMEbus P1 and P2 pin outs as the VR7. The XVME-689-VR7 VMEbus processor integrates an Intel Celeron M processor running at 1.0 GHz with up to 512 Kbytes of level 2 cache and a PCI-to-VMEbus interface. It is also available with 512 Mbytes or 1 Gbyte ECC or Non-ECC DDR, 266/333 MHz SDRAM. The XVME-689-VR7 has VGA Graphics out front panel or rear video support (pixel resolution up to 1600 x 1200 at 85 Hz). The EIDE Ultra-100 DMA controller supports up to three EIDE devices, one PMC 32/64-bit 33/66 MHz site (IEEE P1386/P1386.1) with front panel I/O bezel and user I/O on optional P0 rear connector.



Additional options available on the XVME-689-VR7 are EIDE onboard 1.8-inch hard drive, CompactFlash carrier, two Serial ATA150 (SATA150) external devices and a floppy disk interface. SCSI can be added with the use of a SCSI PMC board. PMC expansion for two additional PMC sites is available using the XVME-976/209. This XVME-689-VR7 processor module allows users to take advantage of the low-power, multiprocessing capability of the VMEbus while using standard off-the-shelf PC software, operating systems and VMEbus I/O modules.

Xembedded
Ann Arbor, MI.
(734) 975-0577.
[www.xembedded.com].

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Qseven-Based Carrier/SBC Duo Rolls

The Qseven connector scheme leads the way on the notion of combining a variety of I/O technologies onto one connection. Supporting that standard, American Portwell Technology has announced the PQ7-M102XL module board and its companion PQ7-C100XL 3.5-inch ESB developer carrier board, which supports an industrial temperature range of -40 to 85 degrees C. At a mere 70 mm x 70 mm (2.75 x 2.75 inches), the ultra compact PQ7-M102XL module board supports the Intel Atom processor Z510PT (1.1 GHz) or Z520PT (1.33 GHz) series and the Intel System Controller Hub US15WPT. The PQ7-M102XL module board features 512 Mbytes system memory; dual independent display by LVDS/SDVO; one Gbit Ethernet; eight USB ports; expansion of two SATA, one SDVO, one PCI-E x1, LPC interface and high definition audio interface.

The PQ7-C100XL developer carrier board is based on Portwell's popular 3.5-inch ESB form factor and features one VGA port and one LVDS port for dual independent display; one Gigabit Ethernet port; seven USB ports; two SATA ports; one SDIO socket; expansion via one mini PCI-E; plus an onboard 12V DC to DC circuit for DC-in applications. Available now, Portwell's PQ7-M102XL module board with companion PQ7-C100XL developer carrier board is suited for low-power, wide-temperature and fanless devices in military applications.

American Portwell, Fremont, CA. (510) 403-3399. [www.portwell.com].

Test System Card Targets AS5653/HS1760

The recently published SAE International AS5653 (High Speed 1760) is a standard that defines communications between aircraft and weapons systems. AS5653 defines a digital data command and control interface similar to MIL-STD-1553 based on Fibre Channel protocol but operating at a 1-gigabaud data rate. AIM-USA has developed a Test Product for AS5653 (aka HS1760) applications. The Test Product combines the AIM-USA APG-FC4-2GB Simulyzer hardware with developed HS1760 protocol software.

The HS1760 Test Product is designed to fully test the hardware interface and protocol compliance to FC-AE-1553 as profiled by SAE AS5653. The product is capable of testing and emulating network terminal, network controller and network monitor functions. The HS1760 Test Product includes an Analyzer display that decodes the HS1760 protocol. It also includes a fully documented Windows-based API for integration into a larger test system. The AIM-USA HS1760 Test Product defines a baseline platform for companies developing aircraft/platforms and weapons stores to test compliance with the AS5653 high-speed Fibre Channel network.

AIM-USA, Omaha, NE. (402) 763-9644. [www.aimusa-online.com].

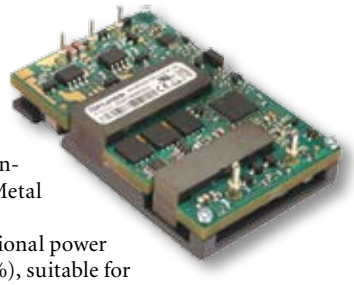
MicroSD Cards Offer Extended Temp Rating

Specialized memory cards are required in environments where reliability is required along with data integrity. With just that in mind, Delkin Devices has announced their line of industrial microSD cards. The microSD cards are capable of write speeds up to 16 Mbyte/s and read speeds up to 17 Mbyte/s, which surpasses the typical Multi-Level Cell (MLC) microSD card by at least six times. Furthermore, the cards are capable of operating in extreme temperatures ranging from -40° to 85°C. They also offer enhanced shock and vibration stability and over ten times the number of standard programming write cycles. Delkin's industrial microSD cards are built with SLC NAND Flash and are available in 128 Mbyte to 2 Gbyte capacities.

