COTS JOURNAL

Tech Focus:
Fibre Channel Boards Roundup

RUGGED BOX-LEVEL SYSTEMS

LAUNCH THE NEXT EMBEDDED TREND

PLUS:

Power Converters Sharpen Aim at Military Apps

Design Update: JTRS HMS Radios

Volume 8 Number 11 November 2006
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Features	XE–900	XE–800	XE–700
CPU	Via Eden	AMD Geode GXI	STPC
Clock speed	400 MHz; 733 MHz; 1.0 GHz	300 MHz	133 MHz
BIOS	General software	Phoenix	Phoneix
DRAM support	to 256 MB	to 256 MB	32/64 MB
Compact/Flash	Type I or II	Type I or II	Type I or II
COM 1	RS–232	RS–232/422/485	RS–232
COM 2	RS–232	RS–232/422/485	RS–232/422/485
COM 3	RS–232	NA	RS–422/485
COM 4	RS–232	NA	RS–232
COM 5	RS–232/422/285	NA	NA
COM6	RS–422/485/TTL	NA	NA
LPTI	0	0	1
EIDE	2	2	1
USB	2	6	2
CRT	1600 X 1200	1280 X 1024	1280 X 1024
Flat panel	LVDS	yes	yes
Digital I/O	24–bit prog.	48–bit prog.	24–bit prog.
Ethernet	10/100 Base–T	Dual 10/100 Base–T	10/100 Base–T
Expansion	PC/104 & *Plus*	PC/104 & *Plus*	PC/104
Power	3.6A operating	1.6A max.	1.6A max.
Temp. range	–40° to 70/85° C	–40° to 80° C	–40° to 80/85° C
Shock/vibration	40/5g	40/5g	40/5g

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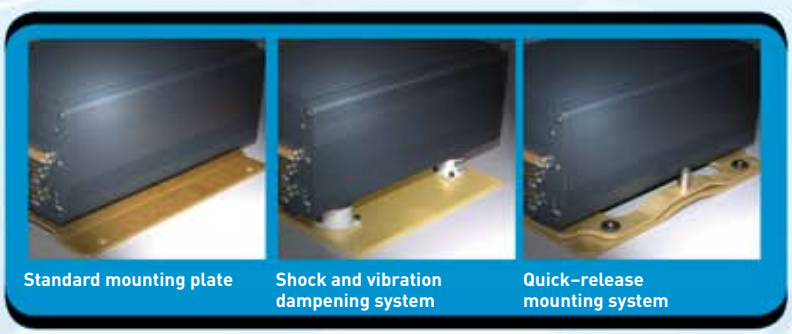

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COTS JOURNAL

Features

November 2006 Volume 8 Number 11

Departments

Coming in December...
...See Page 77

Main Feature

Tech Recon

System Development

Technology Focus

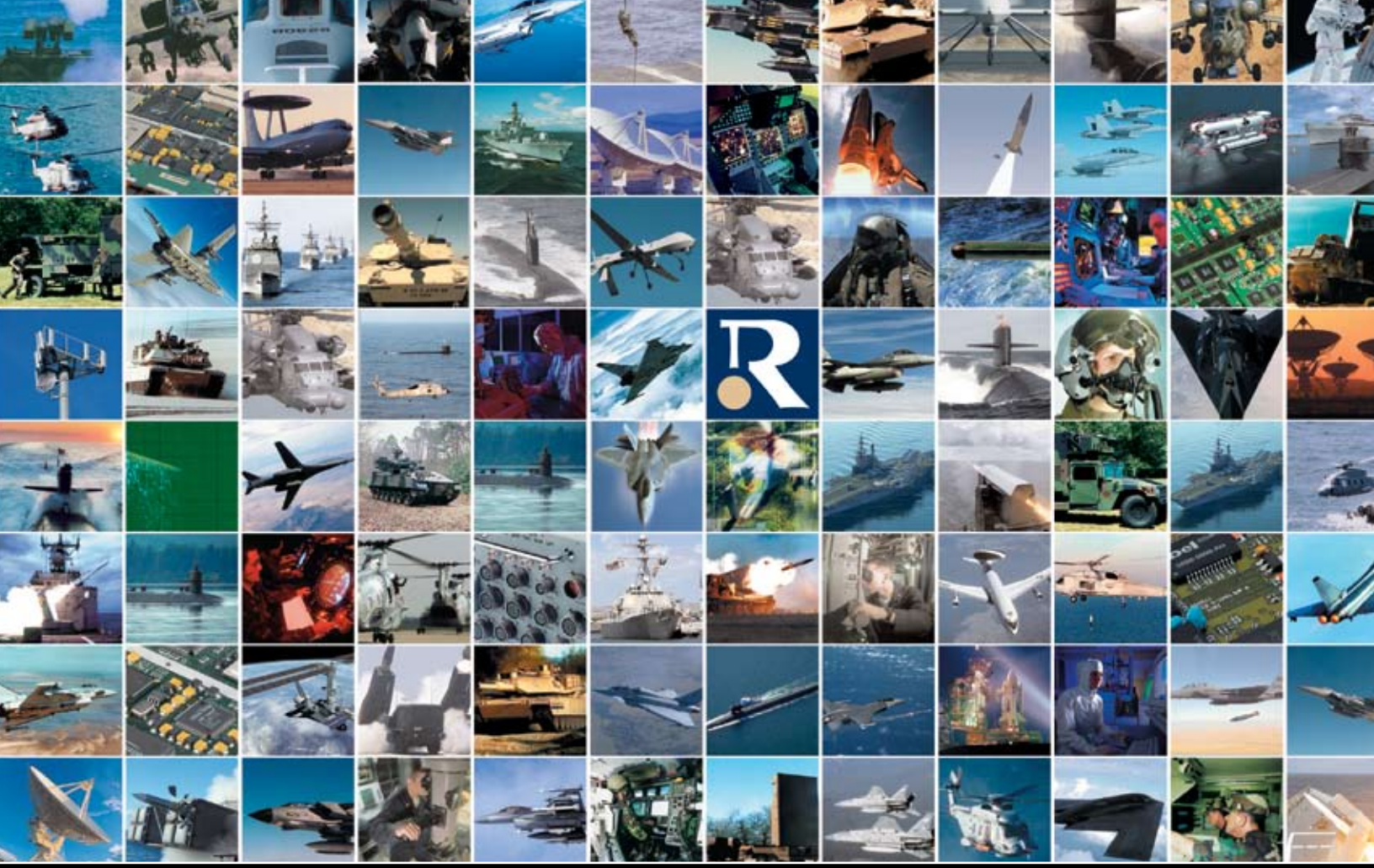
COTS (kots), *n.* **1.** Commercial off-the-shelf. Terminology popularized in 1994 within U.S. DoD by SECDEF Wm. Perry's "Perry Memo" that changed military industry purchasing and design guidelines, making Mil-Specs acceptable only by waiver. COTS is generally defined for technology, goods and services 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.*

Cover Story ..... Page 30

The USS Ohio (SSGN 726) is shown here on its return last year to Puget Sound Naval Shipyard and Intermediate Facility in Bremerton, WA, after completing sea trials. Ohio was the first ballistic missile submarine to complete conversion to the new class of guided missile submarines (SSGN). SSGNs will serve as platforms to develop and test new weapons systems, sensors and operational concepts that could further transform naval warfare. These payloads will include large unmanned undersea vehicles and off-board sensors.

Courtesy: (U.S. Navy photo by Mr. Rick Chaffee)



When all you do is military computing, you'd better be the best.

Our business is rugged computing for military applications. It's all we've ever done. It's our only business.

So if our future depends only on what we do today, and what we've always done, we'd better make sure that we do it better than anyone else. And we think we do. We were among the very first to seize the COTS opportunity. We wrote the book on rugged. We pretty much invented long term program support, helping our customers manage their way through the challenges of deploying systems over multiple decades.

And as well as being leaders in COTS, leaders in rugged and leaders in customer support, we're also leaders in technology: we were, after all, first to market with a family of 3U VPX products. We're also leaders in our ability to help you deliver a more complete solution - from sensors, data acquisition and video tracking through our unique AXIS-enabled multiprocessing capabilities to advanced graphics and communications solutions.

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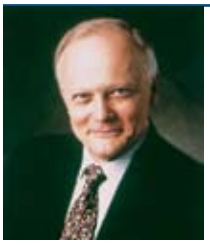
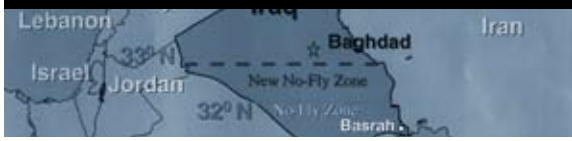
Publisher's Notebook





Politics, the Military and the Embedded Market

Several times since last spring you've read about military funding issues that won't be resolved until the November elections. Hopefully, by the time you read this resolutions will be in progress. It's inevitable, but politics that endanger our warfighters really irk me. For many of us old timers, the big issue with the Vietnam "Conflict" was that if you commit our military you have to be in it to win, not to be politically correct. These last few months have resurrected the issue of political correctness versus winning. Before I get a thousand emails regarding what is meant by "winning," let me just say that for each of us that means something different. But each of us also knows when politics are interfering with the military's ability to achieve its mandate.

Now that I've stirred up everyone's adrenalin with this subject, let's start with the embedded computing market. Like most changes we experience, there's good news and bad news. The good news is that we've recently seen another surge in consolidation of suppliers. The bad news is that we've recently seen another surge in consolidation of suppliers. The recent slow down in the embedded military market and the now anticipated upswing must have had some influence into the level of acquisition activity. As a user of embedded products, assessing a move like this as good or bad depends solely on the individual products or services you are acquiring. If the product you are utilizing is supplied by a company that is being acquired—and that product may be considered for a reduced life span because it is redundant or doesn't fit into the acquiring company's plans—then you may feel nervous. However, if the merger now provides you greater product access, integration and support, then you are pleased.

Moving from the personal effect consolidation has to a more global look, there appears to be a strong positive picture for embedded electronics. Embedded electronics in the military are of increasing importance for new entrants into the military market, and embedded electronics importance is increasing at the other end: deliverable military systems. Publications that focus on deliverable systems are providing greater detail on the technology that is embedded in the systems—not at the level that we do in *COTS Journal*, but sufficiently to enable their readers to understand the concepts. At the newcomer end of the spectrum we usually have small companies with unique or clever implementations of products that are increasingly of interest to the military. This pincer movement from the deliverable system side and the entry-level side has been keeping our editorial team very busy and confirms the long-term strength and growth of our market.

We all need to remind ourselves that the military marketplace moves at a much more steady pace than the non-military market. The much larger than normal uptick that we will experience in deliverables the next ninety days will more than likely not sustain itself indefinitely. It will be a result of fulfilling the delayed deliveries and orders from the last five months. Smart companies—those that have made acquisitions and those that have entered the military market during the lull—must now stay on top of the curve and make sure they provide the customer service and products demanded. This is not the time to lose potential customers your company fought and paid to get. The non-mil market is currently re-learning that customer service has a high value. Companies that will be most successful in the Mil market will have customer service as a major component of their sales and marketing effort.

Now a comment on a much larger plane but in line with the initial comment of politics versus what is right for the military. Even I can easily see that the current manpower level of the U.S. Army is too small. No matter what increased effectiveness technology can provide the U.S. Army, you need to have feet available on the ground. Our current legal manpower limit is somewhere around 512,000. The strain we are putting on our Reserves and National Guard, along with our inability to project the ability to deal with an additional global crisis should not be continued. Those individuals that are proposing to increase the manpower limit to 560,000 should be supported.

The occasional commentary here on more global military issues should not be construed as a shift in focus. *COTS Journal* still focuses on delivering the latest technology information to an ever-increasingly sophisticated technical decision maker from the project to the deliverable system. Our readership may be broadening with increased subscribers from the DoD and companies providing deliverable systems, but we clearly understand the service that we provide and where our value is to the marketplace. We will continue as the book of record for embedded military electronics technology. ■■

Pete Yeatman, Publisher
COTS Journal

COTS JOURNAL

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The Inside Track

Barco to Provide Display Workstations for FCS NLOS-Cannon Prototypes

Barco has been selected by BAE Systems Land & Armaments LP, Armament Systems Division, Fridley, MN, for the Non-Line-of-Sight Cannon (NLOS-Cannon) early prototypes. Through its dedicated subsidiary for mission-critical applications, Barco Federal Systems, the company will provide rugged display workstations. The NLOS-Cannon early prototypes are 155 mm, self-propelled cannon systems developed for the U.S. Army's Future Combat Systems program. Each system will be equipped with four display workstations configured in a two-man crew station.

Barco's 17-inch rugged displays incorporate the latest backlight solution using LED technology, while the computers integrate the latest in desktop graphics boards within a small and sealed package. The displays and computers are then mounted together to form a small, easy-to-install workstation core. The new display and processing product designed for this program is an extension of Barco's existing Modular Rugged Display System (MRDS) product range, providing the next generation of powerful embedded computing with high-performance display capabilities within a single product platform. The NLOS-Cannon early prototypes are the lead systems for the Boeing/SAIC-led Future Combat Systems Manned Ground Vehicle program and will be delivered for developmental testing beginning in 2008.

Figure 1

Scheduled to be delivered for developmental testing beginning in 2008, the Non-Line-of-Sight (NLOS) Cannon early prototypes are the lead systems for the Boeing/SAIC-led Future Combat Systems Manned Ground Vehicle program.

Barco Federal Systems
Duluth, GA.
(678) 475-8000.
[www.barco.com].

Mercury and Barco Team Up for Sensor Visualization and Data Fusion System

…. and in other Barco news: Barco Federal Systems and Mercury Computer Systems have announced a collaboration to design and develop a forward-deployable system for counter and human intelligence (HUMINT). Mercury and Barco have completed initial concepts in conjunction with the Battle Command Battle Lab at Fort Huachuca, Arizona. The system will include a Mercury module based on the Cell Broadband Engine (BE) processor and the Mercury MultiCore Plus SDK (Software Development Kit), with visually rendered displays and a sensor acquisition subsystem from Barco. Designed to use algorithms involving human intelligence, modeling and computer gaming features, including a high-performance physics engine, the concept system provides real-time intelligence for predictive analysis and decision support.

Mercury's Cell BE processor-based products are optimized in size, weight and power (up to 205 Gflops) to enable the war fighter to execute algorithms in a deployable platform that previously could not have been executed. Mercury's Cell BE processor-based solutions provide a marked increase in processing power over traditional fielded computer systems.

Barco Federal Systems
Duluth, GA.
(678) 475-8000.
[www.barco.com].

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

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CG2 C3D Demo Employed in Army AAEF C4ISR On-The-Move Test

CG2, a wholly owned subsidiary of Quantum3D, announced today that its software developed under a Phase II contract from the U.S. Army Communications Electronics Research, Development and Engineering Center (CERDEC), Ft. Monmouth, NJ, is being employed in the fall Air Assault Expeditionary Force (AAEF) C4ISR On-The-Move experiment at Ft. Benning, GA.

The Command and Control in 3 Dimensions (C3D) technology demonstration combines FBCB2 VMF messaging, a Quantum3D GeoScapeSE COTS McKenna MOUT geospecific terrain database, high-resolution digital map imagery and Mil-STD-2525B symbology into an innovative C4ISR application. It is designed to provide warfighters with an enhanced, real-time view of the battlefield environment by including 3D terrain and culture combined with an intuitive, game-style 2D/3D user interface that is designed for use in high-stress environments across multiple tactical platforms. The graphical rendering engine used for the technology demonstration is based on the Quantum3D

cross-platform IData COTS Visual Computing Framework, which includes the IData Human Machine Interface (HMI) suite, IData3D integrated real-time 3D scene manager and IDataMAP Digital Map components.

CG2/Quantum3D
San Jose, CA.
(408) 361-9999.
[www.quantum3d.com].

PrismTech Java Middleware Chosen for Navy DDG 1000 Destroyer Program

Raytheon has selected PrismTech's OpenFusion RTOrb Java Edition CORBA middleware for development and deployment in the U.S. Navy's DDG 1000 Zumwalt Class Destroyer program. Formerly known as the DD(X) destroyer program, DDG 1000 Zumwalt is the lead ship of a class of next-generation multi-mission destroyers tailored for land attack and littoral dominance. DDG 1000 will provide forward presence and deterrence, and operate as an integral part of joint and combined expeditionary forces. Raytheon serves as the prime mission systems equipment integrator for the DDG 1000 program.

PrismTech's OpenFusion RTOrb Java Edition CORBA middleware provides a unified solution for integrating diverse distributed systems. Raytheon will incorporate OpenFusion RTOrb Java Edition in its implementation of the Total Ship Computing Environment Infrastructure (TSCEI)—an integrated suite of standardized, open architecture hardware, operating system, middleware and infrastructure services. Developed for the U.S. Navy by Raytheon and its subcontractors, TSCEI forms the backbone of the Navy's Total Ship Computing Environment—a robust, enterprise-network computing system on which all DDG 1000 application software programs run.

PrismTech
Burlington, MA.
(781) 270-1177
[www.prismtech.com].

General Dynamics Awarded Navy Contract for Navy ADNS Land-to-Sea Network

General Dynamics C4 Systems has been awarded a $5.5 million task order under the Air Force's Network-Centric Solutions (NETCENTS) contract for the U.S. Navy's Automated Digital Network System (ADNS) Increment III. General Dynamics will develop, document and demonstrate two engineering-design model systems and two shore-demonstration model systems to serve as fully meshed communication networks linking seaborne and terrestrial assets and personnel.

Figure 3

L-3's Panoramic Cockpit Display supplies pilot control and display for the major functions of the F-35 aircraft, including flight displays, sensor displays, communication, radio and navigation systems and identification systems, providing the pilot with total situational awareness.

ADNS is the Navy's program of record for wide area networking. The program consists of multiple components that are fielded on surface ships, submarines and at on-shore communications facilities. ADNS Increment III is a requirement for a fully meshed network with increased throughput capability, in support of real-time, mission-critical data transmission with a high degree of reliability, capable of supporting the latest Internet protocols.

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

Green Hills RTOS Selected for F-35 Panoramic Cockpit Display

L-3 Communications Display Systems has selected the INTEGRITY-178B RTOS for the System Processor within the Panoramic Cockpit Display (PCD) for the F-35 Lightning II aircraft, also known as the Joint Strike Fighter (JSF). The L-3 Display Systems Panoramic Cockpit Display supplies pilot control and display for the major functions of the F-35 aircraft, including flight displays, sensor displays, communication, radio and navigation systems and identification systems, providing the pilot with total situational awareness. This cost-effective, low-weight display is intended for production insertion into the F-35 Lightning II program and is designed to meet the demanding environment of the F-35 fighter aircraft. The display subsystem for the L-3 Display Systems will be integrated with other Operational Flight Program software developed by Lockheed Martin Aeronautics.

INTEGRITY-178B is an ARINC-653-2 full-time and memory-partitioned RTOS and has been certified multiple times to the FAA's safety-critical standard DO-178B. The stealthy F-35 is a supersonic, multi-role, 5th-generation fighter designed to replace a wide range of existing aircraft, including AV-8B Harriers, A-10s, F-16s, F/A-18 Hornets and United Kingdom Harrier GR.7s and Sea Harriers. The Green Hills Platform for Avionics is being deployed for a growing list of current and next-generation aircraft including the Lockheed Martin JSF F-35, F/A-22 and F-16.

Green Hills Software
Santa Barbara, CA.
(805) 965-6044.
[www.ghs.com].

L-3 Display Systems
Alpharetta, GA.
(770) 752-7000.
[www.L-3Com.com/displays]

Figure 2

The C3D system is designed to provide warfighters with an enhanced, real-time view of the battlefield environment by including 3D terrain and culture combined with an intuitive, game-style 2D/3D user interface tailored for use in high-stress environments across multiple tactical platforms.

COTS Websites

www.dod.mil/dbt

Business Transformation Site Tracks Reform Efforts Throughout DoD

As the largest purchasing organization in the world, the Department of Defense (DoD) must strive to ensure its acquisition function is reliable, responsive and cost-effective. With that in mind, Deputy Secretary of Defense, Gordon England, directed the establishment of the Defense Business Transformation Agency (BTA) in a memorandum effective October 7, 2005. Driven by the need to enhance support to the warfighter and provide better financial accountability, the Defense Business Systems Management Committee (DBSMC) approved the establishment of that defense agency to lead and coordinate business transformation efforts across the Department of Defense (DoD). The mission of the BTA is to transform business operations to achieve improved warfighter support while enabling financial accountability across the Department of Defense.

The BTA's Web site offers a rich variety of links and information on all things related to defense business transformation. Included are details on the Transformation mission, as well as specific transformation priorities within each DoD branch and subgroup. News, event and FAQ info are provided. There's information on transitioning to common logistics data standards, and a variety of Case History descriptions of Transformation in Action.

Defense Business Transformation
Washington, DC.
[www.dod.mil/db].

Main Feature

Power Conversion

Power Converters Evolve to Suit the FPGA Era

As military and avionics designs embrace today's advanced, integrated FPGAs and ASICs, power conversion solutions are racing to keep pace.

Jeff Child
Editor-in-Chief

Modern digital electronics present a challenge to designers of power systems for critical reliability applications in military and avionics programs. The latest high-performance FPGAs, ASICs and processors require increased high performance from the power supply. Typical requirements include low voltages, high currents, tight regulation, fast transient response and even supply voltage sequencing. These requirements present an even greater challenge to the military designer who does not have access to the latest new components but instead must choose from a limited set of high-reliability power converters and discrete components.

The typical high-performance digital board may require 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. In the past, engineers would typically place a DC/DC power converter at each output, which today is very expensive, very heavy, and can be inefficient.

The trend today is to improve efficiency while supplying various low voltage requirements on a single board.

