

# COTS

JOURNAL

# RUGGED BOX-LEVEL SYSTEMS CAPTURE MILITARY MINDSHARE

Tech Focus:  
PC/104 and EPIC Boards



**PLUS:**

Complexities Abound in  
Network Testing

Safety, Energy Density  
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**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.*

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Stand-alone rugged box-level systems are particularly attractive in military vehicle systems. SprayCool makes a Multi-Processor Unit (MPU)—in a fully rugged, sealed enclosure that enable's commercial boards to meet the temperature, vibration and EMI requirements of MIL-STD 810F and MIL-STD 461—that will be used in Marine Corps' new Expeditionary Fighting Vehicle (EFV). The EFV will replace the Marines' Amphibious Assault Vehicles (AAV). Shown here, AAVs maneuver on the beach as part of a comparison exhibit with the EFV.

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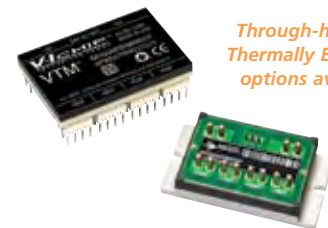


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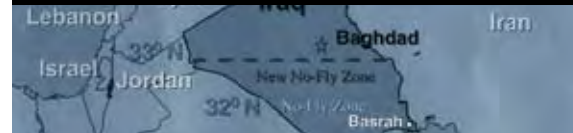
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# Publisher's **Notebook**



## *A Change Is Gonna Come*

**E**veryone seems to be in a frenzy these days: politics, economics, job security, electronic data bombardment. My brain hurts. More, more, more. Faster, faster, faster. I keep getting things jammed at me that, for the most part, I have no interest in and it's making me numb. That's not a good thing, or at least I don't think it is. I find I'm spending as much time avoiding or getting rid of things that are of no interest as I spend doing productive work or thought. Don't worry, I'm not going to do yet another rant on broadcast media or blogs or anything similar. Let's just look at the big issues.

The potential political change occurring every four or eight years in this country never fails to throw our industry into turmoil. Most people just hunker down and wait to see how things fall out. This election cycle probably has more potential issues at stake that could influence our marketplace than any since the '90s. While many pundits have already determined who will be the leader of the new Administration, there are others that aren't so sure. Certainly the last Congress hasn't proved to possess the stellar influence over the government that it said it would. Who will control Congress going into 2009 is not certain and few want to even discuss this.

Closer to home, the proposed 2009 Military Budget has no major shifts in it. And there isn't one politician that will attack it for fear of losing votes. As a result, it probably won't see any significant changes—only a general and weak sort of political bashing. That means there won't be any major attacks or shifts in individual programs. R&D money will be like watching a very poor juggler: some projects will not have any problems, but some will. And it will be anyone's guess which balls will stay in the air and which ones will fall.

Another element of change facing our market is the general economy. When there's uncertainty in the commercial electronics market, suppliers try to move into the "more stable" military market. (Stable military market? I never thought I'd say that.) And forgive me for saying again what I've said hundreds of times, but you can't just move into the military market, even if you are producing COTS products. Even though design-in cycle times have shrunk way down, it's still rare to see any significant revenue on a design win in less than 24 months.

So here's another hurdle for new market entrants: Along with all the unique technology and reliability requirements that many military projects have, program managers are now more eager than ever to expect product offerings that are as state-of-the-art as products available in the consumer market. In the past the military was reluctant to integrate programs with silicon that wasn't tried and proven for years. Now with this increased

desire that technology used in military programs parallels the commercial world, there's even more pressure on suppliers who have to prove reliability and endurance. And why wouldn't military system developers want the latest and greatest? Intel for one is producing processor chips with unprecedented performance. Moreover, the current chips are not only screamers in performance but also boast unbelievably low power. Those are just two features at the heart of all manpack and autonomous vehicle programs, for example.

Even closer to home is the information flow about programs, projects and products. The e-mail blasts I get these days about a company's product—either directly or guised as an e-mail blast from a third party—rivals the mortgage and personal enhancement emails I used to get about three or four years ago. That being the case then, why does a recent focused survey hint at a better option?

It's important to put all surveys and market studies in context and to remember that the experience and methodology of the organizations doing them is a very important factor when determining the validity of the results. Late last year eg3 and the William Baldwin Group produced a survey of marcom (marketing communications) personnel—called Embedded Marcom Survey '07. Its goal was to assess trends in the promotion of companies and products. One of the items in the study showed an increased use of conferences and trade shows. This is definitely contrary to the word on the street over the years touting that there's no need to travel when you have the Internet. As part of our own research on the military embedded market that we do every two years, we thought it prudent at least to ask a question regarding conferences and trade shows.

At least preliminary information would suggest that trade shows and conferences that produce sales leads are of keen interest to suppliers. This is in conflict with users who want to go to conferences for useful information, not necessarily a sales pitch. Does this mean that data bombardment isn't working for either users or suppliers? Are there people out there that feel the way I do? Maybe it's time for a change in more than politics, budgets, programs and technology. Maybe it's time for a change in the way suppliers and users interact.

**Pete Yeatman, Publisher**  
*COTS Journal*

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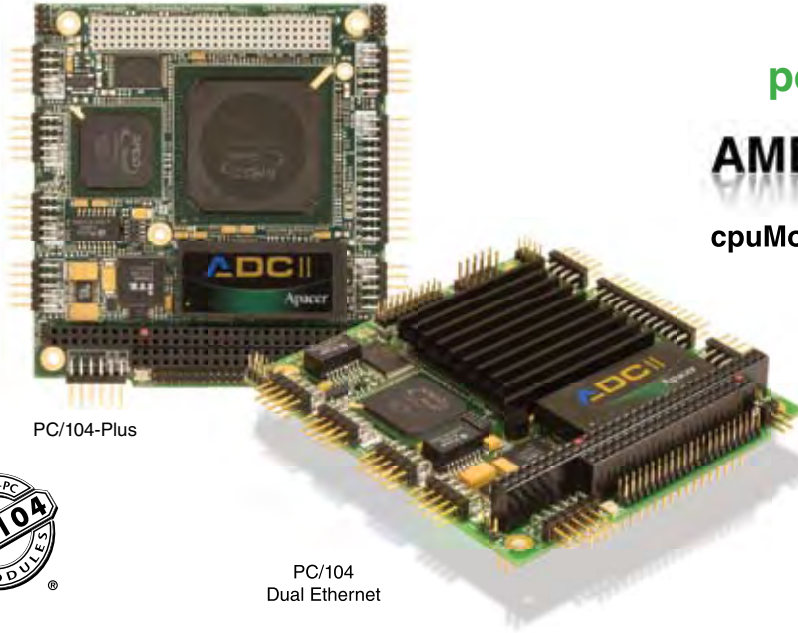
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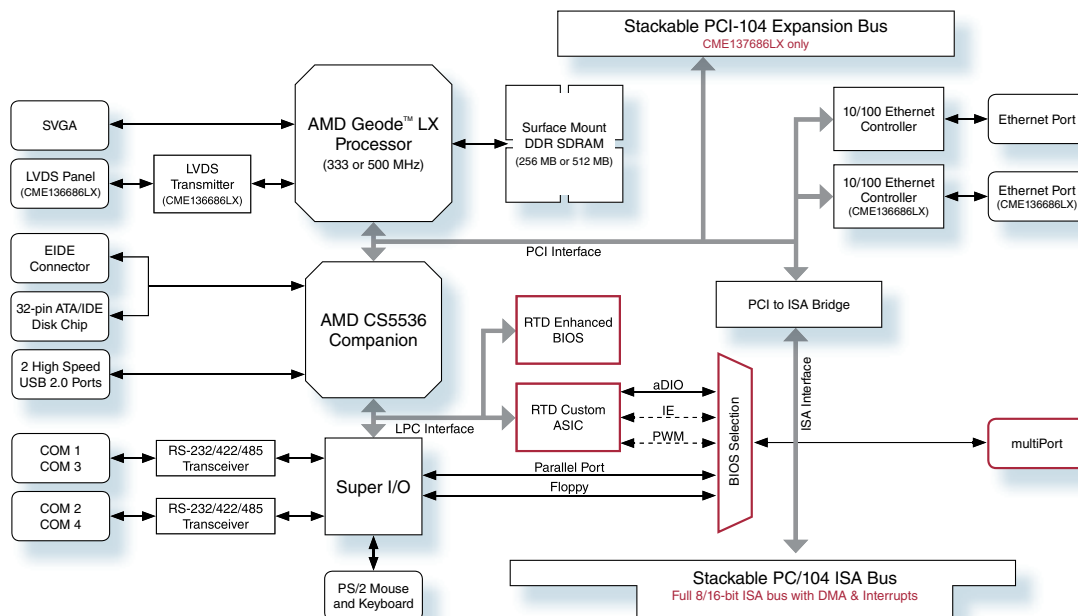
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# The Inside Track

## Wind River Chosen for Next-Gen Periscope on RN Astute-Class Subs

The Royal Navy's new Astute-class submarines will be using Thales UK's non-hull penetrating, optronic mast. The state-of-the-art electro-optic system will allow greater flexibility in boat design and provide improved surface visibility without giving away the position of the submarine. The optronic mast will be powered by Wind River's VxWorks mission-critical real-time operating system (RTOS). The Astute submarines (Figure 1) will deploy a number of technologies to reduce its sonar signature; however, submarines are most vulnerable to detection when the submarine commander uses a periscope to assess the situation on the surface. The Thales optronic mast minimizes this risk by deploying a non-hull penetrating design, which enables the Sensor Head Unit (SHU) to be extended from the submarine fin, and rapidly perform a 360 degree scan above the surface, enabling the commander to analyze the image data afterwards.

The optronic mast will use Wind River's VxWorks mission-critical RTOS running on Thales quad PowerPC AltiVec boards and



Figure 1

The Astute submarines will deploy an optronic mast to minimize the risk of detection by deploying a non-hull penetrating design, which enables the Sensor Head Unit (SHU) to be extended from the submarine fin, and rapidly perform a 360 degree scan above the surface.

AdaCore GNAT Pro to power the stabilization system (high-performance 3 axis to sub-pixel accuracies), video and thermal camera control, communication with the in-hull systems and control all the mechanisms and motors in the SHU. The SHU is a pressure-proof, electro-optical assembly that contains high-performance cameras, optics, environmental sensors and stabilization mechanisms. Inside the submarine hull,

the Mast Control Unit (MCU) coordinates overall system activity, controlling a number of other units and communicating with the submarine's tactical, data and combat systems. The MCU uses two processors, both also running Wind River's VxWorks.

Wind River  
Alameda, CA.  
(510) 748-4100.  
[www.windriver.com].

(CDR) conducted in January and February. During the CDRs, the Army assessed the systems' final designs to validate that baseline requirements would be met. A key success factor in this CDR was the detailed plan to enable

mobile battle command down to the company level. In particular, WIN-T Increment 2 will provide tactical communication nodes, mobile "points of presence," vehicle wireless packages, and soldier network extensions to enable mobile battle command in a completely ad-hoc, self-forming, self-healing network. These warfighter mobility features will support a commander's ability to exercise command-and-control and synchronize warfighting functions from anywhere on the battlefield. Prime contractor General Dynamics and partner Lockheed Martin lead a team of communications, network systems and platform integration experts that includes BAE Systems, Harris Corporation and L-3 Communications.

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

## FLIR Systems Inks \$18.4 Million Deal for H-60 Black Hawk

FLIR Systems has received two contract awards for a total of \$18.4 million for its Star SAFIRE class stabilized, multi-sensor systems to be used on H-60 Black Hawk helicopters. One of the orders represents a follow-on contract in support of the United Arab Emirates GHQ, while the other order is in support of the U.S. Army Black Hawk operations. The Star SAFIRE systems were chosen in part due to their environmentally rugged design, a characteristic they share with the H-60 Black Hawks.

Including these orders, FLIR will have delivered over 200 sys-

## Army Approves Final Design of On-the-Move WIN-T Network

The U.S. Army has approved the final design of Increments 1 and 2 of the Warfighter Information Network-Tactical (WIN-T) program, authorizing General Dynamics C4 Systems and partner

Lockheed Martin to prepare for field testing in October 2008. Testing will be followed by deployment of the WIN-T on-the-move communications capabilities in 2009. WIN-T will be the Army's primary battlefield communications network.

The approval follows successful critical design reviews



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Figure 2

FLIR Systems' Star SAFIRE systems were chosen in part due to their environmentally rugged design, a characteristic they share with the H-60 Black Hawks.

tems in the Star SAFIRE product line for Black Hawk operations. These systems are used by the U.S. Army, the U.S. Air Force and other U.S. Government agencies, as well as by several other nations around the world. Work on the delivery orders will begin in July and is expected to be completed by year end. This work will be performed in FLIR's Portland, Oregon facility.

FLIR Systems  
Wilsonville, OR.  
(800) 322-3731.  
[www.gs.flir.com].

### Quintron Provides VoIP System to U.S. Army-NATO Mobile Training System

Quintron Systems announced that it has completed an expansion in support of U.S. Army-NATO mobile training requirements. This followed the successful introduction last year of the Quintron DICES IV system technology. Working under a contract with a Major U.S. Prime Contractor, Quintron has supplied a DICES Voice-over-IP (VoIP) (Figure 3) communications system that provides voice links between training exercise controllers and combat commanders in the field.

The major new feature of DICES VoIP for this project was the use of industry-standard servers for all central communications audio distribution and con-

trol, providing very light weight, low power and small physical size—all critical parameters for mobile applications. The DICES VoIP equipment was housed in an air-transportable shelter, along with radios and other required equipment. The system included the innovative DICES T1 Gateway, which facilitates connection of legacy analog audio



Figure 3

The Quintron DICES Voice-over-IP (VoIP) communications system provides voice links between training exercise controllers and combat commanders in the field.

interfaces—in this case up to 192 radios—directly into the VoIP environment provided by the other central DICES VoIP servers. Full interoperability for radio control and keying is supported from the user Apple computers. The system is configured for up to 35 simultaneous controller positions, and this can be expanded by simple software updates. It is expected that this new training system will become operational in late summer 2008, following final commissioning tests in Germany.

Quintron Systems  
Santa Maria, CA.  
(805) 928-4343.  
[www.quintron.com].

### Carlo Gavazzi CS Selected to Provide Enclosures for MDAR Project

Carlo Gavazzi Computing Solutions has been an innovative leader in system architecture

for computing platforms. The company was selected to provide rugged electronic enclosures for EchoStorm Worldwide's Mobile Data Archive and Retrieval (MDAR) box—exclusive video and data surveillance technology for the U.S. Military. Set to be deployed in early 2008, the MDAR box is a mission-critical situational awareness tool that processes and archives video and data from unmanned aerial vehicles (UAVs) in near real time using EchoStorm Worldwide's adLib software. Since the MDAR box will be used in harsh environments, EchoStorm Worldwide needed an enclosure that protected the hard drives running adLib from extremes in temperature, vibration, humidity and contaminants. The MDAR box is completely sealed, protecting the computer cards from sand and other contaminants. The enclosure, manufactured completely in-house at Carlo Gavazzi Computing Solutions, is conduction-cooled with an internal recirculating fan and heat sinks through the walls.

Carlo Gavazzi Computing Solutions  
Brockton, MA.  
(800) 926-8722.  
[www.gavazzi-computing.com].

### SprayCool Gets Another Enclosure Contract for Marine Corps EFV

SprayCool has been awarded a contract by General Dynamics to supply additional enclosures for the Command Variant of the USMC Expeditionary Fighting Vehicle (EFV) (Figure 4). The units will be used to support ongoing hardware/software integration efforts throughout the current System Design and Demonstration (SDD) phase. Once deployed, the EFV will help the Marines sustain inland combat operations by maximizing tactical surprise; minimizing vulnerability on land; providing improved firepower, lethality and survivability; and providing on-



Figure 4

The USMC Expeditionary Fighting Vehicle (EFV) will help the Marines sustain inland combat operations and provide on-the-move command and control capabilities. The heart of the C2 architecture is the Multi-Processor Unit (MPU) that SprayCool is under contract to provide.

the-move command and control capabilities. The heart of the C2 architecture is the Multi-Processor Unit (MPU) that SprayCool is under contract to provide.

The Command Variant of the USMC EFV uses high-end commercial-grade electronics in a SprayCool enclosure to deliver mission processing demands. The commercial boards in the SprayCool MPU, which were originally designed to be air-cooled, include five servers, a switch, an I/O board and two expansion cards. The SprayCool MPUs are fully rugged, sealed enclosures that enable commercial boards to meet the temperature, vibration and EMI requirements of MIL-STD 810F and MIL-STD 461, and have been extensively tested in the EFV vehicle environment.

The SprayCool 9-slot enclosure uses the company's patented 2-phase liquid-cooling technology for maximum environmental control and flexibility, and can operate in temperatures ranging from -40° to +60 °C. The product is also easily upgradeable, capable of accepting a wide range of card types within the same chassis, simplifying the technology refresh cycle.

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



## COTS Websites

[www.acq.osd.mil/jctd](http://www.acq.osd.mil/jctd)

### JCTD Website Is Home for Joint Tech Initiatives

The Joint Capabilities Technology Demonstrations (JCTD) Office, part of the Advanced Systems & Concepts office at the Defense Department, is tasked to exploit mature and maturing technologies, to introduce new operational concepts to solve important military problems, and to facilitate transition of these new capabilities from the developers to the users. Entering its third year, the JCTD business model replaced the Advanced Concept Technology Demonstrations (ACTD) model in fiscal 2007 to rapidly move advanced technology and innovative concepts into the hands of warfighters in the field.

Building on the successful ACTD model in which new operational concepts



are combined with maturing technologies in a joint environment, JCTDs focus more on tailoring projects to a combatant commander's specifically identified needs—emphasizing “needs pull” over historical “technology push.” The JCTD tracks the progress of

several new Joint Capability Technology Demonstrations. The site has an update of the Joint Capability Technology Demonstration (JCTD) projects for fiscal 2008 and three JCTD projects that started at the end of fiscal 2007. Among these are the Combat Autonomous Mobility System (CAMS), the Communications AirBorne Layer Expansion (CABLE) and the Hard Target Void-Sensing (HTVS) Fuze. The JCTD Web site provides access to articles, reports, links to knowledge centers and other resources for all these and other JCTD demos.

Joint Capability Technology Demonstrations  
Arlington, VA. (703) 697-6446.  
[[www.acq.osd.mil/jctd](http://www.acq.osd.mil/jctd)].

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# Special Feature

Stand-Alone Rugged Boxes

## Stand-Alone Box Trend Broadens and Deepens

Driven by a desire for more complete solutions, the embedded computing industry is bulking up its investment in complete stand-alone rugged box-level system products.

