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Annual *COTS Journal* Articles Index

Volume 9 Number 12 December 2007 www.cotsjournalonline.com

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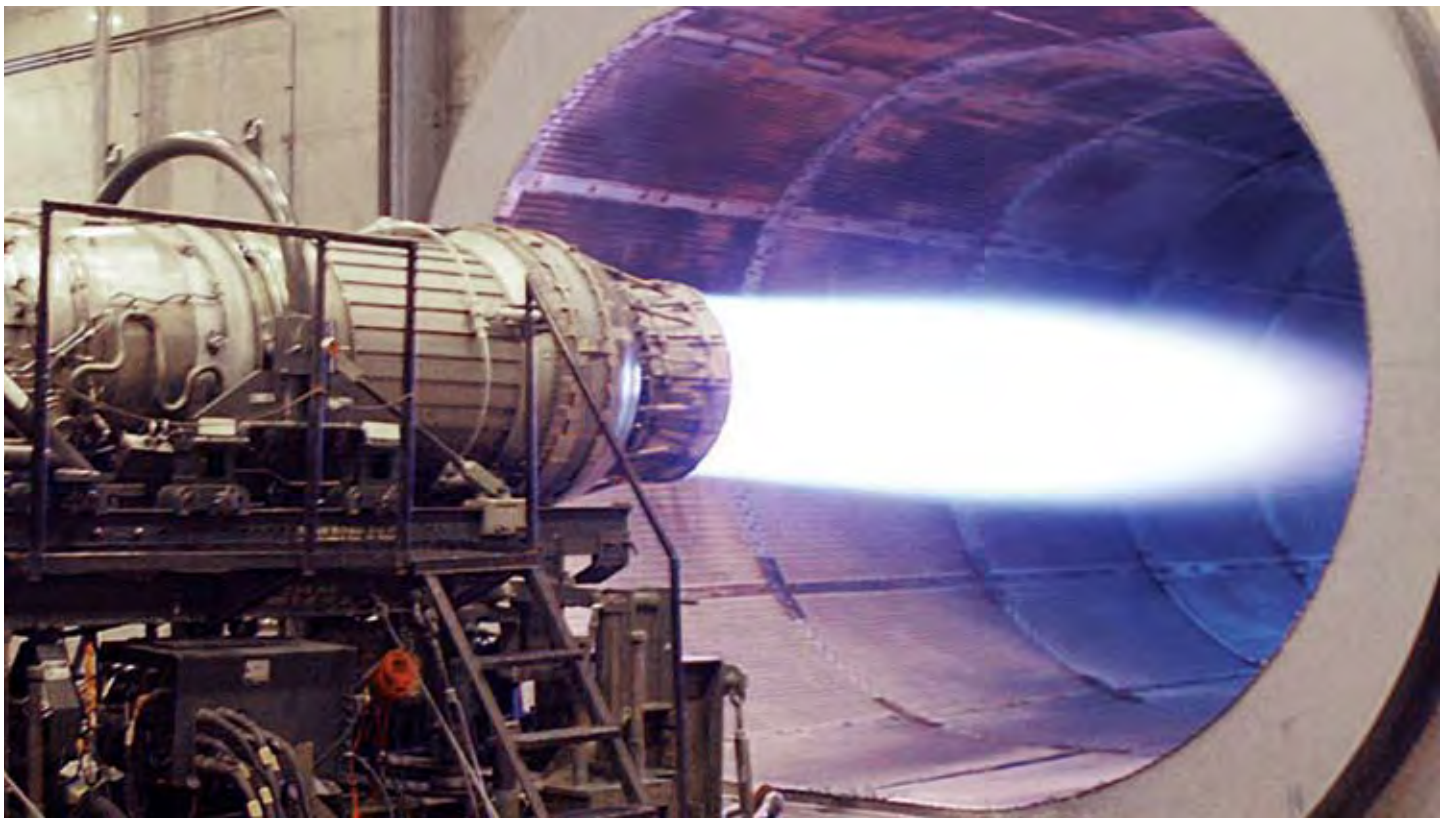

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2007

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The first tilt-rotor aircraft to be fielded in the military, the V-22 Osprey has redundant digital fly-by-wire flight controls that are used in lieu of traditional hybrid redundancies. Its maintenance station used between flights automatically identifies defects and conducts trend analysis to predict future maintenance actions. Here, a U.S. Air Force V-22 Osprey aircraft, 58th Training Squadron, performs a training mission last year at Kirtland Air Force Base, NM.

U.S. Air Force photo by Staff Sgt. Matthew Hannen

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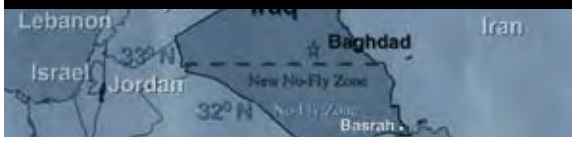

When Will It End?

The pendulum swing continues. Last year when we went to I/ITSEC (Interservice/Industry, Training, Simulation & Education Conference), we reported on the dramatic swing to the utilization of commercial-grade hardware. If I were to guess, last year more than 60 percent of the computer hardware was PC-based. This year I estimate the number at more than 80 percent.

I may be getting ahead of myself. This is the fifth year that our editorial team attended I/ITSEC, so we're in a pretty good position to notice year-to-year changes. Unlike the military markets covered by the big hardware shows our team attends, simulation and training is an end-use segment of the embedded military market that has strong ties to the commercial market. That raises many issues. If the only thing you were able to look at was the hardware under the tables or behind the cabinets, you'd think that I/ITSEC was a Dell showroom. Multiple desktop PCs or laptops drove many if not most of the demos. And anything that multiple Dell PCs couldn't cope with was driven by racks of embedded PCs or very high-end, expensive gaming computers.

Several decades ago it was the Space Race that pushed the development of the computer industry. Now it's the commercial gaming market pushing the computer industry. Everything in simulation is now true real time. The graphics are unbelievable—I even saw an enormous flat screen display with a resolution four times greater than the current 1080p HD sets on the market. The question in my mind is how much is too much for a training and simulation system? The commercial gaming industry can find a market for simulation and graphics that allows, for example, a player to count the eye lashes of the game's villainess. That depth of resolution isn't really necessary for an effective realistic military simulator or trainer.

When I step back and analyze this market from ten thousand feet—using this conference as the yardstick—it seems to me that most vendors at I/ITSEC were really offering different ways to skin a cat. Some people focused on fat cats, some were experts in spotted cats. Some could do a down and dirty job, while others were like brain surgeons. That's not unusual, we do the same thing in the embedded computer market. But like the embedded computer market, it does leave itself open to consolidation.

One thing I was shown at the conference that caught my interest was very basic in concept, but seemed to me a very clever idea. Those of you who have served on the line in the military will be very familiar with this scenario: You have hours of boredom interrupted with minutes of shear terror with an explosion of adrenalin. At the Future Combat Systems (FCS) display, I met with Gordon Sayre, a division manager with SAIC. Gordon gave me a rundown of what they were providing in the way of simulation and training equipment for FCS. He mentioned that they were proposing the inclusion of a feature on the deliverable systems that would allow the FCS vehicles to be used in a training mode when not on actual missions. FCS platforms are already envisioned to function as remote terminals that can be networked with each other and to all the levels of the control functions. As a result, the onboard computing can be used to do very realistic training while stationed in extremely remote front line positions, eliminating the need to take operators out of the combat zone for brushups. Such embedded training also provides a productive way to spend those hours of boredom.

Like all pendulums, the swing eventually has to stop and change direction. The question now is, is the market expansion of the simulation market close to its maximum swing? The gaming market is outpacing the performance needs of the military simulation and training market. As a consequence, military training and simulation market suppliers are focusing their product development on fast-paced, short-lived gaming and PC building blocks. And many of this market's suppliers' products are offering very similar solutions. There are just too many things hanging over this market that will force a change in the near future—all of which were more evident at this year's show. Will the suppliers start to produce products with more performance than the military wants? Will the rapid obsolescence of building blocks produce unacceptable alternatives for the military? And will the military's purchasing requirements for simulators and trainers support the expanding supplier base? These are all questions that will keep marketing people and purchasing agencies busy over the next year.

Something more personal: We at *COTS Journal* and the entire RTC Group want to wish you happy holidays and a healthy and prosperous New Year. With all the things that will be in play next year, 2008 is sure to bring change, and if history repeats itself this will be good for the embedded electronics market. We look forward to your continuing support and comments. They keep us on our toes, and help us provide what you want. ■■

Pete Yeatman, Publisher
COTS Journal

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COTS Journal

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The Inside Track

CymSTAR Selects Quantum3D KC-10 BOT Programs

CymSTAR—a firm specializing in training device development, concurrency modification and technology upgrades—has selected the Quantum3D Independence IDX 3000 COTS Image Generator (IG) Solutions, GeoScapeSE COTS Synthetic Environments and Facets COTS Realtime 3D Models for upgrades of the U.S. Air Force KC-10 (Figure 1) Boom Operator Trainer (BOT) program.

CymSTAR was awarded contracts by the U.S. Air Force (USAF) to upgrade KC-10 BOTs located at Travis and McGuire Air Force Bases and improve the capabilities, supportability and maintainability of the air-refueling training devices. CymSTAR purchased the IDX 3000 IGs, which provide host-controllable advanced weather effects, 3D ocean with reflections and real-time lighting and dynamic shadows, along with GeoScapeSE Synthetic Environments and Facets Realtime 3D Models, to enhance the realism and improve device fidelity for increased training effectiveness of the BOT simulators.

Figure 1

Shown here a KC-10 Extender connects to a second KC-10 over Iraq. The refueling maneuver allowed the connecting KC-10 from the 380th Air Expeditionary Wing to offload more fuel for coalition aircraft missions in the area. A KC-10 can carry as much as 55,385 gallons of fuel.

The KC-10 BOT devices were recently accepted by the USAF and placed into training service this month. Effective training is of vital importance because aerial refueling is a dangerous operation between two aircraft and tons of jet fuel conducted day and night in all kinds of weather. Enhancing the fidelity of the training solution for KC-10 boom operators helps improve the safety and efficiency of this mission-critical activity.

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

Saft to Provide Li-ion Batteries for Navy Tango Bravo Program

Saft has received a new order from General Dynamics Electric Boat to supply lithium-ion (Li-ion) batteries to serve as a high-power stored energy system for an external electric actuator designed to operate submarine steering and diving planes. This actuator was designed and tested by Electric Boat in Phase 1 of the Tango Bravo program, which is jointly sponsored by the Defense Advanced Research Project Agency (DARPA) and the Navy.

The Tango Bravo program is focused on developing advanced technologies that meet stringent submarine performance requirements while reducing ship-acquisition and life cycle costs. This element of the Tango Bravo program aims to replace hydraulics with electric actuators. The steering and diving actuators can operate normally on ship service power, but require a compact stored energy system that provides surge power under peak load conditions and also serves as an "uninterruptible power supply" if ship service power is not available. Li-ion batteries have very low internal impedance and high electrochemical potential (up to 4.2V per cell) enabling efficient energy storage in a compact form.

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

L-3 Coleman Aerospace to Build Target for Arrow Interceptor Program

L-3 Coleman Aerospace, a division of L-3 Communications, announced that it has been tasked by the U.S. Air Force for a Short Range Air Launch Target (SRALT). Coleman Aerospace will provide one launch vehicle as well as mission management services in support of the Arrow System Improvement Program (Figure 2). The award is being made under the Sounding Rockets Program 2 (SRP-2), which is managed by the Space and Missile Systems Center (SMC), Space Development and Test Wing. The contract will be performed over a 20-month period.

Figure 2

An Arrow anti-ballistic missile is launched as part of the on going United States/Israel Arrow System Improvement Program (ASIP).

L-3 Coleman Aerospace will design, build and test the SRALT at its facility in Orlando, Florida. SRALT was developed by L-3 as a target for realistic testing of the Missile Defense Agency's

Ballistic Missile Defense System (BMDS). The advantage of SRALT is that it uses air launch as a method to relieve the test constraints imposed by fixed ground launch sites. Coleman Aerospace has been 100% successful in previous SRALT launches for the Arrow program.

L-3 Coleman Aerospace
Orlando, FL.
(407) 354-0047.
[www.coleman-aerospace.com].

Lockheed Martin and Parvus Ink Deal for F-22 CNI Battery

Parvus Corporation has signed an agreement with Lockheed Martin Aeronautics Company (Fort Worth, TX) to build 185 smart battery units for the F-22 Raptor's Communications, Navigation and Identification (CNI) system. This CNI battery provides redundant, fail-safe power in all situations to critical encryption/decryption

Figure 3

Shown here are the two first F-22A Raptors assigned last year to the 94th Fighter Squadron as they move into the Langley Air Force Base pattern.

equipment on board the F-22 (Figure 3) aircraft. This $3.56 million agreement covers retrofit, new production and spare quantities required by the F-22 program through 2010.

This production agreement follows a $1.6 million prototype development contract awarded last year, 10 months of accelerated engineering efforts by Parvus, and six months of successful flight tests on board the F-22 aircraft. The final design has exceeded Lockheed's specifications and performed without any failures or maintenance during flight tests. Due to this highly reliable and robust design, the CNI power subsystem is expected to save hundreds of man-hours per month of maintenance time. Earlier this month, Parvus also received orders for the next lots of an Inline Lightning Filter (ILF) and Input Voltage Limiter (IVL) device also developed and manufactured for the F-22 program.

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

RTI Teams with Northrop Grumman on Tactical Data Link Effort

Real-Time Innovations (RTI) has announced its collaboration with Northrop Grumman Corporation to develop a Data Distribution Service (DDS)-compliant interface to the Common Link Integration Processing (CLIP) system. CLIP enables the exchange of information between Air Force and Navy platforms that natively support incompatible tactical data links (TDLs). CLIP also provides TDL processing for platforms that do not currently have a data link, by bridging the legacy host mission computer's software to the new TDL radio/terminal. DDS provides a standards-compliant mechanism for accessing data using commercial off-the-shelf DDS software, which is already broadly used within defense systems.

CLIP solves interoperability problems by providing a common interface for multiple TDLs and a bridge so legacy platforms can connect to the standard Internet Protocol (IP)-based systems. CLIP's common TDL software greatly reduces platform-development and lifecycle-maintenance costs. When deployed, CLIP makes it possible for defense systems to seamlessly communicate with one another and with the aggregated data-analysis and display systems, thus enabling integration with the Global Information Grid.

DDS provides a network-centric interface to CLIP, easing integration of new and legacy TDLs. The interface also complies with Net-Centric Enterprise Solutions for Interoperability (NESI) guidelines, ensuring best practices for DDS use in open-architecture environments. The DDS interface was developed by a collaborative team of engineers from RTI and Northrop Grumman using RTI Data Distribution Service, RTI's DDS-compliant middleware.

Real-Time Innovations
Santa Clara, CA.
(408) 200-4700.
[www.rti.com].

BAE Systems Gets Contract to Reset Bradley Fighting Vehicles

BAE Systems has been awarded a contract modification from the U.S. Army TACOM Life Cycle Management Command, totaling $709.4 million, for the reset of Bradley Fighting Vehicles (Figure 4) and associated components. This modification represents the largest national level reset award for Bradley Combat Systems to date. When combined with an earlier award of $234 million for long lead materials

Figure 4

Soldiers from the 2nd Brigade Combat Team, 2nd Infantry Division drive a Bradley Fighting Vehicle to an assembly area in east Baghdad earlier this year.

and the option worth $57 million, this effort represents over $1 billion for the reset of Bradley Fighting Vehicles.

Under the base contract, BAE Systems will reset 1,042 Bradley A3 and ODS Combat Systems returning from Iraq and reset additional A3 components. The contract also carries an option for an additional 58 vehicles. Vehicles that undergo the reset process not only have their useful life restored that was consumed during combat operations, they also receive the latest survivability enhancements and other improvements to greater protect our soldiers in future conflicts. Vehicle deliveries under this contract are scheduled to begin in June 2008 and continue through June 2009, while resetting the components will begin in this month and continue through December 2008.