Figure 1

An example point-of-load DC/DC converter is VPT's DVPL0510S, a non-isolated, synchronous, buck regulated converter that steps down the voltage at the point of end use. Measuring just over one square inch, the DVPL0510S delivers up to 10A (33W) of high current for a low voltage output of 0.8V to 3.4V, with up to 96% efficiency.

Today, engineers are turning to a single high-power DC/DC converter, with several point-of-load converters to power individual devices on the board.

Point of Load Converters

The critical difference is in the new class of point-of-load converters, employed instead of linear regulators or full DC/DC converters. The point-of-load converters (Figure 1) provide extreme power efficiencies, are less expensive than full DC/DC converters, are small and lightweight, and they ensure mil-grade reliability. Together with DC/DC converters, the point-of-load converters are today's COTS solution to the need for multiple voltages in a single system.

Meanwhile, the shift toward distributed power schemes and advances in power conversion technologies are affecting all types of systems, from VME to PC/104 to non-standard form-factor designs. No longer a foreign concept to the military realm, distributed power architectures are now the topology of choice for most any modern embedded system. Distributed power schemes provide a number of advantages.

They let you operate with a higher bus voltage and provide a lot of power

Point-of-load converters provide extreme power efficiencies, are less expensive than full DC/DC converters, are small and lightweight, and they ensure mil-grade reliability.

directly to a component. The higher voltage is converted to what's needed right at the point of load. That means less current is drawn for the same amount of power, avoiding the power losses incurred sending high current over long trace lengths. Designers must rely on printed-circuit-board-mounted DC/DC converters, slot-card power supplies and other power conversion components as their building blocks for crafting distributed power schemes.

More Integrated Supplies

To advance up the power density curve, power supply component vendors innovate by wringing whatever improvement they can from the magnetics and discrete components that comprise their products. Such innovations significantly reduce the stresses on the power switching elements—the FETs. By moving to higher frequencies, all the reactive components in their supplies—capacitors and so forth—can be much smaller with less heat dissipation. That enables power supply component vendors, in turn, to make the power supply smaller.

One area that's directly benefited by that trend is the PC/104 space. Makers of PC/104 power supply boards take advantage of those component innovations. No longer forced to do customer power supply designs, they take miniature supply components and add additional filtering and control circuitry around them. That results in PC/104 power supplies that are generally so "plug and play" that integrators can stack them with their PC/104 CPU and other boards without worrying about vexing system engineering concerns such as noise and heat management. ▮▮

Main Feature

Power Conversion

Component Module Approach Wins for Custom Military Power Supplies

For custom military power supplies, a component power solution often can be superior to a discrete power solution—and can be completed faster and with less risk.

Keith Nardone, Sr. Manager, Defense Products
Mark Connolly, Product Marketing Manager, Custom Systems, Vicor

It is not unusual for military systems designers to build their own power supplies from discrete components. Power supply design is perceived by many to be a low-tech, relatively low-cost task assignable to any design engineer—preferably junior level. Furthermore, it's often thought that the schedule can be easily managed in-house as part of the overall system design. More often than not, nothing could be further from the truth. For some who have suffered the pitfalls of the do-it-yourself approach, a custom power supply designed and built by a specialized power supply manufacturer is thought more likely to result in an optimum technical solution.

Custom power solutions are, however, usually expensive and risky, and they require long lead times. Custom power solutions for the military are, if anything, likely to be even more expensive, involve greater risk, and take longer to realize than non-military custom power solutions. Design risks in custom power solutions can often be traced to midstream changes or simply the unpredictable, which is inherent in traditional approaches. Typically, custom power design cycles can run six to nine months.

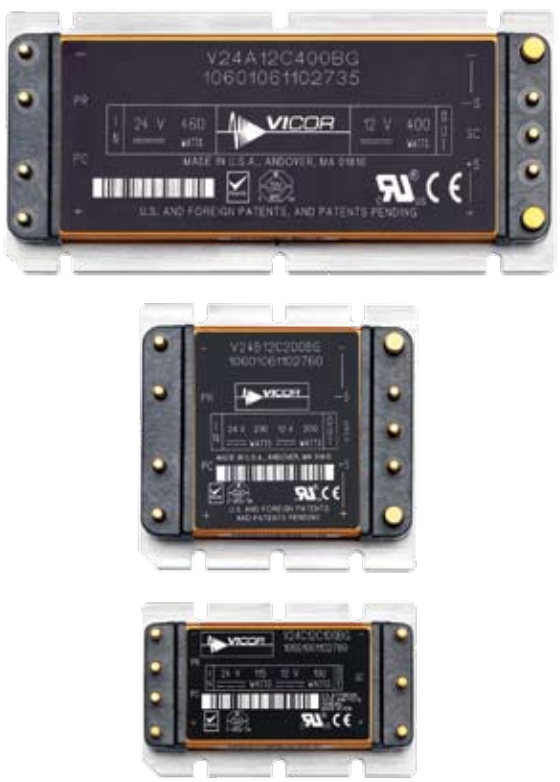

Figure 1

An example family of component power modules.

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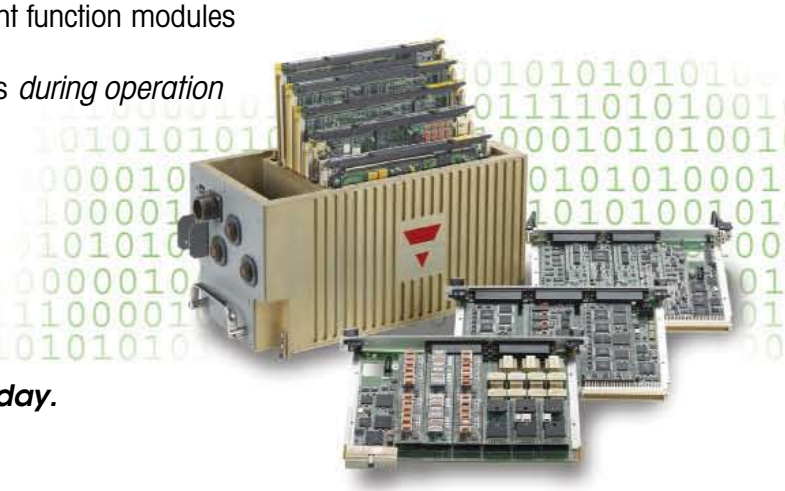

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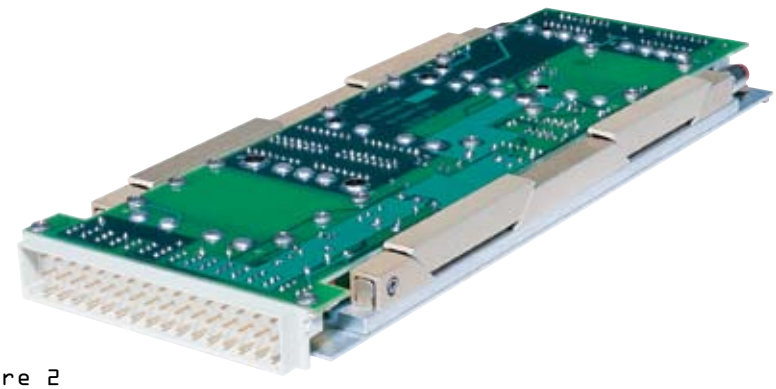

Figure 2

Shown here is a custom power supply designed for a manned space vehicle. Most high-density DC/DC converter modules are qualified to stringent environmental requirements, and some standard bricks—those that are fully encapsulated—can handle high-g forces.

Myths About Power Tradeoffs

A frequently quoted axiom claims that a buyer can expect a product to have high quality, fast delivery and low price—just not all three at the same time. Nevertheless, if the product is a custom military power supply, a component power solution often can be superior to a discrete power solution, completed within a shorter lead time, at lower cost, and with less risk.

The number of custom power supply manufacturers is very large, but the number whose designs are based on component power modules is relatively small. Figure 1 shows an example family of component power modules. Those manufacturers—especially the ones who specialize in the military market—possess some advantages over conventional custom power manufacturers. Of course, that's largely because modular power components—DC/DC converters—are manufactured in volume, undergo rigorous testing, and they have proven their worth in many demanding applications, including military applications. But there are other reasons.

Power Component Advantages

Although the military primarily uses input voltages of 28 volts for ground and airborne, 270 volts DC for airborne, plus AC, modular components come in great range of different voltages, powers and physical sizes. Modular components used for COTS applications satisfy the other input characteristics as well, including low- and high-line conditions and the capability to handle voltage spikes, surges and excessive input ripple. Available output powers range from tens of watts to kilowatts, from single outputs to 40 outputs. Most high-density DC/DC converter modules are qualified to stringent environmental requirements, and some standard bricks (those that are fully encapsulated) handle high-g forces. Figure 2 shows a custom power supply for a manned space vehicle. The building-block design approach is cost-effective and offers quick turnaround and reliable performance.

Furthermore, some module manufacturers offer an accompanying array of accessories that facilitate the design of a custom power system. Military COTS filter modules, for example, are available to complement the converter modules, offering EMI and transient compliance for both DC and AC systems. These compatible accessories help designers arrive at solutions faster and with less risk and less cost—considering there is no design time or contribution to what would otherwise be higher NRE. Custom manufacturers who routinely use such accessories further improve the advantages of using power components.

Power Components Defy Obsolescence

Risk of obsolescence is an important problem for many military systems. A substantial segment of custom power manufacturing business comes when replacement or upgrade of the power system is needed for an old system. Custom military systems manufactured with component power modules often give designers cost-effective options for such systems. A high likelihood often exists that the replacement or upgrade could even be pin-compatible with the original. Or, with the availability of fractional-sized bricks, made smaller.

One case, for instance, involved replacement of an obsolete power supply and reducing the weight of the Harpoon missile (Figure 3), which has a unique configuration. The designer couldn't change the missile; so the power solution had to fit in the space available. Interestingly, the retrofitted power supply was made so much smaller and lighter that a piece of steel had to be inserted to maintain proper balance. In some new programs, however, such as the Joint Strike Fighter or other new aircraft, the requirements are much more demanding: more power in a smaller package, no airflow and lighter weight.

Military customers want, and in fact need, long-term support. The life expectancies of military systems commonly extend as long as 20-25 years. Interestingly enough, some of the first modular DC/DC converters ever built are still in operation today. But more to the point, those designs are still being manufactured today. There's no need to redesign or re-qualify, and even the documentation can still, in general, be used.

Power Components Ease EMC Compliance

Another potential area for risk in a custom military environment is the satisfaction of EMI/EMC requirements. Most component power manufacturers, especially those with COTS customers, make provisions for meeting such EMC compliance requirements as MIL-STD- 461. While it's true that switching power supplies generate noise, in recent years they have replaced the previous holder of the quiet crown, linear power supplies.

EMC filtering can be achieved using discrete components or filter

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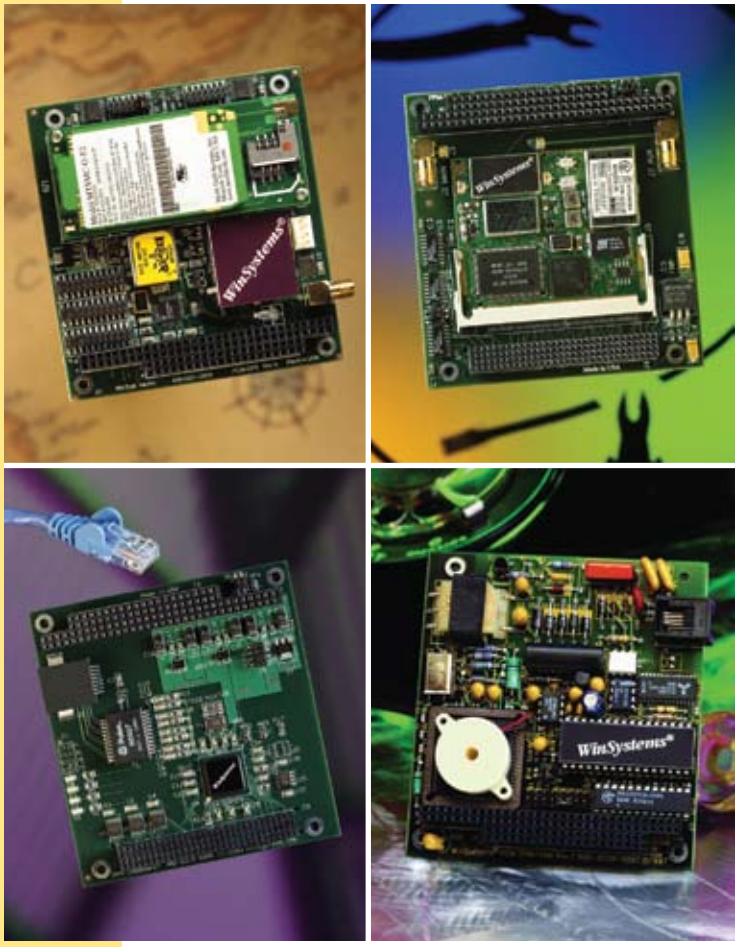

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a)

b)

Figure 3

Shown here is a custom power supply (a) for the Harpoon missile. An AGM-84D Harpoon missile (b) is shown here being loaded onto a P-3 Orion using an electric bomb hoist.

modules. A common solution, for example, is the availability of an accessory module designed to provide the EMI/RFI filtering and transient protection required in military applications. Such modules meet the conducted emissions specifications of MIL-STD-461C/D and offer input transient, surge and spike protection to the most severe levels of MIL-STD-1275A and 704A.

Off-the-shelf power components are routinely designed and manufactured to satisfy MIL-STD-800 requirements for humidity, fungus, salt, fog, explosive atmosphere, acceleration, vibration and shock. Some undergo environmental testing as specified by MIL-S-900 and MIL-STD-202 and 100% environmental stress screening as well.

Because operating temperature is one of the most important factors in determining overall module reliability, its design must ensure efficient heat transfer to the system ambient. An exposed baseplate design facilitates heat removal, and a 10°C decrease in baseplate temperature can increase MTBF by over 50%. Some modules use a spin fill process to ensure complete, void-free encapsulation, making them suitable for the harshest military environments. In addition to providing mechanical rigidity, the encapsulant is thermally conductive, eliminating hot spots and improving heat transfer to the baseplate.

Power Components and Manufacturer Experience

In spite of the head start gained with components, and in spite of starting with a known, proven product, the nature of a custom system is that it's unique. It needs experienced, knowledgeable power specialists—engineers with a track record.

Many custom manufacturers have the skills and experience to offer effective complete solutions to meet unique military power requirements. Fewer, however, can provide module-based custom solutions and have the requisite experience with military and aerospace applications. Of those custom manufacturers that specialize in the design and manufacture of power supplies using power components, some are related by investment or organization to a large power component manufacturer, with access to substantial resources: sales, technical and financial.

Incidentally, the COTS approach eliminates the need for full MIL for many applications. The full MIL programs still go to the larger companies that can support the specialized resources that are required. Recently, a small power manufacturer entertained an opportunity to design and build 60 power supplies for the Turkish Air Force and had to turn it down after determining that specialized manpower would be needed just to manage the paperwork.

With components, some significant part of the design is already done when the custom design really begins. Proven, reliable DC/DC converters are simply selected. Vicor, for instance, builds over a million DC/DC converters a year. They are the heart and soul of these custom power supplies, so the risk is mitigated when the component approach is taken.

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Main Feature

Power Conversion

Fuel Cells Invade Next-Gen Mobile Equipment

Offering better weight, safety and energy density characteristics than traditional military batteries, fuel systems are staking a claim on next-generation portable military designs.

Ted Prescop, Senior Applications Engineer
UltraCell

The modern soldier relies on an increasing array of sophisticated electronic equipment. Soldiers and commanders alike have improved capability to gather intelligence, to communicate, and to coordinate their actions due to advances in the equipment they carry. But military missions are limited by the high cost and weight of batteries and the severe burden they place on individual soldiers. Fuel cell systems—which have much higher energy density than batteries and lower weight than electric generators—will either replace or supplement batteries as the primary soldier power source and will result in more mobile soldiers, longer mission lengths and lighter pack loads.

For a typical 72-hour mission at 20 watts average power usage, a fuel cell with three fuel cartridges today weighs 6.3 pounds—only a third of the weight of lithium-ion batteries. Fuel cell systems are able to power the full range of devices that soldiers carry—from sensors to ruggedized computers to satellite phones.

Figure 1

An example reformed methanol fuel cell is UltraCell's XX25. It blends a 10-liter reservoir fuel cartridge with a smart power manager that hybridizes an XX25 with a lead-acid battery.

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High interest has also been shown by emergency first responders—fuel cells can provide power in disaster areas for a broad range of applications including: radio, mesh networks, laptop computers, cameras, medical devices and AA battery recharging. As electronic equipment becomes more powerful and ubiquitous, the need for portable power will only increase.

An RMFC (Reformed Methanol Fuel Cell) system for portable electronics applications, produces hydrogen from highly concentrated methanol. The system then feeds that hydrogen into a fuel cell to generate electricity. The most user-friendly systems provide the convenience of hot-swappable and inexpensive methanol fuel cartridges with the high power density and efficiency of a hydrogen fuel cell. Figure 1 shows an example of a reformed methanol fuel cell product.

Safe and Mature Technology

In the past five years, fuel cell technology has started moving out of laboratories and into the real world. Fuel cell system manufacturers have begun designing, building and testing easy-to-use fuel cell systems for consumers. Operationally, fuel cell systems are safe. Unlike batteries, fuel cell systems keep their reactants (their fuel) separated from the reaction site. Only small amounts of fuel are used at a time in a controlled chemical reaction that produces electricity. To

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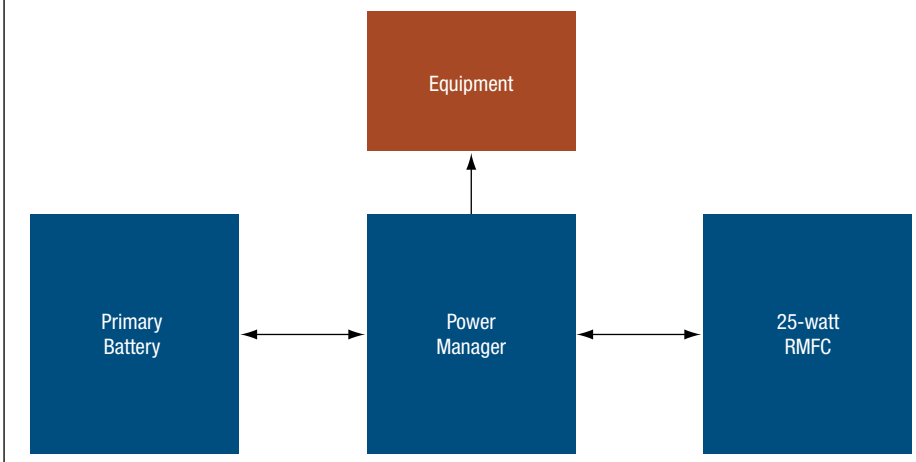

Figure 2

A hybrid solution consists of a fuel cell, a rechargeable battery, and a power manager that intelligently manages power draw from the fuel cell system and battery to maximize efficiency. In a hybrid scenario, a 25-watt fuel cell system can power any equipment requiring up to 25 watts average power.

Figure 3

Many military and government officials, as well as emergency responders, depend on rugged laptops to ensure reliable computing in difficult environments. Fuel cells in this particular application give longer run-times. For example, one of the popular ruggedized laptops has an average power draw of 11W to 15W. For this laptop, you can expect 12-16 hours of run-time on a single fuel cartridge.

further ensure safety, there are many rigorous test standards including Mil-STD 810F, 461E, 462D, OSHA emissions requirements, and IEC PAS 62282-6-1 safety standards for fuel cells and fuel cartridges.

The safest systems also undergo further testing such as shock, drop and vibration testing (including MIL PRF 49471B(CR), IEC PAS 62282-6-1, shock and vibration per MIL-STD-810F and cartridge crush test per UL 2265A). Then next step for the highest of quality systems is to pass high-temperature operation, short circuit and salt water immersion tests. When all of these tests have been passed, a Safety Assessment Report verifies that the fuel cell system is safe for use by soldiers.

Effective January 2007, the ICAO (International Civil Aviation Organization) has agreed to a new provision allowing passengers and crew of commercial aircraft to carry onboard portable electronic devices powered by fuel cell systems, along with spare fuel cartridges (105-96-PAS1).

Fuel Cells and Batteries: Hybrid Solutions

Fuel cells and batteries both have their benefits. While RMFC systems excel at high-efficiency power generation and can run as long as fuel is available, batteries are better at responding quickly to changing power demands and providing high currents for power pulses.

