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The Journal of Military Electronics & Computing

Tech Focus: PXI, VXI and LXI Boards Roundup

Small Form Factor Camp

BOASTS INNOVATIVE BOARDS AND STANDARDS

PLUS:

MicroTCA and AMC Meet High Integration Needs

1U Rackmount Server Systems Expand Their Territory

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The Journal of Military Electronics & Computing

Features

October 2009 Volume 11 Number 10

Special Feature

Small Form Factor Boards and Standards

Tech Recon

MicroTCA and AMC in Military Systems

System Development

1U Blade Servers Invade Military Designs

Technology Focus

PXI, VXI and LXI Boards

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

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

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Coming in November...
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Thousands of Unmanned Ground Vehicles (UGVs) like this have been performing dangerous work in Iraq and Afghanistan. Congress has mandated that one third of all U.S. ground military vehicles be unmanned by 2015. Small form factor embedded computers will help UGV developers to outfit future designs with more functionality and less operator involvement so they can perform a wide range of missions under varying conditions.

Photo courtesy of Center for Commercialization of Advanced Technology, Southern, Calif.

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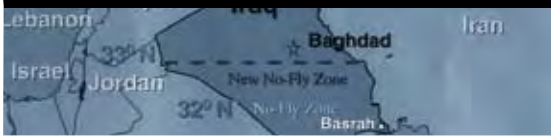

Committing Heresy

Since the invention of the integrated circuit—and every evolution in chip density and capability—there have been the Chicken Littles that claim this evolution means the death of computer boards. And, yes, I was around when ICs were invented. With every evolution the only thing that really happened was that more capability was packed on the boards. The prophecy that boards may no longer be relevant is still wrong, but we are seeing shifts as to where they will be most relevant.

Ever since the inception of the computer industry—and this little outcrop of it we call the embedded computer market—everyone has only had one continuing product development goal in mind: more functionality, faster and cheaper. While doing so, there's also the added drive to do all that while maintaining or reducing the total cubic inches that these boards occupy in a chassis or system.

COTS Journal focuses on the embedded electronics market for the military. And that's a market that has its own unique requirements that are not universally required by the whole embedded market. With that in mind, my comments here are not relevant to the high-end non-military market—where there's virtually no end to the amount of functionality and performance required. Ten years ago a military system would require four or five 6U boards in a chassis to provide the same system features and performance that we can now put on one 3U board or PMC module. All this now places many program managers in a position of making some hard decisions when it's time to do system upgrades or technology insertions. Should we stick with the bus and internal interconnect system that we've been using for years? Or switch to a different bus or interconnect? Or even to a solution that has no bus or requires no internal interconnects?

Some large AdvancedTCA boards are being employed in military systems. Most, if not all, of them are contained in subsystems and very few if any are individually selected boards used in do-it-yourself tactical systems. High-end military tactical systems are instead the target market of the VPX suppliers. VPX technology offers oodles of performance, functionality and I/O pins on each 6U or 3U board. All that said, if we've learned anything over the last few decades, it's that the military has a much lower interest in extreme performance and functionality than the rest of the world. That's never deterred a supplier's product design group from focusing their efforts on the most leading-edge technology, because that is what challenges their engineering ability. We have a substantial group of suppliers chasing a very limited number of opportunities, although those opportunities could represent substantial revenue.

I'm sure the previous paragraphs didn't create any new friends for me and will keep me very busy responding to emails that I'm a heretic. So what is happening in the heart of the embedded military computer market? The basic problems program managers faced haven't changed. They need the most cost-effective, high-quality product that will be available through the anticipated life of the system. Unlike numerous commercial market applications, the military market rotates around the software applications, which are the royal jewels of any deliverable system. Most military application software programs interact at different operational levels with a large number of other systems and agencies. They are not rewritten and requalified because someone wants to change hardware. Just another problem for the already long and daunting list of issues for the program manager.

We're definitely going to see more and more use of FPGAs. They not only allow for upgrades and technology insertions as components become more and more difficult to obtain over the life of programs, they also allow for "emulation." As it becomes more difficult to provide a link that works with the application software, you emulate functionality in FPGAs so the software sees no difference as the hardware is changed. We're already seeing this as half-ATR short systems are being replaced with much smaller stand-alone proprietary systems that have no need for internal interconnection buses. We're also seeing systems packaged around one 3U or PMC board. They contain all the performance required and have a virtually unlimited option on functionality and I/O so they can be configured just for the specific needs of the project.

So how will the military embedded computer market look in the future? Some people will make a good business at the "bleeding" edge of technology. Other suppliers will generate revenue with products that have moderate performance and functionality improvements, but have high levels of transparency for application software. Many programs that have a legacy will continue using the form factor and bus technology that they currently use. Systems without a legacy—or those that are capable of considering a change in form factor—will strongly consider completely self-contained systems without any internal buses, or systems built around 3U or smaller form factors, saving space and power. Although there will be a need for even smaller systems—as the military's need for smaller handheld, man pack or sub-miniature UAVs increases—these areas *currently* do not offer sufficient revenue potential to warrant the development costs for COTS products by suppliers offering a range of standard products.

Bottom line: Now is the time for both suppliers and users to start rethinking and planning for the future. ▮▮

Pete Yeatman, Publisher
COTS Journal

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The Inside Track

GE Fanuc Secures 3U VPX Order from GD Land Systems

GE Fanuc Intelligent Platforms, a unit of GE Enterprise Solutions, today announced that it had secured an order from General Dynamics Land Systems (GDLS) of Sterling Heights, MI for 3U VPX single board computers, graphics processors, disk subsystems and switches in support of GDLS's work on the Abrams Evolutionary Design (AED) program for the M1A2 tank. The AED is the design development program for future Abrams tank computer systems and will see the gradual replacement of 6U VME-based systems supplied by GE Fanuc to GDLS for the Abrams Continuous Electronics Enhancement Program (CEEP) and System Enhancement Program (SEP V2). The AED program is expected to be at least equal to the scope and value of the CEEP program.

Figure 1

Abrams Evolutionary Design (AED) program for the M1A2 tank. The AED is the design development program for future Abrams tank computer systems.

All these GE Fanuc products comply with the REDI (Ruggedized Enhanced Design Implementation) VITA 48 standard. The REDI/VITA 48 standard provides guidelines that enable designers to develop boards that are capable of operation in the harsh environments typical of military operations. They also provide the Army with a Line Replaceable Module (LRM) solution that makes Level Two Maintenance possible, ensuring faster, more cost-effective repair and replacement in the field—a key requirement for the armed forces. The order from GDLS includes a variety of GE Fanuc products including VPX SBCs, a VPX XMC carrier, a VPX Ethernet switch and a VPX SATA SSD. All are 3U form factor.

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Kontron Acquires PC/104 Vendor DIGITAL-LOGIC

Kontron has announced the acquisition of the non-public DIGITAL-LOGIC AG, headquartered near Solothurn, Switzerland. Kontron takes over a 78 percent majority of DIGITAL-LOGIC AG, which has specialized on highly reliable and compact rugged embedded computer boards and systems since 1992. Kontron intends to increase its ownership of the company with 15 million Euros revenue and 100 employees to 100%.

With the acquisition, Kontron complements the product portfolio with DIGITAL-LOGIC's small form factor single board computers PC/104, PC/104-Plus and PCI/104-Express, as well as fan-less, rugged and compact embedded computers for stationary and mobile applications. The products are designed and manufactured with the typical Swiss precision to withstand extended temperature range and high shock/vibration in harsh environments. DIGITAL-LOGIC will be integrated under the Kontron AG as "Kontron Compact Computers AG."

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U.S. Marine Corps Taps Aeroflex Radio Test Systems

Aeroflex has won a five-year, $40.5 million contract with the U.S. Marine Corps to supply Ground Radio Maintenance Automatic Test Systems (GRMATS). For this contract Aeroflex will supply its newly developed test platform, the 7200 Configurable Automated Test Set (CATS) (Figure 2). The 7200 is a COTS platform for testing software-defined radios, including military tactical radios and other high-technology devices.

The 7200 combines industry-standard hardware modules and multi-gigabit/second data buses with a component-based plug and play software architecture. The 7200 is based on the Aeroflex Common Platform architecture, which was designed to be compatible with the Software Communications Architecture (SCA) used by JTRS (Joint Tactical Radio System). The 7200 supports the testing of existing and planned JTRS radio families.

Figure 2

The 7200 Configurable Automated Test Set is designed for testing software-defined radios, including military tactical radios and other high-technology devices.

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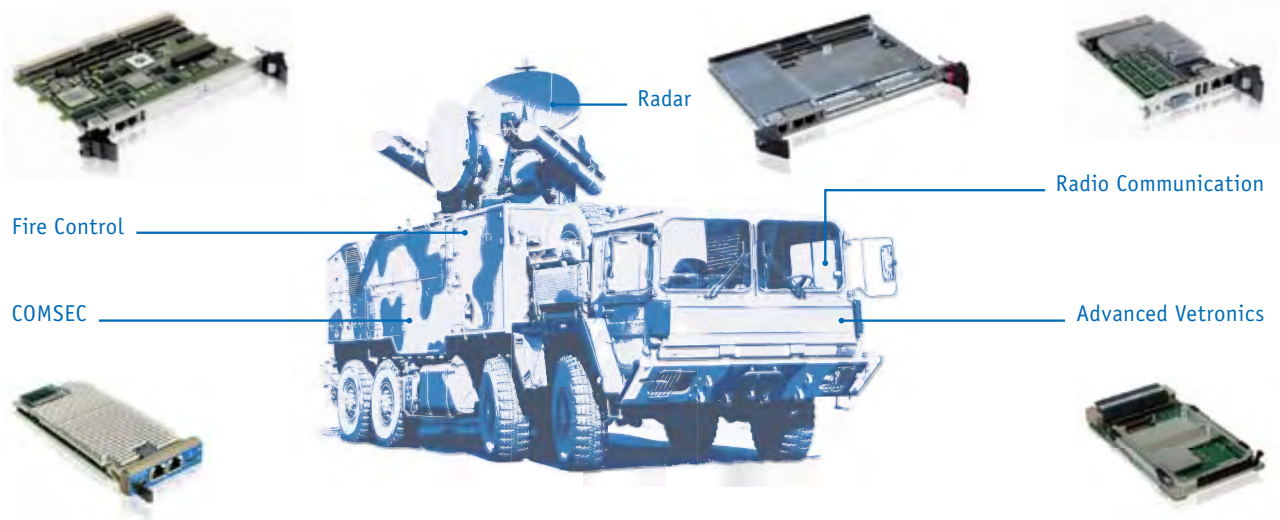

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Navy Approves Northrop Grumman Sub Navigation System Upgrade

Northrop Grumman Corporation's Sperry Marine business unit has announced that the Chief of Naval Operations (CNO) has approved the latest upgrade to its electronic navigation software for U.S. Navy submarines. Version 8.3 of Sperry Marine's Voyage Management System (VMS) was approved for submarines by the CNO following an extensive certification testing program carried out by engineers from the Naval Surface Warfare Center (NSWC), Port Hueneme, Virginia Beach detachment.

Figure 3

The USS Oklahoma City (SSN 723) was the first submarine to have the Voyage Management System (VMS) installed on board.

VMS is the standard naval electronic chart display and information system (ECDIS-N), which is being deployed across the Navy's fleet of surface ships and submarines. The newest VMS version for submarines will enhance the vessels' ability to navigate in extreme northern latitudes and conduct under-the-ice operations. In 2007, the USS Oklahoma City (SSN 723) (Figure 3) was the first submarine to have the VMS installed on board. To date, 58 U.S. nuclear submarines have been equipped with Sperry Marine VMS-based navigation systems, and 92 percent of them have been certified to use ECDIS-N as the primary navigation plot.

Northrop Grumman Sperry Marine
Charlottesville, VA.
(434) 974-2134.
[www.sperrymarine.northropgrumman.com].

GoAhead Fault Management Software Used on Aegis Combat System Trial

GoAhead Software has announced that its software is the first off-the-shelf fault management solution to be part of a successful U.S. Navy operational trial. Deployed as part of Lockheed Martin's Aegis Combat

Military Market Watch

Growth Predicted for Military Embedded Communications Boards Market

The requirement of connecting more soldiers and military equipment for useful—literally life-saving—access to information is driving a major demand for military communications equipment and the embedded computing infrastructure to support it. As the militaries of the world become much more network centric, it is driving a proliferation of embedded communications computing infrastructure in the COTS market, particularly out at the edge of military networks.

In VDC Research's report on the Embedded Military COTS Board market, released in October 2009, the market for embedded boards used in military communications in North America was sized at $110.9 million in 2008, with a projected CAGR of 9.20% through 2011 at which time the market is projected to be $144.4 million (Figure 4). Note that these figures count only board-level COTS products sold, so that when the system-level products are included, the embedded communications computing market in military communication applications is much larger. VDC estimates that in 2008 18% of the embedded boards used in military communications applications in North America went into routing or switching applications and 35% went into servers. The remaining 47% went into "other" military communications applications, which could be anything from SDR to signal processing for communications to gateways and everything in between.

VDC expects the market for military communications gear to expand significantly in the future as the DoD moves toward its vision of connecting soldiers, equipment, and all of the nodes in the theatre to drive intelligence and do so through a much more unified network than the stovepiped networks that exist today. In particular, the embedded communications equipment required at the edge of military communications networks, where low-power, lightweight, compact and rugged solutions are required, is projected to increase substantially in the coming years. For more information please contact Eric Heikkila of VDC at: erich@vdcresearch.com.

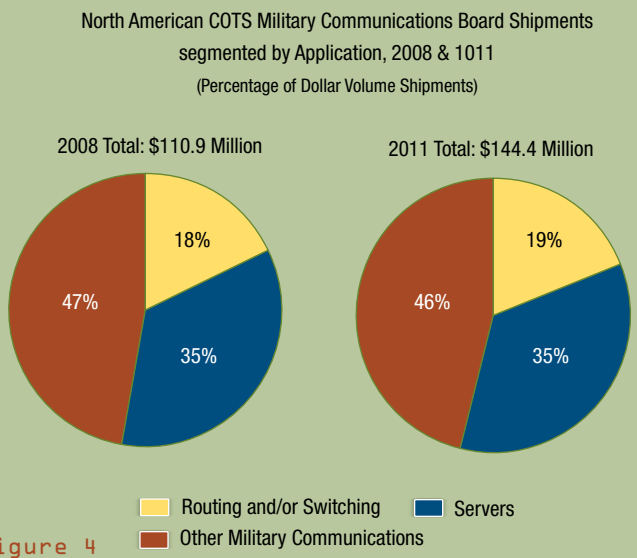

Figure 4

VDC forecasts that the market for embedded boards used in military communications in North America will experience a CAGR of 9.20% through 2011 when they project the market to be $144.4 million in dollar volume shipments.

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

Figure 5

The guided missile cruiser USS Bunker Hill was recently modernized with the open architecture Aegis Weapon System.

System, the Navy trial tested combat readiness of the guided missile cruiser USS Bunker Hill's full combat system (Figure 5), recently modernized with the open architecture Aegis Weapon System. The integration of GoAhead Software's proven solution into Aegis' tactical infrastructure, helps ensure high availability of the system, as well as successfully demonstrates the applicability of COTS and open standards in mission-critical defense systems.

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Event Calendar

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

October 29
Real-Time & Embedded Computing Conference
Seattle, WA
www.rtecc.com/seattle2009

November 17
Real-Time & Embedded Computing Conference
Reston, VA
www.rtecc.com/reston2009

November 19
Real-Time & Embedded Computing Conference
Patuxent River, MD
www.rtecc.com/paxriver2009

November 30 - December 3
I/ITSEC
Orlando, FL
www.iitsec.org

December 8
Real-Time & Embedded Computing Conference
Copenhagen, Denmark
www.rtecc.com

December 10
Real-Time & Embedded Computing Conference
Gothenburg, Sweden
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January 26
Real-Time & Embedded Computing Conference
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Special Feature

Small Form Factor Boards and Standards

Small Form Factor Realm Churns out Boards & Standards

As constrained spaces and tight power budgets become top priority in many of today's military programs, standards-based and non-standard small form factor boards are in demand as never before.

Jeff Child
Editor-in-Chief

Small embedded computers—in both standard and non-standard form factors—are in high demand for military applications that are extremely space- or weight-constrained or where traditionally only a fully custom solution would do the job. When it comes to standard form factors, this industry segment was—until just these past couple of years—holding its breath. But today, even though there are significant differences in strategy among the various small embedded computing standards groups, the overall results are positive.

In some cases disagreements about technology standards can sometimes slow down progress. But in this case it seems to be sparking a lot of innovation. Such computing technology—although always of interest to the military market—is becoming ever more critical for defense applications. These include small UAVs, robotics, mission-specific handheld systems, intelligent munitions and many others. The Scan Eagle UAV, for example, has a PC/104 SBC as part of its network control subsystems. Scan Eagle is a small GPS-guided UAV that can fly up to 15 hours and transmit real-time imagery directly to its home link.

In this area of the embedded computer market, there are three groups that take different—although often overlapping—views on how to move forward with standards-based small form factor technology. The PC/104 Consortium seems to favor marrying PCI Express with the tried and true PC/104 form factor. The Small Form Factor Special Interest Group (SFF-SIG) meanwhile is focused on trying a variety of different approaches to suit the miniaturization of board-level electronics. Unlike the others, the SFF-SIG is pushing the idea that the connector interface scheme can and should be independent from mechanical board form factors. And not to be left out, the StackableUSB camp remains focused on using USB (and I^2C and SPI) to replace ISA as the board-to-board interconnect in rugged stacked systems.

Although it was only formed about two years ago, the SFF-SIG has been quite productive in its accomplishments so far. At ESC San Jose earlier this year, the SFF-SIG followed up on its earlier work by ratifying Revision 1.0 of the MiniBlade spec and also introducing a new revision

Figure 1

The Scan Eagle UAV has used a PC/104 SBC as part of its network control subsystems. Scan Eagle is a small GPS-guided UAV that can fly up to 15 hours and transmit real-time imagery directly to its home link.

