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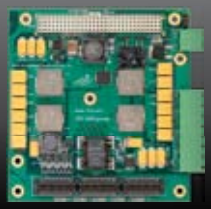

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System Development

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Technology Focus

Rugged Ethernet Switch Boards

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An EA-6B Prowler, assigned to the "Scorpions" of Electronic Attack Squadron One Three Two (VAQ-132), flies over the aircraft carrier USS John F. Kennedy (CV 67). The EA-6B is a twin engine, mid-wing aircraft that is designed for carrier-based operations to provide an umbrella of protection for strike aircraft by jamming enemy radar, electronic data links and communications.

(U.S. Navy photo by Photographer's Mate 3rd Class Joshua Karsten)

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The Journal of Military Electronics & Computing

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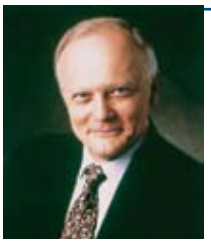

Publisher's Notebook

Whew…We're Not Wrong Yet

Right now there are so many economic and governmental issues afoot that could affect the military that it's hard to keep up. After eight years Anthony Tether is leaving as head of DARPA (Defense Advanced Research Projects Agency). Tether saw the mission of DARPA as funding and supporting projects that had specific goals to provide systems that could be fielded. Prior to Tether, DARPA was a source of funding for universities to work on more esoteric open-ended projects. Consensus is that the current administration would like to see the funding go back to the universities rather than to individuals or companies that focus on specific goals.

Then there's the stimulus package. And it's not the concept of the package that matters to us, rather the devil is in the details. Like the RoHS exemption for the military, the stimulus package exempts the military from the "Buy America" clause. There are two problems with this. Who is going to try to figure out if the steel used in the screws comes from the U.S. and how? Will the Europeans care that the military programs are exempt? Or will one of our positive export segments—military hardware—end up subject to protective retaliation?

Well, the administration released their budget. I haven't looked at it directly, not that I ever do more than pick out line items of interest. But the *Wall Street Journal* was kind enough to do a quick analysis as I was trying to put this column together. They state that the administration's proposed "base" defense budget and wartime spending would increase about 1.4 percent in fiscal 2010 from the 2009 figures. The reported 4 percent overall increase takes the Defense Departments "base" budget from $513 billion to $533 billion—which is more reflective of what's really happening. And, yes, there will be supplemental spending requests to cover the wars in Iraq and Afghanistan. It's reported that moving things around is for more honest reporting. But as an old cynical marketing person, I think this could just be to confuse any potential comparisons with the past. I'm already confused with the 1.4 percent versus the 4 percent.

I didn't do anything with any of the other information in the article; after all, the budget is a request to Congress; now the House of Representatives gets to do what it wants. The most reassuring thing that came out of the administration's budget proposal is that they really don't have any major ominous proposals or trends in the budget. Yeah, they're going to recommend moving some of the program "deck chairs" around to satisfy some of the pre-election promises, that's expected. Then there are the potential actions of Congress; the good news is that it's not known for decreasing the total budget amount.

Getting back to my marketing-based cynicism, last week Jeff Child, Editor in Chief, Warren Andrews, Editorial Director, and I made one of our many conference forays. We went to the AUSA Winter conference in Fort Lauderdale, Florida. While in the Press Room I overheard two people laughing over something they read in *Defense News* (DN). I ran downstairs to verify what I had heard, picked up a copy at the DN booth, and they were correct (*Defense News*, February 23, 2009, p. 44). Apparently the administration has directed defense officials to sign a document that they will not share any 2010 budget information with individuals outside the government.

Getting away from politics, the AUSA conference was again very interesting and provided that connection that we need between the suppliers of electronic systems and the users of those systems. Normally, we see very few embedded electronic vendors at AUSA, but we actually found more than a dozen this year. That is a noticeable increase from previous years, and piggybacks on the increase of vendors we encountered at MILCOM a few months ago. It's amazing how much information you can obtain from just casual conversations while getting a bite to eat or a coffee.

Most of what we heard substantiates things we've stated here in the past. Prime contractors are going to have to start sharpening their pencils, meeting commitments and schedules. One senior gentleman said he saw information that came out of the Government Electronics and Information Technology Association that was good news for our market. The information said that they project the future will become a very positive environment for small to mid-size companies that provide interesting and innovative military embedded electronic solutions without having the burden of all the politics, lobbying and the investor funds of the big guys.

So everything we predicted over the last quarter is still valid. No major change in military funding for at least the next 18 months. The embedded military electronics market is going to continue to buck the rest of the economy. And we'll see some deliverable system chair shuffling—like we always do. If Secretary of Defense, Bill Gates, has his way, we may see some shifts away from systems designed for potential peer-to-peer conflicts and toward more systems for regional conflicts—like what John Tether was focusing on. As more scrutiny is placed on some of the primes, there will be less effort to try and get around some of the procurement policies requiring justification to develop products that are already available. Overall the military will have to forgo some new programs and upgrade and retrofit existing systems and programs. So in the short term, we will continue to exchange hearsay at the water cooler trying to find out if something else has happened that could change what seems like the antithesis of the rest of the economy. A pretty good outlook. ▮▮

Pete Yeatman, Publisher
COTS Journal

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The Inside Track

Saft Inks $13 Million Contract from Raytheon to Power ITAS

Raytheon has awarded Saft a $13 million contract to supply its rechargeable lithium-ion (Li-ion) battery systems for the Improved Target Acquisition System (ITAS) (Figure 1). This is the second largest order Raytheon has placed for the Li-ion systems since choosing Saft as battery supplier for ITAS nearly five years ago. Under the new contract, Saft will begin to provide the batteries to Raytheon in 2009 and will continue deliveries through 2010. Saft has already delivered more than 1,500 batteries for ITAS under previous contracts with Raytheon.

Figure 1

U.S. Army Soldiers assemble the ITAS (Improved Target Acquisition System) TOW Missile system in Riyadh, Province Kirkuk, Iraq.

Saft's rechargeable 28V battery systems will power the surveillance, target acquisition and fire control system for the ITAS system. Saft's high-energy VLE series cylindrical cells provide sophisticated electronic control systems and health monitoring software. Raytheon selected Saft's 28V battery systems in 2004 to replace the previous silver-zinc technology, resulting in numerous advantages including faster recharging capabilities, increased run-time and a longer life cycle.

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

Raytheon to Produce GPS-Based Anti-Jamming Antenna System

A subsidiary of Raytheon Company has received a U.S. Air Force contract for initial production of the GPS Advanced Digital Antenna Production system. The ADAP system protects GPS-based navigation and precise timing systems from deliberate jamming and accidental interference. The U.S. Air Force Global Positioning Systems Wing award to Raytheon Systems Limited (RSL), which is valued at $1.4 million, provides for 41 antenna electronics and 28 controlled reception pattern antenna to equip U.S. Navy surface platforms and fixed- and rotary-wing aircraft.

The ADAP system is a successor to the highly successful GAS-1 GPS antenna system that has been in continuous production at RSL since 1998. Current orders include more than 5,000 units for the U.S. government and foreign military sales customers. To date, more than 4,500 GAS-1 units have been delivered to the U.S. government, achieving more than eight continuous years of 100 percent on-time delivery.

Raytheon Company
Waltham, MA.
(781) 522-3000.
[www.raytheon.com].

Thales Selects Aonix PERC Ultra for Ground Radar Systems

Thales Air Systems has Aonix's Ultra virtual machine for the NORMANDIE and Ground Master 400 (GM 400) (Figure 3) programs. Deterministic behavior at a very low latency time (a few milliseconds) was the primary challenge of the applications done in Java. PERC's predictable behavior and deterministic garbage collector enabled the Thales software team to achieve their time-critical execution deadlines.

NORMANDIE is a French radar system, funded and managed by the DGA, and dedicated to Ballistic missile tracking and measurement during the last part of the fly. GM 400 is a new high, medium and low-altitude fully digital radar family of products. With an operational availability of greater than 99.9 percent and a mean time between critical failures of more than 3000 hours, the GM 400 is setting new standards in the air defense radar market. The PERC Virtual Machine is expected to be implemented and deployed in all of the new generation ground-based radars sold by Thales.

Figure 2

Thales' GM 400 is a new high, medium and low-altitude fully digital radar family of products.

Aonix
San Diego, CA.
(858) 457-2700.
[www.aonix.com].

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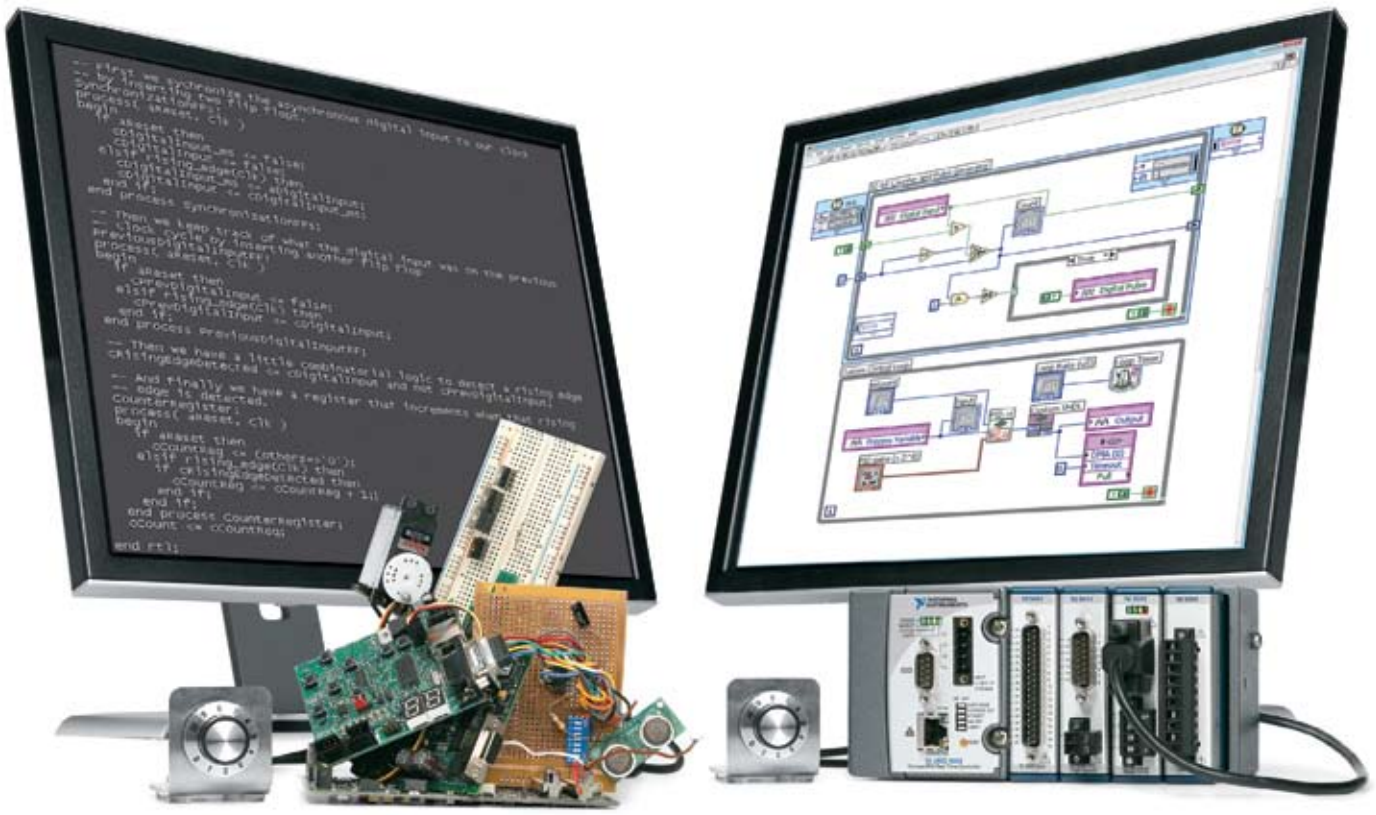

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NATIONAL INSTRUMENTS

Lockheed Martin Unveils Soldier Exoskeleton Tech at AUSA

Lockheed Martin debuted an advanced robotic exoskeleton designed to augment Soldiers' strength and endurance and prevent their premature fatigue. The Human Universal Load Carrier (HULC) exoskeleton, introduced at the Association of the United States' Army Winter Symposium in Fort Lauderdale, FL, is designed to meet future

Figure 3

The Human Universal Load Carrier (HULC) exoskeleton transfers the weight from heavy loads to the ground through the battery-powered, titanium legs of the lower-body exoskeleton.

mobility and sustainment needs of Warfighters by providing strength and survivability. Under an exclusive licensing agreement with Berkeley Bionics, a world leader in exoskeleton technologies, Lockheed Martin will advance the development of the HULC design to provide Soldiers a powerful advantage in ground operations.

Dismounted Soldiers often carry heavy combat loads that increase stress on the body, leading to injuries and exhaustion. HULC transfers the weight from heavy loads to the ground through the battery-powered, titanium legs of the lower-body exoskeleton. An advanced onboard micro-computer ensures the exoskeleton moves in concert with the individual. HULC's completely un-tethered, hydraulic-powered anthropomorphic exoskeleton design allows for deep squats, crawls and upper-body lifting with minor exertion.

Lockheed Martin
Bethesda, MD.
(301) 897-6000.
[www.thermacore.com].

OpenVPX Industry Working Group Announces Call for Participation

The OpenVPX Industry Working Group, an alliance of defense prime contractors and embedded computing systems suppliers, announced it has opened membership to its Technical Working Group, effective immediately. The OpenVPX Industry Working Group was recently launched to take a proactive approach in addressing the VPX system-level interoperability issues associated with the VPX (VITA 46) family of specifications. At its inaugural meeting held in Dallas, Texas last week, members of the anticipated Steering Committee, which is in the final stage of formation, set forth guidelines for the OpenVPX Industry Working Group's organizational structure, policies, and development of a system specification with a completion goal of October 2009. The recommendations were submitted to meeting participants on day two of the assembly.

Effective March 5, any defense contractor or embedded computing supplier that is in good standing with the VITA Standards Organization (VSO), and is committed to the OpenVPX Industry Working Group's mission and aggressive schedule for completion of a system specification, is invited to apply for membership to the Technical Working Group. Once the OpenVPX system specification is transitioned into VITA, the Working Group will disband.

OpenVPX Industry Working Group
Chelmsford, MA.
(978) 967-1518.
[www.mc.com/OpenVPX].

Northrop Grumman Receives U.S. Navy MQ-8B Fire Scout LRIP Production Deal

Northrop Grumman Corporation's MQ-8B Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) program (Figure 4) has moved closer to Operational Evaluation (OpEval) with a recent U.S. Navy modification award to a previous firm fixed-price contract for the procurement of three VTUAV systems. This award, for an amount not to exceed $40 million, is the last of three planned low-rate initial production (LRIP) buys.

The Navy authorized an LRIP 1 contract to Northrop Grumman for the Fire Scout VTUAV program in June 2007. The program achieved a series of program milestones and the Navy awarded an LRIP 2 contract in September 2008.

Figure 4

The Northrop Grumman MQ-8 Fire Scout is an unmanned autonomous helicopter developed to provide reconnaissance, situational awareness and precision targeting support.

Under this LRIP 3 contract, the company will provide the Navy with three complete MQ-8B Fire Scouts with electro-optical payloads, three ground control stations, three light harpoon grids, three UAV common automatic recovery systems and six portable electronic display devices. Work is expected to be completed in March 2011. The Navy plans to conduct Technical Evaluation of the Fire Scout program in early 2009. OpEval is scheduled for later in the year. The Fire Scout program will reach Initial Operating Capability soon after OpEval in 2009.

Northrop Grumman
Los Angeles, CA.
(310) 553-6262.
[www.northropgrumman.com].

COTS Websites

www.aaai.org

AAAI Site Offers Portal to a Wealth of Artificial Intelligence Info

The military's interest and investment in unmanned vehicles—land, sea and air—continue to soar. As a result, interest in the science of artificial intelligence is moving into the foreground of military system designers. One source of such information is the American Association for Artificial Intelligence (AAAI), a nonprofit scientific society devoted to advancing the scientific understanding of the mechanisms underlying thought and intelligent behavior and their embodiment in machines. Founded in 1979, AAAI's goals also include increasing public understanding of artificial intelligence, improving the teaching and training of AI practitioners, and providing guidance for research planners and funders concerning the importance and potential of current AI developments and future directions.

AAAI's Web site provides a wealth of information about major AAAI activities such as conferences, symposia and workshops, and its books, proceedings and reports. The list of AI topics and subtopics on the site number in the hundreds, and the links to each topic page are listed alphabetically in an index list. Of particular interest is the topic page on Autonomous Vehicles, which in and of itself packs a wealth of information and links to related sites.

American Association for Artificial Intelligence. Menlo Park, CA. (650) 328-3123. [www.aaai.org].

Special Feature

FPGAs in Radar and SIGINT

FPGA Boards Revamp the Radar and SIGINT Landscapes

FPGA advances—in both the component and board side—are fueling a flurry of new design capabilites for military radar and SIGINT applications.

Jeff Child
Editor-in-Chief

Waveform-intensive applications like sonar, radar and SIGINT 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.

As FPGAs evolve to ever greater sophistication, complete systems can now be integrated into one or more FPGAs. As a result, the rack and backplane-based systems based on FPGAs offer the compute muscle of yesterday's supercomputers. Modern radar systems are operating over an ever increasing frequency range. Analog conversion technology—both A/D and D/A converters—are also feeding the radar needs of the military.

System developers can now build radar receiver systems with a higher instantaneous bandwidth thanks to the converters, and can handle the corresponding increase in compute power required to process the received data streams using FPGAs. The ASIC-based radar design approaches of the past can achieve the performance needed, but that path lacks the flexibility inherent in designs based on FPGA technology. A wealth of FPGA board-level products are available aimed specifically at this area.

