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Tech Focus: Fibre Channel Boards

MILITARY ON ROAD TOWARD HIGHLY INTEGRATED VETRONICS

PLUS:

Military I/O Options Expand Their Reach

PMC, AMC and XMC Vie for Mezzanine Mindshare

Volume 9 Number 10 October 2007 www.cotsjournalonline.com

An RTC Group Publication

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PC/104

2050 PC/104 SBC

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HE 104 power supply

–40° to +85°

EPIC™ XE–900 1.0 GHz CPU

2050	–40° to 85° C	Ethernet	CompactFlash		Linux & Windows available
2060	–40° to 85° C	Drives CRTs & flat panels	CompactFlash		265 MB DRAM for large programs
2133	–40° to 85° C	17 digital I/O lines	Serial port used as console		"headless" systems
2732	–40° to 85° C	Analog module, autocalibrating	16-bit resolution	32 analog inputs	Settings constant over temp. range
2851	–40° to 85° C	CardBus card adapter	Type I, II, III formats	Supports 8–16–, 32–bit data widths	Linux & Windows support
HE 104 Mobile Power Supply	–40° to 85° C	6–40 VDC input	40–60 watts	+5V, +12V, –12V	Mounts on PC/104 stack

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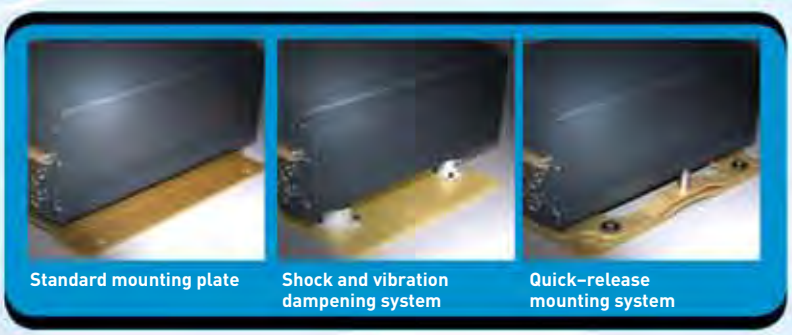

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Features

October 2007 Volume 9 Number 10

Special Feature

Vetronics

Tech Recon

Military I/O Options

System Development

Mezzanines in the Military

Technology Focus

Fibre Channel Boards

COTS View

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

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

Departments

Coming in November...
...See Page 73

Cover Story ..... Page 14

Designed to survive IED attacks and ambushes, deployment of Mine Resistant Ambush Protected (MRAP) vehicles has been called by Defense Secretary Robert Gates the military's top hardware priority. Shown here, Air Force Airmen at Charleston Air Force Base, S.C. prepare to load an MRAP vehicle into a C-5 Galaxy aircraft for shipment to Iraq.

Courtesy: DoD Staff Sgt. Jason Robertson, U.S. Air Force.

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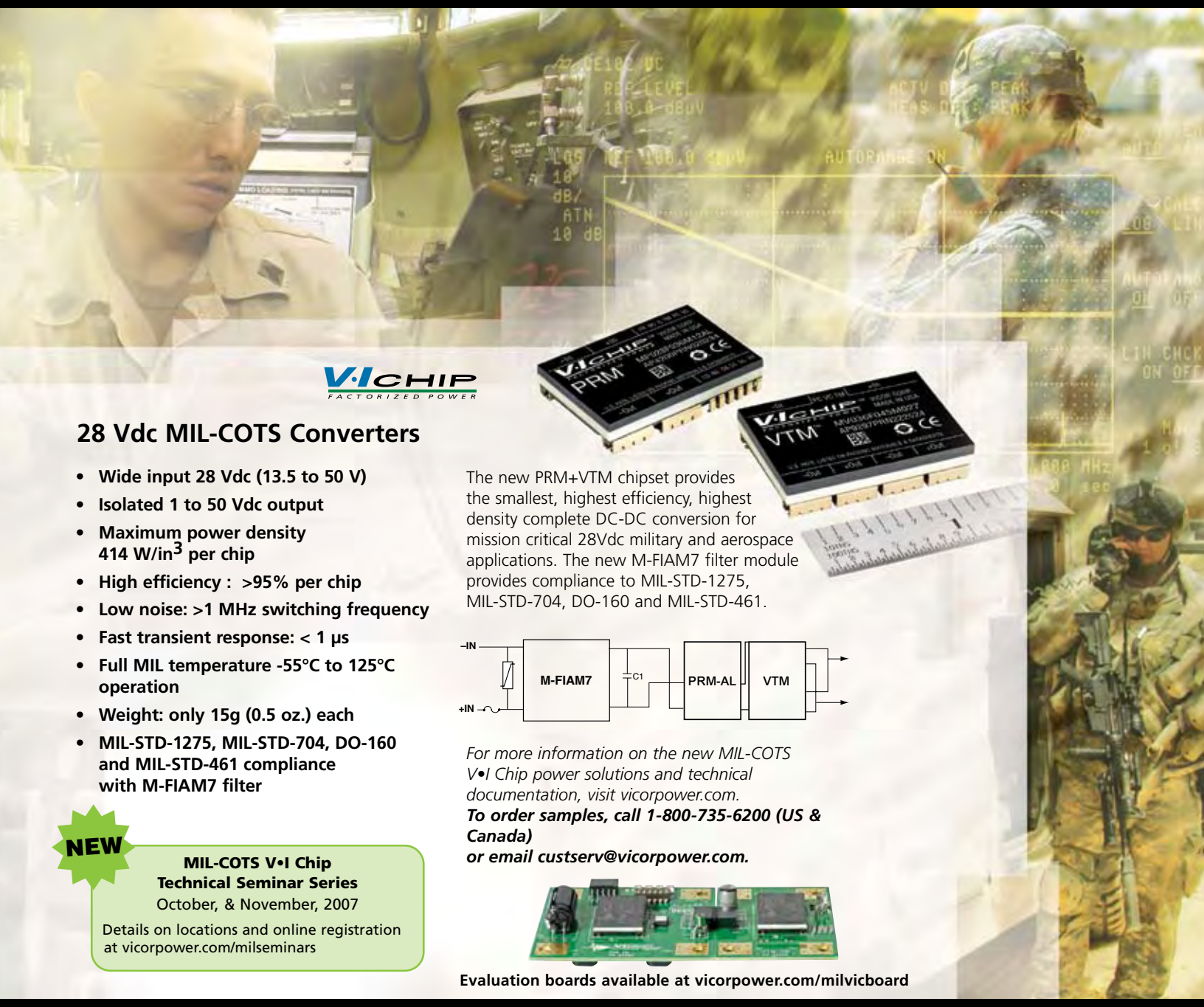

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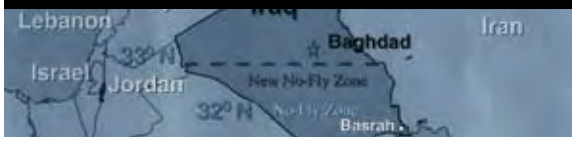
Publisher's Notebook



That's One Small Step for the Industry…
One Giant Leap for Procurement

Why can't we run government procurement like a business would (without government intervention)? Would any company buy products that wouldn't arrive for years after they were needed? Would any company put up with whiney suppliers trying to drag them through the courts and holding up their product production for years? If not, then why do we put up with it for military procurement? My guess is that if we peel away all the rhetoric, the bottom line is politics and "influence."

The politicians want their hand in everything so they can manipulate it for their constituency. I read that as votes for them. Influence is much trickier to define in this context. It may be like looking up a word in the dictionary and finding a dozen different numbered definitions. One definitely has to be closely related to politics, as in corporate support for politicians, or voting blocks of large numbers of individuals. At the other end of the spectrum may be an individual's influence. Their position in the scheme of things provides immunity from requiring them to make the best decision for the company. Okay, so all of this is an over simplification, but to a certain degree this is why the government has all these checks and balances—some may perceive them as obstacles—in place when they try to procure something.

Last century I was employed by several moderate-size companies. Some did more work than others with the government. It was not uncommon that a company would have a whole team of contract personnel to start work before any proposals were made, and end after all deliveries, options, upgrades and warranties expired. These were highly trained and experienced individuals whose sole purpose was to work the government's paperwork systems. They also helped to position the company—not the product—for obtaining the contract and generating the largest revenue for the company possible. As a supplier eager to get military contracts, this is exactly what you wanted and needed then. There were instances where I thought there was competitive product available that was probably a better fit for the customer. Our edge then was our contract team. In contrast, most competitors were only used to dealing with commercial customers.

Things started to change in the late '90s and it became easier for companies without a contract team to participate in supplying products to the military. The last three or four years things have become confusing again. Different camps with different axes to grind are stating that going back in time is the way forward, while others say going forward faster is the way to go. The humor in all this is that I think the basis for a company to support one approach or the other is based on where they perceive their "influence" to be strongest. Meanwhile, many of the companies that should be sharing in supplying products to the military are on the outside looking in.

Several years ago, I suggested that what the military embedded electronics industry needed was a trade association that focused on the issues that suppliers and users face in designing into military programs. I can only say that there was no clamoring of agreement or support for that idea from either the supplier or the user side. There are trade associations for every conceivable technology, but none to work on resolving servicing a particular market segment. Someone told me when I first suggested this idea that it had two big problems: First, you won't find any big companies to spearhead it. And second, it will always be under attack by someone stating it is restraint of trade or collusion and so forth. I agree with the first part. There is no benefit for a big company to spearhead something they already have an internal staff to do. As for the second issue, I can't believe that everything a single company does has to be illegal if two or more companies do it. Sure there are some things that would be taboo, and the organization would have to stay away from touching on those.

I'm sure that an association of users and suppliers of electronics to the military would never have the clout or influence that one big prime contractor has with the military. That said, if a military program office wanted a forum to explain what their needs are—and to find out if there was a technology available to meet those needs—I can't imagine them not wanting to participate. Nor do I see that if there were a group of individual suppliers that wanted to participate at a big hardware Mil conference that they would not consider going in aggregate. Those are only two basic examples. What about exchanges between DoD procurement czars at an association conference? Or politicians espousing procurement reform?

I'm hoping that one or more suppliers, or user organizations, get together and take the first few steps forward with this type of concept. The implementation of market-serving trade associations is way overdue and they will serve users and suppliers much more than another trade association for yet another bus or chip architecture. Wouldn't this be a giant leap toward improving procurement?

Pete Yeatman, Publisher
COTS Journal

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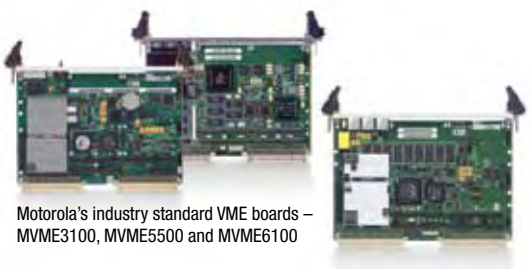


Motorola's industry standard VME boards – MVME3100, MVME5500 and MVME6100

The Inside Track

ITCN Demos 1553 Bus Testing Gear for B-2 Bomber

The Aeronautical Systems Center's 726th Aeronautical Systems Group (B-2 Program Office) successfully demonstrates a prototype B-2 1553 avionics databus diagnostic performance characterization and cable plant integrity test capabilities under an "enhanced" Phase II Small Business Innovative Research (SBIR) initiative. The supporting SBIR vendor, ITCN, Dayton, OH, responded to B-2 Spirit maintainer requirements by adapting and integrating an existing high-end ITCN engineering test instrumentation capability. This capability was established by ITCN under an alternative SBIR effort, with time domain reflectometry technology to give B-2 flightline avionics maintainers at Whiteman AFB, MO the ability to characterize individual databus performance and to isolate avionics network health anomalies.

Incorporated TDR functionality will assist B-2 technicians with isolating 1553 wiring cable problems to within 6-12 inches, enabling them to identify performance discrepancies with pinpoint accuracy. The prototype unit, developed over a 13-month period, will be exercised by B-2 technicians, involving direct connectivity with multiple B-2 aircraft data buses, later this month at Whiteman AFB, MO. The B-2 Spirit bomber's (Figure 1) avionics systems are the heart of the stealth bomber's combat capability, linked together through a 1553 network. Enhanced 1553 diagnostic tools and embedded logistics data tracking features will have a direct effect on B-2 aircraft availability/mission readiness.

Figure 1

The B-2 Spirit avionics systems are the heart of the stealth bomber's combat capability, linked together through a 1553 network. Enhanced 1553 diagnostic tools and embedded logistics data tracking features have a direct effect on B-2 aircraft availability and mission readiness.

ITCN
Dayton, OH.
(937) 439-9223.
[www.itcninc.com].

Emerson to Acquire Motorola's EEC Unit

Emerson has agreed to acquire Motorola's Embedded Communications Computing (ECC) business for $350 million in cash. The move is expected to boost Emerson's position in the $6 billion-and-growing merchant embedded computing industry. Motorola ECC business had revenue of approximately $520 million in 2006. Based in Tempe, Arizona, Motorola's ECC business has approximately 1,100 employees. The business has driven open standards and pioneered technologies based upon them since it was formed in 1980. Upon completion of the transaction, Motorola's ECC business will become part of Emerson Network Power. The transaction is expected to be completed by the end of the calendar year.

Embedded Communications
Computing, Motorola
Tempe, AZ.
(602) 538-5720.
[www.motorola.com/computing].

Emerson Network Power
St. Louis, MO.
(314) 553-2000.
[www.emersonnetworkpower.com].

Quantum3D Thermite Tapped for U.S. Marine Tactical UGV

Carnegie Mellon University (CMU) National Robotics Engineering Center has selected the Quantum3D's Thermite Tactical Visual Computer (TVC) and IData Human-Machine Interface (HMI) Software Tool Suite as key components for the U.S. Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) Operator Control Unit (Figure 2).

Figure 2

The Gladiator TUGV will provide the USMC Air-Ground Task Force with a tele-operated, semi-autonomous vehicle specifically designed to increase human survival by neutralizing threats and reducing risks to Marines on the ground.

The Gladiator TUGV will provide the USMC Air-Ground Task Force with a tele-operated, semi-autonomous vehicle specifically designed to increase human survival by neutralizing threats and reducing risks to Marines on the ground. The unit will be equipped with remote unmanned scout, reconnais-

sance and surveillance capabilities. In support of the Gladiator TUGV program, Quantum3D is providing Thermite TVC systems and the IData HMI Software tool suite to CMU, which is using them to develop and deploy the Gladiator OCU, as well as to provide data display, storage and distribution capabilities.

The Thermite TVC was chosen for its light weight, small form-factor, ease of mounting, long battery life and advanced computational, storage, video and 2D/3D graphics capabilities. Those factors—coupled with its support for a variety of display devices—enable the Gladiator OCU to meet its mission objectives, including interactive mission-planning. With its IData-based HMI, the Gladiator OCU will provide tele-operators with an intuitive user interface that supports 2D/3D graphics, live video display and digital maps with MIL-STD-2525B Symbology for both the Gladiator platform and its mission payloads.

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

DataPath Wins Contract for Marine Corps' SWAN Program

DataPath has received $8.7 million in delivery orders for continued support and enhancements to the U.S. Marine Corps' Support Wide Area Network (SWAN) programs. Under the delivery orders, DataPath will upgrade VSAT fly-away systems and Satellite Transportable Terminals (STTs). It will also provide spares kits, training programs and other services and support. In 2007, DataPath has received more than $50 million in contracts related to the SWAN programs.

SWAN is an integrated, IP-based communications system that utilizes commercial satellite terminals, network baseband equipment, wireless systems, software and support personnel to provide forward-deployed Marines with robust communications capabilities. The various SWAN programs provide connectivity for the delivery of mission-critical communications such as surveillance video from unmanned aerial vehicles (UAVs) and data support services. DataPath has supported SWAN since the company worked side by side with the Marines to launch the programs in 2004. The contracting authority for the SWAN delivery orders is Program Manager WIN-T's Commercial SATCOM Terminal Program at the U.S. Army Communications-Electronics Command in Fort Monmouth, N.J.

DataPath
Duluth, GA.
(678) 597-0300.
[www.datapath.com].

Figure 3

The Euro Hawk is a derivative of the Global Hawk High-Altitude Long-Endurance UAV system developed by Northrop Grumman, equipped with a new SIGINT mission system developed by EADS.

VMETRO to Provide Data Recorders for Euro Hawk Program

EADS Deutschland GmbH has contracted VMETRO for the delivery of integrated real-time solid-state data recorder systems based on VMETRO's product family. Delivery is expected in 2007 and 2008. The subsystems will be used in the Euro Hawk (Figure 3) Program. VMETRO's strategy is to expand the product offering within embedded computing toward becoming a total systems supplier. Data recording and storage is an important part of that.

The Euro Hawk is a derivative of the Global Hawk High-Altitude Long-Endurance Unmanned Air Vehicle system developed by Northrop Grumman, equipped with a new SIGINT mission system developed by EADS. It will replace the aging fleet of Breguet Atlantic aircraft, which have been in service since 1972. The SIGINT system provides stand-off capability to detect electronic intelligence (ELINT) radar emitters and communications intelligence (COMINT) emitters. EADS will also provide the ground stations that will receive and analyze the data from Euro Hawk as part of an integrated system solution.