A hybrid solution consists of a fuel cell, a rechargeable battery, and a power

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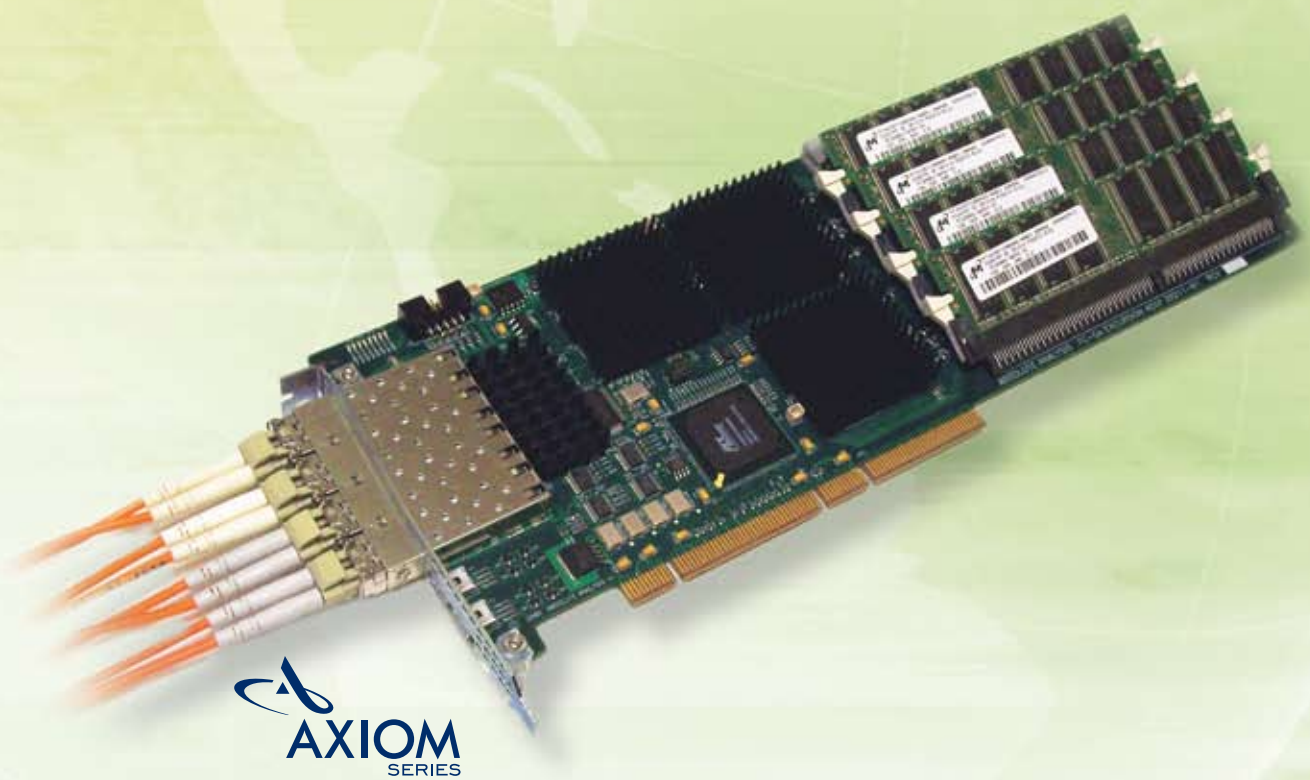

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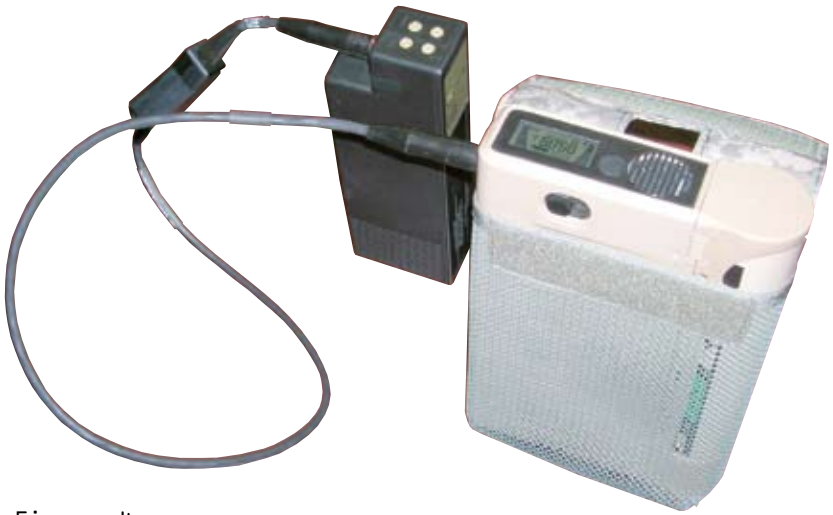

Figure 4

UltraCell Corporation is working with the U.S. Army to develop a field-demonstrable system compatible with Land Warrior. To power the electronics on the military vests used by the Land Warrior/Future Force Warrior (FFW) programs UltraCell offers a hybrid XX25—a lithium-ion battery system: a current-limited UltraCell system in parallel with the Land Warrior battery.

manager that intelligently manages power draw from the fuel cell system and battery to maximize efficiency. In a hybrid scenario, a 25-watt fuel cell system can power any equipment requiring up to 25 watts average power. Figure 2 shows a diagram of a generic hybrid fuel cell solution. When the equipment is using less than 25 watts, the fuel cell charges the battery. When the equipment uses greater than 25 watts, the battery provides peak power above 25 watts. If the equipment is only using a few watts, the power manager can shut off the fuel cell and run off the battery alone.

Ruggedized Laptops

Today, many military and government officials, as well as emergency responders, are using ruggedized laptops (Figure 3) to ensure reliable computing in difficult environments. Fuel cells in this particular application give longer runtimes. For example, one of the popular ruggedized laptops has an average power draw of 11W to 15W. For this laptop, you can expect 12-16 hours of run-time on a single fuel cartridge.

Laptop and fuel cell compatibility are of primary importance in the manufacturing of new fuel cells. One design to ensure the system will provide the correct voltage output for the laptop is by plugging in a variable voltage tether from the fuel cell into the laptop. If the laptop needs more than 25 watts, the output voltage of fuel cell will drop and the laptop will either switch to its internal battery for power, or will draw power from both its internal battery and the fuel cell.

It is also important that correct power management software will be able to communicate to the laptop that it is a fuel cell system—not a battery or AC/DC adapter. The laptop will then remain in a low power mode when attached to the fuel cell and, in most cases, will be able to keep power consumption below 25 watts. For some systems, this requires USB communications between the fuel cell and the laptop.

PC/104, Remote Video and Sensor Apps

Many military electronics programs are started with the development of a PC/104 embedded platform. Twenty-five-watt fuel cells are capable of

powering most PC/104 applications and have the capability of extending run-time far beyond what is realistic for batteries today. If the application is in a remote location, the cost of batteries and battery replacement can be prohibitive compared to a tank of fuel.

Another application fuel cells are projected to impact is where extremely long run-times are required in remote locations. One system, the UltraCell XX25, is trying to solve the problem by combining a 10-liter reservoir fuel cartridge with a smart power manager that hybridizes an XX25 with a lead-acid battery. This unit can power most applications that currently run on 12V lead-acid batteries and can provide one month of continuous run-time at 10 watts average power—greater than 8,000 watt-hours for each fuel cartridge—and weighs approximately 30 pounds fully fueled. That's half the weight and eight times the run-time of the lead-acid batteries that are currently used for remote power.

This unit, dubbed the MS25, can be used to power mesh networks, satellite phones, video and audio surveillance equipment and remote sensors for military applications, for extremely long periods of time between re-supply. The MS25 can take input power from a solar panel array and can power more than one device or sensor at the same time.

In addition to long-range, remote location missions, the UltraCell XX25 may be the answer to large energy but low weight requirements of the modern solider for several reasons. The already completed Safety Assessment Report ensures more than just operational safety and ruggedness. There are many uses for the UltraCell because of the high level of compatibility with ruggedized laptops, wearable vest configuration, PC/104 embedded configurations, ease of convertibility into a hybrid configuration by communicating via SMEbus and design that complies with the ICOA rulings for use aboard commercial planes. Also, the UltraCell's SMEbus v1.1 adds extra capabilities by allowing external devices to operate the system. Ultimately, the high compatibility with existing systems, ease of implementation and energy storage capabilities 2-3 times the energy density of Li Ion batteries, will drive the market for UltraCell XX25 and fuel cell technology.

Wearable Vest Configuration

UltraCell Corporation is working with U.S. Army RDECOM CERDEC to develop a field demonstrable system compatible with Land Warrior (Figure 4). To power the electronics on the military vests used by the Land Warrior/Future Force Warrior (FFW) programs for the future warfighter, UltraCell's solution is to use a hybrid XX25—a lithium-ion battery system: a current-limited UltraCell system in parallel with the Land Warrior battery. Early testing has shown that this hybrid system satisfies power requirements.

Driven by the increasing use of portable electronics equipment by military, government and emergency responder personnel, and due to the large weight of batteries needed to run this equipment for extended run-times, fuel cell systems are becoming more attractive. Fuel cell systems are a reliable way of reducing weight while increasing run-time in both portable and stationary equipment. Fuel cells are ideal for the military and emergency responder markets that are driving these applications. ▮▮

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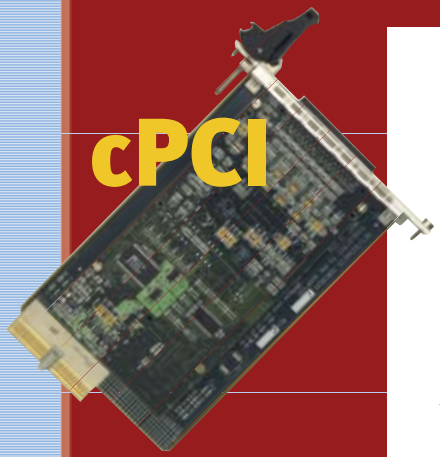
How to Choose a Data Acquisition Board



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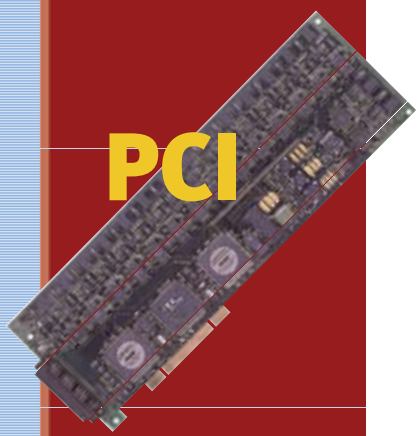

The following is a comparison of 24-Bit Delta-Sigma Data Acquisition Board Characteristics of General Standard's offering and the leading competitor.

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Power Dissipation/32 Chan	12 Watts	35 Watts
Phase Skew	55ns (0.1 deg at 5KHz)	Not specified
Crosstalk	96dB	90dB
SINAD	93dB (cPCI, PMC, & PC/104+)	86dB (cPCI), 90dB (PCI)
Gain Accuracy	± 0.1mV, ± 0.1 percent	Not Specified
Sample Rate	200K per Chan (cPCI,PCI,PMC, PC/104+)	108K per Chan (PCI) 216K per Chan (cPCI)
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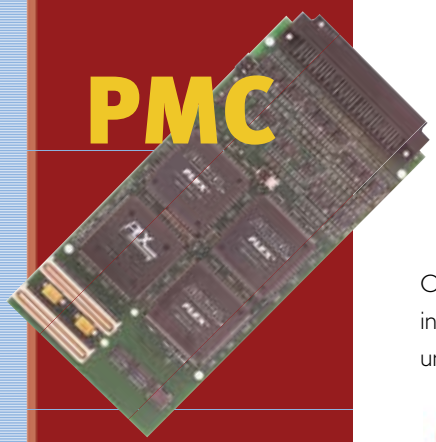
* Cost is for Commercial Temp Version. Quantity discounts available. Conformal coating available.



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Tech Recon

Stand-Alone Rugged Boxes

Stand-Alone Rugged Boxes: The Newest COTS Hardware

As compute density increases, military technology gets more complex and primes adopt open standards, they are asking subcontractors more often for box-level COTS solutions.

Ann R. Thryft
Senior Editor

A current trend in military system design reflects both changes in what prime contractors need from their subcontractors and overall trends in electronics. The primes are giving more responsibility to subcontractors by pushing the definition of COTS from the board level to the box level. That way, the prime doesn't need as many different types of in-house expertise, turning over more to the subcontractor.

Subcontractors are now providing not just board-level products, but stand-alone box-level products, including data acquisition and processing systems, laptops, tablet PCs, displays and handheld LCD monitors, as well as more systems integration and testing.

At the same time, advances in electronics technology are combining with an increase in the adoption of open standards to help consolidate what used to be multiple, separate computers or boxes into just one or two. This is occurring in the mobile battlefield control and information systems in ground vehicles (Figure 1). Other environments include missile-guidance systems, ground-based or shipboard radar/sonar sensors and unmanned aerial vehicles (UAVs).

Figure 1

Much of the consolidation in compute platforms is occurring in stand-alone rugged boxes used for ground vehicles, such as Humvees and tanks. In Dibbis, Iraq, a member of Company C, 96th Civil Affairs Battalion, maintains security from the turret of a Humvee while inspecting abandoned buildings slated for conversion to barracks for members of the Iraqi Civil Defense Corps. *Photo by Sergeant April Johnson, courtesy of U.S. Army.*

Smaller, Denser Systems Analyze More Data

Much of the push behind this trend comes from the current war effort. Size, weight and power, as well as gigaflops per watt, are two main drivers, says Joey Selvin, partner development director for Mercury Computer Systems' Defense Business Unit. "In back of those are the need for data collection, such as more intelligence in smaller UAVs and unmanned ground vehicles (UGVs), and on larger platforms such as JSTARS, meaning more sensors."

At the same time, image resolution and consequently the amount of data is increasing, so more computing power is needed to get more information out of that data for target detection, identification and tracking routines.

Sensor fusion is a good example of consolidating previously separate systems. Mercury's PowerStream6600 is an integrated multicomputer that enables sensor fusion by replacing separate computers fed by separate sensors, often from separate vendors. The 6600 system comprises CPU and FPGA processing modules and I/O mezzanine carriers, interconnected via the Serial RapidIO backplane switch fabric and housed in a VPX-REDI chassis.

"We're getting hints that the primes don't want to think about what boards are inside the box," says Selvin. "What's keeping them awake at night is worrying about EOL for boards, but that shouldn't matter, so let us manage that," he says.

Consolidation Aids Frequent Technology Upgrades

Consolidating the multiple boxes inside a vehicle into a single box enables more data to be analyzed in-vehicle,

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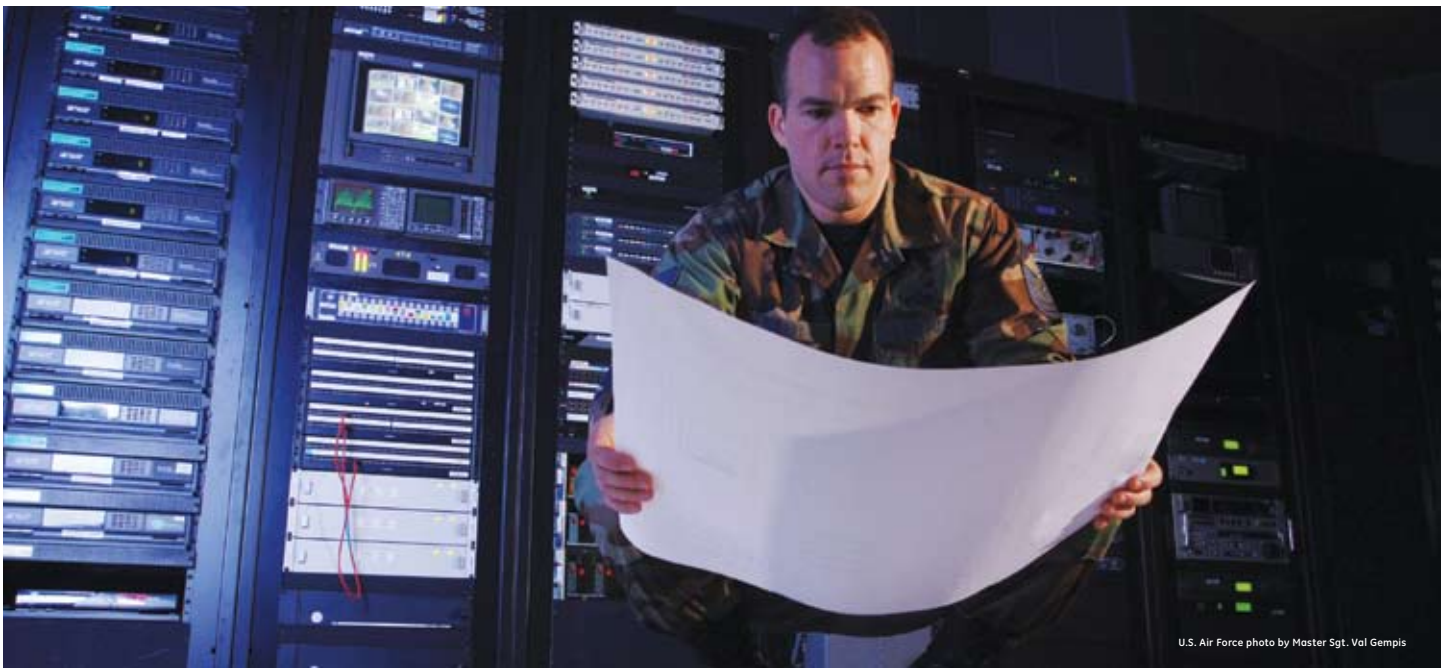
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Figure 2

Many stand-alone rugged boxes deployed in ground mobile vehicles function as mobile battlefield control and information systems, such as this Video Display Terminal from Interstate Electronics Corp., a subsidiary of L-3 Communications. The integrated computer and display unit with video interface, used on the Army's Stryker Vehicle, provides a ruggedized, affordable, lightweight package with design enhancements to open-architecture COTS subassemblies.

instead of sending it to the U.S. for analysis.That helps speed up identification and tracking of vehicles in a convoy so none of them can get lost, says Greg Martz, marketing manager for Interstate Electronics Corp. The wholly owned subsidiary of L-3 Communications produces ruggedized mobile network information systems (Figure 2).

No single box will fit every application possible on a given platform. But, especially in a ground mobile environment, three or four different computers or boxes and video monitors inside the vehicle can be condensed into one box to save space and make it easier for one or two people to operate a system. "This also allows newer technologies, which come along every six months or so, to be implemented more easily," he says.

For example, network information systems require integrating GPS used in several different ways. A receiver that used to be a stand-alone radio or other gear can now be integrated on the vehicle's inside display units. In the future, the network system will let drivers safely view conditions outside, serve as a weapons control station and track soldiers on foot or other vehicles in the convoy.

Faster, Denser Electronics Boost Performance, Functionality

Changes in technology have helped make all of this possible. The increasing CPU MIPS per watt has helped Kontron America build an in-vehicle unit that used to require multiple boxes, says Farhad Sharifi, director of Systems EPC. Used in Humvees for blue force tracking in Iraq, the system can perform data and video processing in a single, rugged, fanless box. In addition, open-standards technologies such as MicroTCA

and PCI Express increase I/O bandwidth, so small ruggedized units can do much more. In particular, demand is increasing for small, portable tablet PCs that can process live video feeds.

Smaller, more application-specific boxes are more reliable and cost-effective, says Kontron's Systems product manager Tony Hallet. "There's more functionality in boards than ever before. In the past, we had to add on video, sound and USB cards. But as boards shrink and acquire more functions, the end result is a highly integrated system that doesn't need all the expansion slots it once did, boosting processing power."

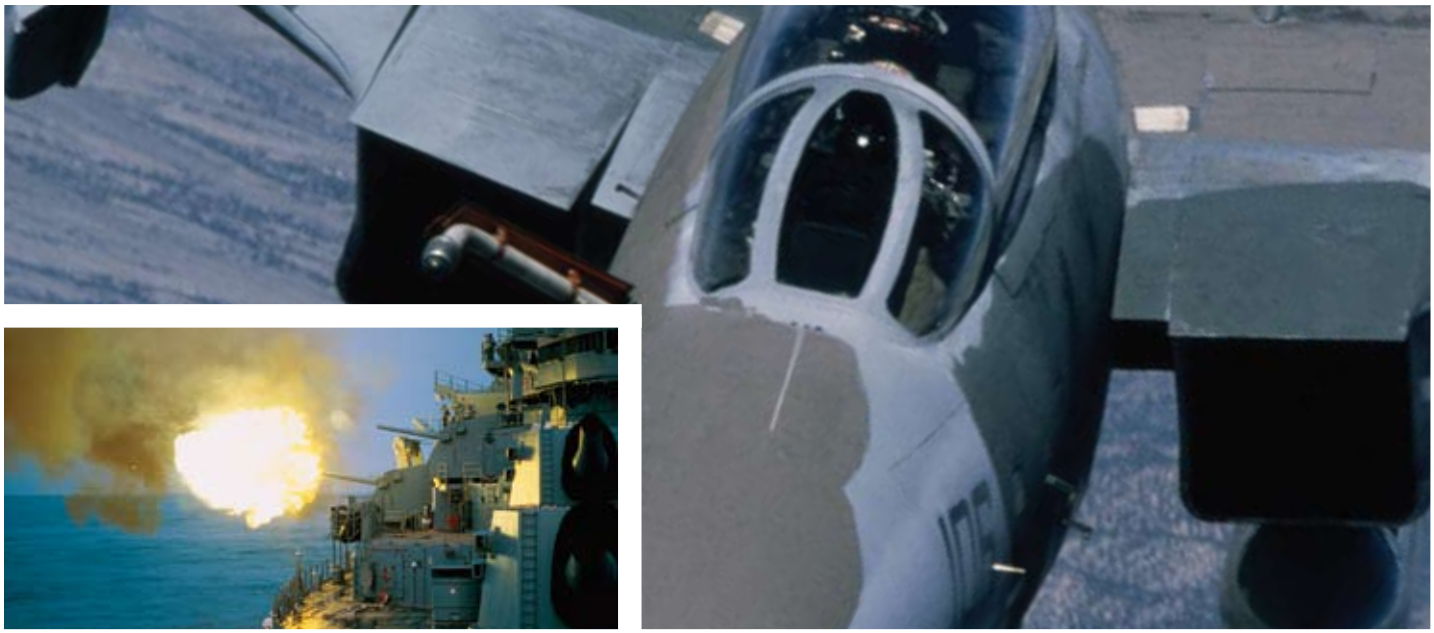
The types of systems being designed for the military today are becoming very complex, spanning multiple boxes and often in separate physical locations, says David Pursley, pre-sales applications engineer for Kontron's Pittsburgh, PA division. "The whole point of Future Combat Systems is having many smaller rugged systems deployed throughout the field communicating in a fairly seamless big system. Customers are looking at integrating at one level higher than they were before."