BAE Systems
Rockville, MD.
(301)838-6000.
[www.baesystems.com].

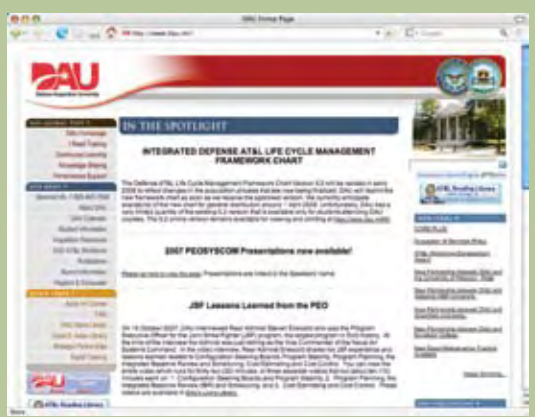
COTS Websites

www.dau.mil

DAU Site Is Gateway to Defense Acquisition Education

The Defense Acquisition University (DAU) is a United States military training establishment that trains and enables military and civilian Department of Defense personnel in the fields of Acquisition, Technology and Logistics, including Leadership and Program Management. The mission of the DAU is to provide practitioner training, career management and services to enable the AT&L community to make smart business decisions and deliver timely and affordable capabilities to the warfighter.

The DAU vision is to enable the AT&L workforce to achieve the right acquisition outcomes. It has five regional campuses located throughout the United States: Fort Belvoir, Virginia; Huntsville, Alabama; San Diego, California; California, Maryland; and Kettering, Ohio. DAU serves the 128,242 members of the DoD Acquisition, Technology and Logistics workforce, and their DoD industry counterparts. DAU has a variety of online resources available. These online resources let users apply for a course, take a continuous learning module for continuous learning credit, research policy and other documents, link to related learning and knowledge content, ask a professor a question, contribute knowledge objects—such as lessons learned, best practices, templates, or samples—or collaborate with peers on work issues.



Defense Acquisition University
Fort Belvoir, VA. (800) 845-7606.
[www.dau.mil].

Special Feature

High-Performance Processor Boards

High-Performance CPU Boards Strike a Tricky Balance of Tradeoffs

The future of embedded military multicomputing will be shaped by switched fabrics, high-speed data paths, multicore processors and increased pressures to reduce "SwaP."

Mark L. Littlefield, Product Manager, FPGA-Based Products and
Ian Stalker, Product Manager, Advanced MultiComputing
Curtiss-Wright Controls Embedded Computing

The future of embedded military multicomputing will be defined by several trends affecting developers and system integrators who work in applications such as airborne SIGINT and COMINT, and airborne and shipborne radar, as well as those targeting large programs such as Future Combat Systems (Figure 1). These trends include the increased use of switched fabrics, such as Serial RapidIO (SRIO), and the continued use of alternate high-speed serial data paths. In addition, the adoption and growth of multicore processors; increased pressures to reduce size, weight and power (SWaP); and increased pressures for faster development and system integration will shape the future of military multicomputing.

Figure 1

Programs such as Future Combat Systems (FCS) are exemplifying a number of trends in future military embedded computing. These trends include the increased use of switched fabrics; multicore processors; increased pressures to reduce size, weight and power (SWaP); and increased pressures for faster development. Shown here is a graphical representation of the Non-Line of Sight Cannon (NLOS-C), an indirect fire support component of FCS.

Fabrics Gain Acceptance

Switched fabrics have been generally accepted by the military multicomputing community. Increasingly developers and integrators are choosing to use switch fabrics in new projects, and that trend can be expected to continue. The current crop of switched fabrics—SRIO at 3.125 Gbits/s with four lanes and PCI Express (PCIe) at 2 Gbits/s with four or eight lanes—appears to be adequate for all but the most demanding applications. The next speed bump for SRIO will be 6.25 Gbits/s. PCIe will first move to 5 Gbits/s in rev 2.0 and later to 5 Gbits/s in rev 3.0, which will actually double the rev 2.0 speed since it will employ a more efficient encoding scheme.

For now and the foreseeable future, many high-performance military systems will be able to take advantage of SRIO. Serial RapidIO has a number of advantages over alternatives such as PCIe and Aurora. For instance, PCIe, with roots in desktop PCs, was designed primarily as a host CPU and I/O solution. In contrast, SRIO was designed to support peer-to-peer multiprocessing systems. Compared to PCIe, SRIO has relatively low overheads and an addressing scheme that supports up to 64K endpoints, versus PCIe's more confining flat memory model. Its other advantages include reliable transport, built-in message passing and multicast support.

The need to accommodate high-speed sensor I/O will continue to increase. There may be another speed bump for I/O solutions like Serial Front-Panel Data Port (S-FPDP). But it's highly likely that military integrators and developers will instead turn more to Aurora-based serial connections. 10 Gbit Ethernet (XAUI) will also start to play a larger role. Like FPDP, S-FPDP and Fibre Channel before them, these newer connections are likely to be used as inputs from sensors. A technology to watch as a potential backplane interconnect is 10 Gbit Ethernet, but implementations today are burdened with high-power offload engines and switches and the lack of determinism caused by the lack of guaranteed packet delivery.

Multicore Processors

There's little doubt that the most important trend facing military multicomputing is the rise of multicore processors. Even though this technology is basically another way of achieving what's been done previously via multiprocessing and multithreaded programming, its multicore solutions promise dramatic increases in processing density.

High-performance communications middleware will continue to serve developers dealing with multicore processors in a role similar to that of which it has played for multiprocessing systems. This middleware can ease the distribution of data and/or tasks across the multicore multicomputer. It lets multiple processors—on separate chips or on the same chip—communicate with each other, while abstracting that process away from the developer. This improves developer productivity while also ensuring highly efficient processing. There are a number of options for such communications middleware, both proprietary and standardized. Examples include the RTI Data Distribution Service from Real Time Innovations and Curtiss-Wright's Continuum IPC.

Pressure to Reduce SWaP

While the trend to reduce SWaP is not new, it can be expected to continue for the foreseeable future. One consequence of this trend is the wider adoption of heterogeneous, or "hybrid," systems based on combinations of general-purpose processors with FPGAs and/or DSPs.

FPGAs have been used for some time in the front end of a signal- or image-processing chain. However, in this role they were usually considered to be part of the sensor system and were not tightly linked to later stages of processing. In addition, FPGAs were likely to be custom hardware designs. In the future, the FPGAs in signal- or image-processing systems will become more of a flexible processing element that will be more tightly linked to the later, microprocessor-based stages of processing. The main role of FPGAs will be to accelerate certain computationally intensive portions of an application.

Both of the above situations will require software tools and infrastructure to make the integration of FPGAs and general-purpose processors easy and efficient. An example of this trend is the recent developments by Intel and AMD to integrate FPGAs more tightly with the microprocessor. Intel's QuickAssist and AMD's Torrenza/Direct Connect Architecture both provide high-performance microprocessor-FPGA connectivity with advanced software tools and communications infrastructures. Both offer the potential of dramatically accelerated algorithms with only modest development investment.

Perhaps the most important part of the SWaP equation for military applications is processing performance per watt consumed (Figure 2). There are multiple ways of increasing this measure of efficiency, but one that stands out is the higher integration possible with the latest Power Architecture (also known as PowerPC) microprocessors, such as P.A. Semi's PWRficient dual-core PA6T-1682 processors.

Each of these chips integrates two processor cores—each with a VMX vector unit (Altivec compatible), DDR2 memory controllers, a 2 Mbyte L2 cache and a flexible I/O subsystem—and runs at speeds of up to 2 GHz per core. The chip's I/O includes high-speed PCIe, 10 Gigabit Ethernet (XAUI) and Gigabit Ethernet (SGMII) serial interfaces. It incorporates multiple advanced power management techniques, including the ability to dynamically adjust power supply voltage and clock rates in order to minimize power consumption as operating conditions dictate. The P.A. Semi part is anticipated to provide at least twice the performance per watt of existing Power Architecture 7448 and 8641 designs (Figure 3).

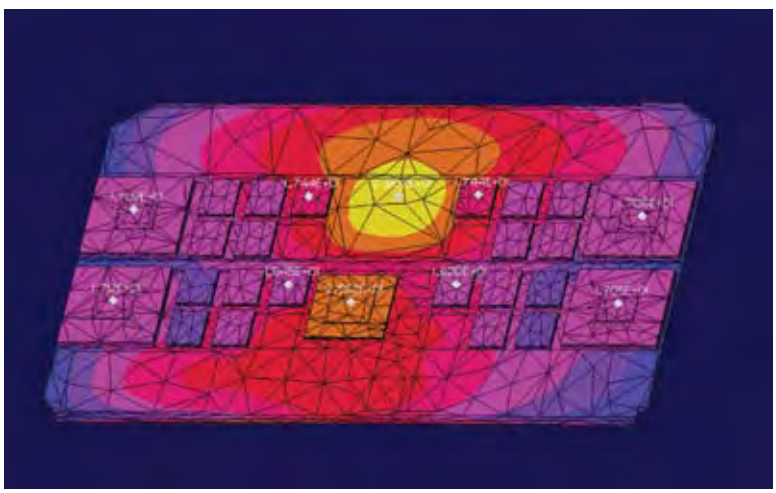


Figure 2

High-performance embedded computer designs depend on achieving the optimum balance of performance, functional density and power consumption. Advanced thermal modeling techniques allow designers to analyze the tradeoffs among these three goals. The use of low-power processors such as those from P.A Semi and the use of FPGAs as processors are allowing big advances in the critical performance/watt benchmark.

Figure 3

Curtiss-Wright's CHAMP-AV5 multiprocessing board combines two dual-core PA6T-1682 processors from PA Semi with a Xilinx Virtex-5 FPGA to let applications take advantage of the strengths of each. It delivers up to 64 Gflops of low-power performance and features input voltage and current sensors for measuring power consumption.

Shorter Development Cycles

Finally, development cycles for many high-performance military systems have been greatly reduced, sometimes to as short as only a few months. The net result is that military integrators will increasingly turn to commercial off-the-shelf technology and products for solutions. Developers and integrators in military markets simply cannot expect to develop their own processing and I/O platforms while also meeting these shrunken time-to-deployment pressures.

As these pressures mount, commercial board and subsystem vendors will also be asked to provide much more in the way of tools and software infrastructure, such as middleware, to speed system integration and multiprocessor application development even more. For instance, a communications middleware that easily integrates processors, FPGAs and I/O devices is likely to be more attractive to an integrator than one that is only processor-based.

Another element that is likely to be attacked is the MATLAB/target gap. Today, scientists and military developers use MathWork's MATLAB to design their algorithms. The kernels are then often integrated into a system by systems engineers using MathWork's Simulink simulation and model-based design tool. At that point, however, algorithms and system description are given to a system development team as documentation. This team must then recreate the algorithms and system from scratch using the target hardware development tools. Not only is this a fairly inefficient development path, but the lack of any target hardware knowledge in the MATLAB and Simulink stages means that this process must sometimes be reiterated before the system can meet its performance goals.

One method for bridging this gap would be to provide a way to move directly from the Simulink design to efficient microprocessor code and FPGA bitstreams. If, in addition, some sense of the hardware architecture could be driven into the system design phase to constrain that design to match the limitations and peculiarities of the target hardware, a dramatically shortened design cycle would be the likely result. ■■

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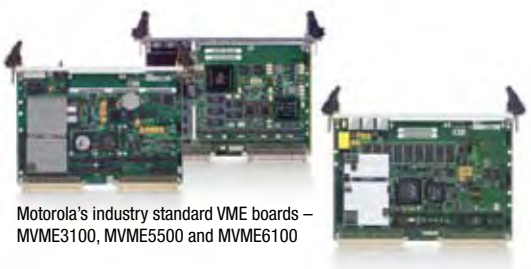

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Special Feature

High-Performance Processor Boards

Compromise Has its Place in Military Board-Level Processing

Applications like radar processing are hungry for high-performance computing. But raw performance must be weighed against other factors when making design choices.

Michael Stern, Product Manager
GE Fanuc Intelligent Platforms

In the world of military embedded computing, high performance—in terms of the ability to process the required amount of data in the shortest possible time—is a given. But raw processing performance does not exist in a vacuum: it may be an important requirement, but it is seldom, if ever, the only one. The art is to find the compromise that satisfies not only the performance requirements, but all of the other requirements also.

Take, as an example, a processor board to be designed for demanding radar, sonar and signal processing that will be deployed as part of a mobile platform—whether an air-transportable platform, or integrated within a jet fighter, a helicopter or an unmanned aerial vehicle (UAV). The nature of the application—detecting and identifying a threat—requires the elapsed time from input to output to be measurable in perhaps microseconds if appropriate evasive action is to be taken: performance here is, literally, a matter of life and death. Along those lines, MEADS (Medium Extended Air Defense System) (Figure 1) is typical of a demanding radar processing application.

Complicating matters, the environment or application planned for the board could involve a substantial legacy investment in software and in working within an existing software paradigm. Moving outside that paradigm involves not only additional cost, but delayed time-to-market. Beyond that, deployment parameters in terms of size, weight, power and heat are key factors.

Figure 1

MEADS includes a lightweight launcher, 360-degree fire control and surveillance radars, and plug-and-fight battle management command and control abilities.

Conflicting Factors

Designing a new high-performance processor board, therefore, involves making trade-offs between vectors that are often conflicting. Notching up raw performance invariably notches up power consumption and heat dissipation—possibly making the solution non-viable for the intended application. Proprietary silicon may seem to have performance advantages over off-the-shelf silicon, but if there is minimal software infrastructure to support it, how long will it take before the solution is deployable?

Consider for example a new processor board being designed for radar processing. The overall system architecture will be as in Figure 2. At the front end are analog to digital converters and digital to analog converters, responsible for sending and receiving the radar signal. The FPGA takes the raw received data and performs first pass processing on huge amounts of raw data perhaps collected from a 360 degree sweep. Its job is to significantly reduce the amount of data through a rapid characterization process, eliminating data that is obviously

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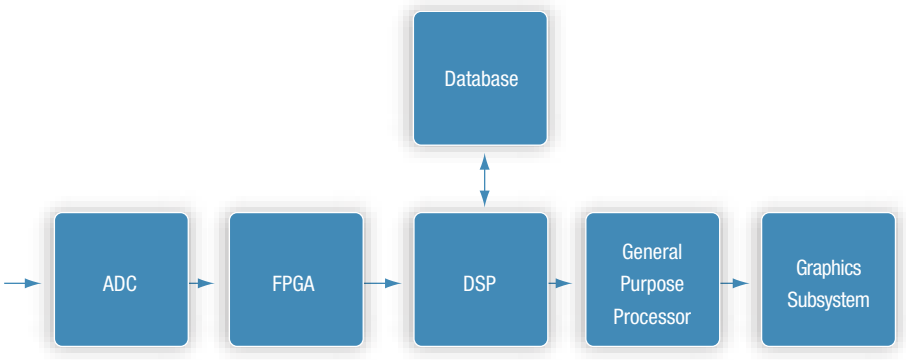

Figure 2

This processor board design for radar processing has, at the front end, analog to digital converters and digital to analog converters. They are responsible for sending and receiving the radar signal. The FPGA takes the raw received data and performs first pass processing on huge amounts of raw data, and passes data of interest through to the DSP.

extraneous—such as noise, clouds, birds and so on—and to pass data of interest through to the DSP.

Here, the incoming data is more closely scrutinized, sophisticated algorithms turning it into data that can be compared with information held in a database that will allow the threat to be precisely identified. Next, this data is passed to a general-purpose processor to determine possible courses of action. A likely final stage is output to some form of graphics processing subsystem for operator display.

The design of the board will comprehend the fact that expertise already exists—and probably extensive investment—in developing radar front-end processing and in developing sophisticated algorithms for a specific FPGA architecture. The task of the processor board, therefore, is to accept the input from the FPGA, process it and output it to the operator station.