Delkin Devices microSD cards adhere to a strictly controlled specification using only certified Single-Level (SLC) flash to ensure no variation in performance or longevity. Control of each memory card's performance is assured by a configurable part number and a locked down Bill of Materials, minimizing the prospect of unscheduled field inspections and product replacement. Only extended temperature components are used and cards are continually tested for enhanced shock and vibration performance.

Delkin Devices, Poway, CA. (858) 391-1234. [www.delkinoem.com].

Quarter Brick Power Modules Target Tight Spaces



Many military systems are asking for high-power consumption in confined spaces. TDK-Lambda has expanded its line of high-power quarter brick modules with the introduction of the iQL and iQG Series. Available with nominal output voltages from 2.5V to 12V and power ratings up to 300W, these wide input range fully regulated and isolated DC/DC converters deliver exceptional performance in the industry standard DOSA quarter brick footprint. The iQL/iQG Series has been designed with confined space and demanding thermal environments in mind. These single board open-frame converters offer up to 95% efficiency, 181W per cubic inch power density and up to 60A of useable output current. Metal baseplates are provided on most models to facilitate conduction cooling when needed.

The fully regulated iQL Series are ideal for powering distributed, intermediate and ATCA bus applications. For conventional power rails, the "standard" output voltages of 2.5V, 3.3V and 5V are equipped with both remote sense and output trim (-20/+10%), suitable for powering a wide array of devices. The 8.3V and 12V output models feature output trim (+20/-10%) without remote sense. This family also boasts wide input voltage ranges of either 18-36V or 36-75V. Output power ratings range from 150W to 300W depending upon the output voltage. The iQL and iQG series are available now and priced from $58.00 each in 500-unit quantities.

TDK-Lambda, San Diego, CA. (619) 628-2859. [www.us.tdk-lambda.com].

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Instrumentation Cases Feature Dust- and Moisture-Resistant Design

Battlefield electronic gear needs a special level of enclosure ruggedness. Along those lines, the Optima EH-case is the newest member of the E-case family, designed with enhanced filtering. The enclosure has either a Hepa filter on the front door with special gasketing to prevent dust ingress, or solid with NEMA type gasketing. Both types can be adapted to provide acceptable EMC requirements. This design also provides superior compression of the gasketing with the included swing handle found in larger electronic enclosures.

The Optima E-case family of instrumentation cases is designed to house EIA standard 19-inch wide sub-racks and chassis. The rugged yet lightweight and stackable structural design is achieved with rigid front and rear aluminum bezels joined by rounded, extruded aluminum corner members. The modular design of the E-cases allows a wide range of configurations with various top, bottom and side panel options. Accessories for doors, shelves, power and cooling are also available. Pricing is under $500 depending on options and volume.

Optima EPS, Tucker, GA. (770) 496-4000. [www.optimaeps.com].

Rugged Enclosures Boast Low Lead Times for Faster Integration

Putting together a prototype subsystem quickly can make or break the chances of winning a contract. Serving such needs, SIE Computing Solutions announced that its rugged military and industrial ATR enclosures are now available with a quick time-to-market. SIE Computing Solutions has relied on its engineering expertise to develop a flexible and scalable customized design to fit each unique application, while eliminating the industry-standard 12-26 week lead time for finished goods. SIE customers can now receive ready-to-use products within 6-12 weeks of placing an order. SIE offers several base-model rugged ATR enclosures for harsh environment applications in the military and industrial markets. This capability encourages customers to collaborate with SIE Computing Solutions' engineers in designing the ideal solution for their application.

Among the range of ATR enclosures available from SIE is the company's latest offering: the 716 Series of 3U and 6U ATR enclosures engineered for smaller harsh-environment and military applications. Also available is the company's 714 Series line of Mil-Spec rugged, air-cooled ATR enclosures, ideal for maximum durability in harsh environment air, land and sea deployments, and the 717 Series of air-over conduction-cooled ATR enclosures, well suited for harsh environments in both air- and land-based military applications.

SIE Computing Solutions, Brockton, MA. (800) 926-8722. [www.sie-computing.com].

Radar Scan Conversion Package Solves Complex Problems

Radar system development ranks as one of the most active areas of today's military system development. Curtiss-Wright Controls Embedded Computing has announced SoftScan, a radar scan conversion package that enables system integrators to easily and quickly develop a high-end radar scan conversion workstation using a general-purpose computer. With the appropriate graphics card, SoftScan brings GPU acceleration to radar scan conversion applications. SoftScan uses a unique GPU-based algorithm that performs high-resolution scan conversion on large polar stores with minimal CPU overhead and requires no specialist hardware.

SoftScan receives and renders polar format radar video from either radar acquisition hardware, such as the Curtiss-Wright Controls Osiris dual channel radar interface board, or from the network. It is able to render plan-position indicator (PPI), A-Scan and B-Scan representations that can be scaled, rotated and translated in virtually any way that an application may require. Furthermore, SoftScan's extensible architecture provides for custom functionality to be added in a low risk and low cost way. SoftScan is initially available as an option on Curtiss-Wright Controls' Cougar radar input and scan converter VME board. Pricing for SoftScan enabled Cougar radar input and scan converter starts at $12,000. With a radar video acquisition interface, pricing for SoftScan starts at $16,500.