Jeff Child,  
Editor-in-Chief

A couple years ago *COTS Journal* coined a new term to describe a trend steadily gaining steam for the past seven or so years. The term is “Stand-Alone Rugged Boxes” and it applies to complete system boxes—which often support standard form factor boards inside them. These systems provide a complete, tested and enclosed computing solution that eliminates complex integration chores for military customers. This idea has been gathering momentum in the past couple years whereby traditional embedded board vendors are adding stand-alone rugged box-level systems to their military market offerings. Within the last two years the concept has really become a fixture in this market. And now it has broadened to include a larger contingent of smaller form factor board vendors. And it’s deepened with the emergence of rugged box-level systems that offers complete environmental control including advanced cooling technologies.

Exemplifying the environmental control direction is SprayCool’s 9-slot



Figure 1

This Command Variant of the USMC Expeditionary Fighting Vehicle (EFV) USMC EFV uses high-end commercial-grade electronics in a SprayCool enclosure to deliver mission processing demands. The commercial boards in the SprayCool MPU, which were originally designed to be air-cooled, include five servers: a switch, an I/O board and two expansion cards. The SprayCool MPUs are fully rugged, sealed enclosures that enable commercial boards to meet the temperature, vibration and EMI requirements.



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enclosure. Although not a complete stand-alone box itself, it’s expected to facilitate the trend toward more integrated

box-level solutions. The SprayCool 9-slot enclosure uses the company’s patented 2-phase liquid-cooling technology for max-





## Arrivals

Origin	Board	Model	Status
FIBRE CHANNEL	PENTEK	4207	NO DELAY
SERIAL RAPID IO	PENTEK	4207	NO DELAY
PCI EXPRESS	PENTEK	4207	NO DELAY
GIGABIT ETHERNET	PENTEK	4207	NO DELAY



## Departures

Destination	Board	Model	Status
PCI-X	PENTEK	4207	NO DELAY
VXS	PENTEK	4207	NO DELAY
PMC / XMC	PENTEK	4207	NO DELAY
ROCKET IO	PENTEK	4207	NO DELAY

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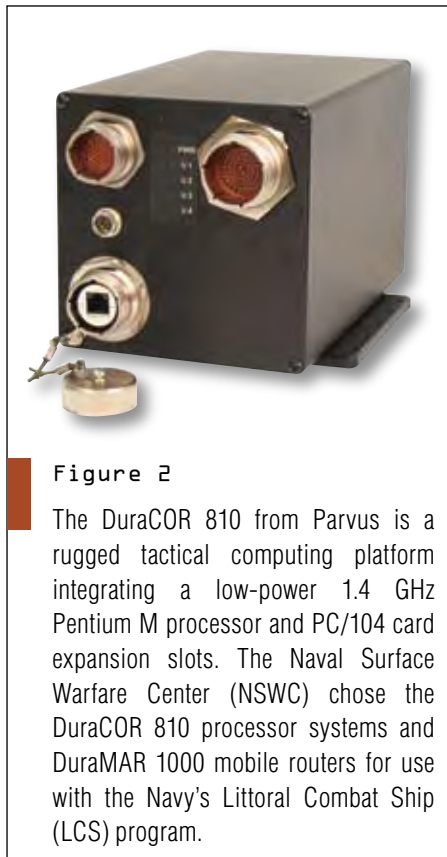


Figure 2

The DuraCOR 810 from Parvus is a rugged tactical computing platform integrating a low-power 1.4 GHz Pentium M processor and PC/104 card expansion slots. The Naval Surface Warfare Center (NSWC) chose the DuraCOR 810 processor systems and DuraMAR 1000 mobile routers for use with the Navy's Littoral Combat Ship (LCS) program.

imum environmental control and flexibility, and can operate in temperatures ranging from  $-40^{\circ}$  to  $+60^{\circ}\text{C}$ . The product is also easily upgradeable, capable of accepting a wide range of card types within the same chassis, simplifying the technology refresh cycle. It provides years of thermal headroom as it is capable of supporting sets of boards with almost twice the power and thermal load as those deployed today.

## Environmental Controlled Enclosures

Last month SprayCool was awarded a contract by General Dynamics to supply additional enclosures for the Command Variant of the USMC Expeditionary Fighting Vehicle (EFV) (Figure 1). Once deployed, the EFV will help the Marines sustain inland combat operations with onboard electronics that provide on-the-move command and control capabilities. The heart of the C2 architecture is the Multi-Processor Unit (MPU) that SprayCool is under contract to provide. The Command Variant of the USMC EFV uses

high-end commercial-grade electronics in a SprayCool enclosure to deliver mission processing demands. The commercial boards in the SprayCool MPU, which were originally designed to be air-cooled, include five servers, a switch, an I/O board and two expansion cards. The SprayCool MPUs are fully rugged, sealed enclosures that enable commercial boards to meet the temperature, vibration and EMI requirements of MIL-STD 810F and MIL-STD 461, and have been extensively tested in the EFV vehicle environment.

At present, there are more than a dozen vendors that have some sort of stand-alone rugged box-level system in their offerings—many even have whole product lines in that category. Among these are Advantech, Aitech Computers, Ampro Computers, AP Labs, Curtiss-Wright, DRS Technologies, General Micro Systems, GE Fanuc Embedded Systems, Macrolink, MEN Micro, Octagon Systems, Parvus, Quantum 3D, Rave Computer, RTD Embedded Technologies, Tracewell Systems, VersaLogic, VMETRO, WIN Enterprises and Win-Systems.

## Many Different Twists

As a product category, stand-alone rugged boxes are somewhat difficult to define because they're available in a variety of shapes, sizes and capabilities. They typically comprise a set of modular embedded boards housed in a rugged enclosure that has its own power supply and interface ports to link to a variety of user terminals. Often the boards in the box are standards-based cards such as PC/104, PMC and 3U CompactPCI. But the enclosures by and large aren't in any industry standard footprint, although that may change as standards like MicroTCA and some box-level VITA standards gain acceptance in the military realm.

Recently a number of vendors from the PC/104 communities have joined the stand-alone rugged box trend. This stacked multi-board PC/104 architecture provides for a shock- and vibration-resistant off-the-shelf computing solution by eliminating backplanes and metal card cages, making PC/104 ideal for military vehicles such as tanks or even Humvees.

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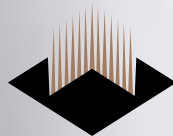
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Built especially for military program requirements, a growing assortment of semi-custom PC/104 enclosure and chassis solutions has been available from several PC/104 vendor companies. Within the past year or so that trend has advanced to where these stand-alone box-level computers with PC/104 inside are now part of many vendors' product lines, rather than just a pure custom

solution. This fits in with the broader trend where traditional embedded board vendors are adding stand-alone rugged box-level systems to their military market offerings.

An example along those lines is the DuraCOR 810 (Figure 2) from Parvus. It's a rugged tactical computing platform integrating a low-power 1.4 GHz Pentium M



Figure 3

Quantum3D's third-generation Thermite Tactical Visual Computer (TVC-3.0) Model 1000 is suited for vehicle-mount and man-wearable advanced visual computing applications. Example applications include embedded training and mission rehearsal, 3D-enabled C4ISR, sensor processing and C2 that require desktop-level visual computing performance in a small form factor, conduction-cooled, mil-spec rugged system.

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processor and PC/104 card expansion slots. The Naval Surface Warfare Center (NSWC) chose the DuraCOR 810 processor systems and DuraMAR 1000 mobile routers for use with the Navy's Littoral Combat Ship (LCS) program.

Most rugged-box vendors are traditional board-level product vendors who expanded up the food chain by adding box-level products to their offerings. In contrast, Quantum3D began in the small, wearable computing space and expanded into rugged box-level systems for larger form factor applications.

Late last year Quantum3D rolled out its third-generation Thermite Tactical Visual Computer (TVC-3.0) Model 1000 (Figure 3), in both deployable units and development kits, and it is now available for purchase. The 3.0 version is designed to complement the Thermite TVC-2.0 family by providing a range of higher performance models that are optimized for deployed, extended-environment, vehicle-mount and man-wearable advanced visual computing applications. Example applications include embedded training and mission rehearsal, 3D-enabled



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C4ISR, sensor processing and C2 that require desktop-level visual computing performance in a small form factor, conduction-cooled, mil-spec rugged system.

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Figure 4

Octagon Systems' Core Systems line of rugged systems with expandable I/O and fanless operation. The RMB-S shown here optimizes the electrical, thermal and mechanical components for maximum reliability. The basic unit includes the processing power, mobile power supply, memory, connector card and I/O for most applications. Heat from the system is channeled directly to the case to help prevent internal hot spots. The RMB-S mobile server operates in ambient temperatures from  $-40^{\circ}$  to  $70^{\circ}\text{C}$ .

### Expandable Box with Thermal Features

A high-performance mobile server arrives as the latest member of Octagon Systems' Core Systems line of rugged systems with expandable I/O and fanless operation. The RMB-S (Figure 4) is a "no compromise" design that optimizes the electrical, thermal and mechanical components for maximum reliability. The basic unit includes the processing power, mobile power supply, memory, connector card and I/O for most applications. Standard I/O includes dual Ethernet, quad USB 2.0, dual serial, CRT & LCD video and digital I/O. The RMB-S is fully functional out of the box, and additional I/O, such as GPS, analog, radio or Wi-Fi, can be readily added via PC/104 and PC/104-Plus modules.

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## Special Feature



Figure 5

SprayCool 9's MPE has a controlled operating environment that enables all electronics to operate effectively in the military's most demanding environments. The MPE enclosure can scale from 4 slots to 21 slots and is designed to meet industry standard designs for 6U x 160 mm VME-64X, VPX, VXS, cPCI and CPCle.

ators, connectors and controls. Heat from the system is channeled directly to the case to help prevent internal hot spots. The RMB-S mobile server operates in ambient temperatures from -40° to 70°C, depending upon the processor speed, user options and mass storage devices. A MIL-810F version offers a case with military-grade connectors and gasket sealing to provide dust-resistant, waterproof protection in outdoor environments.

As a follow on to their SparyCool 9 line of enclosures, SprayCool recently introduced its Multi-Platform Enclosure (MPE). The MPE (Figure 5) chassis employs the company's patented two-phase cooling technology. The MPE's controlled operating environment enables all electronics to operate effectively in the military's most demanding environments. The MPE enclosure can scale from 4 slots to 21 slots and is designed to meet industry standard designs for 6U x 160 mm VME-64X, VPX, VXS, cPCI and

CPCle (EXP.0), and proprietary electronics boards, and offers significantly more cooling capability per slot (above 300 watts) than enclosures using older cooling technologies such as air or conduction cooling. ■■

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# Special Feature

Stand-Alone Rugged Boxes

## Pre-Tested Packaged Approach Speeds System Development

Military prime contractors are hungry for even more integrated solutions. Pre-tested, pre-qualified box-level systems up the ante for that trend.

Jacob Sealander, Product Manager  
Curtiss-Wright Controls Embedded Computing

**W**hen a system integrator undertakes the challenge of building a new subsystem from the ground up, he or she faces a time-consuming, risky project that can typically involve from two to six months of qualification and testing. A better strategy that both obviates risk and dramatically reduces time-to-market is an approach we call "Packaged COTS" (PCOTS).

This approach is based on the development of standard off-the-shelf single board computers, both PowerPC and Intel-based, a wide variety of I/O cards, and rugged enclosures that have been pre-qualified and pre-configured through rigorous testing regimes to ensure operation in harsh environments and optimal performance. Even better, this approach significantly reduces NRE costs, since each new project leverages prior development, testing and data.

While it is rare that a single baseline offering will exactly satisfy any given application requirement, the availability of ready-made, pre-tested platforms minimizes the amount of tailoring that needs to be performed to perfectly meet a particular customer application. The confidence, too, that a pre-qualified, pre-tested subsystem design and all its associated test data provides to a customer, also provides confidence and peace of mind

Typical MPMC 350 "PCOTS" Configuration	
Slot 1	66 MHz/32-bit cPCI system controller slot. Supports two dual-redundant 1553 channels with an optional 601 PMC.
Slot 2	PICMG 2.3-compliant slot for an ARINC 429 PMC on a PMC carrier. 32 channels of ARINC 429 are provided with each channel individually selectable as an input or output.
Slots 3 and 5	Both PICMG 2.3-compliant for a 704 PMC video card. Each video card provides two video channels, each of which can be LVDS, DVI or VGA, and two video inputs which can be NTSC or RS-170. The video cards can be mounted on a PMC carrier or on an SBC.
Slot 4	Integrated for a generic 64-bit PMC on a PMC carrier or SBC.

**Table 1**  
Shown here is the typical PMC mix that provides the slot composition of a typical MPMC 350 implementation.

as they enter into their own qualification process. Knowing the environmental integrity and performance range for a given platform provides assurance at the beginning of a project that the subsystem won't be an obstacle to successful completion of qualification of a larger program.

### Trainer Aircraft Example

One recent design win provides a good example of how the PCOTS approach reduces time-to-market. In this particular application, for the mission computer on a new advanced trainer aircraft, the customer was seeking an alternative to an older 6U-based custom subsystem solution that they had deployed on another platform. Their goal was to obtain the

increased performance of newer, higher-integration components while reducing weight (fully configured to 16 pounds) and space (10.72 x 5.11 x 7.62 inches) via a move to a 3U CompactPCI architecture.

The mission controller on the aircraft drives the graphics display on the trainer's and the student's cockpit consoles, and requires four channels of video output and a wide variety of I/O types including 1553 and ARINC. Curtiss-Wright had the SBC required off-the-shelf, the PowerPC-based, conduction-cooled DCP-124 SBC, as well as many of the I/O cards required, either internally or through third-party partners. In addition, we had already developed and tested a rugged 5-slot 3U enclosure, intentionally designed for maxi-



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## Special Feature

mum modularity, and able to meet the cooling and vibration extremes that the subsystem would need to withstand. The resulting subsystem design, the MPMC 350p (Figure 1), is a rugged 5-slot compact chassis loaded with three DCP-124 SBCs and three mezzanine cards that provide the 1553 and ARINC military communications interfaces and control the graphics display.

Because Curtiss-Wright had all of the components and had much experience both in lab testing and field deployment with the various cards and the enclosure, it freed the customer from spending their time and resources on identifying and characterizing all potential vendors and offerings with which they could integrate a satisfactory system. This both saved the customer money and reduced risk in their to-market timeline.




Figure 1

An example of the PCOTS approach is the MPMC 350p, a rugged 5-slot compact chassis loaded with three DCP-124 SBCs and three mezzanine cards that provide the 1553 and ARINC military communications interfaces and control the graphics display.

Curtiss-Wright also provided the testing that was required for this power-dense solution, including temperature testing to ensure proper cooling and power testing to ensure that the off-the-shelf power supply would provide the appropriate voltage rails for all of the cards under all of the testing requirements. These tests included DO-160, voltage variation, voltage spikes and dropouts and noise. In addition, packaging testing included vibration and shock, EMI testing, DO-160, emissions, susceptibility tests, lightning tests, humidity, salt fog and dripping rain.

### Lab and Field Tests

A system integrator will typically undertake many of these tests in a laboratory environment, which because it provides an optimally controlled situation, will typically enable successful results on 80 or 90% of a system's functionality. It is when a development system is exercised over some stringent environment, the remaining 10% of functionality testing, that experience fielding systems and dealing with real-world experiences



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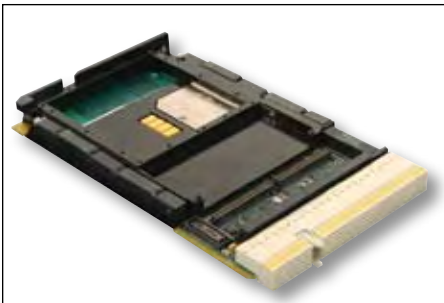


Figure 2

The DCP-124P peripheral-only processor is a variant of Curtiss-Wright's standard DCP-124 SBC and supports PMC I/O, dual Ethernet channels, and a USB 2.0, RS-232 and dual RS-422 ports.

pays dividends. The complexity of getting multiple cards, designed by multiple vendors to successfully perform together over temperature and vibration profiles can be a challenge. The PCOTS approach, in which all of the cards and the enclosure are known to work together over specific environmental conditions, such as -50° to +45°C temperature ranges and vibration profiles defined by MIL STD 810, eliminates this integration challenge.

### Accumulated Expertise

Another advantage of the PCOTS strategy is how the resulting accumulated data from each previous subsystem solution benefits follow-on opportunities. In this particular case, the basic platform developed for the trainer aircraft application was a fully qualified platform that's also ideal for critical applications such as combat vehicles, helicopters and UAVs that are space, weight and power (SWaP) constrained. In fact, it has already also been selected by two additional customers.

In one case, the application was also a mission computer, for which the customer needed no modifications to the existing platform. In the other case, for a data accumulator application, the customer needed the SBC to be Intel-based (an EOS card) rather than PowerPC. Because the enclosure was designed to be optimally modular internally, all of its peripheral slots are generic, designed to the 3U CompactPCI PICMG 2.3 specification; the only change required was to

the backplane to replace the system controller slot.

Designed to meet or surpass DO-160E Environmental Conditions for Airborne Equipment, the MPMC 350 has successfully passed numerous environmental tests including Temperature, Altitude, Shock, Vibration, Fluid Susceptibility, Voltage Spikes, Electrostatic Discharge and more. Circuit cards

installed in the sealed compact chassis (10.72 x 5.11 x 7.62 inches) are completely isolated from external environmental conditions such as humidity, dust and sand. Optimal system cooling is ensured via thermal transfer between the card edge of its conduction-cooled 3U cPCI cards and the chassis's side-walls, and a rugged integrated fan provides the necessary cooling air across the walls. EMI

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The main processing power of the MPMC 350p is provided by up to three

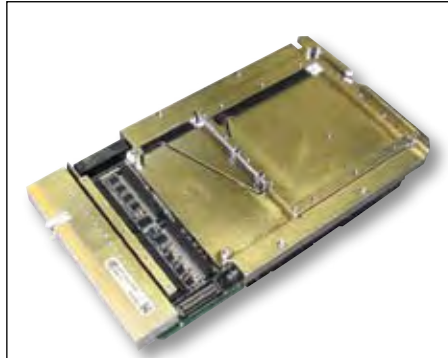


Figure 3

The MPMC 350i features up to three of these Intel Core2 Duo-based DCP-1201 and 1201P SBCs. In addition to running Windows, the SCP/DCP-1201 runs both Solaris 10 and WindRiver GPP Linux 2.6 operating systems.