Packaged COTS and a Common Software Architecture

For Curtiss-Wright Controls Embedded Computing (CWCEC), the trend is called "packaged COTS," says Chris Wiltsey, director and site manager of the San Diego, CA facility. "In the past, with something as complicated as a performance-based spec, we would have specified the boards and packaged them."

Now, the idea is to let the COTS vendor collect boards, install them in a box and stand behind the performance of everything in it while customizing it as little as possible. Customers are trying to be flexible so the solution is as close to an off-the-shelf solution as possible, and doesn't come with the large cost associated with custom engineering, he says. "We are being smarter about which parts and enclosure technology we use so we are 90% of the way there." To do this successfully demands knowledge of a program's requirements as well as of the modules and their integration, interoperation and interperformance.

The big drivers are really time-to-market demanded by the defense contractors and complexity, says John Wemekamp, CTO, CWCEC Ottawa. Integrating formerly separate LRUs into one box creates more pressure for interoperability. In response, CWCEC has developed the Continuum Software Architecture to reduce development, integration, life-cycle maintenance and support costs by enhancing ease of integration with the company's system building blocks, such as SBCs and mezzanine cards. The architecture delivers a cohesive, comprehensive approach to compatibility and interoperability beyond traditional hardware interfaces, providing a common, comprehensive set of APIs. "We've gone through the learning curve so customers don't have to," says Wemekamp.



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Tech Recon

Stand-Alone Rugged Boxes

Open Architectures Enable Fully Integrated Systems

A scaled-down need for ruggedization combined with open architectures is enabling fully integrated, box-level systems to be provided from a single vendor.

Laura Cooper, Director of Marketing
Next Computing

The emergence of open architectures is evident across nearly all areas of technological development today. Interoperability is critical in an age when multiple technology devices are relied upon everywhere, including military applications. Proprietary interfaces limit technology use, no matter what the application. Military and defense applications vary greatly, and many require an extensive and complex computing infrastructure. Hence, the adoption of open systems for military applications has surfaced.

In the initial phases of the COTS movement, there was a shift early on from proprietary board-level solutions to commercial subsystems, allowing easier integration and future expandability, as well as significant cost savings. Although this shift brought improvements, it has also resulted in several inherent problems.

The number of component types necessary to complete the infrastructure using a board-level solution is vast. Hardware includes SBC cards, graphics accelerator cards, power supplies, cabinets, ruggedized enclosures, network interface cards, network switches, extensive network cabling, SCSI disk drives, 1553 or other legacy I/O cards and solid-state memory devices.

Figure 1

The ATI FireGL 7350 Graphics Accelerator with PCI Express form-factor.

Commercial software components may include the operating system, application-specific software, compilers, graphical user interface generators, debuggers and network interface software drivers. In addition to commercial components, some amount of custom hardware and software is often required.

Challenges of Integrating Board-Level COTS Components

Although the obvious intent of moving to board-level COTS components was

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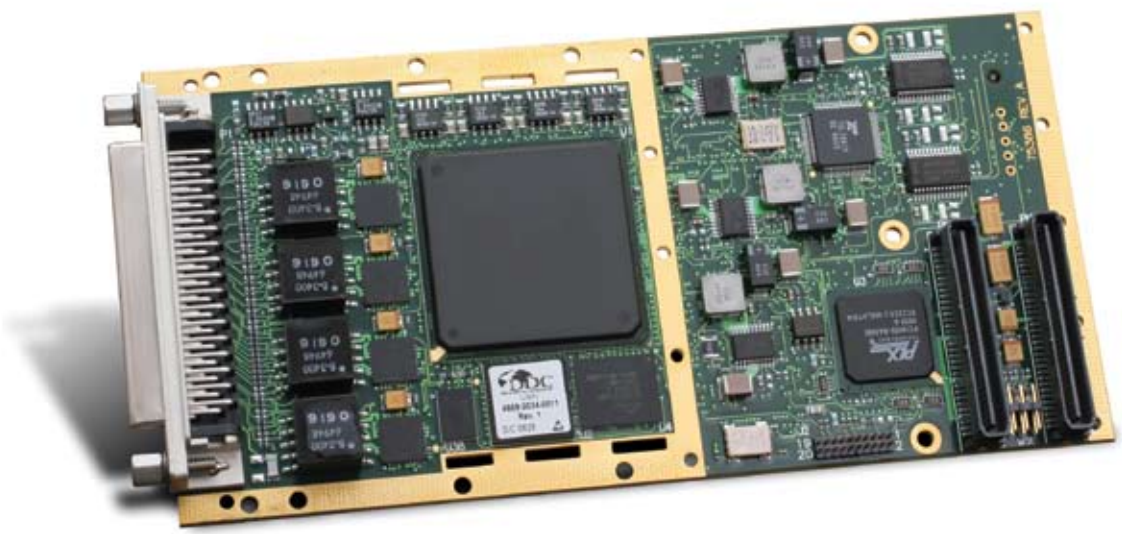

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Figure 2

NextComputing's NextDimension, a portable workstation.

to make application integration easier, it seems that the solution has fallen short of the expectation. When it comes to applications with ever changing requirements, which includes just about all of them, flexibility and future upgradability are key. Just as important is the compatibility of each open component.

While board-level solutions addressed these problems to a degree, there have still been issues of components not fitting the "plug-and-play" model, and modifications have often been necessary to make them work together. In addition to compatibility modifications, proper enclosures housing all of the different pieces must be retrofitted and/or custom built. These issues seem to make the solution proprietary in many areas, after all. Since each vendor makes its own technological advancements as it sees fit, its product becomes a proprietary component in and of itself.

Since new products are introduced every 6 to 18 months, components chosen for a project's upgrades are often phased out or not supported over the duration of the project. It is therefore critical to team with commercial vendors to ensure that the components chosen will last at least as long as the program's development and preproduction phases.

Due to the significant technological and cost advantages of using commercially available hardware and software, a distributed, open-standards approach is being used more frequently in both stationary and deployed applications. By opening up the architecture, future upgrades and new mission capabilities may be implemented with minimal integration and testing requirements. The desire for this type of solution has been previously difficult to accommodate, requiring either several third-party vendors to create a complete solution, or customized enclosures to address the application.

COTS Solutions Shift to the Box Level

The ideal solution has become the integration of all components inside a box that itself is commercial, designed to open standards and pre-loaded with all necessary components distributed by a single vendor.

Technology compatibility issues, including the possibility of components by other manufacturers reaching EOL, becomes the responsibility of the system vendor, offloading this problem from the agency and project team. Effectively, the vendor is now responsible for the whole package working together.

Selection of a vendor with the ability and willingness to support long-term, sometimes years-long projects by providing systems and technical support throughout the duration, makes it much less likely that pieces of the integration puzzle will fall off as component manufacturers move to new technologies.

An increasing need for deployability and/or smaller form-factors makes the requirements of the box itself a key factor. A smaller chassis for stationary applications reduces size, weight and power requirements, takes up less space, and can be moved easily from place to place as needed for various projects. Hardware longevity is significantly increased, since one system can be used for future projects as well.

The same benefits are applicable to a deployable integrated box. Most of the time in today's military/defense/intelligence applications, MIL-SPEC is not even a requirement, making the production of MIL-SPEC boxes often unnecessary. Out of this scaled-down need for ruggedization has come the development of smaller, semi-rugged systems. This development may represent a trend.

However, only a small number of innovators have recognized and responded to this possibility as a superior solution, thereby limiting the number of vendor choices these types of projects have to choose from. Instead, many deployable system manufacturers tend to over-

ruggedize, thus compromising the system's technology, cost, size and weight.

Optimally, customization is possible with commercial components, allowing the flexibility to move systems from one project to another as the project itself or current configuration becomes antiquated. If the system itself is open enough to accommodate changing technology, a single vendor can orchestrate the system and component upgrades, software changes and technical support needed for new implementations.

A Graphics Example

An increasing need for high-end graphics capabilities for imaging, testing, analysis and simulation applications in military projects is one example. This need has led to the use of commercial graphics boards. NVIDIA and ATI graphics solutions, for instance, are being applied to the overall open trend in these applications, boosting performance while maintaining the benefit of using a single vendor (Figure 1).

Graphics boards are just one example of a commercially available "accessory" that can arrive together with the box, fully integrated, all from one vendor that has strategically partnered with these specialized vendors to ensure complete compatibility of current and future technology. Open commercial interfaces such as PCI Express make this integration possible.

Further enhancing flexibility and expandability are powerful multicore processors, multiple I/O options, integrated keyboard/video/mouse capabilities, external multiple monitor support and support for all major OSs, including legacy programs like Solaris x86. Long-term support for years-long military projects, even for technology that has reached EOL, and extensive military experience are critical to the success of military projects as well.

But computer manufacturers that provide all of these benefits are rare. NextComputing is one of the first computer design companies to address all of these needs with fully integrated systems. From 4U rackmount blade servers, to semi-rugged deployable workstations, to the first FlexTop computer—a durable, portable graphics workstation not much bigger than a laptop, called the NextDimension—the company has been addressing these requirements within the military for years (Figure 2).

Future military programs will continue to require open systems, interoperability, intense computing power, smaller form-factors, I/O options and future upgradability, and vendors must innovate to meet those needs. ■■

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Bus	AT Expansion Bus			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bus	PCI Universal Expansion Bus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		
Bus	PCI Bus Masters	4	4	4	4	4	4	4	4	4	4		4	4		
Bus	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9	9	9	9					
CPU and BIOS	CPU Max Clock Rate (MHz)	1400	1400	1400	1400	650	650	650	650	650	650	333	333	333	100	100
CPU and BIOS	L2 Cache	2MB	2MB	2MB	2MB	256k	256k	256k	256k	256k	256k	16K	16k	16k	16k	16k
CPU and BIOS	Intel SpeedStep Technology	✓	✓	✓	✓											
CPU and BIOS	ACPI Power Mgmt	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0					
CPU and BIOS	Max Onboard DRAM (MB)	512	512	512	512	512	512	512	512	512	512	256	256	256	32	32
CPU and BIOS	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CPU and BIOS	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CPU and BIOS	Quick Boot Option Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CPU and BIOS	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	IDE and Floppy Controllers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Peripherals	SSD Socket, 32 DIP						1		1		1	1	1		2	1
Peripherals	ATA/IDE Disk Socket, 32 DIP	1	1	1	1	1		1		1				1		
Peripherals	Audio	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
Peripherals	Digital Video	LVDS	LVDS	LVDS	LVDS			TTL	TTL	LVDS	LVDS	TTL	TTL	TTL		
Peripherals	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA		
Peripherals	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Peripherals	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
I/O	RS-232/422/485 Ports	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
I/O	USB 2.0 Ports	2	4	2	4											
I/O	USB Ports					2	2	2	2	2	2	2	2	2		
I/O	10/100Base-T Ethernet	1		1		1	1	1	1	1	1	1	1	1		
I/O	ECP Parallel Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	aDIO(Advanced Digital I/O)	18	18	18	18	18	18	18	18	18	18	18	18	18		
I/O	multiPort(aDIO, ECP, FDC)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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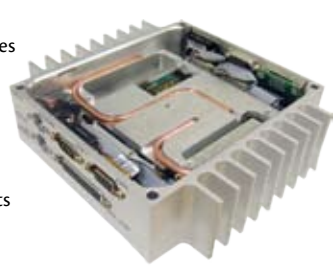

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Bus	AT Expansion Bus	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI Expansion Bus Master	✓	✓				✓							✓	✓
	McBSP Serial Ports	✓	✓				✓								
Analog Input	Single-Ended Inputs	16	16	16	16	16	16								
	Differential Inputs	8	8		8	8	8								
	Max Throughput (kHz)	1250	1250	40	500	100	1250								
	Max Resolution (bits)	12	12	12	12	16	12								
	Input Ranges/Gains	3/7	3/7	3/1	3/4	1/4	3/6								
	Autonomous SmartCal	✓	✓												
	Data Marker Inputs	3	3		3		3								
Conversions	Channel-Gain Table	8k	8k		8k	8k	8k								
	Scan/Burst/Multi-Burst	✓	✓		✓	✓	✓								
	A/D FIFO Buffer	8k	8k		8k	8k	8k								
	Sample Counter	✓	✓		✓	✓	✓								
	DMA or PCI Bus Master	✓	✓		✓	✓	✓	✓						✓	
	SyncBus	✓	✓				✓								
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	48	18/9	32	64	32	48	48
	Bit Programmable I/O	8	8		8	8	8	8	24	6/0				48	✓‡
	Advanced Interrupts	2	2		2	2	2	2	2					2	
	Input FIFO Buffer	8k	8k		8k	8k	8k							4M	8M
	Opto-Isolated Inputs										16	48	16		
	Opto-Isolated Outputs										16	16			
	User Timer/Counters	3	3	3	2	3	3	3	3	3				10	6
	External Trigger	✓	✓		✓	✓	✓	✓	✓					✓	
	Incr. Encoder/PWM									3/9					✓‡
	Relay Outputs												16		
Analog Out	Analog Outputs	2	2		2	2	2	4							
	Max Throughput (kHz)	200	200		200	100	200	200							
	Resolution (bits)	12	12		12	16	12	12							
	Output Ranges	4	4		3	1	4	4							
	D/A FIFO Buffer	8k	8k				8k	8k							

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Prime suppliers are taking greater advantage of commercial system-level products, including the outsourcing of acceptance and qualification testing.

Dave Wessing, Systems Product Manager
GE Fanuc Embedded Systems

Cutting costs is a way of life for most military suppliers, yet that practice can hurt rather than help if it is not done correctly. An adept supplier would do well to focus on the areas that are central to its product and services strategy and then streamline its business by outsourcing the non-value-added processes to trusted partners.

Outsourcing of non-core competency, embedded boards for military program applications has always been an option. Because of tighter budgets and shrinking time-to-market windows, more prime suppliers are taking advantage of commercial products. Since many military applications use the same basic building blocks, such as I/O interfaces and SBCs, there is little reason for a supplier to reinvent the wheel.

Adapting Rugged System-Level COTS Products

Given the success of the COTS approach, military suppliers have been purchasing basic and even complex rugged COTS systems and adapting their configurations to meet an application's specific requirements. Usually, an excellent starting point is a basic system that includes an SBC, a data bus, analog and discrete I/O, a power supply packaged in a rugged enclosure and ample spares to accommodate growth.

This system can be the basis for multiple military/aerospace applications,

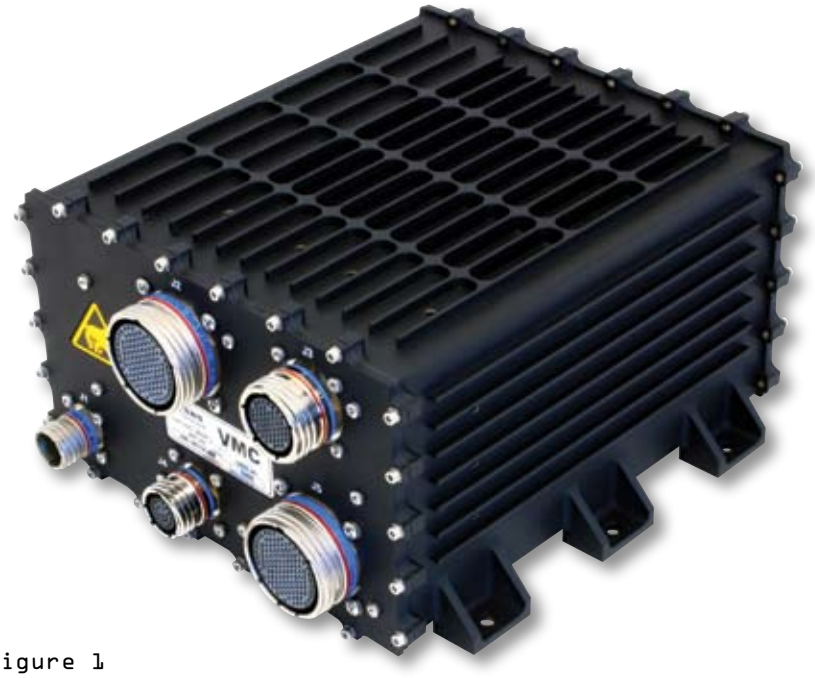

Figure 1

The GE Fanuc Embedded Systems' ruggedized AVC-3003 Advanced Vehicle Computer is designed to meet the needs of military applications where extreme stiffness, low weight and cooling are required.

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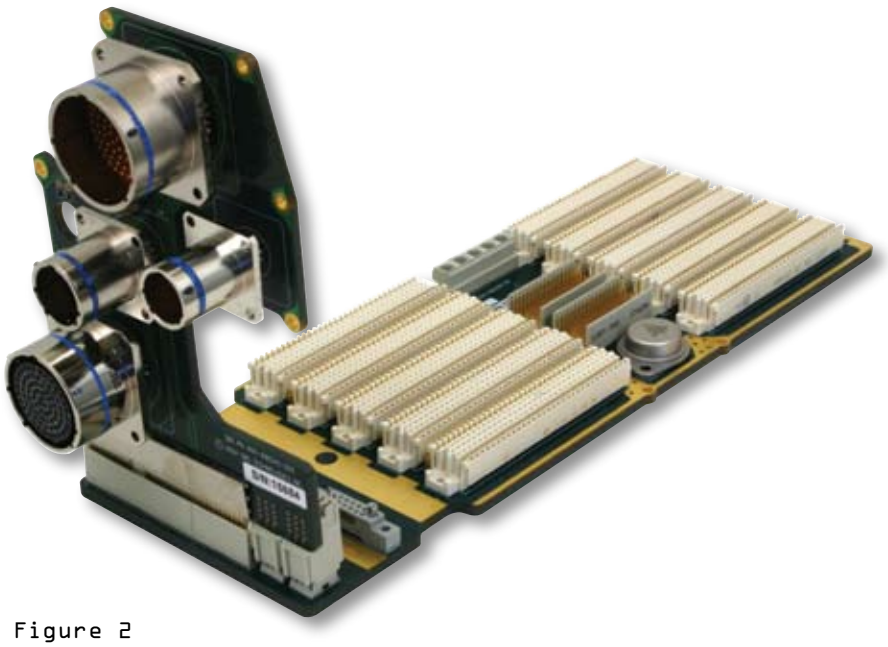

Figure 2

Weight savings and reliability for rugged vehicle computers are increased by eliminating the backplane wiring harness and using the GE Fanuc Embedded Systems PCB to route I/O signals through the backplane to user-defined front-panel connectors.

including unmanned aerial vehicles (UAVs), missile-guidance systems, ground-based or shipboard radar/sonar sensors, control and monitoring systems, telecommunications systems, air traffic control systems and even the space shuttle.

The key to making rugged system-level COTS products work for the military is to build them around open-standards interfaces that allow developers to capitalize on new technology by upgrading individual modules while maintaining backplane compatibility. In this way, designers get reduced non-recurring engineering (NRE) costs in the initial design phase.

As long as the module and associated software adheres to industry-standard bus interfaces, form-factors, RTOSs and application programming interfaces (APIs), the technology insertion can usually be done without paying for the design of completely new modules. This approach enables system upgrades and performance increases without re-engineering.

Because an embedded systems provider can manufacture large quantities of rugged systems, which before modification are essentially general-purpose systems, the cost savings can be passed on to the customer. What's more, the customer's application software is not bound to a single piece of hardware/software, and there is flexibility in the hardware source code, allowing the customer to make changes.

Systems Become the Computing Design Platform

A basic system chassis can provide a rugged yet flexible computing platform. It usually comprises three compartments: the backplane card slots, the power supply and the external I/O connections via cabling. The I/O routes through the backplane to an I/O flex cable via an interconnect that contains military connectors mounted to the front panel.

Design engineers can use this basic system chassis as a starting point, adding a ruggedized SBC, discrete I/O and high-speed serial interfaces. These enable the system to become a mission computer or, by adding a display processor, to provide the underpinnings of an aircraft communications system. The I/O is usually modified for each platform and can be based on MIL-STD-1553, ARINC 429, high-speed serial (HSS), digital and analog I/O, Fibre Channel or IEEE 1394 Fire Wire, for example.

Designers can make changes to the backplane and I/O PCB "relay out" to reroute customized I/O to the external interface. They can also change the chassis connector front-panel faceplates if different external connectors are required.

As technology advances, the requirements for more functionality and speed in smaller, lighter, lower-power computing platforms are increasing. These requirements are driving a trend in which many design engineers are using 3U form-factors in lieu of 6U. This reduces the footprint by half and helps to lower the weight of a system.

Tier 1 and 2 military suppliers are increasingly buying a basic COTS system for one project and then using the same system, with minor modifications, for other projects. The most obvious advantage in doing it this way is the reduction in electrical and mechanical design changes, thereby minimizing NRE costs. There are also huge costs savings in software because much of a prime contractor's application code can be carried over.

In addition, system integration is fairly straightforward and upgrades are easier, saving time. Often, test peripherals and lab equipment can be reused, not to mention the fact that because qualification tests have already been performed on earlier projects, such tests can often be waived or leveraged to satisfy new requirements.

COTS Systems in UAVs

In designing a UAV such as the U.S. Navy's Fire Scout, for example, designers

strive to reduce the gross takeoff weight of the vehicle's internal/external payload, since mission flight endurance is directly proportional to weight. One way to accomplish this is to reduce the number of components required to control the UAV and group them into several rugged subsystems that help ensure the survivability of the craft.

A vehicle control system such as GE Fanuc Embedded Systems' AVC-3003 provides a rugged, yet highly flexible, flight control platform for military aviation and other applications such as UAVs, booster vehicles and ground vehicles requiring rock-solid reliability (Figure 1). It is also suited to UAVs like the Fire Scout. One advantage of a rugged COTS system that meets an application's requirements is the supplier's ability to add innovative techniques that help solve application problems while lessening the customer's R&D risk.