Figure 2

At ESC Boston last month, WinSystems Field Applications Engineer/Product Manager Jeff Child the new EBC-Z8510-G SBC—an EBX board that supports the SUMIT-ISM I/O expansion standard, and is also the first board supporting the Computer-on-Module interface standard COMIT.

Figure 3

The Express-ATC is a "Compact" COM Express module measuring only 95 x 95 millimeters. The board sports the ultra-low-power Intel Atom N270 processor and Mobile Intel 945GSE Express chipset.

to its SUMIT specification. SUMIT Interface Standard Revision 1.3 supports four additional PCIe x1 lanes for a total of six, one additional USB 2.0 interface for a total of four, and DMA support on the LPC bus to enable higher-speed data transfers. The update is fully upward compatible with the earlier SUMIT version.

COMIT Debuts

Perhaps the most interesting SFF-SIG development this year is its rollout of a new form-factor-independent, Computer-on-Module interface standard. Called COMIT (Computer On Module Interconnect Technology), this electromechanical interface specification is designed to be processor-independent and focuses on bus interconnect and module manufacturing technology rather than any single processor, DSP, or microcontroller architecture. The idea is to use COMIT to support different processors with a single baseboard, allowing easy migration to future processors. Both concepts are well suited to the performance/feature tech upgrade and obsolescence mitigation needs that are so key for the military.

Putting that concept into action, WinSystems at last month's Boston ESC show, announced their EBC-Z8510-G SBC that supports both the SUMIT-ISM I/O expansion standard plus COMIT (Figure 2). The board is powered by an Intel 1.1 GHz Atom processor and measures 203 mm x 147 mm (8.5 x 5.75 inches). With a blend of high-bandwidth PCI Express (PCIe) lanes, USB ports and lower-speed multiplexed and serial buses, SUMIT and COMIT can be added to a variety of board form factors, and is flexible and compact enough to meet a very broad range of application requirements.

In recent standards activity, the SFF-SIG at ESC Boston announced the availability of revision 1.0 of both the Pico-ITXe and Pico-I/O Specifications for small, rugged, stackable embedded systems. The Pico-ITXe Specification builds on the momentum of the unexpandable Pico-ITX standard to enable stackable I/O expansion using SFF-SIG's flexible SUMIT (Stackable Unified Module Interface Technology) interface. Pico-

ITXe boards are the same size (72 x 100 mm) and have the same mounting hole placement as Pico-ITX boards, allowing easy migration to support SUMIT-based, stackable I/O modules.

Expansion for Pico-ITX Form Factor

The Pico-I/O Specification defines small 60 x 72 mm stackable I/O expansion modules for use with Pico-ITXe or, in fact, any other SBC form factor that incorporates SUMIT expansion with Pico-I/O mounting holes. Stackable I/O expansion is implemented using the SUMIT standard. Through the inclusion of one or two 52-pin SUMIT connectors, a Pico-ITXe SBC can provide PCI Express (up to five x1 lanes or two x1 and 1 x4 lanes), four USB 2.0, LPC, I2C and/or SPI interfaces to the Pico-I/O modules. In anticipation of the release of these Specifications, VIA Technologies has rolled out a Pico-ITXe SBC, and Pico-I/O modules are available from member companies ACCES-I/O and WinSystems as well as VIA.

Figure 4

The PC/104-based BU-65590C Multi I/O card provides a mix of MIL-STD-1553 and ARINC 429 Receive/Transmit Channels along with user-programmable digital discrete or Avionics Discrete I/O, selectable external or internal time-tag clock, and an IRIG-B time synchronization input and output.

For its part, the StackableUSB camp at ESC introduced the concept of using other standard format embedded boards as carrier boards for Stackable USB modules. The idea is for StackableUSB Clients to be used in conjunction with any Nano-ITX, Pico-ITX or full-size PC/104 Form Factor single board computers. This is made possible by the use of carrier boards that conform to each of these popular SBC form factors. These carrier boards attach to the SBC and provide up to four USB mounting bays for StackableUSB Clients. For SBCs that don't have a StackableUSB connector, a USB cable can be used to attach the carrier board to the SBC.

In keeping with a strategy of preserving ties to legacy PC/104, the PC/104 Embedded Consortium's major ESC announcement was the addition of USB connections to the stackable PCI/104-Express and PCIe/104 specifications. Since the adoption of those two specs a year ago, a number of vendors have rolled out

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products based on the PCI/104-Express and PCIe/104 specs. The addition of the industry-standard USB will help provide quick connectivity for add-on modules that have USB-driven devices. Interestingly, the result of marrying USB and PCI Express to the PC/104 world may eventually be the elimination of PCI bus for the PC/104 realm, even though the venerable ISA bus will still have a place. Any application—whether it's in the embedded or desktop/server space—that needs performance will want to migrate to PCI Express or USB anyway. In contrast, ISA still has a role as a low-speed, easy-to-implement interface to sensors, analog/digital I/O and so on.

Atom CPU Makes an Impact

Aside from form factor standards, the most significant trend impacting small form factor boards in the past year has been the proliferation of boards based on Intel's Atom processor. The Intel Atom processor has been among the top architectures on new SBC products over the past year. The emergence of the Atom means there's no longer a reason to suffer with high power dissipation as a trade-off for using an Intel Architecture platform. The Intel Atom processor Z5xx series provides a variety of design options with 2.0 or 2.2W power levels, two package sizes and industrial as well as commercial temperature ranges. The Atom's low power makes it suited for the kind of Size, Weight and Power (SWaP)-constrained applications–small UAVs, UGVs, portable comms gear and so one—that are so critical these days. For the military, a key point is that the Atom has embedded lifecycle support. Military system designers were reluctant to consider the Atom until the assurance of 15-year part availability was offered.

COM Express, meanwhile, has taken its place as the new standard for bus-less embedded computing. COM Express safeguards development investments and lowers total cost of ownership by enabling designers to partition commodity host-processor COM Express modules from proprietary, value-added platform building blocks, including FPGAs and specialty I/Os on custom baseboards.

Marrying both the COM Express and Atom trend is ADLINK Technology's Express-ATC (Figure 3), the newest member of its Computer-on-Module (COM) family. The Express-ATC is a "Compact" COM Express module measuring only 95 x 95 millimeters, and is fully compatible with the Type 2 pin-out of the PICMG COM Express specification. Based on the ultra-low-power Intel Atom N270 processor and Mobile Intel 945GSE Express chipset, the Express-ATC comes with integrated support for high-resolution CRT, single/dual channel LVDS and TV out (SDTV and HDTV). The Express-ATC supports up to 2 Gbytes of DDR2 533 MHz memory on a single SODIMM socket. The module supports three PCI Express x1 lanes via the Intel I/O Controller Hub 7-M (ICH7-M) Southbridge, one Gbit Ethernet connection and two SATA chan-

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nels. Legacy support is provided for a single Parallel ATA channel, 32-bit PCI and Low Pin Count bus (LPC). The Express-ATC supports onboard IDE-based Solid-State Drive (SSD) up to 8 Gbytes, and comes standard with an integrated Trusted Platform Module (TPM 1.2).

The latest COM Express offering from American Portwell is a Type II COM Express Basic (small footprint) that has a footprint of 125 mm x 95 mm (4.92 x 3.74 inches). The compact PCOM-B213VG includes the GM45 and ICH9M-E chipset and integrated GMA 4500HMD graphic engine that supplies extreme 3D performance for media applications such as high-definition 1080p imaging. Active Management Technology (AMT) 4.0 and Trusted Platform Module (TPM) support effective remote management and enhanced security. Two SO-DIMM sockets support DDR3 SDRAM up to 8 Gbytes and the board has both EIDE and SATA as well as one Gigabit Ethernet. I/O expansion (via the Com Express carrier board) includes one PCI-E x16 multiplexed with SDVO interface, five PCI-E x1, four PCI, LPC interface and high-definition audio interface, and a PCOM-C210 Developer COM Express Type II carrier board.

Compact COM Express Version

Kontron's latest COM Express offering is a microETXexpress evaluation kit aimed at providing system developers a fast introduction into the compact class of COM Express-compatible Computer-on-Modules. At the heart of the kit are the Kontron microETXexpress-SP or -DC Computer-on-Modules (95 x 95 mm) based on the Intel Atom series processors and the Kontron ETXexpress miniBase-board. Starterkits are also available for evaluation with other microETXexpress modules. Thanks to its low profile height of approximately 44 mm—including the Computer-on-Module and the optional heat spreader—it can easily be integrated into space-constrained military embedded applications.

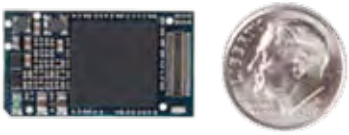

Figure 5

The dime-sized Torpedo System on Module (SOM) and Development Kit is based a 0.4 mm BGA pitch OMAP processor that leverages Package-on-Package (PoP) technology.

Military I/O specific boards have also embraced the small form factor trend. And in this era of the multifunction board, the PC/104 space is riding that trend too. PC/104 is well accepted in the military realm. Serving those needs, Data Device Corp. teamed with Advanced Digital Logic (ADL) to supply PC/104-Plus and PCI-104 cards for use in applications that require MIL-STD-1553 or ARINC 429 interfaces. DDC and ADL have proven interoperability of DDC's BU-65578C MIL-STD-1553 card and BU-65590C (Figure 4) Multi I/O (1553 and 429) card with the ADL systems.

DDC's cards provide a mix of MIL-STD-1553 and ARINC 429 Receive/Transmit Channels along with user-programmable digital discrete or Avionics Discrete I/O, selectable external or internal time-tag clock, and an IRIG-B time synchronization input and output. The cards have an intelligent hardware offload engine that dramatically reduces PCI bus and host CPU utilization, while storing 1553 Monitor data in a convenient and portable IRIG-106 Chapter 10 file format.

Dime-Sized SOM Solution

Representing the ultra-small portion of the small form factor computer trend, Logic recently rolled out its dime-sized Torpedo System on Module (SOM) and Development Kit, based on Texas Instruments' OMAP 3 processor family. The Torpedo SOM (Figure 5) is an ultra-compact form factor for applications that require low power and high performance within tight space constraints. By using the 0.4 mm BGA pitch OMAP processor that leverages Package-on-Package (PoP) technology, the dime-sized Torpedo SOM requires 45 percent less surface area and 12 percent less volume when compared to the equivalent OMAP 0.65 mm BGA package and external memory solution. A discrete design using the 0.4 mm BGA package usually requires advanced PCB technologies that result in higher board costs in addition to PoP technology, which requires specialized manufacturing assembly processes. The Torpedo SOM solves these development complexities; as a result, customers can design lower cost baseboards and use common manufacturing procedures while still benefiting from the small package OMAP35x processor and PoP technology. ■■

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SUMIT Interconnect Spec Revamps Small Form Factor Landscape

The military's demand for highly integrated small form factor computing continues to rise. The SUMIT Interconnect specifications provide a way to marry high-speed interfaces and legacy I/O together in small footprint boards.

Bruce D. Virell, Product Manager
VersaLogic

Designers of high-performance embedded systems need to incorporate growing numbers and types of I/O in smaller and smaller off-the-shelf and semi-custom boards, while keeping their design platforms flexible enough to accommodate a variety of designs, including some that must maintain compatibility with legacy I/O. Demand for processing performance and higher bandwidth is increasing while space and power constraints are getting tighter.

Many applications now require faster throughput associated with the PCI Express bus, and primarily address either newer video (HDMI) and/or high-speed Ethernet applications. This is especially true in video-intensive situational awareness military applications that use picture-in-picture and mapping overlays. Demands for connectivity and communications capability in these applications are growing, such as in systems used in the Department of Defense's Global Information Grid, which requires a robust networked force for improved information sharing.

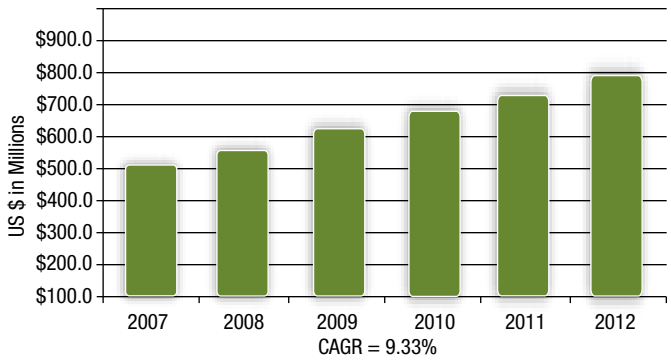

Figure 1

VDC expects a compound annual growth rate of 9.33% for shipments of all stackable modules between 2007 and 2012.

Demand for Small Footprints

Developers of military applications are looking for a small footprint, compact modular size, and the ability to use the multitude of existing expansion modules available today. They want to be backward-compatible with legacy devices in the installed base, while still supporting a hardware environment that will accommodate very high-speed devices.

Although space, power, bandwidth and performance issues are being addressed in semiconductor electronics at the CPU and chipset level, designing boards with new 45nm technologies such as Intel's Atom processor has still been a challenge. This challenge is caused primarily by mechanical and connector issues, as well as the sheer number of buses that must now be accommodated to cope with the proliferation of I/O, including PCI Express, Universal Serial Bus (USB), Serial Pe-

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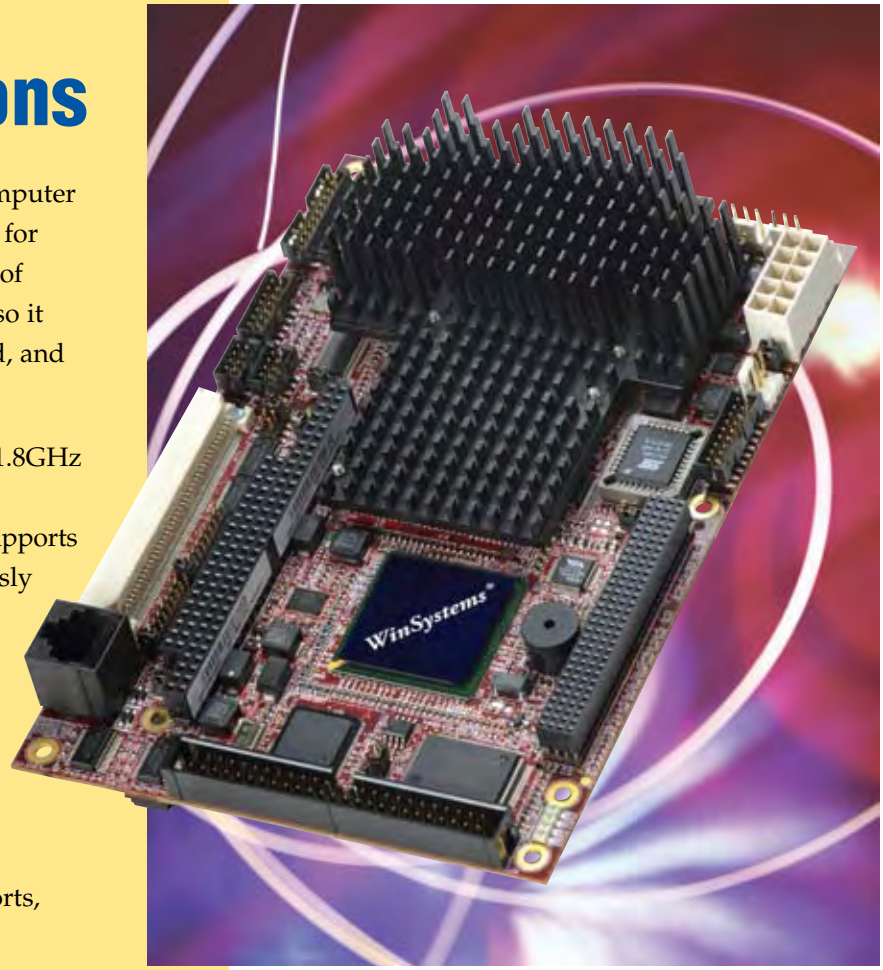

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Figure 2

An example SUMIT Ethernet board. The SUMIT-A and SUMIT-B connectors are the two connectors shown here near the top of picture.

ripheral Interface (SPI), Low Pin Count (LPC), System Management Bus (SMBus) and ExpressCard.

Form Factors and Interfaces

Over the last few years, high-speed serial buses, or switch fabrics, have replaced older, slower and cumbersome parallel interfaces in embedded designs. Most of them have not lasted. Meanwhile, most microprocessors, primarily Intel silicon, have adopted the PCI Express bus. PCI Express is a serial bus that allows data to be sent in two directions at the same time, doubling the effective bandwidth. Each PCI Express lane (port) provides more bandwidth than the original 133 Mbyte/s PCI parallel bus. PCI Express typically provides throughput of up to 250 Mbytes/s per lane, (500 Mbytes/s per lane bidirectional) in version 2.0, and up to 1 Gbyte/s per lane (bidirectional) in version 3.0. It is used both as a motherboard-level interconnect and as an expansion card interface for add-in boards. Table 1 compares the bandwidth of PCI Express x1 versus the bandwidth of several other interconnect technologies.

In military applications, higher bandwidth is needed for manipulating data and for Ethernet-based communications, as more and more systems and subsystems become networked and requirements for high-speed, multiple Gigabit Ethernet connectivity increase. According to industry researchers VDC Research Group (VDC), PCI Express is emerging as the dominant high-speed serial interconnect in the stackable module space. VDC also finds that the largest vertical markets for all stackables include industrial automation and control, instrumentation, medical and military/aerospace/defense.

Existing solutions have included a growing array of small board form factors and interfaces. As I/O has proliferated, designers are faced with two choices. The first is to build larger-footprint single board computers (SBCs) with more integrated I/O, such as Embedded Board eXpandable (EBX) boards, at 8 x 5.75 inches (203.2 x 146.05 mm). The second is to construct taller, stacked-board systems based on stackable architectures such as Embedded Platform for Industrial Computing (EPIC), at 4.5 x 6.5 inch (115 x 165 mm), or PC/104, at 3.6 x 3.8 inches (90 x 96 mm), which enable I/O modules to be stacked on top of an SBC and can accommodate these expansion needs.