Curtiss-Wright Controls Embedded Computing, Leesburg, VA. (703) 779-7800. [www.cwcembedded.com].

PC/104-Plus Watchdog Timer Board Protects Against Failures

Mission-critical applications need watchdog timer technology to ensure reliable operations. ACCES I/O Products announced a new series of dedicated watchdog timer boards for PC/104-based embedded systems. The Model P104-WDG-CSMA board will vigilantly stand guard over your system and will help avoid costly system failures. The board can be used to monitor the operation of an application program as well as operating system and will initiate a system reset in case of lockup. In addition, the P104-WDG-CSMA can monitor and control a variety of system hardware parameters such as temperature, voltage, fan speed, humidity, and more.

Supplementing the standard features expected from a watchdog timer, the P104-WDG-CSMA includes a remarkable assortment of additional attributes. These include one general-purpose optically isolated input, two isolated digital outputs to control/switch external events, two non-isolated digital outputs, two general-purpose A/D inputs, and even a security light sensor that can be used to detect if the darkened interior of an enclosure is opened. Pricing for the P104-WDG-CSMA family ranges from $149 to $249.

ACCES I/O Products, San Diego, CA. (858) 550-9559. [www.accesio.com].

10-Inch Mobile Computer Provides Mil-Grade Ruggedness

Sophisticated mobile computers have become an indispensable tool for the warfighter. The Industrial Automation Group of Advantech has introduced the PWS-8101M, a 10.4-inch XGA TFT LCD rugged mobile computer with an Intel Core 2 Duo U7500 processor, 802.11 a/b/g WiFi, built-in Class2 V2.0 +EDR Bluetooth, Windows XP Pro and an optional 3.5G/HSDPA GPRS and SiRF III GPS. With its military-grade MIL-STD-810F and MIL-STD-461E certification, while meeting rugged demands such as a 3 foot drop and an extreme operating temperature range, the PWS-8101M also provides 6sides of IP65 for superior dust and water resistance.

The PWS-8101M is driven by a four-hour continuous operation high capacity battery. Additionally, this device comes with a variety of ready to use accessories such as hand straps, shoulder bag, vehicle mounting bracket, VESA bracket and more. The PWS-8101M supports Windows XP Embedded, XP Professional and Vista Embedded allowing users to choose from multiple operations systems.

Advantech, Industrial Automation Group, Cincinnati, OH. (800) 205-7940. [www.advantech.com].

6U VME SBC Serves Up 1.33 MHz Dual-Core Altivecs

VME SBCs with PowerPC Altivecs are a staple of many legacy military applications. It's a platform that's ideal for VME technology refresh. With that in mind, Kontron has introduced a long-term available Kontron VM6250 6U VME multi-processor board. With a power consumption down to only 27W the Kontron VM6250 6U VME card offers a choice of Freescale MPC8640 single or dual core processors with 1.00 or 1.25 GHz and Freescale MPC8641 single or dual core processors with 1.33 GHz. It combines high processing power and exceptional memory bandwidth. High data throughput is guaranteed by the high-speed backplane switch for PCI Express, Gigabit Ethernet and the double-edged source synchronous transfer VME 2eSST according to ANSI/VITA 1.5.

Kontron's new 6U VME board, in the rugged conduction-cooled version, is destined for applications in harsh environments where extremely secure and reliable performance is a must. The Kontron VM6250 features soldered DDR2 SDRAM with Error Correcting Code (ECC) and onboard USB flash support for software storage without rotating non-volatile memory. Data security of the highest level is additionally ensured by 128 Kbyte NOVRAM for back up of critical data in case of power failure.

Kontron America, Poway, CA. (858) 677-0877. [www.kontron.com].

ATCA Storage Blades Serve Up 1.8 Terabytes

ATCA's product ecosystem continues to expand, and storage blades are part of that mix. The ATCA-S201 (shown) is an ATCA carrier blade designed to meet in-shelf, shared storage requirements and enables access to a common storage resource for multiple processor via 10 Gbps Ethernet, iSCSI connectivity on the ATCA fabric interface. An onboard SAS controller provides hardware RAID to off-load the processor blades for better application performance.

The blade can be connected to a host processor blade in a direct attached, JBOD (Just a Bunch Of Disks) configuration or as additional storage capacity for shared storage via external connection to the ATCA-S201 storage blade. The AMC-S402 is a mid-size AdvancedMC storage module equipped with high performance, high reliability enterprise class SAS disk drives. Versions with 146 Gbyte and 300 Gbyte SAS HDDs are currently available. The AMC-S320 is a mid-size storage module with an 80 Gbyte extreme duty hard disk drive and SATA interface. Both blades offer up to 1.8 Terabyte of storage capacity across four mid-size hot-swappable AMC slots and a rear transition module (RTM) with two direct-mount storage devices. Traditional SAS and SATA based rotating media as well as SATA based solid state device (SSD) storage products are supported.