For example, as with all UAVs, total vehicle weight is an issue: more weight means more fuel consumption and less flight time. To help reduce the weight of a UAV flight control system such as the AVC-3003, engineers can use a different approach for bringing the system's I/O to the connector ports. Instead of a traditional internal wiring harness with its myriad bunches of wires and cables, the AVC-3003 reduces weight and increases reliability by using a ground-breaking lightweight PCB to route all internal I/O to the external front panel (Figure 2).

To meet application-specific requirements, a prime contractor can also outsource acceptance and qualification of a rugged system by having a system-level supplier perform a comprehensive battery of tests, including shock, vibration, altitude, thermal cycles and EMI. However, a project does not need to be put on hold until all testing is completed. Often, suppliers can deliver an engineering development unit, basically a non-rugged system, so that work on the application software can begin while ruggedization and qualification testing is in progress. By employing parallel efforts, time-to-deployment is greatly accelerated.

Program contractors can also request advanced services from a vendor, including design practices based on extensive military packaging experience, analyses to simulate qualification of thermal and vibration levels, and testing to prove system worthiness during qualification. In short, prime contractors can purchase a basic ruggedized COTS system and adapt it to meet many application requirements. Without question, this kind of outsourcing saves time and money. ▮▮

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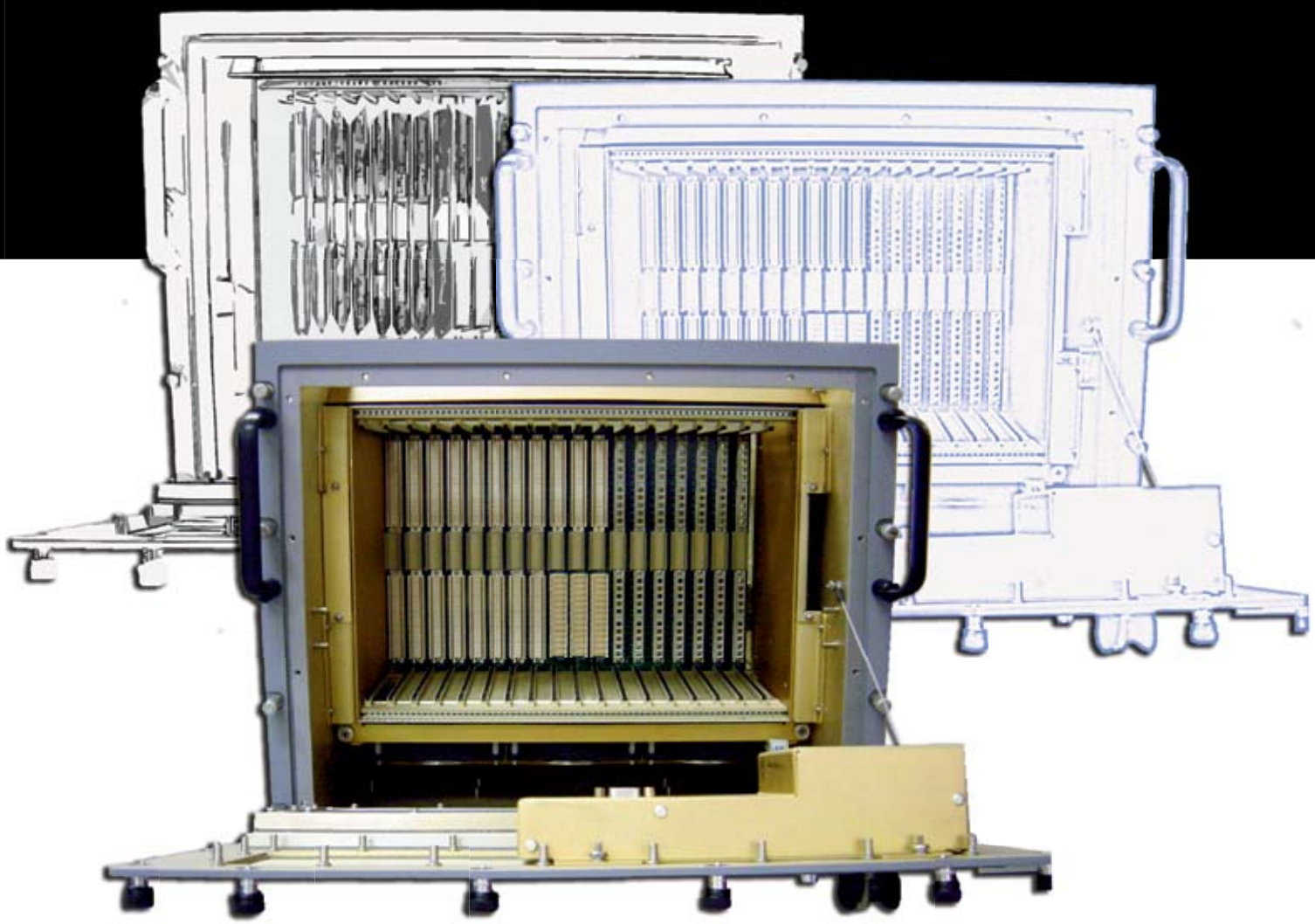

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JTRS HMS Design Considerations

JTRS HMS Radio Designs Wrestle with Size, Weight and Power Challenges

A mix of daunting electronic integration issues and complex software porting challenges makes the HMS class of JTRS radios a tough nut to crack. New development platforms of cryptographic solutions are helping to ease the way.

Jeff Child
Editor-in-Chief

The DoD's Joint Tactical Radio System (JTRS) is arguably one of the most sweeping and technically challenging programs ever conceived. Tasked with the goal of meeting diverse warfighter communications needs through software programmable radio technology, JTRS is central to the military's plan for Network Centric operations using seamless real-time communications—both with and across the U.S. military services, and with coalition forces and allies. Within the JTRS program the HMS (Handheld, Manpack and Small Form Fit) faces some unique challenges. Formerly called Cluster 1, the JTRS HMS domain includes essentially any portable ground radio unit not mounted on vehicles. It includes handheld and manpack units and forms suitable for integration into platforms requiring a small form-fit radio.

These radios require a software defined architecture that supports multiple protocols while providing standardized hardware that can implement a broad range of systems from simple baseband to complex wideband radios. In many cases, the same radio hardware, such as a soldier radio, may need to support multiple waveforms as it is supplied to different groups within the military.

Easing that task, Texas Instruments rolled out its Small Form Factor Software Defined Radio (SDR) Development Platform (Figure 1) at the SDR Forum Technical Conference earlier this month. The platform, developed in collaboration with Xilinx and other third parties, provides the entire signal chain hardware from antenna to baseband as well as a software board support package that supports a complete suite of software development tools in a single integrated development platform. Developers can use the kit to design waveforms as well as create and test single or multi-protocol radios for applications in military and other markets.

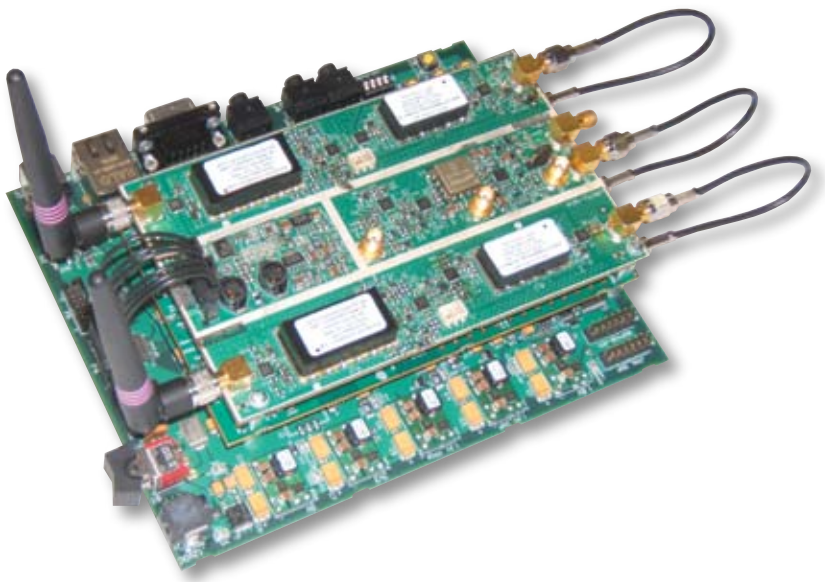

Figure 1

Texas Instrument's SDR Development Platform is a hardware/software co-development environment that supplies the full signal chain for a multi-protocol software defined radio, including RF front-end module, A/D and D/A data conversion module and digital processing module.

Quick Test Proofs

The platform is integrated to work with the Simulink model-based design tool; developers have the option to use C/HDL or MATLAB Simulink to quickly

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Figure 2

The JTRS HMS family of radios consists of eleven different SFF variants, each designed for a different set of platforms, as well as one and two-channel Handheld (a) (urban and maritime) and two-channel Manpack (b) form-factors. The SFF radios (c) are constrained by the JTRS ORD to 1 lb for a one-channel set and 2.2 lbs for a two-channel set. Similarly, the volume of these radios is constrained by specification to between 10 to 25 cubic inches.

test proof-of-concept designs and then optimize the architecture for cost and power. The SDR Development Platform is a hardware/software co-development environment that supplies the full signal chain for a multi-protocol software defined radio, including RF front-end module, A/D and D/A data conversion module and digital processing module. By separating out the baseband, IF and RF as distinct modules rather than as a single fixed architecture, developers are able to extend their radio development capabilities, as well as optimize for cost and power consumption, by substituting their own or third-party modules.

Because of the inherent mobility requirements of wireless radios, power consumption is an important factor that is a key challenge in creating an efficient and cost-effective radio design. The SDR Development Platform includes the Power Measurement API, which enables developers to track real-world power consumption of the digital baseband unit precisely while algorithm functions are being executed. Traditional power measurement techniques require external measurement of power consumption that offers rough estimates at best, but this development kit will include five different API functions to measure power consumption for all the different elements of the kit. The Power Measurement API gives developers more visibility into their systems, enabling them to measure currents drawn from individual components such as the DSP and the FPGA.

A Variety of Radios

The HMS family of radios consists of eleven different SFF variants, each designed for a different set of platforms, as well as one and two-channel Handheld (urban and maritime) and two-channel Manpack form-factors. Figure 2 shows a representation of each of the variants. The SFF radios are constrained by the JTRS ORD to 1 lb for a one-channel set and 2.2

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lbs for a two-channel set. Similarly, the volume of these radios is constrained by specification to between 10 to 25 cubic inches. Table 1 shows a detailed description of size, weight and transmit power.

The design constraints on the SFF sets can be better appreciated by comparing them with the existing JTRS GMR (Ground Mobile Radio) parameters. The GMR is designed to be integrated into vehicular platforms. A four-channel GMR weighs 150 lbs and has a total volume of greater than 5000 cubic inches. The GMR hosts the Wideband Networked Waveform (WNW), has a higher transmit power and a greater number of channels. But even with these differences, the comparison serves to highlight the significant challenges faced when designing the SFF radios to achieve the networking and interoperability required while meeting the size and weight constraints. At present, the HMS radios are being designed to use a number of legacy waveforms (SINCGARS, EPLRS, UHF SATCOM and HF) and the SRW networking waveform.

Small Form-Factor Variants	No. of Channels	Size (cubic inches)	Weight (pounds)	Transmit Power (watts)
SFF A, IMS (Intelligent Munitions Systems) & UGS (Unattended Ground Sensors)	1	10	1	2
SFF B, LW (Land Warrior) Leader	2	50	2.2	5
SFF C, Land Warrior Soldier	1	25	1.2	5
SFF D, UAV, I, II (Unmanned Aerial Vehicle)	1	25	1.2	5
SFF E, UAV III, IV	2	50	2.2	5
SFF F, SUGV (Small Unattended Ground Sensor)	1	25	1.2	5
SFF G, NLOS-LS (Near Line of Sight, Launch System)	1	80	3	10
SFF H, IMS & UGS	2	30	2	2
SFF I, LW Soldier	1	25	1.5	5
SFF J, NLOS-LS Ground	2	120	6	10
SFF K, Next Gen Range Instrumentation	4	140	6	80

Table 1

Outlined here are the size, weight and power distribution of the SFF variants. (Source: JTRS HMS Product Management Office).

SRW includes networking requirements focused on the Dismounted Soldier, UGS, IMS, Unmanned Aerial Vehicle (UAV) and Non-Line-of-Sight Launch System (NLOS-LS) employments. The use of the SRW imposes specific demands on

General Communication Architecture	GPP				DSP				FPGA		
	MIPS	Int. RAM	RAM	FLASH	MIPS	Int. RAM	RAM	FLASH	Logic Elements	Multipliers	BRAM
Candidate Design	300	128 kB	100 MB	275 MB	260	320 kB	16 MB	32 MB	61K	192	2.5 Mb
Networking Waveform											
Mode 1	225	24 kB	80 MB	245 MB	140	320 Kb	1.84 MB	-	60802	132	2.053 Mb
Mode 2	200	24 kB	80 MB	245 MB	140	320 Kb	1.84 MB	-	43495	88	0.245 Mb

Table 2

Listed here are the JTRS HMS hardware processing and memory resource recommendations for networking waveforms. (Source: JTRS HMS Product Management Office).

the resources of memory, General Purpose Processors (GPPs) and Digital Signal Processors (DSPs) measured in Millions of Instructions per Second (MIPS) and Field Programmable Gate Array (FPGA) processors measured in Logic Elements (LEs). Table 2 summarizes the resource allocations that JTRS HMS is presently working to for the GPP, DSP and FPGA devices as well as the resources available in the current candidate SFF set design.

More SRW Challenges

While it appears that the current HMS resources are sufficient to meet the SRW requirements, these estimates are based on the existing developmental version of the waveform, which is a layer 2 waveform without layer 3 processing or cryptography. A SFF set operating on an SRW network integrated with the WNW and other JTRS waveform networks will likely require more resources than indicated. The impact of this difference is dependent on the specific design of the additional waveform components and the approach for the integration of HMS into the JTRS Enterprise.

A system byproduct that must be managed, and one that is especially difficult to manage in SFFs, is thermal dissipation. Transmit power (and duty cycle) along with memory and processing impacts thermal dissipation requirements. As MIPS, memory and LEs are added, the thermal load increases. Unlike larger vehicular-based radios or computers, the SFF radios will not have fans to assist with this function, and the small size of the radios limits the ability to eliminate heat through conduction.

Another complication in JTRS radios that affects chip count—and therefore size and power—is the requirement for secure partitioning between the black (unencrypted) and red (encrypted) sections of a radio architecture. The usual implementation calls for the black and red sides to be completely separated—with an FPGA on the black side and an FPGA on the red side, and a cryptographic engine chip between the two. With issues like power and size so critical, it goes without saying that a move from a three-chip solution to a single chip is desirable. That would require a single-chip cryptographic solution that lets you create physical black side/red side separation within a single device.

Fortunately work appears to be underway to do just that. A paper co-authored by Jason Moore of Xilinx's Aerospace & Defense Division and Mark McLean of the National Security Agency at last month's Milcom conference, describes a design flow and verification process based on NSA requirements for high-grade cryptographic processing using a Xilinx Virtex-4 FPGA. The paper, entitled "FPGA-Based Single Chip Cryptographic Solution," discusses leveraging Xilinx's partial reconfiguration to enable the black side and red side on the same device. ▮▮

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Porting Waveforms to the JTRS HMS Domain

Developers designing for the handheld, manpack and small form-fit (HMS) JTRS domain face porting challenges. The right tools and techniques help smooth the way.

Mark Hermeling, Principal Application Engineer
Zeligsoft

The 15 or so small form-factor terminals that comprise the Handheld, Manpack and Small Form Fit (HMS) portion of JTRS, contain fewer computing resources than the large and more powerful terminals being developed by other clusters, and they rely more heavily on specialized hardware processors such as DSPs and FPGAs, which differ significantly from the General Purpose Processors (GPP) used in other clusters. Despite the differences in form-factor, Cluster HMS must be ready to port waveforms developed by other clusters, such as the Ground Mobile Radios (GMR), and have them deploy optimally in fielded systems.

A systematic development process that includes SCA-specific automation and validation will greatly reduce risks associated with HMS radios. The Software Component Architecture (SCA) (Figure 1) was developed by the U.S. DoD as a foundational element of the Joint Tactical Radio System (JTRS) Program, providing an open architecture framework enabling programmable radios to load waveforms, run applications and be networked into an integrated system. Methodologies and tools exist that treat the SCA as a first class aspect from day one to allow waveform-platform constraints to be uncovered early in the porting cycle. Automation of SCA artifacts ensures correct-by-construction, high-quality and consistent code throughout the project, providing benefit to all team members across the project.

SCA Architecture Layer Diagram

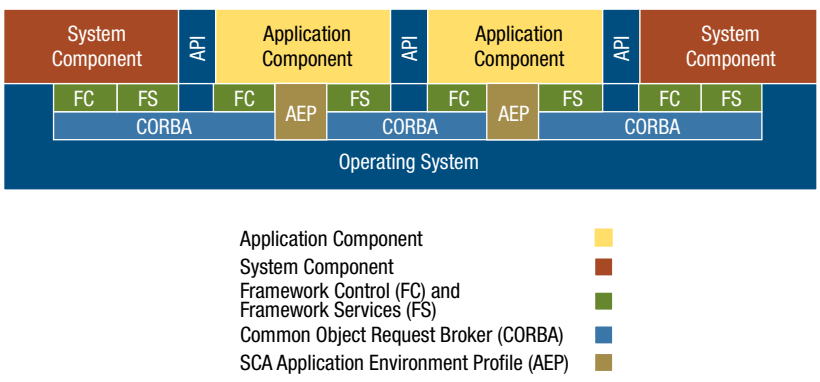

Figure 1
Shown here are the layers that comprise the SCA architecture.

Porting in Phases

Porting of a JTRS waveform is typically done in sequential phases. The porting team receives a set of artifacts that makes up the existing waveform. This includes the source code for the components in the waveform as well as the Domain Profile: the set of XML descriptor files that describe the components, their resource and service dependencies as well as how they interconnect to provide the full waveform functionality.

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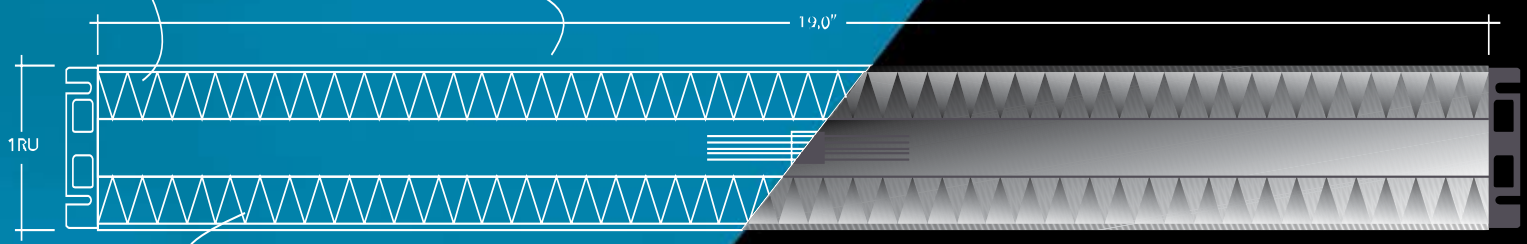

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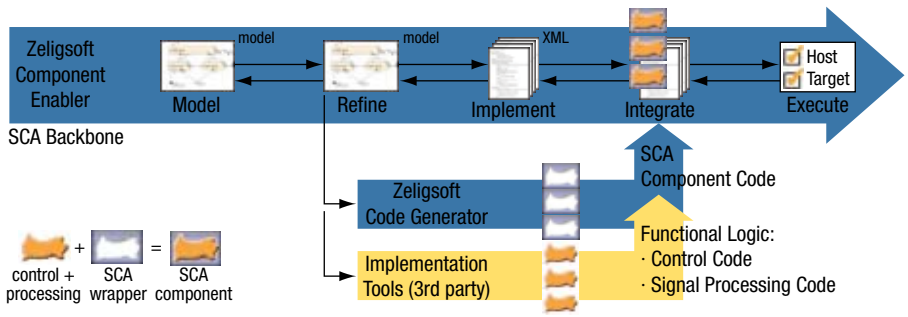

Figure 2

Zeligsoft's Component Enabler (CE) is a model-driven development tool designed to accelerate development and improve software quality of SCA-based applications and platforms. CE serves as the SCA backbone development tool: it provides a modeling methodology conforming to the SCA standard, and abstracts the complexity and intricacy of the SCA rules away from designers. CE validates against the SCA rules at the architectural level, and generates correct- by-construction SCA-compliant artifacts.

Software models of the JTRS waveforms such as the Soldier Radio Waveform (SRW) and the Single Channel Ground-Air Radio System (SINCGARS) are currently available, making less work for the HMS designer. Waveforms for which a model is not readily available can be efficiently reverse engineered into a model using a tool. Today's SCA-specific tools and development environments enable team members to quickly model all waveforms deployed to their HMS platform. This model then provides the engineers with a detailed understanding of the type and amount of resources that are required by the original waveform.

At the same time the modeling tool is used to describe the make-up of the intended platform—the SCA abstraction layer of the small form-factor terminal. The platform model provides a complete view of the computing resources on the terminal, including which processors are available and the level of resources each of these processors has. The nature of the HMS cluster is that it will have to support many different platforms running the same set of waveforms. Hence, the model will have to include representations of all of these platforms.