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

PrismTech Helps JPEO JTRS Craft Waveform Portability Guidelines

PrismTech has completed work for the Joint Program Executive Office (JPEO) for the Joint Tactical Radio System (JTRS) (Figure 4) to help define waveform portability guidelines for the Department of Defense's JTRS program. The guidelines are designed to provide the industry with a clear strategy and procedure for implementing portable JTRS waveforms. These guidelines were developed by the JPEO's Network Enterprise

Figure 4

Shown here, the JTRS HMS radios allow individual warfighters to have networked communications capability, enabling coordinated joint force and coalition operations.

Domain Test & Evaluation (NED T&E) organization with contributions from PrismTech as well as other leaders in the Software Defined Radio (SDR) industry.

For its effort, PrismTech focused on providing enhancements and refinements to the guidelines and targeting areas where improvements were needed. PrismTech is currently playing a key role in the next revision of the guidelines by extending these to cover the use of modeling techniques for achieving waveform portability. Specific areas PrismTech addressed included coding language, CORBA middleware, XML and SCA component design. The revised guidelines document is expected to be released in the fourth quarter of this fiscal year. JPEO JTRS will make the guidelines available to all contractors working on JTRS.

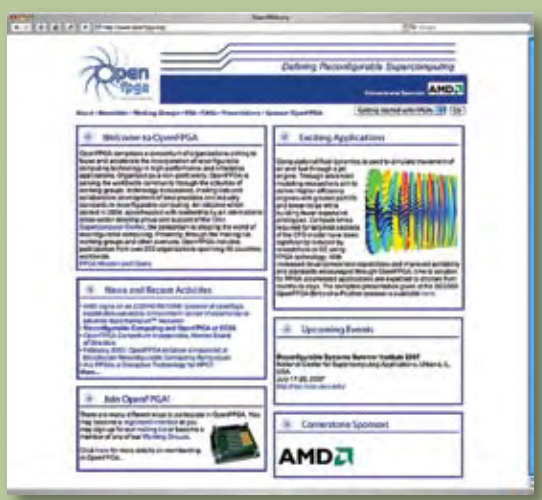
PrismTech
Burlington, MA.
(781) 270-1177.
[www.prismtech.com].

COTS Websites

www.openfpga.org

OpenFPGA Site Pools Reconfigurable Computing Resources

It's mainly FPGAs that deserve credit as the key enabler and building block for reconfigurable computing—a technology vital in military applications such as radar, sonar, SIGINT and software defined radio reconfigurable computing. OpenFPGA comprises a consortium of organizations aiming to foster and accelerate the incorporation of reconfigurable computing technology in high-performance and enterprise applications. Organized as a non-profit entity, OpenPFGA is serving the worldwide community through the activities of working groups, technology discussions, mailing lists and collaborative development of best practices and industry standards in reconfigurable computing.



An initiative that started in 2004, spearheaded with leadership by an international cross-sector steering group and support of the Ohio Supercomputer Center, the consortium is shaping the world of reconfigurable computing. OpenFPGA's Web site offers a wealth of valuable FPGA information resources. Among these are a Web resources index, forums, presentations, a technology roundtable and more.

OpenFPGA,
Springfield, OH.
(937) 322-0959.
[www.openfpga.org].

Special Feature

Vetronics

System Solutions Keep Military Vetronics on Track

To meet the complex processing and communications requirements of today's military vehicles, vetronics designers are relying on integrated system solutions.

Jeff Child
Editor in Chief

The challenges inherent in today's military vetronics (vehicle electronics) designs are magnitudes more complex than vetronics of a decade ago. The sophistication of onboard communications and control electronics is expected to multiply for both next-generation and Current Force fighting vehicles. All that is putting pressure on system designers to find ways to meet the trickier cooling, shock and vibration problems that emerge when more computing gear is packed into those vehicles. The time is perhaps near when even the term "vetronics" is obsolete as it implies a focus on electronics and not the embedded computing and networking that truly drive the functionality of today's systems.

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

Such was the case when General Dynamics developed its SATCOM-on-the-Move (SOTM) system. The TCN-M, or

Figure 1

General Dynamics' Warrior Model 20-20 SATCOM On-the-Move (SOTM) system includes a 20-inch diameter antenna, antenna controller, servo system, inertial reference unit, radome, power amplifier, Low Noise Amplifier (LNA), up/down converters and ancillary equipment. The SOTM antenna system will be installed on platforms such as this Stryker Infantry Combat Vehicle.

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Figure 2

WIN Enterprises's PL-06058 is an enclosed fanless computer designed for harsh environments like military vehicles. It is powered by a 34W Intel Celeron M ULV or Pentium M processor with low power requirements. The unit provides silent operation where ambient noise is unwanted. Internal heat pipes conduct heat to the aggressive heat-sink design of the rugged aluminum enclosure.

Tactical Communications Node-Mobile, a derivative of the WIN-T TCN, stripped away some of the user services but preserved the essential transmission system elements in order to meet the strict payload requirements of an up-armored Humvee. General Dynamics is the prime contractor for the Warfighter Information Network-Tactical (WIN-T) program.

More Integrated Solution

As a result, the new SOTM system is integrated into a much smaller volume, compared to the current-generation stationary Joint Network Nodes (JNNs). For example, in the stationary system, boards and subsystems—like the Cisco router—were housed in 19-inch racks and relied heavily on server computer blades and subsystems in 1U form-factors, and some CompactPCI cards. The on-the-move version leverages today's highly integrated board-level solutions to accomplish the task in half the space, and considerably less weight.

In May, General Dynamics SATCOM Technologies was awarded a contract to provide Ku-band on-the-move satellite communications terminals to the U.S. Army. Under this order, General Dynamics is providing a single Warrior Model 20-20 SATCOM-on-the-Move (SOTM) antenna system for verification and testing, with additional purchases to follow successful tests. The Warrior Model 20-20 SOTM system includes a 20-inch diameter antenna, antenna controller, servo system, inertial reference unit, radome, power amplifier, Low Noise Amplifier (LNA), up/down converters and ancillary equipment. The SOTM antenna system will be installed on High Mobility Multipurpose Wheeled Vehicles (HMMWV), Bradley Fighting Vehicles or Stryker Infantry Combat Vehicles (Figure 1).

One broad trend that's been helpful for reducing vehicle embedded computing system is a move toward stand-alone rugged boxes. Traditional embedded board vendors are adding stand-alone rugged box-level systems to their military market offerings. These complete system boxes—which often support standard form-factor boards inside them—provide a complete, tested and enclosed computing solution that eliminates complex integration chores for customers.

Feedback from the Field

Driving this trend toward rugged box-level systems is feedback from the current war effort. The push is to minimize size, weight and power, while cramming in more Gflops per watt to boost the processing muscle in smaller, lighter spaces on-board up-armored vehicles. This new area of rugged boxes is outside the category of ATR enclosures—although those continue to be a main staple in avionics, and more recently in vetronics as well. The stand-alone rugged box trend also is separate from the strategy know as "appliqué,"—the term used by the DoD for its initiative under that name a couple years ago. Appliqué involves complete computer units—like rugged laptops—that are mounted into existing military vehicle platforms and integrated with government-furnished software.

At present, there are more than a dozen vendors that have some sort of stand-alone rugged box-level system in their offerings—many even have whole product lines in that category. One example is GE Fanuc's Rugged Operational Computer (ROC). Weighing less than

six pounds and measuring less than 100 cubic inches, the ROC fits well into the tight spaces usually found in military vehicle applications. The ROC can be configured with an Intel or PowerPC processor PMC.

Serving the need for low-power, fanless operation, WIN Enterprises offers an enclosed computer designed for harsh environments like military vehicles. The PL-06058 (Figure 2) is powered by a 34W Intel Celeron M ULV or Pentium M processor with low power requirements. The fanless unit provides silent operation where ambient noise is unwanted.

Internal heat pipes conduct heat to the aggressive heat-sink design of the rugged aluminum enclosure. The PL-06058 is an enclosed version of WIN's popular IP-06058 single board computer (SBC). The compact unit supports a CompactFlash socket, Mini-PCI slot and up to 1 Gbyte of DDR RAM. Also featured are: one 10/100 Ethernet port, four serial ports, one parallel port, an IDE interface, three USB 2.0 ports and a FDD interface packaged into an industrial-grade enclosure of 12.3 (width) x 5.5 (depth) x 2.6 (height) inches.

Tested for Shock and Vib

Pre-testing for shock and vibration specs is often done by the vendor for this new generation of rugged box-level systems. An example along those lines is Purvis's DuraCOR 810 (Figure 3), a rugged military-grade processor system designed for high-reliability applications requiring MIL-STD-810F environmental compliance with extreme temperatures, shock/vibration and ingress.

Mechanically designed with considerations for dust exposure, EMI/EMC, corrosion resistance, power protection and system mobility, this field-ready computer integrates a low-power 1.4

Figure 3

Parvus' DuraCOR 810 is a rugged military-grade processor system designed for high-reliability applications requiring MIL-STD-810F environmental compliance with extreme temperatures, shock/vibration and ingress. It integrates a low-power 1.4 GHz Pentium M processor together with a MIL-STD-704/1275-compliant power supply. Up to six spare slots are available for PC/104-Plus expansion cards.

GHz Pentium M processor (equivalent to a 2.8 GHz Pentium 4) together with a MIL-STD-704/1275-compliant power supply securely mounted in an aluminum PC/104 card cage. Up to six spare slots are available for PC/104-Plus expansion cards.

Another innovative direction vetronics designers are taking is toward more robust interconnect technologies. In an example along those lines, Tyco Electronics'

Army FCS Program: An Update

Numerous successes and advances have occurred in the life of the Army's Future Combat Systems (FCS) program over the past 12 months. As expected, the program did suffer some budget cuts in the 2008 budget proposal, but the cuts were less severe than many expected. Funding cuts in the 2008 budget for the FCS program included two of the program's classes of UAVs and one of its unmanned ground systems, and the Intelligent Munition System. Boeing and Science Applications International Corp. (SAIC) are the Lead Systems Integrators for the FCS program.

Perhaps the most significant milestones this year for FCS was the successful completion of an eight-month field experiment said to be the cornerstone of soldier evaluation activities and an important step toward the early infusion of key FCS capabilities to the current force. Experiment 1.1, spanning July 2006 through February 2007, is a three-phase effort that combines laboratory, field and demonstration activities with soldier testing of early FCS prototypes.

The experiment was designed to help reduce program risk and provide early feedback into the development, integration and verification process of the program. It also helped to enable the early spin out of key capabilities to the current force in 2008. The final demonstration phase of Experiment 1.1, which was conducted from January 2007 to February 2007 at the White Sands Missile Range and Ft. Bliss test complex, included 36 soldier participants who provided "hands-on" feedback of early FCS prototypes, while exercising initial doctrinal concepts for employing these new capabilities. Phase 3 represented the first time soldiers collectively employed FCS systems in a live training environment and used an FCS computer-based training support package.

In another important milestone for FCS, in March General Dynamics C4 Systems and Rockwell Collins announced the delivery (on schedule) of the first ICS to the U.S. Army's FCS program. ICS is the common computing environment for most of the platforms in the FCS program family of systems, which comprises sensors, UAVs and manned and unmanned ground platforms.

Called the Large Networking Processor, this first ICS provides computing, networking and information assurance resources to enable U.S. Army current force vehicles to be a part of the FCS network. Based on 3U CompactPCI cards with Pentium M computing and 10-port Gbit Ethernet switching, the ICS is scheduled to be installed—as part of the first spin-out of FCS future force technologies in 2008—on Bradley fighting vehicles, Abrams main battle tanks and Command-Variant Humvees.

Answer: Both.

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(a)

(b)

Figure 4

Tyco Electronics' Pro Beam Jr. (a) expanded beam fiber-optic connectors were accepted for use in the Mounted Battle Command on the Move (MBCOTM) HMMWV (b) platform.

Pro Beam Jr. (Figure 4a) expanded beam fiber-optic connectors were accepted for use in the Mounted Battle Command on the Move (MBCOTM) HMMWV (Figure 4b) platform. The MBCOTM will also be considered for integration onto Bradley and Stryker vehicle platforms. The MBCOTM is a C4I mission equipment package integrated into TO&E authorized platforms, which allows brigade and above commanders to move to the decisive point on the battlefield.

Pro Beam Jr. expanded beam fiber-optic connectors are a ruggedized interconnect capable of high-speed data transmission between various communication network components, an essential aspect of digitizing the battlefield. With Pro Beam Jr. expanded beam fiber-optic connectors, data rates up to 2.5 Gbits/s and beyond are possible.

The expanded beam fiber-optic technology used in Pro Beam Jr. connectors withstands shock and vibration commonly found on tactical military vehicles. Furthermore, the connectors are very easy to clean and maintain compared to other fiber-optic connectors. In addition to tactical communications, Pro Beam expanded beam fiber-optic connectors have been deployed on military aircraft, radar systems, rugged communication systems and other hardware requiring high-speed, rugged-connection interfaces. Ace Electronics, in conjunction with Tyco Electronics, provides the U.S. Army and its contractors with value add services and integration of Pro Beam expanded beam fiber-optic connectors and cable assemblies. ■■

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Configurability Is Key for Custom ATR Designs

No longer just for airborne use, ATRs are attractive for a variety of military ground vehicle systems. Configurable designs help right-size ATRs to particular program needs.

Jim Tierney, V.P. of Government Systems
Carlo Gavazzi Computing Solutions

High-powered embedded computing equipment using the Air Transport Rack (ATR) form-factor is playing an ever-larger role in extreme, mission-critical applications in air, land and sea environments. This compact, rugged and light form-factor has been around for nearly 70 years, and has proven to be both durable and flexible. Its small size meets the tight space constraints of the current generation of military grade equipment, and its flexibility, coupled with the proliferation of off-the-shelf embedded computing components, allows ATR-based systems to meet cost and upgradeability goals for both legacy and emerging systems.

ATRs, typically used in aircraft, are increasingly being deployed in wheeled and tracked vehicles, and in shipborne applications. Each application is subject to its own array of harsh environmental factors—including shock, vibration, temperature, moisture and salt—that need to be taken into consideration. The ATR has been introduced into applications never before imagined, including surveillance, data collection and storage, and weapons control, all made possible by advances in open computing technology.

As computing power has increased, however, and ATRs are used in more strenuous avionic and military applications, performance requirements for ATR designs have steadily increased as well. This creates a challenge for systems designers working within the COTS framework. Each new application brings additional requirements

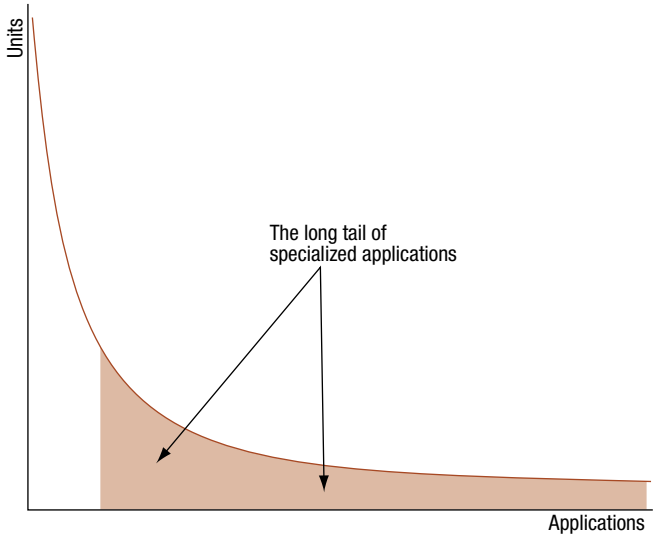

Figure 1

Significant market growth is to be found in the long tail of the demand curve, which is usually composed of a collection of micromarkets with specific needs. As the understanding of these military sub-markets grows, manufacturers are now offering multiple enclosure options so that customers have to accept fewer compromises.