Freescale 7448 PowerPC-based DCP-124 and DCP-124P (Figure 2) single board computers. The DCP-124P peripheral-only processor is a variant of Curtiss-Wright's standard DCP-124 SBC and supports PMC I/O, dual Ethernet channels, and a USB 2.0, RS-232 and dual RS-422 ports. Table 1 shows the slot composition of a typical MPMC 350 configuration.

The MPMC 350i features up to three Intel Core2 Duo-based DCP-1201 (Figure 3) and 1201P SBCs. In addition to running Windows, the SCP/DCP-1201 runs both Solaris 10 and WindRiver GPP Linux 2.6 operating systems. Support for real-time applications using VxWorks 6.x OS is planned.

### Power, I/O and Graphics: All Included

The MPMC 350 family supports a full selection of standard and optional I/O. Standard I/O includes Ethernet, RS-232 serial, RS-422 serial and DIO. Two dual-redundant channels of MIL-STD-1553 are supplied via a Curtiss-Wright

PMC-601 PMC module. Thirty-two channels of ARINC 429 can be provided via a 429 PMC with each channel individually selectable as Rx or Tx. Graphics and video support includes up to four video outputs that can be generated in DVI, LVDS or VGA formats by one or two Curtiss-Wright PMC-704 video PMCs. The PMCs support capture of up to six NTSC or RS-170 video inputs (two channels simultaneously). The PMC-704s may be hosted by either the system controller or a dedicated SBC. The MPMC 350p and MPMC 350i can be ordered with a modified front panel connector set, modified backplane wiring or a modified card set to fit a unique application's exact needs. ■■

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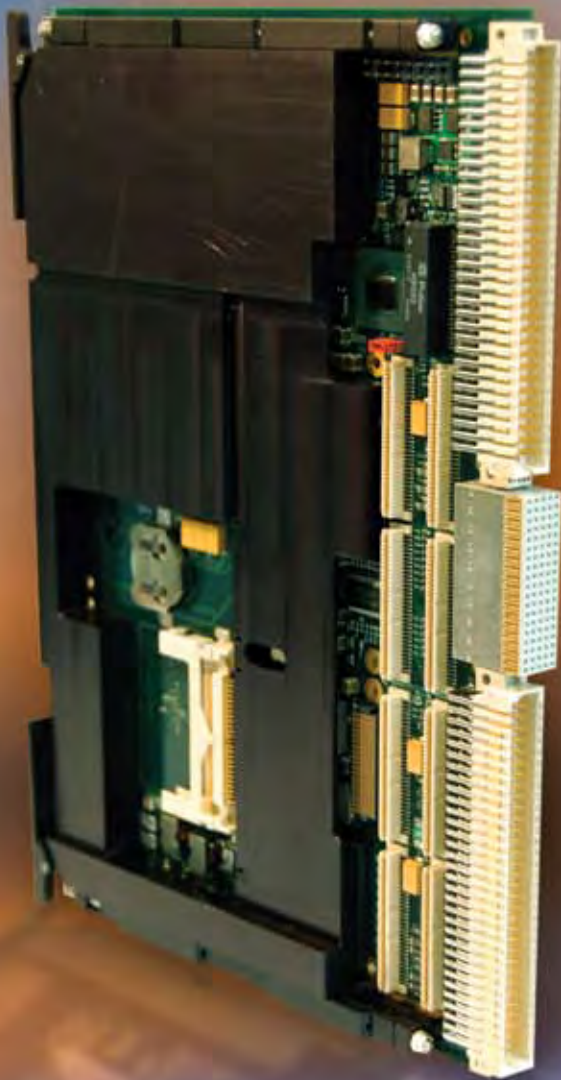
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# Tech Recon

Evaluating Mil Networks

## Predictability a Challenge in Net-Centric Warfighter Systems

Designing and deploying network-centric warfare systems push the limits of network simulator technology. What's needed is more realistic real-time communication models for R&D, test and evaluation, and training.

Dr. Rajive Bagrodia, Founder and CEO  
Scalable Network Technologies

Today's network-centric military relies heavily on mobile ad-hoc networks. Net-centricity is a force multiplier that relies on adaptive communication technologies and dynamic network quality of service (QoS) to enable mission-critical applications. In order to build next-generation communication systems, system developers need to accurately predict end-to-end performance. But while traditional network simulations assumed near-perfect communications, they don't reflect the reality of the battlefield.

In a modern-day combat theater, decision making depends on information flow. Combat networks pass data that are subject to delays. These delays are unequal depending on routing protocols, terrain, environmental effects, connectivity, hops, priorities, available bandwidth and traffic. The perceived truth of the state of a network can significantly lag the truth on the ground.

Because so many factors go into determining network performance, the sim-

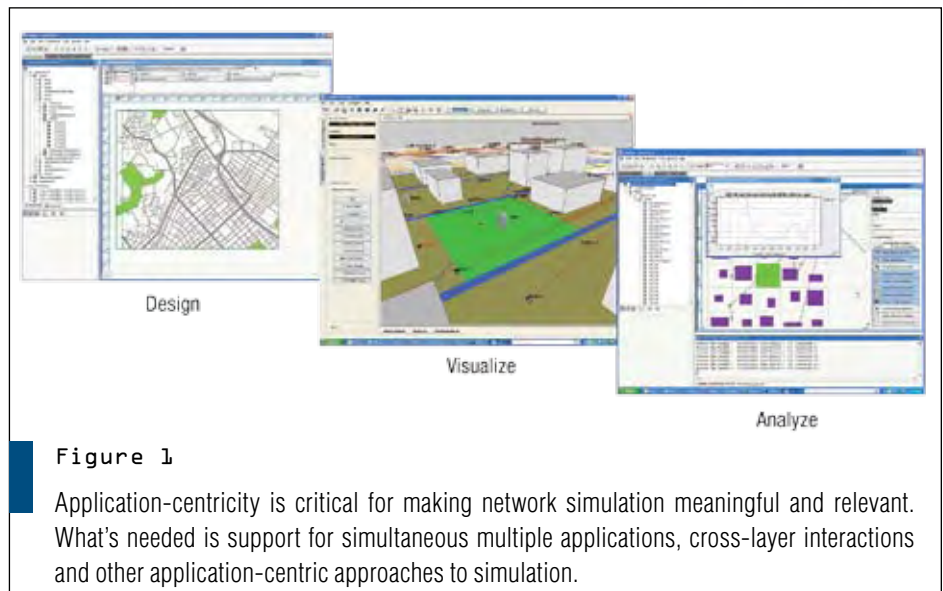


Figure 1

Application-centricity is critical for making network simulation meaningful and relevant. What's needed is support for simultaneous multiple applications, cross-layer interactions and other application-centric approaches to simulation.

ulation of such systems is computationally very demanding. To be an expert on next-generation wireless networking requires a complex set of expertise. This includes an understanding of mobile communication, quality of service, software defined radios and the network-centric services that support them. Network and equipment tests traditionally required months to perform all the calculations, or much of the details were abstracted, rendering the results useless. Still other solutions modeled only small scale networks (200 or

fewer devices), whose performance is not extrapolatable to the larger scale networks expected to be deployed in combat.

### Fidelity and Scalability

High-fidelity network models are hard to achieve in simulation, yet they are critical to effective analysis of adaptive communications (Figure 1). Existing tools use abstractions that hide critical effects. Scalability is also a big issue with network simulation. Models must project to operational size for meaningful results,



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but existing tools do not have sufficient processing power. Existing simulation programs, written with legacy sequential processing code, can only simulate a maximum of about 200 devices, and fidelity drops as you approach that number.

Application-centricity is key to making network simulation meaningful and

relevant. Rather than providing results in terms of delay or packet delivery rate, simulations are most valuable when they can test protocol and device impact on end-to-end performance. Existing tools can't support simultaneous multiple applications, cross-layer interactions or other application-centric approaches to simulation.

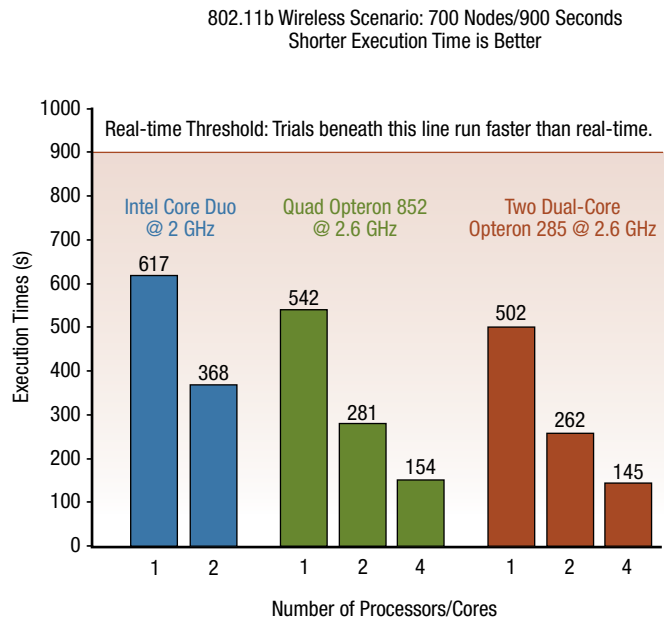


Figure 2

Shown here is an example of how parallel processing affects simulation speed in a 700-node detailed wireless simulation. QualNet runs on all leading embedded operating systems and hardware, including multicore processors, multi-processor architectures, clusters and supercomputers.

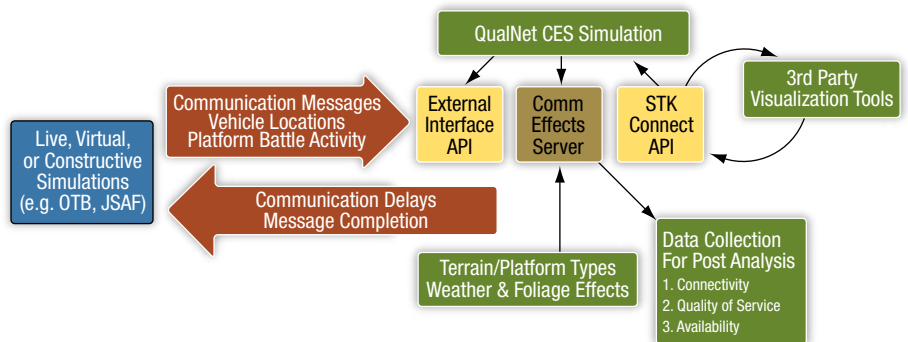


Figure 3

QualNet is embeddable as a Communication Effects Server in diverse network-centric planning, training and demonstration systems.

An example of a tool that supports high-fidelity emulation and simulation for predicting network performance is Scalable Network Technologies' (SNT) QualNet product. It brings the speed and scalability of parallel processing to wireless network modeling and simulation applications for military and commercial wireless network design and deployment. QualNet enables developers to digitally represent an entire network—devices, software, transmitters, antennas, terrain effects, atmospheric effects and human interaction effects. One can now represent every variable that will affect the performance of your real network in QualNet without trading accuracy for scalability, or vice versa.

With real-time simulation speed, network and equipment tests that traditionally required months to perform all the calculations can now be performed in minutes, with real-time speed and real-network behavior. QualNet allows developers to move from months to minutes. QualNet scales up and simultaneously offers ultra-fidelity at 50 or 5,000 nodes. That means it's possible to get the same accurate representation of a network whether you're testing 50 nodes or 5,000.

The tool's highly scalable kernel is natively multiprocessing and thread safe. QualNet runs on all leading embedded operating systems and hardware, including multicore processors, multi-processor architectures, clusters and supercomputers. Figure 2 shows an example of how parallel processing affects simulation speed in a 700-node detailed wireless simulation. QualNet also allows integration of customer-developed models. It can run the most detailed protocol models so users can directly incorporate their code into QualNet without abstracting or re-writing it.

### Standards Enhance Quality

Key enablers of traditional off-the-shelf network simulators have been open standards such as DIS, HLA, SDF and PDEF. They have enabled free market competition to drive quality up and prices down. QualNet supports those standards and interfaces with other simulations readily. It is also embeddable as a Com-

munication Effects Server (Figure 3) in diverse network-centric planning, training and demonstration systems. By serving as a simulator of a specific type of network, where only one particular stack is relevant, QualNet can be optimized even further for leaner and meaner network simulations. By being natively parallel, QualNet has eliminated the trade-off of network simulation in the past, which

meant giving up one for the other—such as speed, scalability and fidelity. ■■

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# Tech Recon

Evaluating Mil Networks

## Ethernet Poised to Become Unifying Fabric for Grid Computing

As the DoD builds out its Net-Centric capabilities, there are significant advantages to employing Ethernet as a unified fabric to help virtualize distributed networked platforms.

Stephen Garrison, VP Marketing  
Force10 Networks

Boasting a mature set of features, low cost and sufficient performance, both 1 and 10 Gbit Ethernet are poised to become strong contenders for architecting current and next-generation Network-Centric platforms in military air, land and sea applications. Using today's available 1 Gbit Ethernet technology it's possible to work around end-to-end node bottlenecks. Furthermore, with 10 Gbit Ethernet solutions now moving into the mainstream, advances in backplane standards, end node architectures and evolving CPUs and NICs are making it possible for both 1 and 10 Gbit Ethernet to be the cost-effective switched fabric solution of choice for low, medium and even higher-speed network applications.

Most of the current rhetoric on the evolution of Net-Centric operations is focused on three technology areas: infrastructure virtualization, cluster computing and Grid computing. These concepts all share the notion that enterprise applications should be able to tap a common pool of computing resources (servers, storage and networking) as if it were a single large virtual system. Depending on the application, the resources might be located in a single military network center or distributed across a number

Comparison of cluster/system interconnects			
	Mellanox InfiniBand	GbE Ethernet	GbE 10 with RiWARP DMA
<b>Crossbar Chip</b>	24 port	Multiple ASICs	Multiple ASICs
<b>Switch Topology</b>	Fat tree	Crossbar	Crossbar
<b>Max Cable Length (Switch to Host)</b>	10m copper	90m cat 5e 500m multimode fiber	10-25m 10GBase-CX
<b>Max Size Standalone Switch</b>	288 ports	1,260 ports	224 ports
<b>Host Adapters</b>	PCI-X	PCI-X	PCI-X
<b>Port Speeds</b>	2.5, 10, 30 Gbps	1 Gbps	1 Gbps
<b>MPI Throughput of Large Messages &gt;64KB</b>	6.6 Gbps (10 Gbps ports)	1 Gbps	1 Gbps
<b>CPU Utilization at Max Throughput</b>	3%	50%	50%
<b>Send/Receive Latency 16B Message</b>	5 µsecs	~60 µsecs	20 µsecs store and forward 10 µsecs cut through
<b>Send/Receive Latency 4KB Message</b>	15 µsecs	N/A	N/A

Table 1

As these benchmarks show, the application performance advantage for InfiniBand is relatively modest in view of its superior benchmarks in terms of throughput, latency and CPU utilization offered by Gbit Ethernet.

of military network centers, or even the entire enterprise network. For all of these technologies, the single system view is accomplished by interposing a middleware

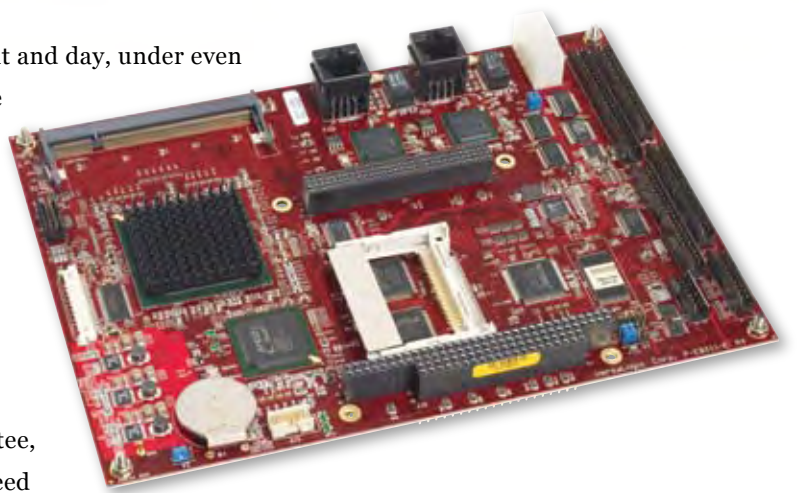
layer between the application and the resource pool as shown in Figure 1.

Grid Computing is taking shape as a general-purpose distributed computing

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Expansion Bus	PC/104 ISA Bus	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		
	PCI-104 PCI Bus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	PCIe/104 PCI Express Bus														
	<b>PCI Bus Masters</b>	4	4	4	4	4	4	4	4	4	4	4	4		
	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	1400	400	650	400	650	400	650	500	500	
	L2 Cache (KB)	2048	2048	2048	2048	2048	256	256	256	256	256	256	16	16	
	<b>Intel SpeedStep Technology</b>	✓	✓	✓	✓	✓									
	<b>ACPI Power Mgmt</b>	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0			
	Max Onboard DRAM (MB)	512	1024	1024	1024	1024	512	512	512	512	512	512	512	512	
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	<b>RTD Quick Boot</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
		Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Peripherals	<b>ATA/IDE Disk Chip (MB)</b>	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096		
	Audio		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS			TTL	TTL	LVDS	LVDS	LVDS		
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	I/O	<b>RS-232/422/485 Ports</b>	4	4	2	4	2	2	2	2	2	2	2	2	2
		<b>USB Ports</b>	4	2	4	2	4	2	2	2	2	2	2	2	2
		10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1	1	2	1
ECP Parallel Port			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SW	<b>aDIO (Advanced Digital I/O)</b>	14	18	18	36	36	18	18	18	18	18	18	18	18	
	<b>multiPort (aDIO, ECP, FDC)</b>		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

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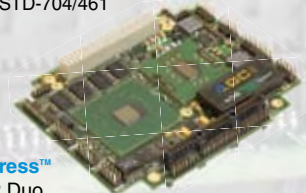
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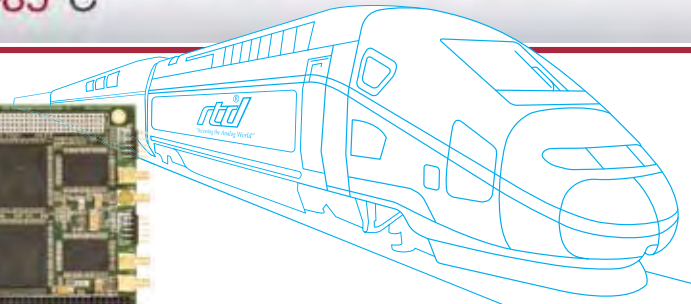
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<b>Bus</b>	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA			ISA	ISA						ISA		PCI		ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
<b>Analog Input</b>	Single-Ended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

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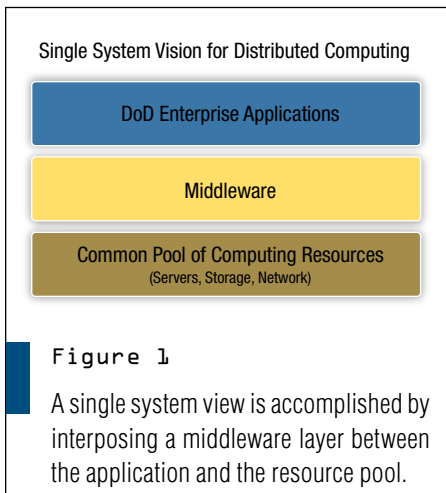


Figure 1

A single system view is accomplished by interposing a middleware layer between the application and the resource pool.