Emerson Network Power, Tempe, AZ.
(800) 759-1107. [www.emersonnetworkpower.com].

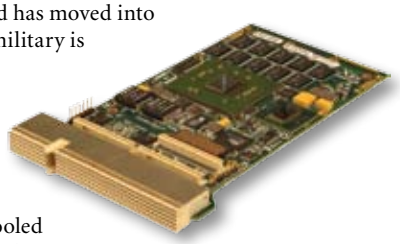
Military Batteries Suit Rugged Requirements

The battery needs of single-use applications such as avionics, navigation systems, ordinance fuses, missile systems, telemetry, electronic warfare systems, GPS tracking and emergency/safety devices, shipboard and oceanographic devices are a level above the requirements of ordinary batteries. Tadiran has just introduced TLM Military Grade Batteries, a family of rugged, high energy lithium metal oxide batteries developed specifically for military and aerospace applications.

TLM Military Grade cylindrical batteries feature an open circuit voltage of 4V, with a discharge capacity of 500 mAh (20 mA at 2.8V RT), capable of handling 5A continuous pulses and 15A maximum high current pulses. These batteries are constructed with a carbon-based anode, multi metal oxide cathode, organic electrolyte, and shut-down separator for enhanced safety. TLM Military Grade batteries also feature low self-discharge and a wide operating temperature range of -40° to 85°C. These batteries comply with MIL-STD 810G specs for vibration, shock, temperature shock, salt fog, altitude, acceleration (50,000 gn) and spinning (30,000 rpm), and conform to UN 1642 and IEC 60086 standards for crush, impact, nail penetration, heat, over-charge and short circuit, and can be shipped as non-hazardous goods.

Tadiran, Port Washington, NY. (516) 621-4980. [www.tadiranbat.com].

3U CompactPCI SBC Sports Core2 Duo



The multicore processor trend has moved into all areas of computing and the military is no exception. Along those lines, Extreme Engineering Solution's XPedite7130 is a 3U CompactPCI SBC based on the Intel Core2 Duo (SL9380) processor. A full range of convection- or conduction-cooled configurations are available. XPedite7130 also provides a PMC/XMC site with Ethernet and the traditional PCI bus (PMC) or PCI Express (XMC) support, ideal for high-bandwidth data-processing applications, storage or additional I/O.

The board's features include up to 4 Gbytes of DDR2-400 SDRAM, 2 Mbyte firmware hub flash and 4 Gbyte of NAND flash, the board's J2 connector I/O includes GPIO, two SATA ports, two USB ports, PMC/XMC I/O and two RS-232/RS-422/RS-485 serial ports. XPedite7130 is shipping in commercial, industrial and military configurations. In-house X-ES operating system support includes Green Hills INTEGRITY Board Support Package (BSP), Wind River VxWorks BSP, QNX Neutrino BSP, Linux LSP and Windows drivers. Pricing starts at $4,995 and discounts are available based on memory configuration, environmental requirements and volume purchases.

Extreme Engineering Solutions, Middleton, WI.
(608) 833-1155. [www.xes-inc.com].

VXS Digital Receivers Boast Dual FMC Sites

FPGAs are a critical technology for today's sensor data processing applications. Feeding such needs, Mercury Computer Systems has announced two Echotek Series products, both using three Xilinx Virtex-5 FPGA processors, two high-speed fiber transceivers, and two FPGA Mezzanine Card (FMC) sites for high-bandwidth I/O. As integrated components, they extend the functional range of Mercury's VXS and RACE++ Series systems with digitization and FPGA processing of sensor-based data streams.

The new Echotek Series DCM-V5-VXS digital receiver features the latest in A/D and D/A technology via converters mounted on the FMC sites, allowing for high-speed/high-resolution data conversion while still preserving the quality of the original signal. The module couples this data conversion capability with market-leading processing power delivered by a set of three Virtex-5 SX240T or LX330T FPGAs, which can be programmed by the end user for customer-specific application features. Moreover, these FPGA processors provide up to 3,156 DSP slices. Each Virtex-5 FPGA is accompanied by both DDR-II-SDRAM and QDR-II-SRAM chips and is connected by multiple high-speed data paths to the FMC sites, to the system backplane interface, and to two fiber transceivers.

Mercury Computer Systems, Chelmsford, MA.
(978) 256-1300. [www.mc.com].

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Synchro/Resolver Angle Measurement Card Enhances Capabilities

North Atlantic Industries has announced that enhanced features have been added to its industry standard Synchro/Resolver angle measurement instrument. The 8810A now provides fully independent dual-inputs, high-resolution touch screen controls, 0.001 degree resolution, 0.004 degree accuracy and auto-ranging inputs. The unit also offers an optional 2.2 VA reference supply, LXI compatibility, 47 Hz to 20 KHz operating frequency, auto-phase correction, and interface compatibility with Ethernet, USB, IEEE-488 and parallel ports. New features include front panel analog and digital display modes, resolution adjustable between one-ten-thousandth degree and one-degree, output angle display scaled in degrees/radians or any user programmable scale, angle offset of output display and display of last angle upon power-on.