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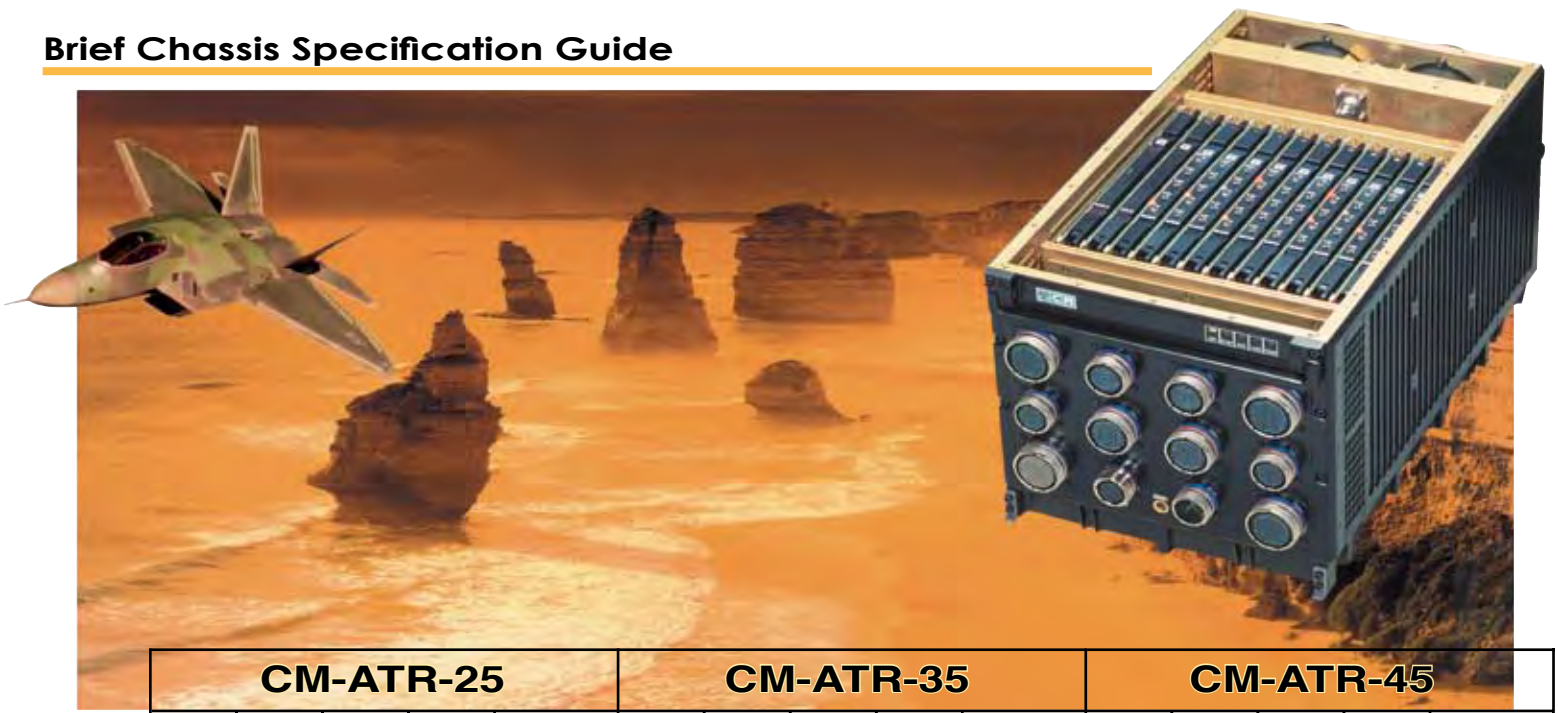

	CM-ATR-25					CM-ATR-35					CM-ATR-45				
(*)	FAC	S	SEF	HES	SIXHEX	FAC	S	SEF	HES	SIXHEX	FAC	S	SEF	HES	SIXHEX
Size / Slots	½ ATR - Long / 5 Slot 6U VME64x or cPCI					¾ ATR - Long / 7 Slot 6U VME64x or cPCI					1 ATR - Long / 12 Slot 6U VME64x or cPCI				
Power Supply	400 Watts				575 Watts	500 Watts				775 Watts	1050 Watts				1450 Watts
+5 / +3.3 VDC	20 Amp / 23 Amp				40 A / 23 A	40 Amp / 23 Amp				80 A / 23 A	80 Amp / 45 Amp				160 A / 45 A
±12 VDC	12 Amp each					12 Amp each					20 Amp each				
Chassis Vin	All PSU models accept: 28 VDC; 48 VDC; 270 VDC; Autorange 90-264 VAC @ 47-880 Hz and 200 VAC 3-Phase @ 47-880 Hz														
Board Format	Slot-by-slot user configured card-cage allows intermixing conduction-cooled IEEE-1101.2/ANSI-VITA 30.1 and air-cooled IEC-297/IEEE-1101.1 boards														

(*) Cooling Options: FAC - Flowthrough Air Cooled; **S** - Sealed; **SEF** - Sealed, Extended Fins; **HES** - Sealed, Heat Exchanger Sidewalls; **SIXHES** - Sealed, Six Heat Exchangers

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that, if developed as custom solutions, would lead to unacceptably long development times.

These requirements include variations in size and weight, exterior and aesthetic features, I/O and cabling, power supply and performance characteristics, and thermal management. After considering these points, it's clear that customization is no longer the exception, but rather the norm, and measures must be taken to ensure that customers receive a solution that meets their unique needs in a timely manner.

The Problem of Mass Customization

Manufacturing firms in many industries are experiencing a growing need for so-called "mass customization," sometimes referred to as the long tail (Figure 1). This concept has primarily been used to understand the evolution of consumer markets. The idea is that while a product with a single configuration of features may satisfy a large part of the market, market growth is to be found in the long tail of the demand curve, which is usually composed of a collection of micromarkets with specific needs.

In fact, as the understanding of these sub-markets grows, manufacturers are discovering that they can better meet the needs of all their customers by offering multiple options so that customers have to accept fewer compromises. The top suppliers of ATR enclosures, operating in a market where compromise is not an option and where customers demand fast turnaround on both initial shipments and reorders, have met this challenge through a strategy of configurability rather than customization.

Configurable Aspects of ATR Designs: A Checklist

- √ Multiple form-factors meeting ARINC 404A specifications
- √ Modular power supply using AC or DC inputs
- √ Adjustable card cage
- √ Multiple cooling schemes, including convection and conduction, high-altitude configurations and cold start-up heaters
- √ Modular frame
- √ Configurable I/O panels

Table 1

Listed here are configurable aspects of custom ATRs that must be engineered into the core platform design of the ATR enclosure. Making these configurable enables customization to be a matter of assembly and testing rather than ground-up redesign.

Flexible Platform

The key to achieving the goals of custom requirements, fast turnaround times and rigorous standards begins with platform architecture. The core platform has

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to be designed from the outset to meet a variety of uses, even if those uses are not yet known. Products developed in this way can be configured to meet multiple emerging and future standards as well as requirements for flexibility and scalability. The leading ATR enclosure manufacturers have designed their products to be configurable in the dimensions listed in Table 1 and illustrated in Figure 2. Those capabilities must be engineered into the core platform design of the ATR enclosure, so that customization is a matter of assembly and testing rather than ground-up redesign.

It is important to remember that, as specialized needs and the expectation of rapid delivery times increase, the requirements for reliability and performance remain high. In addition to the configurable components listed in Table 1, the core enclosure design features need to address ruggedization and specification driven performance criteria, allowing the unit to meet strict specifications in the areas list in Table 2.

ATR Ruggedization and Spec-Driven Performance Criteria

- √ Operating temperature, from -40°C to +71°C
- √ High humidity and altitudes up to 50,000 feet
- √ Structural integrity to withstand the abuse of combat conditions
- √ Electromagnetic Compatibility (EMC). This requires that systems/equipment be able to tolerate a specified degree of interference and not generate more than a specified amount of interference to surrounding equipment

Table 2

Allowing the unit to meet strict program requirements, a core ATC enclosure design must address these ruggedization- and specification-driven performance criteria.

Thermal Management and Configurability

Perhaps the most difficult challenge of ATR design is thermal management. At the same time that form-factors are getting smaller, computing hardware is getting more powerful, increasing heat dissipation requirements. In addition, today's embedded boards have greater cooling requirements and are constantly pushing the cooling envelopes traditionally used. Conventional systems can use forced-air convection-cooled designs. Harsh and caustic environments (chemical, salt, sand and dust) require conduction-cooling, which is less efficient and often requires creative solutions. To accommodate different cooling strategies for different environments, manufacturers such as Carlo Gavazzi Computing Solutions have designed innovative solutions to meet a wide range of situations.

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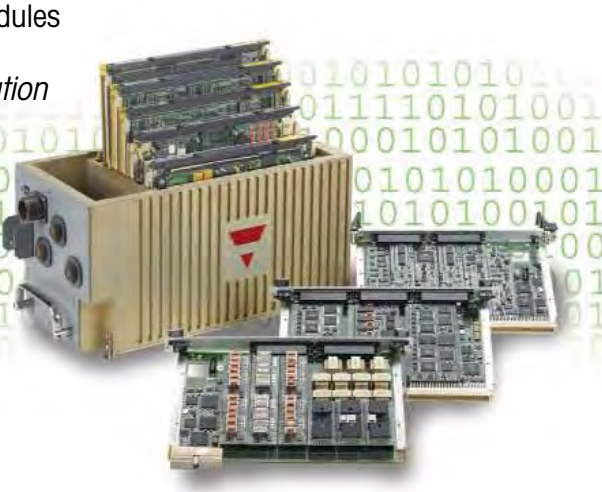

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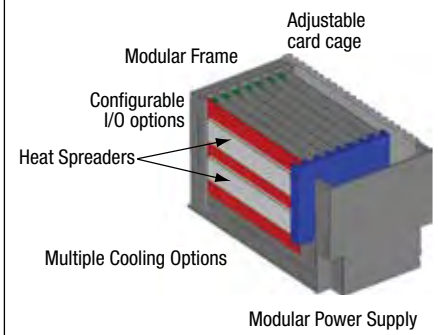

Figure 2

The leading ATR enclosure manufacturers have designed their products to be configurable in terms of the unit's modular frame, power supply options, cooling options, card cage configuration and I/O panel design.

Positioned to Meet Future Needs

The ATR has been proven again and again, and will continue to be utilized as designers adapt it to new situations. Enclosure manufacturers will respond with new materials, designs and technologies such as liquid cooling systems. Those manufacturers who have embraced the design philosophy of modularity and configurability over customization, and who leverage their experience to anticipate future needs, will be the best positioned to deliver in time and on spec. This approach supports the rapid deployment of embedded boards and other cutting-edge components, to ensure that the latest and greatest technology is available to today's warfighter, and the many other users of mobile computing systems. ■■

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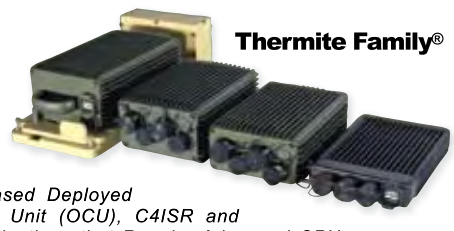
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Military I/O Options

1553 Vies with Ethernet for I/O Dominance

MIL-STD-1553 remains a popular military interface for meeting data integrity and low latency requirements. Gbit Ethernet, Extended 1553 and Fibre Channel are vying as options for upward migration.

Jeff Child
Editor-in-Chief

At over 30 years and counting, the venerable MIL-STD-1553 bus still holds its grip as the dominant, internationally accepted data bus standard for many military platforms. And for applications where data integrity and low latency are the priorities, MIL-STD-1553 is likely to remain the military interface of choice. Meanwhile Fibre Channel, Ethernet and Extended 1553 top the list of possible upward migration paths from 1553. Although fundamentally an avionics bus, a wide variety of systems such as tanks, ships, missiles, satellites and even the International Space Station, rely on 1553.

Some recent activity on the 1553 standards front is Edgewater Computer Systems' flavor of 1553 called Extended 1553. This summer, on board a U.S. Air Force F-16 at the Air National Guard (ANG) Air Force Reserve Command (AFRC) Test Center (AATC) in Tucson, AZ, Edgewater Computer Systems' Extended 1553 data bus technology successfully completed a flight test. The primary purpose of the test was to demonstrate an increase in network capacity roughly 100 times the legacy throughput with no interference to the legacy 1553 system.

Figure 1

Edgewater Computer Systems' Extended 1553 data bus technology successfully completed a flight test this summer, on board a U.S. Air Force F-16 at the Air National Guard (ANG) Air Force Reserve Command (AFRC) Test Center (AATC) in Tucson, AZ, The primary purpose of the test was to demonstrate an increase in network capacity roughly 100 times the legacy throughput with no interference to the legacy 1553 system.

During the flight test, the ANG Block 30 F-16 (Figure 1) performed typical mission flight and aircraft maneuvers including multiple-target tracking with radar and sensor systems and high-G turns. Extended 1553 operated concurrently with the legacy 1553 operation. There was no interference or impact to the legacy 1553 operations before, during or after the flight test while high-speed video traffic

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Figure 2

The S703 from Aitech Defense Systems is a MIL-STD-1553B I/O PMC. It provides fast, high-speed access for dual redundant 1553B channel (BC/RT/MT) for Low Earth Orbit (LEO) and Mars terrestrial applications, with an option for Geosynchronous Orbit (GEO) environments. The 1553B interface includes a space-rated DDC SpaceAce hybrid device, featuring a dual encoder/decoder, complete MIL-STD-1553B protocol.

was communicated bidirectionally across the E1553 network.

Two flight-certified line replaceable units (LRUs) were equipped with E1553 network interface cards—a programmable display generator (CPDG) and a commercial central interface unit (CCIU), both provided by advanced storage-management systems company EFW, color multi-function displays, display processors, digital moving maps and helmet-mounted cueing systems specifically for F-16 aircraft. This flight test is a significant milestone for the E1553 project and solidifies that the technology is at an advanced technical readiness level in support of operational flight.

Adding high-capacity networking across the existing 1553 bus without changing the legacy software or disrupting the legacy communications has implications. The rate monitor maintained a consistent connection of greater than 100 Mbits/s through the entire flight. In March 2006, the U.S. Air Force sponsored the revision to MIL-STD-1553B referred to as Notice 5, which is based, in large part, on Edgewater's development of E1553.

1553 in Many Form Factors

A key part of 1553's ecosystem is its acceptance into other bus and interconnect realms. Even consolidation caused by mergers and acquisitions in the embedded board business hasn't seriously hurt the range of product choices available. As the Product Roundup on the following pages shows, products with 1553 interfaces exist in myriad board form-factors including VME, CompactPCI, PMC, PrPMC, PC/104 and others.

Well suited for I/O interface needs, the PMC mezzanine form-factor is popular platform for 1553 implementation. Aitech Defense Systems provides the S703 (Figure 2), a MIL-STD-1553B I/O PMC—compliant with the PCI 2.1 interface and optimized for minimum traffic on the host PCI bus. The card provides fast, high-speed access for dual redundant 1553B channel (BC/RT/MT) for Low Earth Orbit (LEO) and Mars terrestrial applications, with an option for Geosynchronous Orbit (GEO) environments. The 1553B interface includes a space-rated

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DDC SpaceAce hybrid device, featuring a dual encoder/decoder, complete MIL-STD-1553B protocol, 32 or 64 kwords of shared RAM, memory management logic for all three modes (BC/RT/MT), a backplane hardwired or software RT address, and integrated built-in test capability. The 1553B channels can be specified as direct coupled or transformer coupled, with I/O available from the backplane.

If a complete processor subsystem is required, the Processor PMC form-factor is a good approach. Ballard Technology's OmniBus PMC is a MIL-STD-1553 to PMC interface combined with a PowerPC PrPMC, Serial I/O and avionics discretes. The product can be obtained with 1 or 2 dual redundant 1553 buses and in commercial or conduction-cooled versions. The PrPMC offers the user a monarch/non-monarch PrPMC with DMA, at the cost of just a MIL-STD-1553 interface. The PowerPC is provided as a user-programmable device that when combined with the optional development kit, can control I/O, function as a system back-up controller and even record directly to user-provided disk.

Figure 3

Critical I/O's SensorLink 10 CXMC Mezzanine Card is an FPGA-based fully self-contained sensor-to-10 Gbit Ethernet bridge. It bridges multiple parallel sensor data ports—which can be configured as industry standard parallel FPDP and FPDP2, high-speed parallel LVDS, or PCIe—to standard 1 Gbit or 10 Gbit Ethernet, without the need for any host processor at the sensor.

VME Multi-Channel 1553 Solution

An example of a VME-based 1553 solution is the EXC-1553ccVME/Px from Excalibur Systems. The board is a multi-channel (up to sixteen) MIL-STD-1553A/B interface board for conduction-cooled VME systems. The channels are fully independent, dual redundant, each of which can operate simultaneously as a Bus Controller and up to 32 Remote Terminals, and also as a Triggerable Monitor. The card supports extensive error injection and detection capabilities, and an internal loop back, which requires no external cabling. The card has an operating temperature range of -40° to +85°C. The EXC-1553ccVME/Px is designed for rugged embedded applications, especially those requiring operation in a sealed, conduction-cooled, extended temperature environment.