Choosing DSP Silicon

The first design decision becomes, therefore, which DSP silicon to use on the board? There are a number of alternatives, including, for example, the SHARC family or the C6 family from Texas Instruments. Performance of the DSP at this stage of the processing cycle is, of course, a key concern. On the other hand, it may be more important to leverage the existing expertise and investment in the PowerPC AltiVec vector processing engine. Do the alternatives to the AltiVec engine offer a sufficiently compelling raw performance advantage that would justify developing new expertise?

Like many decisions in designing a new, high-performance processor board, this is one that cannot be made in isolation. Choosing the AltiVec engine for digital signal processing operations implies choosing the PowerPC architecture over alternative processor architectures. In the military embedded computing market, the PowerPC architecture has enjoyed substantial success, and there is widespread familiarity and comfort with, and confidence in, the PowerPC.

All that said, the Intel alternative needs to be evaluated, not least because of Intel's increasing commitment to the world of embedded computing, not to mention the processing power of the dual core CPUs that are available, with compatible quad core CPUs not far down the track. The vector processing available

from Intel's processors also compares favorably with that which is available from the AltiVec engine.

Market acceptance of the PowerPC/AltiVec architecture is, however, compelling, and this together with the huge code base, software infrastructure and developer expertise that supports it, are all factors that will have at least as much impact in the development and deployment cycle as raw processing power. It is easy to forget that, typically, investment in software hugely exceeds any investment in hardware. Furthermore, careful analysis indicates that the performance requirements of the intended application can be more than met: as such, while absolute performance could perhaps be improved, the available performance is sufficient—and the architectural and silicon choices bring with them significant cost, time-to-market, long-term support and deployability advantages.

Even better: while there are possible advantages in implementing DSP and general-purpose processing silicon as discrete elements, the PowerPC/AltiVec architecture provides a unified environment blessed with a plethora of operating systems. LynxOS, VxWorks and Integrity are three such examples, along with tools such as GE Fanuc Intelligent Platforms' AXIS multiprocessor development capability. The development effort is thus integrated and harmonized, resulting in reduced time-to-market.

Selecting the Right Interconnect

After selecting the processing node architecture for the board, the next decision to make is how to interconnect them, and choosing the silicon that implements that interconnect. There is little point in having the processing power available bottlenecked by the interconnect implementation. The obvious choice is, of course, serial switched fabric, but which?

Decisions about the design of a new board until now have taken market acceptability strongly into account. Following that course, Gbit Ethernet, with its widespread deployment, could be seen as the primary contender for the node interconnect strategy. But Gbit Ethernet comes with a hefty performance penalty, given the requirement for a TCP/IP stack to be resident on each node. Market acceptance would also require consideration of the ubiquitous PCI Ex-

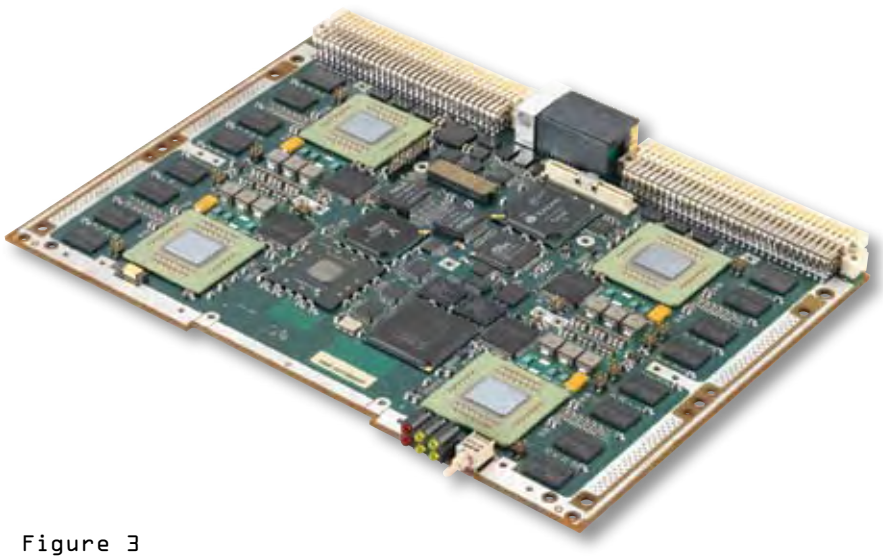

Figure 3

GE Fanuc's DSP220 is a 6U VXS (VITA 41.2) quad 8641/8641D multicomputer with four single or dual core Freescale PowerPC 8641 system-on-chip nodes and a VITA 42.2-compliant XMC slot. The board is available in six ruggedization levels.

press. That said, the type of application under consideration—demanding radar processing—is typically a highly scalable application, with some customers either running or planning to run up to 80 nodes. PCI Express, for all its virtues, does not scale easily.

With those drawbacks of Ethernet and PCIe in mind, Serial RapidIO stands out as the best alternative. It has gained traction in the military market and it is high-performance—higher performance than either PCI Express or Gbit Ethernet. It has the intelligence and determinism necessary to ensure correct routing but without, for example, the overhead of Ethernet, and it is inherently scalable. Even better, Serial RapidIO is a natural partner for the PowerPC architecture, given the 8641's support for an on-chip end point. Now, the search for appropriate Serial RapidIO silicon begins. There are contenders, some with potential advantages: the IDT switch, for example, features ten ports where the Tundra Tsi-578 features only eight. But for the planned application, eight is enough.

Real-World Applications

In summary, it's vital to consider carefully the design decisions that are central to the performance of a new board design. First and foremost, it takes the processing requirements of the target application as its primary goal, and ensures these can be met and perhaps even exceeded. Second, and no less importantly, it's critical to consider the real world in which today's military embedded computing operates, a world that operates within many severe constraints—not the least of which are financial and physical. And third, it's important that the board can be supported over the long term, which is typical of today's military programs. An example of a board meeting those criteria is the GE Fanuc Embedded Systems DSP220 (Figure 3).

The design of today's high-performance processor board is inevitably a compromise—but that's not a bad thing. Higher performance could unquestionably be achieved—either with alternative off-the-shelf silicon or with proprietary silicon—but at the cost of unacceptable compromises in deployability, compromises in time-to-market and compromises in long-term support. Few, if any end users will object to theoretical compromises in performance—especially where performance is more than good enough—when they gain so much else. Compromise can be a good thing—it's only inappropriate compromises that are a bad thing. ▮▮

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Form-Factor Choices Expand for High-Density Computing

Where once VME was the only game in town, a variety of embedded computing form-factors have emerged suited to high-density military computing needs.

Tom Roberts, Product Marketing Manager
Mercury Computer Systems

Defense electronics applications, especially those based on signal and image processing, are consistent in demanding ever increasing levels of processing density. The total processing requirement varies greatly across applications, while the space available is dictated largely by the platform. A missile cruiser, a fighter aircraft and a small UAV all present different design constraints. Regardless of their differences, all of these applications are similar in requiring more processing to drive the next generation of solutions.

For these applications, processing density means more than just compute cycles, though packing more GFLOPS in a small space is important. To maximize system performance, the available compute cycles must be matched by available bandwidth, both I/O bandwidth and, for multiprocessor systems, bandwidth between processors. Balance is essential.

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Figure 1

Embedded industry vendors have created embedded computing systems based on VXS, VPX-REDI, ATCA and (soon) MicroTCA, all capable of high-density computing. The montage shows (left to right) the Ensemble ATCA platform, the VXS-based PowerStream 6100 system and the VPX-REDI conduction-cooled PowerStream 6600 system.

A series of positive steps have resulted in a situation where the embedded industry can choose solutions based on several viable standards. Vendors have created embedded computer systems based on VXS, VPX-REDI, ATCA and (soon) MicroTCA, all capable of high-density computing (Figure 1).

Building on Past Success

For 25 years, the VME architecture defined military embedded systems that met the demand for increases in computing and connectivity. Successive generations of new processors provided more and more compute cycles, while VME bandwidth evolved in a similar fashion from 40 Mbytes/s on the original VMEbus to 80 Mbytes/s, then 160 Mbytes/s and fi-

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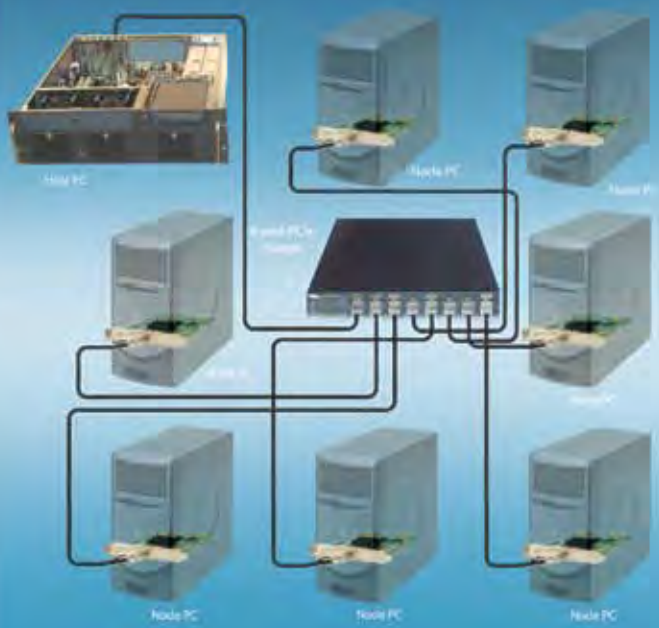

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Different Form-Factors, Different Advantages

VXS	Backward compatibility to VME, initial level of ruggedness
VPX-REDI	Enhanced ruggedization and cooling, 2 level maintenance
ATCA	Lower cost, enhanced processing and I/O flexibility
MicroTCA	Lowest cost, scalable, smaller form-factor (rugged potential)

Table 1

These four form-factors are all capable of supporting high-density computing, but each has certain advantages. Decision factors include the level of backward compatibility needed, the environmental restrictions, size and cost constraints.

nally 320 Mbytes/s on 2eSST. Some vendors developed switch fabrics, like Mercury Computer Systems' RACE++, which were implemented over the user-defined P2 pins on the VME connector.

VME was also proven to be flexible in supporting a range of system sizes and many levels of ruggedization. In its familiar 6U form-factor, VME found its way into small 6-slot chassis and large 21-slot systems, as well as a great many ATR and ½ ATR configurations. VME systems were created with environmental specifications running the gamut from benign commercial to fully military-grade rugged, although the industry did suffer from an absence of any ruggedization standards.

A few years ago, after an incredibly long run, the VME connector finally ran out of gas. It simply wasn't possible to coax out any more bandwidth, while processors continued to get faster. Innovations were needed to meet the need for balanced systems with ever greater processing density. In a manner that reflects well on the maturity of the embedded industry, standards bodies have stepped up and created several choices, each capable of supporting high-density computing but with areas of unique strength. Systems architects and designers can compare potential solutions based on different standards and choose the option that best meets an applications' specific need.

VITA (VMEbus Industry Trade Association) has created two of these options, embodied in the VXS (VITA 41) and VPX-REDI (VITA 46 and VITA 48) standards. Meanwhile, PICMG (PCI Industrial Computer Manufacturers Group) has created two others, AdvancedTCA (ATCA) and MicroTCA.

Of the two VITA standards, VXS offers the greatest similarity to traditional VME. VXS retains the P1 and P2 connectors of VME64, but adds an improved P0 connector that supports modern multi-GHz serial switch fabrics like RapidIO. With a VXS backplane, system engineers can carry forward

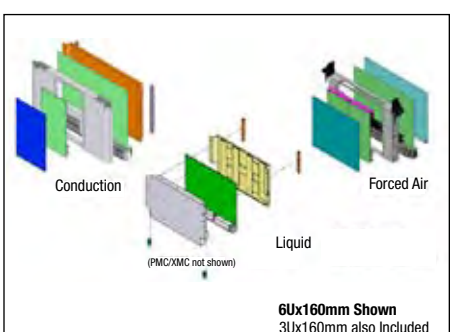

Figure 2

The REDI (VITA 48) standard supports higher slot power budgets, enhanced ruggedization and an array of open-standard cooling methodologies, including traditional forced air, air flow through, liquid flow through and conduction.

VME64 cards without the need for a hybrid backplane.

Two VXS Card Types

The VXS base specification describes two types of cards—payload and switch—and a corresponding backplane slot for each. A VXS payload card follows the basic construct of a 6U VME64 card with an added high-density, high-speed P0 connector and corresponding alignment and keying features. Each payload board supports up to two serial ports. Payload cards can support processors and/or mezzanine cards. Using mezzanine cards for I/O increases system flexibility, as the market provides many choices, which can be changed over the life of a system.

A VXS switch card, a new design, is architected to provide an aggregation point for serial fabric connections, and uses multiple high-speed differential signaling connectors to provide the necessary high-speed pins. Switch cards also have an enhanced power connector and a user-defined I/O connector.

Backward compatibility with VME64 is an important characteristic of VXS. Payload slots are fully compatible with existing VME64 cards that do not contain a P0 connector. For a pre-VXS VME64 card installed into a VXS slot, the VME64 connectors P1 and P2 on the payload card simply mate into the backplane normally, and the backplane J0 does not interfere or make contact with the card.

Like its VME64 predecessor, a 6U VXS payload card can easily be configured with four processors. With the additional bandwidth capacity of the VXS P0 connector, typically two full-duplex links at 1 Gbyte/s, VXS is well able to support generations of balanced, high-density computing.

While VXS offers increased power inlet capability, it makes no changes to cooling and offers no increased thermal removal methods beyond the conventional VME64 slot configuration. VXS slots maintain the same 0.8-inch pitch as with VME64, and are designed for cooling via forced-air convection methods. As with VME, the 6U form factor lends itself to adding a certain level of ruggedness to VXS.

Examples of high-density processing with VXS exist at both the system and module levels. The PowerStream 6100 system scales up to deliver 756 GFLOPS in a 19-inch rack-mountable system, which definitely qualifies as high-density processing. A modular single board computer, the VPA-200 can be configured into many kinds of VXS systems; it has two PowerPC 7448 processors and two PMC-X sites for high-speed I/O, all in a 6U card.

VPX-REDI: Ground-Up Rethink

Unlike VXS, VPX is a ground-up redesign of the chassis backplane. VPX replaces the legacy VME connectors entirely with new multi-GHz connectors. These new connectors have much greater I/O pin capacity, enabling VPX systems to achieve more than 5 Gbytes per second using today's fabric speeds. A VPX backplane enables inter-slot data transfer via a fabric interface without the use of a central switch card.

When teamed up with the REDI standard (VITA 48), the result is truly revolutionary, supporting higher slot power budgets, enhanced ruggedization and an array of open-standard cooling methodologies: traditional forced air, air flow through, liquid flow through and conduction (Figure 2). The fusion of VITA 46 and 48 standards is popularly termed VPX-REDI.

REDI standardizes features in the mechanical and thermal domain to build upon IEEE 1101's deployability in harsh environments and provides a configuration level that is mechanically compatible with VPX modules. In addition to supporting multiple cooling methods, VPX-REDI modules introduce industry-standard enhancements such as compatibility with two-level maintenance (2LM) plus wider module and backplane slot pitch. At a functional level, 2LM enables relatively unskilled maintenance personnel to replace a failed module and restore the system to an operational state in a limited time period. 2LM also reduces logistical costs for deployed systems as sparing is done at the module rather than the chassis level.

While it sacrifices backward compatibility to VME64 solutions, VPX-REDI supports very high-density computing in very rugged systems. Current examples of VPX-REDI systems include the conduction-cooled PowerStream 6600; its 16 payload modules can house 64 Power Architecture processors. Alternatively, the system can be configured with a heterogeneous mix of Power Architecture processors and Xilinx Virtex-4 FPGAs. With four Power Architecture processors, the system still has capacity for 21 user-programmable FPGAs.

AdvancedTCA (ATCA)

With its genesis in the telecommunications industry, the Advanced Telecom Computing Architecture (ATCA) PICMG standard was conceived to offer a carrier-grade-based system infrastructure (Figure 3). Lowering system costs was a goal; by opening the platform's design to any supplier, it was hoped the competitive market forces would drive costs down. In addition, once the platform was standards-based, any system developer or integrator could take advantage of processing components

(called "blades") that come from a wide variety of sources.