The 8810A is a full-function instrument capable of performing most Synchro/Resolver evaluation, calibration and test functions on components, assemblies and systems. It automatically accepts and displays input voltages from 1.0 to 90 VL-L and Reference voltages from 2 to 115 Vrms over a broad frequency range of 47 Hz to 20 KHz. The 8810A is CE-compliant. It is available with an operating temperature range of 0 to 50 degrees C. Its power supply requirement is auto-ranging from 85 Vrms to 265 Vrms, 47 to 440 Hz. Pricing for 100 pieces of 8810A starts at $5,270.

North Atlantic Industries, Bohemia, NY.
(631) 567-1100. [www.naii.com].

1U Accelerator System Marries GPUs and PCIe-Over-Cable

Always hungry for more compute density, the military has turned to graphics processors as a source of computing muscle. One Stop Systems offers a 1U accelerator expansion system that employs either the AMD FireStream 9270 or 9250 graphics processor-based accelerator boards to provide a system tailor-made for high-end computational applications. The 1U 9270 from One Stop Systems contains one or two AMD 9270 boards while the 1U 9250 system employs up to four AMD 9250 boards. The 1U accelerator expansion system is equipped with a PCIe x16 Gen 2 host cable adapter that installs in a host computer's PCIe x16 expansion slot, delivering data transfers of up to 80 Gbits/s to the host system.

A 1-meter standardized PCIe x16 cable is included. The GPU expansion system off-loads the host CPU engines and will be used by research laboratories, video imaging systems and gaming applications. The new product family supports maximum compute density in the datacenter, allowing users to deploy up to 4 single-precision TFLOPS and 800 double-precision GFLOPS of compute performance. The 1U 9250-4 Accelerator Expansion System with four FireStream 9250s lists for $7,495. OEM quantities can be quoted on request.

One Stop Systems, Escondido, CA.
(760) 745-9883. [www.onestopsystems.com].

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ATCA SBC Targets Advanced Networking

ATCA has found a solid niche in the military realm. High-performance military communications applications lead the pack. RadiSys offers an ATCA SBC based on the new Intel Xeon processor 5500 series. The ATCA-4500, with the new Intel Xeon processor L5518, has been designed to offer the highest performance while minimizing the total cost of ownership. The processor and feature set were selected so it could pass the NEBS thermal requirements in chassis already deployed in the field, eliminating the need for a fork lift upgrade. Support for a massive 8 DIMM array of VLP DDR3 scales up to 64G of memory while providing cost-effective options for applications with lower density memory requirements.

The board offers multiple storage options, including RAID, SAS/SATA, solid-state USB flash drives and supports iSCSI boot, allowing TEMs to achieve their storage requirements around performance, flexibility, reliability and cost. For low-level software, the ATCA-4500 is based on Extensible Firmware Interface (EFI), which is a significant improvement over the old legacy BIOS firmware. The EFI provides a pre-operating system shell where customers can build and execute EFI applications, such as setup, OS install, diagnostic or configuration utilities. Support for extended Intel Virtualization Technology (VT-x and VT-d) on the board decreases the overhead associated with virtualization, making it the ideal platform for use cases that require virtualization.

RadiSys, Hillsboro, OR. (503) 615-1100. [www.radisys.com].

Compact, Rugged PC/104-Plus SBC Rolls

Fans are frowned on in harsh environment applications. They represent a single point of failure that's not worth the risk. Offering its latest fanless SBC solution, VersaLogic began shipping a new PC/104-Plus SBC called the "Manx"—a mid-range SBC featuring a highly efficient AMD Geode LX 800 processor. The product is function and pin-out compatible with VersaLogic's older Puma SBC, offering customers a higher performance migration path from that popular product. The new Manx incorporates mid-range processing speed (500 MHz) with very low power consumption (less than 5W). The ACPI suspend-to-RAM state feature reduces power draw to an incredible 0.2W between active sessions.

This high-reliability fanless design is available in both standard (0° to +60°C) and extended (-40° to +85°C) temperature versions. The Manx has standard onboard features that include 256 Mbytes of soldered-on DRAM, 10/100 Ethernet, four USB 2.0 ports, LPT port, IDE interface, three COM ports and analog audio. A CompactFlash socket provides reliable, high-capacity onboard storage with no moving parts. The PC/104-Plus expansion interface supports both ISA and PCI add-on modules. The Manx will be available in production quantities in June. Pricing is about $550 in OEM quantities.

VersaLogic, Eugene, OR. (541) 485-8575. [www.versalogic.com].

VME, VXS and VPX SBCs Gallery

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Web: www.EmersonNetworkPower.com/EmbeddedComputing

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Automated Compliance Test Package USB 3.0

It took a while for USB to find its way into embedded applications, and longer still to be embraced by the military. Now, as USB 3.0 comes into play it's gaining more and more design wins. An automated compliance test package for USB 3.0 (SuperSpeed USB) is available for use on the recently released WaveMaster 8 Zi Oscilloscope platform from LeCroy. QualiPHY USB3 provides SuperSpeed USB physical layer compliance testing according to the USB-IF Electrical Test Specification, and more importantly, enables rapid debugging of compliance failures to identify the root cause of serial data problems.