Serving small form-factor needs, Data Device Corp. offers a PCI-104 card with up to four dual-redundant MIL-STD-1553 channels, five user-programmable digital discrete I/Os, selectable external or internal time-tag clock, and an IRIG-B time synchronization input. PCI-104—which is basically PC/104-Plus sans ISA bus—is a popular form-factor for space-constrained rugged applications. The new BU-65577C is a rugged

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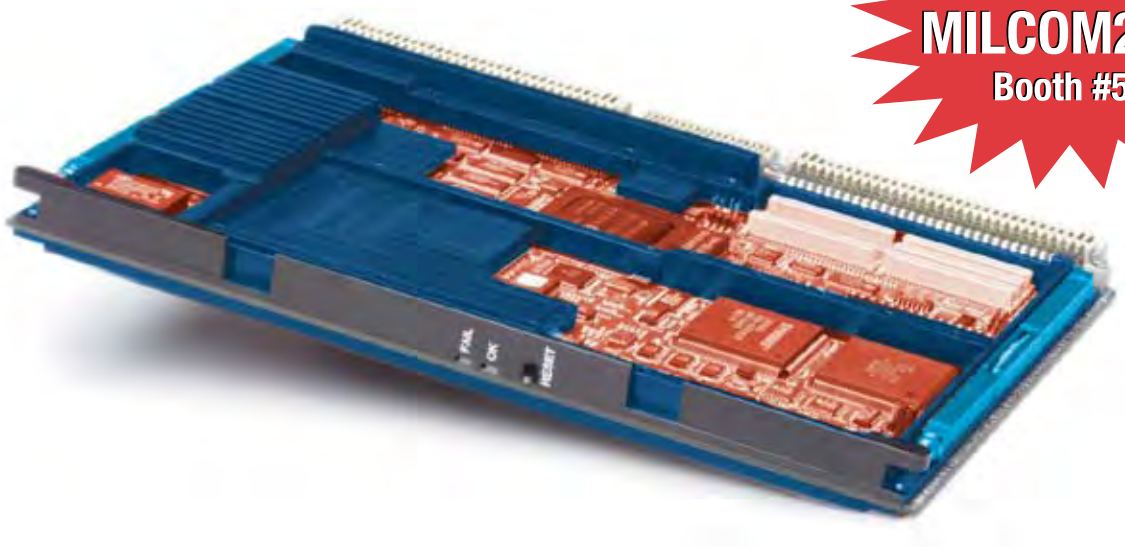

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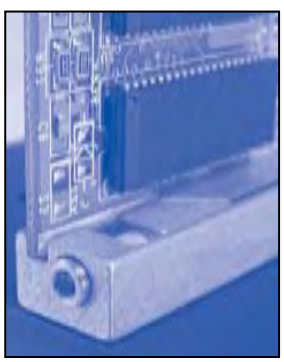

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card that can be used in both convection- and conduction-cooled applications. The PCI-104 and PC/104-Plus form-factors are commonly used in flight data recorders, displays and other avionics systems.

Not to be left out is 1553 development work in the lab. There, desktop slot-card form-factors fit the bill. Along those lines, AIM-USA has a new pair of fourth-generation, PCI-X-compatible cards for test, simulation and monitoring applications. The APX1553-2 is a dual-stream, dual-redundant card while the APX1553-1 is a single-stream, dual-redundant card. Both are provided on a PCI-X-compatible, short-length card format. The APX1553 cards are available as Full Function, Single Function and Simulator-only versions, include an onboard IRIG-B time code generator/decoder, and can monitor/stimulate up to eight discrete I/O signals.

High-Performance Upgrade Path

For several years now much speculation has centered on what interconnect technology will take 1553's place. Fibre Channel looks to be a strong candidate, although it's shifting to more of a pure storage interface solution. For a look at how Fibre Channel is positioned these days see "Fibre Channel Tightens Grip as High-Bandwidth Choice" on p.54 in this issue. Meanwhile, Ethernet is coming into the picture as perhaps a more attractive migration path up from 1553. An important strength of Ethernet is its standardized software infrastructure. For its part, MIL-STD-1553 has never had a standard software API, which has forced 1553 subsystem vendors to craft their own APIs.

Offering higher and higher levels of performance and capability, Ethernet is now taking on much more data-intensive and time-critical applications. Both 1 Gbit and 10 Gbit Ethernet can now—when properly implemented with offload technology—provide a highly deterministic, high-performance fabric suitable for the most demanding real-time applications.

In particular, both 1 Gbit and 10 Gbit Ethernet technologies are finding a home in the implementation of flexible Sensor Data Networks that are used to connect multiple sensors to data processing, recording and instrumentation systems in a variety of sea, land and airborne military systems. Examples of sensor subsystems that can leverage Ethernet sensor networks include radar and sonar sensors, digital imaging systems, digital receivers, video systems and many others.

Critical I/O's SensorLink 10 CXMC Mezzanine Card (Figure 3) is a specific example of an FPGA-based fully self-contained sensor-to-10 Gbit Ethernet bridge. It bridges multiple parallel sensor data ports—which can be configured as industry standard parallel FPDP and FPDP2, high-speed parallel LVDS, or PCIe—to standard 1 Gbit or 10 Gbit Ethernet, without the need for any host processor at the sensor. ▮▮

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Bus	AT Expansion Bus	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI Universal Expansion Bus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
	PCI Bus Masters	4	4	4	4	4	4	4	4	4	4			4
	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9	9	9	9			
CPU and BIOS	CPU Max Clock Rate (MHz)	1000	1400	1400	1400	400	650	400	650	400	650	333	333	333
	L2 Cache	512KB	2MB	2MB	2MB	256k	256k	256k	256k	256k	256k	16K	16k	16k
	Intel SpeedStep Technology	✓	✓	✓	✓									
	ACPI Power Mgmt	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0			
	Max Onboard DRAM (MB)	512	512	1024	1024	512	512	512	512	512	512	256	256	256
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Quick Boot Option Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	EIDE Controller (MB/sec)	100	100	100	100	100	100	100	100	100	100	33	33	33
	ATA/IDE Disk Socket, 32 DIP	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB	4GB
	Audio			✓	✓	✓	✓	✓	✓	✓	✓			
	Digital Video	LVDS	LVDS	LVDS	LVDS			TTL	TTL	LVDS	LVDS	TTL	TTL	TTL
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	RS-232/422/485 Ports	2	2	2	1	2	2	2	2	2	2	2	2	2
	USB 2.0 Ports	4	4	2	4									
	USB Ports					2	2	2	2	2	2	2	2	2
	10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1		1	1
	ECP Parallel Port			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO(Advanced Digital I/O)	14	14	18	18	18	18	18	18	18	18	18	18	18
	multiPort(aDIO, ECP, FDC)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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

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Steve Rood Goldman, Product Manager
Data Device Corp.

Ethernet's widespread use and longevity have resulted in an abundance of embedded hardware and network application software for military use. 10/100 Mbit/s Ethernet has been deployed for years, and now Gbit Ethernet is being designed into both system upgrades and new weapon systems.

Gbit Ethernet is not without its critics within the military supplier community. Arguments regarding quality of service, reliability, latency and processing overhead are ongoing, as are comparisons to alternate high-speed networking technologies. All that said, Gbit Ethernet's cost and performance characteristics are hard to ignore. The recent trend has been to address Gbit Ethernet's limitations using a combination of updated standards such as IPv6, performance-enhancing middleware, protocol modifications and protocol offload. This progress has resulted in the selection of Gbit Ethernet for UAV programs (Figure 1), helicopter and transport aircraft upgrades, various Navy applications, and as widely reported, the U.S. Army's Future Combat System (FCS).

The Challenges of GigE

The switch to Gbit Ethernet presents new challenges if the benefits of increased throughput are to be realized. When we talk about Ethernet, we generally include the layer 3 and layer 4 communications protocols associated with it: IP (Internet Protocol) and TCP (Transaction Control Protocol) or UDP (User Datagram Protocol.) These protocols have traditionally been handled in software since at 10

Figure 1

The Global Hawk UAV has a Sensor Management Unit (SMU) on board that provides a common interface between the sensor payloads and the rest of the aircraft systems. The SMU's 1 Gbyte/s Ethernet network provides communications redundancy and enables a remote operator to select onboard sensor data.


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Mbit/s and 100 Mbit/s speeds, processor overheads have been acceptable.

A rule of thumb used for TCP/IP is that every bit-per-second of network throughput consumes 1 Hz of processor bandwidth. As shown on the left bar graph in Figure 2, 100 Mbit/s throughput on a 1 GHz processor represents only 10 percent overhead. This leaves plenty of room for the mission function as well as reserved bandwidth. At gigabit speeds, shown by the bar graph on the right, TCP/IP processing represents significant overhead and may overwhelm the processor.

Measurements made using the integrated Gbit Ethernet ports on various single board computers (SBCs) demonstrate the severity of the host loading problem. Layer 2 (MAC) processing on the SBC is managed by the system controller or the onboard Ethernet controller. The layer 3 and layer 4 protocol stack runs on the processor, typically a PowerPC. For a range of packet sizes, throughput is good, up to 60 percent of maximum line rate. Receiving packets, however, represents a significant burden on the host. At less than 300 Mbit/s throughput, host loading is 50 percent or more. At higher throughput levels, host loading increases to 80 percent or more.

TOE to the Rescue

Other than throttling back throughput, a practical method of addressing protocol processing overhead is by using protocol offload. TOE (TCP/IP Offload Engine) is implemented using dedicated processing resources based on either hard-wired implementations (commercial ASICs or FPGAs) or commercial processors. Hard-wired, parallel-processing techniques can offer the highest throughput, but have the disadvantage of being based on commercial silicon developed for the iSCSI market. This means that real-time operating system (RTOS) drivers may not be available, available products may not be rated for extended temperature operation, and end users may be subjected to commercial market life cycles.

Processor-based approaches cannot provide wire-speed performance, but they can offload the single board computer as efficiently as ASIC controllers. Using a standard processor provides a number of advantages including long lifecycle support, ability to meet extended temperature requirements and flexibility to implement additional protocol layers and to address custom protocols.

To be clear, most commercial Ethernet controllers include offload features, typically TCP and UDP checksum calculation and TCP segmentation offload. While these features improve performance, they provide only limited relief to the host processor. More sophisticated controllers may offload data path processing, but rely on the TCP/IP protocol stack resident on the host for exceptional conditions such as receiving out of order packets or expiration of a TCP timer.

Operating System Issues

These partial offload approaches require that the host operating system provide the needed hooks into the protocol stack. Operating systems commonly used in commercial and storage applications, such as Windows and Linux, provide partial offload hooks. Real-time operat-

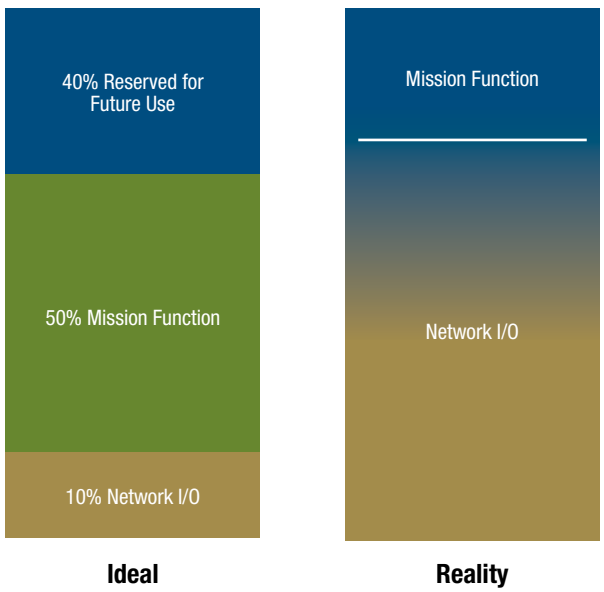

Figure 2

A rule of thumb used for TCP/IP is that every bit-per-second of network throughput consumes 1 Hz of processor bandwidth. On the left bar graph 100 Mbit/s throughput on a 1 GHz processor represents only 10 percent overhead. This leaves plenty of room for the mission function as well as reserved bandwidth. At gigabit speeds, (right bar graph), TCP/IP processing represents significant overhead and may overwhelm the processor.

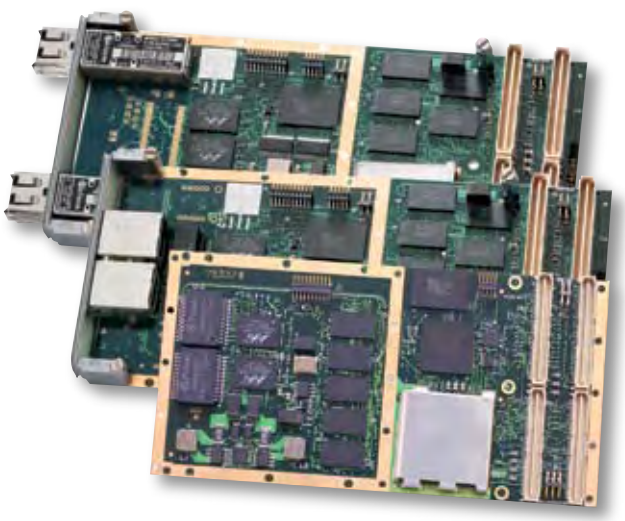

Figure 3

Data Device Corp.'s ET-71000 Gigabit Ethernet Network Access Controller, designed for rugged military applications, uses a processor-based TOE implementation to provide full, transparent offload of the protocol stack.

ing systems such as VxWorks, Integrity and LynxOS do not recognize the partial offload features common to commercial controllers. The drivers for network adapters that use these controllers will function, but without offload.

The driver implementation can impact the usefulness of the TOE function. The industry standard method of connecting a network application to the TCP/IP protocol stack is the BSD sockets interface. A socket is a means of accomplishing interprocess communications. As long as the host and network adapter maintain a socket interface, standard network applications such as FTP, Telnet, NFS and CIFS will operate transparently. The drivers for some TOE implementations use non-standard interfaces between the application and the offloaded stack. This may be acceptable for custom-developed network applications, but is incompatible with the use of embedded military applications. Even when a TOE uses a socket interface, special parameters may be passed in the socket( ) command used to create the socket. These parameters are used to identify the offloaded stack. Again, this approach makes it impossible to use standard network applications without modification and recompilation. For full offload to be effective, the driver implementation must maintain transparency, such that the application is unaware that protocol processing has been transferred to the TOE.

Implementation Options

The requirement for TOE and its implementation approach are application-dependent. New designs that can take advantage of the latest dual-core processors or use multiprocessor SBCs may have adequate bandwidth to handle TCP/IP processing on their own. Space- or power-limited applications, such as sensors, data loaders and remote interface units, may not use embedded computer boards with the fastest processors. Programs retrofitting systems with Gbit Ethernet may need to maintain existing processor architectures to limit firmware impact. These applications are good fits for a transparent TOE implementation.

Several factors need to be considered when making the choice between processor and ASIC-based TOE controllers. If maximum throughput is a primary consideration, then a controller approach may be the best fit. TOE controllers use custom processor cores and distributed memory resources to boost performance. End-to-end throughput will be limited by the design of the interface that moves data across the PCI/PCI-X bus between the network adapter card and the host. The performance difference between processor and controller-based TOE will vary with driver implementation and the host operating system choice.

Processor-based TOE may be the only choice for applications that require modification of the TCP/IP protocol stack. Custom stacks are used to enhance quality of service, reliability and per-

formance for demanding applications. Commercial controllers provide little support for customization because they were designed to meet general market requirements. Likewise, commercial TOE controllers are not IPv6-capable as mandated by the DoD.

One example of a TOE is the DDC ET-71000 Gigabit Ethernet Network Access Controller (Figure 3). This mezzanine card, designed for rugged military applications, uses a processor-based TOE implementation to provide full, transparent offload of the protocol stack. Compared to commercial Ethernet controllers, the processor supports extended temperature operation and provides the flexibility needed to incorporate enhanced QoS and redundancy protocols.

TOE's Future Fit

Military users of TOE must also consider life-cycle support. Since shifting program requirements may lead to design changes, there are benefits to choosing a flexible architecture. General-purpose processors provide the ultimate flexibility, but ASIC-based TOE controllers can offer some degree of firmware adaptability. It is critical to determine who controls the intellectual property (IP) for the TOE implementation. Third-party ownership of IP can impede needed access to firmware and source code. Business objectives can also get in the way. ASIC TOE controllers were developed above all, to address commercial storage area networks (SAN). At present, TOE within the SAN market dwarfs military usage, resulting in relatively short ASIC life cycles and the potential for unexpected "end-of-lifed" products.

System designers are already thinking about 10 Gbit Ethernet for backbone connections between switches and as a backplane for loosely coupled processors. 10G Ethernet introduces new challenges to be addressed for military applications. Today, fiber-optic physical media is required for multi-gigabit links. Existing transceivers used for 10G Ethernet such as XENPAK, XPAK and XFP are bulky and power hungry compared to the SFF and SFP optical transceivers or the ubiquitous 1000Base-T interfaces used at Gigabit speed. IEEE 802.3an and 802.3ap are new standards for 10G-Base-T interconnect and 10G Ethernet copper backplane physical layers. These will be key enablers for military use of 10G Ethernet. Equally important will be the development of next-generation TOE. At 10G speeds, the fastest host processors have no chance of processing TCP/IP. Hardware assist will be mandatory. ▮▮

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System Development

Mezzanines in the Military

Mezzanine Cards Push Density and Speed Barriers

Compute and I/O densities continue to ramp for mezzanine products—both in the tried and true PMC, and the fast ascending XMC and AMC mezzanine form-factors.