Exemplifying this trend, TEK Microsystems offers a 6U VITA 41-compliant dual-channel high-speed digitizer board called Neptune-V5 (Figure 1). The board sports three Virtex-5 processors, advanced DDR3 SDRAM, and the latest flexible I/O communication modules (SFP+ and QSFP). Full ruggedization has been designed into the architecture providing full support for harsh environments. Firmware and software support for a range of open standards and protocols is provided including Gbit Ethernet, Serial FPDP (ANSI VITA 17.1 and 17.2) and Fibre Channel.

Figure 1

The Neptune-V5 board sports three Virtex-5 processors, advanced DDR3 SDRAM, and the latest communications technologies available. Support for Gbit Ethernet, Serial FPDP (ANSI VITA 17.1 and 17.2) and Fibre Channel are included.

Fast Sensor I/O Interfacing

For inter-FPGA and inter-board communications, protocol support is provided for Xilinx Aurora and PCI Express. The approach to the architecture focuses on the sensor I/O processing

and allows it to more efficiently utilize three V-5 processors than competitive offerings of up to seven FPGAs, resulting in a lower price point and reduced power consumption. A very broad range of analog sensor I/O configurations provides compatibility with the widest range of analog signal options, addressing multi-channel, high-resolution sampled data requirements at 2 Gsamples/s and beyond.

Nallatech's latest FPGA product aims at using FPGAs for Intel Front Side Bus (FSB) acceleration. The FSB Compute Module enables up to 660K logic cells per module by utilizing two large Xilinx Virtex-5 FPGAs that are user configured to host the accelerated algorithm. The modular platform includes an FSB Base Module that interfaces directly to an Intel Xeon processor socket.

FPGA-Based Mezzanine Form Factor

FPGAs have become such a key part of the embedded computing landscape that they've even captured their own form factor spec. The FPGA Mezzanine Card (FMC) specification—VITA 57—defines an I/O mezzanine module designed to work intimately with an FPGA. FMC modules enable I/O devices that reside on an industry standard (VITA 57) mezzanine card to be attached to, and directly controlled by FPGAs that reside on a host board. About half the size of a PMC mezzanine module, FMCs provide a small footprint, reduced I/O bottlenecks, increased flexibility, and reduced cost through the elimination of redundant interfaces. To maximize data throughput and minimize latency, the FMC connector provides numerous I/O pins that support high-speed signals for moving data between the FMC and the FPGA. The FMC specification was developed to enable FMCs to be supported on a wide range of existing form factors, including but not limited to VME, CompactPCI, VXS, VPX, VPX-REDI, CompactPCI Express, AdvancedTCA and AMC.

Figure 2

This FPGA Mezzanine Card (FMC/VITA 57) module, the ADC512, is a 3 Gsample/s, 8-bit, dual-channel analog-to-digital converter (ADC) card, able to support up to 6 Gbyte/s data throughput. It's available in both air-cooled and conduction-cooled rugged versions.

Fueled by its acquisition of VMETRO—the creator of the FMC concept—Curtiss-Wright this month rolled out its highest sampling rate, highest bandwidth FPGA Mezzanine Card (FMC/VITA 57) module, the ADC512 (Figure 2), a 3 Gsamples/s 8-bit, dual-channel analog-to-digital converter (ADC) card, able to support up to 6 Gbyte/s data throughput. The module eliminates data bottlenecks to increase DSP subsystem performance by routing high-speed ADC I/O directly to the host board's FPGAs via the FMC connector. Available in both air-cooled and conduction-cooled rugged versions, the ADC512 has two onboard National Semiconductor ADC083000 ADC devices. Each of the module's ADCs supports a sampling rate up to 3000 Msamples/s per channel. By routing the ADC device interfaces directly to the FMC connector, the ADC512 enables an FPGA on the host board to directly control and receive data.

FPGA ICs Push Density, Performance Barriers

On the component side, last fall Xilinx rolled out its Virtex-5 FXT devices, the industry's first FPGAs with embedded PowerPC 440 processor blocks, high-speed RocketIO GTX transceivers and dedicated XtremeDSP processing capabilities. The Virtex-5 FXT platform offers the first FPGAs to provide up to two industry-standard PowerPC 440 processor blocks. Each processor, with integrated 32 Kbyte instruction and 32 Kbyte data caches, delivers up to 1,100 DMIPS at 550 MHz. Tightly coupled to the PowerPC440 blocks is a new integrated 5x2 cross bar processor interconnect architecture that provides simultaneous access to I/O and memory. The device includes dedicated master and slave processor local bus interfaces, four DMA ports with separate transmit and receive channels, and a dedicated memory bus interface enabling high-performance, low-latency, point-to-point connectivity.

Altera, meanwhile, began shipping its new 40nm Stratix IV FPGAs in December. The first device available was the EP4SGX230, offering 230K logic elements (LEs), 36 embedded transceivers operating up to 8.5 Gbits/s, 17 Mbits of RAM and 1,288 embedded multipliers. The Stratix IV FPGA family is comprised of two variants, an enhanced (E) version and transceiver-based (GX) version. The Stratix IV family offers up to 680K logic elements. The devices also support DDR3 memory interface speeds of 1067 Mbits/s. Stratix IV GX FPGAs feature up to 48 transceivers operating up to 8.5 Gbits/s. They also incorporate up to four hard IP cores for PCIe Gen1 and Gen2 (x1, x4 and x8), and support a wide range of protocols including Serial RapidIO, Gbit Ethernet, XAUI, CPRI (including 6G CPRI), CEI 6G, GPON, SFI-5.1 and Interlaken.

FPGAs and ADCs Working Together

Analog converter technology is also fueling new radar capabilites, especially when used hand in hand with advanced FPGAs. Last fall Texas Instruments debuted its new ADS5485 A/D Converter. Four of these 200 MHz, 16-bit monolithic A/Ds were designed in the front end of Pentek's Model 7153 PMC board (Figure 3). These new A/Ds exhibit a signal-to-noise ratio of 75 dBFS and a spurious-free dynamic range of 87 dBc at a 70 MHz input frequency.

The Model 7153 DDC offers two modes of operation. The two-channel DDC mode sacrifices two DDC channels to boost the maximum decimation to 65,536 and extend the lower bandwidth limit down to 3 kHz. The four-channel DDC mode provides an independently programmable decimation range from 2 to 256 on each DDC, covering signal bandwidths from about 700 kHz to 90 MHz.

In applications such as radar, direction finding and diversity receivers, it is essential to synchronize multiple channels, perform digital downconversion, control the gain and the phase delay of each channel and then perform a summation of the DDC outputs. All of these critical beamforming facilities are included in the Model 7153. In addition to synchronous sampling and DDC for all four channels, the 7153 provides independent control of gain and phase for each DDC, and includes a summation block for the four DDC outputs. ▮▮

Altera
San Jose, CA.
(408) 544-7000.
[www.altera.com].

Annapolis Micro Systems Inc
Annapolis, MD.
(410) 841-2514.
[www.annapmicro.com].

Figure 3

Suited for radar beamforming, Pentek's Model 7153 PMC board has four of TI's new ADS5485 A/D Converter. These new A/Ds exhibit a signal-to-noise ratio of 75 dBFS and a spurious-free dynamic range of 87 dBc at a 70 MHz input frequency.

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Tech Recon

VPX, VXS and VME: Legacy vs. Leading-Edge

VPX and VXS Raise Unique Design and Testing Challenges

The military is looking hard at VPX and VXS to solve a variety of high-performance embedded computing problems. But designing and testing such systems takes some creativity.

Justin Moll, Marketing Manager
Elma Electronic

VPX is getting much of the attention these days in Mil/Aero applications, and for good reason. Acceptance of the architecture continues to grow thanks to its sharp increase in potential bandwidth, level 2 maintenance features, design flexibility, I/O options and more. That said, VME/VME64x is still the dominant player in deployed systems. Many shipboard, submarine and aircraft applications are more than happy with legacy VME performance. Meanwhile, VXS's share of the market is growing in niche applications. It offers a significant performance boost over VME64x and its backward-compatibility is particularly attractive in many applications.

The growth in these architectures brings new, creative backplane/enclosure design solutions in several areas. This includes development/test, backplane/chassis configurations and integrated solutions. The ecosystem is expanding for the newer VITA 41 (VXS) and VITA 46 (VPX) architectures. Their growth and design similarities (including related components such as the MultiGig connector) continue to bring comparisons.

VXS vs. VPX

VPX is growing rapidly and is being selected for a larger proportion of Mil/Aero designs than VXS. However, VXS is often the right choice where its balance of performance, compatibility and price meets the application demands. For its part, VXS has been perceived by many as being a mere stepping stone to VPX. Despite that perception, VXS is a viable technology in its own right that will be successful for many years to come. The VITA 41 (VXS) architecture continues to expand and grow. While there have been many feature comparisons of VPX vs. VXS, it's helpful to examine some of the less-discussed points from a system platform perspective.

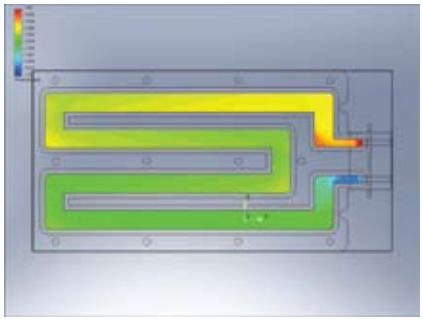

Figure 1

In this heat analysis simulation, the liquid runs through the chassis walls. The VPX card wedge locks conduct the heat to the enclosure wall, which can remove the heat.

Compared to VXS, VPX uses more of the MultiGig connectors for comparative-sized backplanes. Using a mesh topology in most cases, VPX typically has higher backplane layer counts—and thicker layers—than VXS, as well as more complex routing. All of those can lead to higher backplane prices. On the chassis side, VPX can have significant power and cooling demands. This often requires the use of more expensive components and solutions. VPX has a lot of flexibility in its specification, and as a result the architecture is typically highly customized, which can increase the costs.

Cost Differences

With all that in mind, it's clear why there's often a significant cost difference between the two. Mil/Aero programs are obviously not as price-sensitive as other markets, but for applications with less demanding bandwidth needs VXS can be an attractive option. Since it is more conducive to backward-compatibility and has a larger ecosystem, the architecture is seeing design wins in various applications.

At last count, there were seventeen VXS board manufacturers with a total of 54 blade products. Compare that to five VPX manufacturers with a total of 39 VPX blade products offered. Even given that VXS only has a 6U board size while VPX has both 3U and 6U sizes, the VXS ecosystem is still significantly larger. All that doesn't mean that system designers will favor VXS over VPX. VXS has carved out a nice niche and will remain an enticing technology. But VPX

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is rapidly gaining acceptance thanks to its combination of performance, ruggedness, flexibility and more. Both architectures have some very interesting and creative design concepts arising. This includes backplane topologies, chassis solutions and system accessories

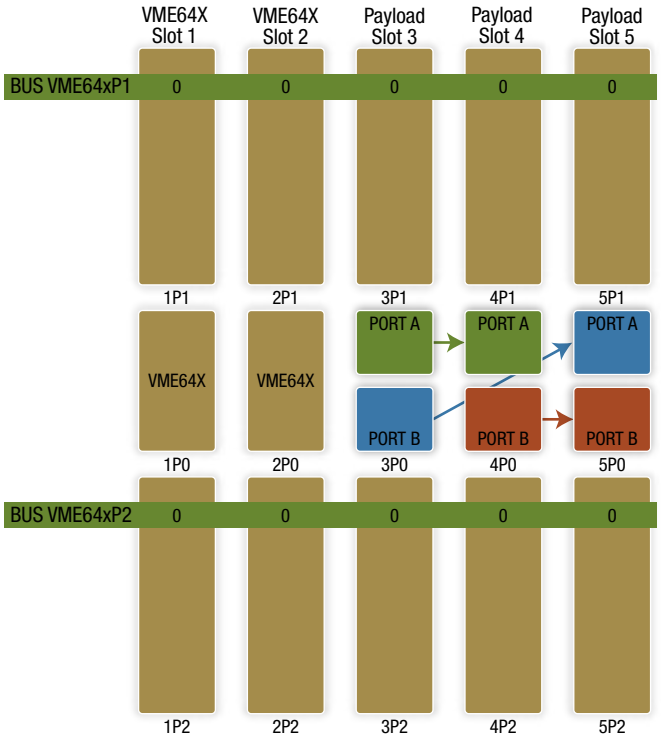

Figure 2

A point-to-point routing scheme in this VXS backplane configuration allows interconnection of the cards without needing a switch card.

Overcoming Challenges

New system architectures naturally bring design challenges as they push the limits of performance. VXS and VPX are no exception. One issue is enclosure cooling—particularly for VPX. VPX can theoretically reach 468W per slot, but in practice today the cards are more in the 100W range. Many applications for VPX designs will be ones where forced-air cooling may not be an option. Conduction-cooling for that amount of heat transfer can be challenging. To address that issue, VITA 48 is underway offering liquid cooling flowing through the individual modules. This requires elaborate piping with quick disconnects, and presents design challenges. In the meantime, there is a less costly, modular and simpler method to dissipate today's heat levels. One solution is to have the liquid run through the chassis walls. The VPX card wedge locks will conduct the heat to the enclosure wall, which can remove the heat (Figure 1).

The liquid-heat-exchange approach has been proved to dissipate up to 150W per slot. Redundancy and modularity can be built in. Each side of the chassis wall can have an independent cooling mechanism. Therefore if one side is damaged, the other chassis wall can provide the cooling until repairs can be made. Or, for lower costs, just one side of the chassis wall can have the liquid-cooling mechanism.

Development and Test

Beyond the power, signal and cooling challenges of VXS and VPX, there's also the matter of testing. Testing VXS and VPX calls for some creative thinking. There are several products developed specifically for development and testing for VITA systems. These include VME/64x load boards, test extenders, development chassis and test backplanes.

The development system is a good place to start. Development systems are available in portable-style chassis and facilitate test and debugging of the cards. It may surprise you that there are creative solutions for the test chassis. For example, in VXS it is possible to do development on payload cards without using switch cards. By incorporating a point-to-point signaling topology, payload cards can be tested. If you have a couple of slots as VME64x, then you can do full testing across new VXS cards and legacy VME64x. Figure 2 shows a backplane diagram along those lines.

Open Frame Systems

Development systems can come in open frame styles, where they do not have the side walls of the enclosure. This provides easier access to the cards. However, one should be careful when selecting one for VPX. The VITA 46 architecture can have high power loads and demand a lot of cooling. A development chassis for VPX needs to have special considerations for more airflow and power options.

In addition to development systems, the VXS or VPX system platform that will go into the field needs to be tested. Both of these architectures need a way to easily test the signal performance, cooling capability, power conditions, and debug new cards. To make cooling and power testing easier, a load board can be devised for these systems. The board can aid designers in locating hot spots in the chassis and confirming the power and electrical connections meet the VITA specifications. Figure 3 shows a VPX Load Board with go-no-go indicators.

Using Flex Circuits

Another challenge for test and debug is the lack of right angle connectors for VXS and VPX extender boards in the market. Extenders plug into the chassis and extend the signals outside of the card cage, allowing for space for debug, particularly in adjacent slots. A way to overcome the absence of the required Multigig connector format for extenders is by using flex circuits. Incorporating a rigid-flex-rigid PCB design provides a fix, allowing the VXS or VPX extender card to accept the board-under-test as a straight-mate alignment versus a right angle. Frames and injector/ejector handles can be used to securely hold the boards and facilitate plugging.

Finally, testing the signal across the backplane and/or full interconnect path is very important. Particularly with mil/aero systems and the more stringing testing requirements, designers cannot afford to risk that their system does not work properly. Some internal company labs do not have adequate equipment to accurately characterize the signal performance of today's high-speed

fabrics. Or, the expensive lab equipment is so tied up there aren't resources available to do a "health check" of the system. SerDes test modules can be designed in VPX, VXS, or other form factors to test the signal quality without tying up a lab. These boards can simply plug into an open slot and test the BER (Bit Error Rate), skew, jitter and so on of the board or backplane path. They can also be used for pattern generation, such as eye diagrams, ensuring the signal quality meets the specification.

Integration Challenges

Doing individual testing of the VXS or VPX designs is one thing. But the dynamics change when they're all packaged together within a system platform with other boards, and software. Integration is another important step in the process. Depending on the application, the subsystem integration for embedded systems may be done in-house, at an integrator, or by the enclosure manufacturer if they provide that service. Integrating the SBC, switches and other cards in a VXS or VPX system can be tricky. As mentioned above, the cooling, power specification, signal issues, can all cause headaches. Plus, there may be considerations for high temperatures, shock and vibration, hot-swap, system management, and other requirements. It is important to perform complete verification, validation and qualification testing along with all of the supporting documentation. Figure 4 is an example of a fully integrated VXS subsystem designed with the backplane, system platform and integration done together. Troubleshooting and testing is much more seamless, allowing a quicker time-to-market and less program risk.

Figure 3

A VPX load board can have a microcontroller to allow stepping up of the voltages for testing. The board shown goes up to 100W with the power load saved in EEPROM.

It can be advantageous to start development with a turnkey bundle. This includes a completed and integrated subsystem that has been fully tested. Naturally, this can provide time and expense savings. The VXS and VPX ecosystems continue to expand.

Figure 4

Shown here is an example of a fully integrated VXS subsystem designed with the backplane, system platform and integration done together.

There are creative solutions for handling the faster speeds, cooling and power demands, and other barriers from the newer architectures. Further, new test tools are making it easier for designers to ensure the performance of their system. The future is looking brighter for VITA-based systems. ▮▮

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Tech Recon

VPX, VXS and VME: Legacy vs. Leading-Edge

Bandwidth and Legacy Needs Drive VPX/VXS/VME Choice

The VME legacy lives on, even as new alternatives like VXS and VPX emerge on the scene. Choosing between VME, VXS and VPX isn't as cut and dry as it may seem.