Performance was also an ATCA goal. ATCA addresses the requirements of high-performance, high-bandwidth, low-latency telecommunications applications with both I/O capacity and computational power. ATCA defines a fabric-agnostic backplane that supports many different fabrics, including 1 and 10 Gbit Ethernet and serial RapidIO, among others.

ATCA board form-factors and architecture allow for an unprecedented amount of I/O connections for front and rear panels. The carrier blades at the front panel allow for optical or other types of I/O connections on both sides to bring data in and out, while the rear transition modules (RTMs) form-factor provides a large amount of physical space for I/O connections from the rear.

Diverse Processor Types Coexisting

The ATCA architecture is very flexible as to the types of processors that can co-exist in the system. An AdvancedMC mezzanine module (AMC)—which connects to a carrier blade—can contain processing modules of very different natures; for example, processors of one type, or processors of the same family. The AMC concept allows for the creation of highly specialized compute engines for particular applications. And, if application requirements change, the old AMC can be removed from the carrier blade and a new AMC can be connected that has different processing modules that match the application's needs. AMCs provide the flexibility to process the data and to match it to the application's data needs.

Easily configured ATCA systems deliver high-density processing in a variety of system sizes. Mercury's Ensemble ATCA systems are available in off-the-shelf 2-slot, 5-slot and 14-slot chassis. Processing elements on AMCs include Xilinx FPGAs, TI DSPs, PowerQUICCs and the PowerPC 8641D. A 14-slot system with FPGAs has 1.5 TeraOPS of processing, with I/O bandwidth to match. While they may not be rugged, ATCA systems will deliver cost-effective, high-density processing to applications operating in a normal commercial environment.

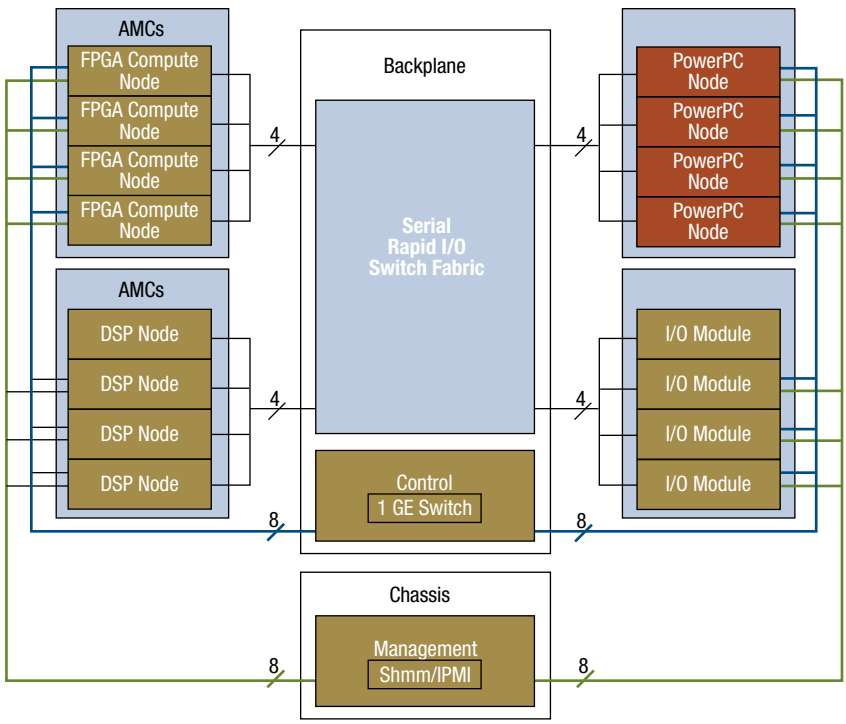

Figure 3

The AdvancedTCA standard, which addresses high-performance, high-bandwidth, low-latency telecommunications applications, supports many different fabrics, board form-factors and processors, and an unprecedented amount of I/O connections.

MicroTCA Turns Mezzanines into Slot Cards

A relatively new standard, MicroTCA, is based around the AMC standard. The MicroTCA system architecture enables AMC cards to be plugged directly into the MicroTCA backplane, so they can be used without a carrier card. The AMC module contains 170 gold-plated pads that are inserted into a female connector mounted onto the MicroTCA backplane. Each AMC module has its own face plate attached to the board, and an ejector handle. MicroTCA is designed to reach even lower cost points than ATCA. While implementations are still evolving, MicroTCA holds the promise for small, scalable, high-density computing solutions. A brand new concept, Rugged MicroTCA is also being explored as a way to extend the benefits of MicroTCA to some harsh environment applications.

Designers who require high-density computing can choose to base their systems on any of several standards, with multiple embedded computing solutions available. As shown in Table 1, decision factors include the level of backward compatibility needed, the environmental restrictions, size and cost constraints. VXS, VPX-REDI, ATCA and now MicroTCA, are all capable of supporting high-density computing, but each has certain advantages. ▮▮

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System Development

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Partitioning Rethink Enhances Military Power Designs

In this era of multi-voltage electronics and distributed architectures, military power system design is getting tricky. A new approach to separating functions keeps those challenges in check.

Keith Nardone, Sr. Manager, Defense Products
Vicor

Designers of military embedded applications are generally slow to adopt new technology, opting for the tried and true. There are times, however, when a new approach offers such compelling advantages for the military that traditional methods are overcome. Separating DC/DC converter functionality, especially at the point of load, provides important benefits to military application such as flexibility and size and weight reduction.

For decades, the bricks of Distributed Power Architecture (DPA) delivered the classic functions of the DC/DC converter—isolation, voltage transformation and regulation—to the point of load. As the number of voltages required at the board level began to proliferate, however, DPA increasingly consumed valuable real estate and unnecessarily replicated full converter functionality.

Handling Multiple Voltages

The Intermediate Bus Architecture (IBA) was introduced to deal more cost-effectively with the growing need

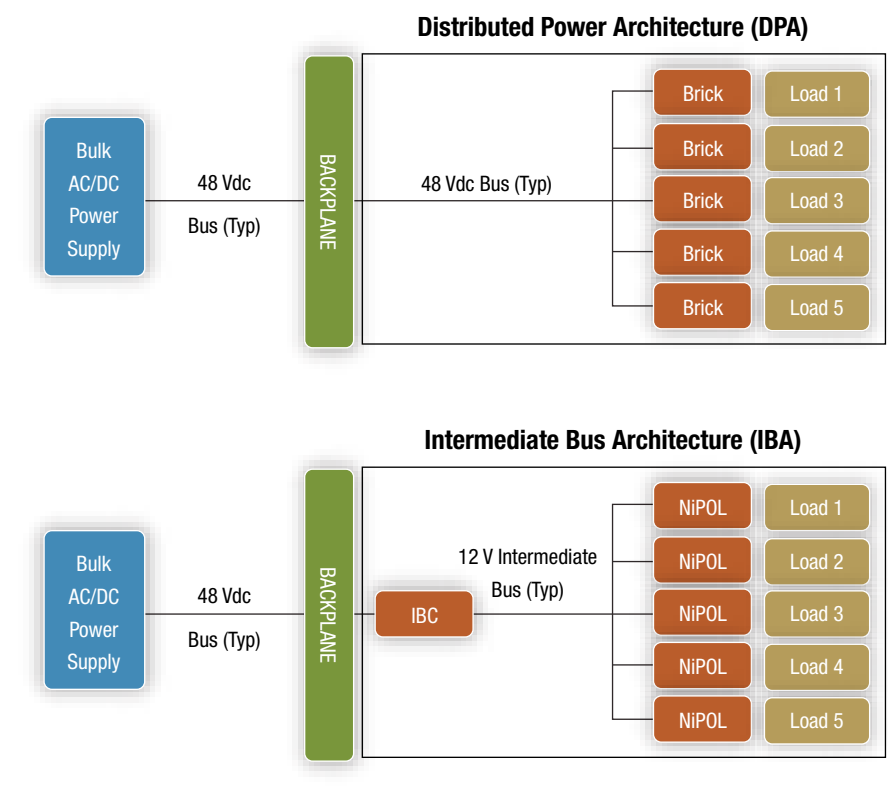

Figure 1

The Intermediate Bus Architecture uses one or more IBC module to provide upstream isolation and a lower intermediate bus voltage distributed to non-isolated point-of-load regulators.

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Figure 2

In Vicor's military V•I Chips, the VTM current multiplier and the PRM regulator are each 1.28 x 0.87 x 0.26 in (32.5 x 22.0 x 6.6 mm) in size, with a footprint of 1.1 in2.

for many low voltages (Figure 1). IBA relies on non-isolated point-of-load regulators (niPOLs), reducing the POL function to regulation and transformation. The niPOLs operate from an intermediate bus voltage provided by upstream isolated converters. The IBC (Intermediate Bus Converter) will typically be unregulated and have a narrow input range, resulting in somewhat better efficiency and mitigating the loss of efficiency resulting from an intermediate stage followed by a point-of-load stage. The typical IBC is also isolated. IBA can be a more cost-effective solution because niPOLs, being non-isolated, are less expensive than complete DC/DC converters.

In a second DC/DC converter architecture with decoupled functionality, Factorized Power Architecture (FPA) breaks power conversion into flexible and scalable power building blocks called V•I Chips (Figure 2). The Voltage Transformation Module (VTM) is a current multiplier that provides transformation and isolation. The Pre-Regulator Module (PRM) provides a regulated, non-isolated output voltage—a "factorized bus"—that is settable within the range of 26 VDC to 50 VDC from an unregulated input source.

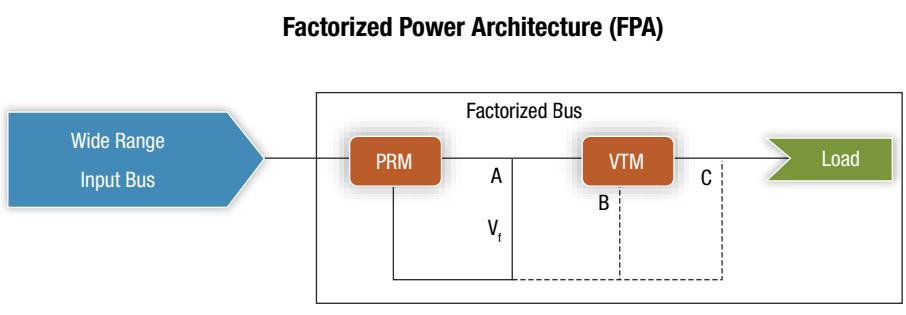

Figure 3

Decoupled functionality increases power designer flexibility. In this example, the output voltage of the VTM can be controlled with a choice of methods.

The combination of the PRM and VTM creates an isolated, regulated DC/DC converter. PRMs can also be used standalone as non-isolated voltage regulators when the input and output returns are not common. A military PRM-VTM chip set can provide up to 100A or 115W at a system density of 172 A/in^3 or 198 W/in^3 and because the PRM can be located, or factorized, remotely from the point of load, these power densities can effectively be doubled.

Separation Gains Flexibility

As suggested earlier, separating DC/DC converter functionality whether by IBA or FPA provides important performance benefits as well as size and weight reduction, which are often highly valuable in military applications. Moreover, the simple act of separating functionality gives power designers additional design flexibility. The ability, for example, to place a small component such as the VTM at the point of load with its equally small complement (PRM) located elsewhere, can have important benefits for military embedded applications, such as lower heat dissipation at that point.

A large number of manufacturers supply niPOLs with many input voltage ranges and different output voltages available. Most contemporary systems require a large number of lower power voltages on a card that serve, for example, microprocessors, DSPs, ASICs and FPGAs.

An intermediate bus converter, or IBC, which is sized for whatever the card needs, commonly feeds this card. It provides the common voltage source from which multiple niPOLs are powered to supply a regulated voltage to their respective loads. The "intermediate" voltage level is chosen to "bridge the gap" between the input distribution bus and a typical load. Power levels can vary greatly depending on the application, but in some military airborne radar systems, a card may be required to provide greater than 4 KW, which is achievable with a V•I Chip solution.

One of the key objectives of factorized power and V•I Chips is to increase power system flexibility. Families of V•I Chips, optimized for different nominal input and output voltages, and packaged for power capabilities, provide power systems designers with a stable of power conversion components that can be used to solve a wide variety of power conversion problems.

Eliminating External Components

Complex systems can use combinations of V•I Chips to rapidly configure high-density, low-profile solutions that minimize the need for external components, are cost-effective and highly efficient, and provide state-of-the-art performance. A simple example shown in Figure 3 suggests the flexibility of decoupled functionality. The output voltage of the VTM can be controlled with a choice of methods. The local loop control method, connected to A, regulates the Factorized Bus voltage. The adaptive loop control method, connected to B, improves regulation to within 1 percent. The remote loop control method, connected to C, improves regulation to within 0.2 percent.

As stated earlier, one of the advantages of separating the DC/DC converter into two components is to eliminate the unnecessary duplication of functionality. In some military applications, such as powering ground mobile RF amplifiers, an isolation stage is not required—only a stable voltage is needed. Here a PRM alone can be used as the sole regulator. PRMs can also be paralleled for higher power as required by the application.

Both the PRM and VTM can each achieve higher than 97 percent efficiency. Overall efficiency for a power system—including the combination of a PRM and a VTM—operating from an unregulated DC source and supplying a low-voltage DC output typically ranges from 90 percent to 95 percent. In many cases, it is possible to achieve overall system efficiency exceeding 95 percent even at full load. With higher efficiency comes lower total heat dissipation, another important consideration in Military power systems design where thermal management options are strained due to the amount of and the challenging environment to which they are subjected.

Figure 4

In contrast to traditional units occupying two VME chassis slots, this one-slot VME power card provides higher efficiency (85 percent versus 78 percent), less weight (2.4 pounds versus 3.5 pounds) and the output, of course, is 450W versus 300W. It uses six PRMs and six VTMs.

Benefits of Integration

With niPOLs and V•I Chips weighing just a fraction of an ounce and having a footprint of a square inch or so, they offer clear advantages to designers of military power systems in mission-critical portable and airborne applications. V•I Chips have been and are being designed and deployed in, for example, electronic systems mounted in military ground vehicles as well as airborne platforms (manned and un-manned), including helicopters.

An example military solution (Figure 4) is the one-slot VME power card—28 Vin, 450W out, four outputs. It meets MIL-STD-810 for shock and vibration as well as MIL-STD-461 for EMI specifications. In contrast to traditional units occupying two VME chassis slots, the one-slot VME power card provides higher efficiency (85 percent versus 78 percent), less weight (2.4 pounds versus 3.5 pounds), and the output, of course, is 450W versus 300W. It uses six PRMs and six VTMs. ▮▮

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Bus	AT Expansion Bus	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI Universal Expansion Bus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
	PCI Bus Masters	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)	1000	1400	1400	1400	400	650	400	650	400	650	333	333	333
	L2 Cache	512KB	2MB	2MB	2MB	256k	256k	256k	256k	256k	256k	16K	16k	16k
	Intel SpeedStep Technology	✓	✓	✓	✓									
	ACPI Power Mgmt	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	512	1024	1024	512	512	512	512	512	512	256	256	256
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Quick Boot Option Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	EIDE Controller (MB/sec)	100	100	100	100	100	100	100	100	100	100	33	33	33
	ATA/IDE Disk Socket, 32 DIP	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB
	Audio			✓	✓	✓	✓	✓	✓	✓	✓			
	Digital Video	LVDS	LVDS	LVDS	LVDS			TTL	TTL	LVDS	LVDS	TTL	TTL	TTL
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	RS-232/422/485 Ports	2	2	2	1	2	2	2	2	2	2	2	2	2
	USB 2.0 Ports	4	4	2	4									
	USB Ports					2	2	2	2	2	2	2	2	2
	10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1		1	1
	ECP Parallel Port			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO(Advanced Digital I/O)	14	14	18	18	18	18	18	18	18	18	18	18	18
	multiPort(aDIO, ECP, FDC)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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

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Steve Butler, Vice President of Engineering
VPT

Military, avionics and other high-reliability system designers are under continual pressure to reduce costs and development times. Off-the-shelf hardware can offer the latest technology, is readily available, can minimize system development cycles and reduce acquisition costs. The idea is good, as long as the pitfalls can be avoided. The challenge is to take advantage of commercially available hardware without sacrificing system performance or reliability.