Jeff Child,
Editor-in-Chief

Driven by Moore's Law, the on-going magic of semiconductor integration means that yesterday's board and rack-level systems can now be crammed into compact mezzanine form-factors. Mezzanine boards rank among the most vivid examples of that. When mezzanines like the PCI Mezzanine Card (PMC) form-factor first emerged, the typical product was a single I/O or comms channel product or some other single function card. Today, entire sophisticated systems such as a complete software radio transceiver, a quad symmetric multiprocessing engine or an advanced multi-function I/O solution can fit onto the same PMC real estate. For its part, PMC stands out as the most popular mezzanine standard for military applications. PMC slots are found everywhere from on board the popular VME and CompactPCI form-factors, to a myriad of custom base board designs.

With over a decade and a half of maturity under its belt, PMC enjoys a rich infrastructure comprised of all types of products. It's not at all surprising to see a sub-category within which, conduction-cooled PMCs, likewise thrive. Nearly every VME and CompactPCI single board computer available today supports an IEEE-1386.1-compliant PMC slot. Marry that with a VME industry that, with its strong military following, offers the most advanced conduction-cooling technology and specs, and it's clear that PMC's position is solid. When used along with VME, PMCs now typically use the additional cooling that's defined in the VITA 20 Conduction-Cooled PMC spec.

Figure 1

Aitech Defense Systems M222 is a conduction-cooled PMC that provides up to 64 Gbytes of NAND Flash memory in two banks. The M222 provides a sustained data transfer rate of up to 40 Mbytes per second and is suitable for high-density, local data storage applications such as detailed maps, large databases and radar or sonar images.

Fabrics Arrive on Mezzanines

Offering an upgrade path for switch fabric support, the XMC (Switched Mezzanine Card) specification is nearing ANSI approval. The VITA 42 XMC set of standards provide backward compatibility with legacy PMC modules while allowing PCI-bus products to integrate switched fabric architectures. The standards build on the existing PMC standards by adding switched fabric interconnects to the existing PCI bus interface. XMC has a conduction-cooled option that piggybacks off the VITA 20 Conduction-Cooled PMC standard.

Meanwhile, the Advanced Mezzanine Card (AMC) form-factor—although much further developed and established than XMC—was primarily created as a mezzanine for PICMG's telecom-targeted ATCA form-factor. That said, AMC is expected to gain traction in military application mostly as the slot-card component of the MicroTCA form-factor. A rich and growing infrastructure of AMC products is already in place—mostly networking- and communications-oriented in nature.

Products Proliferate

Over the past twelve months, vendors have rolled out a treasure chest of PMC, AMC and XMC products, including a variety of conduction-cooled offerings, military-specific I/O cards and sophisticated DSP and graphics/video engines. If there's a trend in these products it's toward increased "density," whether that takes the form of compute density, I/O function density or memory density.

Exemplifying that trend, Aitech Defense Systems offers a high-density conduction-cooled PMC that provides up to 64 Gbytes of NAND Flash memory in two banks. The new M222 (Figure 1) provides a sustained data transfer rate of up to 40 Mbytes per second and low power consumption of less than 7W. Designed for high-speed read, write and erase perfor-

Figure 2

Technobox's PCIe-to-XMC Adapter lets military system designers adapt an existing PCIe solution to an XMC site on a carrier or single board computer. It's an especially useful tool for software development where an existing PCIe solution is to be ported to an XMC equivalent.

Figure 3

Pentek's Model 7140-420 Dual Digital Transceiver with Wideband Digital Downconverter (DDC) Core and Interpolation Filter is a complete software radio system in a PMC/XMC module. It includes two A/D and two D/A converters for connection to HF and IF ports.

mance, the M222 is suitable for high-density, local data storage applications such as detailed maps, large databases, radar or sonar images, software programmable radio ELINT data or other graphics. Available in commercial, rugged and military-grade configurations, the M222 Flash memory PMCs are designed to resist shock and vibration for trouble-free performance, even in high-stress military environments.

While VME and CompactPCI are the most common carrier formats that host PMC slots, they're not the only ones. Now even PCI-X is getting into the PMC slot game. Dynamic Engineering's latest PCI-X product is the PCIBPMCX1, an adapter/carrier converter card that provides the ability to install one PMC card into a standard PCI/PCI-X slot. It is suitable for PCI or PCI-X operation with 32-bit or 64-bit data and 33, 66, 100 or 133 MHz clock. The PMC user I/O connector Pn4 is available on a SCSI II connector. The PCIBPMCX1 has a cooling cutout for increased airflow to the PMC.

Facilitating PCIe to XMC Migration

The broad proliferation of PCI Express (PCIe) and the ruggedness of the XMC mezzanine form-factor together make an ideal recipe for migrating functionality from one to the other. Fueling such efforts, Technobox has introduced an XMC card that facilitates the development of XMC cards and/or related software. Using the PCIe-to-XMC Adapter (Figure 2), called the 4876, an engineer can adapt an existing PCIe solution to an XMC site on a carrier or single board computer.

The card is an especially useful tool for software development where an existing PCIe solution is to be ported to an XMC equivalent. Side one of the 4876 has a pair of XMC connectors for the P15 and P16 interfaces that mate with the host XMC site. A single 8x PCIe connector is located on the opposite side of the adapter, along with some headers and jumpers. Two 64-pin headers are provided to permit probing of various XMC signals from the P15 and P16 connectors. Pin assignments conform to VITA 42.0-2005 and VITA 42.10-200x. Onboard LEDs provide indication of key XMC signals and power status.

Leveraging the similarities of PMC and XMC, vendors like Pentek offer a number of products that implement a system in a PMC/XMC product. An example is Pentek Model 7140-420 Dual Digital Transceiver (Figure 3) with Wideband Digital Downconverter (DDC) Core and Interpolation Filter. This is a complete software radio system in a PMC/XMC module. It includes two A/D and two D/A converters for connection to HF and IF ports. The card handles a range of input and output signal bandwidths from 4.8 kHz to 40 MHz—highly extraordinary for a single product. The GateFlow Core 420 includes a two-channel, wideband DDC IP core that complements the multiband Texas Instruments GC4016 ASIC.

Curtiss-Wright Controls Embedded Computing's latest XMC offering is the XMC-442, its first Xilinx Virtex-5 FPGA-based XMC module (VITA 42) compute engine. The new XMC-442 mezzanine module combines the flexibility of a Xilinx Virtex-5 SXT (SX50T/SX95T) FPGA, the high bandwidth of serial switched fabrics such as PCI Express and Serial RapidIO (SRIO) and rich I/O options. It significantly speeds the integration of high-performance FPGA-based custom calculation blocks onto embedded platforms that feature onboard XMC sites, such as VPX, VME and CompactPCI boards. The

XMC-442 is designed to operate in rugged environments and is available in both air- and conduction-cooled formats.

AMC for Military Comms

Advanced Mezzanine Cards provide the modularity needed in many demanding military communications systems. A single-wide AMC from Mercury Computer Systems, the MPC-102 is a control and signal processing AMC that provides a dual-core e600 8641D PowerPC processor at up to 1.3 GHz with up to 2 Gbytes of DDR2 memory, SATA, RapidIO or PCI-E, and Gbit Ethernet connectivity. The module is AMC.0-compliant and designed to meet AMC.4. The SATA interface supports a HDD in the neighboring AMC bay, making this an ideal host or control node. The architecture and AltiVec vector processing units of the e600 core are compatible with Mercury's industry-leading Scientific Algorithm Library, supporting use of the MPC-102 in dense floating-point processing applications such as radar, sonar and image inspection.

Helping to smooth the task of configuring MicroTCA systems and their AMC slot cards, GE Fanuc Embedded Systems last month announced two new "pre-validated" MicroTCA platforms, the MicroTCA MP-2000 and MicroTCA MP-3000. Pre-validated means that each has been pre-configured and pre-tested, ensuring that customer development and deployment times are kept to the minimum possible. Field-proven IPMI code is provided to ensure interoperability. Each platform is designed to deliver the performance and flexibility needed for cost-sensitive network-centric MicroTCA development applications in a variety of markets including telecom, commercial and military.

The MicroTCA MP-2000 platform features a 2U, 13-slot MicroTCA chassis while the MicroTCA MP-3000 features an 8U, 15-slot MicroTCA chassis. Both platforms come pre-configured with a Power Module, dual Cooling Units and MicroTCA Carrier Hub (MCH) with PCI Express fabric module, together with GE Fanuc Embedded Systems Telum Intel-based processor, dual SATA storage modules, multi-port Gbit Ethernet I/O interface and VGA graphics AdvancedMCs. A Linux (CGL) operating system and Linux Support Package (LSP) with CGL drivers are pre-installed on the platforms. ▮▮

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Figure 4

Mercury Computer Systems' MPC-102 is a control and signal processing AMC that provides a dual-core e600 8641D PowerPC processor at up to 1.3 GHz with up to 2 Gbytes of DDR2 memory, SATA, RapidIO or PCI-E, and Gbit Ethernet connectivity. The module is AMC.0-compliant and designed to meet AMC.4.

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Mezzanines in the Military

VITA 42 XMC on Path Toward ANSI Standard

Following in the footsteps of the popular PMC form-factor, XMC's layered architecture brings switched fabric technology into the mezzanine realm.

Andrew Reddig, President and CTO
TEK Microsystems

Military applications have always combined the requirement for high-performance processing and I/O with aggressive size, weight and power constraints along with the need to operate in severe environments. Beyond just raw performance, military programs also require long product life cycles. That drives a need for open industry standards with an ecosystem of interoperable products from multiple vendors as well as the potential for technology refresh within the framework of a set of standards over the lifetime of the deployed system.

The most common standard for modular I/O in military applications today is the PCI Mezzanine Card (PMC), which was standardized as IEEE 1386.1 in 2001 but was widely adopted by industry during the draft standard stage. The PMC standard defines a common form-factor with two possible bus interfaces, PCI Local Bus and SBus, as well as allowing application-specific bus interfaces. Over the lifetime of the standard, the PMC standard has been extended to include the PCI-X protocol, 3.3 and 5V signaling, 66, 100 and 133 MHz clock frequencies, PCI-X protocol, and a range of application-specific I/O options through the Pn4 connector. PMC modules are used today on military programs in a wide range of architectures, including VME, VXS, VPX, CompactPCI and ATCA.

Figure 1

An example XMC product is Pentek's 7141, a digital receiver card. The card uses an FPGA-based implementation to support both PMC and XMC interfaces with IP core support of PCI, PCI-X, RapidIO and PCI Express using a common hardware platform.

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The success of the PMC standard is based on several key features. First off, the standard leverages PCI Local Bus, which is the de facto standard for I/O to local processors from Intel, Freescale, AMCC and others. PMC also allowed performance extensions over time while maintaining backward compatibility with legacy PMC modules and carriers. That also included application-specific standards for I/O extensions as well as project-specific I/O. Moreover, PMC met the requirements of military deployed programs, especially vibration, shock, temperature and support for both convection and conduction cooling.

The next evolutionary step in modular I/O is defined by the VITA 42 family of standards, known as XMC. The XMC standards duplicate many features of the previous PMC standard:

Layered Architecture: The XMC standard uses a layered architecture, defining the common mechanical, power and interconnect requirements in the base standard while allowing a number of choices for switched fabrics (PCI Express, RapidIO) as well as application-specific options (Aurora) through separate protocol standards.

PCI Express and RapidIO Support: XMC leverages PCI Express and RapidIO, making it compatible with two of the common standards for I/O to processors. The XMC connector has the potential to support PCI Express Gen 2, providing headroom to double throughput in future applications.

User I/O: XMC provides a user I/O connector (Pn6) for high-speed I/O connections to application-specific interfaces.

Backward Compatibility: XMC provides backward compatibility with PMC modules, allowing carriers to support either PMC, XMC or hybrid modules.

The XMC protocol standards for RapidIO and PCI Express have completed the standardization process and are now available as ANSI/VITA standards. The XMC base standard, VITA 42.0, was initially issued as a Trial Use Standard and is now moving through the ANSI balloting process.

As with PMC, market adoption of XMC has moved forward in parallel with the standardization process. There are currently XMC modules and carriers on the market from dozens of companies, providing systems integrators with a wide range of choices for standards-based modular I/O to support the next generation of high-performance embedded computing systems. A typical XMC module is the 7141 digital receiver card from Pentek shown in Figure 1, which uses an FPGA-based implementation to support both PMC and XMC interfaces with IP core support of PCI, PCI-X, RapidIO and PCI Express using a common hardware platform. ■■

Andrew Reddig serves as chair of the VITA 42 XMC task group as well as chairing, sponsoring and participating in several other VITA task groups.

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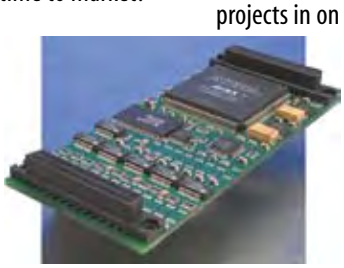

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Technology Focus

Fibre Channel Boards

Fibre Channel Tightens Grip as High Bandwidth Choice

Entrenched now as a solution for high-bandwidth avionics networking, Fibre Channel's future path seems toward its storage interface roots.

Jeff Child
Editor-in-Chief

Although Fibre Channel literally took decades before it became an overnight success, the technology now boasts a solid position as a de facto standard for high-performance avionics networking. And while it hasn't displaced MIL-STD-1553 for traditional command and control avionics duties, Fibre Channel has carved out territory as a solution for such bandwidth-intensive tasks as linking sensors, radar arrays and electronic warfare (EW) systems with processing and embedded storage subsystems

The way Fibre Channel is used in military embedded systems is notably different than how it's used in the commercial market. In the large—and growing—storage area network (SAN) market, it's seen as a "here today" interface to storage media. Meanwhile, interconnects like the Ethernet-based iSCSI is starting to displace Fibre Channel. In contrast, military systems used Fibre Channel as more of a peer-to-peer networking technology.

Aboard an aircraft, for example, very high bandwidth data streams that might be coming from sources like a radar front end sensor are moved over a Fibre Channel network. In effect, high-resolution video sources, high-resolution radar sources and EW sources are being collected over a Fibre Channel network. That data is then processed by a cluster of processors and then stored to storage devices—typically solid-state drives (SSDs). An example Fibre Channel application is the Navy F-18's (Figure 1) tactical area moving map capability (TAMMAC). In the TAMMAC, the interconnect between the program load device and the map generator is Fibre Channel.

Coming full circle back to storage, the shift happening now in Fibre Channel is back to that of a high-bandwidth storage interface solution. The shift is away from using it as a peer-to-peer networking tool to more of a pure storage. System designers want to use Fibre Channel to store lots of data very quickly. This isn't happening across the board by any means. Many still prefer Fibre Channel for peer-to-peer networking, but fewer as Ethernet has moved in to fill that role.

Driving this shift back to storage is an infrastructure of storage technology that brings all the pieces together. A decade ago, the requirement in military embedded systems to acquire data and store it in large amounts wasn't really an option. Storage subsystems didn't have enough bandwidth or capacity. Moreover, they weren't robust enough—at the densities needed—to fly aboard an aircraft. Today, solid-state drives at high densities boast interfaces with 4 Gbit/s Fibre Channel, going up to 8 Gbit/s Fibre Channel—in ruggedized RAID systems. You can now acquire a lot of data and analyze it after the mission.

Figure 1

Fibre Channel is used in the tactical area moving map capability (TAMMAC) system on board the Navy F/A-18C fighters. In the TAMMAC, Fibre Channel serves as the interface between the program load device and the map generator. An F/A-18C Super Hornet here launches from the flight deck aboard the aircraft carrier USS Ronald Reagan (CVN 76).

The "Fibre Channel Boards Roundup" on the following pages showcases some examples of today's crop of products that have capitalized on the roadmap of Fibre Channel. As 1 and 2 Gbit Fibre Channel boards mature, 4 Gbit products are becoming mainstream. Meanwhile, 8 Gbit Fibre Channel is on the near horizon, and this same set of vendors is expected to begin rolling out 8 Gbit versions by the end of next year. ▮▮

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Technology Focus:

Fibre Channel Boards Roundup

PMC Card Eases Transition to 4 Gbit/s FC

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

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

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

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[www.astekcorp.com].

Fibre Channel Climbs aboard PCI Express XMC

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

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

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Dual FC PMC Saves System Slots

In many military applications, saving space by fully utilizing each Single Board Computer (SBC) or PMC slot can be very important. The Curtiss-Wright Controls FX400 Dual-Channel (DC) Fibre Channel PMC cards are high-performance host bus adapters (HBA) ideally suited for demanding high-bandwidth data communications and storage applications. The FX series of products provides support for SCSI Fibre Channel Protocol (FCP) and Internet Protocol (IP), eliminating the need to deal directly with the Fibre Channel interface. In addition, the FX400 DC cards feature two separate high-performance RISC I/O engines to minimize host CPU overhead. The superior communication and interconnect capabilities of the Fibre Channel standard are maximized by the Curtiss-Wright Controls/ FX400 DC cards.