Frank Phelan, Mil/Aero, Government Div. Principal Engineer
Kontron

Just past its 25-year mark, VME has been the embedded computing mainstay for military and aerospace applications. And while its capabilities are still solid as a rock, new computing requirements such as differential signaling and high-speed radar processing have prompted the need for new platform standards that build on the power and legacy of VME computing. If VME is the four-star general of military computing, then newer platforms such as VXS and VPX are the forward-thinking lieutenants that flex their strength in support of leading-edge, higher bandwidth-intensive military systems.

While it would seem that next-generation applications would warrant a more leading-edge computing platform, military system designers may still realize that VME is not only viable but an optimal solution compared with the newer VXS or VPX computing platforms.

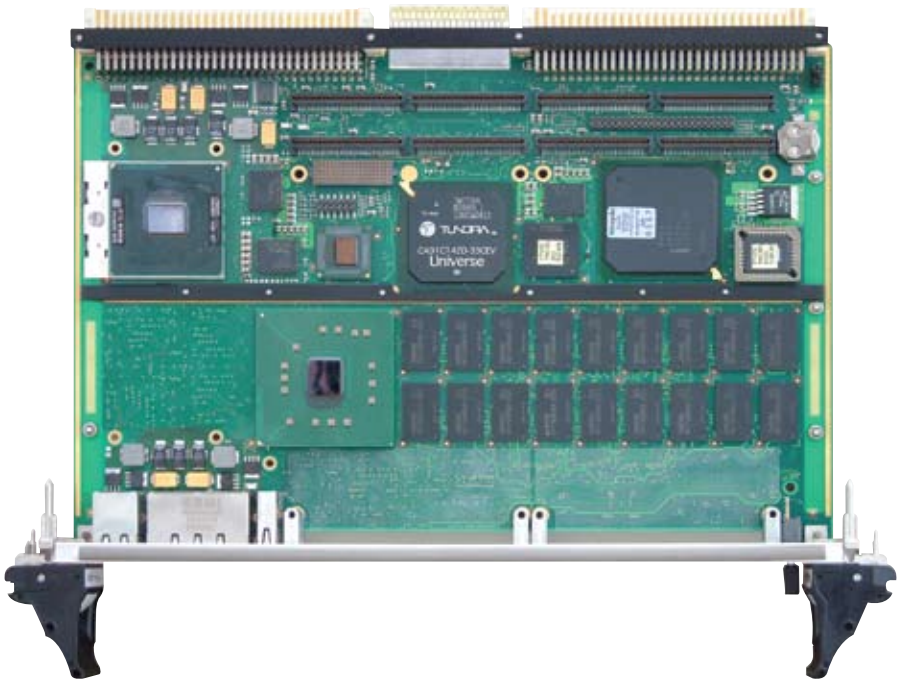
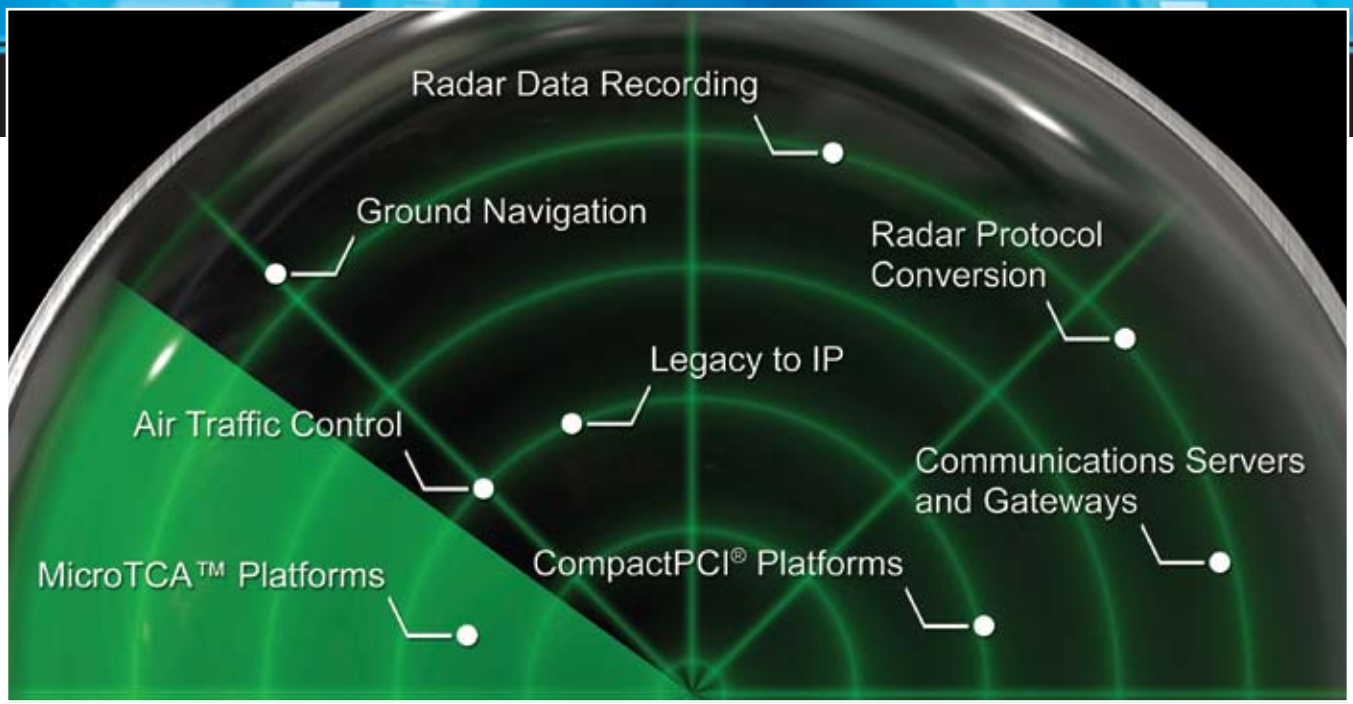


Figure 1

The PENTXM2 6U VME board is an example of VME's continued adaptability for military applications providing high-performance multicore processor technology.

Comparing the Options: A History

VME: In comparing VME to the upgrade path platforms of VXS and VPX, it is probably a good starting point to have some historical perspective. VME is significant in that it gave designers computing industry standards. VME was one of the first open standards freeing designers from the headaches of dealing with proprietary operating systems and computing architectures. Plus, the VMEbus architecture offered a long list of benefits. At the time, it provided high bus bandwidth and its backplane offered users easier maintenance and improved configuration flexibility: It was optimized for real-time computing, featured a 32-bit



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As systems evolved and required increased performance, I/O and ruggedness, VME64X became the new standard and demonstrated VME's adaptability. It supported a 64-bit bus plus I/O features that included an additional backplane connector with 95 more pins and rear I/O capabilities. That extended the life of the VME, but the connector technology changed very little, which, unfortunately, did not solve the growing requirement for handling increased signal rates. Figure 1 shows a VME board example.

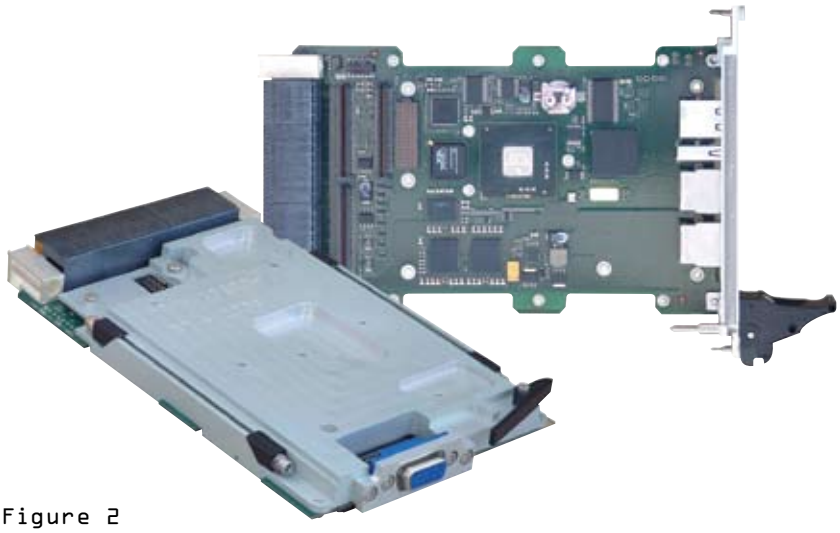

Figure 2

Both new VPX boards, the Kontron VX3020 (left) is based on the 1.5 GHz Intel Core2 Duo LV (L7400) and the Kontron VX3230 (right) based is on the 1 GHz Freescale PowerPC MPC8544E.

CompactPCI: CompactPCI has gained popularity in military systems because it provides a high-density connector solution for additional I/O requirements. In recent years, CompactPCI suppliers have developed an HSHM(High-Speed HM) connector that enables users to run high-speed signals and is backward-compatible. However, CompactPCI's connector technology still does not have the differential signaling performance some designers were looking for.

Military systems began to integrate high-speed communications such as 10 Gbit Ethernet, RapidIO and PCI Express that were just too fast for VME connectors. With the quantity of data quadrupling and higher resolution HDTV video becoming a requirement, 60 Hz frame rates, not 30

Hz frame rates, were needed. Component hardware also has become more and more integrated enabling additional I/O features.

VXS and VPX: The industry really needed newer computing standards for high-speed serial communications in demanding military applications with the backplane, signal speed and I/O technology that could take these systems into the future. This need spurred the new VXS and VPX platforms.

VITA, the VME International Trade Association, specified the VITA 41 standard as an interim step before VPX was defined. VITA 41 became known as VXS and it answered the call for I/O with a high-speed differential connector in place of the P-Zero connector on VME64X to support PCI Express, Serial Rapid I/O and Gbit Ethernet in the backplane. VXS gained popularity with the rise in use of field programmable gate array (FPGA)-based boards because the signaling was too high a frequency to go over the standard VME connectors. VXS gave VME-based systems the ability to leverage switched fabric interface so military systems could tap into the necessary computing power.

Figure 3

For UAV military applications, VPX-based boards provide an optimal high-bandwidth, I/O-intensive computing platform.

VPX: Designed for Next-Gen Mil Systems

As previously mentioned, many of today's military and aerospace communication applications are moving beyond the processing capabilities of VME. Trends in embedded systems have traditionally followed the commercial PC market. The same is true for the evolution that has driven the need for VPX to a certain extent. When looking at ways to improve new applications, the pressing question in the military environment became, "If my PC can deliver high-resolution video, why can't the video imagery on our UAV do the same?"

VPX is the VITA 46 standard, which breaks out from the traditional connector scheme of VMEbus to merge the latest in connector and packaging technology with the latest in bus and serial fabric technology. VPX CPU boards combine all the fundamental strengths of the VMEbus architecture, such as robustness and excellent EMC, with new high-bandwidth connector capabilities for high-speed differential signaling over the backplane. They also offer support over wider operational temperature ranges with cooling methodologies. These features in a smaller 3U form factor make VPX ideal for a broader spectrum of new real-time,

data-intensive and network-centric applications that require reliable performance in harsh environments.

VPX is seen as the future of rugged military systems computing and is already mandated by the larger defense programs because of its ability to provide high-frequency processing required by many of the modernized battlefield applications. VPX also provides a reliable fabric solution that facilitates onboard checking and retransmission that is easy to work with and maintain. For example, 10 Gbit Ethernet can take in a fast data rate and dispatch it to several processors that manage the workload in parallel. The ability to design in this kind of functionality makes VPX an ideal platform for network-centric military systems, leveraging more I/O per slot and higher computing density from today's processors and chipsets. VPX is certainly gaining popularity for new designs, new systems and new programs. Figure 2 shows an example of a VPX board.

Legacy, Leading-Edge or In-Between

Existing military systems have a huge installed base of VME or VME64X legacy controller boards. It is a costly undertaking to redesign these boards, reprogram them and write the device drivers for them. So it is very important to evaluate whether a system requires a whole new computing platform rather than inserting a newer or faster upgrade to the current VME-based board. Depending on the system requirements, a higher-performance legacy VME board may still be a very attractive solution.

VME is not going away at all. In fact, the number of VME-based systems in use today on ships and aircraft that could upgrade by simply changing out the board is most likely increasing and is less expensive. So legacy VME is around to stay for many years. Many legacy VME suppliers are looking for ways to extend its use by developing new products that match the processor, memory and other component feature sets of new VPX boards on VME64X boards. The only difference will be the same high-speed I/O.

As an example, VME boards are still a viable computing solution for a missile launch control application on Triton submarines. In addition, acoustic data is relatively slow compared to video, so sonar systems can easily get by with VME64X. Although, some newer sonar applications are looking at VPX to support massive parallel banks of processors to communicate between them very rapidly, even though the I/O requirement rate is slow.

VXS supplies access to serial switched fabrics so it is finding a home in software defined radio applications. However, VXS actually has a lower pin count that VME64X because it replaces that center connector with a differential one, giving a net reduction in I/O pin count. The biggest downside is that VXS requires a new or custom backplane. Where VXS has a place is in FPGA-based systems that have a limited number of high-speed signals that are needed on a VME board. How-

ever, designers who need the I/O may now see VPX as a much more attractive and long-term solution.

VPX, on the other hand, was designed with future application requirements in mind. Designers using a VPX-based board will also realize the requirement for a new backplane, but it is definitely the computing solution for high-bandwidth, I/O-intensive military applications such as high-speed radar signaling systems and any video processing systems such as UAVs (Figure 3) or other video surveillance applications. New missile launching systems, too, are capitalizing on 1080 pixel video to allow military personnel to accurately guide them.

Benefits of Integration, Performance

Contributing to the increased I/O density has been integration achieved due to sub-micron device technology. By integrating more and more transistors, there has been a tremendous improvement in I/O. What used to take a 6U board can now be put on a smaller 3U board. The advantage for space-constrained applications such as vehicles or UAVs is that designers can reduce SWAP (size, weight and power) to build systems that they could not have otherwise.

Component integration also enables military system designers to maximize performance with a multicore processor, built-in memory and controller technology, plus increased interface support all in a low-power, single-chip solution. Traditionally, military systems have had an insatiable appetite for performance, and the latest processor technology readily satisfies the need. But it's the added features of the processor that will drive new applications with PCI Express and Rapid I/O to better deliver high-performance backplane support.

Not a Black and White Choice

Military electronics are certainly evolving, but it is not as simple as older designs using VME and newer designs using VXS or VPX. Even a modernized battlefield includes types of data processing that require less performance and I/O requirements such as acoustic data or sonar systems. Designers of military systems are advised to evaluate the legacy environment and consider the types of data being processed, upgradeability for future demands, multiprocessor benefits, budgets and time-to-market—all as equally important as high-level design priorities.

VXS and VPX were designed to continue the VMEbus architecture legacy. Positioned to meet the needs of current and future applications, these newer computing platforms overcome the size, bandwidth, interface, performance and I/O signaling challenges that have plagued the inspired innovation of military system designers. ■

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Tech Recon

VPX, VXS and VME: Legacy vs. Leading-Edge

VPX Trade-Offs: Getting to Common Backplanes

VPX has secured a beachhead in the mindshare of many military system designers. Such early adopters face trade-offs between centralized and distributed VPX architectures.

Nauman Arshad, Manager, SBC Product Marketing
Mark Littlefield, Product Marketing Manager, FPGA-based Computing Products
Steve Edwards, Applications Engineering Manager, Curtiss-Wright Controls Embedded Computing

The first wave of "beachhead" innovators and early adopter customers for VPX (VITA 46) boards and subsystems quickly established the preeminence of the architecture. They were attracted to the high levels of data plane bandwidth and compute power never before obtainable from an open bus architecture, delivered by this new standard. VPX's ability to handle higher power cards than VME and its standardization of protective metal covers, ESD (Electrostatic Discharge) protection and advanced cooling techniques, such as liquid-flow through (LFT) cooling added to the advantages VPX delivers.

For these early adopters, the space, weight and power (SWaP) issues inherent to their applications were paramount. Their first job was to define VPX systems destined for harsh environments and to bring the rugged deployed high-performance processing, networking and signal processing modules that these early adopter's applications required to market as rapidly as possible. For these customers, the investment required to build a custom VPX backplane was far offset by the superior performance they could obtain. General Dynamics C4 Systems and Rockwell Collins, for example, chose a VPX-based solution for the General Processor Modules (GPM) that comprises the Integrated Computer System (ICS) of the U.S. Army's Future Combat Systems

Figure 1

The vehicles of the FCS program will use VPX-based computing modules. Shown here is the Medical Vehicle (Evacuation version)—one of the manned FCS vehicles.