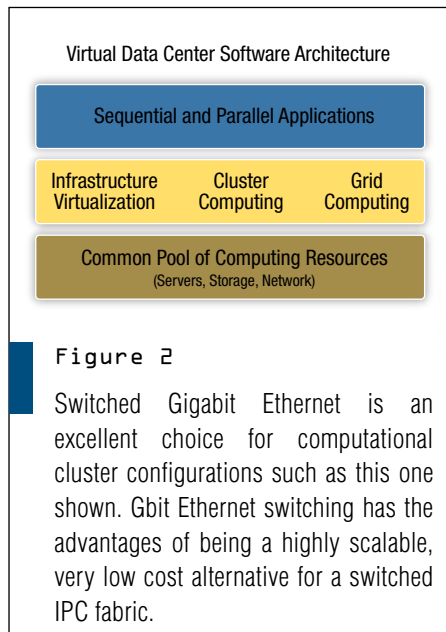


Figure 2

Switched Gigabit Ethernet is an excellent choice for computational cluster configurations such as this one shown. Gbit Ethernet switching has the advantages of being a highly scalable, very low cost alternative for a switched IPC fabric.

model where heterogeneous systems on an Intranet or the Internet can publish services (computational services, data services, or other types of service) that may be accessed and used by other systems participating in the Grid. With Grid computing, computer systems and other resources therefore aren't necessarily constrained to be dedicated to individual users or applications, but can be made available for dynamic pooling or sharing in highly granular fashion to meet the changing needs of the organization. The vision of the Global Grid Forum (GGF) is that standards-based Grid middleware will allow Internet-wide resource sharing and collaborative prob-

lem solving by multi-institutional "virtual organizations."

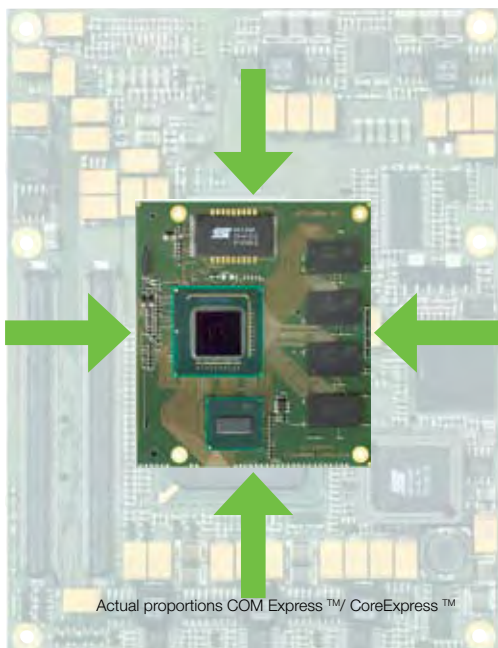
As military network centers begin to deploy server virtualization and computational cluster computing, the existing Ethernet switching fabric will be required to support two new types of traffic. The first is transfers of context (state) to/from virtual servers. The second is cluster IPC for synchronous parallel applications.

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switch can easily provide the bandwidth for these additional traffic types. However, for tightly coupled parallel applications that require very low end-to-end latency (equal to switch latency plus the delays required for host message processing), more specialized IPC fabrics, such as InfiniBand, may need to be considered. However, before increasing the complexity of the military network center with an additional switching fabric, a careful analysis should be performed to understand the performance benefits that can be expected both today and with future generations of the various technology options. The remainder of this section of the document provides an overview of the primary options for computational cluster interconnects.

### IPC over Ethernet

Switched Gigabit Ethernet is an excellent choice for computational cluster configurations such as the one shown in Figure 2. Gbit Ethernet switching has the advantages of being a highly scalable, very low cost alternative for a switched IPC fabric. The cost for switch ports and high-performance server adapters is expected to continue to drop rapidly as more enterprise campus LANs and desktops migrate to Gbit Ethernet. 1000Base-TX supports cable lengths of up to 90m for



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Gigabit Ethernet supports system-to-system data transfer approaching wire speed at around 1,000 Mbits/s and send/receive message latencies on the order of 60 microseconds for short messages. The send/receive latency (or “ping pong” la-

tenency) is measured as one half the round trip delay between a message being sent and a reply received. The round trip latency includes the switch latency (on the order of 10 microseconds in each direction) and the receive/send latency of the remote host due to TCP/IP processing and buffer-to-buffer transfers, both of which typically involve software processes.

Most of the end-to-end latency incurred with Ethernet data transfer and

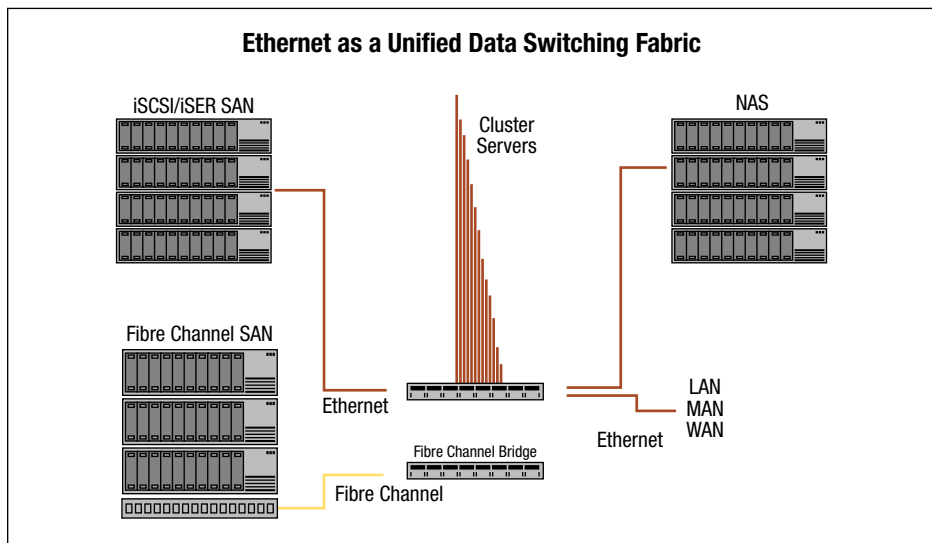


Figure 3

Shown here is a military network center with Ethernet as the unified fabric providing IPC, SAN, NAS and LAN/MAN/WAN connectivity.

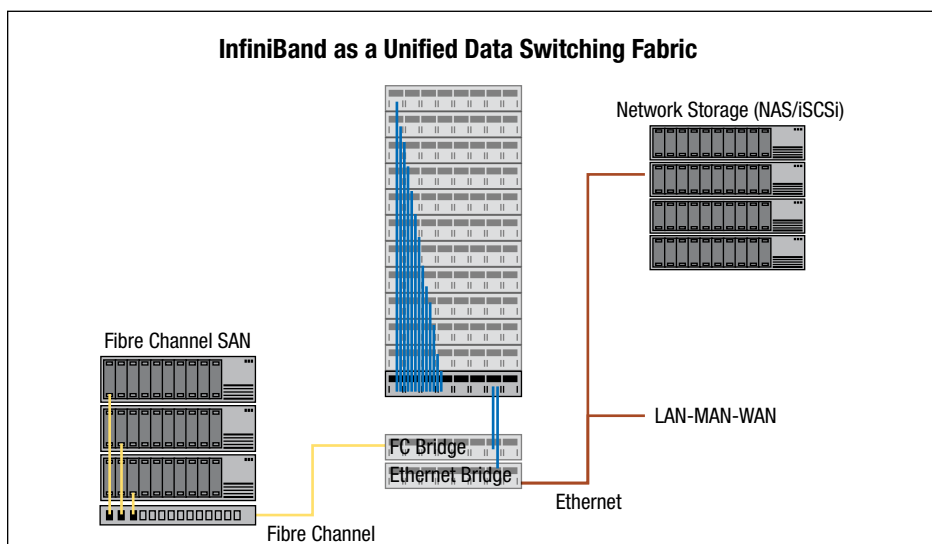


Figure 4

A single InfiniBand server adapter can provide indirect connections to SAN and LAN switch fabrics via the InfiniBand switch, as shown here.

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IPC is due to software processing on the hosts. Another drawback of network I/O processing in software is that it results in fairly high CPU utilization during intense network activity. The usual rule of thumb is that each bit per second of TCP/IP bandwidth consumes one Hz of CPU capacity. Thus a sustained Ethernet transfer at 800 Mbits/s would involve approximately 80% CPU utilization of a 1 GHz CPU. High CPU utilization can have an impact on applications that require high levels of concurrent computation and IPC, but is less of a concern when intense computation and communication do not overlap. The obvious implication of the 1 Gbit/s per GHz rule is that 10 Gbit Ethernet NICs will have to be designed to eliminate host processing in software in order to achieve line rate. NICs that offload the host CPU will also be of benefit for Gbit Ethernet end-to-end performance.

Intelligent hardware-assisted Gbit Ethernet and 10 Gbit Ethernet NICs are expected to become widely available over the next year or two. These NICs will leverage the iWARP specification issued by

the RDMA Consortium, including hardware-assisted Transport Offload Engines (TOE), Remote Direct Memory Access (RDMA) and kernel bypass. iWARP includes support for multiple application interfaces: MPI for IPC, Socket Direct for general IP applications, iSER (iSCSI over iWARP) and NFS/RDMA.

### Near Wire Speed

With these enhancements an iWARP NIC will feature hardware-assisted throughput at or near wire speed along with low CPU utilization and much lower end-to-end latency (see Table 1 below for some performance comparisons for iWARP NICs). The first iWARP Ethernet host adapters were introduced in the latter half of 2004 with support for 1000Base-T and 10GBase-CX. When the 10GBase-T standard for 10 Gbit Ethernet over twisted pair is ratified, it is expected that the first implementations will be iWARP NICs. As more iWARP NICs are introduced and 10 Gbit Ethernet becomes more widely adopted in enterprise LANs, Ethernet product volumes are expected to result in rap-

idly decreasing costs for both NICs and 10 Gbit Ethernet switch ports.

InfiniBand is a standards-based switching technology intended as a general-purpose "server area" I/O fabric envisioned to function as an IPC fabric, a SAN fabric, and even as a possible replacement for the PCI bus for embedded system interconnects. InfiniBand was evidently modeled to some degree on the proprietary cluster/system IPC interconnects from Myricom (Myrinet) and Quadrics (Qs-Net) used extensively in High Performance Computing (HPC) and high-end computational clusters. All of these technologies employ switch fabrics based on cut-through switching across "fat tree" configurations of relatively small crossbar switching chips assembled to build a modular chassis switch with as many as 128 to 288 ports.

Larger switching fabrics with thousands of ports can be assembled as fat tree federations of multiple stand-alone switches. InfiniBand HCAs also feature hardware-supported network transports and RDMA support pioneered by Myrinet and QsNet. As a result, InfiniBand offers very low end-to-end latency, very low CPU utilization and good throughput, while supporting three link speeds: 2.5, 10 and 30 Gbits/s.

The performance of clustered database applications is quite dependent on the latency of IPC. IPC is required among cluster nodes to establish exclusive access (or lock) to a block of data. These tests have shown that a small Oracle 9i RAC cluster with 10 Gbit InfiniBand IPC can process 100% more block transfers per second (at 16 Kbytes per block) than a similar cluster with Gbit Ethernet IPC. These peak transfer rates were achieved with CPU utilizations of 60% and 90% for InfiniBand and Gbit Ethernet respectively. It is worth noting that the application performance advantage for InfiniBand is relatively modest in view of its superior benchmarks in terms of throughput, latency and CPU utilization vs. Gbit Ethernet as shown in Table 1.

### Unified Fabrics

As computational cluster computing becomes a mainstream military network center technology, there is the possibility that military network center servers would be attached to three distinct switching fabrics: Ethernet for IP communications, a SAN for shared ac-

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cess to storage resources, and a cluster fabric for IPC between cluster nodes. Although each fabric might be well optimized for its function, deploying three separate fabrics, each with its own cabling, host adapters and management systems, involves too much cost and complexity for most enterprise IT departments to accept. The ideal alternative would be to use a single switching fabric (a "unified" fabric) for all three functions. Settling on a single fabric involves some degree of sub-optimization at

any particular point in time, but in the long run could contribute significantly toward optimizing the cost-effectiveness of the military network center through consolidation of disparate technologies and the resulting reduction or control of TCO.

The primary candidate for a unified fabric is Ethernet in conjunction with TCP/IP. Ethernet has been adopted almost universally as the network technology of choice for enterprise LANs, and

is beginning to extend its reach into the MAN and WAN. Although there are fabric technologies that currently offer better end-to-end performance benchmarks for SANs and IPC cluster interconnect.

Ethernet/TCP/IP has done a creditable job of providing very flexible and cost-effective solutions in both of these areas. As the next generation of iWARP Gbit Ethernet and 10 Gbit Ethernet NICs becomes available and prices of 10 Gbit Ethernet NICs and switch ports continue to fall, the end-to-end performance gap of Ethernet will either disappear completely (for SANs) or be reduced to relative insignificance (for IPC). Figure 2 shows a military network center with Ethernet as the united fabric providing IPC, SAN, NAS and LAN/MAN/WAN connectivity. In addition, a FC gateway or storage bridge/router can be deployed to provide backward compatibility to protect the prior investment in a FC SAN.

### InfiniBand Alternative

InfiniBand is a second possible candidate for a unified fabric. InfiniBand has performance characteristics that have been optimized for use as an IPC or SAN fabric. However, InfiniBand is still in the early stages of adoption as a cluster interconnect and has not yet gained support from storage device manufacturers for InfiniBand-attached storage. Therefore, InfiniBand can provide a unified fabric only in the sense that servers in the military network center would not need three separate types of adapters for different networks. A single InfiniBand server adapter can provide indirect connections to SAN and LAN switch fabrics via the InfiniBand switch, as shown in Figure 4.

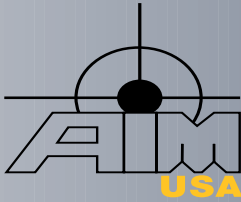
Connectivity from the InfiniBand fabric to Ethernet and FC SANs is provided by a gateway function that may be performed by a stand-alone device or a gateway card installed in the InfiniBand switch. These gateways are potential bottlenecks that can limit the aggregate LAN or SAN bandwidth available to the server cluster, unless multiple gateways are deployed in parallel. The main drawback, however, is that with the InfiniBand-based fabric unification, there are still three separate fabrics to provision and manage. ■■

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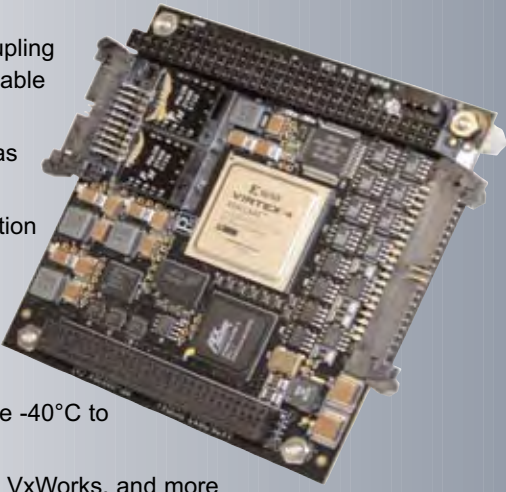
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Silver-zinc batteries have a long record of safe service in commercial, aerospace and military applications. Primary batteries comprised of silver-zinc have been used for decades in portable electronics applications, such as cameras, where high current drain is needed. Manned space flight missions beginning with the Mercury (Figure 1) program have successfully deployed rechargeable silver-zinc batteries without any incidents. The military has used silver-zinc batteries in missiles, torpedoes and submarines for over 50 years.

Lithium-ion technology is volatile by nature. Even the myriad of "safe" lithium-ion technologies suffer from a potentially catastrophic combination of highly exothermic decomposition of the battery materials and low-flash-point organic electrolytes. Silver-zinc batteries with their stable materials and water-based electrolyte do not pose a flammability issue. Silver-zinc chemistry and

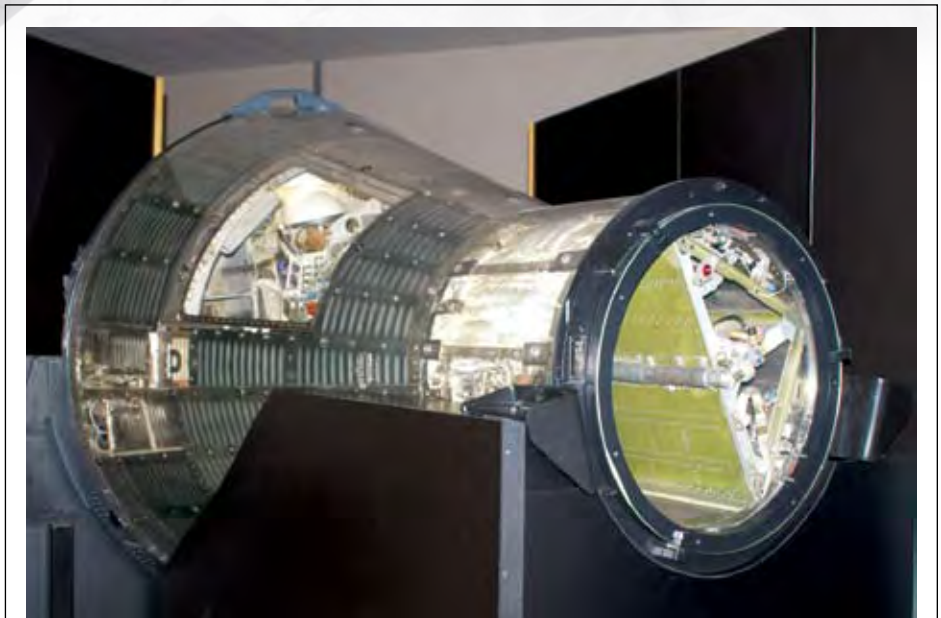


Figure 1

Manned space flight missions beginning with the Mercury program have successfully deployed rechargeable silver-zinc batteries without any incidents. The military has used silver-zinc batteries in missiles, torpedoes and submarines for over 50 years. Shown here is the Mercury spacecraft on display at the Smithsonian National Air & Space Museum. It is a flight-rated production spacecraft that never flew.

behavior are similar to alkaline batteries used safely by consumers today.