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

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

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

PMC Targets Air-Cooled Avionics and Vetronics Apps

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

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

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

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

AdvancedMC Serves Up 4 Gbit/s FC

The AdvancedMC (AMC) mezzanine form-factor is gaining decent traction in the military, thanks in part to the emergence of MicroTCA, which uses AMCs as slot cards. GE Fanuc Embedded Systems offers as part of its extensive line of AdvancedMC modules, the Telum FC2432 Fibre Channel (FC) Host Bus Adapter (HBA) AdvancedMC with dual fiber interface.

The Telum FC2432 HBA in single-wide, full-size or mid-size AMC.O form-factor, provides connectivity to a x4 PCI Express baseboard. The HBA offers two independent channels of 4 Gbit/s Fibre Channel and is currently available in dual fiber (supports multimode and single-mode fiber optic) with two SFF

ports supporting LC-style connectors. These AdvancedMC HBAs, together with supporting software tools, provide the high sustained throughput and low latency required for demanding real-time and storage applications. SCSI-FCP protocol support is provided for Linux operating systems.

The Telum FC2432 HBA includes the Intelligent Platform Management System and is Hot Swap compliant to limit system downtime. The FC2432 communicates with the carrier/shelf through a packet-based serial interface, which features up to four lanes of high-speed I/O (2.5 Gbits/s each).

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

PMC Supports FC-Audio/Video Protocol

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

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

video applications, like driving synchronous displays and sensor fusion applications.

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

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

PMC Boasts a Variety of I/O Options

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

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

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

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

Data Recording SoC Supports Fibre Channel

Advanced applications such as UAVs, signals intelligence, imaging and surveillance applications all have something in common. They all put issues of weight, power and size as top priorities. TEK Microsystems and QinetiQ Real-Time Embedded Systems teamed up to address exactly those needs with their latest product developed as a result of the alliance between the companies. Called the JazzStore SoC, the product is a complete data recording solution available as a "System-on-a-Chip."

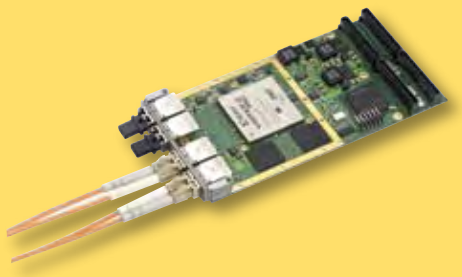
Firmware used in the JazzStore SoC utilizes the unique Tekmicro real-time FAT32 file system, which enables users to swap out a disk and simply mount it on a PC for review, analysis and playback if required. JazzStore SoC includes a QinetiQ-developed Fibre Channel core that takes advantage of the

PowerPC 405 processors present within a Xilinx Virtex II Pro FPGA. All JazzStore components, including enclosures and RAIDs, are available in commercial grade as well as ruggedized versions for harsh environments. Under a commercial alliance, TEK Microsystems and QinetiQ jointly develop, market and sell high-performance carrier, payload, PMC/XMC and computer boards in the United States. The JazzStore SoC is available today as an add-on option and is priced at $5,000.

TEK Microsystems
Chelmsford, MA.
(978) 244.9200.
[www.tekmicro.com].

Multifunction Board Handles Fibre Channel and More

In this age of multi-function boards, Fibre Channel is not always a stand-alone board-level function. Some products offer Fibre Channel capabilities and much more. For example, VMETRO's PMC-FPGA03F is an XC2VP50 Xilinx Virtex-II Pro FPGA PMC supporting two or four fiber-optic I/O channels each connecting to a RocketIO channel on the FPGA. This product provides front-panel high-



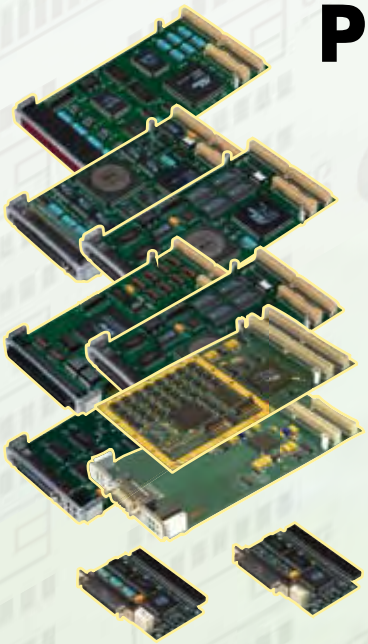
speed serial communications via fiber-optic transceivers. The Xilinx Virtex-II Pro FPGA supports the use of Fibre Channel, serial FPDP or other communication IP cores. The PMC-FPGA03F is a user-programmable product. In addition to a communication IP core, the user can implement logic in the Virtex-II Pro to process the data that is being communicated across the RocketIO channels.

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

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

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

PCI-to-PMC

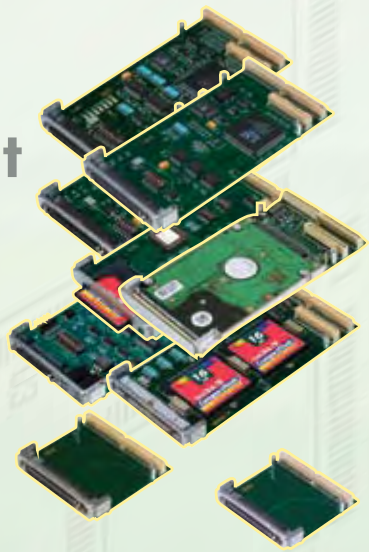


Serial

Ultra320

FPGA

Quad Ethernet



Adapters

SCSI

Async

SATA

Reconfigurable

RoHS

CardBus

IDE

Digital I/O

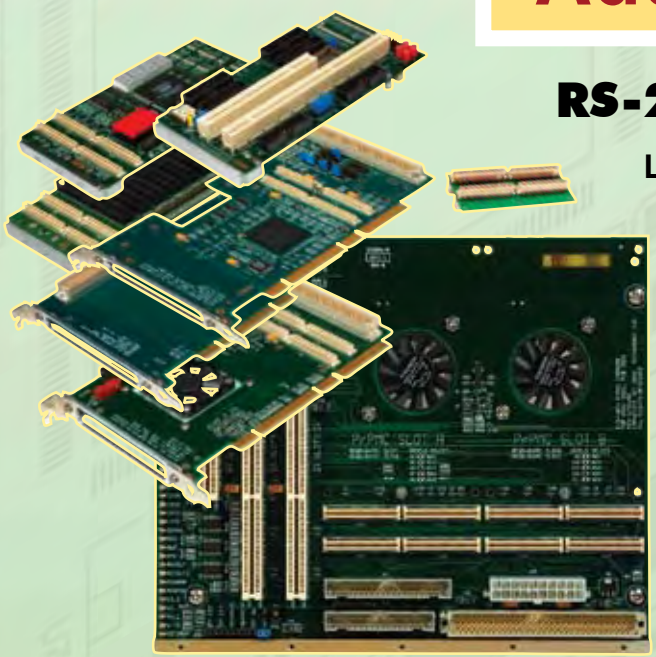
CompactFlash

Fast/Wide

PrPMC

SAS

PMC-to-PCI



RS-232/422/485

LVD/SE

PIM

PMC-X

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Fax 609-261-1011

500W DC/DC Converter Suited for High-Reliability Chores

Harsh environment military systems can't skimp when it comes to power converters. A level of reliability is called for where failure is not an option. Along such lines, Century Electronics has announced a new family of extra high-power DC/DC converters, providing up to 560 watts of output power with 90% efficiency. The new Model DC500 Series Converter operates at 28V input in accordance with MIL-STD-704 Magnetic Isolation.

The power supply is unaffected by time, temperature or radiation, as the feedback circuit does not use optocouplers. A primary current sense transformer and a secondary output current sense resistor are used for output short-circuit and current-limit protection creating higher reliability. Soldering is not required for interface connection with the module, as D-type input and output connectors are utilized. The input connector is an integral part of the six-side shielded EMI input filters. Input In-Rush current is limited to less than 50A. A power On/Off remote-control input pin is available. Unit size is 6 x 5 x 1 inches and weighs 1.85 lbs.

Century Electronics, Westlake Village, CA. (818) 706-8224. [www.centuryele.com].

1.8 GHz Pentium M EBX SBC Runs at -40° to +70°C

Compute density seems to be the watchword these days in all manner of embedded autonomous military computing applications. The EBX form-factor has a lot to offer for such applications. WinSystems has launched their EBX-compatible Intel 1.8 GHz Pentium M single board computer. The EBC-855-G-1.8-1 is a RoHS-compliant, processor- and I/O-intensive board offering -40° to +70°C temperature operation. Based on Intel's 855GME chipset with the ICH 4 communications controller and integrated Extreme Graphics 2 video 3D controller, the EBC-855-G-1.8-1 offers long-term product availability and full x86-Pentium compatibility. It supports up to 1 Gbyte of industry-standard PC2700 SDRAM and up to 8 Gbytes of CompactFlash. It also supports rotational floppy and hard disk drives.

The EBC-855-G-1.8-1's I/O interface features include a 10/100BaseT Ethernet port (with remote boot capability), VGA and dual channel LVDS flat panel video, a miniPCI connector for an 802.11 wireless networking module, four USB 2.0 ports, four serial COM ports, AC97 audio (5.1 codec), LPT and a PS/2 port for keyboard and mouse. A software-programmable 48-line digital I/O controller provides input, output or output with readback for each I/O line. More I/O expansion is possible by self-stacking modules plugged onto the PC/104 and PC/104-Plus connectors. The EBC-855-G-1.8-1 is priced at $895.

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

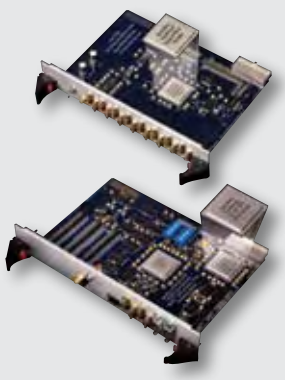
Digital Transceiver Embeds Interpolation Filter IP Cores

Applications like SIGINT, military communications systems and radar have big appetites when it comes to transceiver bandwidth and range. Feeding those needs, Pentek has released its Model 7140-420 Dual Digital Transceiver with Wideband Digital Downconverter (DDC) Core and Interpolation Filter. This is a complete software radio system in a PMC/XMC module. It includes two A/D and two D/A converters for connection to HF and IF ports.

This module is also available in a variety of form-factors including PCI, 3U and 6U cPCI, as well as a PMC/XMC conduction-cooled version. The Model 7140-420 Dual Digital Transceiver with Wideband DDC Core and Interpolation Filter handles a range of input and output signal bandwidths from 4.8 kHz to 40 MHz—highly extraordinary for a single product. The GateFlow Core 420 includes a two-channel, wideband DDC IP core that complements the multiband Texas Instruments GC4016 ASIC. This DDC can be driven directly from the A/D converters to achieve decimations from 2 to 64 for signal bandwidths up to 40 MHz. The Model 7140-420 PMC/XMC module's prices start at $11,995.

Pentek, Saddle River, NJ. (201) 818-5900. [www.pentek.com].

Boards Support Rad-Hard SPARC and FPGA Eval



Radiation-hardened components aren't the kind of devices that get stuck onto a board and shipped out the door. Rigorous testing and verification are required to ensure their capabilities. Easing that process, Aeroflex has added to their RadHard portfolio two new evaluation boards: the UT699FP-EVB LEON3 Fault Tolerant SPARCTM V8 Processor FPGA Evaluation Board and the UT200SpW16RTR-EVB SpaceWire Router Evaluation Board.

The UT699FP-EVB LEON3 Fault Tolerant SPARC V8 Processor FPGA Evaluation Board is a compact PCI-based board containing an FPGA version of the UT699RH RadHard pipelined monolithic, high-performance, fault-tolerant LEON 3FT SPARC processor with four dual SpaceWire ports, Ethernet and CAN ports. The UT200SpW16RTR-EVB SpaceWire Router Evaluation Board's router is designed to provide 16-port SpaceWire connectivity at 120 Mbits/s. Aeroflex currently offers a SpaceWire Physical Layer Transceiver and SpaceWire IP for the RadHard Eclipse FPGA; the 16-Port Router Evaluation Board and Router solutions are next. The UT699FP-EVB LEON3 Fault Tolerant SPARC V8 Processor FPGA Evaluation Board and the UT200SpW16RTR-EVB SpaceWire Router Evaluation Board are $20,000 each.

Aeroflex, Colorado Springs, CO. (719) 594-8035. [www.aeroflex.com].

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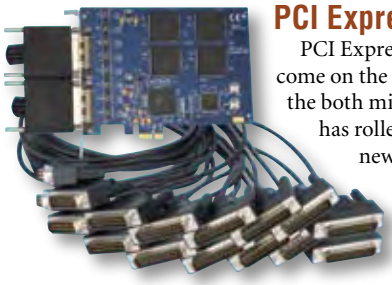


PCI Express Board Serves up 16 RS-232 Ports

PCI Express was by no means the first switched fabric technology to come on the scene, but it has definitely captured the widest adoption, in the both military and general embedded applications. Sealevel Systems has rolled out a 16-port RS-232 serial I/O adapter designed for the new PCI Express bus design. The board uses 16C854 UARTs with 128-byte FIFOs—16 times larger than other boards. Each serial port provides a maximum data rate of 460.8 Kbits/s, and the COMM+16.PCIe has an operating range from 0° to +70°C. Extended temperature versions operating from -40° to +85°C are available. All Sealevel I/O products have a lifetime warranty.

The COMM+16.PCIe is ideal for connecting to PLCs, bar code readers, scales and other data acquisition/control devices using the included DB-25M fan-out cable (DB-9M fan-out cable available as an option). The product includes SeaCOM software for Windows 98/ME/NT/2000/XP/Vista and Linux operating systems. As an added value, customers also receive WinSSD, a full-featured application for testing and diagnostics including BERT (Bit Error Rate Testing), throughput monitoring, loopback tests and test pattern message transmissions. The COMM+16.PCIe standard price is $679 and product is available for shipping.

Sealevel Systems, Liberty, SC. (864) 843-4343. [www.sealevel.com].

Dual 19-inch Flat Panel KVM Mounts Vertically

Military control stations face requirements for even more sophisticated graphics and video display. Serving that need, Neuro Logic Systems provides the first vertical "over-under" Dual 19-inch Flat Panel display and keyboard drawer (KVM) unit that mounts into a 2U (3.50-inch) space. Called the RFT2-19-L2, the unit was originally designed for piloting Unmanned UAVs and features a sealed, backlit, full-travel keyboard and sealed 38 mm 3-button trackball for use in harsh battlefield environments. When closed, the lightweight, aluminum alloy RFT2-19-L2 stows into a single, 24-inch deep 2U space in a transport case or standard RETMA equipment rack.

The two high-quality, wide view angle 19-inch LCDs, with 1280 x 1024 native resolution, are protected by strengthened, anti-reflective glass filters. The RFT2-19-L2 also comes equipped with a backlit, sealed, full-travel keyboard and large 3-button trackball. Video connections are HD-15 and keyboard connections are PS/2 while options exist for DVI, NTSC and RS-170 video and keyboard options for USB. Single piece pricing is $5,775 and quantity discounts are available.

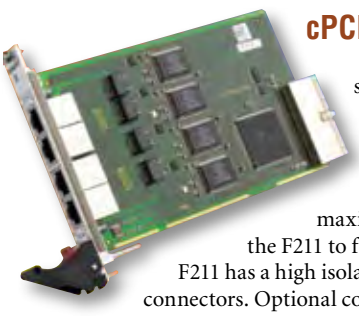
Neuro Logic Systems, Camarillo, CA. (805) 389-5435. [www.NLSdisplays.com].

Repeater Does Safe CAN-Data Transmission via Fiber

Already a fixture in automotive electronic systems, the CANbus continues to gain mindshare among military vetronics (vehicle electronics) system designers. CANbus expert IXXAT has rolled out its new CAN-CR210/FO, a line-up version of its approved FO-Repeater. Several CAN-CR210/FO can be connected via the integrated backbone bus, which allows the set-up of a star-coupler with an almost unlimited number of channels.

The main operational area for the FO-Repeater is the transmission of CAN messages in an environment with high electromagnetic influences as well as the dependable galvanic isolation of subassemblies. As with all IXXAT repeaters, the CAN-CR210/FO allows the automatic recognition and separation of a defective segment from the rest of the network, so that the remaining network can continue working. After elimination of the defect, the segment is automatically switched into the network again. The CAN-CR210/FO has one high-speed CAN interface (ISO/IS 11898-2), an integrated backbone-bus and a fiber-optic interface (50/125 micrometer duplex). For the fiber-optic version, F-SMA or ST-Socket is available. The repeater is delivered in a small plastic case for DIN rail mounting. The power supply can be provided in a wide range from 9 to 35 VDC.