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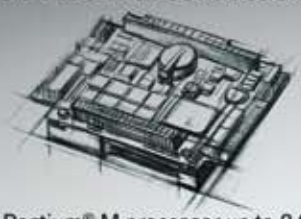

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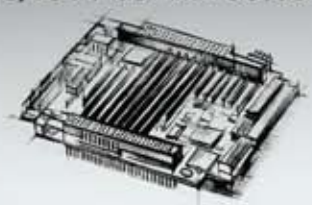

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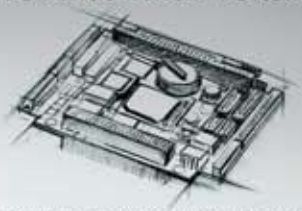

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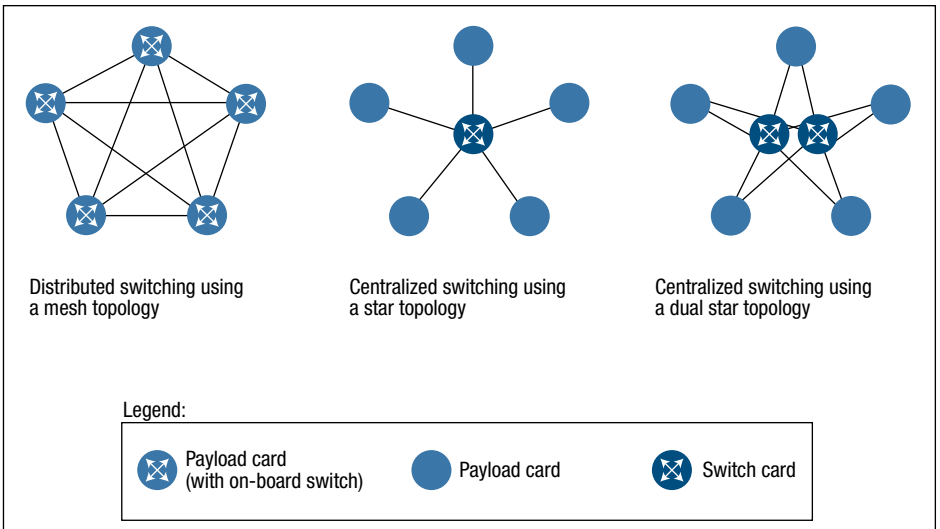

Figure 2

A mesh VPX architecture is comprised of two or more payload cards that connect to each other through the switch chips on board (a). VPX payload modules can also be connected via centralized switches via one or two centralized switch slots. This connection topology is also known as "star" (b) or "dual star" (c).

(FCS) program. Figure 1 shows the Medical Vehicle (MV-E) (Evacuation version), one of the manned FCS vehicles.

Trend Toward Distributed Systems

Vendors of VPX cards found that the clear majority of first wave early adopters were designing distributed switch backplane architectures. In distributed architectures, unlike centralized architectures, a switch chip is built into each individual payload card, saving valuable system slots in SWaP-constrained platforms that otherwise would require either single or dual centralized switch cards. Distributed architectures enabled system integrators to field the highest level of performance with the least amount of cards.

Now, as the popularity of VPX grows apace, a wider variety of early majority customers and applications has emerged. This wider market interest is seen in the increased vendor participation taking place in the VITA 46 Working Group over the last year. The increasing activity is an indication of the success of the working group's efforts, and spotlights the proven model of open industry "co-opetition" that earlier led to the creation of the VME standard, VPX's predecessor, and its position as the de facto military embedded bus architecture for over 25 years. To encourage and sustain the increasing adoption rate of VPX, it is now necessary to help proliferate the bus architecture's market ecosystem. To that end, the VSO is now focusing its collective, open efforts on defining a common set of backplanes that will satisfy the widest range of applications and users. Today, the VPX Working Group is defining the VITA 46.20 centralized switching and VITA 46.21 distributed switching topologies for VPX.

The advantages of a common backplanes are most evident during the development phase of a system. In many cases, when the system is ready to be deployed, the customer will turn to a custom backplane to optimize cost and performance for their particular application. The availability of industry standard backplanes helps build the bus architecture ecosystem. It enables backplane vendors to build and offer rugged backplane products. It also enables board vendors to build embedded computer payload cards with standards-based interconnects that will work within those backplanes. The result is faster time-to-market, lower development costs and reduced risks to systems integrators due to a stronger ecosystem of interworking em-

Figure 3

VPX chassis can be built to support a distributed architecture or a dual-star centralized architecture over Gigabit Ethernet (GigE).

bedded computer products that conform to a unified industry standard.

Both distributed and centralized architectures offer distinct benefits and advantages to system integrators. With its slot-saving advantage and multiple fabric interfaces that can form a meshed backplane, the distributed architecture proves much more attractive to SWaP-constrained applications that require higher backplane bandwidth. On the other hand, centralized architectures offer greater flexibility and lower complexity as the system is not affected by empty slots.

Today, progress is proceeding rapidly in the VITA 46 Working Group to define the VPX common backplane. As the VPX ecosystem matures, a need for more standardized serial backplanes has emerged. The VITA 46 base standard initially defined a distributed VPX switched backplane using a 5-slot meshed topology that ensured every payload card connected to every other payload card through 4 data plane fabric ports. This work has now expanded into a dot-spec called VITA 46.21 that will enable larger systems to connect using distributed switch architectures. In parallel, the VITA 46 Working Group is also defining a VITA 46.20 centralized switch slot specification that can be used in centralized backplanes, such as that used in VXS. Centralized switching is not new. VXS's centralized architecture looked to earlier backplanes such as PICMG 2.16, VITA 31.1 and ATCA.

The work currently underway on the VITA 46.20 and VITA 46.21 dot-specs will define a set of standards-based backplanes that will enable backplane manufacturers to build and offer a set of common backplane products with varying slot counts. The goal of the VITA 46 working group is to ensure VPX payload and switch modules can work in either system topology—distributed or centralized. A distributed system is comprised of payload cards only—such as SBCs or DSPs. In contrast, a centralized system is comprised of payload cards plus one or two switch cards.

Distributed Switching

VPX payload modules, with their use of the RT2 connectors, which provides high bandwidth and high pin count, are ideally suited for distributed switching. The VPX

standard defines 4 ports of 4 lanes each for each payload card. This allows the user to set up mesh topologies in the backplane.

A mesh is comprised of two or more payload cards that connect to each other through the switch chips on board (Figure 2a). Typically you can mesh 'n+1' cards with 'n' fabric links (where 'n' = number of fabric ports that you want to connect in a mesh on a payload card). So if a payload card has 4 fabric links, you can connect five cards in a full mesh.

Full mesh topologies support 'n-1' levels of redundancy. So using four fabric links, a five-slot cluster mesh can be formed. Each of the five cards connects to every other card. Depending on how the switch chips on the payload cards are configured, there can be one primary link and 3 (or (n-1) = (four fabric ports minus 1) = 3) redundant links. Alternatively, all ports on the switch can be made active to enable higher backplane bandwidth.

Mesh topologies, on the other hand, are optimal in SWaP-constrained systems. Some systems are limited by size, weight and power and hence do not want to use up a slot or two for dedicated switch cards, which add to the overall size, weight and power of the system. The need for smaller size, weight and power is compelling enough for certain applications that they will select distributed switching over centralized switching.

Centralized Switching

VPX payload modules can also be connected via centralized switches. Unlike distributed switching, the payload modules are not connected directly together but via one or two centralized switch slots. This connection topology is also known as "star" or "dual star" (Figures 2b and 2c).

It is comprised of one or two switches that connect a number of payload cards in a chassis. It provides 1+1 redundancy (one switch is the primary (or master) and the other is the slave). The switch cards use an inter-switch connection to keep a heartbeat so the system knows when to switch over in case the primary (or master) switch fails. An alternative variant of this centralized switch architecture is where the switches don't manage the redundancy, but instead both switches are active and the redundancy is managed at the end nodes.

Star and dual star are well-known architectures in the industry (PICMG 2.16, 3.0, VXS (VITA 41), ATCA, VITA 31.1, etc.). Star/dual star topologies are typically easier to implement than meshed topologies. There is no need to put a switch chip on a payload card unless you have more than one CPU or System-on-Chip (SoC) on a motherboard that needs to be connected to the data plane; software may also be much simpler.

Centralized switching is optimal for many applications that do not need the highest levels of backplane bandwidth. It is typically easier to add and remove cards from the overall system as the software algorithms to provide connectivity to the payloads are simpler. Furthermore, by removing the switch chips from the payload cards, potentially lower cost, lower power targets, and increased board real-state per payload slot can be achieved.

Progress toward Common Backplane

One of the key efforts currently underway in the VSO is the definition of a common switch card. The VITA 46.20 dot-spec defines the switch card, while 46.21 defines several distributed switching topologies. Both 46.20 and 46.21 includes backplane routings.

Because the VITA 46 Working Group anticipated the need for both distributed and centralized bus architectures, VPX payload cards were designed to be "architecture neutral" and are able to work in both types of backplanes. Curtiss-Wright has already built both these systems, with chassis (Figure 3) that support a distributed architecture and that support a dual-star centralized architecture over Gigabit Ethernet (GigE). Curtiss-Wright payload cards today support distributed switching with a Serial RapidIO dataplane and centralized switching with a Gigabit Ethernet control plane. The next step for the VITA Working Group is to complete the centralized and distributed backplane standards to allow the next wave of applications by the "early majority" to begin deployment. ▮▮

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Tech Recon

VPX, VXS and VME: Legacy vs. Leading-Edge

VPX and VXS Strike a Balance of Choices for Designers

VXS and VPX each have different strengths as alternatives for today's military embedded system developers. It's important to understand the capabilities and the trade-offs they offer compared with traditional VME.

Anne Mascarin, Product Marketing Manager
Tom Roberts, Product Marketing Manager
Mercury Computer Systems

Developers of high-performance embedded computing systems for defense must satisfy both tactical and technical requirements of the programs they serve. Since the life cycle of most defense systems is in the 10- to 20-year range, these systems must be durable, maintainable and upgradeable over the course of a long deployment. Ideally, such systems should be based on open standards to facilitate both initial system integration and technical refreshes. Performance, in terms of data throughput, is mandated by program requirements; this throughput performance is delivered by matching sufficient levels of compute power with available bandwidth, I/O bandwidth and, for multiprocessor systems, bandwidth between processors. Balance is essential.

The VMEbus standard has certainly satisfied the requirements of many defense systems since its introduction in 1981. Successive generations of new processors provided more and more compute cycles, while VME bandwidth evolved in a similar fashion, from 40 Mbytes/s on the original VMEbus to 80 Mbytes/s, then 160 Mbytes/s, and finally 320 Mbytes/s on 2eSST. Some vendors developed switch fabrics, like Mercury Computer Systems' RACE++ Series, that were implemented over the user-defined P2 pins on the VME connector. However, after a run of more than two decades, it simply was not possible to coax any more bandwidth out of the VME connector.

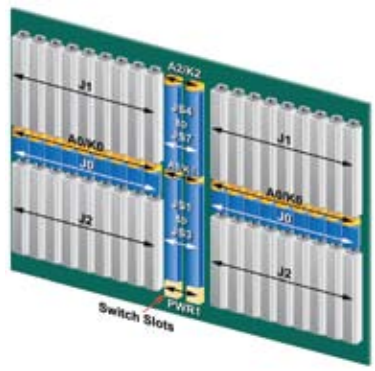

Figure 1

This diagram shows a 6U VXS backplane. J0, J1 and J2 correspond to P0, P1 and P2 on payload module connector.

The VXS standard (VITA 41), begun in March 2002 and ANSI-approved in May 2006, has extended the life of VMEbus, offering both increased bandwidth and a high level of board-level backward compatibility. An alternative is the VPX standard (VITA 46), with a different set of characteristics for system bandwidth and backward compatibility. It's important to understand some key capabilities and explore the trade-offs with respect to these three standards.

VME's Long Run

The VMEbus standard is a flexible, scalable, open-ended bus system based on the Eurocard standard. While the original VMEbus standard featured a 16-bit bus, VME64x features a 64-bit bus for 6U cards and a 32-bit bus for 3U cards. Most significantly for system bandwidth, the 6U connector is comprised of three sections designated as P0 (95 pins), and P1 and P2 (160-pins each).

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

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commercial grade to almost Mil-Spec, though the industry did suffer from an absence of any ruggedization standards.

Balancing Legacy and Bandwidth Needs

The VXS standard was developed to provide greater system bandwidth while maintaining enough backward compatibility to preserve the value of investments in VME board-level technology. VXS achieves this through an updated connector, and the addition of a switch fabric architecture.

The VXS base specification describes two types of cards—payload and switch—and a corresponding type of backplane slot for each. For payload cards, supporting processing, memory and I/O, VXS retains the P1 and P2 5-row DIN connectors of the VME64x connector, providing compatibility with the P1/P2 resident VME parallel bus and the P2 resident user-defined pins, which are often used to distribute system-specific I/O data streams. With a VXS backplane, system engineers can also carry forward VME64 cards in payload slots, without the need for a hybrid backplane. Figure 1 shows a VXS backplane.

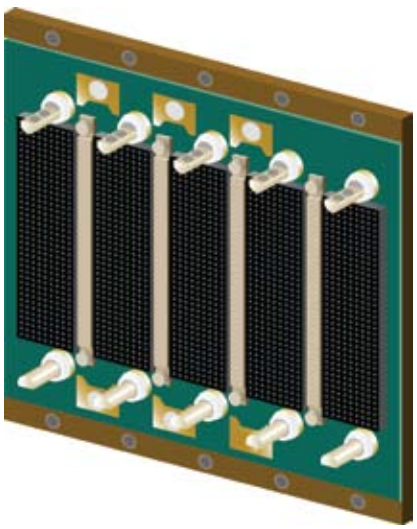

Figure 2

Shown here is a diagram of a 5-slot 3U VPX backplane.P0, P1 and P2 on payload module connector.

To meet the requirement for adding high-speed serial I/O, the VXS standard incorporates a new contemporary P0 connector for payload cards, plus an alignment and keying pin. The VXS P0 resides between P1 and P2, has high-pin density and supports multi-gigahertz signaling.

Centralized-Switch Approach

The VXS switch card implements a centralized-switch approach, serving as an aggregation point for serial fabric connections to the payload cards. A switch card contains crossbar switching elements and in some cases, external I/O interfaces. The VXS standard suggests star and dual-star as the target backplane topologies. A VXS system may have one or two switch cards, or even none for small configurations. Unlike the payload card with its compatibility requirement with the existing VME64 ecosystem, the switch card has the new style connector top to bottom.

Characteristic	VME64x / VME2eSST	VXS	VPX / VPX -REDI
Specification	ANSI/VITA 1.1 / ANSI/ VITA 1.5	VITA 41	VITA 46 / VITA 48
VME Bandwidth	VME: 320 MB/s	VME: 320 MB/s with roadmap beyond	VME: 320 MB/s
Fabric	RACE++ over P2 DIN connector 534 MB/s per board	16 differential pairs: Serial RapidIO dual 4x lanes 4 GB/s per payload board Roadmap to 20 GB/s	Up to 192 differential pairs: Serial RapidIO 4+ 4x ports 8+ GB/s per board Roadmap to 32 GB/s
Topology	Determined by P2 Interlink	Star or dual-star	Any
Faceplate user I/O	Yes	Yes	Yes
Backplane user I/O	205 single ended pins	110 single ended pins + 32 differential pairs + 31 pins RFU (future use)	48 single ended pins + 192 differential pairs
User I/O for 3U systems	0	NA	80 pins on J2
Backplane I/O bandwidth	205 pins @ 1 Gb/s	110 pins @ 1 Gb/s 16 pairs @ 10 Gb/s	192 pairs @ 10 Gb/s
Defined differential PMC/ XMC I/O mapping	No	No	Yes
Existing VME64/x forward compatibility	Yes	Yes for VME64 cards. VME P1 and P2 compatible. VME64x P0, require a hybrid backplane	Yes, with hybrid backplane Optionally supports VME signal mapping
Slot pitch	0.8”	0.8”	0.8” / 0.85” or 1.0” w/REDI
Available power	5V: 90W / 3.3V: 66W	5V: 90W / 3.3V: 66W	5V: 120W / 12V: 384W or 48V: 768W
Cooling	Air, conduction (vendor-specific mechanicals)	Same as VME	Air, conduction. REDI enhances implementations for air, conduction, and liquid.

Table 1

This table compares the characteristics of VPX, VXS and VME.

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

VPX Brings it All Together

The VPX baseline standard, begun in 2003 and ANSI-approved in October 2007, retains the 6U and 3U card formats, but does not retain the connector system used by VME64x and VXS. It is a ground-up redesign of the chassis backplane; replacing the legacy VME connectors entirely with new multi-GHz connectors. The revolutionary difference is that the VPX payload card uses this new connector top to bottom in the P0-P6 locations. (The 5-row DIN of VME64x heritage is no longer used.) The new connectors have much greater I/O pin capacity, enabling VPX systems to achieve more than 5 Gbytes/s using today’s fabric speeds. A VPX backplane enables inter-slot data transfer via a fabric interface without the use of a central switch card. Figure 2 shows a 5-slot VPX backplane.

When teamed up with the REDI standard (VITA 48), the result is truly revolutionary, supporting higher-slot power budgets, enhanced ruggedization,

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Expansion Bus	PC/104 ISA Bus	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI-104 PCI Bus	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
	PCI Bus Masters	4	4	4	4	4		4	4	4	4	4	4		4
	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9	9	9	9	9	9		
CPU and BIOS	CPU Max Clock Rate (MHz)	1400	1400	1400	1400	1400	650	400	650	400	650	400	650	500	500
	L2 Cache (KB)	2048	2048	2048	2048	2048	256	256	256	256	256	256	256	128	128
	Intel SpeedStep Technology	✓	✓	✓	✓	✓									
	ACPI Power Mgmt	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0
	Max Onboard DRAM (MB)	512	1024	1024	1024	1024	512	512	512	512	512	512	512	512	512
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RTD Quick Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	ATA/IDE Disk Chip (MB)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
	Audio		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS				TTL	TTL	LVDS	LVDS	LVDS	
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	**RS-232/422/485 Ports**	4	4	2	4	2	2	2	2	2	2	2	2	2	2
	USB Ports	4	2	4	2	4	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	2	1
	ECP Parallel Port		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO (Advanced Digital I/O)	14	18	18	36	36	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	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA				ISA	ISA		PCI				ISA		PCI	ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
Analog Input	Single-Ended Inputs	16	16	16	16	16	16	16	16							
	Differential Inputs	8	8	8	8	8	8	8	8							
	Max Throughput (KHz)	1250	1250	500	100	1250	500	500	500							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Input Ranges/Gains	3/7	3/7	3/4	1/4	3/6	3/3	3/3	3/3							
	Autonomous Calibration	✓	✓													
	Data Marker Inputs	3	3	3		3										
Conversions	Channel-Gain Table	1K	1K	1K	1K	1K	1K	1K	1K							
	Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓	✓	✓							
	A/D FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Sample Counter	✓	✓	✓	✓	✓	✓	✓	✓							
	SyncBus	✓	✓			✓	✓	✓	✓							
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	16	48	18/9	64	48	48	48	48
	Bit Programmable I/O	8	8	8	8	8	8	8	8	24	6/0		48	48	48	✓‡
	Advanced Interrupts	2	2	2	2	2	2	2	2	2			2	2	2	✓‡
	Input FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Versatile Memory Buffer												4M	4M	4M	8MB
	Opto-Isolated Inputs											48				
	Opto-Isolated Outputs											16				
	User Timer/Counters	3	3	2	2	3	3	3	3	3	3		10	10	10	6
	External Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓‡
	Incr. Encoders/PWMs										3/9		4/8	4/8	4/8	✓‡
Analog Out	Analog Outputs	2	2	2	2	2	2	2	2							
	Max Throughput (KHz)	200	200	200	100	200	100	100	100							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Output Ranges	4	4	3	1	4	5	5	5							
	D/A FIFO Buffer	8K	8K			8K	8K	8K	8K							

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and an array of open-standard cooling methodologies: traditional forced air, air flow through, liquid flow through and conduction. The fusion of VITA 46 and 48 standards is popularly termed VPX-REDI.