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material leading to even more rapid decomposition. This accelerating decomposition leads to thermal meltdown of the battery. The temperatures generated by a decomposing lithium-ion battery are high enough to melt aluminum or copper and ignite any combustible materials they contact. None of the materials in a silver-zinc battery decompose in this way and are therefore immune from thermal meltdown.

Silver-zinc batteries use a water-based electrolyte that is nonflammable, while the flash point of the electrolyte used in lithium-ion batteries is below room temperature. The flash point is the lowest temperature at which flames will propagate through the vapors of the solvents used in lithium-ion batteries. It is the flammability of these vapors that leads to the spectacular jets of flame seen coming from lithium-ion



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<b>Normal Discharging Operation</b>	At normal discharging current, the cell temperature is below 45°C.
<b>On-Stand</b>	Like the traditional alkaline battery, ZPower's silver-zinc battery has long on-stand life due to very low gassing rate of zinc anode and Ag cathode and silver electrode formulas.
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Table 1

ZPower's new 4A-hour silver-zinc cells were tested in-house under a variety of conditions to demonstrate their inherent safety against explosion and fire. Listed here are the four conditions they were tested in.

batteries when they catastrophically fail. There is currently no way to produce high-performance lithium-ion cells without the use of these flammable solvents. It is clear that the stability of the silver-zinc battery materials and the complete nonflammability of the silver-zinc electrolyte make it an intrinsically safe battery technology. They are also the best choice where batteries with high volumetric energy density and intrinsic safety are required (Figure 2).

### Basic Silver-Zinc Cell Structure

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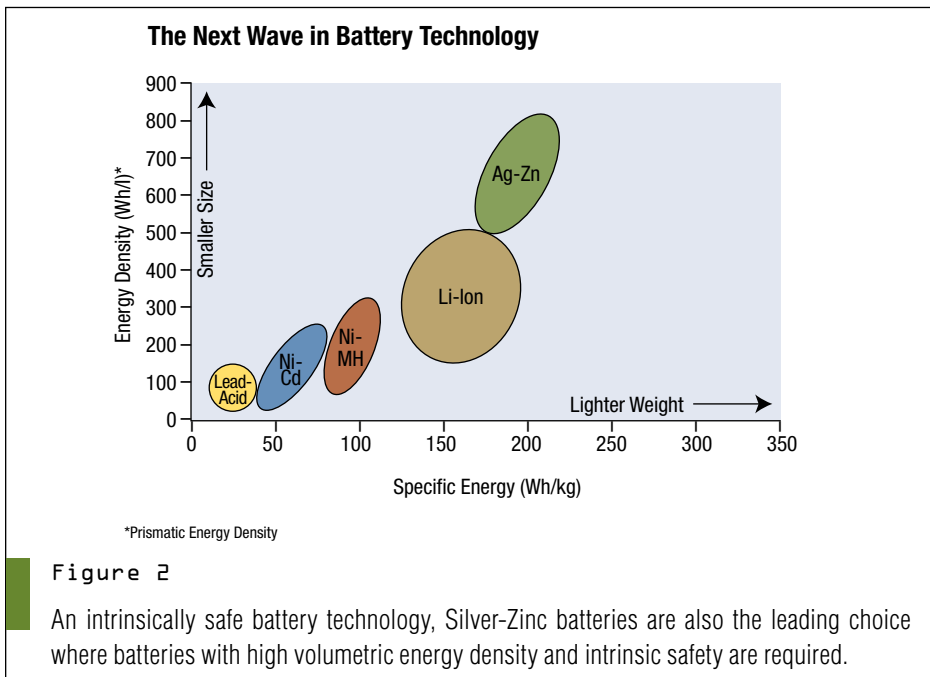
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200°C, at which point the AgO loses oxygen to become Ag<sub>2</sub>O and produces 19.5 J/g of heat. The material remains stable until Ag<sub>2</sub>O releases the remaining oxygen to form Ag at 442°C in an endothermic reaction. Silver (II) oxide is classified by the EU as corrosive and an oxidizer, and rated by the NFPA as zero for fire and reactivity. For relative comparison purposes, fully charged lithium cobalt oxide begins decomposing at about 200°C as well, but releases 40-70X the amount of energy, or approximately 800-1,400 J/g. Clearly, the ZPower electrode is a much safer material than lithium cobalt oxide.

The negative electrode consists of zinc (Zn) metal alloy, zinc oxide (ZnO), electrolyte with additives and polymer binder pressed onto a wire mesh current collector. Pure Zn itself is thermodynamically unstable in alkali solutions, resulting in the evolution of hydrogen. Alloying is effectively used by all manufacturers of zinc containing batteries to suppress hydrogen evolution. TGA and DSC analysis of the anode paste shows the anode paste is essentially stable, except for water loss, up to 250°C when oxidation of zinc in the presence of air begins to take place. Complete oxidation occurs by 450°C. For relative comparison purposes, a fully charged lithium-ion negative electrode

lyte, the battery contains multiple layers of polymer separator that prevent physical contact between the electrodes, and keeps the electrolyte in place. The cell uses either a plastic or metal case, which is sealed and contains a standard safety vent deployed on most batteries today. Figure 3 shows a laptop version of Zpower's Silver-Zinc battery.

The battery's silver electrode is a mixture of silver (II) oxide, conductive additive and binder pressed onto a wire mesh current collector. Figure 4 illustrates the basic specs and charge curves of the Silver-Zinc battery. Thermal Gravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC) of the mixture indicate thermal stability up to about

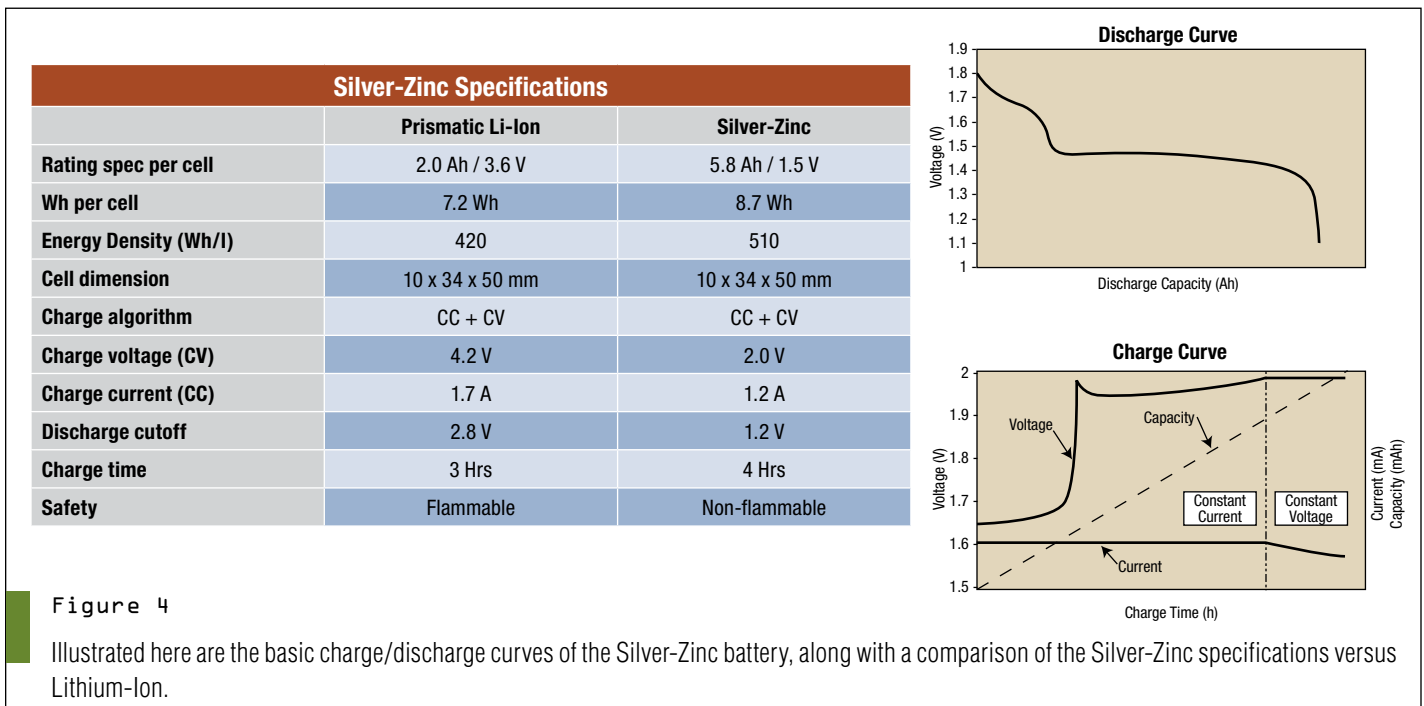




Figure 3

The Silver-Zinc cell uses either a plastic or metal case, which is sealed and contains a standard safety vent deployed on most batteries today. Shown here is a laptop version of ZPower's Silver-Zinc battery.

using mesocarbon microbeads (MCMB) begins decomposing at about 150°C and releases about 200 J/g. Again, the ZPower electrode is safer.

Flammability of the electrolyte is really the key safety difference between silver-zinc technology and lithium-ion. Silver-zinc, like alkaline primary batteries, uses water, which is made conductive through the addition of potassium hydroxide (KOH). The liquid is caustic, but is nonflammable and stable.

Lithium-ion batteries use flammable organic liquids, such as dimethyl carbonate (DMC) and ethylene carbonate (EC), which contain dissolved lithium hexafluorophosphate (LiPF<sub>6</sub>). DMC itself has a flash point of only 18°C, meaning it can ignite upon contact with air once released from the cell due to internal heating. The electrolyte also reacts rapidly at elevated temperatures with the materials used in both electrodes, so lithium-ion batteries should not be subjected to temperatures above 60°C. Onset of thermal runaway of a fully charged lithium-ion battery starts at 160°C with pressure rising to over 1000 psi. In summary, the relative safety of silver-zinc batteries is similar to that of other aqueous primary and rechargeable batteries, such as alkaline and nickel-cadmium.

### In-House Safety Testing of Cells

New, 4Ah silver-zinc cells manufactured by ZPower were tested in-house under a variety of conditions to demonstrate their inherent safety against explosion and fire. Table 1 lists the four conditions they were tested in. These cells represent

what could be packaged within a battery enclosure, which would be designed to contain any liquid electrolyte discharged during a controlled and safe shutdown.

The 4 A-hour cell can sustain up to 48A short circuit current with a rapid pressure increase and gradual temperature increase to 110°C. After the cell reached a critical pressure point, the pressure protection mechanism in the cell

case design activated, causing the rapid drop in the cell pressure and expulsion of the nonflammable, aqueous electrolyte. It is also worth noting that the maximum achievable current is limited by loss of electrolyte through the safety vent, which provides an additional layer of protection for the battery.

Like other batteries, silver-zinc can experience overcharge misuse due to the

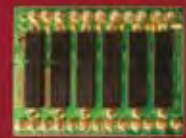


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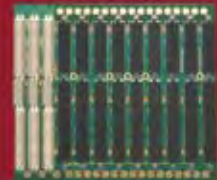
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VPX Hybrid



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## System Development

failure of controlling circuitry or charging imbalance between cells. In essence, hydrogen and oxygen gas evolve from the zinc and silver electrodes respectively. One Ah of current will decompose 0.3361g water and generate 0.0376g hydrogen and 0.2985g oxygen. However, in ZPower's current cell design, there are multiple self-limiting and protection mechanisms to prevent the continuous gas generation. First, loss of electro-

lyte will significantly increase the internal ionic resistance and limit the overcharge current. Second, gas generated will cause the delamination of the electrode stack, reducing the contact area and increasing the cell resistance. And thirdly, accumulation of gas will eventually cause the opening of the safety vent. In combination with loss of electrolyte, this will significantly prevent further overcharge.

ZPower performed the overcharging test of its silver-zinc cells, in which a power source was used to provide a 3V charge (normal cut-off is 2V), with maximum charging current above 3.8A. Under such severe overcharging conditions, the cell safely vented as expected, with no fire or any other hazardous events occurring, and the maximum cell temperature reached only 60°C.

### Overdischarge, Crush and Punch Tests

Silver-zinc cells are able to safely handle overdischarge and cell reversal conditions as can occur when multiple cells are connected in series. Overdischarge and cell reversal of a 4Ah cell were caused by discharging at a rate of 4.5A and below the recommended 1V cut-off. Cell potential dropped to -3.5V, cell temperature rose to 125°C, and internal pressure reached a maximum of only 12.5 psi. The cell maintained its structure and the case was fully intact, although the cell was internally shorted.

The center of the silver-zinc cell was crushed in a 20-ton press between two 1-inch cylinders, while the cell voltage and temperature were monitored continuously. As a result of crushing, the cell case breached open at the side seam, and cell voltage dropped instantly indicating severe shorting inside the cell. Cell temperature reached a maximum of 112°C, with no fire or other dangerous occurrences. Cells were also subjected to a nail punch test. One nail was punched through the fresh cell in the fully charged state. The cell safely vented as expected after 4-5 minutes. Unlike similar tests performed with lithium-ion cells, no smoke and fire occurred.

ZPower's silver-zinc battery employs materials in the battery construction that are intrinsically compatible and safe. The battery has demonstrated excellent normal operation, misuse and abuse safety. In combination with its superior energy density as compared to the lithium-ion battery, ZPower's silver-zinc battery is the right choice for future designers of portable military electronics. ■■

ZPower  
Camarillo, CA.  
(805) 445-7789.  
[[www.zpowerbattery.com](http://www.zpowerbattery.com)].

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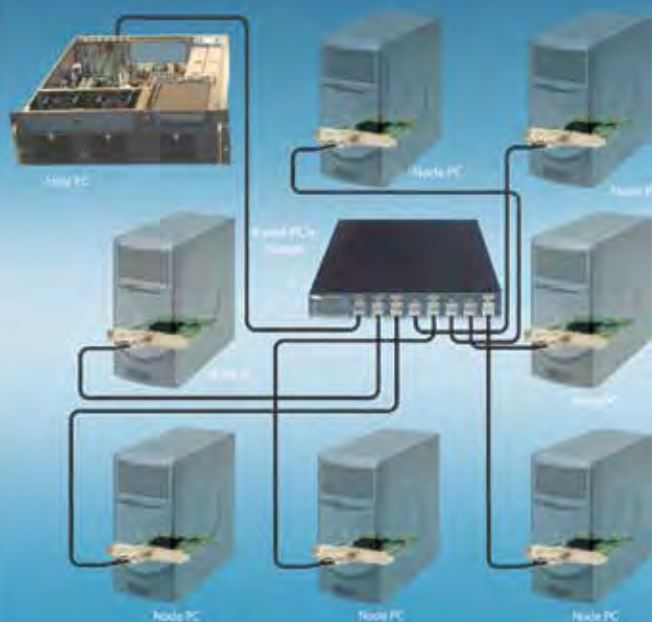
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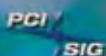
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# Technology Focus

PC/104 and EPIC Boards

## PC/104 Crowd Assimilates PCI Express into Its Camp

Their compact size and inherent ruggedness make PC/104 and EPIC popular form factors for military systems. Now PCI Express is on deck to join the PC/104 family's legacy of buses.

Jeff Child  
Editor-in-Chief

Military system developers' affection for PC/104—and its wider community of form factors including PC/104-Plus, PCI-104, EPIC and EPIC Express—shows no sign of waning. This family of stacked multi-board system form factors provides a shock- and vibration-resistant off-the-shelf computing solution that eliminates backplanes and metal card cages, making PC/104 ideal for military platforms such as missiles, tanks, Humvees, fighter-jets and UAVs.

An example of a small UAV design that relies on PC/104 technology is the Aerosonde (Figure 1), a small, low-cost UAV platform designed by a company of the same name. Aerosonde has been developing small UAVs for military, paramilitary and civilian missions for more than a decade. A typical Aerosonde payload includes a SatCom PC/104 processor card. This card applies selectable wavelet compression to images captured by the UAV's camera. The processor then adds aircraft metadata from an interface to the UAV's avionics computer, and controls data transmission between satellite and ground control station.

Last month the PC/104 Embedded Consortium put the stamp of approval on its long awaited efforts to integrate PCI Express into the realm of PC/104. The Consortium has detailed a consolidated and consistent stackable PCI Express roadmap, starting with the adoption of the PCI/104-Express and PCIe/104 specifications. The fruit of the Consortium's Technical Committee of over 22 members, the spec brings PCI and PCI Express buses together to form PCI/104-Express. For additional room on a module, the PCIe/104 removes the PCI bus.

This new stackable PCI Express bus can be immediately incorporated across the Consortium's 104, EPIC and EBX form factors. A new high-speed surface mount connector was specially sponsored and designed for this application. Maximum effort went into configuring this connector so that it was capable of handling the rugged environments of the embedded mar-



Figure 1

The Aerosonde UAV platform has payload that includes a SatCom PC/104 processor card. Shown here, an engineer prepares the Aerosonde UAV at the NASA Wallops Flight Facility, Wallops Island, VA., for flight into a tropical storm.

ket, optimized for the 0.600-inch (15.24 mm) stack height of the PC/104 architecture, and capable of transporting the high-speed signaling of PCI Express over large stack heights while keeping PCI Express Gen 2 in sight. Information about the PCI/104-Express and PCIe/104 specifications and how they are incorporated onto the 104, EPIC and EBX form factors can be downloaded from [www.pc104.org](http://www.pc104.org).

The "PC/104 and EPIC SBCs Roundup" on the following pages showcases some representative examples of such PC/104 and EPIC single board computer products. Most of these vendors offer both PC/104 and EPIC families of products, but for the purposes of this product roundup they were asked to choose just one of their latest and greatest products to include. ■■

# -40° to +70°C Fanless 1GHz Industrial SBC. List Price \$595

Applications such as robotics, transportation, pipelines, MIL/COTS, medical, security, machine control, and industrial automation that must work in harsh, demanding environments need WinSystems' EBC-855.