IXXAT, Bedford, NH. (603) 471-0800. [www.ixxat.com].



cPCI Card Features Quad Fast Ethernet Links

Drawn to its longevity and ubiquity, the military has warmed to Ethernet for even the harshest of deployed systems. MEN Micro now offers a single-slot, 3U CompactPCI (cPCI) network controller with Quad Fast Ethernet (QFE) for expanded control of multiple network configurations. The new 32-bit, 33 MHz F211 is qualified for an extended temperature range of -40° to +85°C, making it ideal for harsh and mobile applications.

The IEEE 802.3u-compliant network controller features four full-duplex/half-duplex channels that support 10Base-T and 100Base-TX physical layers and provide auto-negotiation, collision and link detection with a maximum data transfer of 200 Mbits/s per channel. Each of the four channels has a unique MAC/IP address, enabling the F211 to function in a redundant mode when the lines are used in parallel, especially useful for high-availability systems. The F211 has a high isolation voltage of 1,500V and a low power consumption of 3.3V. The front panel features four standard 8-pin RJ45 connectors. Optional conformal coating further ensures the controller's resistance against rugged conditions. Pricing for the F211 is $544.

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

PICMG 1.0 SBC Sports Core 2 Duo, 1033 MHz FSB

Not long ago the Pentium M seemed to dominate the new product announcements for embedded SBCs. Now the Intel Core 2 Duo is stepping into that role, offering military systems designers the boost in computer density they crave. NEXCOM has rolled out its first PICMG 1.0 SBC to support the Intel Core 2 Duo processor up to 1033 MHz Front Side Bus, and to provide backward support of ISA peripherals.

Since all components of the PEAK 765VL2 are designed to mount only on one side of the board, the PEAK 765VL2 board requires less manufacturing and components. As a result, the PEAK 765VL2 has a much lower failure rate due to the component failure. Since many existing peripherals in the military embedded computing market are connected through a legacy ISA expansion port, and all NEXCOM industrial computing products come with five years shelf-life support, the PEAK 765VL2 provides a great opportunity to upgrade your system's performance without giving up the legacy peripherals and applications for many years to come.

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

VME/ATR Supply Powers 28V Avionics and Vetronics

The military power supply realm remains a high barrier of entry market space. That's because a select set of vendors has earned the trust of military system designers over decades of working with them. Designed to satisfy the needs of many of today's 28V input military applications, Rantec's new line of power supplies is available in conduction-cooled 6U x 160 mm single slot and convection-cooled 6U x 160 mm two-slot models. Rated for up to 250W, output voltages of 3.3, 5.0 and +/- 12 VDC are provided. In addition, there are two electrical configurations in order to serve cost-sensitive applications and a wide-input ANSI VME64-compliant version for performance-driven requirements.

All of the power supplies meet MIL-STD-461 EMI, MIL-STD-810F environments and MIL-STD-901C shock. The device is compliant to MIL-STD-704A-F steady state, normal and abnormal conditions. Operating temperatures are -55° to +85°C for single-slot conduction models and -55° to +65°C for double-slot convection models. The supplies support thermal protection with auto-recovery as well as overcurrent and overvoltage output protection.

Rantec Power Systems, Los Osos, CA. (805) 596-6000. [www.rantec.com].

Expandable Rugged Box Can Take the Heat

The military is embracing the trend toward stand-alone rugged boxes with full force. Feeding those needs, Octagon Systems has announced the RMB-S CORE, a high-performance mobile server, the latest member of its CORE SYSTEMS line of rugged systems with expandable I/O and fanless operation. The RMB-S is a "no compromise" design that optimizes the electrical, thermal and mechanical components for maximum reliability.

The basic unit includes the processing power, mobile power supply, memory, connector card and I/O for most applications. Standard I/O includes dual Ethernet, quad USB 2.0, dual serial, CRT & LCD video and digital I/O. The RMB-S is fully functional out of the box, and additional I/O, such as GPS, analog, radio or Wi-Fi, can be readily added via PC/104 and PC/104-Plus modules. An option panel can be easily removed and punched for custom annunciators, connectors and controls. Heat from the system is channeled directly to the case to help prevent internal hot spots. The RMB-S mobile server operates in ambient temperatures from -40° to 70°C, depending upon the processor speed, user options and mass storage devices. A MIL-810F version offers a case with military-grade connectors and gasket sealing to provide dust-resistant, waterproof protection in outdoor environments.

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

Ethernet Media Converter Adds SFP Option

The jury is in. The military market has accepted Ethernet for numerous networking and fabric interconnect chores. Aaxeon Technologies has released its Optolinx FCU-3002SFP 1000BaseT Ethernet to 1000BaseSX/LX Ethernet Media Converter with SFP (Small Form-Factor Pluggable) interface. The FCU-3002SFP is exactly like its FCU-3002 counterparts except that it has the luxury of having an SFP Slot. Users now have the option to use either Single-Mode or Multi-Mode by simply changing SFP modules. They can also easily change wavelengths and reach by doing a simple SFP swap.

Since the SFP modules are hot-swappable, changing to the desired mode is a breeze. The FCU-3002SFP will work with any MSA (Multi-Source Agreement)-compliant transceiver. The FCU-3002SFP is fully compliant with IEEE 802.3z and IEEE 802.3ab standards. With supports to Link Alarm, Jumbo Frame (64-9216 byte) and Voltage Monitoring, users should have no problem implementing the FCU-3002SFP into their application. Installation and operation procedures of the FCU3002SFP are simple and very straightforward.

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

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UPS Family Is Designed for Critical Military Use

When it comes to back-up power for mission-critical military systems, a unique set of Uninterruptible Power Supplies (UPS) requirements comes into play. Right up that alley, Falcon Electric has launched its FN Series UPS Plus family of parallel or N+1 redundant UPSs. Designed to meet the demands of military network infrastructures with a scalable platform and N+1 redundancy, the new double-conversion online UPSs achieve many technical milestones including a faster processor utilizing DSP.

The new hardwired FN Series UPS will be available in various model configurations. All models support a hardwire connection to any 208-240 VAC single-phase, 2-wire plus ground power source. In contrast to the current parallel UPS solutions offered in the marketplace, Falcon's innovative UPSs are stand-alone units that may be connected in parallel, providing low-cost, scalable solutions from 3 kVA up to 24 kVA. This approach eliminates the added expense of buying cabinets to house power and battery modules. When the FN models are configured in parallel, with the addition of one extra UPS, true N+1 redundancy can be achieved. Available now, the FN Series UPS Plus models are designed to UL and cUL standards and meet FCC Class A requirements. List pricing starts at $3,889.

Falcon Electric, Irwindale, CA. (800) 842-6940. [www.falconups.com].

Multifunction VME Card Blends Five Functions in One

As military programs—including airborne, shipboard, ground mobile and C3I applications—go into upgrade mode, the desire is always to do in one slot what used to take several. Satisfying just such needs, North Atlantic Industries (NAI) has announced the availability of a second-generation 5-module, multi-function, single-slot VME card. This universal and highly flexible card eliminates the complexity and size constraints of using multiple, independent, single-function cards.

The 64CS4 VME card can accommodate up to five independent function modules. Modules can be selected from a library that includes D/S (2-channels), D/LVDT (2-channels), S/D (4-channels), LVDT/D (4-channels), A/D (10-channels), D/A (10-channels), AC Synchro Reference Generator, Function Generator (4-channels), Discrete I/O (16-channels), TTL I/O (16-channels), Transceiver I/O (11-channels) and RTD (6-channels). The 64CS4 also incorporates a Gbit Ethernet interface that can be used to transfer data to and from the board, without using the VME backplane bus. The 64CS4 is available with operating temperature ranges of -40° to +85°C and 0° to +70°C. Conduction-cooled versions with wedgelocks are also available. Pricing for 100 pieces of the 64CS4 starts at $3,500 each.

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

Kitting Solutions for TFT LCD Displays with Rugged SBCs

Complete solutions help smooth the way when bidding for a defense program. With that in mind, a range of kitted TFT LCD solutions includes LCDs and industrial single board computers. Apollo Display Technologies develops complete TFT LCD systems, consisting of a display, adapted industrial single board computer (SBC) from IBase, and all accessories—completely tested and ready for use. These systems or "kits" consist of combined and coordinated components, as many as 10 depending on the application. Apollo is now offering kits for TFT LCDs ranging in size from 6.5" to 82" diagonal. The kits typically include an Apollo LCD, the appropriate IBASE industrial SBC, matched BIOS, a backlight inverter and data interface cables with multiple O/S choices.

The IBase component of the new Apollo TFT LCD kits may be a CPU card (full-size, half-size or industrial backplane), industrial motherboard (Mini-ITX, ATX, Micro ATX or Networking), Disk-Size SBC (5.25", 3.5" or ECX), ETX (COM Express module, ETX CPU module or ETX baseboard), Compact PCI board, or PC/104 Plus module. Pricing varies depending on customer requirements. For example, a standard kit including a 15" XGA LCD, IBASE IB881 with Intel ULV CPU, matched BIOS, backlight inverter and data/inverter interface cables is priced at approximately $655.33 in 1000 piece quantities.

Apollo Display Technologies, Ronkonkoma, NY (631) 580-4360. [www.apollodisplays.com].

Gbit Ethernet LAN Controller in PC/104-Plus Format

The military has warmed completely to the idea of using Ethernet for all manner of embedded applications. A 1 Gbit LAN controller connects PC/104-Plus computers and control systems to Ethernet networks. The 32-bit MSMGE104+ from Digtal-Logic is based on an i82541 network controller and supports data transmission speeds of 1000/100/10 Mbits/sec. For network access it is equipped with an RJ-45 port. A setup program controls the I/O address section and the IRQ number. The board consists of an Ethernet IEEE802.3 network interface with 10BASE-2 and 10BASET connections. Selections are performed by setting jumpers or by using software tools supplied with the Ethernet tool disk. Drivers for Windows and Linux are available. The card is connected to the 32-bit PCI bus and requires only one PCI resource.

The MSMGE104+ requires a 3.3V power supply and operates within the standard temperature range of -25° to +70°C . On request, it is also available for an extended operating temperature range from -40° to +85°C (100 MB). The MTBF (mean time between failures) is specified with over 100,000 hours.

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

Mini-ITX Embedded Digital Video Board with Core2 Duo

This is turning into the "year of the Core 2 Duo." Board-level products are tending to favor that processor. An embedded digital video motherboard in a Mini-ITX form-factor is powered by an Intel Core 2 Duo processor with integrated video capture function. The Mini-ITX form-factor and low power consumption of the Intel Core 2 Duo processor will help software companies design a very compact video surveillance solution. DVMB-554E embedded digital video motherboard from Advantech has integrated PCIe video capture and provides the small footprint required for DVR solutions.

The Intel Core 2 Duo processor offers cool thermal performance, while providing high-power computing. DVMB-554E is optimized for processor-intensive video analysis and object tracking applications. PCIe support delivers generous bandwidth, more than enough to pump four channels of integrated video capture at D1 resolution, up to 120/100 frame per second. A complete SDK with demonstration programs will allow software companies to customize their application for this new platform.

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

Touch Screen Embedded Panel PC Aims at Low Power Apps

The military's move toward net-centric operations means more user interface nodes across the military. Feeding such needs is a new compact embedded panel PC features a 7-inch touch panel LCD and fanless low-power design, along with a compact 8.39" x 5.71" x 2.87" frame for use in applications such as kiosks, electronic manufacturing, factory automation and transportation systems. The NuPPC-0701T from Adlink Technology is powered by a 1.0 GHz Intel Celeron M processor, 915GME + ICH6-M chipset and 533 MHz DDR2 SDRAM (up to 512 Mbytes). The NuPPC-0701T supports a variety of data storage and connectivity options: one CompactFlash slot, three USB ports and 10/100BASE-T Gigabit Ethernet ports. The resolution of the HMI display supports up to 800 x 480 with a brightness of 400 cd/m2.

Adlink also offers a professional customized service to improve competitive advantages and reduce the total cost of ownership for our customers. Customization options include CPU type, memory, operating system and extended IO functions. The NuPPC-0701T is available now and is priced starting at $1,495, and is available with volume discounts.

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

MARTIN'S CORNER

Straight Talk: Engineer to Engineer

Hello, Sprechen Sie talk?

It's me, Martin, again with October's edition of Martin's Corner. This month I have found some interesting links and information that you have to check out. I hope you enjoy them as much as I do.

Auf wiedersehen for now!

Is That Bug a *Bug* or a High-Tech Spy?

When someone says, "I'd like to be a fly on the wall for that conversation," they may soon be able to thanks to some new nanotechnology developments.

The idea behind this development is to implant Micro-Electro-Mechanical Systems (MEMS) into an insect during its larva stage of metamorphosis. The implanted MEMS would enable the insect to be remotely controlled to transmit conversations, or sense certain chemicals. Now is that embedded technology or what!?

The following link takes you to an interesting article that highlights some of the applications that this type of technology can be used for.

http://news.bbc.co.uk/2/hi/americas/4808342.stm

Pentagon Speak?

Say what? The missile is guided by what?

If you or your company has ever done business with the military or defense contractors you need to check out "Pentagon Speak" under our Interesting Links section on www.corvalent.com/martinscorner. This soundbite highlights just how confusing Pentagon Speak (as I call it) can be. It's hilarious and well worth the visit.

Corvalent is an embedded solutions provider focused on Intel Architecture. Corvalent is an Affiliate member of the Intel Communications Alliance, a community of embedded and communications developers and solution providers.

www.corvalent.com/martinscorner

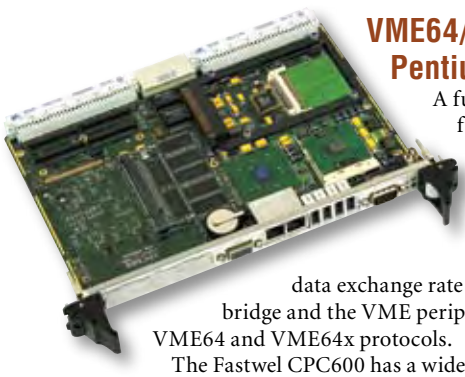
CORVALENT

MicroTCA Backplane Offered in Cube-Format

MicroTCA is beginning to gain traction in military designs. Designed in the cube-style format, a new MicroTCA backplane from Elma Bustronic features six AdvancedMC, 1 MicroTCA Carrier Hub and 1 Power Module slot. The backplane has a Star topology and fits in a 4U-wide cube-style MicroTCA portable enclosure at the bottom for a Cooling Unit and at the top for temperature sensors. The 12-layer routing includes 12 ports, including Fat Pipe lanes and allocations for PCI-Express traffic.

The pinout of Connector 2 of the MCH is the first alternative pinout defined in the MicroTCA Spec. This pinout contains half a Fabric (FabricB) and three clock networks. The Fabric on this connector is not used at all, instead the according Ports 2 and 3 of the AMCs are connected directly between the cards. Elma Bustronic also offers MicroTCA backplanes in both Star and Dual Star topologies and in Pico and Subrack formats. Pricing is under $1,000 depending on volume and configuration requirements.

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



VME64/VME64x/2eSST SBC Sports 1.8 GHz Pentium M

A full 6U VME CPU board offers system developers the functionality of VME 64x parallel bus capabilities as well as the opportunity to use x86-compatible software components. The CPC600 from Fastwel is based on Intel Pentium M CPUs running at 1.8 GHz from their long-term manufacturing program, and on Tundra Semiconductor Tsi148 bridge. This bridge provides a data exchange rate up to 320 Mbytes/s (2eSST protocol) between the south bridge and the VME peripheral cards and is backward compatible with VME32, VME64 and VME64x protocols.

The Fastwel CPC600 has a wide selection of communication capabilities—four independent Gigabit Ethernet channels, two of which are available at front panel and two are routed to P0 backplane connector according to VITA31.1 standard. This allows using CPC600 in cluster systems with packet switching via backplane. CPC600 uses an onboard graphics controller for video signal output. CPC600-01 version has a site, where either a 1.8" HDD or a 64-bit PMC module is installed. CPC600-02 version is capable of carrying an additionally a 2.5" HDD at the expense of heat sink size. Operating temperature range for the industrial version of CPC600 is -40° to +85°C, commercial version is intended for operation at temperatures from 0° to +70°C.

Fastwel, Brooklyn, NY. (718) 554-3686. [www.fastwel.com].

New Rev of LabView 8.5 Supports Multicore

A new version of National Intstruments' LabView graphical system design platform for test, control and embedded system development extends the LabView embedded platform to program multicore, real-time processors. LabView 8.5 combines the familiar graphical programming environment of LabView software with commercial multicore hardware to achieve significant performance gains. Additionally, LabView 8.5 introduces the LabView Statechart Module for higher-level designs to run on targets including FPGAs, real-time systems, PDAs, touch panels and a variety of microprocessors.

Design engineers have historically relied on tools that are not optimized for the parallel programming required to take full advantage of multicore systems. With the inherent parallel nature of LabView graphical code, embedded developers can enhance applications ranging from design validation systems such as hardware-in-the-loop simulators to complex control systems such as high-speed particle accelerators. To achieve real-time symmetric multiprocessing (SMP), NI developed a real-time load balancing scheduler to automatically assign tasks to different processor cores, providing performance improvements without sacrificing determinism or requiring user code changes. With LabView 8.5, users can also manually assign portions of code to specific processor cores to fine-tune real-time systems or isolate time-critical tasks on a dedicated core.