Mapping the Waveform Components

The first tangible step in the porting process is to map the components of the original waveform to the resources provided by the intended platform. This mapping (also known as the "deployment model") provides the porting team with an indication of the amount of work that will be required to complete the porting. The deployment model will list mappings of every waveform to every platform—this allows the porting team to understand how well the waveforms will be able to deal with the varying platform requirements of the cluster. There will be a significant number of mismatches in this mapping. Components that were deployed on a GPP in the original platform now might have to run on a DSP. These types of violations will be reported when the deployment model is validated against the rules and regulations in the SCA standard.

The list of violations primes the pump for the porting team; they can clearly see the work they have in front of them. This work is highly specialized and detailed. Tooling can help by abstracting the SCA and automating modeling, validation and code generation for SCA artifacts (Figure 2). However, the detailed radio logic porting work will have to be done by the developers themselves. To illustrate, the SCA modeling tool can generate source code that implements the SCA required behavior (such as implementations of CF::Resource), however, the engineers will still have to port the signal processing behavior, especially if a component is re-deployed from a GPP to a DSP.

Automation also allows developers to quickly build evaluation and test. Generation of source code and the required SCA descriptors provide the developers with all the artifacts they need to execute parts of the waveform on a host workstation for example. This provides the engineers with the required "stick time" to understand how the original component behaves under normal operating conditions, and also in difficult conditions to achieve failure scenarios. These scenarios can be executed on the intended hardware, if available, but also on simulator boards, host machines and can even combine hardware-in-the-loop simulation.

One of the key HMS design considerations for waveform porting should be utilizing an SCA design and tooling environment from the beginning. An SCA-specific development environment will take care of the SCA aspects of the system, facilitating modeling, and automating validation and code generation for SCA artifacts, leaving designers to focus on radio logic, and porting functional code from one processor type to another. By automating SCA compliance, project teams can reduce the risks that affect software quality, cost and time-to-market. ▮▮

Zeligsoft
Gatineau, Quebec, Canada.
(819) 684-9639.
[www.zeligsoft.com].

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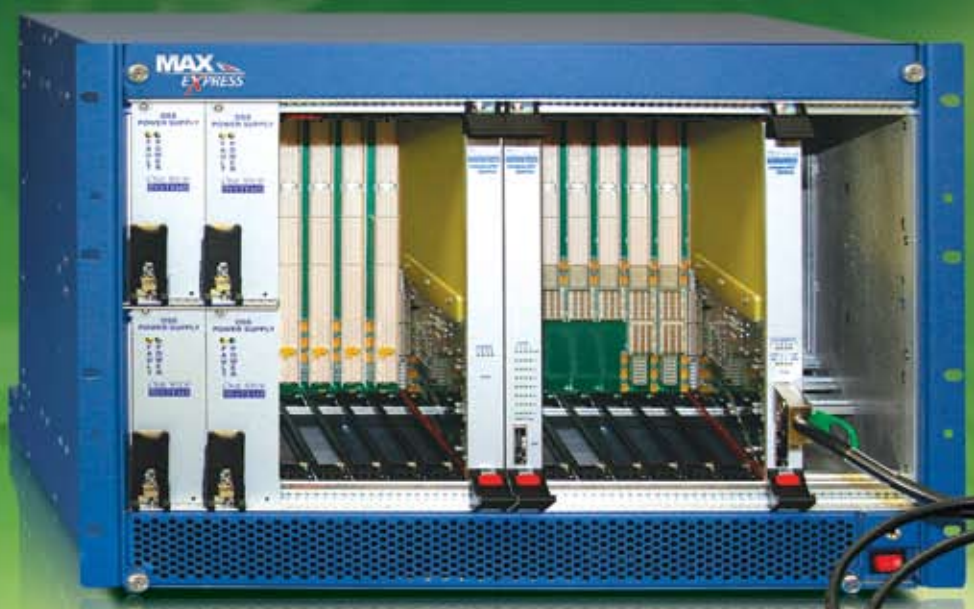

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Technology Focus

Fibre Channel Boards

Turbulence May Lay Ahead for Fibre Channel Boards

Applications that currently use Fibre Channel will probably continue to do so for the foreseeable future. Some new applications might also opt for Fibre Channel, but others may choose to use either Ethernet or SAS.

David B. Cotton
Contributing Editor

In the military/aerosapce market space, Fibre Channel is employed for high-bandwidth, low-latency, uncompressed digital video transmission (ARINC 818) as well as other networking and storage applications (Figures 1 and 2). However, what's happening to the Fibre Channel market in the real-time and embedded space—or, more particularly, in the COTS marketplace—isn't really clear at this time. Is the market fading away, as it might seem to be, or is it merely experiencing normal vendor consolidation?

We've been told that the number of units sold into the military/aerospace marketplace is still substantial and may actually be still growing. If this is so, why has the number of vendors dropped significantly, and why does there seem to be a dearth of new products?

When *COTS Journal* last published a "Fibre Channel PMC Gallery" in August 2004 (pp. 68-71), the article featured eleven vendors. Now, two and a quarter years later, the list has dropped to eight. Consolidation accounted for the loss of several, as GE Fanuc Embedded Systems swallowed SBS and Curtiss-Wright Controls Embedded Systems acquired both Dy 4 and Systran. Radstone no longer appears to be interested in Fibre Channel (and it, too, will soon be acquired), while Delphi Engineering says that their sister company, Critical I/O, now handles Fibre Channel for both of them. On the plus side, Data Device Corporation (DDC) has been added to the 2004 list of vendors.

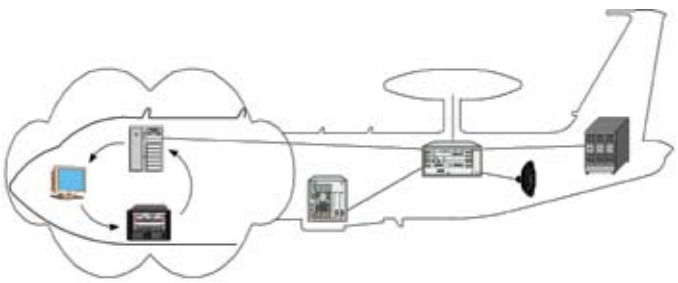

Figure 1

The AWACS Radar Upgrade uses Fibre Channel products like Curtiss-Wright Controls Embedded Computing's FibreXpress to move data around the aircraft.

The Power of Convergence...

Reliability. Scalability. Mobility...on a gateway blade.

Open architecture drives costs down and performance up.

Modular VoIP "blades" based around standard, interoperable modules like PMC and AdvancedMC reduce costs by limiting the number of unique blades that telecom OEMs and carriers have to purchase and stock. A softswitch or media gateway controller can be deployed in a minimal configuration and scaled up later (to OC-3 and beyond) without replacing the whole blade and without taking it offline. SBE provides high-performance DSP resource modules that deliver premium carrier class voice processing with world-class features using Texas Instruments' DSPs with Telogy Software. In addition, these modules support transcoding and transrating to enable the integration of voice, video, data, and wireless.

SBE products are scalable from daughterboard modules to complex gateway blades, and provide telecom carriers/service providers with a choice of programmable voice platforms featuring SBE's line of network interface cards, ranging from T1 and T3 to Gigabit Ethernet and IPsec/SSL/WLAN acceleration. Full Linux support is available on every board.

sbe

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flexibility on demand | 925-355-2000 | info@sbei.com | www.sbei.com

Figure 2

Military aircraft can use Fibre Channel products for high-bandwidth, low-latency, uncompressed digital video transmission between cameras and processing units.

In the product space, the picture doesn't seem to be much brighter. To be sure, seven of the eight vendors featured had products that were new since August 2004, but in several cases these were merely upgrades of older products from 2 Gbits/s to 4 Gbits/s. And one vendor told us that almost all of their attention had shifted to Serial Attached SCSI (SAS) because it was cheaper and provided greater throughput.

So here's a possible scenario: Since change comes very slowly, existing applications that use Fibre Channel will probably continue to do so for the foreseeable future. Some new applications might also use Fibre Channel, but others may opt for either Ethernet or SAS. And while the result might produce a short-term increase in the number of Fibre Channel units shipped, the longer-term prognosis seems to suggest a gradual drop-off in units. ▮▮

Technology Focus:

Fibre Channel Boards Roundup

Dual Channel 4 Gbit/s Card

Fibre Channel has speeded up—from 2 Gbits/s to 4 Gbits/s. Astek Corporation now offers their A7204-PMC-01, a dual channel 4 Gbit/s Fibre Channel Host Bus Adapter (HBA) in the PCI Mezzanine Card (PMC) form-factor. The card is supported under all major operating systems including Microsoft Windows XP and Windows Server 2003, Linux and VxWorks 5.5.x.

The A7204 board is intended to provide a low-risk storage solution for the industrial, medical and military embedded computing markets, and is ideally suited to help customers make the transition to 4 Gbit/s Fibre. Astek provides hardware and software support, including drivers and system level integration support such as SAN management software tools to support enterprise level customers.

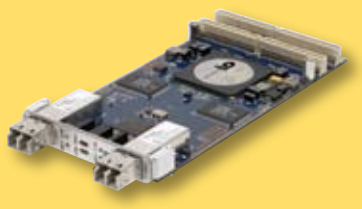
The dual port A7204-PMC-01 offers front panel I/O with two optical SFP transceivers and PCI-X 64-bit/133 MHz support for up to 800 Mbits/s of data transfer. Direct, switched and FC-AL loop topologies are supported without special software drivers. Multi-path redundant connectivity with automatic failover is also supported. The HBA is compatible with 1 Gbit, 2 Gbit and 4 Gbit devices. Astek's family of storage adapters allows upgrade or switching between parallel SCSI, Serial Attach SCSI (SAS) and Fibre Channel with no changes to software drivers, reducing the integration effort and providing lifetime upgrade options. The A7204 HBA is certified under FCC Class A, UL-recognized and CE Mark-compliant. The card is in full production and is available for immediate sale.

Astek
Colorado Springs, CO.
(719) 260-1625.
[www.astekcorp.com].

Ideal Interface for Performance Networking and Storage

Ultra-high performance makes Fibre Channel the ideal interface for demanding applications such as networking and storage. The FCA2420 PMC from Critical I/O provides an implementation of 4 Gbit Fibre Channel for embedded systems. The FCA2420 transfers 1000 Mbytes/s of data over a Fibre Channel network with minimal host CPU loading and ultra-low latency. It also offers two independent channels of 4 Gbit/s Fibre Channel in a PMC, with each channel capable of 800 Mbytes/s and an overall sustained transfer rate of 1000 Mbytes/s.

Critical I/O's Fibre Channel interfaces allow system designers to easily integrate Fibre Channel into storage and networking I/O (processor-to-processor) applications. The FCA2420 PMC is the 6th generation of Fibre Channel interfaces from Critical I/O. It employs a Silicon Stack architecture, which completely offloads all protocol processing



into dedicated silicon, unlike FPGA-based Fibre Channel products, which push the upper layer protocol processing back onto the host ("software stack"). It is supported by Critical I/O's industry-leading software, complete with libraries and drivers, for a variety of embedded processors like PowerPC, DSP and Intel.

Critical I/O
Irvine, CA.
(949) 553-2200.
[www.criticalio.com].

Saving Slots with Fibre Channel

In embedded systems, saving space by fully utilizing each Single Board Computer (SBC) or PMC slot can be very important. The Curtiss-Wright Controls FX400 Dual-Channel (DC) Fibre Channel PMC cards are high-performance host bus adapters (HBA) ideally suited for demanding high-bandwidth

data communications and storage applications. The FX series of products provide support for SCSI Fibre Channel Protocol (FCP) and Internet Protocol (IP), eliminating the need to deal directly with the Fibre Channel interface. In addition, the FX400 DC cards feature two separate high-performance RISC I/O engines to minimize host CPU overhead. The superior communication and interconnect capabilities of the Fibre Channel standard are maximized by the Curtiss-Wright Controls/ FX400 DC cards.

The FX400 DC cards incorporate the functionality of two independent FC 4.25 Gbit/s channels on a single HBA. This compact design minimizes the number of required host computer slots, while providing the performance of two separate HBAs. As a result, an efficient Fibre Channel system is established using only a minimal number of SBC or PMC slots.

Each channel on the FX400 DC card is capable of sustaining a 400 Mbyte/s transfer rate, and up to a 800 Mbyte/s transfer rate in full duplex, thus achieving 1600 Mbytes/s in combined throughput. In addition, both channels on the FX400 DC card support 1.0625 Gbit/s, 2.125 Gbit/s and 4.25 Gbit/s rates, automatically detecting and switching to the appropriate rate using Auto-Speed Negotiation. This feature enables the FX400 cards to interoperate with existing Fibre Channel devices at 1.0625 Gbits/s and 2.125 Gbits/s and provides a seamless transition to higher performance 4.25 Gbit/s devices.

Curtiss-Wright Controls
Embedded Computing
Dayton, OH.
(937) 252-5601.
[www.cwcembedded.com].

Controller Card Targets Air-Cooled Apps

Conduction-cooled boards serve some harsh environment needs, but there's a significant segment of avionics applications—like testing and simulation lab systems—where air-cooled cards are a better choice. With that in mind, Data Device Corp. (DDC) has introduced an air-cooled Network Access Controller (NAC) to its series of Fibre Channel data networking solutions. The FC-75162 is the latest installment in DDC's second-generation FC-75100 Series NACs. The FC-75162 further expands the capabilities of DDC's suite of dual-channel, PMC Fibre Channel NAC cards.

Available with copper or optical interfaces, the cards operate in point-to-point, arbitrated loop, or switched-fabric topologies. The FC-75162 is targeted specifically to data management in the laboratory environment, avionics maintenance, and testing and simulation, as well as a wide variety of embedded avionics and vetronics applications that rely on air cooling.

FibreACCESS FC-75100 Series cards support Class 2 acknowledged and Class 3 unacknowledged Fibre Channel service. The cards provide the capability of operating at sustained data rates of over 300 Mbytes/s with 2 Gbit/s signaling and memory-to-memory latency of under 20 µS. Built-in DMA engines and 64-bit/66 MHz PCI initiator/target interface, operating together with the frame, sequence and outbound exchange management logic, autonomously move payload data to and from PCI space. Using host-initiated descriptors, frames are assembled and disassembled autonomously to and from payload buffers in host memory.

Data Device Corp.
Bohemia, NY.
(631) 567-5600.
[www.ddc-web.com].

2 Gbit/s Fibre Channel AdvancedMC HBA

AdvancedMC is the Advanced Mezzanine Card form-factor. The Telum FC2312 from GE Fanuc Embedded Systems is the industry's first 2 Gbit/s Fibre Channel (FC) Host Bus Adapter (HBA) in the AdvancedMC form-factor. The Telum FC2312 provides connectivity to a x4 PCI Express baseboard. It is designed for applications such as storage I/O and server platforms and is available in either dual fiber or copper interfaces.

These AdvancedMC HBAs—together with supporting software tools—provide the high-sustained throughput and low latency required for demanding real-time and storage applications. Designed to take full advantage of industry standard Fibre Channel features and benefits, these GE Fanuc Embedded Systems AdvancedMC HBAs incorporate an onboard protocol engine that minimizes host CPU intervention and provide auto-negotiation of link speed (1 Gbit/s or 2 Gbits/s). Dual independent channels support concurrently operating nodes. Also, 200 Mbyte/s half duplex and 400 Mbyte/s full-duplex sustained transfer rates are supported. SCSI-FCP protocol support is provided for selected operating systems. Device drivers are available for 32-bit and 64-bit Carrier Grade Linux operating systems.

An AMC.0 Module Management Controller (MMC) subsystem that is Intelligent Platform Management System (IMPI) v1.5-compliant initializes board level parameters, monitors board voltage and temperature conditions, maintains system status and manages hot-swap operation. A microcontroller is used as the IMPI intelligence and connects to the AMC management bus. This module is hot-swap capable and is field-replaceable in accordance with AMC.0.

GE Fanuc Embedded Systems
Albuquerque, NM.
(505) 875-0600.
[www.gefanucembedded.com].

PMC supports new ARINC 818 Digital Video Bus

ARINC 818 is a new video interface and protocol standard built on the FC-AV protocol that was developed for high-bandwidth, low-latency, uncompressed digital video transmission. ARINC 818 video may include: infrared and other wavelength sensors, optical cameras, radar, flight recorders, map/chart systems, synthetic vision, image fusion systems, heads-up displays and heads-down multifunction displays, video concentrators and other subsystems.

Great River Technology's new GRAV64_PMC_FCAV_DVI card is ARINC 818-compliant for 1-3X Fibre Channel (FC) rates. The card can be used as a frame grabber, a graphics generator, or to convert ARINC 818 video to/from DVI video. Each Gravity FC-AV card is Fibre Channel-compliant at the FC-0, FC-1 and FC-2 layers and uses Frame Header Control Protocol (FHCP). The protocol is flexible to accommodate many uncompressed video applications, like driving synchronous displays and sensor fusion applications.

The cards can be ordered for 1.0625 Gbit/s, 1.5 Gbit/s, 2.125 Gbit/s, or 3.1875 Gbit/s link speeds. Either 850 nm or 1310 nm SFF Fiber Channel transceivers are available. The cards have two 32 Mbyte (ping and pong) image stores allowing PCI to access image memory during live transmit and receive. The GRAV64 PMC has a 64/66 PCI interface capable of 160 Mbytes/s. SDKs are available for Win 98SE/XP/NT4/2k and Linux, with VxWorks support available. Operating temperature ranges from 0 to +70°C, or -40° to +85°C. Price ranges from $5,000 to $7,000 in small quantities.

Great River Technology
Albuquerque, NM.
(505) 881-6262.
[www.greatrivertech.com].

Fibre Channel PMC Board Boasts a Variety of I/O Options

One of the interesting aspects of Fibre Channel is that it is actually several standards in one. It has different flavors for networking, audio/video and storage interfacing. Leveraging that advantage, SANBlaze Technology offers a variety of options in its SB-PMC-FC family of host bus adapters (HBAs). The SB-PMC-FC is available with single or dual independent 1 Gbit/s and 2 Gbit/s Fibre Channel ports supporting multimode optics or copper. The product line supports auto-negotiation and switch and loop topologies.

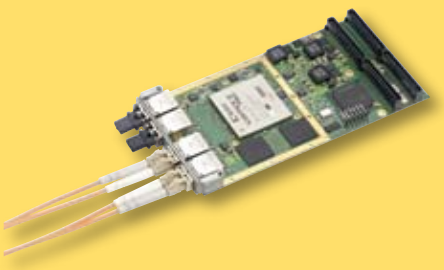
The SB-PMC-FC family is available in five options. The dual channel version is available with two front panel ports, two rear I/O ports (via J/P 4) or one front panel and one rear I/O port (via J/P 4). The single channel version is available with either a single front panel port or a single rear I/O port. These options allow for maximum design flexibility, while delivering the high-performance SAN connectivity of Fibre Channel in a PMC form-factor.

By offering a full complement of I/O options, port configurations and auto-negotiation for multiple SAN speeds, the SANBlaze PMC-FC family is able to address most embedded system Fibre Channel design requirements. The SANBlaze SB-PMC-FC PMC Fibre Channel products support all major operating systems and are available immediately. Single piece pricing ranges from $1,175 to $1,395, depending on configuration.

SANBlaze Technology
Maynard, MA.
(978) 897-1888.
[www.sanblaze.com].

Fibre Channel—and Much More

Some products offer Fibre Channel capabilities and much more. For example, VMETRO's PMC-FPGA03F is an XC2VP50 Xilinx Virtex-II Pro FPGA PMC supporting two or four fiber-optic I/O channels each connecting to a RocketIO channel on the FPGA. This product provides front-panel high-speed serial communications via fiber-optic transceivers. The Xilinx Virtex-II Pro FPGA supports the use of Fibre Channel, serial FPDP or other communication IP cores. The PMC-FPGA03F is a user-programmable product. In addition to a communication



IP core, the user can implement logic in the Virtex-II Pro to process the data that is being communicated across the RocketIO channels. This combination of flexible I/O capabilities and FPGA processing capabilities enables the PMC-FPGA03F to be utilized in a wide variety of applications to lessen the processing and bandwidth requirements in other parts of the system.

Two independent banks of 16-bit, 64 Mbyte DDR SDRAM are connected directly to the FPGA on the PMC-FPGA03F. The memory banks can be used completely independently or collectively. This memory is accessible from the PCI bus and provides a large pool of memory to buffer DMA transfers and other large data block operations.

The PMC-FPGA03F is fitted with up to four duplex LC optical fiber connectors on the front panel. A range of transceivers are offered to provide hardware level support for a number of different data rate and transmission range requirements. Though these transceivers are compliant with ANSI Fibre Channel hardware standards, they can be used for any data communications purpose. Most of the FPGA resources in the Virtex-II Pro are left free for user applications. To aid FPGA configuration, example VHDL library code blocks are provided to show how the PMC-FPGA03F resources can be used. Flash programming utilities are also provided.

VMETRO
Houston, TX.
(281) 584-0728.
[www.vmetro.com].

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First Core Duo-Based AMC Boosts Compute Power

One thing developers of high-speed communications applications need to take advantage of ATCA is more, and faster, processing from the AMC form-factor. The Momentum Series Intel Core Duo-based AXA-100 AMC from Mercury Computer Systems nearly doubles available compute resources. It can be configured with either an Intel Core Duo or Intel Core 2 Duo processor and supports high-speed interfaces for both ATCA and MicroTCA systems in a single-width, full height module. The card features the Intel Core Duo processor L2400, the Intel 3100 integrated chipset and up to 4 Gbytes of memory.