Demand Ramping Up

VDC has said that stackable board architectures such as PC/104, EPIC or EBX are attractive to OEMs and integrators facing these challenges, since expansion boards can be added vertically to preserve a small footprint. VDC expects a compound annual growth rate of 9.33% for shipments of all stackable modules between 2007 and 2012 (Figure 1).

Today, many designs begin with the I/O, not with the CPU. Since the I/O drives the bus requirements, and then the CPU requirements, it makes sense for the designer to start with the most unique I/O and work back to a standard CPU. Although the form factor of an SBC is tied to its mechanicals—how the board is mounted in the system and its cabling attachments—the interfaces are important because of data throughput and how easy it is to attach I/O. At the same time, the strong drive toward smaller board sizes and the flexibility needed for a platform to serve multiple uses means that a taller, stackable platform is more likely than a larger-footprint SBC with everything on it.

The SUMIT Solution

Instead of assigning one connector per bus, and instead of defining yet another board form factor for next-generation, low-power, high-performance, small board-based systems, it makes more sense to separate the interconnect standard from the form factor standard, and design a new interface that integrates and consolidates both high- and low-speed serial and legacy buses. Keeping the same form factors and updating only the interfaces, lets form factor standards and interface standards evolve separately. When a new form factor becomes available, it can support all of those interfaces, which helps minimize revisions to the specifications and increases the design platform's longevity.

The Stackable Unified Module Interconnect Technology (SUMIT) from the Small Form Factor Special Interest Group (SFF-SIG) does exactly that. The interconnect technology chosen for the open standard SUMIT interface accommodates multiple high- and low-speed buses in a single high-speed connector (SUMIT-A connector), using less board space than previous solutions. The SUMIT-A connector supports several buses, including PCI Express, USB, LPC, SPI, SMBus and ExpressCard.

An optional second connector (SUMIT-B), with the identical size and pin count, supports additional PCI Express lanes for more channels or higher bandwidth. Either or both connectors can be used on a board. Another optional connector offers support for legacy ISA devices. The specification is designed to optimize cost per pin, pin density and signal integrity. It provides the basis for a stackable, I/O-centric, multi-board solution via an expansion approach that is independent of any particular board form factor. It is also designed to be processor-independent, since it focuses on bus and

PCI Express x1 vs. Other Interconnect Speeds

Interconnect	*Maximum Bandwidth*
PCI Express x1	250 Mbytes/s (500 Mbytes/s bi-directional)
SATA	150 Mbits/s
PCI	133 Mbits/s
Gigabit Ethernet	125 Mbits/s
IDE (ATA 100)	100 Mbits/s
USB 2.0	60 Mbits/s
IEEE 1394 (Firewire)	50 Mbits/s
ISA	16.67 Mbits/s

Table 1

PCI Express provides vastly more bandwidth than these other interconnect technologies.

interconnect technology rather than on a particular processor.

Not Tied to Board Size

The SUMIT interface specification defines the two different connectors, their respective pin assignments, and their relative placement on the board. Because it does not define a specific board size, the SUMIT connectors can be implemented across multiple board form factors, such as PC/104 and EBX in standard and semi-custom SBCs. A board built to this specification can use only the SUMIT connectors, in which case it is a COM. Or a SUMITBoard can also include pin headers for other I/O such as IDE, Ethernet, or GPIO, in which case it is a hybrid SBC/COM. By using two smaller, separate connectors instead of one large connector, the maximum amount of I/O bandwidth is balanced with the minimum amount of board space. An expansion or add-on board built with only a single SUMIT connector can plug directly into other processor or expansion cards populated with both SUMIT connectors, reducing overall system cost.

The SUMIT-A connector's more space-efficient, low-speed buses are the same ones integrated into many of today's processor chipsets. Those connections are useful when designers who want to migrate to low-speed I/O functions—used for tasks such as low-rate data acquisition or switching relays on and off—to those buses to replace the bulky ISA bus. SUMIT connectors can also co-exist with ISA connectors, since ISA occupies a different location on the board. Figure 2 shows an example SUMIT Ethernet board. The SUMIT-A and SUMIT-B connectors are the two connectors shown here near the top of picture.

SUMIT Technical Description

The connectors chosen for the SUMIT interface play a critical role in meeting the specification's goals. The SUMIT interconnect system has several requirements for connectors that implement the interface. They must be able to handle the high-frequency signals required by PCI Express and USB, and must be available off-the-shelf as a standard product. They must have closely spaced, fine-pitch pins in order to minimize the board space consumed.

The SUMIT specification's connectors are based on the Samtec QFS/QMS Micro High Speed Connector series. The Samtec connector is a one-bank terminal assembly that provides a ground blade in the center of the connector body. The QFS connector measures only 0.88 x 0.32 inch (22.35 x 8.13 mm). It features a unified internal ground interface for improved routing characteristics and for efficient use of all 52 pins.

Both the A and B SUMIT connectors are 52-pin, high-density (0.634 mm-pitch) connectors. In addition to the high- and low-speed buses, they also contain +12V, +5V, +5V standby, +3V, grounds, and other control and status signals. Center ground blades provide impedance, EMI and DC ground return.

Figure 3

This SUMIT-ISM board diagram shows relative positions of SUMIT-A and SUMIT-B connectors, ISA connector and mounting holes.

The SUMIT-A connector contains one PCI Express x1 lane, four USB 2.0 ports, an LPC bus for expansion serial ports and other legacy I/O, an SPI port, an ExpressCard port, and a general-purpose Inter-Integrated Circuit (I^2C) bus that is usually connected to the SMBus for use with x86 chipsets. The SUMIT-B connector contains one PCI Express x1 lane and one PCI Express x4 lane, as well as additional power, ground and control signals. The PCI Express x4 lane can be split into four x1 lanes. SUMIT supports PCI Express 1.0 and 2.0, with speeds of up to 500 Mbytes/s per lane (bidirectional).

Supporting Low and High Speeds

With a variety of bus signals on the SUMIT interface, multiple types of I/O cards can be combined in a stack, giving the flexibility of both high- and low-speed functions. The SUMIT-A connector supports low-speed applications, similar to ISA speeds, via the LPC bus, as well as a USB expansion scheme. The SUMIT specification defines the relative placement of the A and B connectors to each other on the board in order to ensure proper routing as signals are passed from one connector to another up through the stack of cards, as well as to ensure mechanical compatibility.

A separate SUMIT specification, SUMIT ISM (Industry Standard Module) (Figure 3), uses the SUMIT stackable architecture on a PC/104-sized, 3.6- x 3.8-inch (90 x 96 mm) module. The specification for the location of the SUMIT connectors is such that the original PC/104 (ISA) connector can be used along with SUMIT on the same board. This makes it easy to migrate from systems with PC/104 ISA expansion modules to a system with mixed SUMIT and PC/104 expansion stack. The SUMIT interconnect is currently specified for EBX, EPIC and PC/104-sized CPU and expansions boards. ■■

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Tech Recon

MicroTCA and AMC in Military Systems

AMCs Expand MicroTCA's Military Potential

By re-purposing AMCs as slot card boards instead of mezzanines, MicroTCA leverages the established portfolio of AMC products and the military is embracing the idea.

David Pursley, Field Applications Engineer
Kontron

Modern warfare systems must expertly blend issues of ruggedness, flexibility, mobility and high-end processing with the need for standards-based solutions that can be developed and deployed within demanding timeframes and budgets. Modular components such as Advanced Mezzanine Cards (AMCs) offer a significant design advantage in this monumental challenge—providing the building blocks that make MicroTCA a powerhouse platform for military embedded design.

With an incredibly diverse set of application requirements, today's military technology initiatives demand similar versatility within overall system design. System management, redundancy, processing power, form factors, housing and usage of fabrics are just some of the performance considerations keeping system designers on their toes—constantly working to understand performance issues and work within primary military requirements such as standards, processing capacity, cost and upgradeability. MicroTCA is a practical choice in many of these design scenarios, gaining significant ground in high-performance military computing due to its standards-based, rugged, high-bandwidth performance in a small footprint. AMCs in turn are at the heart of MicroTCA, and are probably the most misunderstood element behind its versatile performance punch.

Figure 1

This compact AMC platform supports any standard compliant AMC and MCH. This system saves cost by using a standard power supply unit.

AMCs Defined

Based on PICMG's Advanced Mezzanine Card (AMC) specification, AMCs provide high computing power and multiple switch serial connections in a 2U board format, making it a more compact platform than even 3U VPX or 3U CompactPCI. Additionally, many infrastructure programs can benefit from AMC's hot-swappable feature. This means they can be replaced without powering down the entire system, an ideal function for mission-critical, real-time military computing and networking applications.

There are many types of AMCs, and which to use simply depends on the functionality being designed into the system. Processing performance, communications, data storage and input/output options are chief among the high-performance features enabled by AMCs. Processor AMCs host microprocessors and network processors. Storage AMCs might host flash memory chips or a solid-state drive to store critical data.

Flexible Format

AMC modules offer a flexible combination of size, performance options and features that make them versatile building blocks for system design. Designers can create MicroTCA systems with as few as one or two AMC modules, creating the potential to be more cost-effective than its larger counterpart, AdvancedTCA (ATCA). MicroTCA systems can offer up to 12 slots, which makes the platform highly suitable for high-bandwidth, high-

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performance military applications.

MicroTCA is also a very flexible platform, offering a wide range of design and performance options as each slot could contain a different type of AMC module. For example, using six slots for CPUs and the remaining six for network communication could result in a mini network offering high-bandwidth processing and real-time data transmission for COMSEC applications handling red, black and colorless information. Integrating twelve CPUs in a single MicroTCA system could create a mini super computer, ideal for the demanding processing chores of military applications such as SDR (software-defined radio), image processing or TRANSEC (transmission security) for sharing voice, data and video securely throughout the battlefield and command centers. Figure 1 shows an example system designed to serve such roles. The Kontron OM6120 is a compact AMC platform, supporting any standard compliant AMC and MCH. In comparison to conventional MicroTCA implementations, it achieves significant cost improvements by a simplified design, which eliminates the need of MicroTCA Power Modules and uses standard PSU instead.

Initially used as a component within the ATCA platform, AMC modules were typically seen in tandem with an ATCA carrier board or within AMC slots in a CPU or switch blade. This allowed for hot-swap and redundant system management with an ATCA system, or provided additional processing functions on a single ATCA node or switch blade.

Figure 2
This Processor AMC is based on an Intel Core2 Duo processor. The board uses high-temperature resistant components making it suited for military applications.

Mezzanines as Blades

As a functional component within the ATCA platform, AMCs are used to add on specific features or functions. In contrast, in the smaller MicroTCA platform, AMCs plug directly into the backplane—essentially turning the mez-

AMCs: Suited for Radar, Sonar and Image Processing

MicroTCA systems can accommodate up to 12 mid-size AMCs and up to two MCHs (MicroTCA Carrier Hubs), supporting a range of configurations that vary depending on the designer's intended application. In a redundant dual-star GbE configuration, the AMCs connect to both MCHs via AMC ports 0 and 1. The fabric ports 4-7 of each AMC would connect to MCH 1, and the extended fabric ports 8-11 of each AMC would connect to MCH 2. The fabrics could use x1 or x4 PCI Express, sRIO, or XAUI as the communications interface.

When AMC bays are fully compliant with the PICMG's AMC standards and MicroTCA standard, any standard-compliant AMC may be used, including single- or double-wide form factors (using adapters as required). In combination with an AMC layout of two rows, fabric options can facilitate a dual-channel processor architecture with arbitration or checkpoints between the channels.

By accommodating a high number of multicore AMCs and allowing a tight coupling of processors over high-speed backplane communication links, this type of MicroTCA implementation is well suited for radar and real-time image processing, or voice, data and video applications in single-channel or dual-channel architectures. Clock distribution on the backplane enables the synchronization of processor AMCs to an internal or external clock for applications such as radar, sonar, or any other real-time parallel processing application. To ensure interoperability among vendors, port mapping and use of clocks in the backplane correspond to the recommendations of the industry consortium, SCOPE alliance.

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zanine into a blade itself. MicroTCA is an open specification intended for plugging in hot-swappable AMCs, creating a small yet highly powerful and scalable system, taking full advantage of the flexibility and performance of modular design.

Due to this modular approach, AMC modules deliver a flexible mezzanine form factor, originally intended to provide telecommunication equipment manufacturers with an open-standard architecture. But as AMCs began incorporating even more advanced performance and features, designers realized this level of versatility could extend much further beyond ATCA-based telecommunications and into the high-performance computing environments found in the range of military applications. Combined with the smaller form factor MicroTCA, AMCs offer the flexibility to be used as a main controller, data server, traffic processor, image or signal processing engine, security appliance or network processor. Figure 2 shows an example Processor AMC, the Kontron AM4011 based on an Intel Core2 Duo processor. The board uses high-temperature resistant components making it an ideal fit for military applications.

The AMC Evolution

Input/output is one area in which AMCs are developing fast, driven by the changing demands of military computing and communications. Serial ports, fiber optics and even the more niche-specific I/O such as MIL-STD-1553 used in airborne applications, are starting to appear in AMC format. sRIO (serial Rapid IO), 1 and 10 Gigabit Ethernet (10GbE), PCI Express and Fibre Channel connectivity can be implemented quickly and easily using the right combination of AMCs. Double-wide (4U) AMCs may span two or even three of these performance categories—for example adding processing power but also acting as an I/O module, and reducing design cost in the process.

Ultimately, there is diverse use of AMCs across the range of military applications.

When integrated with a MicroTCA 2U platform, AMC modules can be configured, depending on the application, with other processor and storage AMC modules for various integrated security services. When a MicroTCA system grows to 3U or perhaps 4U—and every blade is using a multicore processor—it could be operating today with as many as 24 cores. Such a system would still maintain a very small footprint, which may be what military designers consider MicroTCA's most powerful and unique design advantage.

Basing MicroTCA on AMCs enabled its rapid development and adoption. The continued evolution of AMCs and the versatility they bring to military embedded design has had significant impact on the further growth of MicroTCA. Designers can add, layer by layer, niche-specific performance and features that make the most out of MicroTCA's 12 available slots. Scalability and rugged high performance in a small form factor may be the key design values of MicroTCA, enabled by its close relationship with AMCs. And because of its ability to handle greater amounts of band-

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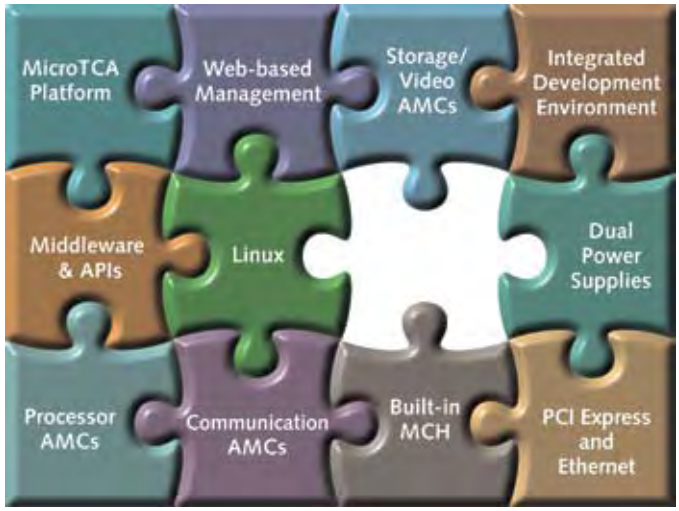

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width, MicroTCA is frequently an ideal design fit for applications within the Army's BCT (brigade combat team) modernization strategy, JTRS (Joint Tactical Radio System) and WIN-T (Warfighter Information Network – Tactical) programs. New and more rugged MicroTCA specifications show even greater promise, applying the design principles of ATCA and AMC to smaller form factor, plug-in systems.

A Rugged Future

AMCs are designed to meet NEBS Level 3 requirements, ready to handle thermal margins, fire suppression, emissions and severe earthquake damage. Today's standard COTS MicroTCA systems and their integrated AMC modules are rugged enough for use in ground installations or on certain types of airborne platforms—but this is evolving, and several additional ruggedized standards are in progress with PICMG.

Rugged air-cooled MicroTCA (PICMG MTCA.1) was ratified recently and extends MicroTCA into more rugged military environments as defined by ANSI/VITA 47's EAC6 environmental class and V2 vibration class. PICMG MTCA.3 is standardizing a conduction cooled interface allowing AMCs to meet ANSI/VITA 47's most extreme thermal, shock and vibration profiles—for example, performing in conduction-cooled systems within sealed ground mobile environments.

MicroTCA boards and systems are available now for high shock and vibration air-cooled environments, performing optimally through use of shock isolation, all soldered components and board locking mechanisms. Also conduction-cooled MicroTCA is available today by using a standard AMC surrounded by a "clamshell" with wedge locks for thermal dissipation, in line with the MTCA.3 standard.

Design Options with AMCs

As a versatile and flexible COTS building block for ATCA and MicroTCA-based systems, AMCs have proven their mettle for military networks designed to be extremely mobile, rugged and adaptable for many battlefield situations. Radar, sonar, telemetry, SDR, COMSEC, image processing and C4ISR are just some of the military applications that require the high performance and high bandwidth provided by MicroTCA. In both redundant and non-redundant MicroTCA platforms, the form factor can vary between single- or double-wide AMCs and provides full-scale PCI Express, GbE, 10GbE or serial Rapid I/O connectivity.

To further reduce SWaP (size, weight and power), a growing number of applications are using AMCs with low-cost backplanes and a reduced-functionality infrastructure, retaining a standard AMC implementation but reducing cost of the overall platform. It's a "pay for what you really need" design approach that satisfies many military requirements such as cost, development time, footprint and specific performance demands.