National Instruments, Austin, TX.
(800) 258-7022. [www.ni.com].

Panel-PC V Boasts Scalable Multicore CPUs

Multicore is the direction of all future processor designs. A new Panel-PC in a selection of popular sizes of touch screen comes equipped with Intel Core Duo T2500 technology on a COM Express-compliant, scalable ETXexpress Computer-On-Module (COM). The new V Panel Express from Kontron with embedded multicore processor technology is suitable for running real-time control, visualization (human machine interface) and other tasks simultaneously.

The Kontron V Panel Express has a maximum RAM of 2 Gbytes, and can be equipped with two CF Cards and up to two SATA hard drives. With a variety of interface options, such as two serial ports, five USB ports (1 x front and 4 x rear), 1x DVI-I, as well as two LAN 10/100/1000 Base-TX, the Kontron V Panel Express easily adapts to customer-specific requirements. Two free PCI slots are available for expansion. Integrated watchdog and power management functions complete the package. The Kontron V Panel Express supports Windows XP, Windows XP Embedded, as well as Linux and Embedded Linux. Cooling allows for passive and fanless cooling at maximum processor performance. The display size is scalable from 12 to 17 inches. The front bezel is available in stainless steel and can be customized for an OEM-specific look & feel.

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

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COTS View

POSIX Fuels Portability, Reusability for Defense Apps

Entrenched as a key enabler of open architecture in complex military systems, POSIX is bringing its rich set of profiles to bear on the trickiest of real-time problems.

Arun Subbarao, V.P. of Engineering
LynuxWorks

High levels of complexity and real-time responsiveness rank high as priorities in military and avionics system designs. In the past, the solution for these demanding environments revolved around specialized software applications based on proprietary operating systems running on customized hardware. The problem with such approaches was low reusability and poor portability of software and system components.

Today, a move toward off-the-shelf solutions for both hardware and operating systems has fueled reusability and allowed for easier migration between different operating systems. In addition to increased usage of off-the-shelf hardware and operating systems, application portability has long-term implications for reuse and deployment longevity in these demanding environments. Application portability is directly linked to the selection and use of open-standard application programming interfaces (API) in military and avionics applications, and has important implications for the maintenance and reusability of embedded applications.

The POSIX (Portable Operating System Interface for UNIX) family of API standards has been integral in fostering development of complex applications for safety- and security-critical systems for military and avionics environments. With the availability of real-time operating systems (RTOS) that support the current version of POSIX, developers are gaining the ability to include ever more rich and complex functionality for the defense and airline industries of both today and the future. POSIX-based LynxOS software is used in a wide array of Navy Open Architecture programs including the DDG-1000 next-generation warship (Figure 1).

Without POSIX, there is no easy way to migrate embedded and Unix-compatible applications between different computer systems. Developers of military and avionics systems would not be able to take advantage of today's powerful hardware and improvements in RTOS. POSIX has enabled these developers to continually innovate new solutions for their markets.

POSIX: A Flexible API

POSIX is a family of related standards governed by the Institute of Electrical and Electronics Engineers (IEEE) and maintained and evangelized by The Open Group. POSIX defines the API for software compatibility with the different flavors of UNIX. First released nearly 20 years ago, POSIX defines the specifications for the characteristics of operating systems, database management systems, data interchange, programming interface, networking and user interface. POSIX enables developers to write their applications for a single target environment in

Figure 1

POSIX-based LynxOS software is used in a wide array of Navy Open Architecture programs including the DDG-1000 next-generation destroyer (Figure 1). The DDG 1000 is the lead ship in the Zumwalt class of next-generation, multi-mission surface combatants.

which they can port and run unchanged on a variety of systems that support the POSIX API.

The key value in the POSIX standard lies in its all-encompassing nature, which allows developers to move from one OS to another—and thus easily port applications to a new OS. This can have far-reaching implications in industries such as avionics, where applications that control certain aircraft operations may need to last a decade or more and execute on multiple operating systems and hardware environments in the future. POSIX allows an easy migration path from the non-embedded space to embedded, enabling applications developed on other UNIX platforms, such as Hewlett-Packard UX, Sun Solaris and others, to be deployed on an embedded RTOS.

The POSIX standards underwent a significant expansion and unification in the 21st century, to evolve into the new standard IEEE 1003.1-2004. This new edition provides a comprehensive set of API standards that allows for myriad applications to be developed using this rich API.

The POSIX committee has also developed the IEEE 1003.13-2003 (POSIX.13) standard for real-time profiles (Figure 2) and applications specifically targeted for embedded applications. This standard defines four real-time POSIX profiles: PSE 51: Minimal; PSE 52: Controller; PSE 53: Dedicated; and PSE 54: Multipurpose.

These four profiles specify increasing levels of complexity and functionality to satisfy the full spectrum of real-time applications that can be designed using POSIX. It also defines a strict API compatibility standard that requires each higher POSIX profile to be a superset of the lower profiles. This guarantees that POSIX applications written to the most minimal profile (PSE 51) will run even on the highest, multipurpose profile (PSE 54) on compatible operating systems.

These POSIX standards, along with other associated specifications, provide the framework for military and avionics applications with high levels of portability, reusability and maintainability.

POSIX Conformance vs. Compliance

The evaluation and selection of an operating system that supports POSIX standards is a key decision that determines the level of reuse and portability that can be designed into a system. POSIX "conformance" and "compliance" are two terms that have been used by vendors somewhat interchangeably to describe their POSIX compatibility. The difference between the two, however, is significant.

POSIX conformance indicates adherence to the standard without any deviation. A conforming implementation of this standard offers the highest level of API compatibility with the specification. POSIX compliance, however, offers a much weaker adherence to the standard. An implementation claiming POSIX compliance merely needs to disclose APIs that it supports—and the ones that it does not.

In evaluating an RTOS, real-time embedded developers first should make certain it holds POSIX conformance status to ensure that they can use an implementation that provides for strict adherence to the standard. A higher level of the standard exists when an RTOS' conformance is approved by an accredited, independent certification organization. LynuxWorks' LynxOS, for example, has been certified conformant to the POSIX standard, by one of the testing firms approved by The Open Group to conduct certification.

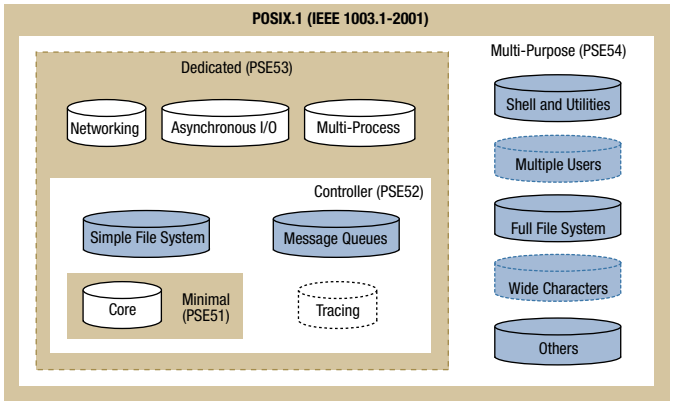

Figure 2

The IEEE 1003.13-2003 (POSIX.13) standard for real-time profiles specifies increasing levels of complexity and functionality to satisfy the full spectrum of real-time applications that can be designed using POSIX. It also defines a strict API compatibility standard that requires each higher POSIX profile to be a superset of the lower profiles.

To be conformant with any POSIX standard, the conforming implementation must undergo independent certification using a third party (such as The Open Group) and obtain a POSIX conformance certification. The presence of this certification guarantees to the RTOS user a complete adherence to the POSIX standard by the operating system.

Special Standards for Military, Avionics

Some of the other companion standards that are prevalent in military and avionics systems provide additional insurance against proprietary lock-in and independence of certification. For example, in an effort to streamline operations and reduce costs, the U.S. military has initiated efforts such as the Navy's Open Architecture initiative, which designates the use of open standards and open systems wherever possible. This has obvious implications for field operations—it is much quicker and cost-effective to swap out code from a malfunctioning computer to a new one than it is to rebuild the broken system out in the field.

Due to the catastrophic consequences of system failures, the military and avionics industries must adhere to the highest standards for safety, security and reliability. To be viable in these environments, an RTOS must adhere to at least one—but ideally all three—of the major security and safety standards set for military and avionics systems. These include ARINC 653, DO-178B and Common Criteria Evaluation Assurance Level (EAL). Table 1 lists a description of this set of standards.

With all these different requirements and certifications, it becomes vital for developers of military and avionics applications to retain portability and certifications when moving these applications between embedded systems. These complex systems comprise millions of lines of code and often take years to develop. It would be cost-prohibitive—not to mention time-prohibitive—to redesign or rewrite an application in order to capitalize on more powerful hardware.

Given the strict standards and requirements laid out for developers of military and avionics systems, the POSIX API fills a very

ARINC 653	ARINC 653 certifies that an operating system has dedicated time, space and resources for each application on its computer. The ARINC 653 standard also provides an API standard (APEX) that has found broad use in the avionics community.
DO-178B	For safety in avionics, the FAA's DO-178B sets the security standard for all software used in commercial planes. The DO-178B standard ranges from the low risk: Level E, in which a software crash would have no impact—to the highest: Level A, in which the results of a software crash would be fatal.
Common Criteria Evaluation Assurance Level (EAL)	The Common Criteria Evaluation Assurance Level (EAL) evaluates the security assurance of an OS, as well as its ability to deal with both classified and unclassified data on the same unit. Like DO-178B, EAL has a range of security levels, spreading from the lowest (Level 1) to the highest levels of security assurance (Level 7).

Table 1

To avoid the catastrophic consequences of system failures, an RTOS must adhere to at least one—but ideally all three—of these major security and safety standards.

urgent need. By employing the POSIX API in conjunction with these other standards, system developers can update hardware systems much more easily, even allowing applications developed years apart—or on different operating systems—to run on the same hardware, without having to recertify the system.

Strong Support for POSIX

Since its founding, LynuxWorks has been a strong supporter of open standards. The company was among the earliest supporters of POSIX, is a member of The Open Group, and is an active participant in the work to keep the standard current. While the benefits of POSIX outlined above show POSIX's relevance and importance in military and avionics environments, it is not an industry-specific standard. POSIX plays a role in many leading technologies, including those from HP, IBM, NEC, Oracle and many others.

In the embedded space there are a number of options with varying levels of POSIX conformance. LynuxWorks products, such as LynxOS-178, LynxOS and LynxOS-SE—all with native POSIX support—offer developers the highest levels of POSIX compatibility and the ability to write their applications directly using the POSIX API. This provides a distinct advantage over other RTOSs that use POSIX as a layer on top of a proprietary API in the areas of performance optimization and compatibility.

As military and avionics systems become increasingly complex and interconnected, POSIX offers developers of military and avionics applications a flexible, rich API. The ability to migrate from one OS to another provides developers the ability to capitalize on today's powerful hardware configuration—and can help retain the portability for the next-generation hardware configurations of tomorrow.

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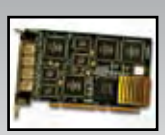

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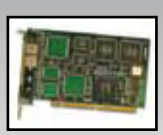

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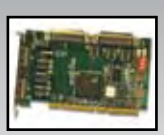

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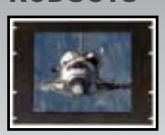

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Coming Next Month

COTS JOURNAL

• *Satellite Networking.* The DoD has a pretty lofty vision when it comes to its future goals for satellite communications systems. Ultimately, it wants laser-based communications via intersatellite links, creating a high-data-rate backbone in space. Over such a network, a visual image from a UAV that would take several minutes to process with existing satellites, would take less than a second, while the warfighter receiving it could be anywhere in the world. This section updates readers on the programs central to those goals, and looks at the technology building blocks that will drive its development.

• *Advanced Signal Processing.* Waveform-intensive applications like sonar, radar, SIGINT and software radio seem to have an endless appetite for signal processing power. Faster DSPs coupled with a broader range of IP cores and development tools for FPGAs are joining forces to form new DSP system architectures. Using those building blocks, board-level subsystems must quickly acquire and process massive amounts of data in real time. Articles in this section examine the upper echelons of signal processing challenges and the products available to address them.

• *Simulation & Test—I/ITSEC Conference Preview.* 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).

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

Editorial

Jeff Child, Editor-in-Chief

Transition Talk

Earlier this month I had the unique privilege of attending an invitation-only luncheon with Secretary of Defense Robert Gates as the guest of honor/keynote speaker. The luncheon was part of the Association of the U.S. Army (AUSA) show in Washington, DC. The Secretary's keynote address focused on his perspective on this time of transition for the Army—where the Army stands today, and where it needs to be headed as it resets from the current conflicts and reshapes itself for the future.

AUSA was actually one of the very first speaking events Secretary Gates accepted back in January shortly after he took office because the state of the Army was one of his chief concerns. The Secretary talked about the high morale of the Army and how recruiting targets are being met, despite enormous challenges. And of the high retention rates that continue to be nothing short of remarkable, especially when considering that those most likely to re-enlist are those most often deployed. That said, the Army's situation is "out of balance", according to Gates. "America's ground forces have borne the brunt of underfunding in the past and the bulk of the costs—both human and material—of the wars of the present. By one count, investment in Army equipment and other essentials was underfunded by more than $50 billion before we invaded Iraq. By another estimate, the Army's share of total defense investments between 1990 and 2005 was about 15 percent," he said.

With that in mind, Gates explained that resources are needed not only to recoup from the losses of war, but to make up for the shortfalls of the past and to invest in the capabilities of the future. How those resources are used, and where those investments are made today will shape the Army for decades to come. "We do not get the dollars or the opportunity to reset very often," said Gates. "So it's vital we get it right."

Although Gates' speech focused primarily on personnel and "human factors" rather than technology or structural shifts in the Army, the "capabilities of the future" he referred to naturally encompasses the modernization plans the Army has underway. Among these is the transitioning of the Army from a division-centric force designed to fight one or two potential major-theatre wars toward a modular, brigade-centric force that is expeditionary in nature and deployed continuously in different parts of the world. "Future capabilities" also refers to next-generation networked units—manned and unmanned vehicular and UAV platforms—comprising the Future Combat Systems program.

Just as the Army is going through a time of transition and change, the military embedded market is facing some significant technology transitions that will shape system designs for decades to come. The day after attending Secretary Gates' luncheon I drove from DC to Tyson's Corner, Virginia where it was my turn to get up and talk about transitions—technology transitions in my case. At our company's own Real-Time Embedded Computing Conference (RTECC), I gave the keynote address on "Five Technology Transitions in Military Electronics/Embedded Computing Market."

In addition to a discussion of the market in general, my presentation focused on the following five technology transitions: switched fabrics in embedded form-factors; multicore processing; FPGAs and FPGA computing; the PC as a military test platform; and stand-alone rugged boxes. These five, naturally enough, make up some of the key focus areas COTS Journal is covering both now and in coming years.

What's interesting about these major trends is that it's really vendors in the military embedded computer market that are facilitating these technologies—not their customers. In other words, vendors of boards, chips and subsystems in this market embraced these transitions long before the military asked for them. While all five trends I focused on fall into that category, serial switched fabrics have emerged as the most vivid example along those lines.

Even when they started to migrate into the mainstream embedded computing realm around seven or so years ago, the military market expressed absolutely zero interest in them. It was considered too risky to apply in any long-cycle development project—which most military programs are—an interconnect scheme that might not be around for the long term. Despite that lack of interest from the military market, the VME community, for example, started the ball rolling a couple years ago on the underlying spec development to bring serial switched fabrics into the VME space—and now fabric-based VXS, VPX and XMC products are up and running and are ready to use. And today, switch fabrics are considered vital and are often mandated in any advanced compute-intensive military system. Transitions can be confusing and disorienting to be sure—and our industry is right in the middle of several. But for technical editors like myself—who live and breathe technology trends—I'm thrilled for any opportunities—in print and in person—to talk about them.

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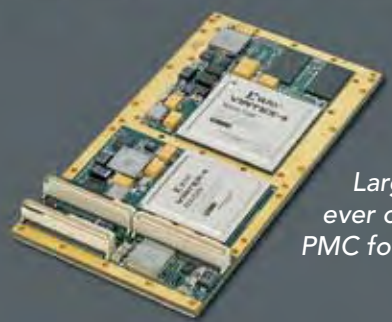

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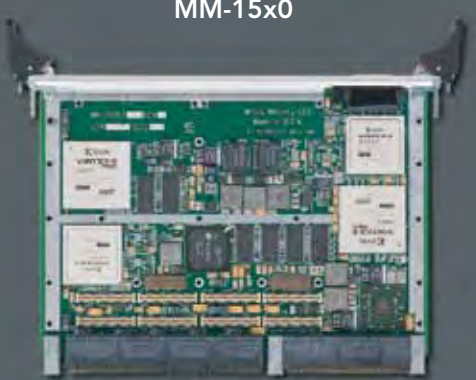

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