The 3100 chipset integrates memory and I/O controllers, supporting a 667 MHz processor bus and single-channel registered DDR2-400 SDRAM with ECC. A four-lane, non-transparent PCI Express interface and dual XAUI interfaces at 3.123 Gbits/s x4 are implemented using Xilinx Virtex-4 FPGAs in the FAT pipes region on the AMC.1/AMC.2-compliant fabric interface. Two 1000Base-BX Ethernet ports and two SATA interfaces are provided in the common options region. An AMC.0-compliant module management controller is implemented using a Renesas H8 microcontroller. Pricing starts at $4,995.

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

Motor Drive Module Eliminates Software Chores

It can take up to one man-year of motor control design time to craft motor control systems for aerospace systems. Much of that time is the laborious code development associated with digital motion control. Instead of complex DSP- or microprocessor-based solutions that require position sensors and sophisticated programming, International Rectifier offers an alternative with their iMOTION platform. The newest member of that family is the IRMCT3UF1, a fully integrated high-reliability (HiRel) hybrid motor control module enabling digital, sensor-free vector control of permanent magnet motors.

The module can be quickly configured to specific applications using the iMOTION ServoDesigner tool that facilitates drive parameter modification via memory-mapped registers. The control functions are contained in a powerful, pre-configured Motion Control Engine (MCE), and its algorithm accommodates motor parameter variation for compatibility with a variety of brushless DC and permanent magnet AC motors, while creating robust Field Oriented Control. The device is built into IR's rugged, high-density plastic ring frame package and screened to various test methods of MIL-STD-883 for operation in severe environmental conditions. Pricing for the IRMCT3UF1 HiRel iMOTION module is $995 each in 100-unit quantities.

International Rectifier, El Segundo, CA. (800) 865-8247. [www.irf.com].

VME/VXS Data Acq Boards Suit EW and Radar Designs

One can always tell when an embedded board form-factor has reached a critical mass—when data acquisition board products start to embrace it. Doing just that for VXS, Acqiris is expanding its product offering with a new family of VME/VXS (VITA 41 form-factor) boards. The series combines state-of-the-art Xilinx Virtex-4 SX and FX functionalities with advanced Acqiris data conversion technology to provide leading-edge performances in electronic warfare (EW), synthetic aperture and phased array radar, software defined radio, semiconductor and medical imaging applications.

The new VME/VXS product family incorporates Acqiris' JetSpeed II technology for clock generation and distribution, while supporting Gsample/s up-to-date ADC and DAC technologies that offer best-in-class performances. Based on a scalable, modular architecture, the new VME/VXS boards feature two Xilinx Virtex-4 FPGAs, one SX55 targeted at digital signal processing and one FX100 for data flow control. The new family also provides support for the VXS interface, two optical links on the front panel, a VME64x interface as well as DDR2 SDRAM memory and auxiliary analog and digital I/Os. The first member of the VME/VXS products family is targeted for release in Q1 2007.

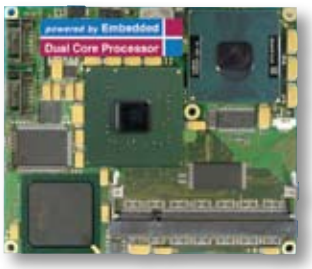
Acqiris USA, Monroe, NY. (877) 227-4747. [www.acqiris.com].

Mini-ITX, EPIC Express Motherboards Reduce System Footprint

The Mini-ITX and EPIC Express form-factors help military system manufacturers improve bandwidth while reducing overall system footprint. The Mini-ITX MightyBoard 821 and EPIC Express ReadyBoard 820 motherboards from Ampro Computers feature ACPI power management and RoHS compliance and include an Intel 915GM chipset, integrated chipset graphics and EIDE interfaces.

The 6.75-in. x 6.75-in. MightyBoard 821 fits in standard Mini-ITX and ATX enclosures and features a 2.0 GHz Pentium M 760 or a 1.5 GHz Celeron M 370 processor and up to 2 Gbytes of DDR2 533 RAM. I/O includes six USB 2.0 ports, a SATA interface, two Intel 82573 PCI Express Gigabit Ethernet ports, a x16 PCI Express slot, VGA and LVDS video interfaces. The 4.5-in. x 6.5-in. EPIC Express-compliant ReadyBoard 820 uses Pentium M 745 processors up to 1.8 GHz and up to 1 Gbyte of DDR2 400 SODIMM RAM. I/O support includes four USB 2.0 ports, two SATA ports, an Intel 82573 PCI Express Gigabit Ethernet port, 10/100 Ethernet with wake on LAN support, LVDS, two UARTs and eight GPIO pins. Three lanes of PCI Express enable high-speed I/O expansion. QuickStart Kits for both boards include drivers and BSPs for Windows XP/XP Embedded/CE Linux 2.6. Prices start in the low $500s for production quantities with an Ampro-installed CPU.

Ampro Computers, San Jose, CA. (408) 360-0200. [www.ampro.com].



Dual-Core Processors Climb onto ETX 3.0

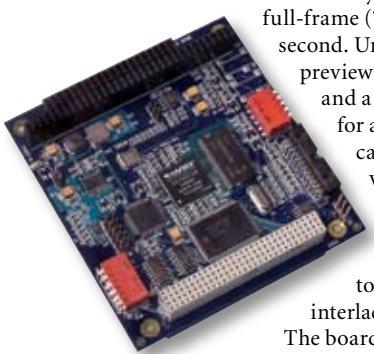
The ETX standard established in 2000 recently received a "refresh" and upgrade to version 3.0, enhancing the supported interfaces while still keeping the design 100 percent backward compatible with previous module revisions. Fanning those flames, Kontron has launched the ETX-CD based on the Intel Core Duo processor. Built around the Intel Core Duo processor, the RoHS-compliant Kontron ETX-CD is the high-end COM for embedded designs requiring PCI, ISA, SATA and USB 2.0 as well as all standard ETX interfaces.

The Kontron ETX-CD Computer-On-Module integrates the new Intel Core Duo processors, the mobile Intel 945GM Express chipset and up to 2 Gbytes DDR2 S0DIMM main storage and offers maximum computing and graphics performance with comparatively low power input. Additional extensive add-ons that go beyond the standard facilitate customized baseboard designs. The standardized display adaptation with EDID 1.3 exemplifies this. Board support packages for the most current operating systems such as Windows XP Embedded and Linux are available for download. In the near future, additional modules for high-performance processors from Intel, AMD and VIA will further expand the array of offerings of Kontron ETX 3.0 modules.

Kontron America, Poway, CA. (888) 294-4558. [www.kontron.com].

MPEG/MJPEG Frame Grabber Captures Video at 30 Frames/s

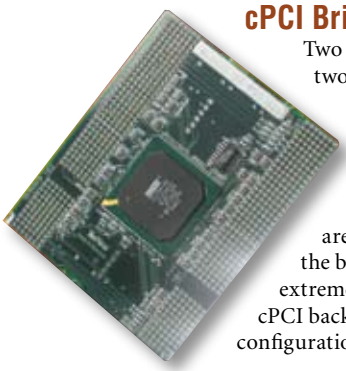
Storing full-motion video requires a lot of memory and transmitting it takes a lot of bandwidth unless the data is compressed into MPEG and MJPEG formats. The Model 314 MPEG-1/2/4 and MJPEG frame grabber from Sensoray compresses images, capturing full-frame (720 x 480) video at 30 frames/second. Uncompressed video is available for previewing through the PC/104-Plus bus and a 96-character buffer is available for adding text to each frame. The 314 can supply real-time uncompressed video and snapshots of single frames. The hardware compression circuit uses a motion estimation algorithm to produce smooth images from interlaced cameras.



The board has two synchronized audio input channels, audio encoder and on-screen display of text (OSD). It performs motion detection in three user-programmable regions of interest. Digitized audio from the 314 is multiplexed into MPEG streams by Sensoray-supplied software in the SDK. External signals connect to the 314 via a 24-pin header. The optional 311TA video termination board provides BNC connections for the 314's composite video inputs. The 314 comes with an SDK including drivers and demo applications for Windows-XP, Linux 2.4 and 2.6, Windows Embedded XP and QNX. Price is $328.

Sensoray, Portland, OR. (503) 684-8005. [www.sensoray.com].

cPCI Bridges Expand Systems Across Multiple Backplanes

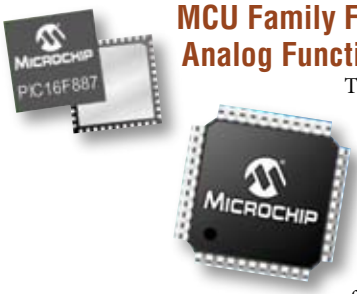


Two cPCI backplane low-profile bridge modules from Elma Bustronic let 33 and 66 MHz systems be expanded across two or three backplanes. The flat, unobtrusive design allows the bridge modules to be plugged into the rear of the backplane without obstructing rear I/O modules. The bridges feature automatic detection of 32-/64-bit systems and support 3.3V and 5V inputs. Eight-layer modules are available with Elma Bustronic 3U and 6U CompactPCI backplanes, enabling both two-backplane configurations (7 + 3-7 slot), and up to 21 slots with three backplanes. All slots are fully accessible from the front.

Seven clock signals and arbitration for seven secondary devices is built into the 95.1 x 79 mm modules, which are available as part of a configured backplane subsystem. By using multiple capacitor types distributed across the backplane, together with Elma Bustronic's backplane routing, crosstalk has been virtually eliminated, and extremely low RF radiation has been achieved in these 0°-70° C rated active modules. The bridges are sold only with the cPCI backplanes and not sold separately. Pricing for a backplane with a bridge starts at $500, depending on volume and configuration.

Elma Bustronic. Fremont, CA. (510) 490-7388. [www.elmabustronic.com].

MCU Family Features Rich Set of Analog Functions



The blending trends of automation, portability and compute density in military systems are driving designers to embrace highly integrated, low-power microcontroller platforms. With its latest offering, Microchip Technology announced a new four-member family of 28- and 40/44-pin PIC microcontrollers for use in a wide range of applications. The PIC16F88X family maintains compatibility with the PIC16F87XA family for easy migration, while providing a host of new features designed to save users time and money—both during and after their design cycle. The enhancements include dual internal oscillators with clock switching and fail-safe clock mode; more (up to 14) ADC channels; an advanced comparator module featuring two comparators and a Set/Reset Latch to allow emulation of many analog circuits; and low-power enhancements that extend battery life. Specific application examples include battery-operated systems and battery management, space-constrained and small form-factor applications, analog-intensive applications and mechatronics.

Pricing for this four-member family starts at $1.58 each in 10,000-unit quantities. The PIC16F883 and PIC16F886 come in 28-pin PDIP, SOIC, SSOP and QFN packages, while the PIC16F884 and PIC16F887 are available in 40-pin PDIP, and 44-pin QFN and TQFP package options.

Microchip Technology, Chandler, AZ. (480) 792-7200. [www.microchip.com].

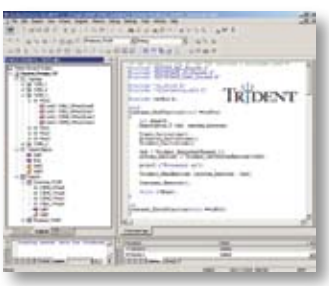
Core 2 Duo SBC Is Backward Processor-Compatible

A new Intel Core 2 Duo SBC from American Portwell Technologies aimed at high-performance mission-critical applications also supports Pentium D, Pentium 4 or Celeron D processors in an LGA775 socket. The Robo8717VG2A utilizes the 1.066 GHz Core 2 Duo's energy-saving advantages, at up to 65W thermal design power. The processor's other advantages include wide dynamic execution, intelligent memory access, advanced power capability, multicore optimized cache and single-cycle SSE/2/3. Its LGA775 socket is equipped with dual-core, hyper-threading, EM64T, EIST, XD and VT technologies.

The Robo-8717VG2A is a PICMG 1.0 PCI/ISA single host board equipped with 4 Gbytes of DDR2-800 memory, the Intel Q965 Express chipset, integrated graphics controller and a Graphics Media Accelerator 3000 that supports DirectX 9.0, Shader Model 2.0 and 256 Mbytes of video memory. The board's I/O includes PCI Express x1, dual Gigabit Ethernet ports, four SATA 300 connectors for increased bandwidth, six USB 2.0 ports, dual serial ports, a parallel port and GPIO. List price is $499.

American Portwell Technology, Newark, CA. (510) 790-9192. [www.portwell.com].

Multiprocessor Environment Supports TigerSHARC DSP



The trick in multiprocessor systems is to ensure that performance will not decrease even as the number of processors increases. Enabling just that situation for the TigerSHARC DSP, BittWare has released Trident, its new multiprocessor operating environment. Supporting distributed multiprocessor application development on Analog Devices TigerSHARC processors, Trident provides system designers a complete operating environment to code, debug and optimize applications on multiprocessor, multi-board and multi-system platforms. Its efficient distributed framework, optimized for low latency and high throughput, can support up to 65,000 processors.

Trident consists of a suite of embedded libraries and host tools that seamlessly integrate with Analog Devices Visual DSP++ development tool-chain. Its modular design supports multiprocessor synchronization for threads on different processors, large-scale messaging capabilities with point-to-point and broadcast APIs, and high-speed data transfers. The underlying inter-process communication supporting each Trident module occurs across high-performance LVDS link ports either directly connected or configured via BittWare's FPGA ATLANTiS framework. BittWare's Trident is available today priced at $10,000 per project (max three development seats). Trident is royalty/run-time free when used on BittWare hardware.

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

Fanless PC/104 Board Sports Geode LX800 Processor

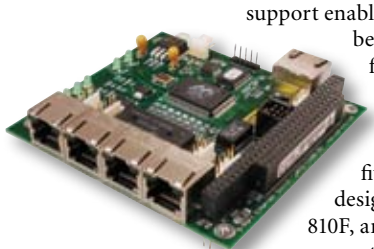
Fans are a no-no in most harsh, battlefield rugged military systems. A fan's vulnerability as a single point of failure usually can't be tolerated. Following the fanless mantra, Digital Logic is offering its low-cost PC/104 module, the MSM800SEL. This robust CPU board is based on the AMD Geode LX800 processor, an x86-based chip that was specially designed for embedded applications and mobile devices. The processor runs at 500 MHz and is said to provide performance equivalent to that of an 800 MHz processor. It does not require a fan, consumes only about 1.6W (CPU) and provides an integrated 2D graphic chip with an analog and a digital output.

State-of-the-art features such as four USB V2.0 ports, graphics, a 100/10Base-T-Ethernet port, and the possibility of expandable functions using PC/104-Plus (ISA and PCI), ensure an almost unlimited range of applications. Up to two parallel display interfaces (VGA/24-bit, digital video interface/TFT) may be connected to display two identical images. For optional assembly with EIDE solid-state memories, the PC/104 board includes an optional CompactFlash type I/II slot. The embedded computer requires a 5V power supply. Designed for low power consumption—from 5 to 10W— it operates within a standard temperature range of 0 to +60°C.

Digital Logic, Luterbach, Switzerland. +41 (0)32 681 58 40. [www.digitallogic.ch].

Five-Port PC/104 Fast Ethernet Switch Supports Port-Based VLAN

When developing space-constrained, high-reliability aviation and military systems for net-centric operations in extreme temperature/high-shock/vibration environments, military engineers are turning to virtual LAN technology. In particular, port-based VLAN functionality support enables any combination of ports to be connected together in subnets for use in a small secure or non-secure network. To meet this need, Parvus has introduced the PRV-1059 VLAN-enabled five-port PC/104 Ethernet switch, designed and tested to MIL-STD-810F, and featuring very low power consumption of 1.5W and highly reliable extended-temperature operation up to +85°C. Its five transceiver ports are fully IEEE 802.3 and IEEE 802.3u compliant and designed so any port can serve as an uplink.



Supporting auto-MDI-MDIX network installation, the board is designed for simple plug-and-play operation, enabling up to five embedded computing devices to be networked together using 10BaseT or 100BaseTX LAN connections. It integrates fully independent media access controllers (MACs), an embedded frame buffer memory and a high-speed address look-up engine, along with support for auto-crossover, auto-polarity, auto-negotiation and bridge loop prevention. The compact, 90 x 96 mm, PRV-1059 switch is available in non-RoHS and RoHS-compliant (lead-free) versions. Pricing is $199 for base models and $249 for models with VLAN support.

Parvus, Salt Lake City, UT. (801) 483-1533. [www.parvus.com].

CompactFlash Cards Operate over Extended Temp Range

CompactFlash cards must operate in harsh environments to benefit military systems with their inherent reliability and versatility. Two new CompactFlash cards from WinSystems, available in densities of 4 Gbytes and 8 Gbytes, operate from -40° to +85°C. They target applications that need high reliability and IDE hard disk drive emulation for program and data storage and are designed to work with SBCs, instruments, cameras or computer systems with a CompactFlash socket for solid-state program and data storage.

Both cards incorporate onboard error detection and correction algorithms coupled with dynamic wear leveling techniques to deliver more than two million program/erase cycles for most applications. The cards are True IDE Mode-capable, including PIO Mode 0-4 and DMA Mode 0-2, as well as ATA-3 compliant. Consequently, they are compatible with operating systems such as Linux, Windows CE and Windows XP Embedded, ROM-DOS and others without requiring a special software driver. List price of the CFLASH-G-8G-I, an 8 Gbyte industrial temperature RoHS-compliant unit, is $479. The 4 Gbyte version is priced at $389.

WinSystems, Arlington, TX. (817) 274-7553. [www.winsystems.com].

A/D Recording System Records at 700 Mbytes/s

As PCs have become more powerful, they're becoming the preferred platform for a lot of military test and data acquisition applications. Serving those needs, Signatec is offering its high-speed DR-series systems, capable of continuously recording up to 700 Msamples/s direct to disk storage without any loss of data. Three standard recording configurations offer solutions to satisfy varying applications and budgets: 700 Mbytes/s, 350 Mbytes/s and 250 Mbytes/s. Signatec offers recording system options with up to eight channels, as well as 8-bit and 14-bit A/D resolution.

The 8-bit options have peak sample rates of 1 GHz per channel, and the 14-bit options can sample at up to 100 MHz per channel. Advanced recording features are built into the system to allow for various segmented or pulse-based acquisitions, as well as channel interleaving, for intelligently maximizing the continuous 700 Mbytes/s of recording bandwidth. Optional features include streaming the digitized data at up to 1 Gbyte/s to Signatec's real-time parallel processing solutions to create best-of-industry data acquisition, real-time processing and recording systems. If user applications also require signal playback features, Signatec's signal waveform generator component features can be added to deliver 16-bit, 1 GHz analog solutions.

Signatec, Newport Beach, CA. (949) 729-1084. [www.signatec.com].

Universal Serial I/O Board for PowerDNA Offers Four Isolated Ports

A new universal serial I/O layer/board for the PowerDNA distributed data acquisition and control system offers four fully independent, isolated RS-232, RS-422 or RS-485 ports. The PowerDNA system targets aerospace, in-vehicle and laboratory data acquisition and control applications. The DNA-SL-501 board from United Electronic Industries supports half- and full-duplex mode for RS-485. Each port is software-configurable as RS-232 or RS-485, and maximum data transfer rates are up to 1 Mbit/s in RS-422/485 mode or up to 256 Kbits/s in RS-232 mode.

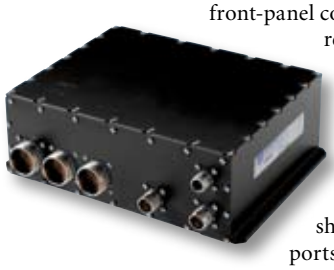
The DNA-SL-501 uses a 16550 UART controller on each port (FIFO mode only). The board is compatible with RS-422 networks when used in RS-485 mode. It provides 200 Ohm software-selectable TX and/or RX termination for RS-485 communications. Additionally, the DNASL- 501 provides 1 kOhm software-selectable fail-safe RX termination for RS-485 mode. Each port features completely independent bit rate settings. The board provides 350V isolation between ports and circuitry and 15kV ESD. It supports the UEIDaq Framework Data Acquisition Software Library for Windows. Linux and QNX drivers are available. Price is $650.

United Electronic Industries, Canton, MA. (781) 821-2890. [www.ueidaq.com].

Managed Switch Has 24 10/100/1000 Ethernet Ports

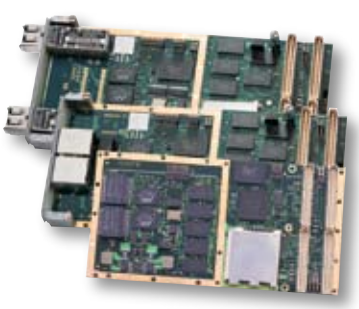
As defense applications become increasingly network-centric, the requirement for improved connectivity is growing. In response to that need, Radstone Embedded Computing offers the fully rugged, fully managed GS24 stand-alone Gigabit Ethernet switch. Featuring twenty-four 10/100/1000 Mbits/s ports, the GS24 is aimed at out-of-the-chassis applications such as the networking of multiple subsystems.

The GS24 offers IPv6 traffic policing and QoS functionality such as guaranteed bandwidth allocation and prioritization. Connection to the lightweight, space-efficient, conduction-cooled GS24 is via rugged front-panel connectors, which meet MIL-STD-810F requirements for humidity, salt spray and dust. The front panel allows customization to accommodate varying connector types, including optical connectors when the optically expanded variant is used. Featuring a non-blocking shared memory architecture, all gigabit ports support both full- and half-duplex operation, providing up to 88 Gbit/s full wire-speed performance with minimal latency on all twenty-four ports simultaneously.



A version with two 10 Gbit/s optical interfaces is available that supports backbone networks and aggregation. The GS24 features a MIL-STD-1275 power supply unit to increase operational reliability. Pricing starts at $15,667.

Radstone Embedded Computing, Billerica, MA. (800) 368-2738. [www.radstone.com].