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# Technology Focus:

## PC/104 and EPIC SBC Roundup

### PCI-104 Celeron M Board Withstands HALT

Considered more rigorous than many MIL-spec test standards, Highly Accelerated Life Testing (HALT) is fast becoming the litmus test for finding the potential weak links in a product design and to determine the true operating and destruct limits. Ampro Computers has put its CoreModule 800 SBC through HALT processes. The company reports that the CoreModule 800 withstood intense multi-axis vibration of 50 Grms while operating over a very broad operating temperature range of -60° to +90°C. This compact embedded computer sports a 1 GHz Intel Celeron M 373 processor in the tiny PCI-104 form factor standard without protruding beyond the required 3.6 x 3.8-inch board outline.



The CoreModule 800 contains a rich set of PC-compatible subsystems, including DDR 333 SODIMM up to 1 Gbyte, USB ports, serial ports, Gbit Ethernet, an IDE channel and AMI BIOS, with support for optional MiniModule ISA PC/104-Plus bridge card for compatibility with the hundreds of off-the-shelf PC/104 and PC/104-Plus modules. The 1 GHz CoreModule 800 is on the shelf and available immediately. The CoreModule 800 QuickStart Kit includes device drivers and Board Support Packages (BSPs) for Windows XP, Windows XP Embedded, Windows CE, QNX, VxWorks and a full Linux 2.6 distribution. The price is around \$1,000 for moderate production volumes.

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

### EPIC-Sized SBC Consumes 2W of Power

For small, ultra-low-power applications, ratcheting down the amount of power consumption in a subsystem can be tough. That's why Arcom designed its ZEUS EPIC-sized SBC to consume only 2W typical. Combined with dynamically adjusted sleep modes, extensive communications options, a wide operating temperature range and a vehicle-compatible power supply, the board's ultra-low-power design makes it ideal for vehicle tracking, mobile terminals and network communications controllers.



The RoHS-compliant board is based on the Intel 520 MHz PXA270 XScale RISC processor. ZEUS has seven onboard serial ports to support a wireless modem and GPS, and provides traditional hardwired serial I/O functions for legacy communications. A small adapter module fitted with a variety of GSM/GPRS, iDEN and CDMA wireless modem modules is optional. The board includes up to 256 Mbytes of soldered SDRAM and up to 64 Mbytes of soldered AMD MirrorBit flash. 256 Kbytes of battery-backed SRAM using the onboard battery are provided.

Other features include a TFT/STN flat panel graphics controller, analog touch screen controller, dual 10/100BaseTx Ethernet ports, I2C controller, dual USB host controller, USB client, AC97 audio/codec, CompactFlash interface, SDIO and a standard PC/104 bus expansion connector. The ZEUS may be powered from the integrated DC/DC PSU (10-30V) or from a single +5V input. The power supply has been designed for use with vehicle power looms and features transient suppression and protection. Pricing starts at \$410 in quantities of \$1,000.

Arcom  
Overland Park, KS.  
(913) 549-1000.  
[www.arcom.com].

### EPIC Card Marries Six Functions in One

The era of the multi-function board has arrived and the evidence is showing up on the EPIC form factor. Diamond Systems' newest EPIC board, the Neptune, is a prime example. It uses a modular CPU architecture to offer an unusually wide processor performance range as well as to pack an unprecedented amount of I/O into a tiny 4.5 x 6.5 inch (115 mm x 165 mm) EPIC footprint. Incorporating the equivalent of five PC/104 I/O modules on a single board, Neptune is offered with processors ranging from 500 MHz AMD Geode LX800 to 1.4 GHz Intel Pentium M 738 CPU.

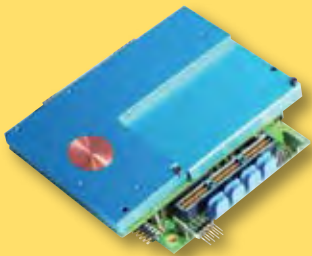


The CPU core consists of an ETX module that mounts on the bottom side of the board for improved thermal management. This technique provides more room on the main board for I/O features. The result is an efficient, cost-effective, reliable and compact embedded SBC rich in I/O and user benefits. Neptune is the first 6-in-1 embedded SBC, integrating processor, system I/O, data acquisition, and even a DC/DC power supply onto a single board in the compact EPIC format. A PC/104-Plus expansion socket enables you to add still more I/O or features if needed, and the built-in 5-28V input DC/DC power supply provides flexibility in integrating the board with your system power supply. The Neptune SBC is available in 500 MHz, 1.0 GHz and 1.4 GHz versions, with and without data acquisition. Neptune and its related products are all available now with prices starting under \$900.

Diamond Systems  
Mountain View, CA.  
(650) 810-2500.  
[www.diamondsystems.com].

## PCI/104 Express Card Sports Core2 Duo CPU

The PC/104 Embedded Consortium's new PCI/104 Express has the bandwidth to support high-speed applications such as 1 and 10Gbit Ethernet, high-end graphics processing, customer-specific FPGA and DSP requirements and I/O-intensive applications. In two to three years, the PCI Express bus will be adapted from 2.5 GHz to 5 GHz. The Q2 connector is specified for 6.25 GHz and can, therefore, also support the next generation bearing the name PCI Express 2.



Among the first to roll out a PCI/104 Express product, Digital-Logic offers its PCI/104 Express CPU board with Intel Core 2 Duo processor with a clock rate of up to 2x 1.6 GHz. Called the MSM945P, the board has all of the standard PC interfaces plus Ethernet LAN, optional DVI and LVDS interfaces (dual screen) and a sound controller. Equipped with the CPU Intel Core2 Duo L7400 in the smartModule SMX945 with COMexpress, this product has the highest performance on the PC/104 form factor. The PCI/104-Express bus (PCI & PCI Express) and six USB interfaces are available as functional extensions. By means of a PC/104-Plus ISA bridge card, an 8-bit ISA bus can be emulated from the 32-bit PCI bus. Power consumption, cooling method, ambient working temperature and performance are directly dependent on the smartModule945.

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

## Pentium M SBC Keeps Within PC/104 Constraints

Not all PC/104-Plus board designs that sport the Pentium M processor stay true to the traditional physical PC/104 form factor. Bucking that trend, the Kontron MOPS-PM meets the PC/104 Consortium specifications entirely. The board is a fully PC/104-Plus-compliant SBC equipped with Intel Pentium M processors. The classic PC/104 footprint of 90 mm x 96 mm could only be achieved by choosing cutting-edge, highly integrated electronic components such as the latest and smallest Super IO controllers and PCI-ISA-Bridges.



The new Kontron MOPS-PM for PC/104-compliant expansion modules is equipped with Intel Pentium M class processors and 855/852 GME/ICH4 chipset. Standard variants include a 1.4 GHz Pentium M 738, 1 GHz Celeron M 373, or a 600 MHz Mobile Celeron processor. The Kontron MOPS-PM has PCI and ISA buses and all other standard interfaces (LAN, 2 x USB 2.0, 2 x COM ports, CRT, LPT, EIDE). In addition, the high-speed on-chip video controller (Intel Extreme Graphics 2 engine) with up to 64 Mbytes of video memory (UMA) can drive dual independent displays at high resolutions. Use of the new JILI30 flatfoil connector allows connection of TFT panels at extremely low cost. Even connections to Transistor Logic panels are possible.

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

## EPIC SBC Boasts Low Power, Multiple Comm Interfaces

For military applications that depend on remote terminals, protocol conversion or data logging in power-shy environments, the ideal SBC would combine a low-power CPU with lots of onboard communications formats. That's exactly what the EPIC form factor SBC4670 from Micro/sys offers. It matches the fast, low-power 520 MHz PX270 ARM processor with Power Over Ethernet, onboard GPS, a socket modem capable of GSM/GPRS, CDMA or Bluetooth, and/or a CAN bus interface. The board also contains support for an 800 x 600 color flat panel display, audio output and debounced keypad input, as well as eight channels of 14-bit A/D with simultaneous reads, eight channels of 14-bit D/A and 24 channels of digital I/O.



The SBC4670's processor can dynamically shift velocity in response to performance or power consumption changes. On-chip cache, an SDRAM controller, a CompactFlash interface and a USB host controller are also on board, as well as five serial ports, 128 Mbytes of SDRAM, 64 Mbytes of boot flash and a 16-bit PC/104 bus interface. The SBC4670 supports Linux, Windows CE and VxWorks. A stackthrough version is available for plugging into a custom OEM I/O card. Pricing for the basic SBC4670 starts at \$595 in single quantity, and at \$650 for an industrial temperature (-40° to +85°C) version.

Micro/sys  
Montrose, CA.  
(818) 244-4600.  
[www.embeddedsys.com].



### Conduction-Cooled EPIC Card Serves Up 733 MHz Eden

In many defense and aerospace platforms, size, weight and power (SWP) are critical design considerations. Developed for applications that need all three, Octagon Systems offers the EPIC form factor XE-900 SBC, designed to operate in harsh, demanding environments. The XE-900 incorporates the 32-bit, low-power VIA Eden ESP CPU family. Three versions are available: the 400 MHz and 733 MHz versions operate at -40° to +85°C and the 1 GHz version operates at -40° to +75°C. Memory includes 512 Kbytes of surface mount flash for BIOS, a SO-DIMM socket for up to



512 Mbytes of SDRAM and 1024 bytes of user-available serial EEPROM. ATA-4 hard drive and CompactFlash interfaces support up to three drives: CD-ROM, hard drive, EIDE flash drives and other EIDE devices. The board includes CRT and flat panel video, six RS-232/422/485 serial ports, two USB ports, 10/100 Base-T Ethernet, PC/104 and PC/104-Plus expansion and 24 lines of bit-programmable, digital I/O with 16 mA sink/source capability. It features ACPI 2.0 and PCI power management. The conduction-cooling system eliminates the need for a fan even at 1 GHz.

Companion XE-900 OS Embedder kits are available for Linux 2.6 and Windows XP. These kits combine hardware and software for instant-on operation. The single piece price is \$795 for the 1 GHz version, \$745 for the 733 MHz version and \$695 for the 400 MHz version. Volume discounts are available for all three.

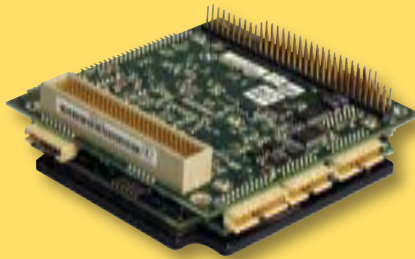
Octagon Systems  
Westminster, CO.

(303) 430-1500.

[[www.octagonsystems.com](http://www.octagonsystems.com)].

### Pair of PC/104-Plus Boards Eyes Rugged Apps

Compute density has become the watchword in numerous military applications such as UAVs, vetronics and avionics systems. Feeding such needs, Parvus has unveiled its CPU-1472 and CPU-1474, two PC/104-Plus form factor SBCs featuring the low-power Intel Celeron M 1 GHz processor and Intel i855GME chipset. The CPU-1472/74 cards operate without any active cooling (fanless) over standard (0° to +60°C) and extended (-40° to +85°C) operating temperature ranges. Like other Parvus/Eurotech CPU modules, system DRAM is soldered on board to enhance shock/vibration resistance, and each card is individually thermally qualified to ensure high reliability. A structural heat spreader plate is integrated on top of each CPU module to dissipate heat from critical components.



The CPU-1474 features dual Local Area Network (LAN) controllers (Gigabit and Fast Ethernet) and four USB 2.0 ports, along with standard PC peripherals and I/O interfaces, including dual serial ports, TFT/LVDS interfaces, AC97 audio interface, keyboard and mouse ports, and IDE controller. The CPU-1472 is similar but provides a total of eight USB 2.0 ports and a single 10/100 Ethernet controller. These x86 CPU modules are compatible with Linux, Windows XP Embedded and other popular operating systems. Hardware development kits (DTKs) and accessories are available, as well as professional services for systems engineering of rugged box-level solutions tailored to customer requirements.

Parvus  
Salt Lake City, UT.

(801) 483-1533.

[[www.parvus.com](http://www.parvus.com)].

### PC/104-Plus, PCI-104 SBCs Boast Rich I/O

Fitting a high-performance embedded computer into the limited space available in many military applications is now easier, thanks to small footprint form factors such as PC/104 SBCs. Even better are small SBCs that have been ruggedized. Serving just such needs are RTD's high-performance PC/104-Plus and PCI-104 cpuModules and controllers. The boards are available with either Intel 1.4 GHz Pentium M or 1.0 GHz Celeron M processors.



Both CPUs support four PCI bus masters and feature BIOS-selectable thermal throttling, ACPI (Advanced Configuration and Power Interface) and APIC (Advanced Programmable Interrupt Controller). Nonvolatile BIOS configuration allows storage of CMOS settings with no battery required. Each SBC features 512 Mbytes of surface-mount BGA ECC DDR SDRAM and one ATA/IDE disk chip socket for an onboard IDE flash drive of up to 4 Gbytes that is natively supported by all major GPOSS and RTOSS.

RTD's latest I/O technologies include two or four USB 2.0 ports and the RTD exclusive multiPort with BIOS-selectable aDIO Advanced Digital I/O consisting of 18 or 36 digital I/O bits, ECP/ EPP parallel port or floppy drive. Standard PC I/O includes SVGA, LVDS flat panel, 10/100 Mbit Ethernet, AC'97 audio, BIOS-selectable RS-232/422/485, keyboard, PS/2 mouse and EIDE controller with UltraDMA-100. Wake events include aDIO interrupt, Ethernet, power button, serial port activity, USB and onboard real-time clock. The Pentium M also features advanced power management including Enhanced Intel SpeedStep Technology. Pricing is \$2,795 for the Pentium M 1.4 GHz version and \$1,995 for the Celeron M 1.0 GHz version.

RTD Embedded Technologies  
State College, PA.

(814) 234-8087.

[[www.rtd.com](http://www.rtd.com)].

## Rugged, Low-Power SBC Targets Harsh Environments

It's not easy to meet requirements for highly reliable operation under extreme environmental conditions. The ability to fit into small spaces and extremely low power consumption are also high on the demand list. Fortunately, vendors such as VersaLogic continue to roll out new products aimed at those needs. VersaLogic's new PC/104-Plus SBC for embedded OEM applications, the Cougar, uses a highly efficient AMD LX 800 processor that provides very low power consumption without sacrificing performance. The benefits of fanless operation (no moving parts), soldered-on system memory, and extended temperature operation (-40° to +85°C) make the Cougar an ideal choice for demanding military and aerospace applications.



The Cougar's highly integrated AMD LX 800 processor delivers Celeron 800 MHz-equivalent performance while drawing less than 5W of power. Standard onboard features include 256 Mbyte soldered-on SDRAM, dual 10/100 Ethernet, four USB 2.0 ports, IDE interface and three COM ports. A CompactFlash socket provides reliable, high-capacity onboard storage, with no moving parts. Flexible options for keyboard, mouse, external storage and other devices are provided via USB ports. The board includes integrated SVGA and LVDS flat-panel support. Standard pass-through connectors allow the board to be used either above or below other PC/104 modules. Available customizations include conformal coating, customized BIOS, revision locks, custom labeling, RTV and wire wrap for shock and vibration protection, and many other options. The Cougar will begin shipping in June 2008. Pricing is around \$795 in OEM quantities.

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

## PC/104-Plus Board Suited for Battery Power Apps

For mobile, battery-driven military systems, such as ground robots and small UAVs, power consumption means everything. Serving such needs, WIN Enterprises offers the MB-07303, a PC/104-Plus CPU module with AMD Geode LX800 processor at 500 MHz. MB-07303 features CRT support, 18-bit or 24-bit TTL LCD and digital I/O functions that include two COMs, four USB 2.0 ports, one Ultra ATA-66 interface and CompactFlash. Low power consumption and low heat production enable fanless operation in a wide temperature range.



The board sports one DDR socket for up to 1 Gbyte of memory and dual 10/100 Mbit/s PCI bus Ethernet. The AMD Geode LX800 processor provides mid-range performance in a small form factor with low power/low heat characteristics. The AMD Geode LX800 processor is partnered on the board with the AMD Geode CS5536 chipset. An optional audio module is available providing mic-in and speaker-out functions. The MB-07303 is available now at the single unit price of \$298. Quantity discounting is provided.

WIN Enterprises  
North Andover, MA.  
(978) 688-2000.  
[www.win-ent.com]

## Fanless PC/104-Plus SBC Runs at -40° to +85°C

Using a fan as a method of cooling an embedded board doesn't fly in military applications. Fans are too fragile to risk as the single point of failure for a system. WinSystems has introduced their PPM-GX500, a PC/104-Plus-compatible single board computer (SBC) that operates throughout the temperature range of -40° to +85°C without the need for a fan. It is based upon the low-power, high-integration AMD GX500 1W processor. This SBC integrates the CPU, video, Ethernet, USB, COM, LPT, mouse, audio and keyboard controllers onto one board, yet it measures only 3.6 x 3.8 inches (90 mm x 96 mm).



The PPM-GX500 supports up to 512 Mbytes of SDRAM. The PPM-GX500 also offers support for both rotational and solid-state disks. Two floppy disk drives and two UltraDMA 66 IDE drives can be connected. Plus, there is a socket for a CompactFlash card, which can support up to an 8 Gbyte device. This solid-state disk solution is a viable alternative for fragile floppy and/or hard disk drives for use with harsh environmental applications. The PPM-GX draws typically 1.5A at +5V—which is about 8W—during normal operation. List price for the board is \$495.

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





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### Conduction-Cooled 3U cPCI Card Boasts Speedy Graphics

Defense system designers are compelled to seek out the highest performance embedded computing available. It's vital that they do, because with the long development cycles of the defense world, technology goes obsolete fast. With that in mind, General Micro Systems introduced a new 3U cPCI Single Board Computer that's an industry first in high-performing board-level electronics. The new SBC, "Pinnacle" (CC70x), provides 2.16 GHz in processing speed, along with extensive memory and high-speed graphics, dissipating only 40 watts of power needed for operation.

The power behind Pinnacle and its ultra performing memory and graphics package is (up to) a 2.16 GHz Core 2 Duo processor with 4 Mbyte of L2 Cache, and 4 Gbyte of 667 MHz DDR-2 SDRAM. A Special Application Module (SAM) on board for custom I/O provides up to 64 Gbytes of high-speed SATA Solid State Drive; custom high-speed I/O via 1 Lane PCI-Express, SATA, USB and I<sup>2</sup>C buses; and up to 8 I/O lines to J2 rear I/O. It also incorporates an optional mini PCI-Module with rear I/O for 802.11 or GPRS. Pinnacle is available in a full rugged extended temperature version for -40° to +85°C. With its onboard heaters, Pinnacle can operate at temperatures below -40°C. Pricing for the conduction-cooled version of Pinnacle starts at \$4,320, in quantities of a 100 units.