QualiPHY USB3 features automated oscilloscope control for accurate measurements, connection diagrams showing the proper setup for each test, and report generation available in HTML, XML or PDF formats. In addition, integration with LeCroy SDA II and Eye Doctor II analysis software ensures that the challenges that come with the faster data rate and unique capabilities of SuperSpeed USB are addressed easily and accurately. QualiPHY USB3 uses LeCroy SDA II analysis software to display eye diagrams and jitter decomposition 50 times faster than other solutions, and contains integrated jitter and timing analysis for clock and data signals. The Price for the QPHY USB3 Software Option is $1,500.

LeCroy, Chestnut Ridge, NY. (800) 553-2769. [www.lecroy.com].

Low-Power Processor AMC Boosts Embedded Comms

PrAMCs have become an established technology in the military embedded realm, particularly in conjunction with MicroTCA. Serving that need, JumpGen Systems offers a PrAMC that features the Intel EP80579 Integrated Processor with Intel QuickAssist Technology and up to 4 Gbytes of ECC DDR2 memory and is targeted for use as coprocessor or host processor for embedded communication applications. The PRM-110 from JumpGen Systems supports up to 5 GigE links including 2 front panel and 3 routed to the AMC connector. It may be deployed with 600 MHz, 1.066 GHz, or 1.2 GHz processors to serve and is available with integrated accelerators that support Intel QuickAssist Technology through software packages provided by Intel.

Additional features include a PCI Express x4 Interface to Fat Pipes Lanes 4-7 (AMC.1, Type 4), dual GigE interfaces to Common Options Lanes 0 and 1 (AMC.2 Type E2) and a single GigE interface to Fat Pipes, Lane 8 (AMC.2, Type 1). Dual SATA interfaces to Common Options Lanes 2 and 3 (AMC.3) are also provided. The front panel I/O includes Dual 10/100/1000BaseT Ethernet, RS-232 Serial and USB. The PRM-110 is available in both full and mid-size AMC configurations for AdvancedTCA (ATCA), MicroTCA and proprietary architecture systems. Unit pricing for a range of configurations is expected to be under $1,000.

JumpGen Systems, Carlsbad, CA.
(760) 931-7800. [www.JumpGen.com].

VME, VXS and VPX SBCs Gallery

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- Up to 30G shock

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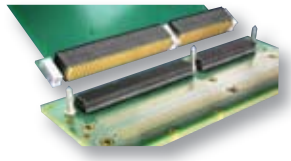
Tyco Electronics

MULTIGIG RT Connector Products for VITA 41 and VITA 46 Standards



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Web: www.tycoelectronics.com/ADM

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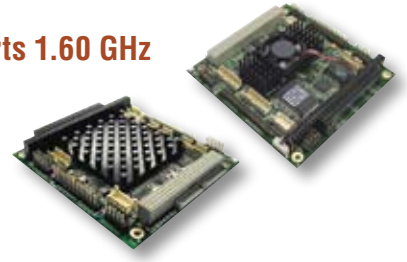
Precision Measurement Tool Works in Any Environment

Extremely high accuracy in analog voltage readings regardless of the environmental conditions is possible with instrumentation using proprietary ISO-Channel technology. The VOLTpoint and TEMPpoint instruments from Data Translation use galvanic isolation to guarantee 1000V isolation between each sensor input. The result is that accuracy is preserved on all input channels. ISO-Channel technology offers increased reliability over older relay front-end designs prone to system failure, by implementing a separate DC/DC converter on each 24-bit A/D converter for all 48 channels. Common mode noise and ground loop problems are eliminated with ISO-Channel design. Sensors at varying ground reference are individually referenced to their own level even at vastly differing voltages, including transients to thousands of volts. The all solid-state design provides digital transfer of valuable sensor data with optical and transformer isolation. The result to the user is preserved accuracy on all sensor inputs without regard to grounding conditions.

VOLTpoint is a precision measurement instrument designed and newly enhanced for measuring a wide range of voltage inputs of ±10V, ±100V and ±400V. TEMPpoint is a series of temperature measurement instruments designed for high accuracy and industrial robustness. Pricing for VOLTpoint and TEMPpoint begins at $3,195 and both are available immediately in USB and Ethernet versions.

Data Translation, Marlboro, MA.
(508) 481-8620. [www.datatranslation.com].

PC/104-Plus SBC Sports 1.60 GHz Atom CPU



The Atom processor is quickly pushing aside the idea that PC compatibly means suffering with high power consumption. Advanced Digital Logic has released its ADLS15PC, which is based on the Intel Atom (Z510, Z530) and the IntelUS15W (Poulsbo) chipset. The Intel Atom is a single core processor built on a 45nm process that boasts an impressive 2.0 watts TDP (Intel) for the CPU. This processor delivers the benefits of genuine Intel architecture to a small form factor for low-power, thermally and space-constrained markets.