Certainly a custom power supply cannot simply be replaced with an off-the-shelf one. However, it can often be assembled from available off-the-shelf DC/DC converter modules, usually by mixing various output power levels and output voltages with a few EMI filter modules and a little bit of custom circuitry. The same end performance can be achieved in a much shorter time at much lower cost. This modular approach can be made to fit most applications, particularly those with standard input voltage ranges.

The first step to a successful modular power system design is selecting the DC/DC converter modules. They will be the heart of the power supply and there is little that can be done to affect their basic performance. A wide array of DC/DC converters is available, with almost as many different sizes, feature sets and quality levels. It can be difficult to choose which is best, or even suitable for your application. The cost can range from a few dollars to a few thousand dollars.

Figure 1
Shown here is a full MIL-PRF-38534 hermetic hybrid DC/DC converter module.

The manufacturer's quality system can range from nonexistent to ISO 9000 to MIL-PRF-38534. Determining what requirements are necessary and which converter is best for you can be difficult. There are four main differentiators that help to sort the available products and answer these questions. They are: quality level, temperature range, mechanical construction and input voltage range. In the end, off-the-shelf DC/DC converter modules can fulfill the need for a low-cost power solution without compromising performance or reducing reliability.

Cost vs. Cost of Ownership

Reducing costs is a worthwhile effort, but it cannot be at the expense of system reliability, or result in increased total cost of ownership. To that end, first look for the right manufacturer. Choose a manufacturer that focuses primarily on the high-reliability, military and avionics markets, and has experience in your type of application, whether space, aerospace, mobile or ground. These manufacturers will be around to support their products in the long run.

Beware of telecom manufacturers looking to widen their customer base. They will probably not have a good understanding of the high-reliability market. They might not understand the MIL specs your system needs to meet; they might not be accustomed to the long product life cycle, or be able to provide the high level of support expected. Next, look at the manufacturer's quality system. An established ISO 9001 quality system is the absolute minimum; certification to

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What's in the Embedded Industry's Basement?

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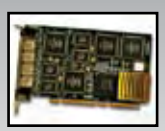

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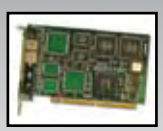

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MIL-PRF-38534 and MIL-STD-883 may be preferred.

The first choice for critical applications is a hermetic hybrid DC/DC converter from a MIL-PRF-38534-certified manufacturer. An example is shown in Figure 1. These hybrid modules are small and lightweight. The internal construction uses printed thick film conductors and resistors on a ceramic substrate. Semiconductors are procured in bare die form, individually attached and wire-bonded to the conductors. The materials and construction techniques are chosen for the absolute highest reliability.

Known Failure Mechanisms

Known failure mechanisms have been considered and dealt with up front in the MIL standards. For example, pure tin finishes are forbidden, for their known ability to grow tin whiskers. The internal components, materials and processes are each qualified, and then strictly controlled under the requirements of MIL-PRF-38534 and MIL-STD-883. Specific details from incoming element evaluation to final environmental screening are called out by the specifications. Audits are performed and the certification is awarded directly by the Defense Supply Center, Columbus (DSCC). Hybrid modules are recommended for critical applications, especially space and critical avionics. This solution poses minimal risk to any program.

Figure 2

The VPT Series COTS DC/DC converters target lower-cost high-performance solutions.

For less critical or cost-driven applications, a non-hermetic DC/DC converter might be the best choice. A typical product is shown in Figure 2. Most commonly used in ground and weapons systems, these modules are built using more conventional assembly techniques without full MIL-SPEC compliance.

In the absence of controlling military specifications, products should be built to the best available commercial standards, specifically J-STD-001 and IPC-A-610 class 3 for high-performance electronic products. It's best to avoid upscreened or re-packaged telecom designs, instead choose products that have been designed from the ground up for military applications. The designs should follow established derating guidelines, with reliability calculations to MIL-HDBK-217 provided. Beware of products using limited life, high failure rate, or temperature-limited

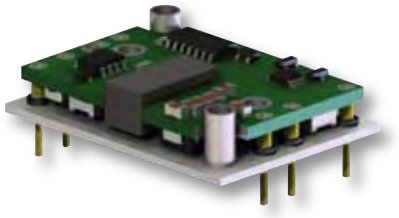


Figure 3

Single board construction integrates power and control circuitry with planar magnetics. Heat is conducted to a metal baseplate.

components, such as optoisolators and electrolytic capacitors. Beware of lead-free solder technology or RoHS compliance. These technologies are relatively new and considered unproven for long-term reliability. Leaded solder is still the best choice for high-reliability applications. The manufacturer should have a tin whisker mitigation strategy in place.

Weeding Out Defects

Environmental screening should be performed at the factory on each module. This 100 percent final step will catch assembly defects and weed out infant failures. For harsh applications, it should include temperature cycling, an extended burn-in (typically 96 hours) and 100 percent electrical test. Screening should be performed to military standards, typically MIL-STD-883. Product qualification should include temperature cycling, mechanical shock, random vibration and an accelerated life test, including temperature, humidity and bias. With the proper quality systems and processes in place, a COTS module can achieve a high level of quality and reliability without the cost of full MIL standard compliance.

The MIL-PRF-38534 hermetic hybrid DC/DC converter is specifically designed to meet the full military temperature range, -55° to 125°C. A metal package with bare die components mounted to a ceramic substrate yields a very low thermal resistance and low temperature rise, from junction to case. Semiconductor junction temperatures can be maintained below 140°C while operating with 125°C on the module case. These modules can operate reliably at very high temperatures in demanding applications.

While hybrid DC/DC converter construction is fairly well defined, construction techniques for non-hybrid off-the-shelf modules vary widely. But regardless of the exact module design, the end system will need to meet the same requirements. There will be requirements for shock, vibration and EMI. Cooling will be via conduction, even when airflow is available. Some environmental coating will be necessary in the absence of hermeticity to provide moisture and chemical resistance. It is better to choose a module that incorporates these factors from the start than to try to add them in the system design.

Most off-the-shelf modules use surface mount components, including plastic

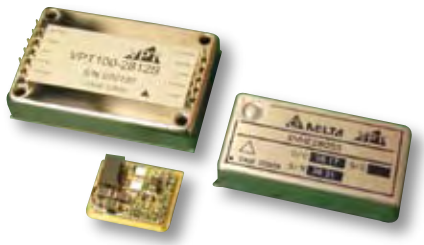


Figure 4

High efficiency isolated and point-of-load power converter modules achieve greater than 90 percent conversion efficiency.

encapsulated semiconductors, which enable high circuit density and high-speed automated assembly. The components are usually mounted to a rigid printed circuit board (PCB). Some designs use an insulated metal substrate (IMS), basically a metal-backed PCB. An IMS design has a good thermal path for the power components but usually requires discrete magnetics and a second PCB to contain all the necessary circuitry, and the end result is a fairly complex design.

Simple Means Reliable

A single board design such as that shown in Figure 3 can offer increased reliability due to the reduced number of circuit boards and interconnects. It also has reduced material costs, assembly steps and hand operations. Integrated planar magnetics further reduce complexity, eliminating flying wires, terminations and solder joints, greatly reducing susceptibility to vibration and temperature cycling. They also maintain a low profile and reduce leakage inductance and associated losses, increasing circuit efficiency. The board is designed with thermal planes and thermal vias to spread heat, and a filled elastomer conducts it to a thermal baseplate. This single board approach allows efficient baseplate cooling and full power operation up to 100°C, and is ideal for low to medium power and high-efficiency designs.

The internal circuit board, solder joints and components should be coated to protect against moisture, a primary cause of failure in non-hermetic components. The coating will also protect against other environmental and chemical contaminants, prevent corrosion and improve long-term reliability. Although some designs utilize a potting material for both moisture resistance and mechanical stability, a dedicated conformal coating can often provide better performance.

Beware of open frame, plastic or epoxy encapsulated power modules, which can cause interference or EMI noncompliance. They usually require additional shielding. A fully enclosed module with a six-sided metal package is recommended for the best performance. The metal baseplate will provide the best temperature distribution and thermal transfer to the mounting surface. The metal package will provide the best EMI shielding. Even if the module is inside a shielded enclosure, the metal package will reduce the likelihood of localized interference and of radiated noise being picked up by the input power or I/O lines and turning into a conducted EMI problem.

Meeting Electrical Requirements

DC/DC converters are readily available in various output voltages and power levels, but the input voltage requirements may be the first hurdle you will face when choosing something off the shelf. Common military power bus standards such as MIL-STD-704 and MIL-STD-1275 require a wide input voltage range, and usually include voltage transients. The required low operating voltages and high transients exceed the capability of the typical 18 to 36V input commercial telecom DC/DC module.

A continuous input range of 16V to 40 VDC is standard for a military DC/DC converter module. Extended ranges down to 15V and up to 50V with transients up to 80V are common. Extreme transients such as the 6V starting disturbance or the 100V, 50 ms surge in MIL-STD-1275 may require an additional input line conditioning module. Make sure this module is available along with MIL-STD-461-compliant EMI filter modules. Obtaining

all the power modules from a common manufacturer ensures they will operate well together and will get your system going with the least complications.

Conventional flyback and forward topologies are commonly used in military DC/DC converter modules. They are simple, proven and reliable. Newer higher-power and low-voltage modules, such as those shown in Figure 4, use advanced techniques to push power conversion efficiency beyond 90 percent. Synchronous rectification replaces conventional Schottky diode rectifiers with controlled MOSFET devices. The MOSFETs, although more difficult to control, have very low "on" resistance, and therefore a much lower voltage drop and lower power loss.

Figure 5

A multiple output power supply assembled from off-the-shelf hermetic hybrid DC/DC converter and EMI filter modules.

Modular Power Supply Design

Possibly the greatest benefit of a modular power supply design is the speed with which it can be developed. Figure 5 shows a multiple output modular power supply. This could have been a large custom development program. Instead, DC/DC converter modules were combined with an EMI filter module and minimal external circuitry to form the complete assembly. A printed circuit board provides interconnections between the modules, the discrete circuitry and the I/O connectors. A rugged aluminum chassis provides a thermal path and secure mounting. The completed assembly was delivered with minimal engineering expense and a greatly compressed schedule.

For easy integration of modules into any power system, look for a good set of standard features. A primary referenced inhibit on/off control provides low standby power consumption. Input undervoltage lockout and output soft start eliminate peak current draw during brownout or startup conditions and provide a well controlled startup sequence without output voltage overshoot. Output voltage trim capability allows the output to be adjusted to various nonstandard voltages.

Remote sensing for higher output power models compensates for pin, trace or connector drop and improves output regulation. Overcurrent and short circuit protection protect the converter and adjacent components and traces in the event of a fault condition. Internal L-C filters give low input current and low output voltage ripple and noise, reducing board-level filtering requirements. A fixed frequency design reduces the chance of compatibility issues with RF systems, while a frequency synchronization input allows synchronization to an external clock for precise control of the ripple frequency.

Modules can be combined in unusual ways to meet almost any requirement. Outputs can be trimmed, or dual output models can be stacked to obtain nonstandard voltages. Outputs can be paralleled for higher power or diode "OR"-ed for redundancy. Individual on/off controls and output voltage telemetry can be provided. Accessory modules can provide extended input ranges and inrush current limiting. A completed power supply assembly can be built to J-STD-001 and easily meet MIL-STD-461 EMI, as well as severe shock and vibration requirements. Whether full MIL-PRF-38534 or military-grade off-the-shelf, DC/DC converter modules can simplify power system design and reduce development costs. ■

VPT
Blacksburg, VA.
(540) 552-5000.
[www.vpt-inc.com].

Technology Focus

PC/104 and EPIC Boards

PC/104 and EPIC Sail Along the PC's Wake

By keeping close to the trailing edge of PC technology, PC/104 and EPIC boards bring PC-compatibility into the space-constrained military embedded computing realm.

Jeff Child, Editor-in-Chief

By leveraging the PC as its core foundation, PC/104—and its wider community of form-factors including PC/104-Plus, PCI-104, EPIC and EPIC Express—has been able to leverage all facets of the PC infrastructure. That infrastructure includes more than just bus timing or packaging. PC-compatibility brings with it an ability to leverage all the components that go into a PC system including the CPU family, DMA, interrupts, timing, serial ports, network interfaces, video and disk storage.

Military system developers select PC/104 technology because of its compact size as well as the ruggedness inherent in its stacking architecture. This stacked multi-board system 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.

An ever-growing number of airborne, marine, handheld and vehicular applications make use of PC/104's modular, off-the-shelf architecture. Certainly the lack of a backplane and the use of a pin-and-socket mating connector naturally help make PC/104 inherently rugged. That said, dealing with heavy loads of shock and vibration energies, submergence in seawater, extreme temperature operation or electromagnetic pulses (EMP), make a sound mechanical design for PC/104 systems all the more critical. With that in mind, a growing assortment of standardized PC/104 enclosure and chassis solutions is available from several PC/104 vendor companies. An example along those lines is the DuraCOR 810 from Parvus. It's a rugged tactical computing platform integrating a low-power 1.4 GHz Pentium-M processor and PC/104 card expansion slots.

Figure 1

Shown here, the nation's first Littoral Combat Ship, named Freedom (LCS 1), was christened and launched at the Marinette Marine shipyard last year. While complementing capabilities of the Navy's larger surface combatants, Littoral Combat Ships will be networked to share tactical information with other Navy aircraft, ships, submarines and joint units.

Last month Parvus announced that the Naval Surface Warfare Center (NSWC) has its DuraCOR 810 processor systems and DuraMAR 1000 mobile routers for use with the Navy's Littoral Combat Ship (LCS) program (Figure 1). The Navy's newest class of surface warship, the LCS operates manned and unmanned vehicles (UVs) for conducting mine warfare (MIW), anti-subma-

rine warfare (ASW) and surface warfare (SUW). Two DuraCORs and one DuraMAR unit are specified as part of the communications equipment package for each LCS Unmanned Surface Vehicle (USV) being developed to carry out these warfare missions. Four ship sets have been delivered to date.

Intended as an upgrade path from PC/104, perhaps the most significant news to spring from the PC/104 community was the roll out a couple years ago of the Embedded Platform for Industrial Computing, or EPIC, form-factor. The EPIC spec was developed jointly by a cross section of major PC/104 players. The EPIC form-factor fills the need for a mid-range-sized form-factor between that of PC/104 and the EBX motherboard standard. The same group of vendors that created the EPIC form-factor followed up with the publication of the EPIC Express Specification, which adds high-bandwidth PCI Express I/O expansion to EPIC form-factor SBCs. Unfortunately connector issues have held back EPIC Express's progress.

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 album they were asked to choose just one of their latest and greatest products to include. ▮▮

Technology Focus:

PC/104 and EPIC SBCs Roundup

Celeron M PCI-104 Card Meets HALT Conditions

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].