This design approach has transitioned the use of AMCs from within an ATCA platform to a MicroTCA platform, con-

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

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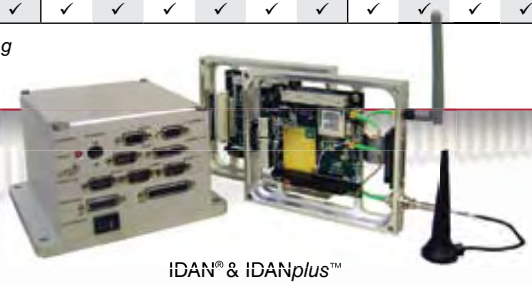

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Bus	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA				ISA	ISA		PCI				ISA		PCI	ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
Analog Input	Single-Ended Inputs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

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sisting of single- or double-wide AMC modules as the primary system components. Based on the PICMG MicroTCA system specification, scaling from four non-redundant to up to 12 AMC modules with redundancy is a permitted configuration with the MicroTCA backplane. This provides a significant level of flexibility in a smaller footprint, and is a vital feature for MicroTCA-based designs in demanding military applications. Low-cost AMC system implementations (with direct interconnectivity between two to four AMC modules via the backplane) also provide flexibility in cost and functionality.

MicroTCA Moving Forward

Integrated battlefield management is essentially the network approach to warfare—an atmosphere of high-bandwidth, high-performance computing ideal for powerful and scalable MicroTCA. Today's missions include intensive signal processing, secure multimedia and battlefield communications, avionics and sensor processing, shipborne servers and a multitude of other demanding computing tasks and environments. AMCs hold significant potential for addressing the military's rapidly transforming technology demands, and have already been adopted by Lockheed and Boeing's P-8A program (Figure 3), and actively deployed by Harris and BAE in WIN-T applications.

Standardization initiatives evolving throughout the defense and aerospace industries will continue to drive technology toward open, standards-based multicore computing platforms. MicroTCA and its connection to the mass market appeal and availability of AMCs should mean continued cost advantages in this high-bandwidth, high-performance, small form factor architecture. Designers are seeing that they enable a cost-effective solution that can speed time-to-market for multiple applications on the same platform—and as a result of this popularity, a strong ecosystem to support them is thriving and innovating as well. ▮▮

Figure 3

AMCs have already been adopted by Lockheed and Boeing's P-8A program. The P-8A Poseidon is a long-range anti-submarine warfare, anti-surface warfare, intelligence, surveillance and reconnaissance aircraft. P-8A has the fuselage of a 737-800 and the wings of a 737-900.

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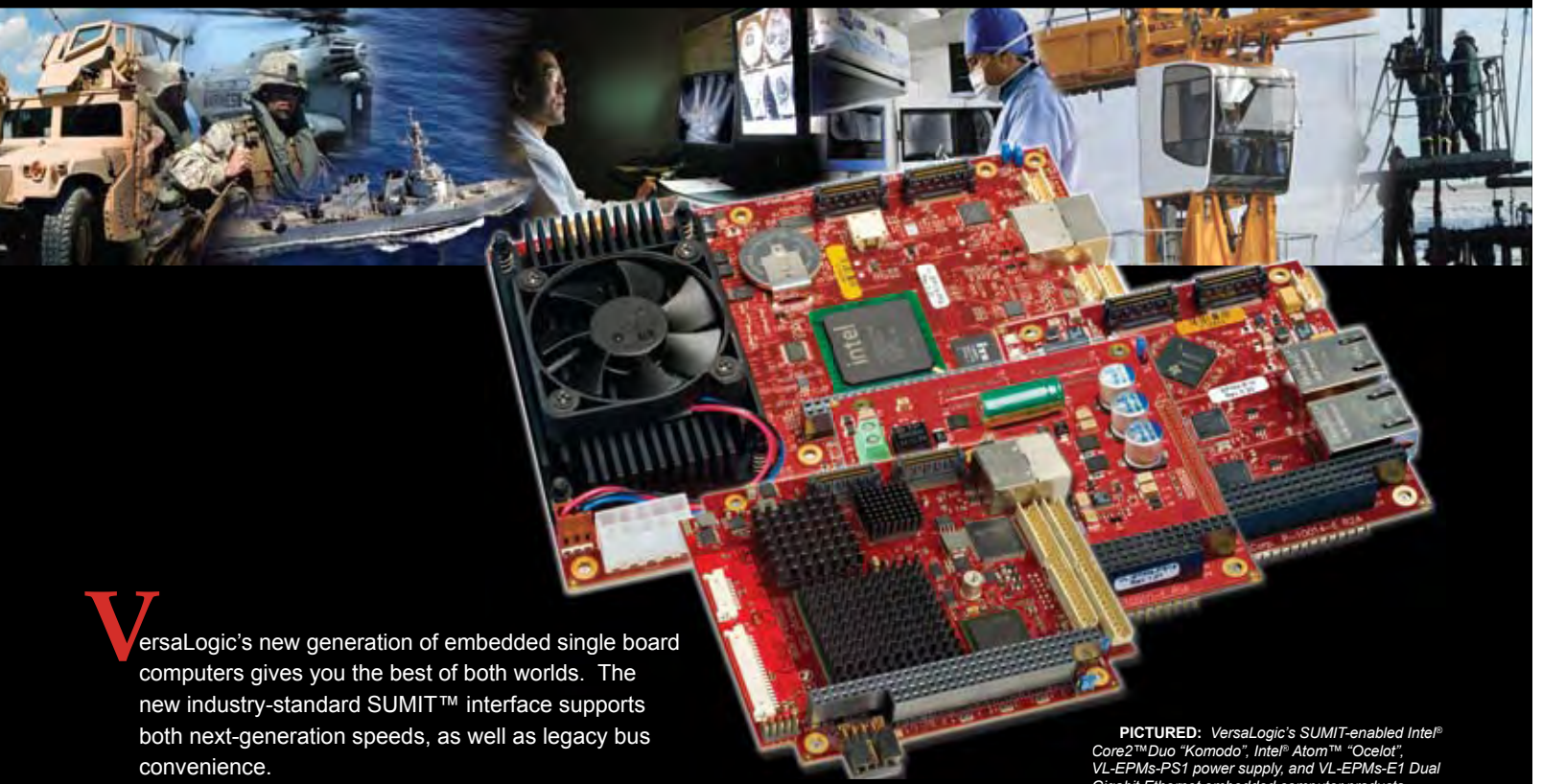

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MicroTCA, in its various proposed flavors, offers various levels of rugged performance. Tests performed to the PICMG specs put MicroTCA connector solutions through their paces.

Phill Shaw, Product Manager, Electronics
Harting North America

MicroTCA connectors are extremely robust and therefore suitable for use in applications beyond telecommunications. In every situation, the connectors have to guarantee secure connections despite being subjected to shocks, impacts and vibrations. Originally deployed for the telecommunications industry, MicroTCA uses a robust mechanism that is highly suitable for simple industrial applications. Conventional MicroTCA systems are, however, limited to low-shock and low-vibration applications. In various tests, it has been shown that MicroTCA solutions can also be used in areas with strong vibrations—for example, in vehicle systems or aviation.

These tests, performed by Harting engineers, were based on PICMG specifications. The "Rugged MicroTCA" workgroup is currently developing various specifications that expand the existing MTCA.0 base specification. Additional requirements and tests for the use of MicroTCA in rugged environmental conditions are to be established. The requirements that connectors have to meet are already largely defined. The requirement profiles are currently divided into three specifications, which target industrial and outdoor applications (MTCA.1) and applications from the transportation market, aviation and defense applications (MTCA.2 and MTCA.3).

Rugged and Hardened Specs

The specifications are named after the cooling concept that, under MTCA.1, is known as "rugged air-cooled." This refers to an air-cooling that is to meet additional requirements regarding vibration and shock testing and is planned, in particular, for industrial applications. As extended temperature ranges are also defined, MicroTCA is also interesting for outdoor applications.

MTCA.2 systems have to meet the "hardened air-cooled specification" and are therefore to be designed for more extreme shock and vibration conditions. Air cooling is also planned for these systems, however, with tougher requirements in terms of shock and vibration.

The MTCA.3 specification describes a cooling without moving parts ("hardened conduction-cooled specification"). The transition between MTCA.2 and MTCA.3 is not really defined yet. It is already clear that in MTCA.3 the modules are fixed in the system by means of wedge locks similar to rugged CPCI, VPX or VME systems.

In all three applications, the system is often exposed to enormous stresses. It is therefore absolutely essential that the connector withstand this stress without any contact interruption. This poses a great challenge for a card edge connector such as MicroTCA. Figure 1 shows the test fixture where three AMC cards were tested. The cards were in "double full size" form factor with a weight of 700 grams each

Figure 1

Shown here is the test fixture where three AMC cards were tested. The cards were in "double full size" form factor with a weight of 700 grams each.

Stress Testing MicroTCA Connectors

To ensure that its MicroTCA connector can withstand these stresses, Harting has

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AD350

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Virtex 5 PMC/XMC

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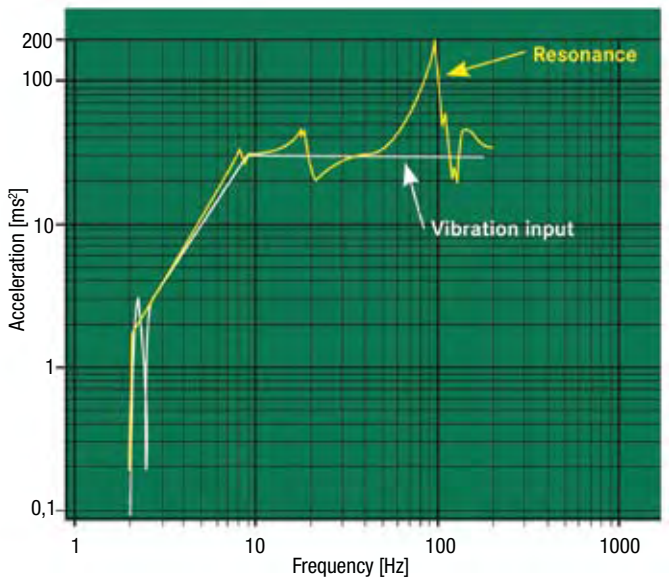

Figure 2

With the sinusoidal vibration at 30 m/s² acting on the system, at a resonance of approximately 100 Hz, the value is almost 200 m/s².

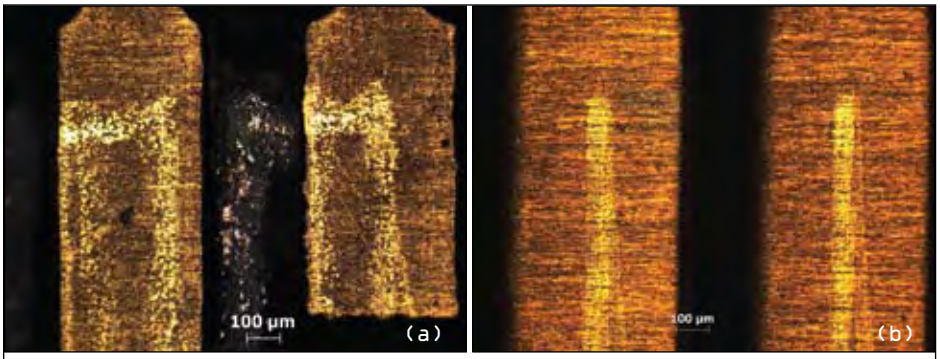

Figure 3

When testing the connectors without con:card+ properties (a), the test module could move and this caused contact interruptions. The Harting con:card+ connector (b) with GuideSpring passed the test successfully.

carried out several tests and simulated the described conditions in an accredited laboratory. The aim was to prove that Harting solutions already meet future requirements for MTCA.1 to MTCA.3. The test system was equipped with mechanical components according to the MTCA.0 specification. Conventional AMC modules according to PICMG AMC.0 were used as test cards.

For MTCA.1, which is ratified since a few months ago, a sinusoidal vibration with an alternating frequency of 2 Hz to 200 Hz is defined as well as a random vibration test. For the sinusoidal test, this frequency range will pass through ten times in three axes; the test setup will simulate three times the gravitational acceleration (30 m/s²). No contact interruptions should occur during the tests. The Harting con:card+ connector passed this test successfully. Figure 2 shows the vibration test results.

Test conditions do not take into account the fact that much greater accelerations can develop in the system. In order to simulate an extreme case, the test cards used with the "double full size" form factor weigh 700 grams. The card that, as in the real system, reveals a little play in the guide rails and fastening, gets in resonance when passing through a certain frequency range. In the axis of oscillation perpendicular to the test card, in the resonance range, up to 20 times the gravitational acceleration was measured on the test card close to the connector.

Figure 4

The con:card+ backplane connector and the plug connector for the AMC module.

When subjected to these enormous stresses, no contact interruptions occurred in the Harting con:card+ connectors tested. The high normal force of the contacts stabilized the test cards during high accelerations. This prevented any contact interruptions that could otherwise have been caused by increasing the resonance.

Stabilizer Solution

In the vibration direction lengthwise of the connector slot, the GuideSpring acts as stabilizer. The original purpose of the GuideSpring is to offset any possible tolerance deviations by means of a defined positioning. The GuideSpring presses the card against the opposite wall and fixes it. During stronger shocks and vibrations, this fixing by the GuideSpring prevents from any movement in the lengthwise direction of the connector and thus also any contact interruptions. The Harting con:card+ connector also passed the shock test with 25 times the gravitational acceleration without interruptions.

Besides the Harting connectors, two conventional MicroTCA connectors without con:card+ features were also tested. In the test, the conventional MicroTCA connectors revealed regular contact interruptions in two out of three axes. These interruptions occurred in both the vibration and the shock test. Figures 3a and 3b show the difference between connectors tested without the GuideSpring and with it.

An optical evaluation of the test modules revealed the reason for the contact interruptions. The wear of the con-

nector contacts on the gold pads (after 100 mating cycles and the vibration and shock test) shows that the test module moved in the connector. This movement was so great that the contact fell off the gold pad. However, as Figure 3 shows, the GuideSpring displaced the module somewhat toward the middle and held it securely in place during the vibration and shock test. The GuideSpring thereby makes a fundamental contribution to the good performance of the con:card+ connector compared with connectors without GuideSpring. Figure 4 shows the con:card+ backplane connector and the plug connector for the AMC module

The plug connector provides an alternative to the card edge and gold pads on the AMC card. The manufacturing tolerance of the plug connector is much lower than that of the PCB card edge. Contact interruptions that are based on the tolerance problems of the card edge are prevented from the outset. This was also shown in the vibration and shock test, which the plug connector passed successfully without any contact interruptions.

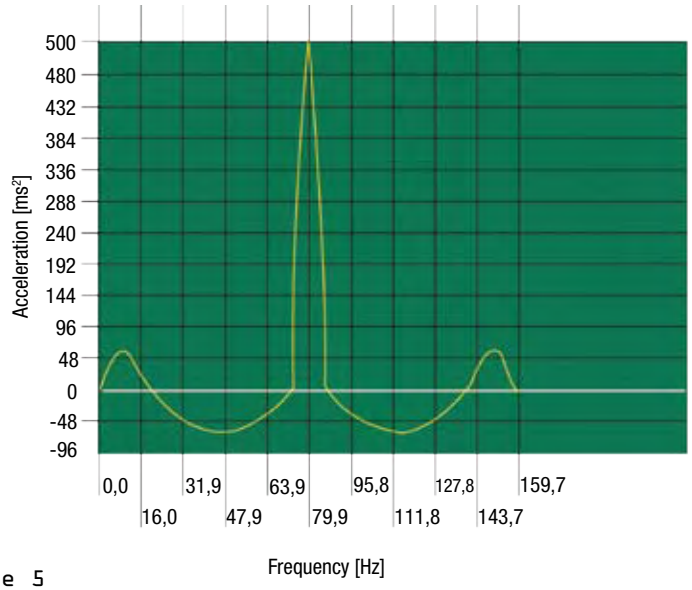

Figure 5

During the MTCA.3 shock test, the system is accelerated to almost 500 m/s².

Testing Ahead for MTCA.2

The specification for the MTCA.2 has only just started. A vibration test with random vibration will be defined as test condition. The intensity of the vibration and thus the system stress is measured in the so-called PSD level (power spectral density). The test, as is discussed today in the PICMG, is to be carried out with the PSD level 0.1 g²/Hz. This corresponds to a maximum acceleration of 13g. In tests,

the con:card+ connector has met this and further requirements: it passed the test at a PSD level of 0.2 g²/Hz (max. 18g). With this test, the requirements for the random test for MTCA.1 (0.04 g²/Hz) are already fulfilled. The shock with 40g did not reveal any contact interruptions.

In the MTCA.3 specification, the AMC cards are firmly fixed to the system. In the test for the hardened conduction-cooled specification, the test setup is also fixed in this way. A test with random vibration is also defined (in accordance with EIA-364.28). The test condition will be a PSD level of 0.2 g²/Hz. The con:card+ connector also passed already a test of an increased PSD level of 1.5 g²/Hz (equal to an acceleration of 46g) without contact interruption. The shock test for MTCA.3 is based on the VITA 47 and the MIL-STD-810 specification with 40 times the gravitational acceleration. Harting increased this requirement again and tested successfully with 50 times the gravitational acceleration. As Figure 5 shows, during the shock test, the system is accelerated to almost 500 m/s².