The ADLS15PC takes advantage of these features by delivering high performance and low thermals in a compact, single board PC/104-Plus form factor. Memory is added via an SODIMM200 socket that will accept up to 2 Gbytes of DDR2-400/533 DRAM. In addition to ACPI/APM functions, the ADLS15PC provides EIDE, 8xUSB 2.0, 2xRS232 COM ports, PS/2 keyboard and mouse, LPT, 7.1 HDA Audio, 10/100/1000 Mbit LAN and more. The ADLS15PC can also come equipped with an onboard Solid State Disk (SSD) of 2 or 4 Gbytes. With the use of ADL's advanced conductive and convective thermal solutions engineered for the Atom design, the boards can be placed in nearly any application under environmentally demanding conditions.

Advanced Digital Logic, San Diego, CA.
(858) 490-0597. [www.adl-usa.com].

10 GigE Switches Ride 6U cPCI, VME and VPX

The military has embraced Ethernet in a big way, both for networking and as a dataplane interconnect fabric. Serving those needs, ACT/Technico offers a family of switches that supports jumbo frames, full-wire speed Layer 2 bridging as well as Layer 3 Unicast and Multicast engine forwarding, all running at full data rate. In addition, the fully managed IPv4/IPv6 ComEth4300a 10 Gbit Ethernet switches support Layer 2 through Layer 4 advanced traffic classification, filtering and prioritization.

Built on the latest generation of Marvell's Prestera GigE packet processors, the new family of Gigabit Ethernet switches ranges from 24 to 28 ports, up to four of which can be 10 Gigabit. The automatic MAC address management, auto-negotiation, auto-polarity and auto-crossover on each port make the ComEth4300 family truly plug-and-play. The ComEth4300 family provides a routing capacity of 125 million packets per second. The switches easily fit in standard 6U CompactPCI systems, comply with the PICMG 2.16 standard and come in standard, extended and conduction-cooled grades. VME and VPX versions, compliant with VITA standards 31.1 and 46.20 respectively, of the ComEth4300 switches will also be available. Pricing starts at $8,995 at quantity 1 for a standard-grade board.

ACT/Technico, Warminster, PA.
(215) 956-1200. [www.acttechnico.com].

PCIe-to-CompactPCI/ PXI Expansion Kit in a 6U Chassis

PCI Express has re-energized a variety of PCI-based embedded form factors, and PXI is one of them. A new PCIe-to-6U CompactPCI/ PXI expansion kit from Adlink Technology includes the company's PCIe-8560 PCI Express host board, the PXI-8656/6U remote system controller and an expansion cable. Adlink's family of bus expansion products includes PCIe-to-PCI, ExpressCard-to-PXI/PCI, PCI-to-PCI/PXI, PXI-to-PXI, and now PCIe-to-6U CompactPCI/PXI systems and kits for use in a wide range of applications. The PCIe-to-6U CompactPCI/PXI expansion kit is specifically designed for applications with high-density I/O requirements such as telecommunication systems, mass production testing and military/ aerospace by providing direct control of 6U CompactPCI/PXI modules via the high-bandwidth, low-latency PCI Express interface.

The PCIe-to-6U CompactPCI/PXI expansion kit supports up to 7 devices in a remote 6U CompactPCI/PXI chassis. The control of the 6U CompactPCI/PXI chassis through the PCIe-8560 PCI Express host board is transparent to software applications and drivers. All CompactPCI and PXI modules installed in the remote chassis will operate as if they are directly installed in the host system. Adlink's 15-slot 6U CompactPCI/ PXI chassis, the PXIS-3320, is also available for use as a remote chassis. The PCIe-to-6U CompactPCI/PXI expansion kit is currently available with a list price of $1,155.

ADLINK Technology, San Jose, CA.
(408) 360-0200. [www.adlinktech.com].

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Coming Next Month

COTS JOURNAL

Special Feature: Multi-Function Boards Revamp the Military I/O Landscape Thanks to the magic of today's level of semiconductor integration, multi-function mezzanine products have emerged, enabling military system designers to blend a variety of I/O functions onto a single PMC, XMC or AMC mezzanine card. This section surveys the available products, mixing multiple channels of 1553, ARINC-429, Serial I/O and other interfaces on one card. We'll also examine how those multi-function I/O cards are being using in military ground, airborne and shipboard applications.

Tech Recon: USB and PCI Express Revamp Military Test Fading fast are the days when complex military electronics systems required large racks on boards to implement test platforms for them. Now the same test functions can be done on the PC using USB, PCI Express data acquisition and test modules. This section looks at the boards and software solutions driving this trend.

System Development: VITA Standard Boards in Tech Refresh/Upgrade Programs Among the reasons for VME's soaring success in military systems is its unique ability to remain backward-compatible and facilitate technology refresh in military programs. A new board with the latest and greatest processor, memory and I/O can easily be dropped in to a slot that could be decades old. That kind of easy upgrade becomes trickier as new fabric-based VITA-standard boards enter the mix. Articles in this section examine the current activity in traditional VME tech refresh along with the trade-offs brought on with newer VITA architectures like VXS and VPX.