Rugged EPIC Board Draws Only 2 Watts

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 Blends Computing and Data Acq

Military system designers who want to save space and lower costs with data acquisition SBCs usually have to compromise. Either the processor's performance is lower than the application needs, or the data acquisition functions are less capable. Fortunately, vendors

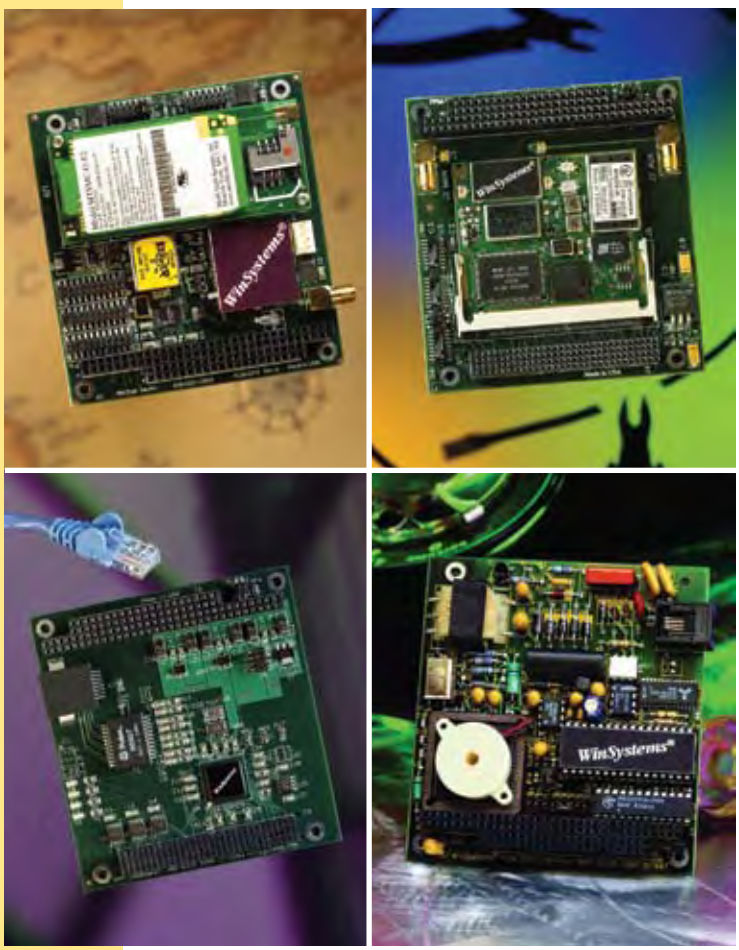
such as Diamond Systems are coming to the fore with workable alternatives. On a single board, the Poseidon EPIC form-factor SBC combines the VIA Eden ULV or VIA C7 processor running at speeds of up to 2 GHz with Diamond Systems' patented, automatically autocalibrating A/D circuitry. The connector board is removable, providing pin headers for a more rugged interface.

The Poseidon includes 256 Kbytes of on-chip cache, a 400 MHz front-side bus and up to 512 Mbytes of onboard soldered 533 MHz DDR2 RAM. The VIA CX700 integrated digital media chipset integrates the VIA UniChrome Pro 2D/3D graphics controller with integral MPEG-2 hardware acceleration, CRT and LVDS flat panel support, and dual independent display capability. The Poseidon SBC also provides four USB 2.0 ports, two RS-232 ports, two RS-232/422/485 ports, IDE and SATA hard drive interfaces, and an Intel 82541 Gigabit Ethernet controller. Typical power consumption is under 10W.

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

PC/104 Embedded Machine to Machine Connectivity

Keep in touch with your industrial application by using WinSystems' wired and wireless modular PC/104 modules. Small, rugged, and operational over extended temperature ranges, they are perfect for transportation, pipeline, instrumentation, MIL/COTS, and homeland security applications.



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  - 802.11 a/b/g Networking
- Ethernet
  - 10/100 Mbps Ethernet
  - Gigabit Ethernet
- Modem (POTS)
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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 Marries Low Power with 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].

Eden-Based EPIC Board Is Conduction-Cooled

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 WindowsXP. 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].


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PC/104-Plus SBCs Are Designed for Rugged Duties

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 8 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].

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].

Rugged, Low-Power SBC Targets Harsh Environments

Most military systems require 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. The company's PC/104-Plus Puma board not only delivers a highly reliable design and low power draw at under 5W typical total power consumption, but also includes a Windows-compatible suspend-to-RAM power management system that reduces power draw to less than 900 mW during standby.

Based on the AMD GX 500 processor, the RoHS-compliant Puma is fanless with no moving parts, and is offered in both standard temperature (0° to +60°C) and extended temperature (-40° to +85°C) versions. Standard onboard features include 256 Mbytes of soldered SDRAM, three COM ports, four USB 2.0 ports, Ethernet, IDE, LPT, audio I/O and keyboard/mouse/floppy support via USB ports. The board also includes integrated SVGA video with LVDS flat-panel support. The PC/104-Plus interface supports both ISA and PCI add-on modules. Standard pass-through connectors allow the board to be used either above or below other PC/104 modules. By plugging it into a proprietary baseboard that includes user I/O circuitry, it may also be used as a CPU module for a larger system. The Puma's customizable, OEM-enhanced BIOS is field-upgradeable. Windows CE/XP/XPe, Linux, VxWorks and QNX are supported. Pricing is approximately $550 in low OEM quantities.

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

PC/104-Plus Card Sports Low-Power Geode CPU

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 up 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 -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-GX, 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-GX supports up to 512 Mbytes of SDRAM. The PPM-GX 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].

PCIe Cable Adapter Extends Laptop Connectivity

One reason the military ranks PCI Express among its favorite switched fabric technologies is that it's the most pervasive. PCI Express is already used in desktop, laptop and server platforms. One Stop Systems has rolled out its PCI Express (PCIe) x1 ExpressCard cable adapter, enabling laptops to operate with high-speed expansion capabilities. The x1 ExpressCard provides cable connectivity from a laptop to any device with a PCIe x1 cable connector such as desktop storage devices, video monitors and add-in board expansion boxes.

OEMs include the x1 ExpressCard in their prepackaged systems to provide the added flexibility of laptop access to their products. Laptop providers include the x1 ExpressCard as an option to their product to allow use with many PCIe x1 devices now on the market. No additional drivers are required for the x1 ExpressCard. The PCIe x1 ExpressCard cable adapter (Part #: OSS-PCIe-HIB2-EC-x1) lists for $250 per unit and is available immediately.

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

24 VDC UPS Features DIN Rail Mounting

An Uninterruptible Power Supply (UPS) is vital in a mission-critical military deployed system. To ensure industrial end users maximum uptime and total protection from unexpected DC power disruptions, Sola/Hevi-Duty has introduced the SDU DIN Rail 24V DC UPS. Available in 10 and 20A designs with a choice of two battery modules, the SDU UPS safely mounts on a DIN rail in a control panel, or can be integrated into an enclosure or machine.

Its compact modular design offers a wide operational temperature range (0°-50°C) to ensure reliable and economical power protection to 24V devices on the factory floor. It delivers the ride-through needed to allow sensitive equipment to safely shut down during extended power failure, preventing costly data losses, mission interruptions and equipment damage. Other features include a rugged, industrial-grade steel enclosure with strong metal DIN Rail mounting connectors, batteries back-up expansion capabilities, LED indicators, alarms, and self-diagnostic capabilities and an optional USB port. The Sola/Hevi-Duty SDU DC UPS is expected to ship early this month. List pricing starts at $219.45.

Sola/Hevi-Duty, Rosemont, IL. (800) 377-4384. [www.solaheviduty.com].

12-Slot Ethernet Chassis Supports a Wealth of I/O

The military seems to be totally sold on the idea of Ethernet as an I/O interconnect scheme. Supporting that trend, United Electronic Industries (UEI) has released its DNR-12-1G (the RACKtangle) Ethernet I/O chassis. Based upon the electronics in the company's popular "Cube" I/O chassis, the new rectangular form-factor increases the number of I/O slots from six to twelve, in a compact and rugged 3U chassis. As the RACKtangle is electrically compatible with the "Cube" form-factors, all of the I/O boards available in the Cube form-factor are also available for the RACKtangle. With over 30 I/O modules available, there will be a configuration ideally suited for almost any application requirement.

The RACKtangle's 12 I/O slots provide up to: 300 analog inputs, 384 analog outputs, 576 digital I/O, 96 counter or quadrature channels, 144 ARINC-429 channels and/or 48 Serial or CAN-bus ports. Software for the RACKtangle 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. The 12-slot RACKtangle chassis is priced at $4,250.

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

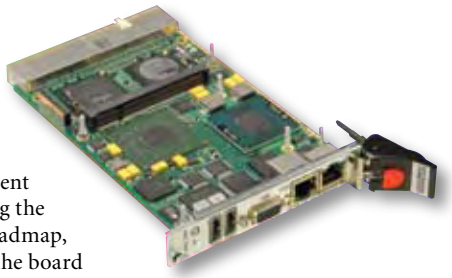
Third-Gen Thermite Embeds Core 2 Duo, 4 Gbyte/s DRAM

The trend toward stand-alone rugged box-level systems has moved to the forefront of military system design. An early convert to that trend, Quantum 3D has announced its third-generation Thermite Tactical Visual Computer (TVC-3.0) Model 1000, in both deployable units and development kits, 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 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.

To support these performance-intensive requirements, Thermite TVC-3.0 systems, including the Model 1000, are available with CPU/memory modules equipped with the latest Intel mobile processors including Core 2 Duo processors with up to 4 Gbytes of high-performance system memory, graphics modules with either NVIDIA or AMD advanced mobile 2D/3D GPUs with up to 256 Mbytes of memory and FPGA-based processing subsystems including Quantum3D's Eidetix advanced, video capture and display subsystems. International, single-unit pricing for Thermite TVC-3.0 Model 1000 systems starts at under $15,000, and it is available for delivery with standard lead times in low volumes.

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

3U cPCI SBC Hosts Core 2 Duo and PMC/XMC



CompactPCI, particularly in its 3U flavor, is now firmly accepted as a military embedded computing form-factor. For its latest 3U cPCI offering, Concurrent Technologies has introduced their TP 442/34x. Using the latest mobile processors from the Intel embedded roadmap, the 1.5 GHz or the 2.16 GHz Core 2 Duo processor, the board is suitable for low-power data-intensive processing applications whereby the processor's dual cores can access up to 2 Gbytes DDR2-667 SDRAM. This versatile 3U SBC supports a variety of peripheral I/O ports, an optional PMC/XMC module and can operate in a system slot, peripheral slot or as a blade.

In addition to the commercial-grade version, two industrial-grade options are also available for operating at temperatures over -40° to +85°C or -25° to +70°C. The Intel 945GME GMCH graphics/memory controller and Intel ICH7-R I/O controller are used to complement the processor to achieve a low-power yet high-performance core design. Using two slots, the TP 442/34x supports a 66 MHz PMC (with front/rear I/O) or XMC site (via a x4 PCI Express port), alternatively there is an option to install an onboard 2.5-inch SATA300 hard disk drive, or for harsher environments, a 2.5-inch solid-state SATA flash drive.

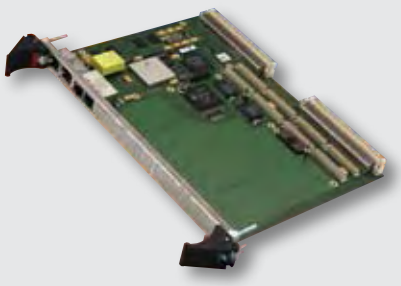
Concurrent Technologies, Woburn, MA. (781) 933-5900. [www.gocct.com].

Power Amplifier Meets Stringent VHF/UHF Comms Needs

With so much attention being paid to emerging digital communications, it's easy to overlook the requirements of analog communications. Demand remains high for power amplifiers specifically designed to meet the strict requirements of VHF/UHF analog communications. AR Modular RF has responded with the KMW2046, a 125W power amplifier. The Model KMW2046 is an RF power amplifier module that supplies 100W continuous output power for OEM applications or integration into a user system. The module comprises a printed wiring assembly housed in a machined aluminum enclosure with feed-through capacitive terminals for connection to the DC power source.

The unit operates at a frequency range of 225 to 512 MHz.. Gain control is 45 dB average at 12V/0V. Gain variation versus frequency is ±1.2 dB maximum at half power. Efficiency at 100W is rated at 30 percent. The KMW2046 provides a DC correct of 12A average at 24V, 14A maximum Noise specs include a harmonic distortion of -45 dBc average, -24 dBc worst case, and spurious noise at ≤ -90 dBc. Operating temperature is -45° to +65°C. Baseplate temperature shutdown is at 71°C.

AR Modular RF, Bothell, WA. (425) 485-9000. [www.ar-worldwide.com].



2eSST, 6U VME SBC Is Flexible Solution

VME's entrenchment in the military market is rock solid. Much of the installed base of VME is still using VME64. MEN Micro has rolled out a new 2eSST, 6U VMEbus single board computer (SBC) that reaches a data transfer rate of up to 320 Mbytes/s using a Tundra TSI148 bridge controller. Built around Freescale's new PowerQUICC-III PowerPC MPC8548 consisting of a highly integrated e500 core with an FPU and MMU as well as L2 cache support, the new A17 provides clock frequencies of up to 1.5 GHz. The soldered 2 Gbytes of fast ECC-controlled DDR2 SDRAM memory firmly withstands shock and vibration, making the A17 suitable for mobile applications.

The board offers two PMC slots that operate at up to 64-bit/66 MHz. One of the mezzanine slots supports rear I/O and can be used for XMC modules with a PCI Express x1, x2, x4 or x8 link. The second PMC-only slot, connected to the onboard FPGA, can also be used for individual additional functions implemented in the FPGA. The SBC operates over an extended temperature range of -40° to +85°C (-40° to +185°F). The RoHS-compliant board offers a standard availability that extends to at least 2017 guaranteeing against obsolescence. Pricing for the A17 starts at $2,397.

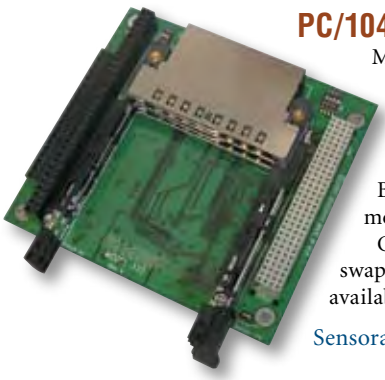
MEN Micro, Ambler, PA. (215) 542-9575. [www.menmicro.com].

COM Express Board Sports Core 2 Duo CPU

The COM Express form-factor has emerged as a flagship of compute-intensive bus-less modular computing. Nexcom has introduced its Core 2 Duo-based ICES 300 Computer-on-Module (COM) Express board, featuring Intel GM965 and ICH8M chipset. It supports Intel Core 2 Duo Merom/ Core 2 Duo Merom LV processors with 667/800 MHz FSB. In addition, it also supports 2 x DDR2 memory with 533/677 MHz up to 4 Gbytes. The ICES 300 COM Express offers high processing power and vivid graphic display solutions for advanced embedded applications.

COM Express products, such as the ICES 300, enable developers to implement the new peripherals with increased bandwidth and to take advantage of performance gain from CPU and chipsets, such as PCI Express and Serial ATA. Integrated with Intel Extreme Graphics 2 technology, the ICES 300 COM Express supports 1 x PCI Express x16 for superb graphic display through the carried board. It also supports other display types include LFP, LVDS and wide screen up to 1920 x 1200. The high performance ICES 300 COM Express Module is compatible with the ICEB 8050 evaluation carrier board, which supports three SATA, eight USB 2.0 and five PCIe x1 Lanes through the carried board.

NEXCOM, Fremont, CA. (510) 656-2248. [www.nexcom.com].

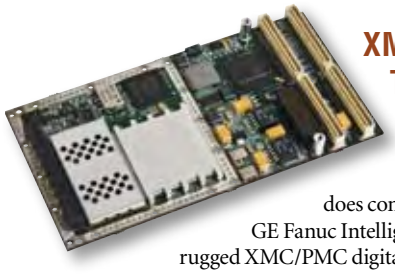


PC/104 Adapter Supports CardBus and PC Cards

Military system designers love the inherent ruggedness of PC/104. But what if that ruggedness could leverage the wide spectrum of PC Card functions? Sensoray does exactly that with its newest addition to their PC/104 line of products, the model 335. The 335 is a PC/104+ module that supports CardBus and PC cards (PCMCIA). The 335 will support two Type I or Type II 32-bit PC cards or one Type III, allowing the expansion of a variety of PC Card functions. These include 10/100/1000 Mbit/s wireless Ethernet adapters, AM/FM radio tuners, biometrics cards, Bluetooth cards, GPS cards, hard drives, memory cards, SmartCard readers, sound cards, VGA interfaces and many more.