The PICMG will continue to work on a specification for a rugged MicroTCA system. It is expected that the specifications and requirements will be changed and adjusted during the course of the discussions. The tests show the fact that the Harting MicroTCA connectors can be used in systems under rugged environments, such as outdoor, transport, aviation and defense applications, and also offer high contact reliability. Conventional MicroTCA connectors, on the other hand, produced much poorer results and cannot currently be used in the same application spectrum. ▮▮

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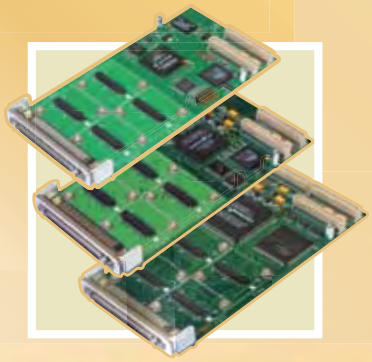

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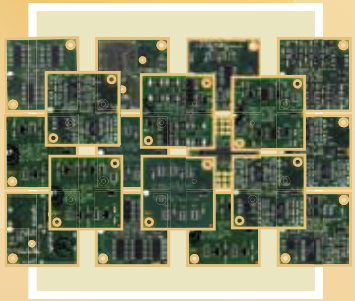
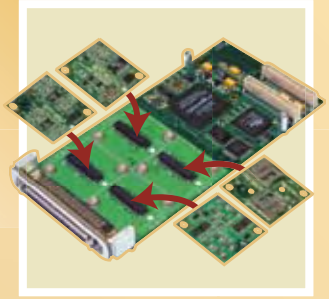


3 Assemble with IP Core and ECM Code



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System Development

1U Blade Servers Invade Military Designs

1U Rackmount Boards Serve Up a Diverse Array of Solutions

The 1U server form factor is slowly carving out a niche in military embedded computing. 1U product vendors are bringing all the key technologies to bear: Ethernet, GPU processing and multicore combined with all the ruggedizing tricks of the trade.

Jeff Child
Editor-in-Chief

1U Blade Server computing solutions and other 1U rackmount boards are rapidly finding a niche in a variety of military applications such as SATCOM-On-the-Move systems. Now that complete server-level computers are available in a 1U blade, it's possible to pack a lot of computing in a convenient rack-based space along side off-the-shelf 1U network routing and advanced communications boards. The 1U form factor makes it easier to put together systems that incorporate existing IT-based 1U boards, such as specialized encryption systems, precision timing boards or tried and true networking gear like Cisco routers.

In contrast to backplane-based architectures like VME or CompactPCI, 1U rackmount systems are busless and typically use Ethernet or other cable-based technology to link boards with one another. The lack of a backplane also significantly reduces overall system weight. An example Ethernet-centric 1U blade is Win Enterprises's PL-8000—a 1U rackmount networking and network security platform based on the Intel EP80579 integrated processor. The EP80579 is a system-on-a-chip (SoC) that integrates CPU, North Bridge, South Bridge and optional Intel QuickAssist accelerator technology on a single chip.

Figure 1

One Stop Systems' 1U PCIe expansion platform supports either two double-slot graphical processing units (GPUs) or four single-slot GPUs.

The platform offers a choice of processor performance of either 600 MHz or 1.2 GHz, a high-bandwidth DDRII DIMM slot with memory up to 2 Gbytes, and a full set of VPN functions such as encryption, hashing and public/private key generation. Storage features include one 3.5-inch SATA HDD and CompactFlash. The platform offers five GbE Copper and a maximum of eight GbE Ethernet ports via PCI-E x1 or x4 that are accessible on the front panel. To prevent network problems when the platform shuts down, PL-8000 supports one segment of LAN bypass function through WDT and GPIO pin definitions.

GPU Accelerator in 1U

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Figure 2

The AMP5071 from Performance Technologies is a 1U MicroTCA system. Designed for military system engineers developing IP-based communication products, it integrates AMC cards into a 1U rackmount subsystem.

One Stop Systems (OSS) for its part offers a 1U PCIe expansion platform (Figure 1), designed specifically for the emerging computational accelerator market. The expansion platform supports either two double-slot graphical processing units (GPUs) or four single-slot GPUs. An internal system monitor surveys system parameters and reports status through an Ethernet port on the rear of the enclosure. The PCI Express interface delivers data transfers up to 80 Gbits/s to the host system through a host adapter that installs in the host computer's PCIe x16 expansion slot. A 1-meter standardized PCIe x16 cable is included with the platform. While it can be installed up to 10 meters of its host system using the standard PCIe cable, greater distances from the host system can be accommodated using fiber optic solutions provided by OSS. Accelerator expansion systems are typically used in military comms centers, video imaging systems and simulation applications.

1U Rackmount Meets MicroTCA

A lot of military applications lend themselves to modular "building block" approaches that allow designers to scale and mix-and-match the functions they need. Performance Technologies brought that idea into the 1U rackmount space by implementing MicroTCA in a 1U format. It uses AMCs as modules just as traditional MicroTCA, but instead puts them in a 1U server card. The newest member of IPnexus MicroTCA systems, the AMP5071 (Figure 2), is designed for military system engineers developing IP-based communication products. The new AMP5071 enables engineers to begin systems faster, without all the time spent integrating disparate technologies from multiple vendors into a working prototype. The fully integrated system is ideal for applications such as WiMAX gateways, LTE infrastructure equipment, radar gateways, weather alert systems, enterprise VoIP/SIP servers and so on.

The AMP5071 comes integrated with a choice of processing Advanced Mezzanine Card (AMC). Developers can select an Intel Core 2 Duo processor, or a Freescale MPC8641D dual-core 1 GHz PowerPC processor. Additional AMC modules for I/O, storage and compute functions can be easily configured and integrated into the system in order to meet a wide range of IP-based communications design criteria.

Ruggedized 1U Solutions

Although the 1U form factor is most dominant in the IT industry, a number of vendors have implemented 1U solutions for rugged environments. Z Microsystems, along those lines, recently announced its ZX 1-2-3 Series of rugged computer servers (Figure 3) for military applications. Available in three slim—1U 1.70 inch, 2U 3.45 inch and 3U 5.15 inch—heights, the ZX 1-2-3 Series servers are compact and lightweight, saving rack space while delivering a flexible and high-performance solution for mission-ready applications.

The ZX 1-2-3 Series integrates the latest computing technology with a system architecture supporting any extended ATX form factor motherboard

Figure 3

A 1U version of Z Microsystems' ZX 1-2-3 Series of rugged computer servers, supports any extended ATX form factor motherboard with support for up to 3, 6 or 12 rugged hot-pluggable TP2 removable drives, a slim line DVD-RW dual layer, and an environmental control board to support proper thermal regulation.

with support for up to 3, 6 or 12 rugged hot-pluggable TP2 removable drives, a slim line DVD-RW dual layer, and an environmental control board to support proper thermal regulation. Optimized for rugged conditions, the ZX 1-2-3 Series servers host PCI card hold-down brackets that secure cards in all three axis (X/Y/Z). In addition, the front panel provides a filtered dust door with a systems status display to quickly monitor the status of the rugged server. Dual redundant 650W power supplies ensure support for all multicore processors and high-end PCI Express graphics cards. The chassis are designed to meet MIL-STD-810G requirements for shock, vibration, humidity and high/low temperature.

Multicore 1U Processing

The multicore processing trend has swept across all areas of embedded computing, and the 1U server arena is no exception. An example is Themis Computer's XR3 family of high-performance servers for mission-critical applications in harsh environments. These boards are the latest Intel Quad-Core Intel Xeon processors with the ruggedized design features of the Themis RES server family. The new RES-12XR3, RES-22XR3 and RES-32XR3 servers are offered in 1RU, 2RU and 3RU chassis. These new servers feature up to 144 Gbytes of RAM memory, up to eight lockable and removable drives, hot swappable fans and hard disk drives, single or redundant power supply options, and optional front panel filters for increased reliability in field deployments.

These systems combine the Quad-Core Intel Xeon 5500 series processors (Intel Nehalem Microarchitecture), with Themis' advanced thermal and mechanical design techniques. The systems make extensive use of specially coated aluminum for light weight and corrosion resistance. Stainless steel is used in selected areas to add strength and stiffness. The systems feature operating shock rating of 3 axis, 25G, 20ms, and an operating vibration rating of 3.0 Grms, 8 Hz to 2000 Hz. Operating temperature range is 0 to 65°C, and humidity up to 90% non-condensing. Fans, power supplies and disk drives are all hot swappable. ■■

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System Development

1U Blade Servers Invade Military Designs

1U Rackmount Servers Feed High-Density Computing Needs

Able to pack a heavy punch of computing muscle in a compact space, 1U rackmount servers are capturing mindshare in both mobile and fixed rackmount military environments.

Dennis Smith, Vice President, Engineering
Themis Computer

Government organizations deploy a vast array of servers for mission-critical applications in a wide variety of networks—including enterprise computing, field operations, command and control and in the field for warfighting. These servers vary in size, spanning the range from 1U rackmount (1RU) to 4RU configurations. As today's new servers package more processing power into smaller footprints, compact 1RU servers are seeing increased use in mobile as well as fixed rackmount environments.

Shipboard systems like the Navy's Common Display System (CDS) program is an example where rackmount servers systems shine. The program calls for a family of common display systems that will be implemented across platform systems on Navy surface ships, submarines and aircraft—including Aegis Guided Missile Destroyers like the USS Roosevelt (Figure 1). CDS is compliant with Open Architecture Computing Environment (OACE) requirements. CDS enhances survivability and reconfigurability by allowing watchstanders access to their applications at any platform display workstation.

Deployment of the latest 1RU servers is a win-win situation for users, especially when rack space is limited and demand for computing power increases. New 1RU servers often have more processing power than older embedded computers. As this technology transition is taking place, rackspace becomes more readily available, energy use is reduced, and datacenters are able to add more servers to their networks, to run new applications and provide additional services to users.

Figure 1

Navy's Common Display System (CDS) program calls for a family of common display systems that will be implemented across platform systems on Navy surface ships, submarines and aircraft—including Aegis Guided Missile Destroyers like the USS Roosevelt.

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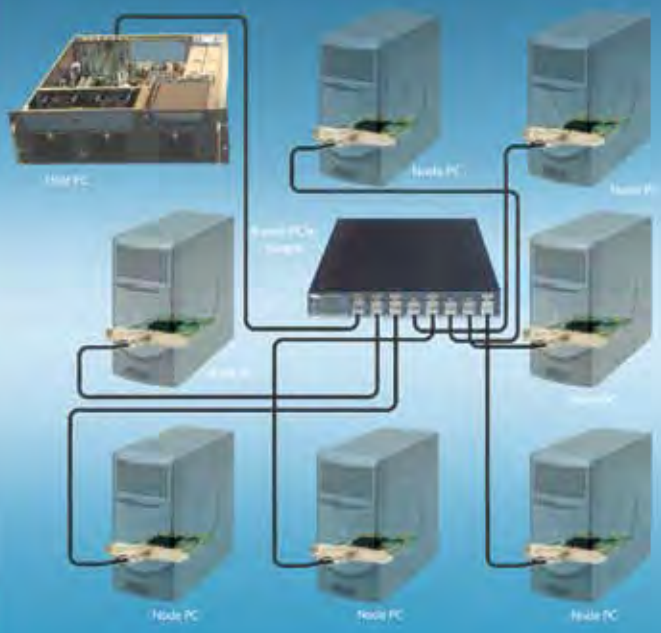

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Figure 2

This 1U version of Themis' XR3 family of high-performance servers uses the latest Intel Quad-Core Intel Xeon processors and features up to 144 Gbytes of RAM memory, up to eight lockable and removable drives, hot-swappable fans and hard disk drives, single or redundant power supply options, and optional front panel filters for increased reliability in field deployments.

Rackmount versus Blade Form Factors

When considering 1RU servers for military programs, keep in mind that there is quite a bit of headroom between the most processor-packed rackmountable technologies and blade technologies. Multicore, multiprocessor socket, high-density rackmountable systems are generally available in a 1RU-sized form factor before it becomes available in a blade form factor. In addition, bladed server processor blades do not have all the storage, memory or performance options that are available in 1RU servers. This flexibility allows 1RU servers to fit in a wider range of applications. Users have to consider the density and I/O potential of rackmountable servers vs. blades, against the performance requirements of the applications they are expected to host.

1RU Server Military Market Trends

COTS motherboards are a valuable resource for anyone interested in leading-edge computing technologies. Motherboard manufacturers are closely coupled to chip and processor vendors, always providing the latest technology as it becomes available. COTS motherboard vendors are also tuned to provide cost-effective, high-value solutions to their commercial customers.

For military applications, having a COTS motherboard solution provides benefits of high density, a mix of general-purpose I/O and low entry price. Packaged into 1RU rackmount packages, COTS motherboard technology allows defense customers access to the latest processor technology. 1RU servers compete favorably with bladed solutions, providing a low entry cost point and good compute density. In addition, 1RU solutions are available from a number of defense-oriented vendors who specialize in adapting the commercial motherboards to the military environment.

COTS vendors serving the defense community are effective at adapting commercial technology to the challenging environment presented by military applications. These include extended temperature operation, high shock and vibration, dust, salt fog, fibers, etc. As more systems are successfully deployed, the requirements get extended to serve a wider set of applications. These applications were at one time depending on full Mil-Spec components, but now are looking for COTS solutions when applications are technology refreshed. In essence, the defense community likes the idea of COTS but needs equipment to operate in traditional harsh environments. To answer this challenge, COTS suppliers are extending the capability of commercial components to allow for wider temperature operation. This is done either as part of the design or as special manufacturing screens.

For airborne contaminants, filters

are being added to products to reduce or eliminate particle contamination of delicate electronic components. Humidity and salt corrosion presents a particularly difficult problem to COTS equipment primarily because the circuit design of the COTS material is not suited to that environment. To meet stringent startup conditions at high humidity, special design techniques need to be employed to reduce sensitivity to localized condensation at power up. These design techniques are not generally employed in off-the-shelf motherboards. COTS suppliers work around these weaknesses in the way the motherboards are packaged, paying particular attention to airflow, to keep moisture buildup to a minimum.

EMI requirements, found in defense standards such as MIL-461, are being called out in COTS RFQs. As such, suppliers have to adapt their products to support these more stringent EMI standards, through special filtering of input power and by paying attention to shielding of the enclosure, as well as I/O cables.

Meeting SWaP Needs

1RU systems measure up reasonably well in SWaP (Size, Weight and Power). They are competitive with blade systems when all the power, cooling and I/O requirements are taken into account. They do not have the modularity inherent in blade designs but provide an easy one-stop solution when the application fits well within the constraints of the 1RU system (CPU, memory and I/O). They are a superior solution compared to commercial bladed systems at accommodating extended temperatures and other military environmental conditions.

1RU servers adhere to MOSA (Modular Open System Approach) precepts—providing both a business and technical strategy for developing a new system or modernizing an existing one. As a business strategy, it enables program teams to build, upgrade and support systems more quickly and affordably. More importantly, the investment in 1RU servers preserves future investment by utilizing a standard rack-based package envelope.

1RU servers are used in a variety of applications today ranging from endpoint control systems to sophisticated display consoles and radar. The attractiveness of these machines is their quick design, qualification at deployment time. Application development can be done on a standard commercial machine and easily transferred to the deployed platform, with a minimum of further testing. Software compatibility issues inherent in VME, cPCI or other bladed bus-based architectures have been reduced significantly.

With their large number of processing cores, 1RU machines also have the ability to consolidate a number of applications that used to take multiple CPU boards, into one machine, possibly having the advantage of higher performance and lower complexity. The investment in software, once made, remains intact over generations of hardware changes. 1RU servers provide a good platform for performance increases due to the improved power and cooling capabilities in the 1RU rack design.

Where 1RU Systems Aren't a Fit

With all the attributes in favor of 1RU machines, there are still applications that are not a good match. Applications that are very low power or in constrained spaces, or need high degrees of modularity, are not good candidates for 1RU servers. Those applications are better served by traditional or custom solutions. Small UAVs are a particular challenge in that they require special interfaces, very low power and are constrained by space.

Themis' 1RU systems are designed as cost-effective, universally applicable solutions for a variety of mission-critical naval combat systems. All key components are high-volume, mass-market COTS products integrated within an "Enabling Environment." The basic system infrastructure facilitates easy and rapid technology insertion, without need for wholesale changes to the system, when only a subset of the system needs to be refreshed. Themis' RES systems (Figure 2) are designed with redundant, hot-swappable power supplies, even for MIL-461 systems.

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Technology Focus

PXI, VXI and LXI Boards

PXI, VXI and LXI Boards Each Find Their Instrumentation Strengths

Now firmly established, LXI and PXI Express architectures provide a road to faster bandwidth. Meanwhile, legacy PXI and VXI continue to serve military test and instrumentation needs.

Jeff Child
Editor-in-Chief

At one time, it took a whole rack of test gear to implement military and aerospace test systems. Now that same functionality can be built using standards-based instrumentation and embedded computer systems. Feeding such needs, three form factors have evolved—PXI, VXI and LXI—and each with its own entrenched ecosystem of board products and options.

PXI (PCI eXtensions for Instrumentation), an open specification from the PXI Systems Alliance, defines a rugged, CompactPCI-based platform optimized for test, measurement and control. PXI products are compatible with the CompactPCI form factor and bus architecture. Currently, more than 56 companies worldwide are members of the PXI Systems Alliance and more than 1150 PXI products are available. In 2005 the PXI Express spec emerged, which integrated PCI Express and CompactPCI technology into the PXI standard. PXI Express provides bandwidths up to 6 Gbytes/s per system while preserving compatibility existing PXI products.

PXI modules, along with a PXI portable monitor and keyboard accessory, was used to upgrade the computer systems aboard Royal Dutch Navy ships (Figure 1). The PXI system was found to be more rugged and a modular expandable PC-based platform. And unlike rugged laptops, the PXI systems made it easy to add functionality and modules to the system. Also, the PXI system enabled the use of off-the-shelf LabVIEW FPGA technology to interface with proprietary protocols.

PXI's older cousin, the VXIbus, was developed by enhancing the VME bus standard to better accommodate instruments. VXI extends VME by adding additional power supply voltages, analog and triggering buses. It also features complete power, cooling and EMC specification requirements for modules, and adds C and D-Size module sizes for larger circuit layout area. VXI also adds the twist of being able to accept PXI, VME and M-Module cards. While new product roll outs in VXI aren't at the same pace as PXI and PXI Express, VXI continues to occupy a critical niche—particularly when VME compatibility is required. An overview of the up-coming 4.0 revision of the VXIbus was presented at the Autotestcon show last month.

Figure 1
PXI hardware and LabVIEW-developed FPGA functionality were used to upgrade the computer systems that control equipment like the Goalkeeper Defense System used by the Royal Dutch Navy.