REDI standardizes features in the mechanical and thermal domain for deployability in harsh environments, and it provides a configuration level that is mechanically compatible with VPX modules. In addition to supporting multiple cooling methods, VPX-REDI modules introduce industry-standard enhancements, such as compatibility with two-level maintenance (2LM) plus wider module and backplane slot pitch.

Comparison of Ecosystems

VME64x bus bandwidth supports up to 80 Mbytes/s for standard 64-bit VME, and up to 320 Mbytes/s for the newer 2eSST standard. VXS improves this by a factor of eight, as each payload card can yield up to 2.5 Gbytes/s to the backplane using two 4x serial ports. Additionally, VXS supports the I/O as a fabric rather than the VME64x implementation as a bus. Thus, VXS systems achieving upwards of 45 Gbyte/s aggregate bandwidth (18 slots times 2.5 Gbyte/s per slot) can be constructed and utilized efficiently in demanding multicomputer applications.

VXS offers significant market advantages in addition to technical improvements. The VMEbus ecosystem—specifically VME64x—is a large community of complementary vendors who offer best-in-class cards, chassis and systems infrastructure. Many types of cards are available including single-board SBCs, multiprocessor and multi-FPGA cards, plus PMC and XMC mezzanine cards. The growing VXS ecosystem can leverage the valuable preexisting VMEbus ecosystem, thanks to backward compatibility.

VXS Offers Mature Ecosystem

VXS systems have been serving the embedded electronics market for several years and have been deployed in a number of programs. As an evolutionary standard, complementary with VME64x, VXS has the advantage of a mature and established ecosystem. The base VXS VITA 41.0 standard is approved by ANSI, as are several of the "doc-specs," enabling vendors and integrators to proceed on a firm foundation.

VPX takes available bandwidth a step beyond VXS—achieving up to 5 Gbyte/s per slot and upwards of 100 Gbyte/s aggregate system bandwidth (20 slots times 5 Gbyte/s per slot). VPX offers four 4x serial ports per card versus two 4x serial ports per card for VXS, yielding twice the bandwidth with the backplane.

These bandwidth enhancements, enabled by the new connectors and backplane, come at the cost of backward compatibility with VME64x. A new ecosystem of cards, chassis and infrastructure will need to evolve for VPX. And, in fact, the VPX standard itself is still maturing. A proliferation of VITA 46 dot-specs has resulted in a situation where VPX components are not able to work together. Sup-

pliers of embedded computing solutions are finding it very difficult to integrate VPX products from multiple vendors into deployable, high-performance systems due to interoperability issues.

Open VPX to Resolve Interoperability Barriers

However, to address this issue, the OpenVPX Industry Working Group was formed from an alliance between defense contractors and embedded computing systems suppliers working to resolve performance and interoperability gaps in the VITA 46 suite of specifications for 3U and 6U VPX-based systems. This will be achieved in part by implementation of predefined system profiles.

Designers who require high-performance, rugged embedded computing solutions can choose between two VME-descendent standards. Table 1 details and compares the aspects of VME64 versus the newer specs. VXS provides a great improvement in system bandwidth, along with board-level backward compatibility to VME64x. VPX delivers even greater increases in system bandwidth and, when combined with the REDI standard, a range of ruggedization levels, while giving up board-level compatibility with previous generations of systems. ▮▮

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Ethernet Gains Momentum as Fabric for VME, VXS and VPX Systems

It's the interconnect fabric technology that no one can dislike. Ethernet has overcome barriers and perception issues, opening the door to widespread use in military embedded computing systems.

John Thomson, Director, Software Engineering
GE Fanuc Intelligent Platforms

Ethernet is everywhere. That's no surprise. In many ways, it's as close to perfect as a technology can be in terms of its scalability, its flexibility, its simplicity and its low cost. From 10 Mbits/second through 100 Mbits/second and on to Gbit Ethernet, 10 Gigabit Ethernet—and beyond?—demonstrates its scalability (and each successive generation has been backward-compatible with its predecessor). It has enabled networks in a host of sizes and configurations—and is, increasingly, finding application as a backplane interconnect. It's a technology with which virtually every computer user feels comfortable: what, after all, could be simpler than plugging one end of a cable into the back of a PC, and the other into a router? And the cables, terminators, switches, multiplexes, modems and routers that give shape to an Ethernet network can be had for the equivalent of mere pennies.

Ethernet has definitely made its mark in the military realm. Rugged Ethernet Switch products are available in many form factors, including VME, VXS and VPX. Switched Ethernet technology is finding its way into numerous programs, both new and upgrades. Switched Ethernet is being used, for example, as an interconnect for the upgraded electronics on BAE Systems' Bradley Fighting Vehicle Program (Figure 1). The Ethernet Switch Unit (ESU) in the A3 Bradley Combat Systems vehicle functions as a router and a switch, making local forwarding decisions to devices operated in the ve-

Figure 1

Switched Ethernet is being used as an interconnect for the upgraded electronics on BAE Systems' Bradley Fighting Vehicle Program. The Ethernet Switch Unit (ESU) in the A3 Bradley Combat Systems vehicle functions as a router and a switch, making local forwarding decisions to devices operated in the vehicle's LAN.

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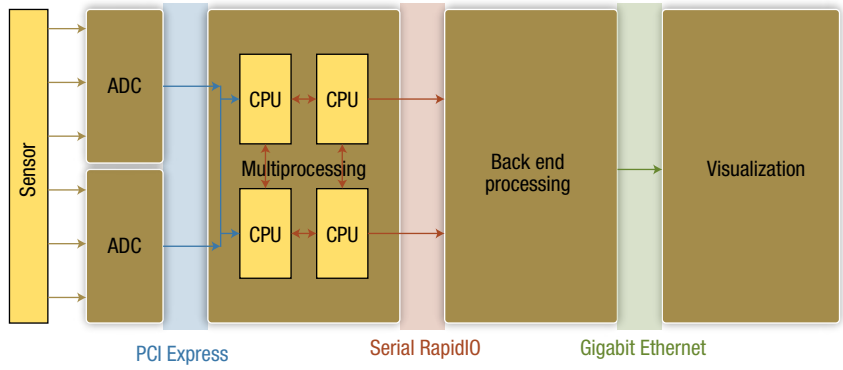

Figure 2

The strengths of individual serial switched fabrics can be leveraged within a single high-performance system.

Figure 3

Shown here is an example of a managed Layer 2 switch VME board.

hicle's LAN. The A3 upgrade version of the Bradley features an advanced digital architecture that integrates communications equipment, digital sensors, battle management systems, embedded diagnostic and training systems.

What is perhaps surprising, however, is the way in which Ethernet has succeeded despite the accusations leveled against it. Some of the criticisms are perfectly valid—but others are much less so. Take, for example, one of the key concepts underlying Ethernet in action: CSMA/CD (Carrier Sense Multiple Access with Collision Detection). The principle of CSMA/CD was that there was a shared medium (originally a big, thick yellow cable) that everyone on the network would try to use. If two nodes tried to use it at the same time, they 'detected' the 'collision', backed off, and tried again.

Non-Determinism Problem

The time delay before retrying was controlled by random and exponential elements. CSMA/CD was a powerful concept, but it led to one of the most basic criticisms: that transmission times were unpredictable and not deterministic, meaning that network design became as much a matter of art as of science. There was no 100% guarantee that any transmission would happen within x milliseconds—or even, in fact, within x seconds. Today's reality, however, is that this 'non-determinism' caused by access to

shared media is no longer true in a world in which full duplex, switched Ethernet networks are the norm. However, the role of CSMA/CD in Ethernet's alleged non-determinism remains one of the most common criticisms.

It is true that there are other causes of the non-determinism that occurs even in full-duplex, switched Ethernet networks—but the practical issues that result from this are very few, and pragmatic answers, such as priority queuing, are solving those. This is a good example of how Ethernet technology has widened and adapted to suit a more diverse set of transmission needs over the years. In its early years, Ethernet traffic would typically have seen a dumb terminal providing user input/output—that may have been field-oriented in order to improve efficiency—carried over a sophisticated network architecture such as DECnet. Today, it is more likely to be Google search results, encapsulated voice, or even captured video streams.

One area where Ethernet has been criticized without good reason is when designers fail to distinguish between the Ethernet technology itself, and the protocols that are commonly used above it. Much has been said about the CPU processing overhead required to calculate IP checksums, or the complexity of packet-window sequencing in TCP. However, these have nothing to do with Ethernet itself.

Protocol Layering

While IP is the most commonly used protocol over an Ethernet network, the arrangement is not an exclusive one, thanks to the simple—elegant, even—concept of protocol layering. Ethernet provides a simple frame-level transmission/reception mechanism—the bottom two layers of the once-famous OSI Reference Model. It can be used (as most installations do) to carry the IP protocol (Layer 3). Then, above IP, TCP might be run, or UDP, Voice-over-IP (VOIP), or any of a number of alternatives (Layers 4 through 7).

That said, it is equally possible to use Ethernet framing to carry any other protocol that can be split into frames (and most can). So, encapsulating ATM frames straight into Ethernet frames is a common solution for certain telecoms situations. Of course, in this case, all the added functionality that a higher-layer protocol like IP brings is lost—but this may be appropriate depending on the network scenario.

There are still those who maintain negative views about the overheads of the TCP and IP layers—but the issues associated with those overheads are now being addressed. There is now significant support in specialist hardware for the offloading of functions like segmentation and checksum calculations—meaning that the TCP/IP protocol stack is no longer the CPU-killer it was once made out to be.

Recently, Ethernet signaling has found substantial favor—along with the likes of Serial RapidIO and PCI Express—in backplanes such as those that can be

found in CompactPCI 2.16, ATCA, MicroTCA, VSP, VPX and so on. This can be seen as a further acknowledgement of the simplicity, reliability and cost benefits of Ethernet. In this circumstance, the designer is not looking for the campus-size reach that Ethernet was originally designed for, but a tried-and-trusted transmission mechanism. Given that Ethernet is forecast to soon reach transmission speeds of 40 Gbits/s or even 100 Gbits/second, it is clear that Ethernet is capable of providing backplane speeds that current processors would be hard pressed to fill with meaningful data.

There will, of course, always be comparisons made between Ethernet and other backplane technologies such as Serial Rapid IO, PCI Express and so on. The decision about which of these is most suitable is complex, and is normally driven by the particular application: Ethernet is, however, proving itself suitable for a growing number of applications.

It is also important to bear in mind that the various serial switched fabrics currently achieving a high profile are not mutually exclusive. Each has its strengths and weaknesses, and the best systems designs leverage those strengths. It's possible, for instance, to envisage a high-performance system in which sensors are connected to high-speed ADCs, which in turn are connected via PCI Express, with Serial RapidIO for node-to-node transfers within a back-end multiprocessing system. The results could then be relayed via Ethernet to a host computer for visualization (Figure 2). That kind of highly typical application architecture is probably what Freescale had in mind when integrating all three fabrics into the 8640 and 8640D processors.

Internet-Style Protocols

It is important to acknowledge that the majority of casual references to Ethernet also bring with them the inference of the rest of the 'Internet-style' protocols such as IP, TCP, UDP, FTP and HTTP. Many of the backplane users of Ethernet are also using these higher layer protocols, and the reason for choosing Ethernet as a backplane transmission method is often its suitability for carrying this type of traffic. The benefit, of course, is that traffic across the backplane can be identical to traffic between backplanes—or even around the world.

This 'geographic transparency' to the software applications can be attractive. The system designer doesn't need to care if the environment is a test situation, where video capture data is from a camera balanced on top of a coffee-cup on a desk, or a deployment situation, where it's in an unmanned drone over some arid desert.

Of course, a fundamental device in modern Ethernet is the switch. Switches did not exist in the original Ethernet concept. First, there was the idea of a 'repeater' to amplify the signals on those lengths of thick, yellow cable. There was

also the concept of the 'bridge' that enabled the connection of two segments of cable, while limiting traffic between the two. The advent of 'Cheapernet' (10Base5) saw the introduction of the hub, allowing the connection of multiple segments. The Ethernet switch is, in effect, a combination of the concept of the hub and the concept of the bridge.

Ethernet switches come in a range of capabilities, from the 'plug-n-play' (sometime called 'dumb') Layer 2 through 'managed' Layer 2—such as GE Fanuc's RM983RC 6U VME 12- or 24-port switch (Figure 3) to 'fully managed' Layer 3. The system designer needs to ensure that the right type of switch is chosen, bearing in mind the needs of the application. A Layer 2 switch makes all its decisions on the basis of information contained in the Layer 2 header—the so-called MAC (Media Access Control) layer, the highest layer that Ethernet knows anything about. Layer 3 switches are able to make more sophisticated decisions based on information from the IP layer—and, in some cases, on information from above the IP layer such as TCP.

Ethernet Switches as Uplinks

Switches that reside on Ethernet backplanes also often offer 'uplinks', allowing connection to other chassis, or to the outside world. These uplinks can be configured to simply look like the backplane ports, or to be in some way 'special'. Some switches will allow configuration as Layer 3—the IP layer, making the switches take on some of the role of a router, and often controlling the traffic between the backplane and the outside world.

A general rule of thumb for switches might be that unmanaged Layer 2 switches are the simplest, and will almost always work, but may not give the level of efficiency required by the application. Managed Layer 2 switches can increase efficiency at the MAC level (for example, the ability to deal with VLANs and multicast handling). Managed Layer 3 switches provide the ultimate in configurability, and are often necessary for IP-based networks.

Ethernet has come a long way in its 30+ years of existence, and has demonstrated a remarkable ability to remain not only a relevant but also an essential element of today's advanced networks. Its potential for high performance, its flexibility, its low cost and the huge ecosystem that now exists of hardware, software and expertise will ensure that it continues to be equally central to tomorrow's networks. ■■

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System Development

Tenth Annual End-of-Life Supplier Directory

EOL and DMSMS Issues Keep DoD and Specialist Firms Busy

The problem of component obsolescence continues to burden military system developers. Today, the issue of RoHS and lead-free components is complicating matters for the government groups and specialty commercial firms that mitigate obsolescence challenges.

Jeff Child
Editor-in-Chief

The defense industry's struggle with obsolescence—referred to in official circles as Diminishing Manufacturing Sources and Material Shortages (DMSMS)—continues to challenge military system developers. Today commercial and consumer system lifecycles continue to shrink, and end products in those areas are almost universally designed to be disposable. The defense industry, in fact, remains one of the very few segments of the electronics market that actually repairs and upgrades its electronics subsystems rather than just throwing out the obsolete product.

Fortunately, there's a well-established infrastructure of companies and government organizations in the business of addressing the obsolescence problem. COTS Journal's Tenth Annual End-of-Life Supplier Directory, displayed on the following three pages, lists those players and what they do. Perhaps a clear indication of the depth of the component obsolescence problem is the fact none of the companies listed have gone out of business—even in this down economy. In fact those that I've talked to recently continue to do a brisk business.

There are a number of ways to deal with the problem of a chip or board that has gone end-of-life. There are numerous after-market chip suppliers who stock inventories of obsoleted devices. Among them is a mix of small firms specializing in after-market business, and large distributors who include after-market products in their portfolio. There are also packaging firms who do custom assembly of obsolete integrated circuits using existing wafer and die. Complicating matters in the past couple years is the issue of the Restriction of certain Hazardous Substances (RoHS) directive.

There's been a great deal of uncertainty on the question of how RoHS will affect availability of obsolete components. Even though there's a rich infrastructure and industry in place that does end-of-life buys of critical semiconductor devices, it isn't clear whether enough of those EOL suppliers are willing to invest in parts with leaded packaging, knowing they could be holding inventory they can't sell to a broader market.