CardBus modules used with the 335 are treated as a normal PCI device with the benefit of being able to be hot swapped with the system powered up. The card supports both Windows and Linux operating systems. The 335 is available immediately with single piece pricing starting at $254.

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



XMC/PMC Digital Transmitter Module Aims at SDR

Software Defined Radio is revolutionizing the way the military does communications. Feeding that need, GE Fanuc Intelligent Platforms offers the ICS-8560 rugged XMC/PMC digital transmitter module. Designed for use with the company's V4DSP 6U VME FPGA/PowerPC digital signal processing platform, the ICS-8560 offers two-channel operation with sampling frequencies up to 400 MHz. Featuring the Xilinx Virtex-4 (FX60 or FX100) FPGA in combination with onboard DAC resources, the ICS-8560 allows VHF waveforms to be processed and converted directly on the XMC module.

Available in five ruggedization levels, the ICS-8560 includes two transformer-coupled analog outputs with 16-bit resolution (Analog Devices AD9726) and supports sampling frequencies up to 200 MHz in single data rate mode and up to 400 MHz in double data rate mode. Algorithms such as modulation and digital up-conversion can be developed for implementation in the user-programmable Virtex-4, using the supplied Hardware Development Kit (HDK). The ICS-8560 provides the user with up to eight lanes of high-speed serial I/O via a single XMC connector, which is directly connected to the RocketIO buffers of the Virtex-4, providing transfer rates of up to 3.75 Gbytes/s with XMC-equipped carrier cards.

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

Li-Ion Battery Family Targets High-Rel Apps

In long-range space applications using large cell Li-Ion batteries, the trend is toward subsystems that promote the safety and longevity of Li-Ion while minimizing battery losses, and providing precision cell measurements via telemetry to the satellite operator. With that in mind, Aeroflex Plainview, at the NASA Aerospace Battery Workshop, Huntsville, Alabama, has announced their Battery Electronic Unit (BEU) family of Lithium-ion (Li-Ion) cell balancing products.

Aeroflex's BEUs promote and facilitate the safe use of large Li-Ion batteries on spacecraft and aircraft missions of greater than 20 years. Employing state-of-the-art DC/DC converter technology integrated with Aeroflex's legacy RadHard MIL-STD-1553 databus and ASIC solutions, allows Aeroflex to deliver a low-mass, energy-conservative subsystem as the ideal solution for satellite programs that desire the benefits of Li-Ion technology. The four Aeroflex BEU products all offer cell balancing to within +/- 5.0 mV, cell voltage monitoring accuracy +/-10 mV, total battery voltage monitoring accuracy +/-0.3 percent of full scale, MIL-STD-1553B telemetry and discrete output lines for critical signaling. Prices vary per each BEU product dependent on quantities and professional services associated with the specific statement of work.

Aeroflex, Plainview, NY. (516) 694-6700. [www.aeroflex.com].

VME64x PowerPC SBC Is Power Efficient

Applications such as SININT and image, radar and sonar processing require high performance, low power consumption and superior reliability. Serving such needs is a new VME64x PowerPC single board computer board that incorporates a newer host-bridge controller and DDR2 memory technology. The Celero CVME-7448ST from Cornet Technology uses the latest host-bridge controller technology, the Tundra Tsi109, which lets the CVME-7448ST offer much higher performance per watt—a key consideration of military embedded applications with tight power budgets, and improved signal integrity, providing significant improvement over older generations of VME PowerPC single board computers.

Incorporating DDR2 technology and the Tundra controller eliminates memory latency caused by pipeline blockage, improving performance by up to 9 percent and reducing overall power consumption by up to 6W over boards using older technology. The board offers 512 Mbytes of DDR2 SDRAM, 256 Mbytes of flash, two PMC sites for I/O expansion, two high-speed Gigabit Ethernet ports, two serial ports and two USB 2.0 ports. Price starts at $4,600. An extended temperature version is also available.

Cornet Technology, Springfield, VA. (703) 658-3400. [www.cornet.com].

Camera Link Mezzanine Boasts 500 Mbyte/s Speeds

Camera Link has become an accepted interface for real-time capture of video. A Camera Link mezzanine board for the StreamStor Amazon high-speed recording system from Conduant provides connectivity for one or two cameras at data rates up to 500 Mbytes/s. Combined with the direct to disk capability of the StreamStor Amazon recording system, the CL-500 provides high speed and long-duration recording capability required when shooting high-resolution and/or high frame rate digital video. The high-speed capability of the StreamStor system is especially important when the application requires the use of uncompressed video.

The Camera Link mezzanine board provides support for nearly any Camera Link full, medium or base configuration. Featuring the fastest available Channel Link components and programmable logic, the CL-500 provides a flexible and highly customizable platform for digital video recording applications. When combined with Conduant's StreamStor Amazon SATA Disk Controllers, the system can reliably record high frame rate and/or high-resolution video for many hours. The StreamStor CL-500 Camera Link board is priced at under $4,000 and is an add-on to Conduant's Amazon SATA Disk Controller.

Conduant, Longmont, CO. (303) 485-2721. [www.conduant.com].

LXI Triggering Box Does Precise Synchronization

Ethernet ranks high among the favorite interconnect technologies for the military. Military system designers like to use it in their instrumentation efforts too. LXI, the Ethernet LAN-based successor to GPIB, offers flexible packaging, high-speed I/O and prolific use of LAN across a broad range of aerospace and military applications. Agilent Technologies has introduced the world's first LXI trigger box that enables precise synchronization over LAN for LXI Class C and GPIB instruments, elevating their performance to LXI Class B standards. When an LXI Class C or GPIB instrument is connected to the Agilent E5818A LXI trigger box, it gains the timing capabilities of an LXI Class B instrument. Leveraging the IEEE 1588 precision time protocol (PTP) synchronization, the trigger box enables sub-nanosecond time triggering and time stamping of events for the attached instruments. With reliable event-log data, users can trace and troubleshoot faults easily.

The Agilent E5818A LXI trigger box is a stand-alone LXI Class B device. It can achieve a synchronization accuracy of up to 13 ns (standard deviation over direct connection) and provide time stamping of up to 5,000 events. The Agilent E5818A LXI trigger box is available now and is priced at $1,500.

Agilent Technologies, Santa Clara , CA. (877) 424-4536. [www.agilent.com].

Managed Fiber Ethernet Switch Supports SNMP

The military has fully embraced the concept of Everything Over IP (EOIP), and that means a growing demand for Ethernet network switch gear. Aaxeon Technologies has released its Lanolinx line of Fiber Ethernet Switches. The Lanolinx Fiber Ethernet Switches include 100FX and Gigabit Fiber models, supporting multimode or single mode fiber. These switches also have up to 24 10/100 Copper ports. In addition, models are available with two fiber ports instead of one.

The units support IEEE 802.3/802.3u, store-and-Foreword switching and IP Security. The 10/100, Full/Half Duplex switches have MDI/MDI-X auto-sensing, Rate Limiting and support both SNMP/Telnet/Console/Web management and port-based VLAN / 802.1 Q Tag VLAN. Offered in a rack-mountable enclosure, the switches provide IEEE 802.1p Class of Service and Port base, Tag base and Type of Service priority method. IGMP with Query mode for multimedia and port mirroring are supported as well. Pricing for the 24-Port SNMP Managed Fiber Switch starts as low as $289.

Aaxeon Technologies, Brea, CA. (714) 671-9000. [www.aaxeon.com].

Compact Digital I/O Modules Have a Variety of Options

Embedded computers may have shrunk in size, but the demand for large arrays of digital I/O linked to those computers keeps rising—the myriad of legacy military I/O interfaces, for example. A series of digital input/output slave modules provides a selection of compact distributed I/O modules with connector options. Each of the three modules in the HSL U series from Adlink Technology features an output current of up to 90 mA/channel and improves on previous designs by encompassing a flat-bottom housing for tight spaces, and by offering I/O connector options.

The HSL-DI16DO16-UJ-N/P is an HSL distributed slave module with 16 discrete input channels and 16 discrete output channels. The US-N/P version is also an HSL distributed slave module with 16 discrete input channels and 16 discrete output channels. However, this model offers shrouded connectors featuring a latch-lock to prevent wires from vibrating loose during operation. And the UL version is an HSL distributed slave module with 16 discrete input channels and a pulse stretcher function. The HSL U series of modules is priced starting at $140, and is available with discounts in volume.

Adlink, Irvine, CA. (970) 377-0385. [www.adlink.com].

Extended Temperature, Conduction-Cooled 3U CompactPCI SBC at 15W.

A new 3U CompactPCI SBC offers flexible, ruggedized high performance. The CPC7525 from Orion Technologies is available in both conduction-cooled and convection-cooled versions, and is designed for high performance in the most demanding applications. The flexible "Personality Module" and the ability to automatically detect whether to function as a system controller or an intelligent peripheral card allow the user to migrate from one application to another without hardware reconfiguration.

The CPC7525 includes standard features such as a PMC slot (PrPMC and PCI-X capable) three Gigabit Ethernet ports, two serial ports, non-volatile RTC, 16 Kbits of EEPROM, PMC P14 and general-purpose I/O. Additional optional features include 128 Mbytes of onboard user flash and customer-specific I/O. Processors supported are IBM's 750FX at 600 MHz and the 750GX running at 1 GHz.

By incorporating the IBM 750 FX/GX PowerPC, Marvell's Discovery III controller and the complement of I/O via the customer configurable "Personality Modules," the manufacturer can adapt to almost any Military, Industrial or Commercial application. Volume pricing for a conduction-cooled 1 GHz 750GX starts at $3,017.

Orion Technologies, Merritt Island, FL. (321) 452-1670. [www.otisolutions.com].

Mini-ITX Motherboard Supports Core2 Duo and Graphics

An Intel 945GM-based Mini-ITX motherboard supports advanced dual core processor technology. The AIMB-253L from Advantech includes the integrated Intel GMA 950 graphics controller and features 256 Mbytes of shared video memory along with DirectX 9 3D hardware acceleration. For multiple displays or future graphics upgrades, a PCI Express x16 slot supports higher performance graphics cards that permit convenient connection to various display devices like CRTs and LCDs.

The AIMB-253L offers a host of integrated I/O interfaces that speed up installation and deployment. Providing dual LAN connectivity, the PCI Express-based Intel 82573 Gigabit Ethernet controller delivers up to 1000 Mbits/s of bandwidth. The AIMB-253L also has two Serial ATA II 300 Mbyte/s connectors. Graphics and I/O expansion are supported by the PCI Express x16 and 32-bit PCI slots. In addition, there are four USB 2.0 ports; three RS-232 and two RS-422/485 ports; one parallel port; LVDS and VGA ports and one PS/2 port.

Integrated graphics are provided by the Intel GMA 950 graphics core, which supports up to 256 Mbytes of video memory for greater resolution, more colors and more realistic game play. The AIMB-253L also has Intel 7.1 channel high definition audio via an S/PDIF output. It is suitable for customers who need dual display and high-quality graphics support. The low power and rich I/O design reduces the total cost of ownership (TCO) for end consumers, and makes the AIMB-253L the most cost-effective choice. The AIMB-253L supports Microsoft Windows XP, 2000, XPE and CE operating systems. The AIMB-253L is RoHS compliant.

Advantech, Irvine, CA. (949) 789-7178. [www.advantech.com].

Slim Version of MicroTCA Portable Chassis

A new 4U wide MicroTCA portable tower from Elma Electronic is a slimmer and more compact version than the 6U wide unit announced by the company early this year. The 4U Type 32M MicroTCA Portable Tower features a Star backplane with up to 6 AMCs. The unit also features 1 MicroTCA Carrier Hub (MCH) slot and a Power Module slot. The backplane has a JSM (J-Tag Switch Module) slot, used for diagnostics. Ideal as a development chassis, the unit facilitates either single or double width format modules in the same backplane.

The Type 32M features advanced EMC shielding, scratch-resistant vinyl clad aluminum covers and power components. Cooling is achieved with 2 x 90 cfm fans and the chassis has 5 temperature sensors throughout the unit. Elma has performed thermal simulations to ensure the optimal performance. The wider 6U version Type 32M has a Dual Star topology with 2 MCH and 2 Power Modules. Elma also offers Subrack MicroTCA enclosures in 4U-8U heights and a 1U Pico-style MicroBox. The Type 32M MicroTCA Tower price is priced under $2,300, depending on volume and options. The lead time is 6-8 weeks.

Elma Electronic, Fremont, CA (510) 656-3400. [www.elma.com].

Serial-to-Ethernet Gateway Connects Existing Equipment to the Internet

A plug and play, gateway module converts RS-232 protocol into TCP/IP protocol—and also includes DB-9 and RJ45 connectors for immediate use. The WIZ110SR from Saelig enables remote checking, managing and control of devices via Ethernet and TCP/IP by connecting existing RS-232 equipment at up to 230 Kbits/s to a network. WIZ110SR is a protocol converter that automatically converts and transmits data sent by serial equipment to TCP/IP data and converts the received TCP/IP data into serial data for the equipment.

Simple software set-up allows users to rapidly create a 10/100 Mbit/s Ethernet interface with a maximum serial rate of 230 Kbits/s. WIZ110SR is a compact 2" x 1.2" board with built-in system connectors to allow any device with serial inputs and/or outputs to be Ethernet/Internet-enabled for less than $29. WIZ110SR offers TCP, UDP, IP, ARP, ICMP, IGMP, Ethernet MAC and PPPoE protocols on a 10/100 Base-T auto-detecting Ethernet network.

WIZ110SR is based on WIZnet's TCP/IP- offload IC W5100 with built-in Ethernet driver stage. Three different modes of operation are supported: TCP server, TCP client and UDP. TCP guarantees data delivery, but UDP doesn't require acknowledgement, so communication can be faster. Once the TCP client and server have established connection, data can be transparently transmitted bi-directionally. WIZ110SR's IP Address can be manually assigned (static IP), or IP, subnet and gateway address can be acquired from the DHCP server automatically. Serial commands can be hardware- or software-triggered. Quantity one pricing is $29.

Saelig, Pittsford, NY. (585) 385-1750. [www.saelig.com].

PCI Express 8-Channel 25 Msample/s 12-bit Oscilloscope / Digitizer card

With eight 25 Msample/s 12-bit ADCs for simultaneous sampling without time-skew errors and up to 2 Gsamples onboard memory, a new PCI Express oscilloscope/digitizer card supports streaming to a host PC to the maximum transfer rate of the PCI Express x1 bus. In the UF2e-3132 from Strategic Test, each channel has a software-programmable amplifier allowing input ranges of ±50 mV to ±10 V. The UF2e-3132 offers a wide range of triggering possibilities, including level, window, pulse-width, re-arm and double triggers, or an external TTL trigger input. Trigger conditions can be set on multiple cards or systems combined with AND/OR logic, a feature often used in production test.

SDKs for Microsoft Windows Vista, XP64, XP and Linux (RedHat, Fedora, SuSe, Sarge) and the SBench 5.3 oscilloscope program are supplied with the card. SDKs for LabVIEW, MATLAB; Agilent-VEE, DASYLab and LabWindows/CVI are available as options. The effective Number of Bits is 10.1 bits; the signal-to-noise ratio is >62.5 dB and the total harmonic distortion is < -61.0 dB and -3dB bandwidth > 12.5 MHz.

In addition, the UF2e-3132 scope card can be customized with hardware options: Onboard memory is available for 32, 64, 128, 256, 512, 1024 or 2048 Msamples; multiple recording via memory segmentation and gated sampling using an output clock controlled by external TTL signal and use of BaseXIO adds 8 asynchronous digital I/O lines. Prices start at $10,390 with discounts for volume.

Strategic Test Corporation, Woburn, MA. (617) 621-0080. [www.strategic-test.com].