Once thought to be a natural follow-on to PXI and VXI, LXI (LAN eXtensions for Instrumentation) has instead carved out its own niche in the instrumentation realm. LXI is an instrumentation platform based on industry-standard Ethernet technology. In particular, military designers are hungry for synthetic instruments that feature state-of-the-art microwave performance. LXI is popular in cases where PXI and VXI implementations simply don't have the board space to create high-performance instruments, forcing integrators to use both card-cage and stand-alone architectures in their systems.

Introduced in 2005, the LXI Standard has been rapidly adopted by 50 companies in the test-and-measurement industry. They recognize LXI as the natural successor to GPIB, and that it was time for instruments to go beyond GPIB to make it easier for test system designers and integrators to create faster, more efficient systems. To date, over 1200 products have emerged that are compliant with the LXI Specification. Last October the LXI Consortium approved the newest version of the Standard (Version 1.3). ▮▮

LXI Consortium [www.lxistandard.org].
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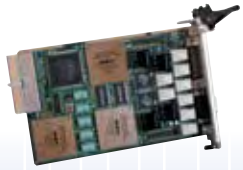

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Geotest – Marvin Test Systems, Inc.
Phone: (949) 263-2222 **E-mail:** sales@geotestinc.com
Fax: (949) 263-1203 **Web:** www.geotestinc.com

GX5291 - 3U PXI High Speed Dynamic Digital I/O Card

- Cost-effective, performance digital solution for low pin count and low cost applications
- 32 input / output channels, dynamically configurable on a per channel and per vector basis
- 128 MB of on-board vector memory
- 50 and 100 MHz versions available

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GX5292e - 3U PXI Express High Speed Dynamic Digital I/O Card

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- Supports 1.5 V, 1.8 V, 2.5 V, 3.3 V, 5 V TTL/LVTTL and LVDS interfaces
- 256 MB of on-board vector memory
- Supports x1 and x4 PXIe configurations for fast loading / unloading of vectors

Geotest – Marvin Test Systems, Inc.
Phone: (949) 263-2222 **E-mail:** sales@geotestinc.com
Fax: (949) 263-1203 **Web:** www.geotestinc.com

Technology Focus:

PXI, VXI and LXI Boards Roundup

16-bit PXI Digitizers Boast up to 40 MS/s Sampling

High-channel count and simultaneous sampling are the watchwords for a variety of military test applications. Feeding those needs, ADLINK Technology offers the PXI-9816 (shown), PXI-9826 and PXI-9846, a series of high-resolution 16-bit PXI digitizers offering sampling rates of 10 Msampeles/s, 20 Msamples/s and 40 Msamples/s respectively. This combination of high resolution and sampling rate enables monitoring of high-speed transient signals while maintaining very high accuracy. Furthermore, each digitizer of the PXI-98x6 series supports up to 512 Mbytes of onboard memory to sustain the continuous

transfer of data between the digitizer and the system for an increased acquisition time.

The PXI-98x6 series also uses the PXI trigger bus to synchronize multiple modules without external routing or cabling. The analog front-end of the PXI-98x6 series has been designed to offer greater DC accuracy and higher dynamic performance over similar cards currently available on the market. For example, the signal-to-noise ratio of the 16-bit, 10 Msample/s PXI-9816 can be up to 78 dB, and its effective number of bits is 12.6 with a 1 MHz sine wave input signal at -1 dBFS amplitude. ADLINK provides drivers for development in Microsoft C++ and Visual Basic environments. The PXI-98x6 series is also supported by ADLINK's DAQPilot 2 task-oriented driver, which not only quickens development time, but also provides Express VIs and Polymorphic VIs for use in LabVIEW.

ADLINK
Irvine, CA.
(949) 727-2077.
[www.adlinktech.com].

PXI Digitizers Provide High-Impedance Mezzanine Function

High-impedance mezzanine functionality is a key enabler for high-voltage measurements.

Along those lines, Agilent Technologies today announced the expansion of its Acqiris high-speed digitizer product line with extended functionality on its PXI digitizers. Both the U1061A and U1062A, 8-bit and 10-bit digitizers now feature an optional high-impedance mezzanine, making these devices ideal for combination with a signal probe in component testing.

The U1062A is the first 10-bit, 4 Gsample/s, 3U PXI digitizer, with input bandwidths of up to 2 GHz and acquisition memories of up to 256 Msamples/ch. The dual-channel 8-bit U1061A, with up to 1 GHz of instantaneous bandwidth, provides synchronous sampling on both input channels of 1 Gsamples/s with up to 8 Msamples of acquisition memory. In single-channel applications both digitizers provide the possibility of channel interleaving. The new high-impedance front-end, which enables high-voltage measurements on both products, uses programmable front-end electronics to provide a complete set of input voltage ranges from 50 mV to 5V full scale into 50 ohms, and up to

50V full scale into 1 Mohm impedance. With a bandwidth into 50 ohms of 1 GHz for the U1061A and 1.4 GHz with the U1062A, using 1 Mohm impedance results in a bandwidth of 300 MHz. The amplifier response is optimized, with switchable filtering and very fast recovery from out-of-range signals. Pricing for the U1061A and U1062A PXI High-Speed Digitizers starts at $7,400.

Agilent Technologies
Palo Alto, CA.
(650) 752-5000.
[www.agilent.com].

PXI Solution Does Boundary Scan and Dynamic I/O

The multi-function trend as hit all corners of board-level electronics and the PXI space is no exception. GOEPEL electronic, for instance, has launched the PXI 5396/FXT-x, a further series of JTAG/Boundary Scan digital I/O modules on the basis of the PXI bus. The PXI5396-FXT was developed in cooperation with SELEX Galileo and supports both the structural JTAG/Boundary Scan Test and dynamic I/O operations up to 100 MHz for the execution of functional tests in critical environments.

The PXI 5396/FXT-x is a two-component solution and consists of a PXI supported Interface Module (IFM) and an offset Core

Module (CM). The distance of the modules can be up to 2m without loss of performance. Two variants are available, which differ in the depth of the onboard memory (72 Mbytes with the PXI 5396/FXT and 144 Mbytes with the PXI 5396/FXT-XM). Both variants provide 96 single-ended channels, configurable as input, output and tri-state, which allow simultaneous driving and measuring, as well as real-time comparison. While the signals are processed synchronously to the test bus operations in the JTAG mode, the dynamic I/O mode allows functional testing with freely programmable clock rates within the range of 500 Hz to 100 MHz. Normally, structural Boundary Scan tests are carried out first with functional tests following.

Goepel Electronic
Jena, Germany.
+49 3641-6896-739.
[www.geopel.com].

Low-Cost PXI Instrument Has Selectable Voltage Levels

Responding to the need for a low-cost, high-performance digital instrument, Geotest has introduced a digital instrument that offers 32 channels of digital I/O, with 32 Mbits of vector memory per channel. The new GX5291 card supports 1.5V, 1.8V, 2.5V, 3.3V and 5V TTL/LVTTL logic families and supports a maximum vector rate of 50 or 100 MHz. The GX5291 is a high-performance 3U PXI dynamic digital I/O board offering 32 TTL or LVDS input or output channels with dynamic direction control. The GX5291 also supports deep pattern memory by offering 128 Mbytes of onboard vector memory with dynamic per pin direction control and with test rates up to 100 MH.

A windowing method is used for PCI memory accesses, which limits the required PCI memory space for each board to only 16 Mbytes, thus preserving test system resources. A direct mode, for continuous data transfer between the test system controller and the I/O pins of the GX5291 is also supported. The GX5291 offers 128 Mbytes of vector memory, with 32 Mbit per channel. Programmable I/O width allows trading vector width for vector depth. The GX5291 provides programmable TTL/LVTTL output clocks and strobes, and supports external clock and strobe. Available now, the 50 MHz card is priced at $115/channel with the 100 MHz card priced at $125/channel.

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

cPCI/PXI Module Sports Eight 16-bit ADCs

Military systems need interconnectivity that's as straightforward as possible. Integrating multiple functions on one card, for example, eliminates the need for complex field wiring. As a result, system noise is reduced and overall accuracy of the data measured is increased. Since the number of modules required in the

system is also reduced, the size and number of chassis required is also minimized. With all that in mind, KineticSystems has announced its CompactPCI/PXI Bridge Signal Conditioning module with onboard Analog to Digital Converters. This single-width CompactPCI/PXI module incorporates 8 signal conditioning channels and 8 independent 16-bit ADCs as well as 16 multi-function digital I/O channels.

The CP246 includes a copy of SoftView, KineticSystems' powerful out-of-the-box solution for card identification, configuration and operation. SoftView also integrates KineticSystems' entire line of cPCI/PXI instruments under a single software package to allow multiple instruments to be managed simultaneously. Typical applications include rocket motor testing, structural testing, wind tunnel testing, fatigue testing, RTD temperature measurements, vibration and torque measurements, compression and tension measurements, weigh scales, automotive test cells, industrial monitoring and control, automated test equipment and general-purpose digital control or monitoring. The CP246 is available immediately starting at $400 per channel.

KineticSystems
Lockport, IL
(815) 838-0005.
[www.kscorp.com].

Chassis and Embedded Controller Duo Ride PXI Express

The PXI Express standard—released in 2005—marries the benefits of PXI with the performance of PCI Express. Leveraging that standard, National Instruments has the NI PXIe-8102/01 embedded controllers and the NI PXIe-1073 chassis. The new high-value chassis and controllers directly address the cost pressures associated with today's widespread budgetary reductions while maintaining high-speed transfer rates of up to 250 Mbytes/s across the PXI Express data bus.

The NI PXIe-1073 chassis, which features an integrated remote controller, lowers the system entry point to PXI Express by 42 percent compared to previous PXI Express systems with similar capabilities. The chassis features five PXI Express hybrid slots that accept both

PXI and PXI Express modules, such as the new National Instruments X Series PXI Express data acquisition modules, to maximize system flexibility. The chassis provides 250 Mbytes/s of total system bandwidth and an integrated MXI Express controller with PCI Express host controller card and cable. It also features built-in timing and synchronization connections integrated into its backplane. The NI PXIe-8102/01 embedded controllers can address the needs of test engineers who require a high-value PXI Express solution that couples the PC and chassis in a self-contained system. The NI PXIe-8102 features a dual-core 1.9 GHz Intel Celeron T3100 processor, and the NI PXIe-8101 includes a single-core 2.0 GHz Intel Celeron 575 processor. Pricing for the NI PXIe-1073 chassis starts at $1,499. Pricing for the NI PXIe-8101 and NI PXIe-8102 controllers start at $2,099 and $3,099 respectively.

National Instruments
Austin, TX.
(512) 683-0100.
[www.ni.com].

VXI Synchro/Resolver Card Provides 0.005-Degree Accuracy

VXI remains the proven choice for VME-compatible instrumentation work. Supporting that area, North Atlantic Industries (NAI) offers a high-density, DSP-based, single-slot VXI card whose modular design provides up to four synchro/resolver instrument-grade measurement channels and up to four synchro/resolver instrument-grade stimulus channels; or up to eight synchro/resolver embedded-grade stimulus channels; and up to six programmable reference supplies. The 65CS4 C-size VXI card performs most synchro/resolver evaluation, calibration and test functions. All functions are independent and user-programmable for either synchro or resolver format and can be formatted for

single- or multi-speed applications. Synchro/resolver measurement and instrument stimulus accuracy is to within 0.005°. Converter-grade stimulus accuracy is 0.015° loaded and 0.008° without load. Instrument stimulus and reference outputs provide 2.2 VA of drive and are programmable from 47 Hz to 4,000 Hz.

The 65CS4's stimulus channels can be programmed for continuous rotation up to 13.6 RPS or for specific start and stop angles. Measurement channels can track signals up to 4.68 RPS and provide both digital and DC angle-rate output signals. Operating temperature range is 0° to +50°C. The card provides a VXI data rate of 2 Mbytes/s, dynamic address configuration and 100 microsecond data processing. Power supply requirement is +5 VDC at 8A (no load). Pricing for 100 starts at $10,000.

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

LXI Modules Provide Flexible Switching Solution

LXI brings the ease of Ethernet into the instrumentation realm. VTI Instruments has released three high-density switch modules, the EX1200-3164, -4128 and -6216. They further enhance the signal switching capabilities of VTI's EX1200 Precision Switch, Measure and Control family of products. The EX1200 is the highest density switching platform available and the only LXI Class A subsystem on the

market. Test engineers can use the EX1200 modules for applications ranging from half rack 1U to full rack 3U while maintaining signal integrity across multiple modules. The EX1200 includes a full-featured 6.5 digit DMM, precision analog and digital I/O modules, and an internal analog expansion bus. The -3164 provides 16 independent (1 x 4) multiplexers that can be reconfigured under software control to build up to a single 64-channel multiplexer.

This configuration offers flexibility when multiplexing various inputs to a common resource. The -4128 is a (4 x 128) crosspoint multiplexer that allows multiple resources to be shared by multiple output channels. The -6216 enables high-density RF switching capable of supporting two 16-channel 1 GHz multiplexers. The new modules allow users to build very flexible switching subsystems that span DC to light. The simplified software infrastructure of the EX1200 allows path-level switching through an IVI switch interface. The robust soft front panel enables direct monitoring and control without the addition of third-party software.

VTI Instruments
Irvine, CA.
(949) 955-1894.
[www.vtiinstruments.com].

High-Res 300 MHz Oscilloscopes Ride Multiple Form Factors

Board-level oscilloscopes can replace benchtop oscilloscopes in many ATE, aerospace and defense applications. The LXI instruments specifically are ideal for applications requiring remote monitoring and control as well as for portable test applications. ZTEC Instruments introduces three new series of high-resolution 300 MHz bandwidth oscilloscopes in PCI, PXI, VXI and LXI form factors. The new ZT4420 (12-bit), ZT4430 (13-bit) (shown) and ZT4440 (14-bit) series of oscilloscopes are the fastest sampling oscilloscopes or digitizers available in PCI, PXI, VXI and LXI at these levels of ADC resolution.

All instruments offer 128 Msamples of acquisition memory on each input channel. The instruments can be interleaved for 256 Msamples maximum acquisition length on one half the channels. The ZT4440 series has 14-bit

ADC resolution and a maximum real-time sampling rate of 400 Msamples/s per channel, or 800 Msamples/s max when interleaved. The ZT4430 series meanwhile boasts 13-bit ADC resolution and a max sampling rate of 250 Msamples/s per channel, 500 Msamples/s max when interleaved. And finally, the ZT4420 series has 12-bit ADC resolution with a max sampling rate of 500 Msamples/s per channel, or 1 Gsamples/s max interleaved. These oscilloscopes provide the same triggering, acquisition, waveform math and analysis functions that are commonly found in today's performance benchtop instruments and that are found in ZTEC's other M-Class oscilloscopes.

ZTEC Instruments
Albuquerque, NM.
(505) 342-0132.
[www.ztec-inc.com].

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Options include:

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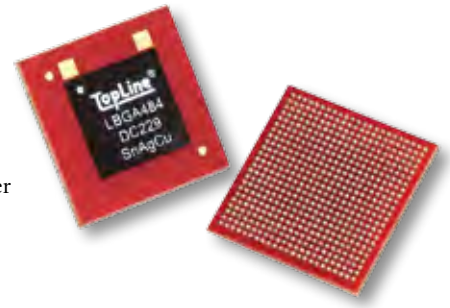

Keeping up with and mitigating the impact of component obsolescence is a constant challenge in the military industry. ICs often move on to tighter packaging schemes forcing board designers to weigh the question of whether or not to redesign their boards to accommodate. Addressing just that sort of issue, Aries Electronics recently added new BGA Switch-A-Pitch Adapters that adapt to pitch bottoms lower than previous models, expanding this unique product line that economically facilitates the use of smaller pitch devices with larger pitch boards.

The new Switch-A-Pitch Adapters have tops where the BGA landing pads are on a 0.50 mm pitch and the adapter bottoms are fitted with BGA balls on a 1.00 mm pitch. By using Switch-A-Pitch Adapters, manufacturers can avoid high costs by utilizing non-multilevel boards that ordinarily could not be used with 0.5 mm pitch devices. The adapters combine readily available, and therefore less-expensive, larger pitch boards with new, tighter pitch devices. Additionally, components can be added to the designs at a much lower cost due to the open space around the small device at the top of the adapter board. Pricing for a typical adapter with 32 positions is $6.50 each in quantities of 1,000.

Aries Electronics, Bristol, PA. (215) 781-9956. [www.arieselec.com].

Rugged Box System Provides Manpack-Sized Computing Platform

The stand-alone rugged box trend has pervaded all corners of the military embedded computing space. Many product lines have even moved on to second-generation, smaller spin-off versions. An example along those lines is Mercury Computer Systems' new, rugged, manpack-sized system. Enhancing the Ensemble 1000 Series family of computing systems, the 2-slot PowerBlock 15 has a convection-cooled or cold-plate mountable design, suitable for deployment on small platforms operating in harsh environments. Approximately the size of an external hard drive, the portable system can be configured with any of the processing, I/O, or storage modules currently used in the award-winning 6-slot PowerBlock 50 chassis.

Ensemble 1000 Series systems, using either the PowerBlock 15 or the PowerBlock 50 chassis, are scalable and optimized for real-time applications. A point-to-point PCI Express connection delivers high-throughput, non-blocking, serial connectivity between processing and I/O nodes. External I/O can be customized to accommodate virtually any type of digital or analog I/O. Processing options include the Intel EP80579 SoC (system-on-chip) device, Xilinx Virtex-4 and Virtex-5 FPGAs, the AMD M96 GPU (Graphics Processing Unit), and Freescale PowerQUICC processors, all supported by SATA hard-disk and solid-state storage drives.

Mercury Computer Systems, Chelmsford, MA. (866) 627-6951. [www.mc.com].