The defense industry, although exempt from the Restriction of Hazardous Substances (RoHS) initiative, is much more affected by it than other industries. In this age of COTS, most companies craft board designs targeted for both military and non-military markets. Even companies purely in the military market can't escape RoHS's effects, because these days it would be extremely costly and inefficient not to use the chips and components designed for the commercial market. The only alternative would be boards populated with completely customized silicon. A number of companies in the military embedded computer business have started taking on the burden of dealing with the RoHS problem and isolating it from their customers. This is both similar to and interrelated with the actions board vendors have been taking for years to successfully keep component obsolescence issues from directly impacting customers. ▮▮

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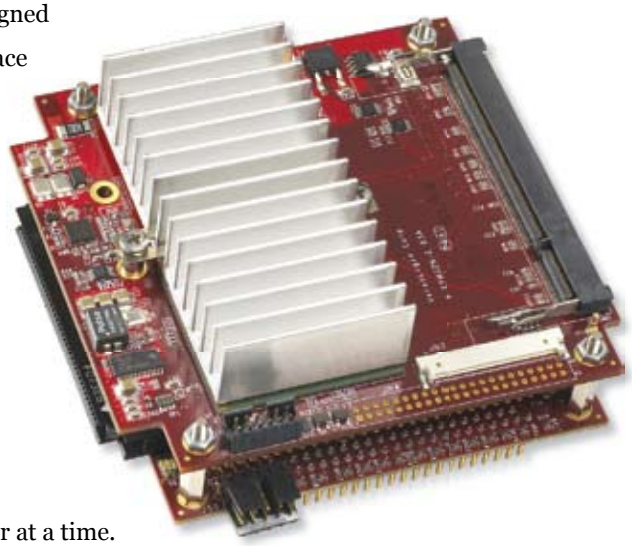

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System Development

Tenth Annual End-of-Life Supplier Directory

Company/ Organization	Contact	Category	Comment
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Arrow/Zeus Electronics	Melville, NY. (631) 847-2000. [www.arrow.com].	O	Distributor targeting North America's military and aerospace markets. Focuses on high-reliability semiconductor, passives and system products. Provides info on Environmental Compliance Research such as RoHS, WEEE, Lead-Free and other Green Initiatives.
Austin Semiconductor	Austin, TX. (512) 339-1188. [www.austinsemiconductor.com].	D, E, L, O, P, S	Deals in semiconductor components (memory, logic, linear and analog) modules and subassemblies, both standard and custom in a variety of hermetic/ceramic and plastic packages. Certifications for MILPRF- 38535 (Class Q) and MIL-PRF-38534 (Class H). Has capabilities for Class S (space level) and radiation-tolerant manufacturing, including MIL-PRF-38534 Class 'V' Assembly. All MIL-STD-883C Methods & Conditions Service provider to the Mil & HI-REL/Space marketplace. Active relationships with DSCC and DMEA.
Avnet	Phoenix, AZ. (480) 643-2000 [www.avnet.com].	DB, E, L, O, P, R, S	Global electronics distributor with numerous value-add services from testing and screening to assembly. Offers supply-chain and design-chain services, logistics solutions, product assembly, device programming, and system configuration and integration.
CALCE Electronic Products and Systems Center	College Park, MD. (301) 405-5323. [www.calce.umd.edu].	B, DB, R, S	Widely regarded as the industry's most knowledgeable source for evaluating and using components outside of OEM specifications. Also known for expertise in design refresh planning and other DMSMS management activities, parts management and supply chain assessment for quality and reliability.
Chip Supply	Orlando, FL. (407) 298-7100. [www.chipsupply.com].	D, P	Offers semiconductor die and packaging solutions. Capabilities include post wafer fab processing, including dicing, inspection, engineering and test services; obsolescence management/life cycle planning; Expertise includes Chip Scale Packaging (CSP) and Multi-Chip Modules.
CPU Technology	Pleasanton, CA. (925) 224-9920. [www.cputech.com].	B, E	CPU Tech produces secure processors that protect software and systems from reverse engineering. Acalis enables the development of secure and compatible electronics modernization technology solving obsolescence problems while reducing size, weight and power (SWAP).
DMEA	McClellan Park, CA. (916) 231-1568. [www.dmea.osd.mil].	B, E, F, G, P	DMEA provides long-term, strategic support for the entire range of DoD systems that utilize microelectronics. DMEA uses a unique, innovative methodology to reverse-engineer microelectronic devices to determine their function and a specification; analyze possible solutions; and design, build and test the best solution. An on-site reconfigurable foundry produces die in several critical process technologies.
DPA Components International	Simi Valley, CA. (805) 581-9200. [www.dpaci.com].	D, P, S	Provides manufacturing, testing and analytical services for electronic piece parts to the U.S. military, aerospace and the space industry
DSCC-VQ	Columbus, OH. (614) 692-0663. [www.dscc.dla.mil/offices/sourcing_and_qualification/].	DB, G, R	Manages over 200 Qualification Listings in 15 Federal Supply Groups (FSGs) and in more than 40 Federal Stock Classes (FSCs). Performs facility and line audits to determine compliance with the qualification requirements, verify product performance, quality and reliability, assist in interpreting technical specifications, and determining manufacturing capabilities.
Electronic Material Industries	Toluca Lake, CA. (818) 763-9584. [www.militarycomponents.com].	O	Buys, sells and stocks military and commercial electronic components. Specializes in military, industrial and commercial-type component parts, and carries a large selection of obsolete and hard-to-find spare parts.
Falcon Electronics	Commack, NY. (800) 444-4744. [www.falconelec.com].	L, O, S	Distributor to the avionics, military and space industry. Segregated product handling per JEDEC and MIL-STD. Offers DMS support services such as Global Semi Search and access to an extensive obsolete inventory. Also offers upscreening.
GD California	Livermore, CA. (925) 456-9900. [www.gdca.com].	B, E, O	Manufacturer specializing exclusively in legacy boards, system-level products and obsolescence management. These products include: VME bus, STD & STD32 bus, CompactPCI, MBI, MBII, SBUS, QBUS, UNIBUS, telecom systems, SCSI bus boards, graphic boards, data storage units;,chassis and canisters and small computer systems. Both custom and off-the-shelf products are manufactured.

Company/ Organization	Contact	Category	Comment
GIDEP	Corona, CA. (951) 898-3213. [www.gidep.org].	DB, G, R	The DoD's centralized database for DMSMS issues. GIDEP is working closely with different government activities on several DMSMS projects that will eventually be migrated to GIDEP system. Among these projects are the DMS Shared Data Warehouse, the DMSMS Prediction Tool, and the Army DMS Info System. Future migration of these systems in GIDEP would facilitate GIDEP's role as the central repository of data for DMS management.
IEC/IECQ	Geneva, Switzerland. + 41 22 919 02 15. [www.iecq.org].	R	IEC generates international standards for the practice of uprating components and using them in systems. IECQ conducts the IEC's certification program for electronic components, processes and related materials, including aerospace.
IHS	Englewood, CO. (303) 790-0600. [www.IHS.com].	DB, L	4DOnline Parts Universe catalogs electronic parts from over 500 manufacturers in 350+ categories. HAYSTACK contains over 100 million parts in Federal Supply Catalog and over 40 U.S. Army, Navy, Air Force and related databases.
Innovasic Semiconductor	Albuquerque, NM. (505) 883-5263. [www.innovasic.com].	E	A fabless semiconductor company that provides embedded solutions and replacement IC services for the long life-cycle market.
Inventory Locator Service (ILS)	Memphis, TN. (901) 794-5000. [www.ilsmart.com].	DB, L	Focuses primarily at the subsystem level.
L-3 Communications, Advanced Products & Design	San Diego, CA. (858) 552-9500. [www.L-3Com.com/apd].	B, E, P	Rapid Retargeting engineering services developer/provider for board-level electronic components and subsystems. Offers obsolescence mitigation services to solve customers' problems related to systems lifecycles, from concept and design to end-of-life.
Lansdale Semiconductor	Tempe, AZ. (602) 438-0123. [www.lansdale.com].	D, E, O, P	Aftermarket support of obsolete ICs from major semiconductor suppliers. Manufactures products using the original tooling to ensure same performance and quality. QML certified to MIL-PRF-38535.
Maxwell Technologies	San Diego, CA. (858) 503-3300. [www.maxwell.com].	E, P	Uses MCM package as form, fit and functional replacement. Qualified to MIL-PRF-38535, Class Q and Class V. Many of our products are manufactured using MIL-PRF-38534 as a guideline and screened to Maxwell's self-defined Class H and Class K flows. Currently pursuing MIL-PRF-38534 qualification.
Minco Technology Labs	Austin, TX. (512) 834-2022. [www.mincotech.com].	D, O, P	Semiconductor, processor and tester serving military, space and commercial industries. Offers custom packaging division with additional emphasis in standard part packaging, known-good die processing, and other high-reliability applications.
MTI	Fort Walton Beach, FL. (850) 664-6070. [www.mtifwb.com].	B, DB, E, L, R	Obsolescence management software, engineering services, design, redesign and manufacturing.
NAPCO	Hopkins, MN. (952) 931-2400. [www.napcointl.com]	B, DB, D, O, P, S	A material manager, procurement, distribution and light manufacturing supplier of military spare and repair parts for a wide range of military vehicles and electronic equipment to the U.S. Department of Defense, OEMs and over 60 Defense Forces around the world.
Now Electronics	Huntington, NY. (631) 351-8300. [www.nowelectro.com].	L, O, P	Distributor specializing in military and aerospace level components. Approved supplier to Lockheed-Martin, Northrop-Grumman, Raytheon, Boeing Sanmina-SCI Systems, the U.S. Defense Dept., NATO and many others.
Pikes Peak Test Labs	Colorado Springs, CO. (719) 596-0802. [www.pptli.com].	B, D, E, L, O, P, S	Lab experienced in electronic component testing and evaluation, including environmental testing, destructive physical analysis, failure analysis. Also offers calibration services. Does high- and low-temperature testing and upgrade screening for commercial, industrial and military parts.
Precience	Gaithersburg, MD. (240) 883-9170. [www.precience.com].	DB	Develops and markets enterprise level Component Supplier Management, Environmental Compliance Management, Obsolescence Management, Content Management, Procurement Decision Support and Design Chain Management products. These products reduce the engineering cycles, mitigate product obsolescence, provide fast product searches, and manage regulatory environmental compliance.
QP Semiconductor	Santa Clara, CA. (408) 737-0992. [www.qpsemi.com].	DB, D, E, F, R	Provides a broad array of DSCC-certified standard products as well as custom solutions for military and high-reliability applications. QP Semiconductor offers QML, SMD and MIL-STD-883-compliant products as well as full support for customer source controlled drawings (SCDs) and ASIC conversions.
Richardson Electronics	LaFox, IL. (630) 208-2200. [www.rell.com].	DB, O, P	Engineering services are available to aid product manufacturing, systems integration, prototype design and parts logistics from design-in through after-market stages.

Company/ Organization	Contact	Category	Comment
Rochester Electronics	Newburyport, MA. (978) 462-9332. [www.rocelec.com].	D, F, O, P, R	Authorized/franchised supplier of aftermarket parts. Manufactures more than 20,000 devices from a wafer bank of over 10 billion manufacturer-supplied die and Rochester-fabricated die using the original manufacturer's tooling and process information. Manufacturing flows include commercial, industrial, military temp, MIL-STD-883, SMD, QML, Space and customer SCD.
Sarnoff	Princeton, NJ. (609) 734-2168. [www.gemes.com].	B, E, F, R, P	Designs and manufactures military quality microcircuits. Utilizing our on-site, highly flexible, MIL-PRF-38535 QML-certified, wafer fabrication facility, Sarnoff has developed a variety of specialized processes and design approaches that provide quick-turn, low-volume, military-quality microcircuits to solve DMS obsolescence problems. Government-authorized contractor for Generalized Emulation of Microcircuits (GEM) program.
Sensitron Semiconductor	Deer Park, NY. (631) 586-7600. [www.sensitron.com].	B, D, E, F, P, R, S	Full-service provider including R&D, design, wafer fabrication, packaging, screening, testing and engineering. Maintains a wafer fabrication clean room and a microelectronics manufacturing clean room. Facility Certified to MIL-PRF-19500 - JANTXV Level. Qualified to MIL-PRF-38534 Hybrids Class H Level.
Sypris Test and Measurement	Orlando FL. (407) 678-6900. [www.wetest.com].	S	Offers test and calibration services to space and defense prime contractors, government agencies and commercial manufacturers, including automotive, avionics, telecom and medical. Services include semiconductor and passive component test, wafer probe, product test and evaluation, and repair and calibration of general electrical and mechanical test equipment. Fixed locations, on-site locations and mobile calibration facilities nationwide. ISO-9001:2000 registered, DSCC-approved, A2LA (ISO/IEC-17025) accredited and ISTA-certified.
T.S.I. Microelectronics	Danvers, MA. (978) 774-8722. [www.tsimicro.com].	D, E, O, P	Manufactures custom thick and thin film hybrids to SCDs for DSCC and military OEMs. Offers custom IC packaging into hermetic packages. Design and reverse engineering; second source to various obsolete hybrid circuits and discrete semiconductors.
Total Parts Plus	Fort Walton Beach, FL. (850) 244-7293. [www.totalpartsplus.com].	DB	Internet obsolescence and material content databases for all grades of semiconductors as well as database enhancement services.

Abbreviation	Categories	Explanation
B	Board level	Solves board-level DMS problems (as opposed to component-level problems).
DB	Database	Provides a database covering topics such as alternate sources, devices that are obsolete, cross-references or uprating results.
D	Die processor	Refers to processing OEM die, not an emulated solution.
E	Emulation/reverse engineering	Vendor may emulate a DMS device in a gate array or full-custom device, or provide a pseudo-form, fit and functional equivalent.
F	Foundry	Has foundry capability to fabricate wafers
G	Government agency	——
L	Locator	The vendor provides a service to locate DMS components and boards/systems.
O	Obsolete inventory	Maintains OEM inventory in die or packaged form.
P	Specialty packaging	Packages components as monolithic or multi-chip modules.
R	Industry reference	Denotes an organization or company with widely recognized knowledge or information concerning the DMS industry.
S	Uprating/upscreening	Performs uprating or upscreening.

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Technology Focus

Rugged Ethernet Switch Boards

Switched Ethernet Broadens its Reach in Land, Sea and Air

With the advantages of both ubiquity and longevity, Ethernet continues to gain broad acceptance in the military. Numerous new and tech refresh programs are looking to Ethernet for both networking and fabric interconnect needs.

Jeff Child
Editor-in-Chief

Once relegated only to command and control systems in the military, Ethernet is now gaining traction in numerous other military applications. As a result, Ethernet switch boards are emerging as a critical building block for a variety of programs. Switched Ethernet is being used as an interconnect fabric in compute-intensive applications like sonar, radar or any application that networks sensor arrays together. It's also deployed as multi-layer switches with dual IPv4 and IPv6 forwarding to support the DoD's sweeping plans to leverage the benefits of IPv6 (Internet Protocol version 6). The number of programs—both upgrade and new advanced systems—embracing Ethernet continues to ramp upward.

Early last year the Aviation Applied Technology Directorate specified the DuraNET 1059 Ethernet switch node from Parvus into a U.S. Army aviation modernization program for the AH-64 Apache helicopter (Figure 1). Parvus' DuraNET 1059 was to be installed on several AH-64 Apache helicopters under a U.S. Army Quick Reaction Capability (QRC) initiative aimed at improving situational awareness. This rugged, unmanaged Ethernet switch node provided local area network (LAN) connectivity to onboard IP-enabled computing devices. Weighing in at less than 2 pounds and equipped with MIL-38999 connectors, a conductively cooled chassis and MIL-STD-704E-compliant power supply, the rugged Fast Ethernet switch module is suited for airborne or ground vehicle networking applications.

Ethernet-based IP technology was also tapped for Raytheon's SSDS Mk 2 (Ship Self-Defense System) program. The SSDS MK 2 Modification 1 is used on aircraft carrier USS Ronald Reagan. Raytheon uses Performance Technologies' Advanced Managed Platform IP-comms platform to provide sophisticated remote monitoring capabilities, and an IP-based networking platform for the SSDS system. The SSDS MK2 system relies on distributed off-the-shelf embedded computers that provide automated detection through engagement capability, coordination and control of weapons and situational awareness command and control at the battle group level.

The Army's Future Combat Systems program has jumped into Ethernet with both feet. A GE Fanuc Embedded Systems' switched Ethernet product, along with other subsystems, is used for the control system in the Non-Line-Of-Sight Launch System (NLOS-LS) platform commissioned by the U.S. Army. NLOS-LS is scheduled to be part of "spin-out one" within the U.S. Department of Defense's FCS initiative. The GE Fanuc processing subsystem selected by Lockheed Martin includes a CPX24 rugged managed Gigabit Ethernet switch, along with other board-level products.

Last summer Curtiss-Wright Controls was chosen to supply its Gigabit Ethernet Switch Module (GESM) for the development and demonstration phase of the U.S. Army's Future Combat Systems (FCS) Integrated Computer System (ICS) program. The GESM contract is being fulfilled by the Curtiss-Wright Motion Control segment facility in Ottawa, Canada and shipped to Rockwell Collins. Curtiss-Wright is supplying the General Dynamics/Rockwell team with a rugged VPX-based line replaceable module called the VPX3-683.

Figure 1

The AH-64 Apache is the United States Army's principal attack helicopter, and is the successor to the AH-1 Cobra. Two U.S. Army Apache helicopters taking off from Camp Victory, Baghdad Province, Iraq in January.

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Technology Focus:

Rugged Ethernet Switch Boards Roundup

Dual-Channel 10GbE XMC Ready for Rough Duties

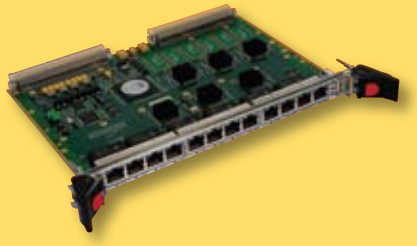
The military has become sold on the idea of using Ethernet not only as a network technology but also as a fabric interconnect. The V1120 from AdvancedIO is the first in a family of conduction-cooled XMC products for 10GbE connectivity and packet processing that addresses emerging requirements for open-standard, extremely high-bandwidth networking and point-to-point connectivity in high-performance real-time systems in harsh environments. The card uses a Xilinx Virtex-5 FPGA to optimize its performance and provide the functionality and flexibility required by high-performance real-time processing and recording applications. To accommodate large line-rate bursts of incoming sensor data, the V1120 can buffer up to 115,000 jumbo-frame Ethernet packets in its onboard SDRAM memory. Additional interface signals are provided to facilitate precise time synchronization and other application-specific functionality that requires deterministic, low latency access to the packets.