Tech Focus: Small Form Factor Boards While standard, open-architecture board form factors continue to dominate in military systems, non-standard form factors free designers from the size and cost overheads associated with including a standard bus. Articles in this section look at the trade-offs between standard and non-standard form factors. A product album compares the latest representative small non-standard boards.

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COTS

Editorial

Jeff Child, Editor-in-Chief

The Future Revolves Around FPGAs

When people think "summer," visions of a slower pace, time off and less stress come to mind. In many industries summer is indeed a time when business slows down. I wish it were so in our case. Our industry seems to be moving faster than ever, and is very upbeat even in the face of uncertainty about how program money will get allocated. Meanwhile, summer for us at *COTS Journal* is the time when we hold important planning meetings where we strategize about the upcoming year—deciding what technology topics will be important in the next calendar year and how to best cover them. It's when we start putting together our editorial calendar for the following year.

As we looked ahead to where military electronics and embedded systems technology is moving, over and over again the role of FPGAs kept cropping up. In a recent study conducted by VDC Research, over one third of the total respondents who answered that they were considering or already using FPGAs were military/aerospace respondents. FPGAs have become a game changer as an enabler in key compute-intensive military applications areas, while also the key influence in general electronics areas such as processing, data acquisition and even power subsystems.

On the application side, FPGAs have had the most impact in radar/SIGINT, UAV payloads and tactical military radios. Modern radar systems are operating over an ever increasing frequency range. Analog conversion technology—both A/D and D/A converters—is also feeding the radar needs of the military. System developers can now build radar receiver systems with a higher instantaneous bandwidth thanks to the converters, and can handle the corresponding increase in compute power required to process the received data streams using FPGAs.

In large UAV payloads, it's not just processing integration that the FPGAs provide. An earlier version of Global Hawk used a multicomputer system made up of only general-purpose processors; it was inefficient when it came to many of the computing tasks. By instead letting FPGAs concentrate on operations like repetitive convolutions—such as image data reduction and manipulation—the general-purpose CPUs are off-loaded to focus on data-dependent control operations. In tactical radios, FPGAs are a pure technology enabler. An FPGA is the only way to combine DSP-intensive waveform processing along with the reprogrammability required in next-generation software-defined JTRS radio implementations.

High-end military data acquisition is yet another area where FPGAs are playing a central role. Military system designers face serious challenges when trying to move signal data in ever-increasing volumes. And that's getting more complicated as sensors jump up in performance, while at the same time more sensors are getting tied together into wider arrays. Makers of high-end data acquisition boards and subsystems are designing the latest analog-to-digital converter (ADC) technology into system architectures designed to avoid bottlenecks at the back-end data movement phase. More and more of these board architectures are embracing FPGAs as a means to efficiently channel digitized data as it's propelled to where it needs to go. Moving the analog to digital conversion closer to the front end gets it into the digital domain, allowing such systems to operate in noisier environments.

Not to be left out, military power supplies and power converters have also morphed to accommodate the growing prevalence of FPGAs. The newest generation of high-performance FPGAs demands a lot from a power supply. They typically require low voltages, high currents, tight regulation, fast transient response and even supply voltage sequencing. Meanwhile, the typical high-performance embedded computer requires several different voltages, 5V and below. For example, each FPGA or DSP will require one voltage for the I/O circuitry and another to power the processor core. As a result, power converters continue to improve their ability to deal with the kind of mixed-voltage architectures common in an FPGA-based system.

Finally, one of the most significant trends that's not far off the horizon is the idea of using FPGAs as a military system's main processor instead of a general-purpose CPU. On-chip CPUs have become commonplace on high-end FPGAs, and as that trend continues, the reason for having a separate general-purpose processor—like a PowerPC, Core2Duo, or Atom—starts to fade. FPGAs have an added advantage of being fairly obsolescence -proof. If a processor architecture becomes obsolete, that processor in the form of an FPGA core can still live on. And it can live on independently of even the FPGA it was first implemented on. We're probably years away from FPGAs completely edging out general-purpose processors—and nothing in the military happens overnight—but we see the trend taking hold fairly soon.

The importance of FPGAs is by no means a new phenomenon in military electronics. In a way, the increasing role of FPGAs is in keeping with the idea that the definition of "system" has changed. A system once meant simply a rack of board-level systems. Now that same functionality can be incorporated in a few FPGAs. But as we look into our crystal ball at the year ahead, they seem to be headed for a new plateau. So, while you won't necessarily see the word "FPGA" in every section topic of our upcoming 2010 Editorial Calendar, rest assured that this critical technology area will somehow get weaved into a majority of them. ■

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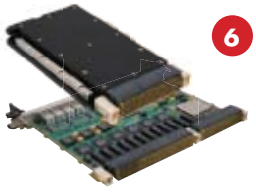

6 System Interconnects
Network Switches
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