Tactical Booster Amplifier Covers 30 to 512 MHz Band

The challenge for military RF systems is to make it easy for troops to maintain constant, reliable communications in even the worst environments. Feeding those needs, AR Modular RF recently announced the completion of a new 50-watt auto-tuning, multi-band tactical booster amplifier. The new AR-50 booster amplifier boosts tactical radio signals from handheld and back-pack transceivers operating in the 30 - 512 MHz band. It provides 50 watts output with as little as 2 watts input and offers two antenna ports dedicated to line-of-sight (LOS) or UHF Satellite (SATCOM).

The system also provides a switchable low-noise amplifier (LNA) and a three-position RF output level control. The small, compact, lightweight unit can run from either 12V or 24V vehicle power systems. AR Modular RF has received its initial order for model AR-50 Booster Amplifiers, and units will begin being shipped shortly.

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

PMC Provides Four UARTs and Rugged Operation

Even as military embedded systems migrate to highly integrated processors and speedy fabric interconnects, there's still a lot of legacy I/O in the form of serial ports. Feeding that need, MEN Micro has released the new high-performance P507 PMC that offers fast serial data transfer via four software-configurable RS422/485 UART interfaces supporting full (RS422) and half duplex (RS485) operation. Each channel on the new PMC features an independent 500V isolation enabling the 32 bit/33 MHz P507 to supply data rates of up to 921,600 bits/s. The UART interfaces also provide a 60-byte transmit/receive buffer. All ports are available on a shielded 50-pin D-sub front panel connector.

Qualified for an extended temperature range of -40° to +85°C and prepared for coating against dust and humidity, the new P507 is especially useful in safety-critical and mobile applications. The P507 can be used on all PMC-compliant host carrier boards in any type of bus system independent of the application, such as cPCI, VME or on any stand-alone SBC. The new PMC offers 32 Mbytes of soldered SDRAM DDR2 memory and a 132 MHz memory bus frequency. 2 Mbytes of FPGA-controlled non-volatile Flash memory is included for FPGA data and NIOS firmware. Fully soldered connections provide performance rated to withstand 15 g/11 ms for shock, 10 g/16 ms for bump and 1 g/10 Hz to 150 Hz for vibration (sinusoidal). Pricing for the P507 PMC is $703.

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

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AMC Carrier Supports Three IndustryPack Modules

The AMC form factor has established itself as one of the mainstays of mezzanine technology. Tews Technologies has released the TAMC200, a standard double-width mid-size or full-size AMC.1-compliant carrier for three single-size IndustryPack (IP) modules. The TAMC200 can be used to upgrade well known and well proven IndustryPack I/O solutions to a high-performance form factor, and to provide AMC users a large selection of over 200 off-the-shelf IndustryPack modules for analog, digital, communications, motion control, CAN and other various functions.

All IP interrupt request lines are mapped to PCIe INTA. Alternatively, Message Signaled Interrupts (MSI) can be used. The TAMC200 also provides a special IP interrupt status register for fast interrupt source detection. The IP power lines are fuse protected by self-healing fuses and RF filtered. Easy I/O cabling is facilitated with the use of three 68 pin SCSI-V type connector (VHDCI/Champ) that provides access to all IP I/O lines. Designed for demanding environments, the TAMC200 operates from -40° to +85°C and has a five year warranty.

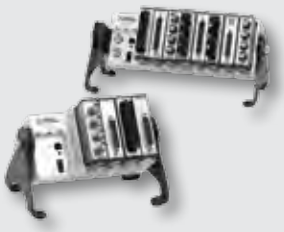
Tews Technologies, Reno, NV. (775) 850-5830. [www.tews.com].

Wireless XMC Blends WiFi, Zigbee, GPS and Cryptography

The magic of chip integration has enabled board designers to pack several functions on one card. Exemplifying that trend, Curtiss-Wright Controls Embedded Computing has introduced the XMC-660, a multifunction mezzanine card that combines wireless, GPS and cryptography to deliver portable, secure in-the-field wireless connectivity. The lightweight, small form factor XMC-660 is an ideal solution for quickly and easily adding high-performance trusted wireless communications to VME, VPX and CompactPCI embedded systems for applications including luggable computers, manpacks and secure laptop computers.

Designed for rugged environments, the XMC-660, based on the VITA 42 XMC standard, uniquely combines support for WiFi 802.11 n/a/b/g communications, Zigbee 802.15 asset tracking, and GPS location services on a single plug-in mezzanine card, to deliver an ideal solution for systems integrators building embedded wireless networks. Power dissipation for the card is 7W (typical)/ 8.4W (max). It requires only a 5V power supply from the basecard. All other necessary voltages are generated on board the XMC-660. Pricing for the XMC-660 starts at $4,600 in single quantities. Targeted availability is scheduled to begin in Q4 2009.

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



Chassis Duo Does High-Performance USB Data Acquisition

Testing complex military systems used to require large racks of instrumentation boards. Today, the same functionality can be done with USB-based modules in a desktop chassis. Along just those lines, National Instruments announced the NI cDAQ-9174 four-slot and cDAQ-9178 eight-slot NI CompactDAQ chassis, which are advanced versions of the popular NI CompactDAQ chassis released in 2006. The two new chassis build on the functionality of the original chassis by adding a four-slot option; the ability to take mixed-sensor measurements at different rates; two built-in, external BNC triggers; and four advanced counters.

With the new cDAQ-9174 and cDAQ-9178 chassis, engineers can sample from NI C Series analog input modules at different rates instead of implementing single-rate sampling in the cDAQ-9172 chassis. The cDAQ-9178 eight-slot chassis features external BNC triggers. The chassis operate in a temperature range of -20° to 55°C and can withstand up to 30g shock and 3g vibration. NI CompactDAQ achieves High-Speed USB throughput with NI signal streaming technology, so that the chassis can simultaneously perform multiple, high-speed operations such as waveform measurements, generation, digital I/O and counter operations. The NI cDAQ-9174 is priced from $699, and the NI cDAQ-9178 from $1,099.

National Instruments, Austin, TX. (512) 683-0100. [www.ni.com].

Li-ion Battery Charger Supports Wide DC Input

Soldiers have become increasingly reliant on a variety of rechargeable electronic devices. Many of those devices are Li-ion battery powered. Micro Power has announced a SMC-65 battery charger module for Li-ion batteries. The module is an open frame charger assembly that operates from a wide range DC input, so it can be used in desktop (via an external AC/DC converter), mobile automotive and military vehicular applications. It will safely charge most popular battery types and pack voltages (up to 19 volts). The 65-watt module has two battery interface configurations; digital (for smart batteries) and analog (batteries with no communications).

The SMC-65 module utilizes a programmable microprocessor charge control system with algorithms capable of charging Li-ion battery packs with or without fuel gauges. The SMC-65 module supports SMBus communications (SBS Level III), and can optionally accommodate DQ and HDQ communication protocols. Other features include variable rate charging and input/output reverse polarity protection. The SMC-65 module is packaged to provide the smallest possible footprint, 55 mm by 55 mm by 12 mm, while maintaining reliable operation and a competitive price. The SMC-65 module significantly reduces the development time and cost of OEM battery chargers or devices requiring embedded charging electronics.

Micro Power Electronics, Beaverton, OR. (503) 693-7600. [www.micro-power.com].

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Probes Enable General-Purpose Differential Signal Measurements

As semiconductor devices get even faster, the burden on test gear keeps pushing test gear developers to keep pace. Agilent Technologies has introduced 200 MHz and 800 MHz, high-voltage differential probes. The differential probes provide superior general-purpose differential signal measurements required for today's high-speed power measurements, vehicle bus measurements and digital system designs. The Agilent N2792A and N2793A differential probes offer 10:1 attenuation, allowing them to be used for a broad range of applications. The probe comes with various probe tip accessories for use with small and large components in tight places.

The differential probes have an input resistance of 1 Mohm (for N2792A) and 200 kohm (for N2793A) and low input capacitance of 3.5 pF (for N2792A) and 1 pF (for N2793A) to minimize circuit loading. The N2792A and N2793A probes are compatible with any oscilloscope with a 50-ohm BNC input. The probe can be powered by any USB port on a scope or computer, or by an internal battery (9V battery included). The Agilent N2792A and N2793A differential probes are available now at a price of $1,700 and $3,000 each.

Agilent Technologies, Palo Alto, CA.(650) 752-5000. [www.agilent.com].

Fanless Mini PC Has Removable Hard Drive and Compact Flash

Fans are frowned upon in military systems. They represent a single-point of failure that's too risky for battlefield deployment. The LPC-395F from Stealth Computer is a fanless noise-free computer that utilizes Intel's ATOM processor technology that offers plenty of horsepower without sacrificing energy efficiencies. The rugged aluminum lightweight chassis measures only 6.54 x 6.18 x 1.89 inches (166 x 157 x 48 mm) in size.

Unique to the LPC-395F mini PC is the front loaded removable media slots for both Hard Drive and Compact Flash. This standard feature provides for easy drive swapping, software updates and added security protection all in a small sized package. The LPC-395F is ideal for a wide range of industrial and commercial applications. Other features include a removable hard drive that's front loading, Compact Flash (CF) and an Intel Atom processor. The unit has a DC Power Input range of 12 to 19 VDC. 3D graphics with 16x9 capability, built-in USB 2.0, video, audio and networking are provided, along with optional solid-state drives (SSD).

Stealth Computer Woodbridge, ON, Canada. (888)783-2584. [www.stealthcomputer.com].

PCI-104 Module with Isolated Digital I/O

The venerable ISA bus, although still used in some military embedded systems, is way past its prime. The PCI-104 form factor provides the benefits of PC/104, but removes the overhead of the 104-pin ISA bus, providing just PCI instead. The Industrial Automation Group of Advantech has introduced the PCM-3730I, a 32-channel isolated digital I/O PCI-104 module. The PCM-3730I supports high-voltage isolation (2,500 VDC) on each input/output channel and resists noise interference while delivering reliable performance. Additionally, 32-channel isolation ensures accurate input/output data values while also allowing the system to simultaneously access more data.

With a wide input voltage range (5~30 VDC), the PCM-3730I is suitable for any application with 12 VDC or 24 VDC input voltage. Moreover, with its standard PCI-104 interface, the PCM-3730I allows different modules to be stacked together in a small system such as an embedded computing platform.

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

Multifunction PCI Card Blends Synchro Resolver, Comms and More

One of the situations where multifunction boards shine is where test functions are combined together. With that in mind, North Atlantic Industries is introducing a Multifunction PCI card for applications requiring Digital-to-Synchro/Resolver (D/S) and Digital-to-LVDT/RVDT (DLV) Simulation and Measurement, as well as I/O and Communication functions. The 76CS3 is a single slot card that can be configured for six separate D/S channels at 1.5/2.2 VA, three separate D/S channels at 3.0VA, or D/S in combination with A/D, D/A, Discrete I/O, TTL I/O, RTD, LVDT/RVDT, S/D or R/D. In addition, the 76CS3 offers communication modules such as RS232/422/485, MIL-STD-1553, CANBus and ARINC429.

Each of the functions of the 76CS3 Multifunction PCI card is highly programmable at the channel level. Automatic background BIT testing is always enabled and continuously checks the health of each channel. This testing is completely transparent to the user, requires no programming, and does not interfere with the normal operation of the card. The 76CS3 is ideally suited for Automatic Test Equipment (ATE) used in the Aerospace, Defense, Industrial and Automotive industries. The 76CS3 is available with operating temperature ranges of 0° to +70°C and -40° to +85°C. Pricing for 100 pieces starts at $3,049 each.

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

DIN Rail Power Supplies Operate with 3-Phase AC Inputs

Power supplier advances tend to be more evolutionary in comparison to the leaps and bounds of components like processors and memories. But the steady progress continues to expand the flexibility for system designers. Along those lines, TDK-Lambda has released a new series of AC-DC DIN Rail-Mount power supplies with outputs rated from 120W to 480W that operate off a 3-phase AC line input from 340 to 575 VAC. These models are ideal for factory automation, industrial control systems and test and measurement equipment.

Each series is available with the most popular output voltages: 12 VDC and 24 VDC outputs are available in the DPP120 series (rated at 120W) plus 24 VDC and 48 VDC outputs are available in the DPP240 series (rated at 240W) and the DPP480 series (rated at 480W). An important feature of these new units is their bi-phase operation; under a dropped phase condition they will continue to operate with the output power derated to 80 percent. Output voltages can be adjusted to allow for the voltage drop in cables and similar factors. The operating temperature range of the power supplies is from -25° to +71°C. The DPP 3-phase series are available now and priced from $64.00 each in quantities of 1k units.

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

Dual Phase IC Offers Power Savings Function

Managing system power has become more important than ever in military system designs. International Rectifier has introduced the IR3527 XPhase dual phase IC with independent power savings function for energy-efficient multiphase server applications. The IR3527 IC drives and monitors two phases of a multiphase synchronous buck converter to significantly reduce overall system cost as well as the size of the complete solution. The IR3527 implements an independent power savings function (PSI) for each power stage and sequential phase timing for use in single output multiphase converters.

When the power saving mode is enabled, the power stage disables its output, eliminating switching losses while the correct converter operation is maintained by the single power stage or in conjunction with other converter power stages. Moreover, the IR3527's current sense amplifiers remain active when in power savings mode to support adaptive voltage positioning. The device is available in a small thermally enhanced 24L 4 x 4 mm MLPQ package and is RoHS compliant. Pricing for the IR3527TRPBF begins at $1.50 each in 10,000-unit quantities.

International Rectifier, El Segundo, CA. (310) 726-8000. [www.irf.com].

High Dynamic Range ADC Board Targets Sonar Apps

Demanding data acquisition applications—such as high frequency, multi-channel sonar systems—are hungry for ever more dynamic and frequency range. Along just those lines, GE Fanuc Intelligent Platforms announced the ICS-1620 and ICS-1640 16-channel Digital/Analog Converters. The boards offer unprecedented dynamic and frequency range, and multiple redundant levels of channel-channel and board-board synchronization, making them suitable for continuous operation in high channel count environments.

Both units are short form factor PCI Express x4 cards, making them extremely compact and well suited to size- and weight-constrained environments such as unmanned vehicles. The ICS-1620 features a 16-bit resolution DAC capability, while the ICS-1640 offers 24-bit resolution. Both operate at 2.5 MHz. The ICS-1620 provides a DAC product complementary to the ICS-1640; the two are designed to work together in systems requiring both receive and transmit elements. As well as serving the needs of acoustic and ultrasound sonar systems designers, the ICS-1620 and ICS-1640 are also appropriate for other applications such as test and measurement and vibration analysis.

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

Atom-Based ETX 3.0 CPU Module Targets Harsh Environments

The ETX form factor is one of the mainstays of non-backplane embedded form factors. The ETX-N270 from Diamond Systems is an ETX 3.0-compliant computer-on-module (COM) based on Intel's low-power, high-performance Atom N270 processor. The board is rated for operation over an enhanced, -20° to +70°C temperature. Within a compact 4.5 x 3.7-inch (114 x 95 mm) footprint, the ETX-N270 integrates a high-performance, low-power 1.6 GHz Intel Atom processor, up to 2 Gbytes of high-speed DDR2 system DRAM, and a complete set of PC- compatible system controllers and interfaces.

The module's high-resolution display controller supports analog and LVDS-interfaced CRTs and LCDs and also provides a TV output option. The ETX-N270 COM's extensive set of I/O interfaces also includes one 10/100 Mbit/s Ethernet port, one IDE interface that supports two drives and two SATA interfaces that support one drive each. The board includes four USB 2.0 ports and two serial ports as well as AC'97 audio (mic in, line in/out). Quantity one pricing is $325.

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

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6U cPCI Blade Does Extended Temps and Conduction Cooling

The Core2 Duo processor quickly became the most widely used multicore processor, and the military embedded space was quick to join the party. The cPCI-6880 from Adlink Technology is a series of 6U CompactPCI blades featuring the 45 nm Intel Core2 Duo processor T9400 with a 2.53 GHz core speed, 6 Mbyte L2 cache, 1066 MHz FSB, and a 40W typical total power consumption. The board uses the latest Mobile Intel GM45 Graphics Memory Controller Hub, supporting dual-channel DDR2-800 SDRAM on one SO-DIMM socket and an optional 4 Gbytes of soldered onboard memory for a maximum of 8 Gbytes.

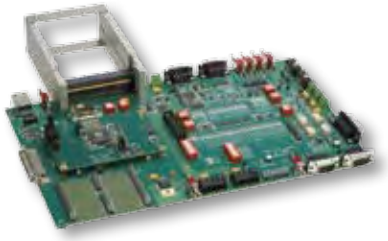
By balancing computing performance and power consumption in a CompactPCI blade for the embedded market, the cPCI-6880 is targeted for transportation, military and mission-critical applications thanks to its soldered memory and optional extended operating temperature range of -20° to +70°C. To meet the needs of applications in harsh environments with extreme thermal range, vibration, shock or other stresses, a rugged conduction-cooled version, the CT-60, with the same electronic design as the cPCI-6880 will be available in Q4 of 2009. The cPCI-6880 Series accommodates a 2.5-inch Serial ATA hard drive directly mounted on the SBC and RTM, an optional CompactFlash slot and built-in 4 Gbyte USB NAND flash for additional storage options. The cPCI-6880 is available at a list price of $2,299.

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

Development Kit Targets ATCA Shelf Management

ATCA is securing a solid niche for itself in the market. Board management reference (BMR) starter kit updates announced by Pigeon Point Systems provide extended TCA management controller solutions, including the first with support for advanced in-shelf network attachment via the Network Controller Sideband Interface (NC-SI) standard. The NC-SI support is implemented in BMR solutions based on the Actel Fusion mixed-signal FPGA. These and corresponding solutions based on Renesas H8S microcontrollers are the first to support R3.0 of PICMG 3.0, the AdvancedTCA specification.

These new solutions boost BMR support for in-shelf network attachment, with the support available on Actel's Fusion mixed-signal FPGAs. In addition, the solutions comply with the latest revision of the AdvancedTCA specification and are available for both Actel's Fusion and Renesas H8S core silicon. In-shelf network attachments for management controllers in AdvancedTCA boards allow these high-speed connections to be used for a variety of purposes that improve usability and reduce operational expense, including remote access to onboard serial interfaces and quick management controller firmware updates.