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



### 5-Volt 1553 Transformer Features Compact Footprint

For situations where data integrity and low latency are the priorities, MIL-STD-1553 still remains the military interface of choice. Beta Transformer Technology is introducing the MLP-2205. It is a compact 0.4- x 0.4-inch footprint, 0.185-inch maximum height single channel transformer. A pair of MLP-2205 transformers can be used for dual channel

applications yielding an overall footprint that is smaller than industry-available dual transformers. The MLP-2205 is available in ratios compatible with 3.3, 5, 12 and 15 volt transceivers.

The 0.185-inch height makes it particularly attractive for today's smaller MIL-STD-1553 board topologies and it has ratios to meet both transformer-coupled and direct-coupled applications. The MLP-2205 uses a robust header-style design that meets all the requirements of the MIL-PRF-21038 specification. It operates over the full Mil-temp range of -55° to +130°C. This series is also available using tape and reel packaging.

Beta Transformer Technology, Bohemia, NY.  
(631) 244-7393. [[www.bttc-beta.com](http://www.bttc-beta.com)].

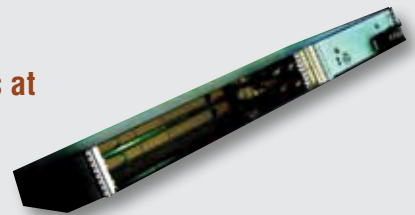
### 1U Microchassis Aims at Rugged Apps

The 1U "pizzabox-style" form factor is quickly gaining popularity in a host of military applications.

Triple E's rugged 1U microchassis addresses inherent problems associated with electronic systems configured for military, aerospace and other harsh environment applications. The microchassis meets IEEE1101.10 and IEEE1101.11 mechanical requirements. Configured with VME64X, cPCI or PICMG 2.16 backplane, the unit allows for up to two 6U x 1.6 mm x 160 mm size boards in front, and two 6U x 1.6 mm x 80 mm direct plug-in rear transition boards. Weighing 10.75 lbs., the unit measures 19-in. rack mount (L-R) x 1.73-inches high x 11.25-inches deep. Construction features 0.036-inch thick zinc plated steel for structural integrity, durable powder coat finish and removable side walls for easy maintenance.

Unlike units with plastic card guides, this design features a patented all-extruded aluminum 901 Series card guide cluster providing exceptional stability to protect boards from vibration damage and maximum cooling airflow between slots to guard against heat buildup. The unit complies with UL, EN and CE safety specifications, and conducted and radiated EN Class B and EN ratings. Costs for units configured with cPCI backplane start at \$1,650.

Triple E, Lowell, MA. (978) 453-0600. [[www.TripleEase.com](http://www.TripleEase.com)].



### GPS Receiver Climbs Aboard StackableUSB

The young but emerging StackableUSB technology ruggedizes USB in a compact form factor enabling the USB technology to move into harsh environments. Micro/sys's USB1700 is the smallest StackableUSB Global Positioning System (GPS) receiver board on the market. At 1.85 x 1.78 inches, the USB1700 is one quarter the size of the PC/104 footprint. The USB1700 is RoHS-compliant, operates from -40° to +85°C (ET version), and provides OEMs with 12-channel, WAAS-capable GPS functionality for space-sensitive applications.

The USB1700's compact form delivers proven performance for a new generation of position-enabled products with revolutionary technology for extremely fast startup times and high performance in foliage-canopy, multipath and urban-canyon environments. The board is shipped with a passive antenna included. A development kit that includes sample software and full documentation is free for new customers. Standard USB cables are also available for use with the PC attached version of the board. The basic USB1700 starts at \$230 in single quantity. An extended temperature (-40° to +85°C) version is available.

Micro/sys, Montrose, CA. (818) 244-4600. [[www.embeddedsys.com](http://www.embeddedsys.com)].

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### Thermal Controllers Are Military Approved

Reliable thermal control ranks as a critical design issue for a variety of in-theatre military systems. Serving that need, Degree Controls has announced a new line of Military-approved thermal controllers for electronics applications. Ruggedized for high-reliability, mission-critical Military applications, the new line of fully configurable, standard controllers offers Military contract manufacturers increased reliability and reduced time-to-market. DegreeC's CAGE Code is 45R61, and the company is ITAR registered.

DegreeC's standard Military controller line is designed to meet both MIL-STD-461 (EMI/EMC) and MIL-STD 810F (Environmental/Physical) testing requirements. These intelligent and ruggedized fan controllers leverage the company's proprietary software allowing for programmable alarm thresholds and fan curves. The onboard microcontroller controls or monitors fan speeds, communicates with the host through serial interfaces, measures temperatures, detects filter blockages and reports alarms. In addition to their thermal control products offering, DegreeC offers a full line of airflow sensors, switches and instrumentation devices appropriate for use in Military products. The company also features robust test and analysis services for Military electronics devices, including HASS, HALT, ESS, MTBF, MIL-STD-1629, MIL-HBK-217F, EMC/I and safety testing.

Degree Controls, Milford, NH. (603) 672-8900. [[www.degreec.com](http://www.degreec.com)].

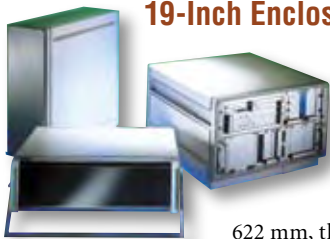


### PC/104-Plus Card Supports ARINC 429 and 717

The multi-function I/O subsystem trend is building steam in the military design world. Ballard Technology has released its PM429-2, a PC/104-Plus-compliant card for ARINC 429 and ARINC 717 avionics databuses. The PM429-2 offers up to 16 ARINC 429 channels and 4 ARINC 717 channels on a PC/104-Plus platform. Another attractive feature of the PM429-2 is its universal API library, which allows developers to program software on a commercial or other Ballard product such as an Ethernet or PCI card and seamlessly import it to the PM429-2.

In addition to these capabilities, the PM429-2 provides an IRIG timer and 16 input / output avionics discrete I/O signals. The discrete I/O can be used as general-purpose I/O or as trigger inputs and sync outputs for protocol functions. The PM429-2 discrete output circuits are open-ground switches capable of sinking up to 200 mA and can withstand up to 35 VDC applied to the pin. The discrete I/O are capable of interfacing with industry standard avionics discrete signals.

Ballard Technology, WA.  
 (425) 339-0281. [[www.ballardtech.com](http://www.ballardtech.com)].



### 19-Inch Enclosures Feature Thermal Management

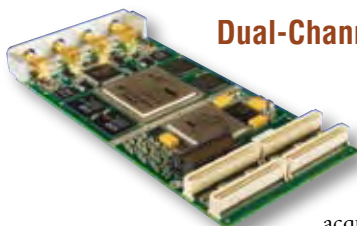
As processors get ever more powerful, power dissipation in the form of heat becomes a real challenge. Addressing that issue, a series of 19-inch and half-width desktop cases, 19-inch vertical and horizontal caseframes from Verotec offers outstanding versatility and thermal management. Available in 3U, 4U, 6U and 9U heights and depths of 322, 422, 522 and

622 mm, the Diplomat cases are equally suitable for use during system development and as a housing for production status units. The caseframes

provide direct mounting for Eurocard format PCBs in an easily configurable subrack system; the cases accept any standard 19-inch component. With power densities steadily increasing, effective ventilation is of paramount importance.

All horizontal versions can be fitted with an optional 38 mm deep filtered ventilation plinth that replaces the standard base cover, allowing cool air to be drawn into the unit from below. The ventilation plinth increases air throughput and provides a uniform airflow across the full width of the unit. The cool air is drawn into the unit through a removable filter in the plinth, and is then directed through the active board area by a rear duct plate that blanks off the space behind the circuit boards.

Verotec, Eastleigh, Hampshire, U.K. + 44 (0)2380 246900. [[www.verotec.co.uk](http://www.verotec.co.uk)].



### Dual-Channel 16-Bit Digital Receiver Rides XMC

Demanding signal acquisition applications—such as radar, software defined radio (SDR) and signal intelligence (SIGINT) platforms—have a heavy appetite for modular high-speed digital receiver technology. Delivering on such needs, Curtiss-Wright Controls Embedded Computing has announced the availability of the XMC-E2201, a rugged and compact high-speed, dual-channel 16-bit digital receiver XMC/PMC mezzanine card. The XMC-E2201 supports analog sampling rates of 160 Msps and speeds the integration of high-performance signal acquisition into rugged deployed COTS VPX, VME and CompactPCI subsystems.

Based on twin Xilinx Virtex-5 FPGAs, the XMC-E2201 combines input bandwidth in excess of 700 MHz, industry-leading signal-to-noise ratio rated at greater than 77 db, and high spectral purity. This small form factor mezzanine card delivers high dynamic range for sophisticated digital signal processing. Its twin FPGA architecture dedicates one "DSP" Virtex-5 FPGA for high-speed acquisition of the dual analog channel inputs. An eight-lane PCI Express (PCIe) interconnect provides direct high-speed off-board data throughput rates up to 2.5 Gbytes/s. The XMC-E2201 is designed to operate in rugged environments and is available in a range of air- and conduction-cooled formats. Pricing for the XMC-E2201 starts at \$9,620. Availability is Q2 '08.

Curtiss-Wright Controls Embedded Computing, Leesburg, VA. (703) 779-7800. [[www.cwembedded.com](http://www.cwembedded.com)].





### Small FHSS Radio Module Boasts 60-Mile LOS Range

There are a growing number of military/aerospace apps where size, weight and power consumption are critical design issues—unmanned vehicles, robotics and portable devices—to name a few examples.

Feeding that need, Intuicom has announced the C1000 $\mu$ , a micro-sized, high-performance RF transceiver module for OEMs. This ultra-small, low-weight FHSS radio module enables long-range, networked LOS & BLOS datalink communications for embedded applications. The module features up to a 60-mile LOS range (extendable to “Beyond Line of Sight” with repeaters) with data rates up to 1.2 Mbits/s. The C1000 $\mu$  is 2.00 x 1.42 x 0.38 inches in size and weighs 18 grams. The unit offers 128-bit AES encryption, secure 900 MHz Frequency Hopping Spread Spectrum technology and is configurable as a master, slave, repeater, or slave/repeater. Its power consumption is a low 6 mA at 3.3 VDC in sleep mode and features -40° to +75°C operation.

For defense contractors desiring to bring their products to market on a “fast track” timeline, Intuicom offers engineering services for custom integration of the C1000 $\mu$  into OEM systems. Intuicom has expertise in adding application-specific capabilities such as GPS Blue Force Tracking, sensor integration, and multi-port functionality that enables video, PTZ command and control, and remote position reporting from a single radio module. The

C1000 $\mu$  is offered in two configurations. Available in late Q2 '08, the standard version provides up to 115 Kbit/s throughput for backward compatibility with legacy Intuicom infrastructure. The high-speed 1.2 Mbit/s version will begin shipping in Q4 '08. Single unit pricing starts at \$400.

Intuicom, Boulder, CO. (303) 449-4330. [[www.intuicom.com](http://www.intuicom.com)].

### Power Modules Boast Densities up to 390 W/in<sup>3</sup>

More efficiency and more flexibility: those are the watchwords when it comes to robust military power supply subsystems. Feeding those desires, the Brick Business Unit of Vicor introduced an advanced modular power platform: the VI BRICK. The VI BRICK family incorporates the superior technical attributes of VI Chip technology and a robust packaging that facilitates thermal management and through-hole assembly. VI BRICK BCMs provide a highly efficient solution for Intermediate Bus Architecture or point-of-load (POL) designs that require multiple output voltages. They are available with nominal input voltages including 48 VDC (11 models) and high voltage up to 380 VDC (three models), and a wide array of output voltages from 1.5 to 48 VDC. The efficiency and compact size of these modules yields power density up to 390 W/in<sup>3</sup>.

VI BRICK models are available in a base temperature grade of -40° to +100°C, operating, and -40° to +125°C, storage, with a slotted-flange baseplate and through-hole pin style. All modules of the VI BRICK family are RoHS-compliant and compatible with lead-free wave soldering processes. Pricing for modules of the VI BRICK family ranges from as low as \$33 in OEM quantities.

Vicor, Andover, MA. (978) 749-8359. [[www.vicorpower.com](http://www.vicorpower.com)].



### RF Power Transistor Design Targets Radar/Avionics

For a long time, advances in RF power transistor technology have been mostly incremental and evolutionary. Setting out to buck that trend, startup HVVi Semiconductors has announced what it claims is the first major advance in silicon RF power transistor design in more than 15 years. Based on the world's first High Frequency, High Voltage Vertical Field Effect Transistor (HVVFET), HVVi's new architecture delivers frequency bandwidth, voltage and power levels to radar and avionic applications that far exceed the capabilities of current bipolar and LDMOS technologies.

As part of its initial announcement, HVVi is also introducing its first three products based on this innovative new HVVFET architecture. Targeted at high-power, pulsed RF applications in the L-band such as IFF, TCAS, TACAN and Mode-S, the three new devices leverage the inherent benefits of the HVVFET process to deliver high output power and high gain in an extremely compact package. All three transistors are designed to operate at 48V. The three products are targeted at commercial and military avionics and ground-based radar systems. All products operate over a wide range of supply voltages from 24V up to 48V. Evaluation kits and small quantities of the PVV1214-25, PVV1214-100 and PVV1011-300 are available now, with volume production in 3Q '08.

HVVi Semiconductors, Phoenix, AZ.  
 (480) 776-3800. [[www.hvvi.com](http://www.hvvi.com)].



### FPGA Devices Embed PowerPC and DSP

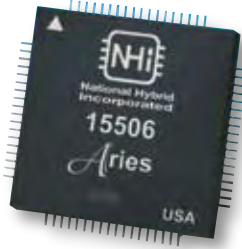
At one time military “system design” meant boards and boxes. Now complete systems can be crammed into a single FPGA device. Exemplifying that trend, Xilinx has announced the availability of its Virtex-5 FXT devices, the industry's first FPGAs with embedded PowerPC 440 processor blocks, high-speed RocketIO GTX transceivers and dedicated XtremeDSP processing capabilities.

The innovative Virtex-5 FXT platform offers the first FPGAs to provide up to two industry-standard PowerPC 440 processor blocks. Each processor, with integrated 32 Kbyte instruction and 32 Kbyte data caches, delivers up to 1,100 DMIPS at 550 MHz. Tightly coupled to the PowerPC440 blocks is a new integrated 5x2 cross bar processor interconnect architecture that provides simultaneous access to I/O and memory.

The device includes dedicated master and slave processor local bus interfaces, four DMA ports with separate transmit and receive channels, and a dedicated memory bus interface enabling high-performance, low-latency point-to-point connectivity. Virtex-5 FXT FPGA samples are now shipping for the FX30T and FX70T devices. The remaining FX100T, FX130T and FX200T devices will be available over the next six months with the first production devices scheduled to be made available in the third quarter of 2008. The FX30T device will list for \$159 in 1,000-unit volumes by the second half of 2009.

Xilinx, San Jose, CA. (408) 559-7778. [[www.xilinx.com](http://www.xilinx.com)].





**1553 Chip Integrates Protocol Engine, Dual 5V Transceiver**

Although fundamentally an avionics bus, a wide variety of systems such as tanks, ships, missiles, satellites and even the International Space Station, rely on 1553. For applications where data integrity and low latency are the priorities, MIL-STD-1553 is likely to remain the military interface of choice.

National Hybrid Inc (NH1), a division of API Nanotronics has introduced NH1's Aries Series with New "Tails Code Key" technology for enhancing bus maintenance quality and enhanced frame sequencing. Aries' reliable pick and place ability offers you an affordable solution for demanding military and industrial processor-to-1553 applications. These devices integrate a MIL-STD-1553 protocol engine, a dual 5-volt transceiver, memory management, processor interface logic, and 4K or 64K words of RAM in a 72-pin Plastic Quad Flat Pack (PQFP) package.

The memory management scheme for RT mode provides three data structures for buffering incoming and outgoing data. Combined with the extensive interrupt capability, these structures serve to ensure data consistency while off-loading the host processor. The NH1-15506 Aries Family devices are pin-to-pin replacements for the DDC BU-65178 and BU-61688. These replacements offer software and electrical compatible solutions. A board designed with the DDC BU-65178 and BU-61688 can work seamlessly with the NH1-15506-178 and 15506-688 without hardware or software changes.

API Nanotronics, Hauppauge, NY  
(631) 582-6767. [www.apinanonotronics.com].

**30A Half-Brick DC/DC Converters Are 93% Efficient**

Once treated as an afterthought, power system design is moving up a notch in the eyes of military system designers. They've come to realize that power supply efficiency can have a direct impact on system operations. Lambda has expanded its line of DC/DC converters with the launch of the new iHG series of 100W fully isolated, single output, half-brick devices. Providing exceptional thermal performance, using the industry standard half-brick footprint with no base plate, the modules are ideal for engineers designing low-airflow, high-temperature, 48V power systems. The initial product offering includes 5V/10A, 5V/20A and 3.3V/30A devices, with further products planned.

The single board construction combined with up to 93% efficiency delivers a very high level of useable power in convection-cooled environments, particularly where airflow rates are low. The iHGs operate over a wide input range from 36V to 75 VDC and feature a very wide output voltage adjustment/trim range from about 50% to 110% of its nominal output voltage. Operating temperatures can range from -40° to +125°C, measured at the module. Safety approvals for Lambda's new iHG family include UL60950 (US and Canada), VDE 0805, CB scheme (IEC950) and CE Mark (EN60950). The iHG series is available now and priced from \$62 each in 1k-unit quantities.

Lambda, San Diego, CA. (619) 575-4400. [www.lambdapower.com].



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LIND battery chargers are designed for charging the battery packs of Panasonic Toughbooks. Chargers are available with one, three or five identical charging bays, mounted together and powered from a single power source. Chargers are available for the Toughbook 08, 18, 19, 29, 30, T4 & T5 series.



Explore the military product section of our website.  
www.lindelectronics.com  
1-800-897-8994

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### PC/104 SBCs Blend Performance with Advanced Data Acq

The multi-function board trend has seeped into the PC/104 realm, and military system designers are feeling the benefit. The Athena II SBC family from Diamond Systems is a technology update of the Athena SBC family, bringing additional performance at the same price while maintaining backward compatibility to support long customer product lifecycles.

The Athena II family is a plug-compatible replacement for Diamond's Athena family of SBCs. It utilizes the new Via Mark processor, operating at 500 MHz or 800 MHz, an improvement over the Athena speeds of 400 MHz and 660 MHz. It offers 256 Mbytes of DDR2 DRAM operating at 533 MHz soldered on-board for increased shock and vibration resistance.