The V1120 facilitates stable, rapid deployment of 10GbE technology into high-performance, real-time, sensor data flow applications such as signal intelligence, radar and high-speed record/playback. Boasting two 10GbE interfaces in a conduction-cooled package, the V1120 is designed for an extended temperature range of -40° to 85°C. Upcoming members of the V1100 family will address different rugged requirements and options.

AdvancedIO Systems
Vancouver, British Columbia
Canada.
(604) 331-1600.
[www.advancedio.com].

VME Gbit Ethernet Switch Board Has 24 Ports

VME and Ethernet have a history of living together on embedded computing platforms. Concurrent Technologies' latest Gbit Ethernet switch board, the FP 210/024, is designed to operate alongside their range of VMEbus-based single board computers. The FP 210/024 is an "unmanaged" embedded Ethernet switching platform that provides a low-cost, low-power switching solution for integrators. Typically consuming less than 20 watts, it offers twenty-four 10/100/1000 Mbit/s auto-negotiating Ethernet ports, twelve accessible via the VMEbus P2 I/O connector and up to twelve via the front panel with the option for two being optical. The switch core contains a wire-speed, Layer 2, Quality of Service (QoS) switch fabric. Commercial and extended temperature versions are now available, and ruggedized, conduction-cooled or air-cooled versions will be available shortly. This switch facilitates communications within a chassis as well as supporting the network outside the chassis in a variety of applications including defense.

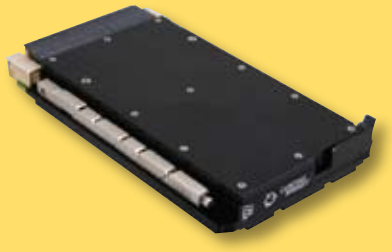


The FP 210/024 sustains full duplex full wire 10/100/1000 Mbit/s speeds on all twenty-four ports. Ports 1 to 12 are used for connection to the nodes via the VMEbus P2 I/O connector. Ports 13 to 24 are via twelve RJ45 connectors on the front panel. The switch can handle time-critical/multimedia traffic such as voice, video and data as it utilizes four hardware priority queues per port and supports a range of QoS traffic classifications: port ID, MAC address, IEEE 802.1p, IEEE 802.1Q, IPv4 and IPv6.

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

3U VPX Card Is GbE Multi-Layer Switch/Router

The VPX ecosystem continues to expand. The latest example is Curtiss-Wright's VPX3-683 FireBlade, available with 24 GbE SerDes ports and up to two (2) x10 GbE XAUI ports, and is ideal for system integrators architecting secure high-performance IPv4/v6 Intra-Platform Networks (IPNs). This rugged, compact 3U VPX card, which can operate either as a fully managed switch/router, provides significant performance and configuration advantages to developers building Layer 2 and Layer 2/3+ networks. With support for the "de facto" industry standard CLI, the VPX3-683 FireBlade significantly speeds time-to-market by reducing set-up, configuration and maintenance times.



Based on the VPX board architecture, the card combines high bandwidth and unmatched ruggedization with support for standards-based 2 Level Maintenance (2LM) to enable in-the-field repair and upgrades while reducing long-term maintenance and sparing costs. Operational as either a fully managed switch/router, the VPX3-683 FireBlade router delivers substantial advantages to system integrators designing Layer 2 or Layer 2/3+ networks. The VPX3-683 FireBlade is supported with numerous advanced management interfaces including CLI, SNMP and Web for easy configuration and network management. Complete Layer 2/3 software, Quality of Service (QoS), IP multicasting and security is provided for a feature-rich solution that can support the simplest to the most complex network requirements. Quantity pricing for the VPX3-683 starts at $7,995.

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

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Managed L2 Switch Climbs on 6U VME

Ethernet switch technology fits well into the "systems" view that's pervading today's military system designs. Exemplifying that trend, GE Fanuc Intelligent Platforms' RM983RC VME Ethernet Switch is a 6U VME form factor RM983RC switch that provides support for 12 or 24 Gigabit Ethernet ports. It ships with GE Fanuc's OpenWare Lite switch management environment, providing customers with the flexibility to manage configuration of the RM983RC from a serial console or via the network.

Capable of Layer 2 switching at wire speed, the RM983RC's 12 or 24 ports are routed to front panel I/O and can be 10/100/1000BaseT, 1000BaseSX or 1000BaseLX. Mixing and matching of fiber and copper media in groups of four is supported. Scanbe front panel and urethane or acrylic conformal coatings are optional. The front panel I/O routing of the RM983RC extends the capability of the NETernity 6U VME product family by offering designers a choice of I/O routing; the recently announced NETernity RM982RC features rear I/O.

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

VME Card Is Full L3 Gbit Ethernet Switch

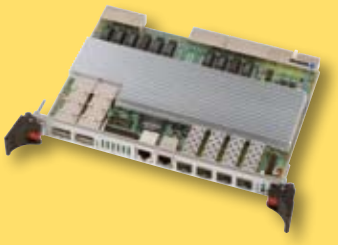
Perhaps the most attractive aspect of VME is its ability to marry today's technology with legacy platforms. Exemplifying that belief, Interface Concept has announced the ComEth4070a family, a complete line of 6U VME L3 fully managed Gbit Ethernet switches for embedded applications. The ComEth4070a series uses the latest-generation Gbit switch engine and PHY transceiver. It combines a Layer 2+ switch and a full Layer 3 router in a single board with optimized power consumption. The ComEth4070a supports full-wire speed L2 bridging and IP routing with L2-L4 Access List for classification, filtering and prioritization.

The ComEth4070a provides 24 Gbit Ethernet ports with a full-wire speed switching capacity of 37 Mpps. ComEth4070a switches are fully managed and can easily be monitored from a browser, a remote application, a CLI or SNMP. The Switchware software provides Layer 3 functions, allowing static and dynamic protocols (RIP, OSPF), IP routing, proxy-ARP and DHCP-relay. The IP protocols are carried out by the processor and the forwarding is carried out by a full-wire speed L3 engine router. These switches can be used in all types of environments with operating ranges from standard, extended, rugged and conduction-cooled grades. Prices start at $5,200 in low quantities.

Interface Concept
Briec de l'Odet, France.
+33 (0)2 98 57 30 30
[www.interfaceconcept.com].

cPCI Ethernet Switch Offered in Three Rugged Levels

The concept of EOIP (Everything Over IP) is catching on strong in the military. Voice-over-IP networks aboard aircraft carriers, for example, are one step in that direction. Cost is a factor in such network implementations. With that in mind, Kontron's CP6923 board provides built-in switching capabilities for cPCI installations at an unmatched price-to-performance ratio by implementing the latest technologies including the highly compact Broadcom BCM56502 Gigabit Ethernet switch chip. The Kontron CP6923 is a 6U hot-swappable cPCI switch with 24 Gbit Ethernet ports and two high-capacity uplinks (10GbE), which makes systems cascadable. It supports all relevant standards in carrier-grade L2 and L3 switching, routing, VLANs and QoS (Diffserv) developed by Kontron.



The Kontron CP6923 now comes in three rugged levels defined as R1, R2 and R3. The R2 and R3 versions are available with E2 capabilities (extended temperature range from -40° to + 85°C). The R1 version is designed for standard application requirements in air-cooled environments. The R2 version is ruggedized for higher shock and vibration environments in accordance with the EN60068-2-27/64 (similar to VITA 47's EAC6) specification. The R3 version is fully conduction-cooled and meets VITA 47's ECC4 requirements.

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

8-Port Ethernet Switches Boast Rugged Design

Low-power, fanless electronics are a must in many harsh-environment military applications. MEN Micro offers a line of intelligent 8-port Fast Ethernet switches that provides three types of front connections (RJ45, M12 and D-Sub) and a rugged design. Consuming less than 7W per switch and packaged in a fanless housing, the new SF Series of Ethernet switches offers an exceptional combination of ruggedness, low power and flexibility that make these switches ideal for mobile, transportation and automation applications. Specific models include the SF1, SF2, SF3 and SF4.

All switches support full-duplex and half-duplex operation, high-speed non-blocking, store-and-forward switching and auto-negotiation as well as Layer 2 switching. They are fault tolerant and restore themselves on their own: if a link is temporarily unavailable, the switches will work again after the disturbance without any restart or reset. A built-in test mechanism makes these rugged Ethernet switches reliable components within an embedded system. The four switches in the new SF Series come in both managed (SF2 and SF3) and unmanaged (SF1 and SF4) versions as well as in stand-alone or 19-inch rack mountable configurations. The managed switches support Power over Ethernet (PoE) on ports 0 and 1, can act as Power Source Equipment (PSE) or a Powered Device (PD), and include an FPGA-based low-power CPU that integrates the management software. Pricing per unit for the unmanaged switches is $1,325, and $1,769 for managed.

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

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

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

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

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

PICMG 2.16 Board Sports Dual 10 Gbit Ethernet Uplinks

Applications like airborne or shipborne communications systems demand a mix of high bandwidths and the resilience of high availability. Feeding such needs, Performance Technologies offers the CPC6620, an advanced PICMG 2.16 embedded Ethernet switch featuring 24 10/100/1000 Mbit switch ports, two 10 Gbit uplink ports and support for IPv6 routing. Available in ruggedized and conformal-coated versions with fiber-optic 10 Gbit uplinks, the CPC6620 can be configured to monitor network status and to continuously check its own health through real-time integrity tests. In the event of system or network failure, data can be automatically re-routed to an alternate path.

Performance Technologies' line of high-availability Advanced Managed Platforms is available in configurations including 1 Gbit or 10/100 Ethernet switches, comprehensive remote shelf management, high-performance x86 and PowerPC compute elements accommodating Linux, SolarisT or Windows operating systems, and HA middleware. Options include applications processors, a wide range of networking I/O products and communications protocols, and NexusWare, the Company's CGL 3.2-registered and POSIX-compliant Linux distribution and development environment. These configurations provide a complete, integrated base platform for system designers looking to develop a wide range of applications, and are designed to reduce integration time and lower development costs.

Performance Technologies
Rochester, NY.
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[www.pt.com].

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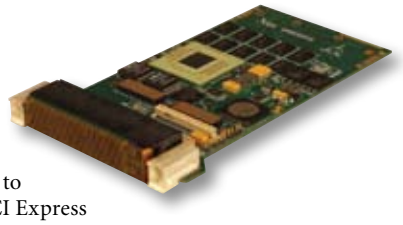


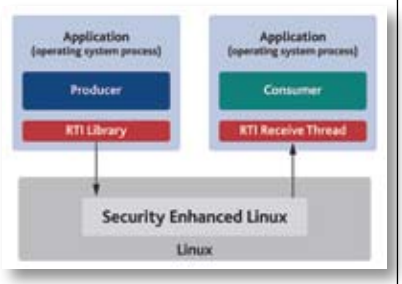
There have been only a handful of SBC vendors so far that have rolled out VPX products. The ones that jumped on board have already got several out. Extreme Engineering Solutions' latest VPX offering is the XPedite5170, a feature-rich 3U VPX (VITA 46) solution targeting Freescale Semiconductor's dual-core MPC8640D processor. The XPedite5170 delivers enhanced PowerPC performance with AltiVec technology and power efficiency for today's military customers requiring high performance in small form factors.

The board runs at up to 1.25 GHz, and includes two channels of 1 to 4 Gbytes of DDR2-533 SDRAM and up to 4 Gbytes of NAND flash and 256 Mbytes of NOR flash. Interconnects included dual Gigabit Ethernet ports, PCI Express or Serial RapidIO Fat Pipe P1 interconnect. The P2 interconnect includes GPIO, two RS-232/RS-422/RS-485 serial ports, I²C and PMC I/O. XPedite5170 is shipping today with XPand1000 development chassis. Pricing varies from $6,000-8,000 depending on ruggedization level, memory configuration and quantity purchased.

Extreme Engineering Solutions, Middleton, WI. (608) 833-1155. [www.xes-inc.com].

Real-Time Messaging Middleware Meets Secure Linux

The Linux operating system has a firm foothold in the defense arena. Software developers like the fact that they can start developing with Linux without the overhead of a commercial OS to consider. Real-Time Innovations (RTI) has announced that RTI Data Distribution Service, its real-time messaging middleware, has been integrated with Security-Enhanced Linux (SELinux). This combination provides real-time and high-performance distributed applications with the ability to securely distribute data by combining RTI's high-performance network communications with the extremely flexible Mandatory Access Control (MAC) facilities of SELinux.



RTI Data Distribution Service allows distributed applications to securely exchange messages and data by authenticating peers and encrypting information that is sent over the network. The MAC capabilities of SELinux add several additional levels of protection against mis-configuration, software errors and application vulnerabilities: System-wide security policies control which applications are allowed to communicate with each other. Even applications with the appropriate credentials and keys can communicate only if explicitly provisioned to do so. Files containing keys, configuration information and logs are protected from unauthorized access. RTI Data Distribution Service and a reference SELinux security policy are available today from RTI.

Real-Time Innovations, Sunnyvale, CA.
(408) 990-7400. [www.rti.com].

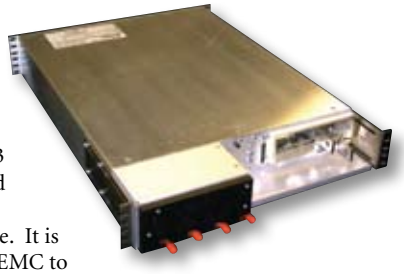
2.16 GHz Core 2 Duo System Is Just 34 Cubic Inches

Applications like UAVs call for the contradictory requirements of high compute density on the one hand with small size, weight and power on the other hand. General Micro Systems attacks that challenge with its "Raider" (S705), a new rugged, ultra-small, Core 2 Duo-based system. Adding to the system's versatility is its super-small envelope with single drive version at only 4.6 x 4.6 x 1.6 inches, weighing only 2 pounds with power requirements as low as 15W. Raider has the ability to support up to six wireless radios on four to six antennae feeds.

Other key features are Dual GigE with TCP/IP offloading engine, high-performance video, Dual Com ports with 232/422, four USB ports, full audio for VoIP applications, full BIT and EBIT testing, and thermal management for safe thermal operation. Raider's facility for rugged environments (-40° to +85°C, MIL-STD 810F), along with its ability to operate from a single voltage source (+16 to +28VDC), makes the S705 ideal for demanding applications such as UAVs. Two optional 256 Gbyte solid-state disks can be fixed or removable, offering the ability to store a half Terabyte of acquired data for security purposes in sensitive operations. Pricing for the conduction-cooled version of Raider (S705) starts at $8,300 in single quantities.

General Micro System, Rancho Cucamonga, CA.
(909) 980-4863. [www.gms4sbc.com].

AC-DC High-Density Power Supply Delivers 30 kW



Liquid-cooling technology is found in many applications that depend on regulated and highly reliable DC current power supplies. Along such lines, Pioneer Magnetics has announced the PM37223-10P, a power factor corrected, 360V at 30 kW liquid-cooled AC-DC power supply with power density of 27.4w/in3 in a 2U 19-inch rack configuration. This is one of a series of high-power products that will include air-cooled versions and a wide range of output voltages. At a high efficiency of over 92 percent at 80 percent of load, the PM37223-10P provides a 360 volt at 83 amp, remote sensed, fully floating, Over Current (OCP), Over Voltage (OVP) and Over Temperature (OTP) protected output. The input voltage is 408 to 528 VAC, 3Ø with Power Factor Correction (PFC) of greater than 0.95 at full load.

The PM37223-10P is a semi-modular unit housed in a 3.47- x 17.38- x 24.4-inch liquid-cooled plate enclosure. It is designed to meet regulatory agency TUV to EN60950-1, EMI Conducted & Radiated to EN55022 Level A, and EMC to EN50082-1. The unit comes with mounting ears for a standard 2U 19-inch rack.

Pioneer Magnetics, Santa Monica, CA. (310) 829-0921. [www.pioneermag.com].

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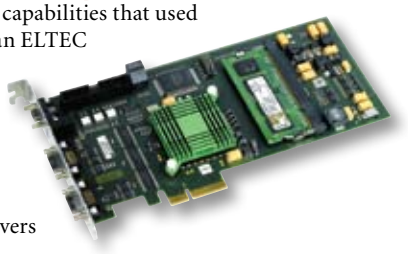
PCIe Frame Grabber Exploits Camera Link-Compatible Camera



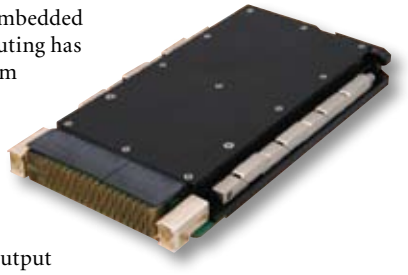
The bandwidth of PCI Express has brought the desktop capabilities that used to require a rack of embedded computing boards. American ELTEC offers an image processing solution for Camera Link-compatible cameras—the PC_EYE/CL—as part of its PCI Express frame grabber portfolio. In conjunction with this tool, the board supports base, medium and full configurations. The PCI Express interface with four lanes (x4) delivers data rates of up to 1 Gbyte/s for maximum speed cameras with full interfaces. The frame grabber delivers speeds of up to 680 Mbyte/s.

The PC_EYE/CL frame grabber has inputs for digital video data compliant with Camera Link standard Version 1.2 (Automated Imaging Association). Since each of the two onboard

Mini-Delta-Ribbon 26-pin connectors supports four ports, a total of eight ports (A-H) can be used. This makes it possible to connect either two independent Base cameras, using ports A-C each, or one Medium (A-F), or one Full (A-H) camera. Each 8-bit-wide Camera Link port uses a high-speed 7:1 multiplexing scheme with a serial transmission rate of 2.36 Gbit/s for optimal utilization of cable capacity. Pricing for the PC_EYE/CL frame grabber is $1,260 in single piece quantities.