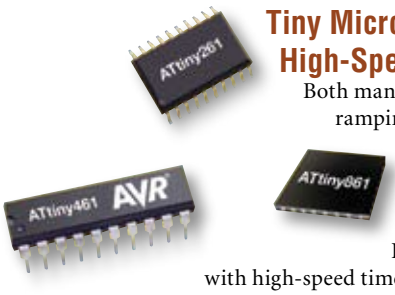


Rugged cPCI Core 2 Duo SBC Targets Military Comm, Control Apps

The most demanding military network, communications and control applications require high throughput and rugged operating capabilities. A ruggedized, single-slot, 3U CompactPCI SBC from Men Micro fills the bill with the Intel 2.16 GHz Core 2 Duo processor. The F17 is a 32-bit/33 MHz SBC that can function as a system controller in a CompactPCI chassis or as a stand-alone embedded processor. The 945GM Express chipset uses six lanes of high-speed PCI Express serial communications and two SATA ports.

The front panel includes two Gigabit Ethernet ports that utilize PCI Express and two USB 2 interfaces. A front-panel VGA graphics port can, as an option, be brought to the front panel as two DVI connectors. Rear-panel I/O is also supported. Onboard resources include up to 4 Gbytes of fast DDR2 memory and a CompactFlash slot accommodating either flash or a 1.8-in. disk drive. A specially designed passive heat sink facilitates efficient thermal management and all components are soldered in place. For humid or dusty environments, the F17 can be delivered with a conformal coating. BSPs are available for Windows, Linux and VxWorks. Pricing starts at $2,635.

Men Micro, Lago Vista, TX. (512) 267-8883. [www.menmicro.com].



Tiny Microcontrollers Sport High-Speed Timers

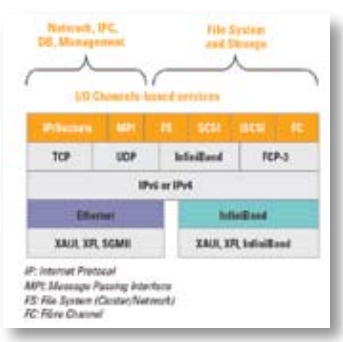
Both manned aircraft and UAVs are ramping up their demand for distributed sensor and motor control subsystems. Atmel has a solution with three new 20-pin tinyAVR Flash microcontroller devices with high-speed timers. The devices are pin-compatible, differing only in the size of their flash, EEPROM and SRAM memories. The ATtiny261 has 2 Kbytes of self-programmable flash memory, whereas the ATtiny461 and ATtiny861 have 4 Kbytes and 8 Kbytes, respectively. All devices deliver 20 Mips throughput when running at 20 MHz.

Commonly used microcontroller peripherals are all integrated. The ATtiny261/461/861 devices include a Universal Serial Interface (USI), which can be easily configured to work as an SPI, UART or TWI. The power consumption of the device in 1.8V active mode at 1 MHz is less than 400 uA, and in power-down mode just a few uA. Complete evaluation and debug tools are available for the tinyAVR microcontrollers. The STK500 and STK505 starter kits are available at $79 each. Samples of ATtiny261, ATtiny461 and ATtiny861 are available in 20-pin SOIC and PDIP and 32-pad QFN packages. All three devices are in volume production. Volume prices for 10k units are $0.80, $0.90 and $1.15, respectively.

Atmel, San Jose, CA. (408) 441-0311. [www.atmel.com].

InfiniBand Adapter Offers 1 and 10 Gbit Connectivity

InfiniBand, one of the first switched fabric technologies to come upon the embedded scene, has won acceptance in a number of military applications, such as shipboard networks. Mellanox Technologies has unveiled its fourth-generation adapter architecture that extends InfiniBand's field-proven price/performance and service-oriented features by incorporating connectivity options such as 1 and 10 Gigabit Ethernet. The ConnectX architecture implements proven and common I/O channels-based services across all protocol and fabric options—including Remote Direct Memory Access (RDMA) and transport offload protocols supported by the OpenFabrics Alliance—allowing for coherent end-to-end I/O services with easy application portability and migration across different connectivity options.



The ConnectX architecture supports 40 Gigabit InfiniBand as well as 1 and 10 Gigabit Ethernet and protocols using either IPv4 and IPv6, as well as popular data networking—sockets, MPI and others—and storage—SCSI, iSCSI, FC—protocols. ConnectX brings dedicated I/O service performance familiar to users of InfiniBand to Ethernet connections, including quality of service, dedicated channels and congestion control. The architecture will include implementation of Intel's I/O acceleration technology (I/OAT) to enhance TCP/IP stateless offload-based performance on both Ethernet and InfiniBand fabrics.

Mellanox Technologies, Santa Clara, CA. (408) 970-3400. [www.mellanox.com].

XMC PCI Express Card Does 4 Gbit/s Fibre Channel

Fibre Channel remains popular as a back-end link to storage in radar, SIGINT and other military systems. Like its predecessor, PMC, the XMC mezzanine form-factor is a great platform for Fibre Channel interfaces. The Critical I/O model FCA2440 is the industry's first 4 Gbit/s Fibre Channel interface to comply with the VITA 42.3 standard (XMC with PCI Express host interface).

Providing 4 Gbit/s Fibre Channel connectivity to PCI Express-based systems, the FCA2440 eliminates the performance limitations imposed by the PCI data bus. It provides sustained data rates of 1500 Mbytes/s, 10 µsec RDMA data transfers, and up to 300,000 IOPS (I/O operations per second), representing 50% higher throughput and 33% reduction in latency over 4 Gbit PMC interfaces. The combination of the XMC hardware and its extensive supporting drivers and libraries is engineered for performance-driven networking and storage applications. The FCA2440 is a part of the sixth generation of Fibre Channel technology from Critical I/O, the world leader in Fibre Channel interfaces for embedded systems.

Critical I/O, Irvine, CA. (949) 553-2200. [www. criticalio.com].

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Function Generator Replaces Legacy HP8116

The growing problem of test equipment obsolescence means that military engineers developing a variety of systems find themselves using equipment that can no longer be maintained properly. With that in mind, Geotest-Marvin Test Systems has introduced the GP1616, a 100% form, fit and function replacement for the obsolete HP8116 function generator. Since the GP1616's firmware is fully compatible with that of the Hewlett Packard 8116, Test Program Sets (TPSs) that make use of this legacy instrument require no code modification when the HP8116 is replaced with the GP1616.

The GP1616 Series utilizes Direct Digital Synthesis (DDS) for stability and accuracy of the full frequency range of 1 µHz to 50 MHz. It offers amplitude modulation, frequency modulation and precision bursts for trigger, gate and burst modes. The GP1616 Series provides internal storage of up to 10 complete sets of parameters and settings by using its internal non-volatile memory. Price is $15,995.

Geotest-Marvin Test Systems, Irvine, CA. (949) 263-2222. [www.geotestinc.com].

Portable Workstation Boasts Thin, Light 17-inch Screen

Advances in situational awareness and the build out of the DoD's Global Information Grid are driving demand for power mobile workstations capable of displaying complex military information. Serving such needs, NextComputing announced today the availability of the thinnest, lightest weight, 17-inch flat panel monitors on its NextDimension product. At only 1-inch thick, two of them can clip right onto the NextDimension, making lightweight portability of your entire desktop feasible. Both functional and sleek, they provide a plasma TV-like look on your desktop as opposed to a bulky monitor. Like larger, high-performance monitors, the displays reach resolutions of up to 1920x1200.

Users can achieve maximum computational and graphics performance by combining up to two ultra-high-end PCI Express graphics boards with up to two best-in-breed AMD Dual-Core Opteron processors. The NVIDIA Quadro FX 5500 SDI by PNY, which delivers uncompressed SDI output in 2K, HD or SD format, provides NextComputing clients with the ultimate portable HD-SDI solution.

Additionally, users desiring high-quality audio features, like those in DCC and the Audio production industry, benefit from the lower noise level of the NextDimension in this desktop configuration. The sound becomes more clearly audible when this system is used in comparison to a bigger, comparably equipped tower workstation.

NextComputing, Nashua, NH. (603) 886-3874. [www.nextcomputing.com].

.NET Micro Framework Development Kit Features iPac 524 SBC

Military engineers developing deeply embedded applications that require a low-cost hardware platform will benefit from the .NET Micro Framework development kit (NDK), created jointly by SJJ Embedded Micro Solutions and EMAC. The kit includes EMAC's iPac 524 SBC running the .NET Micro Framework, as well as source code, instruction manual and other tools, including step-by-step exercises. It can be used to develop a variety of applications from robotics to industrial controls.

The .NET Micro Framework contains a tiny CLR that acts as a mini kernel to run managed code applications. Developers can write C# applications in Visual Studio and download them to the iPac 524. The board features the Sharp 79524 ARM processor in a PC/104 form-factor. The iPac 524 is equipped with a wide variety of I/O to meet multiple applications, including ten A/D channels, 16 digital GPIO lines, eight High-Drive digital output lines, three multi-purpose I/O lines, SD/MMC flash, a graphic LCD interface, 10/100 Ethernet, USB 2.0, RS-232 and five synchronous serial I/O lines (GP/SPP/SPI/I^2S). Price is $129.

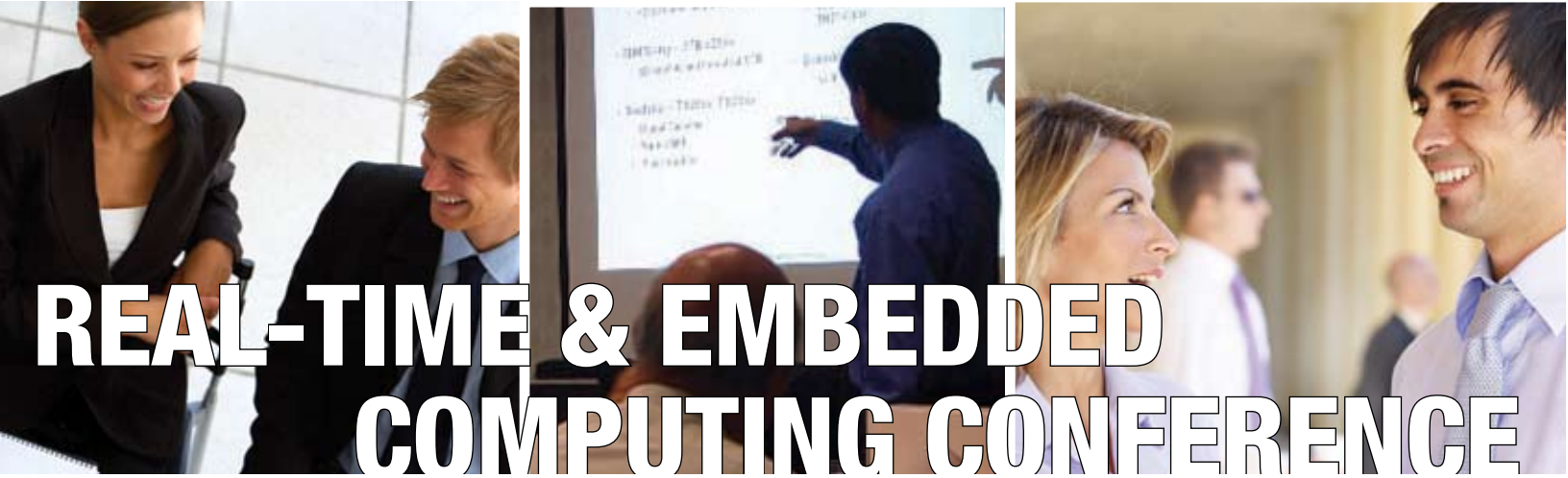
SJJ Embedded Micro Solutions, San Diego, CA. (858) 485-1059. [www.sjjmicro.com].

Rugged MicroTCA ATR Chassis Targets Mil Apps

MicroTCA is fast gaining momentum as an option for highly integrated, modular military systems. Attempts to ruggedize the architecture have been ongoing. A part of those efforts includes Hybricon's new ruggedized MicroTCA ATR chassis. Working closely with industry leaders, Hybricon has developed a ruggedized MicroTCA ATR chassis that accommodates double-width modules. This ruggedized ATR platform remains compliant with the specification and addresses key limitations of commercial MicroTCA for military applications.

Designed to the latest PICMG AMC and MicroTCA specifications, the chassis has locking bars that firmly retain the MicroTCA cards into the card cage, providing significant additional resistance to shock and vibration. A shock-isolated MicroTCA card cage inside the ruggedized ATR chassis attenuates the level of shock and vibration that is seen by the MicroTCA cards, allowing the chassis to meet stringent ANSI/VITA 47 and MIL-STD-810 shock and vibration requirements. The unit features MIL-STD-461 EMI/EMC containment. Military circular connectors are provided for copper and fiber I/O. This I/O can be tailored for specific applications. Power supply front end converters can be configured for Commercial power, MIL-STD-704 aircraft power or MIL-STD-1275 vehicle power.

Hybricon, Ayer, MA. (978) 772-5422. [www.hyrbricon.com].



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Coming Next Month

Coming Next Month in December *COTS Journal*

- *VME Single Board Computers*. As we round out this year—which marked the 25th anniversary of VME—it's clear that VME has earned an enduring role as the most popular embedded computer form-factor for defense applications. Next-generation, fabric-based flavors of VME are coming together in the form of specs such as VXS and VPX. This section updates readers on the progress of those implementations and examines the technologies that are key to the current crop of VME SBC products.
- *Precision Timing Systems*. Sophisticated GPS, navigation and timing systems have moved far beyond a niche segment of military system design. The military's move toward net-centric operations and constant communications has brought GPS and precision timing to the forefront of mission-critical technologies. Articles in this section update readers on those technologies and how they are being implemented as embedded subsystems.
- *Graphics Boards*. Gone are the days when it took a whole multi-board chassis' worth of electronics to drive a display. By leveraging cutting-edge graphics chips developed for the demanding gaming market, military graphics subsystems are now able to offer complex video and graphics functionality in highly integrated board-level solutions. Articles in this section examine the graphics solutions available in PMC, VME, cPCI and other form-factors.
- *Solid-State Drives*. Free from the woes of moving parts, flash-based solid-state disks F-SSDs are able to operate under the harshest conditions, unlike magnetic hard disk drives. And because F-SSDs targeted for military and aerospace apps use the same fundamental flash components as the consumer realm, the price advantages can be leveraged across all markets. This Tech Focus section updates readers on F-SSD products and provides a product album of representative drives.

COTS

Editorial

Jeff Child, Editor-in-Chief

Engineering the DoD's Future

I've long since past the point where my years as a technology journalist began to outnumber those working as an engineer. But that foundation of an EE/Computer Science background serves me well when I cover technologies in our industry. It also allows me to speak comfortably with technologists of most any stripe. That's probably one of the reasons I enjoy engaging with executives in the embedded computing industry so much: the vast majority of them are former engineers as well.

From that bias, I suppose it's only natural that I'm a big fan of Deputy Secretary of Defense Gordon England, and the work he's done to move forward the DoD's transformation over the past couple years. A BSEE himself, England's business career spanned over 40 years as an engineer and senior executive. His resume includes a number of top executive posts at General Dynamics, so he's no stranger to what makes the defense industry tick.

At last month's MILCOM show, I had the privilege of attending the keynote delivered by Gordon England. The fact that England took the time to speak at MILCOM says a lot about his focus on transforming the DoD into a network-centric organization. Much of his speech focused on the Joint Capability Portfolios—an experiment inspired by the QDR aimed at building upon the DoD capability-based planning and management efforts to facilitate strategic choices and improve the ability to make capability tradeoffs. Joint capability portfolios will allow the Department to shift to an output-focused model that enables progress to be measured from strategy to outcomes.

Along those lines, the Deputy England's Advisory Working Group (DAWG) within the Pentagon selected four test cases for the joint capability portfolio management concept: Joint Command and Control, Battlespace Awareness, Joint Logistics and Joint Net-Centric Operations. In his speech, England emphasized the importance of the Joint Net-Centric Operations portfolio in particular. "My suggestion to all industry people here is that you follow this evolution closely, because this approach will have implications for how we procure our net-centric goods and services," he said. "This is a very serious effort within the Department."

According to a September memo from England, a number of ongoing advanced technology communications programs will be included in the initial Joint Net-Centric Operations portfolio. Among them are the Advanced Extremely High Frequency (AEHF) satellite system, the Family of Advanced Beyond-Line-of-Sight Terminals (FAB-T), the Global Positioning System III (GPS-III), the High Assurance Internet Protocol Encryptor (HAIPE), the Joint Tactical Radio System (JTRS), the Mobile User Objective System (MUOS), the Transformational Satellite (TSAT) program, and the Warfighter Information Network (WIN-T).

Because communications and networking technologies, by definition, have to be designed to interoperate with one and another, it's gratifying to see that efforts are being made to orchestrate that interoperability in a broad "concurrent engineering"-style fashion. According to England, the DoD is seeking timely synchronization and integrated delivery of capabilities—and to do it within projected costs and on schedule. Using the joint capabilities portfolios, the hope is to identify gaps and seams, to eliminate redundancies except by design, and to make sure that solutions are completely interoperable. This portfolio tackles a wide range of issues—tools for spectrum management, data strategy, coalition interoperability, bandwidth, collaboration, and information assurance—everything. "Now it sounds complex, but in my judgment it's a much simpler approach than trying to integrate 25 or 30 separate programs, buried in each of the Services' budgets, late in the design and fielding cycle," said England.

England concluded his keynote with a warning that our nation must keep pace in science and technology education. Not to do so, is our greatest threat we face. "It's not WMD, not even WMD in the hands of determined terrorists." he said, "The greatest long-term threat to America, and to our close friends and allies, is falling behind in science and technology. There is no greater threat to this nation. Science and technology are the bedrock of our knowledge-based economy, as well as our military capabilities." Spoken like a man with an appreciation for technology with engineering in his blood.

News of Secretary of Defense Donald Rumsfeld's resignation occurred just as we were going to press with this issue of the magazine, so there wasn't time to offer much insight into what that means for the DoD. But I'll tack on my gut reactions here. Taken together, the bureaucracy of the Defense Department and the defense industry as a whole is pretty entrenched, not one disposed to welcoming change. Someone of Rumsfeld's outspoken, combative nature was, arguably, what has been needed to keep the defense establishment moving toward the vital transformation from a focus on Cold War requirements to the very different needs of the 21st century warfighter. That said, the DoD's process of transformation—of which the COTS movement is one aspect—began before Rumsfeld's tenure. And it appears that the transformation ethos is now so ingrained in the planning and operations of the military branches that a change of leadership at the DoD will have minimal disruption on that progress. For my take on what's encouraging about today's DoD, let me boil it down to this: see above comments about Gordon England. ■

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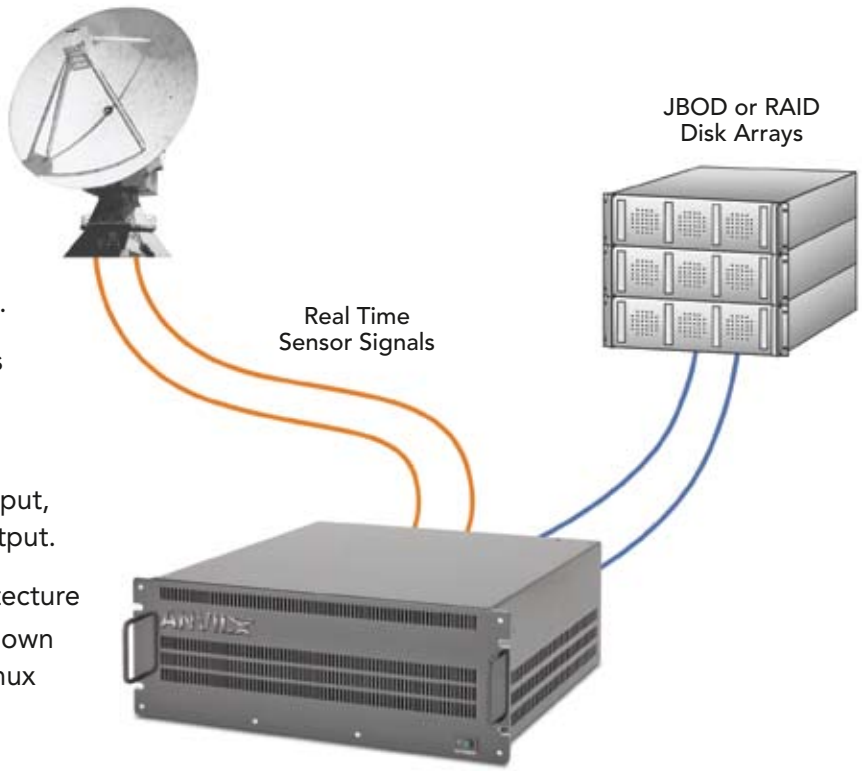

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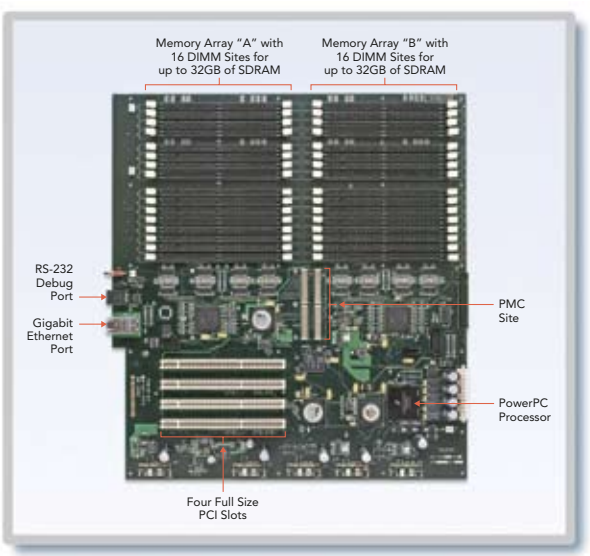

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