Built-in I/O includes a 10/100 Mbit/s Ethernet controller, VGA/LCD display, four USB 1.1 ports, four RS-232 serial ports (two with RS-485), keyboard, mouse and IDE hard drive interfaces. Athena II's integrated data acquisition functions utilize Diamond's autocalibration technology to calibrate the A/D and D/A circuits providing analog I/O performance with the maximum possible accuracy. Athena II has 16 analog inputs with 16-bit A/D and 100 KHz sample rate, four analog outputs with 12-bit D/A and 100 KHz waveform output capability, 24 digital I/O lines and two counter/timers. Prices start at \$575. Volume discounts are available.

Diamond Systems, Mountain View, CA. (650) 810-2525. [[www.diamondsystems.com](http://www.diamondsystems.com)].

### I/O-Rich Micro PCs Aim at Control Applications

Box-level computers are the latest trend drawing the interest of military system designers. Along just those lines, Digital-Logic has introduced a family of ultra-compact computer systems for decentralized control applications. The unit is based on the 3.5-inch single board MSB800 computer from Digital-Logic with all its interfaces. The three members of the family are the MPC21, MPC21A and MPC21B.

In addition to the functions of the MSB800, the MPC21 has two COM ports (1x external, 1x internal), one LPT interface and a PCI/104 slot available. The video input allows connecting a camera. A MiniPCI socket permits the integration of WLAN or field buses. In addition to the functions of the MSB800, the MPC21A system features four COM ports, one LPT interface, four relay outputs and four optically isolated inputs. The MiniPCI socket also serves for the integration of WLAN or field buses. Beyond the functions of the MSB800, the version MPC21B has two COM ports, one LPT interface and two CAN ports with galvanic isolation. In this model the MiniPCI socket allows the integration of WLAN. All computers are able to boot from CompactFlash, LAN, USB or the optionally integrated 2.5-inch 40 Gbyte hard drive.

Digital-Logic, Luterbach, Switzerland.

+41 (0)32 681 58 40. [[www.digitalllogic.com](http://www.digitalllogic.com)].

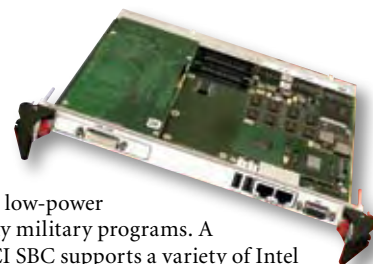


### 6U cPCI SBC Scales Core2 Duo/Core 2 Duo/Celeron M

Packing the most computer processing muscle possible in a low-power footprint is the priority in many military programs. A new 6U single-slot CompactPCI SBC supports a variety of Intel Core Duo and Core 2 Duo processors from the high-end 2.16 GHz T7400 to the low-voltage dual-core versions down to a selection of Celeron M types. It is designed especially for systems that require high computing and graphics performance and low power consumption. The D9 from MEN Micro offers a 32-bit/33 MHz system slot CompactPCI bus interface or can be used without a bus system.

A total of five PCI Express lanes for high-speed communication (such as Gbit Ethernet or graphics) are supported on the D9. Two x1 PCIe links are used for the two onboard Ethernet interfaces, another two x1 links support the XMC slot and one x1 link is available on a specific mezzanine card. For use in harsh environments, the D9 is equipped with soldered DDR2 DRAM (up to 4 Gbytes) to guarantee optimum shock and vibration resistance. It comes with a tailored passive heat sink within 4 HP height.

MEN Micro, Ambler, PA. (215) 542-9575. [[www.menmicro.com](http://www.menmicro.com)].



### Two 6U VME SBCs Serve Up Core2 Duo

VME's legacy remains solid in the military market. Feeding that trend, GE Fanuc Intelligent Platforms has announced the V7768 and V7769 6U VME SBCs. Both single board computers offer the Intel Core2 Duo processor operating at 2.16 GHz and the Mobile Intel 945GME Express Chipset. The dual slot V7769, which provides dual SAS (Serial-Attached SCSI) connectors on the front panel, can optionally be configured with an onboard 2.5" SATA hard drive. It features three PCI-X PMC slots, allowing for maximum user-defined connectivity. The single-slot V7768 can also be expanded via the PMC237 mezzanine board to provide legacy PMC functionality.

The V7768 and V7769 are the first products from GE Fanuc Intelligent Platforms to leverage the power of Intel's dual-core architecture in conjunction with the Universe II PCI-to-VME bridge from Tundra Semiconductor. Up to 4 Mbytes of Level 2 cache and up to 2 Gbytes of DDR2 SDRAM are provided by each board, as are two Gigabit Ethernet ports via the front panel. Two SATA ports, two serial ports, four USB 2.0 ports and PS/2 mouse/keyboard ports are also standard.

GE Fanuc Intelligent Platforms, Charlottesville, VA. [[www.gefanuc.com](http://www.gefanuc.com)].





### 6U Carrier Brings PCIe I/O into the cPCI Realm

CompactPCI has won its place in the mindshare of military system designers. And the CompactPCI Express follow-on brings switched fabric performance into that mix. A 6U CompactPCI Express (CPCIE) carrier board allows the use of a PCIe I/O board in a CPCIE system. OEMs can now access the growing supply of PCIe I/O boards on the market today and use them in their latest CPCIE systems.

Introduced by One Stop Systems, this Type 2 board supports a PCIe short card, usually in PCIe x8, x4 and x1 configurations. While the carrier board is equipped with a PCIe x16 connector, it communicates at x4 speeds.

Most PCIe boards, though rated at x16 or x8, will “train” down to x4 or x1 speeds. This allows the carrier board to be used universally as long as the board fits into the short card form factor. The 6U CPCIE carrier board is a part of One Stop’s larger family of CPCIE products, including switchboards, backplanes, CPU boards, chassis and I/O boards. The 6U CPCIE Carrier Board lists for \$575 and is available immediately.

One Stop Systems, Escondido, CA.

(760) 745-9883. [www.onestopsystems.com].

### Cabinet Boasts Cable-Management Features

A consequence of military embedded systems integrating down to dense amounts of computing resources is that the cabling attached gets ever more complicated. Schroff has introduced a new networking cabinet that can be specified with a comprehensive range of accessories to enable the implementation of an orderly and reconfigurable cable management solution. Known as Varistar NET from Schroff, the new cabinet uses a closed rolled-steel frame construction that not only provides a high load-bearing capacity but also has smooth, rounded edges to prevent damage to Cat 6 and optical-fiber cabling.

Designed to maximize the available cabling space by removing all obstructions to the cable paths, the cabinet comes in two versions—one with a single 19-inch plane and the other with two 19-inch planes and a base plinth. Varistar NET offers a choice of slim-line or heavy-duty frames for static load-bearing capacities of 400 kg or 800 kg respectively, and it is available in a variety of sizes ranging from 1200 to 2200 mm in height, from 600 to 1000 mm in depth, and in widths of 600 or 800 mm. The line-up of cable-management accessories includes plastic or steel 100 mm-square cable hoops that simply clip into the cabinet frame, cable ducting, fiber-optic cable brackets, C-rails and associated clips, cable support rails, cable panels and cable ladders.

Schroff, Warwick, RI. (401) 732-3770. [www.schroff.us].



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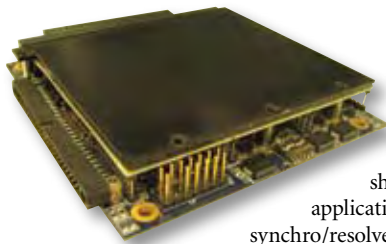
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### Digital-to-Synchro/ Resolver Converter Rides PC/104

Applications such as airborne, shipboard, ground mobile and C3I applications are all hungry for more precise synchro/resolver conversion. Offering 16-bit resolution and 1 arc-minute accuracy provided at 1.2 VA output drive, North Atlantic Industries (NAI) has announced the availability of a 3-channel Digital-to-Synchro/Resolver Converter on a PC/104 card. The DSP-based 73DS2 includes up to three independent, transformer-isolated, programmable Synchro/Resolver simulation channels. Each channel has 16-bit resolution,  $\pm 1$  arc-minute accuracy, and a short circuit protected output with 1.2 VA drive capability. The unit requires +5 VDC and  $\pm 12$  VDC power supplies, and operates over a frequency range of 47 Hz to 10 KHz.

The 73DS2 provides continuous background Built-In-Test (BIT) on all functions and channels, including reference and signal loss detection. The BIT is totally transparent to the user, requires no programming, and doesn't interfere with the normal operation of the card. Each Digital-to-Synchro/Resolver Converter channel is self-calibrating, without requiring removal of the card. The 73DS2 PC/104 card is ideally suited for military and commercial programs, including airborne, shipboard, ground mobile and C3I applications. The 73DS2 is available with an operating temperature range of  $-40^{\circ}$  to  $+80^{\circ}$ C. Pricing for 100 pieces of the 73DS2 starts at \$3,300 each.

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



### BDM/JTAG Debug Link Supports Multiple CPUs

Gone are the days when military system developers had to have separate debug tools for each processor platform. The latest addition to Abatron's worldwide BDI family (BDI1000/BDI2000) of debug interfaces offers high performance and high flexibility. The BDI3000 offers BDM debug support for ColdFire, PowerPC 5xx/8xx and JTAG debug support for PowerPC, ARM, XScale and MIPS. Host communication for the BDI3000 is via RS-232 and Ethernet (10/100).

The BDI3000 has fast program download speed up to 1500 Kbytes/s and BDM/JTAG clock up to 32 MHz. The new BDI3000 supports target system voltages from 1.2 to 5V and offers flash memory onboard programming. Debuggers from leading vendors are supported by the BDI3000, and the same hardware can be used for all supported targets and debuggers. The BDI3000 is available immediately from Ultimate Solutions, the stocking distributor of Abatron products in North America.

Abatron, Rotkreuz, Switzerland.  
 +41 792 09 55. [[www.abatron.ch](http://www.abatron.ch)].

Ultimate Solutions, Tewksbury, MA.  
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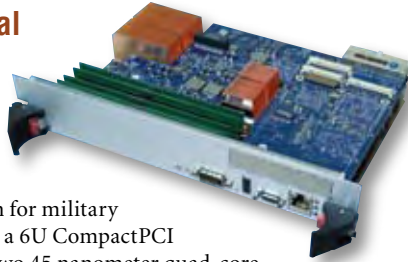
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## cPCI Board Sports Dual 45nm Quad-Core Xeons

CompactPCI has definitely passed muster as an accepted and proven embedded computing platform for military system designs. Kontron offers a 6U CompactPCI processor board that features two 45 nanometer quad-core Intel Xeon L5408 processors complemented by the power-optimized Intel 5100 Memory Controller Hub (MCH) chipset and Intel I/O Controller Hub 9R. With eight processor cores on one board, the CP6014 is an 8HP dual-slot solution designed with a multitude of onboard I/O functionality.

To eliminate the bottleneck of a parallel bus structure, the CP6014 supports a local PCI-X 64-bit/133 MHz on PMC-slot or a PCI Express x4 on the XMC. For faster memory performance, Kontron's 6U CompactPCI board supports up to 32 Gbytes of DDR2 memory (4 DIMMs sockets) at 533/667 MHz and Intel I/O Acceleration Technology (Intel I/OAT) DMA for fast data transfer. There is additionally a VGA interface and a VGA controller on a PCI-E bus ATI M72 that supports CRT.

Kontron, Poway, CA.  
(858) 677-8077. [www.kontron.com].



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## 48-Bit Digital Input Boards Boost Selectable Inputs

Military applications are hot on compute density, but I/O density is a big deal too. A series of high-density digital input boards, the DNA-DIO-448 and DNR-DIO-448 from United Electronic Industries are compatible with UEI's Cube and RACKtangle I/O chassis respectively. The boards read all 48 bits at sustained rates in excess of 1 Ksample/s.

Input switching levels and hysteresis are software selectable from 0 - 28 VDC with 25 mV resolution. As part of UEI's Guardian Series, the boards use an A/D input approach that offers a great deal of input flexibility. A diagnostic input mode measures the analog voltage at each input, allowing quick and accurate detection of short and open circuits as well identifying marginal or failing drive circuitry. The analog input capability is also a powerful installation, diagnostic and data acquisition tool.

Software for the DNA-DIO-448 is provided in the UEIDAQ Framework. The Framework provides a comprehensive, easy-to-use API that supports all popular programming and operating systems including Windows, Vista, Linux and most real-time operating systems (such as QNX, RTX, RT Linux). The board is fully supported by LabVIEW, MATLAB/Simulink, DASYLab or any application supporting ActiveX, OPC or Modbus TCP control. Pricing for the DNA-DIO-448 (Cube version) is \$1,200 and for the DNR-DIO-488 (RACKtangle version) is \$1,350.

United Electronic Industries, Walpole, MA.  
(508) 921-4600. [www.ueidaq.com].

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## Coming Next Month

- **Ethernet Switches for Military Apps.** Ethernet is becoming entrenched as a favorite interconnect fabric in compute-intensive applications like sonar, radar or any application that networks sensor arrays together. This section updates readers on the product and technology trends driving board-level Ethernet switch products. Analysis will be included about representative Ethernet switch board products in form factors such as VME, cPCI, MicroTCA and more.
- **Future Combat Systems Update.** The Army's Future Combat Systems (FCS) program ranks as one of the most complex ever taken on. Comprised of a wireless data network using advanced communications technologies, FCS links soldiers with several new, lightweight manned and unmanned ground vehicles, unmanned aircraft, sensors and weapons. This feature updates readers on the status of the FCS program, with a look at the central role that embedded computing architectures like cPCI and VPX are expected to play.
- **Shock & Vibration for Boards and Enclosures.** As systems get more dense and complex, the problem of engineering boards and enclosures isn't getting any easier. Meeting the stringent levels of shock and vibration ratings required by most defense and aerospace programs is no slam dunk. Relying on outdated Mil-Spec guidelines like MIL-STD-810F is no longer sufficient, and full environment stress screening techniques like HASS and HALT have moved into the forefront. Articles in this section delve into those areas and compare the solutions available.
- **Rugged Displays.** 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. Cockpit displays and simulation/training applications rank as two of the most demanding users of these advanced graphics technologies. Articles in this section examine the graphics solutions available in PMC and other form factors, as well as a product roundup of display interface products.



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# Editorial

Jeff Child, Editor-in-Chief



## Guess You Had to Be There...

There's no doubt that the influence of the Web has dramatically changed the reasons why engineers and other technology decision makers attend tradeshows. But more and more I'm starting to wonder if that's just a convenient excuse for why some tradeshows are less successful. The Internet is a miraculous tool for gathering information, and it's enabled every manner of online community to emerge and flourish. Blogs, forums, and information portals of every size and shape have become almost as common as air. All that said, it's hitting home to me these days that there's no substitute for face-to-face interaction with the industry you're in. It's particularly important for our embedded computing industry and doubly so for the military segment of that and for the military electronics industry at large.

Recently, I was talking with someone at their booth at a tradeshow and I wanted to get his opinion of something going on in the embedded computer industry. He told me he had blogged that particular question already, and proceeded to give me his blog address. I blinked my eyes and paused, and then said, "Well...we're standing here right now. Let's have a conversation." He agreed, and ultimately I got a lot more insights and perspectives out of him from that conversation than I could have by reading his blog. And what emerged from the conversation was exclusive and something unique I could share with you, the readers of COTS Journal. It's amazing to me though, that I had to push to have an actual conversation. It doesn't seem that long ago that a sharing of opinions like that was just the way business was done.

Aside from my main responsibility as the leader of COTS Journal, another of my roles at RTC Group is to serve as Technical Chair for our company's Real-Time Embedded Computing Conferences (RTECC) east of the Mississippi. And despite the rumors of the death of shows, the RTECC shows on average this year have been growing in attendance. Most recently I attended the Greenbelt, Maryland and the Boston RTECCs. We get a good percentage of military and aerospace engineers at both of those shows. I moderated a lunchtime panel discussion at both events, and at the beginning of each I asked for a show of hands as to who in the audience was involved in developing military embedded systems, and a lot of hands went up. Not surprisingly the percentage of mil-aero attendees was higher in Greenbelt than in Boston. The venue for the Greenbelt show, in fact, was near the NASA Goddard center, and Northrop Grumman and Lockheed Martin each had ten-story buildings across the parking lot from the show's location. But in total number of mil-aero attendees the two events were on par with one another, because Boston had significantly more total attendees.

The topic for the panel discussion at the Greenbelt RTECC was "Switched Fabric Interconnects in Military Systems - Sorting Through the Chaos." And I want to thank the following gentlemen for participating on the panel: Thanks to Jim Ison of One Stop Systems, Paul Mesibov of Pentek, Peter Reicker of Mercury Computer Systems, Bob Senko of Extreme Engineering and Peter Thompson of GE Fanuc. Among the highlights of the discussion was how, in comparison to the general embedded computing market, the military market took such a long time to express interest in switched fabrics. The panel shared its thoughts on what the surviving major fabrics such as PCI Express and RapidIO have in common that's allowed them to "make the cut." Also covered was how switched Ethernet—at 1 Gbit or 10 Gbit—is positioned versus other fabrics in military applications. There was a time when PCI held reign as the dominant interconnect in computing and embedded computing, finding its way into a wide array of form factors and implementations. But the panelist by and large agreed that none of today's switched fabric technologies have that level of dominance.

Meanwhile at the Boston RTECC, I moderated another luncheon panel discussion, this time on "FPGA Computing: Redefining System Design." My thanks go out to another great set of panelists there including Rodger Hosking of Pentek, Ken Karnofsky of The MathWorks, Andy Reddig of TEK Microsystems and Patrick Stover of Annapolis Micro Systems. The panelists talked about how FPGAs have been steadily ramping up their on-chip DSP capabilities, and how today's crop of advanced FPGAs trade off versus DSP chip and General Purpose Processor solutions in terms of solving signal processing problems. Another interesting question posed to the panel was the relevance of reconfigurable computing—where an FPGA enables a system to reconfigure on the fly—and how that compares to configurable computing—where a system can be reconfigured in the field, but that reconfiguration isn't part of the application.

After both RTECC panel talks, a lot of engineers came up to me and the other panelists to ask questions and make comments. I found it very satisfying to share insights that way. Now, could something equivalent to the panel talk have been done as a Webinar or similar online format? Well, on the surface you would think so. But I don't think a Webinar can ever reproduce as memorable and interactive an experience. And in the military embedded electronics industry, where the online community model doesn't quite fit the culture, there's truly nothing like being there in person. ■■



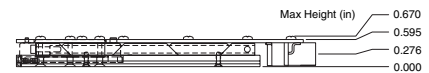
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