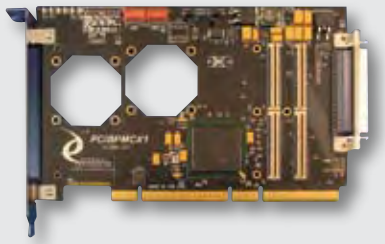
Interface Delivers 10Gb Ethernet to Real-time and Embedded Applications

A 10Gb Ethernet (10GbE) networking interface for embedded, military and avionics applications incorporates Silicon Stack technology that offloads TCP/IP protocol stack processing to hardware, thus allowing wire speed transfers, minimal host processor overhead, very low latency and rock-solid determinism. As a result, the 10GbE XGE interfaces from Critical I/O permit users of high-performance systems to benefit from the low cost, interoperability and networking capabilities of Ethernet, even in such applications as radar, sonar, flight simulation and scientific applications.

According to the company, 10GbE holds the promise of providing an order of magnitude increase in performance, offering an attractive alternative to other more specialized data networking technologies, such as InfiniBand and Serial Rapid I/O. The problem users run into, however, has to do with the software-intensive nature of Ethernet's TCP/IP protocol stack. Many embedded systems have struggled to keep up with the stack processing associated with 1GbE connections, so dealing with 10GbE presents 10 times the challenge. The Silicon Stack technology is used as a solution to offload protocol processing to silicon and reduce host processor loading so as to deliver true 10 Gbit performance.

The XGE 10Gb family is currently available in XMC form-factor with dual 10GbE ports, and employs an 8-lane PCI Express host bus interface. AMC and PMC versions are also planned. Native support for IPv4 and IPv6 is included.

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



Adapter Puts PMC into Standard PCI/PCI-X Slot

PCI is arguably the most successful bus to invade the embedded market, with numerous flavors and form-factors for every need. Dynamic Engineering's latest PCI-X product is the PCIBPMCX1, an adapter/carrier converter card that offers the ability to install one PMC card into a standard PCI/PCI-X slot. The PCIBPMCX1 PMC card slot can be programmed for 3.3 or 5V operation by the user, and the primary PCI bus implementation is universal voltage. It is suitable for PCI or PCI-X operation with 32-bit or 64-bit data and 33, 66, 100 or 133 MHz clock. The PMC user I/O connector Pn4 is available on a SCSI II connector.

The PCIBPMCX1 has a cooling cutout for increased airflow to the PMC. A cutout is preferred over a fan mounted to the PMC adapter for several reasons including: many components are not shielded against close proximity to electromagnetic fields, and the reduction in MTBF that an additional mechanical device represents. The PCI bus is interconnected to the PMC via a 64-bit 133 MHz-capable bridge. The bridge allows the PCI bus to operate with different parameters than the PMC card. Single unit price is $625 and quantity discounts are available.

Dynamic Engineering, Santa Cruz, CA. (831) 457-8891. [www.dyneng.com].

Expandable Rugged Box Can Take the Heat

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 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. An option panel can be easily removed and punched for custom annunciators, 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.

Octagon Systems, Westminster, CO. (303) 430-1500. [www.octagonsystems.com].

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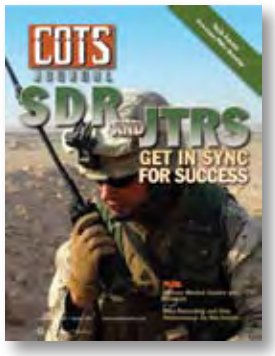
December 2006

Multicore CPUs Put New Spin on VME SBCs

January 2007



SDR and JTRS Get in Sync for Success

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ATCA and MicroTCA Take Wing in Defense Systems

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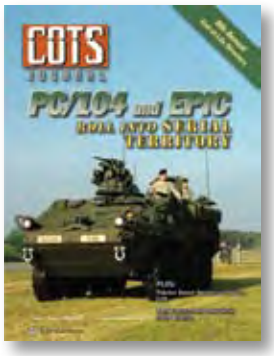

PC/104 and EPIC Roll into Serial Territory

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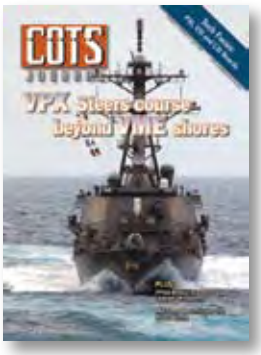

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Special Feature

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-A coalition for COTS Solutions-

The Mountain View Alliance

Specification Development Organizations (SDO) and Special Interest Groups (SIG) coordinate efforts to enable COTS environment in telecom and wireless infrastructure

Mountain View Alliance - the name alone may conjure a vision of Silicon Valley executives sitting around an oversized redwood conference table preparing a forward looking statement for the upcoming year. Actually, for those unfamiliar with it, the Mountain View Alliance (MVA) is a loose coalition of nine (9) Specification Development Organizations (SDO) and Special Interest Groups (SIG) who have a common interest in accelerating the development of modular, commercial-off- the-shelf (COTS) equipment adoption in the communications market.

The MVA announced its formation in June 2005 with a primary objective to promote real-life interoperability. Founded by three representatives from leading open specification organizations: PICMG, the Service Availability Forum, and the Optical Internetworking Forum - originally called the Network Processing Forum, the alliance members work to coordinate their efforts and facilitate communications aiming to avoid gaps, overlaps and inconsistencies that may lead to technical conflict. The MVA acts as a clearing house for communication among its members; individual issues are usually resolved by bilateral interaction between member organizations. On the marketing side, the MVA's role is coordinating efforts and messages between groups to accelerate the growth of the commercial off-the-shelf (COTS) ecosystem for open communications platforms.

"This alliance is best understood as a classic example of the whole being stronger than the sum of the parts", said Russ Dietz in 2005, chairman of the Network Processing Forum. Joe Pavlat, president of PICMG had this to say, "the efforts of the Mountain View Alliance recognize that users are now looking at the 'overall solution' and this requires closer cooperation between our respective organizations"

Today's nine member organizations of the MVA represent over 1,000 total companies. The organization's specifications and documents address most of the elements of the stack for Telecom equipment.

Tom Williams, Editor-in-Chief of RTC Magazine interviews Rob Davidson, PICMG

Tom Williams: How did the Mountain View Alliance form?

The Mountain View Alliance started in 2005 when Henry Turko of the SA Forum contacted other organizations to explore ways of working more closely together. At that time, PICMG and SAForum were already coordinating their efforts around the HPI management interface and we felt it was time to explore coordination between other organizations. I think we all felt that this type of coordination was needed as the COTS market was beginning to mature and those who were building complete systems were using documents from multiple organizations. At the same time these organizations were interested in accelerating the adoption of their documents and felt that the combined story was stronger than the

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individual messages. We all agreed that the time was right for this organization.

What type of coordination does it do?

We like to call the MVA a clearing house for information. Members discuss what their organizations are doing and if that generates interest, we find the relevant contacts in each organization so they can pursue the issue directly. The MVA also provides an excellent entry point for organizations wanting to establish connections in this space. A good example is the TM Forum that recently joined; they want to extend the work they do in system management further down the telecom platform stack and the MVA is the perfect place to start.

What organizations constitute the MVA?

Currently, the Mountain View Alliance member organizations are the Communications Platforms Trade Association (CP-TA), the Linux Foundation (LF), Open Communication Architecture Forum (OCAF), Optical Internetworking Forum (OIF), PICMG, RapidIO, SCOPE Alliance, the Service Availability Forum (SA Forum), and the TM Forum..

What are MVA's main activities?

Aside from the clearing house activities, the MVA has produced white papers, and a coordinated calendar of events for the industry on our web site. The most significant activity the group has established, is the the MVA Communications Ecosystem Conference (MVACEC). This event extends the principle that end results are best achieved by bilateral relationships to the individual level; it brings together companies and individuals from the ecosystem of suppliers and customers who are interested in advancing the adoption of open specification COTS base products. There are many events that focus on some of the individual technologies such as AdvancedTCA, but we felt that we needed to step up and initiate an event that focused on the overall stack. We began this with a joint meeting of PICMG and the SA Forum in 2006 that grew into the first MVACEC in 2007.

MVA Communications Ecosystem Conference 2008

The MVA flagship event brings together members of the entire communications industry. Launched in February 2007, this event is a conference and exhibition program that includes CTOs from established and new Network Equipment Providers as well as leaders of the vendors, system integrators and service providers. It is open to anyone interested in the development of the COTS ecosystem. It is the one event to get the bigger picture with technical and business developments.

Eric Heikkila, Director of Embedded Hardware & Systems at VDC, a research firm that tracks this space recently said: "Adopting ATCA and COTS based systems is such a major change for the NEPs that it is paramount that marketing and sales efforts should be aimed at the office of the CTO where these decisions are ultimately made".

The MVACEC is the event where these influential people will gather to give their views and gather information on the latest developments.

2008 promises to have an excellent program which was compiled by the talented technical chairs: Timo Jokiaho from Nokia Siemens Networks, Magnus Karlson from Ericsson, Mark Kent from BT, and Paul Steinberg from Motorola. They are attracting top notch keynotes and panelists and have selected technical presentations from a large number of submissions.

Jorge Magalhaes, Motorola's Director of Marketing, Embedded Communications Computing remarked about the 2007 MVACEC, "We were most impressed by the broad spectrum of service providers, network equipment providers and communications vendors represented by both the speakers and on the associated panels. There was a high level of engagement in the breakout sessions, which significantly contributed to the overall experience."

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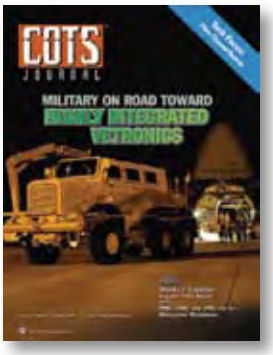

Military on Road Toward Highly Integrated Vetronics

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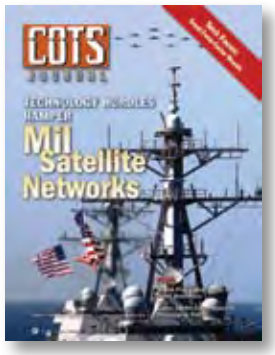

Technology Hurdles Hamper Mil Satellite Networks

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Coming Next Month

- *Software Defined Radio.* Our annual Special Feature section on Software Defined Radio has become a much anticipated feature in *COTS Journal*. It's a great way to kick off the New Year. For the DoD's Joint Tactical Radio System (JTRS) program, many of the technology pieces are coming together with its organizational problems put to rest. Articles in this section delve into the key technology trends driving SDR, with an update on the latest status and developments in JTRS.
- *Military Market Update and Forecast.* The forces controlling the defense market are a blend of many long- and short-term factors. It's a market that doesn't follow the rules of other markets. In this section we examine market trends in broad cross-section of military and aerospace embedded computer applications. The update will also look at where some of the major programs are going and speculate on the probability of their success.
- *RapidIO and PCI Express.* Switched serial fabric technologies continue to jockey for position as the favorite for high-end military embedded computing applications. PCI Express and Serial RapidIO have risen to the top, along with switched Ethernet. This section explores how system designers can benefit from the marriage of switched fabrics with embedded computing form-factors like VPX, VXS, Compact PCI Express, MicroTCA and AMC.
- *Conduction-Cooled CompactPCI Boards.* Now well into its second decade of existence, the CompactPCI embedded form-factor has achieved the maturity and broad product range that military system designers so crave. The 3U flavor of cPCI is particularly attractive to space/weight-constrained applications like avionics. This Tech Focus section updates readers on cPCI trends, and provides a product album of representative conduction-cooled 6U and 3U cPCI boards.

COTS

Editorial

Jeff Child, Editor-in-Chief

The Game's Afoot

There are few topics more serious than that of providing our warfighters with the tools and training necessary to do their difficult work. So it seems almost frivolous to mention gaming technology in the same breath with military simulation. Let's leave aside for the moment the irony that the famous phrase "the game's afoot" comes from one of Shakespeare's most battle-centric plays: Henry V (my favorite incidentally). But the truth is, hardware and software crafted for the PC gaming and game box market have become key to the forward progress of new military training and simulation systems.

This trend—particularly on the hardware side—is far from new. Long gone now are the days when it took a large multiboard chassis' worth of electronics to drive a military simulation program. By leveraging advanced commercial graphics silicon targeted for PCs and game boxes, military graphics subsystem integrators are able to blend a wealth of graphical and video features into the popular PMC mezzanine form-factor. In the past couple years, the move has come full circle to where PCs and servers themselves have become the preferred platform for simulation and training software.

Now the trend has reached a new plateau where gaming software technologies are likewise increasing their impact on military simulation system development. This is helping to solve a conundrum that's long existed for the DoD in the military simulation area. The problem is this: where and how to fund the development of military simulation programs without first knowing what is possible and what's not? Without knowing, for example, what level of realism in a military helicopter simulation is achievable, how can the DoD plan its investments in that area? In the past that problem has led to great inefficiency with some efforts getting too little funding—and some getting too much. Today the PC gaming and game box market provides a satisfactory view of what can be done in terms of simulator realism. And now many components and technologies that comprise those advanced consumer games are becoming available for defense industry military simulation software vendors to build upon.

A number of solutions showcased at last month's Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) exemplify that trend. Perhaps the most high profile of these was the rollout of Microsoft ESP, a software platform designed to bring immersive games-based technology to military and commercial aviation. Microsoft ESP capitalizes on years of investment in the Microsoft Flight Simulator franchise. Not surprisingly the initial version is targeted to military and commercial aviation audiences. But when I spoke to Microsoft representatives they said future versions will expand beyond aviation into ground and maritime operations, indoor and avatar-centric simulations. That means military simulation programmers won't have to start from scratch when tasked to create new simulator programs.

Microsoft ESP provides developers with a PC-based simulation engine, a comprehensive set of tools, applications programming interfaces, documentation to support code development, content integration and scenario-building capabilities. There's also an extensive base of "world" content that can be tailored for custom solutions. Partners and developers can add structured experiences or missions, content such as terrain and scenery, scenarios and hardware devices to augment existing solutions, or they can build and deploy new solutions.

The platform includes geographical, cultural, environmental and rich scenery data along with tools for placing objects, scenery and terrain customization, object activation, special effects and environmental controls including adjustable weather. In keeping with the DoD's Everything over IP (EOIP) direction, ESP includes multiplayer functionality and Internet support including Voice over IP. That means up to 30 warfighters can interact in the simulation around the world using a peer-to-peer broadband connection. This feature fits nicely into the DoD's efforts to embed training subsystems into deployed platforms (armored vehicles, for example) so that warfighters can conduct "brush up" training exercises even while out on the front lines.

Another software solution aimed to aid the development of realistic military simulations is Objective Interface Systems' Digital Molecular Matter (DMMfx) technology. Also announced at I/ITSEC last month, DMMfx achieves a high level of realism by using finite element technology to model the physical stresses that arise within physical materials. Traditionally simulation artists have used tools such as Maya and 3DS Max to create and animate objects within simulation environments.

With DMMfx technology, the work that was previously performed by animators is now performed by the simulation environment itself. When a bomb falls or a tank fires its ordinance, stone walls crumble, wood splinters and metal bends, all in response to user interaction. DMMfx Animator is a plug-in for Maya 8.5 and allows artists to create and convert objects within Maya into DMMfx objects. DMMfx is based on the DMM engine being used by LucasArts for their upcoming "Star Wars: The Force Unleashed" and "Indiana Jones" video games.

Shifting gears away from technology for a moment, I want to take this opportunity to thank all of you in our industry for supporting and being involved with *COTS Journal*. Here's wishing you all Happy Holidays and a healthy, prosperous New Year. And please join me, and our organization, in keeping our thoughts and prayers with our nation's servicemen and women who serve in harm's way. ▮▮

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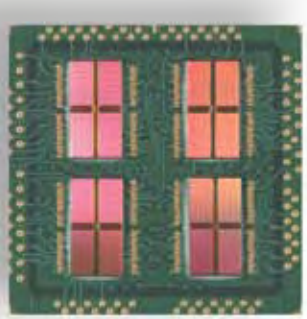

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