Pigeon Point Systems, Scotts Valley, CA. (831) 438-1565. [www.pigeonpoint.com].

cPCI Board and Rear Transition Module Target RAID Apps

CompactPCI, particularly in its 3U flavor, has carved out a large chunk of adoption in the military realm. Kontron's CP307-RS 3U CompactPCI series features enhanced Serial ATA capabilities on the Rear IO for enhanced storage capacity, faster transmission rates and high data safety. With 4 SATA 3.0 Gbit/s ports and high-performance RAID functions (0, 1, 5, 10), the CP307-RS from Kontron performs as a leading-edge RAID controller for rugged environments.

In combination with the Kontron CP-RIO3-RS Rear Transition Module, the new CPU board enables RAID 5 and 10 solutions without additional RAID controller boards. The Kontron CP307-RS is available with Intel Core Duo or Intel Core 2 Duo processors. Integrated with the Intel Mobile 945GM Express chipset and Intel ICH7-R Southbridge, the CP307-RS achieves excellent performance-per-watt values in a 3U form factor. The high-performance version of the CP307-RS features the Intel Core 2 Duo 1.5 GHz low-voltage (L7400) processor; 667 MHz front side bus, up to 4 Gbytes of DDR2-SDRAM with 10.6 Gbit/s memory bandwidth. All Kontron CP307 CPU boards provide extensive communications interfaces including 2 x Gbit Ethernet. The graphics accelerator integrated into the Mobile Intel 945GM Express ensures 2-D, 3-D and video features for the VGA output.

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

SBC Supports Twin AMD 6-Core Processors

The PICMIG 1.3 computing architecture brings the performance of PCI Express into the passive backplane arena. Win Enterprises offers a PICMG 1.3-style SBC that supports twin, AMD Socket F multicore processors, including the AMD Opteron six-core processors. The MB-80020 also features the AMD RS5690 chipset, FireWire, LSI chip and PCI-X. The new device supports 32- and 64-bit data-intensive computing that enables OEMs to easily upgrade within their high-performance product lines. The MB-80020 supports up to 20 lanes of PCI Express providing unsurpassed throughput for high-performance boards.

An MXM-II connector supports an ATI Radeon e2400 mobile MXM-II Graphics Card that enables graphic support for applications such as medical imaging, scientific computing, oil and gas, surveillance and more. Optional cards are available to provide HD Audio output and Firewire support. Features include AMD Opteron Multicore processor support (Socket F)—dual, quad and six-core, the AMD SR5690 / SP5100 Chipset and 4 Gbyte memory. Temperature, fan speed and voltage are monitored and a Watchdog Timer generates software selectable timeouts and system resets. The SBC provides dual 10/100/1000 Ethernet LAN ports with dedicated PCI Express and a HyperTransport Link supports a stackable IP-90330 CPU module with second processor and additional memory.

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

Integrated Embedded PC Line Based on Intel Atom

Rugged box-level PCs are the latest product trend in military systems design. The Microspace PC Systems from Advanced Digital Logic are a family of industrial PCs based on the Intel Atom series of low-power x86 processors. The product family has three basic versions with a host of options among each of them. The MPCX27MIL incorporates a sealed chassis against water and uses MIL waterproof cable connectors. 1 Gbyte of memory and a 32 Gbyte SSD-drive are standard. That Atom 510 processor runs at 1.1 GHz and the system typically consumes 15 watts. All three systems also incorporate the Intel US15W mobile chipset.

The MPCX27R/RL likewise incorporates a sealed case but uses N/M12 waterproof cable connectors. The RL version has a 3.5-inch touch screen and a GPS option lets it be used for navigation and communication applications. Additional options include GSM and WLAN with watertight antenna connections. The MPCX28 series of fanless computer systems is based on a 1.6 GHz Atom processor and has drivers and connectors for enhanced graphics. Graphics also includes DirectX 9 3-D support, and stereo audio input and output are provided. The system offers external connections for VGA and for DVI-I.

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

Instrument Boasts Ultra Accurate Measurement Correlations

A variety of battery-power military systems depend on accurate temperature and voltage measurements. With that in mind, the MeasurPoint from Data Translation is a highly accurate, multipurpose single instrument solution for measuring any combination of RTD, thermocouple and voltage ranges from 300µV to 400V, which allows the user to simultaneously correlate temperature and voltage measurements. The unit addresses a broad array of applications including Li-ion and fuel cell battery measurement, hybrid electric vehicle battery performance, thermal battery management and portable equipment measurement.

MeasurPoint incorporates proprietary ISO-Channel technology that makes measurements almost indestructible and eliminates any common mode noise and ground loop problems under all environmental conditions. In addition, up to forty-eight configurable input channels in groupings of eight voltage, thermocouple and RTD inputs offer ultimate flexibility to the user. Key features include B,E,J,K,N,R,S and T thermocouple types to 0.0004°C resolution, support for Platinum RTD Types: Pt100 (±0.07°C accuracy), Pt500, Pt1000 (±0.01°C accuracy). The unit has software selectable voltage ranges of ±10V, ±100V, or ±400V on a channel basis, and flexible software configuration on up to 48 input channels. Isolation of 1000V between input channels is guaranteed and there is advanced ±500V isolation to earth ground. Pricing ranges from $3,195 to $8,695.

Data Translation, Marlboro, MA. (508) 481-3700. [www.datatranslation.com].

Secure Digital Storage Cards Ready for Rugged Duty

The S-200 Series from Swissbit is an industrial series of Secure Digital (SD) Flash storage cards specifically designed, manufactured and tested to withstand extreme environmental conditions. The usage of single level cell (SLC) Flash components combined with a 32-bit RISC controller provides many enhanced product features, like built-in error correction (ECC), bad block management, wear leveling algorithms, power loss protection and power saving modes.

Swissbit's SD cards are designed specifically to match the needs of rugged systems. The S-200 series of SD cards are robust in nature because of the use of small Land Grid Array (LGA) components and the selection of the materials used to create the housing and printed circuit board. As an optional feature, the S-200 series SD cards support internal write protection as well as a read "Lock / Unlock" feature for cards in compliance with the SD Specification 1.01, 1.10 and 2.0. Swissbit SD cards also support SPI Mode. Additionally, in order to protect copyrighted data recorded on SD cards, all cards support the Content Protection for Recordable Media (CPRM) protocol. Swissbit has SD cards available from 256 Mbyte to 8 Gbyte and in Industrial and Extended temperature grades.

Swissbit, Bronschofen, Switzerland, +41 71 913 03 03. [www.swissbit.com].

1.6 GHz Intel Atom SUMIT-ISM Board Supports COMIT

The SUMIT I/O connector scheme and the COMIT Computer on Module standard rank as the two most significant fruits of the Small Form Factor-SIG in the past year. Supporting both is the EBC-Z8530-G from WinSystems—an SBC powered by an Intel 1.6 GHz Atom processor that measures 203 mm x 147 mm (8.5- x 5.75-inch) and supports the new Stackable Unified Modular Interconnect Technology—Industry Standard Module (SUMIT-ISM) expansion standard. It is RoHS-compliant and operates over an industrial temperature range of -40 to +70 degrees Celsius.

The EBC-Z530-G's I/O interface features two Gbit Ethernet ports; VGA and LVDS flat panel video, a PCI Express MiniCard interface for a wireless networking module, four USB 2.0 ports, four serial COM ports, HD audio, PATA controller for both a CompactFlash and hard disk, 48 lines of digital I/O, LPT and a PS/2 port for keyboard and mouse. Additional I/O module expansion is supported with two SUMIT and legacy PC/104 connectors. The EBC-Z530 supports COMIT and is targeted toward small form factor processor modules and baseboards leveraging the latest ultra-mobile and moderate power processor/chipset combinations. WinSystems is using a 62 mm x 75 mm card (which is roughly the size of a credit card) that includes the Atom, SCH, memory and power supplies.

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

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Special Feature: Distributed Power in Military Systems With more and more computing stuffed into smaller spaces, power has direct implications on the size, cooling and mobility of a system. Selecting power supplies and power conversion electronics ranks as make or break technical choices in embedded military computer systems. Articles in this section examine technology trends affecting DC/DC converters, power supply module bricks and slot-card power supplies (VME, cPCI and others).

Tech Recon: Safety-Critical Standards Update: The military has no stringent software requirements standard of its own after the abolishment of Mil-Specs such as MIL-STD-2167A and MIL-STD-2168. As a result, the DO-178B standard has been adopted as a method of software component approval in many critical aerospace, defense and other environments. Meanwhile, with the increasing use of high-density circuits and programmable logic in safety-critical and avionics equipment, the DO-254 standard is spreading into defense markets. Programs are starting to include DO-254 guidelines requiring all airborne systems featuring complex electronic hardware, such as FPGAs, PLDs and ASICs, to comply with the standard. This section educates readers on how to prepare for compliance with safety-critical standards such as DO-178B and DO-254.

System Development: Military Simulation & Test Trends Military simulation and test systems have taken on a whole different character as PC-based platforms take center stage. Articles in this section analyze the technologies behind that trend. Also featured is a preview of the products and papers to be showcased at the Interservice/Industry Training, Simulation and Education Conference (I/ITSEC).

Tech Focus: Rugged Stand-Alone Box Products Traditional embedded board vendors are adding stand-alone rugged box-level systems to their military market offerings. These complete system boxes often support standard form factor boards such as PMCs or PC/104 cards inside them. The result is a complete, tested and enclosed computing solution that eliminates complex integration chores for customers. This section looks at this emerging product class and outlines the problems they solve. A product album rounds up the latest representative products in this area.

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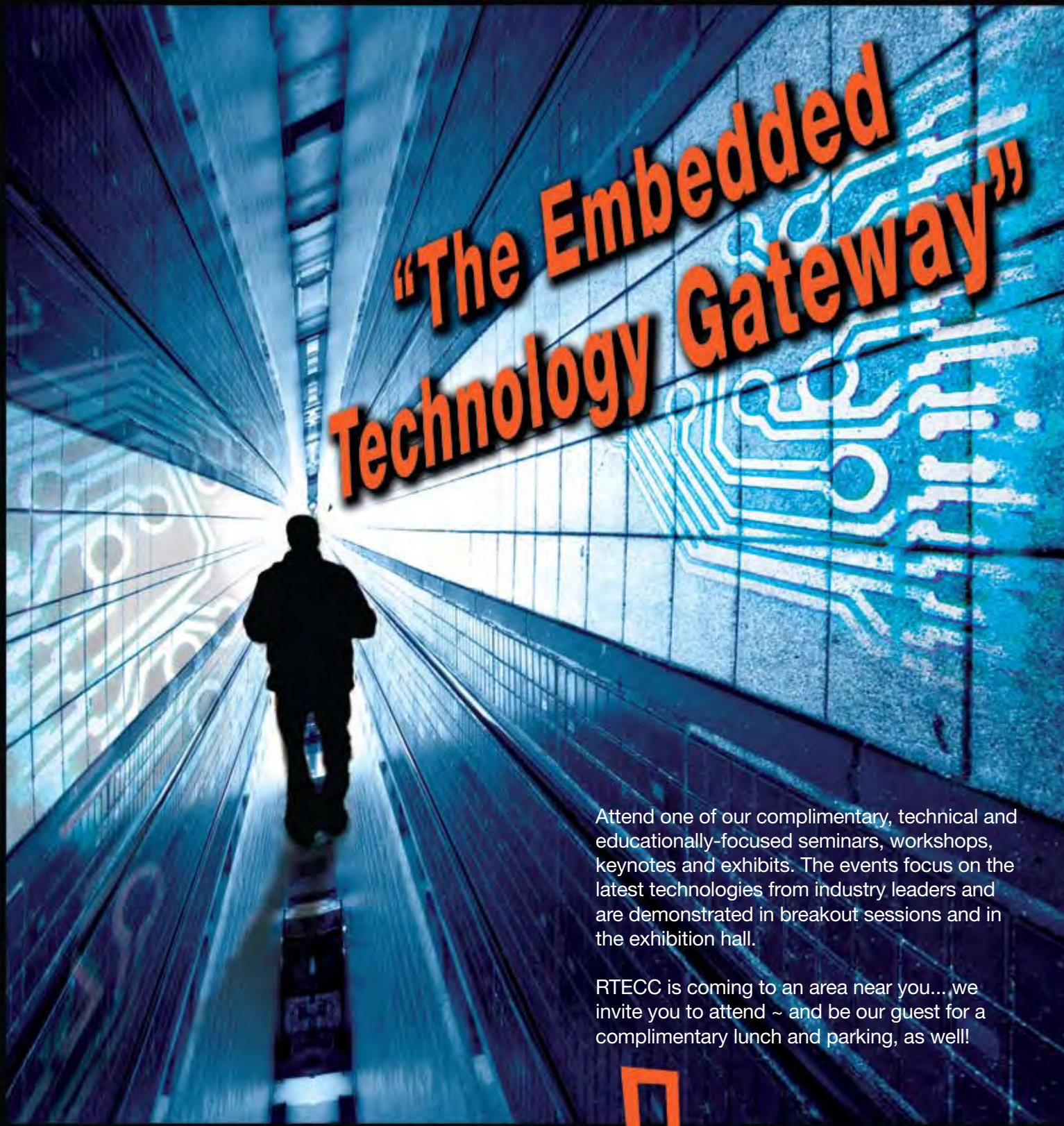

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Editorial

Jeff Child, Editor-in-Chief

Processing and Musical Chairs

Okay embedded processing technologies, when the music stops I want each of you to grab a chair and sit. Musical chairs is a good way to describe the moving targets that are advanced embedded processing and signal processing. This notion is particularly vivid in the military applications that are compute-limited—in other words, those applications where they want as much compute density as they can get. Radar, sonar, SIGINT and advanced military comms systems are examples along those lines. Complicate those systems with the constraints of putting them aboard mobile platforms like aircraft, UAVs and vehicles, and the desire for compact computing technology grows ever stronger.

Long gone now are the days when general-purpose processors (GPPs) carried the full burden of processing tasks in military embedded computing. For a while, Digital Signal Processors (DSPs)—in arrays of parallel configurations—took on the job of an adjunct accelerator, leaving GPPs to handle system management types of tasks. In recent years, FPGAs have all but edged stand-alone DSPs out of the musical chairs of embedded processing, That's because, as FPGAs have become denser and more sophisticated, their on-chip DSP functionality rivals stand-alone DSPs, while also offering the benefit of application-specific—or rather, waveform-specific—logic implemented on FPGAs.

In this game of technology musical chairs, the music is playing again it seems. While the attraction of FPGAs in high-end military systems is today as solid as ever, a disruptive technology could have the potential to unseat them. This disruptive technology is the emerging idea of using the latest crop of high-performance graphics processors to handle general-purpose processing tasks.

On the forefront of this wave is NVIDA, the graphics technology firm that originally coined the term "graphics processor." Graphics processing units, or GPUs, are programmable floating-point graphics-rendering engines primarily used in personal computers, workstations and gaming consoles. But thanks to architectural advancements in recent years, the scope of applications to which GPUs can be applied has grown dramatically. For traditional signal processing algorithms like the FFT (Fast Fourier Transform), they provide unprecedented performance, particularly performance per watt.

Mercury Computer Systems for its part was among the first to craft a system platform designed to leverage GPUs for military parallel processing needs. Last year at Milcom 2008, Mercury rolled out its GPU-based Sensor Stream Computing Platform. The Platform leverages a dual-core Intel Xeon-based SBC and a VXS dual MXM GPU module that provides very high bandwidth connectivity to each GPU from the host, as well as between GPUs. Each MXM GPU module can drive up to 3 display monitors.

Feeding this notion of GPUs as general-purpose processing engines, NVIDA developed a parallel computing architecture called CUDA (an acronym for Compute Unified Device Architecture) that addresses a key weakness of FPGA parallel processing systems: the complexity of programming them. CUDA is the computing engine in NVIDIA graphics processing units (GPUs) that is accessible to software developers through industry standard programming languages. The CUDA architecture enables programmers to write programs in conventional computing languages to access the massively parallel processing capabilities of the GPU. Programmers use "C for CUDA," which is C language with NVIDIA extensions, to write code to run on the GPUs.

Aside from serving applications in radar, signals intelligence, and video surveillance and interpretation, GPUs based on the CUDA architecture have potential in other application areas including target tracking, image stabilization, SAR (synthetic aperture radar) simulation, pattern recognition, video encoding/decoding, graphics rendering, object recognition, in-crowd behavioral monitoring and analysis, cryptography, sensor processing and software defined radio.

Bringing that technology into the military embedded systems space, GE Fanuc Intelligent Platforms earlier this month announced an agreement with NVIDIA to develop new hardware products using NVIDIA CUDA GPUs. According to GE Fanuc, a major prime contractor in the military/aerospace industry has evaluated the CUDA architecture in a radar system, and found that performance improvement of 15x is achievable with minimal reprogramming effort. New GE Fanuc hardware products with CUDA-based GPUs, to be announced in the fourth quarter, will include a CUDA-enabled 3U VPX rugged graphics subsystem and a family of 6U VPX products that combine Intel dual core processors and NVIDIA CUDA-enabled GPUs.

Circling back to the topic of FPGAs, FPGAs aren't in danger of losing a seat in this ever shifting musical chairs game. Not far off the horizon is the idea of using FPGAs as a military system's main processor instead of a general-purpose CPU. On-chip CPUs have become commonplace on high-end FPGAs, and as that trend continues, the reason for having a separate general-purpose processor—like a PowerPC, Core2Duo, or Atom—starts to fade. FPGAs have an added advantage of being fairly obsolescence-proof. If processor architecture becomes obsolete, that processor in the form of an FPGA core can still live on. And it can live on independently of even the FPGA it was first implemented on. That doesn't mean that FPGAs will completely edge out general-purpose processors anytime soon—nothing in the defense market happens overnight. But the musical chairs will certainly go on. ▮▮

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