American ELTEC, Las Vegas, NV. (702) 878-4085. [www.americaneltec.com].

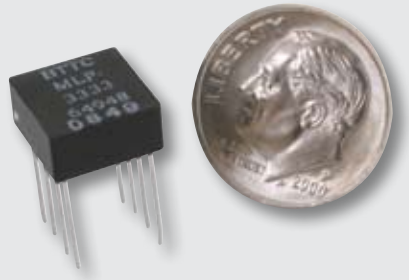
3U VPX ATOM Card Is Highly Secure



This has become the "Year of the ATOM" for military embedded board designs. Curtiss-Wright Controls Embedded Computing has introduced a new low-power, high-performance, small form factor VPX3-1100 ATOMIC board designed for rugged deployed aerospace and defense applications that require highly secure computing. The VPX3-1100 ATOMIC provides a 1.1GHz Intel ATOM processor and up to 512 Mbyte DDR2 SDRAM, 1 Gbyte NAND flash, a BIOS Firmware Hub (FWH) and a Trusted Platform Module for trusted boot. The VPX3-1100 ATOMIC backplane input/output includes two high-performance PCI (x1) fabrics, 2x GbE interfaces, 2x RS-232 Serial interfaces, 8x GPIO, 2x USB 2.0, VGA, Audio (Mic, L/R) and XMC I/O.

Additional features include a Basecard user-programmable FPGA and Secure Computing Mezzanine card for advanced security and perimeter defense applications. Featuring Curtiss-Wright Controls's patent-pending 2-Level Maintenance Secure Computing perimeter defense technology, the VPX3-1100 ATOMIC enables systems integrators to build secure rugged defense electronic systems for multiple applications that need to protect sensitive information, encryption keys, Intellectual Property (IP), or reverse engineering at the blade level. Volume pricing for the VPX3-1100 ATOMIC starts at $2,800. Availability is June 2009.

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



MIL-STD-1553 Transformer in Compact 3.3V Package

The 1553 interface seems like it's been around longer than anything. But it's not going away any time soon. 1553 component makers continue to roll out new products at a steady pace. Case in point is Beta Transformer Technology's introduction of its MLP-3333. It is a through-hole mount, 0.4- x 0.4-inch footprint, 0.185-inch maximum height, single channel, dual ratio transformer. The MLP-3333 is designed for 3.3V MIL-STD-1553 transceivers. The 0.185-inch height makes it particularly attractive for today's smaller board topologies. This dual ratio transformer enables board layouts to accommodate both transformer coupled and direct coupled applications.

The MLP-3333 uses a robust through-hole design, which meets all the requirements of the MIL-PRF-21038 specification and provides an extra margin of safety for vibration and shock tolerance for rotorcraft applications. It operates over the full Mil-temp range of -55° to +130°C.

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

Atom-Based Mini-ITX Motherboards Boast Power Savings, Rich I/O

The perception of Intel CPUs as more power hungry than its competitors is in full retreat now that the ATOM family of microprocessors has entered the game. Riding that wave, Advantech announced production of its first Intel Atom industrial grade Mini-ITX motherboard. The AIMB-210, with an Intel Atom N270 CPU, features a super low-power design, but without sacrificing performance. Rich connectivity with up to eight USB 2.0 and six COM ports is integrated in a standard 170 x 170 mm form factor.

The AIMB-210 incorporates an Intel Atom 45nm processor, and is designed to enable space-efficient solutions with a power saving feature. Equipped with the Intel 945GSE chipset, total power consumption comes in at around a mere 14W. The AIMB-210 has a 533 MHz Front Side Bus and up to 2 Gbytes of DDR2 533 SDRAM. The AIMB-210 supports dual display with multiple display types, such as CRT + LVDS, TV-Out + LVDS, or LVDS1 + LVDS2 (optional) with TV-out via S-Video / Composite Video connections. Video output is complemented by HD audio for a complete audio/visual solution.

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

ECX Board Operates at Under 10W

SWaP—or Size, Weight and Power—issues have moved to the top of many military system designer's priority lists. American Portwell Technology offers Portwell PEB-2738, which utilizes the Intel ECX form factor and supports the latest options of the Intel Atom processor Z5xx series and the Intel System Controller Hub US15W, including industrial temperature range and larger footprint version with 1.0 mm ball pitch. The PEB-2738 is specifically designed to operate at a very low power consumption of less than 10W at full loading. It supports dual independent display by LVDS and SDVO daughter card (DVI/VGA/LVDS, project-based).

Based on the Intel Atom processor Z5xx series platform, the PEB-2738 takes advantage of the low-power processor, ground-breaking power management techniques and wide temperature range so it can be a truly industrial temperature and fanless configuration. In addition, the PEB-2738 supports one SO-DIMM memory slot for DDR2 SDRAM up to 2 Gbytes, and comes with one IDE, one CompactFlash socket, one SDVO connector, one TPM, PCI-E x1 golden finger, two RS-232/422/485, audio CH5.1, six USB2.0 and one SDIO connector.

American Portwell Technology, Fremont, CA. (510) 403-3399. [www.portwell.com].

Scopes Boast Large Display, Mixed-Signal Capability

Electronic design and test teams in aerospace/defense industries continue to produce increasingly sophisticated hardware designs. That calls for test gear to keep pace. With that in mind, Agilent Technologies expanded its mixed-signal and digital-storage oscilloscope portfolio with four new 100 MHz models in the InfiniiVision 7000 Series. The 7000 Series now offers bandwidths from 100 MHz to 1 GHz and delivers an unparalleled deep-memory waveform update rate of up to 100,000 waveforms per second. Each new model is equipped with the largest screen available in a 100 MHz scope—a 12.1-inch XGA LCD display—and comes in a package that is just 7 inches deep and weighs only 14 pounds.

Designers use oscilloscopes as the primary tool to test and debug their designs. The ability to consistently view subtle signal details and infrequent events allows designers to more quickly debug and test their electronic devices. Agilent's InfiniiVision 7000 Series oscilloscopes deliver the best signal visibility for designs that include analog and digital or serial signals. The combination of large-screen and mixed-signal capability for logic and protocol display previously was not available to designers who required scopes with only 100 MHz bandwidth. Agilent InfiniiVision 7000 Series oscilloscopes are available today at prices ranging from $4,995 to $18,248 depending on configuration.

Agilent Technologies, Santa Clara, CA
(800) 829-4444. [www.agilent.com].

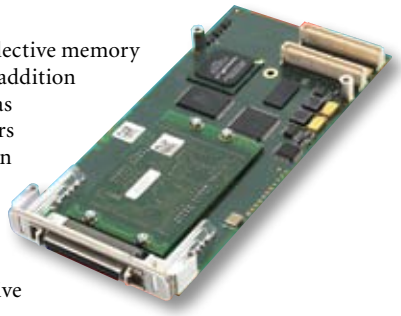
PMC Card Offers Time-Triggered Networking

TTP is a communication protocol for design of fault-tolerant distributed hard real-time systems with clean definition of key system interfaces. TTTech has developed a PMC Card with TTP communication controller and a PowerPC host processor. TTPPMC Card enables time-triggered and deterministic networking for complex distributed systems. It has been designed for the use of all kinds of standard modules with PMC interface. System configuration with TTP-based PMC cards allows customers to benefit from faster time-to-market and reduced lifecycle costs.

Distributed embedded computing with TTPPMC Card enables development of distributed applications independent of the underlying communication architecture, physical layer, topology or embedded host hardware. TTPPMC Card makes application design as easy as possible. It contains an Austriamicrosystems AS8202NF communication controller and a standard Freescale MPC5567 host processor on board. A TTP network facilitates the development of reusable platforms and supports full separation of application design from system interfacing details.

TTTech North America, Tucson, AZ.
(619) 994-8626. [www.tttech.com].

Reflective Memory PMC Provides Data Security



Memory storage can be a critical asset in many military systems. MEN Micro now offers the new P512, a reflective memory PMC that provides real-time redundant memory storage across multiple computers in a networked system. In addition to high transmission speeds and exceptional flexibility, the 32-bit/33 MHz P512 offers increased data security as well as expanded memory capacity, since memory elements can be read from and written to different processors simultaneously and shared among PCs providing a redundant memory architecture. The P512 is widely used in a variety of mission-critical and data-intensive applications.

Each P512 module offers 32 Mbyte soldered, FPGA-controlled DDR2 SDRAM and an LVDS channel with a connection speed of 230 MHz and 86 Mbytes/s. The PMC supports multi-mode transmission up to six feet, so it can be integrated into a mesh connecting all modules of the network to each other. For this, each system CPU needs a PMC module for the connection to the other computers. Pricing for the P512 Reflective Memory PMC is $2,123.

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

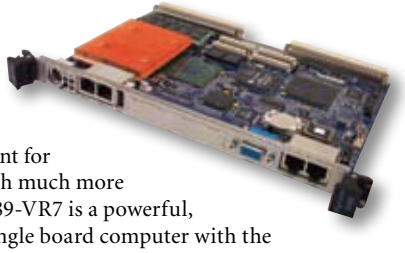
Load Board Ensures VPX Power Compatibility

As more and more vendors roll out VPX products, the new designed-for-military system architecture is quickly gathering momentum. Elma Bustronic has announced a new 3U VPX Load Board. The load board helps confirm the chassis meets the VITA 46/48 power specifications for VPX and aids in locating hot spots within the enclosure. The load board functions to test a system's cooling capabilities by first applying the load to the power supply for verification and creating the necessary heat to confirm chassis cooling. By locating hot spots in the chassis, a system designer can verify where to optimally redirect the airflow to prevent overheating. The 3U VPX load card features a microcontroller-based stepped load control to 100W maximum. Other features include a power reset button (to minimum level) and a SYSRESET signal on the two test point outputs. Go-No-Go indicators are present for 3.3V, 5V, 12V, +12V Aux, -12V Aux and 3.3V Aux. There is also an IEEE injector/ejector handle to provide a secure and convenient latching mechanism. Bustronic is also planning a 6U VPX Load Board as well as a conduction-cooled version in the coming months. Pricing for the 3U VPX Load Board is under $1,000 depending on volume and type.

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

VME Card Is 1 GHz Drop-in Replacement for Predecessor

The longevity of VME in the military is partly thanks to technology updates to legacy slots. Feeding exactly such needs, Xembedded has announced a drop-in replacement for the End of Life SBS VR7, but with much more processor power! The XVME-689-VR7 is a powerful, very low-power single slot 6U single board computer with the same VMEbus P1 and P2 pin outs as the VR7. The XVME-689-VR7 VMEbus processor integrates an Intel Celeron M processor running at 1.0 GHz with up to 512 Kbytes of level 2 cache and a PCI-to-VMEbus interface. It is also available with 512 Mbytes or 1 Gbyte ECC or Non-ECC DDR, 266/333 MHz SDRAM. The XVME-689-VR7 has VGA Graphics out front panel or rear video support (Pixel resolution up to 1600 X 1200 at 85 Hz). The EIDE Ultra-100 DMA controller supports up to three EIDE devices, one PMC 32/64-bit 33/66 MHz site (IEEE P1386/P1386.1) with front panel I/O bezel and user I/O on optional P0 rear connector.



Additional options available on the XVME-689-VR7 are EIDE onboard 1.8-inch hard drive, CompactFlash carrier, two Serial ATA150 (SATA150) external devices and a floppy disk interface. SCSI can be added with the use of a SCSI PMC board. PMC expansion for two additional PMC sites is available using the XVME-976/209. This XVME-689-VR7 processor module allows users to take advantage of the low-power, multiprocessing capability of the VMEbus while using standard off-the-shelf PC software, operating systems and VMEbus I/O modules.

Xembedded, Ann Arbor, MI. (734) 975-0577. [www.xembedded.com].

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4.8 Gbit DDR2 DRAM Offered in Compact PBGA Package

Gone are the days when it took a rack of boards to get a Gbit of RAM memory. Now multiple Gbits of RAM can be squeezed onto one device. Along such lines, the 4.8 Gbit AS4DDR264M72PBG1 device from Austin Semiconductor is a DDR2 device packaged in a 16 mm x 23 mm, 208 ball BGA with a ball pitch of 1.00 mm. It offers performance benchmarks up to 667 Mbit/s data rate while operating within the Mil-Temperature range of -55° to +125°C.

The device offers DLL for alignment of DQ and DQS transitions with clock signal. Eight internal banks are provided for concurrent operation and the device supports auto Refresh and self Refresh modes. The 208 PBGA offers 61 percent space savings, 55 percent I/O reduction, reduced part count and reduced trace lengths for lower parasitic capacitance. The AS4DDR264M72PBG1 has entered full production and is being delivered to all speed variants, including the DDR2-667 Mbit/s variant operating at full military temperature range.

Austin Semiconductor, Austin, TX. (512) 719-7250. [www.austinsemiconductor.com].

6U cPCI Intel Xeon Blade Has Dual Quad Core Xeons

The multicore trend shows no signs of slowing as military system developers push for ever greater compute density. Pushing more power into networking systems, a PICMG 2.0-compliant 6U CompactPCI dual-processor blade features up to two Quad-Core Harpertown or Dual-Core Intel Xeon Processors, server class Intel 5100 San Clemente chipset, four SO-RDIMM sockets for up to 16 Gbyte DDR2-667 registered ECC memory and 1066 MHz front side bus. The cPCI-6920 from ADlink Technology provides network and military equipment providers with higher memory capacity and up to eight times the computing power of previous single-core products.

In addition to multicore computing power, ADlink's new cPCI-6920 offers a 64-bit/66 MHz PMC or x8 PCI-Express XMC site for high-speed I/O expansion, such as 10Gigabit Ethernet and high-end graphics. The cPCI-6920 brings RAID 0/1-enabled SATA/SCSI storage device support via a rear transition module (RTM), and reserves space for a 2.5-inch Serial ATA hard drive directly mounted on the SBC and RTM. A CompactFlash slot and embedded 4 Gbyte USB NAND flash are additional storage options. Single unit pricing is $3,895.

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

Rugged Next-Gen Multiprocessor Links Seven CPUs

Upgradable modularity is critical in a variety of applications such as the Mounted Battle Command On The Move (MBCOTM), Command Post and a host of other C4ISR programs. Along such lines, the MPU COMx from Z Microsystems is a new multiprocessor unit that hosts up to seven hot-swappable processor modules, two sealed hot-swappable TP2 disk drives, dual hot-swappable AC or DC power supplies, 4 Gbyte RAM and optional PCI Express modules. With enhanced graphics, it is designed for full system modularity, seamless processor upgrades and long operational life in harsh mission-critical environments.

The advanced MPU COMx workstation incorporates up to seven Intel or AMD-based processor modules into one durable, sealed aluminum chassis. Operators can mix and match processor modules with optional graphically enhanced PCI Express modules for applications that require extreme graphics capabilities. Dual hot-swappable load sharing power supplies, field-replaceable fans and hot-swappable TP2 disks make deployed serviceability effortless. The MPU COMx can also be easily networked and remotely managed.

Z Microsystems, San Diego, CA. (858) 831-7000. [www.zmicro.com].

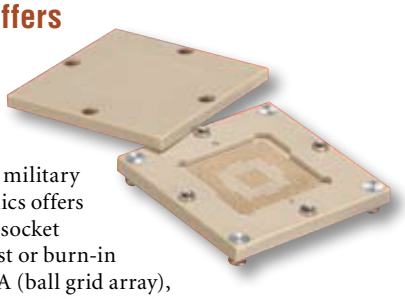
1U Solution Blends High-End Graphics and Eight GbE Links

Military systems continue to gravitate toward 1U form factors, partly because they match the form factor of numerous off-the-shelf blade and comms gear. Designed for high-performance networking and network security applications, the PL-10560 rackmount network appliance from Win Enterprises supports a range of applications including IDS/IPS, firewall, VPN gateway, load balancing and UTM. It offers a choice of Pentium M or Celeron M ULV processors. It features the 915GME/910GMLE integrated high-performance 2D/3D accelerated graphic chip and ICH6-M I/O controller with system memory up to 2 Gbytes with two DDRII memory sockets. A removable cover enables easy access to CompactFlash and memory for system upgrades.

The flexible platform offers a choice of four GbE Copper or eight GbE Copper with one pair optionally reserved for bypass function on the front panel. PL-10560 is available in two configurations: The PL-1056A 1U rackmount appliance with Intel Celeron M 600 MHz/512K onboard, 4 x RJ45 GbE, SATA, CF, PCI-E x 4, PCI-E x 8 is priced at $518; and the PL-1056B 1U rackmount appliance with an Intel socket 479 with 8 RJ45 GbE, SATA, CF, PCI-E x 8 is priced at $591.

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

CSP/BallNest Socket Offers Reliable Test and Burn-In



Keeping up with the latest and greatest chip packaging schemes is a tough challenge for military system designers. Aries Electronics offers a patented CSP/BallNest hybrid socket that is suited for prototyping, test or burn-in of CSP (chip scale package), BGA (ball grid array), microBGA and LGA (land grid array) devices. The socket features a lid that nests each ball termination into the socket for a reliable connection and can be used on any device with a 0.30 mm pitch or larger.

The socket body is PEEK or Torlon, while screws and alignment pins are stainless steel, and all inserts are tin-plated brass alloy per QQ-B-626. The socket's contact forces are 15 g per contact on a 0.30 mm to 0.35 mm pitch, 16 g per contact on a 0.40 mm to 0.45 mm pitch, 25 g per contact on a 0.50 mm to 0.75 mm pitch and 25 g per contact on a 0.80 mm pitch or larger. Operating temperature is -55° to 150°C (-67° to 30°F) and estimated contact life is 500,000 cycles. A BallNest socket for a typical 50 lead BGA device with 0.3 mm pitch is $500 each at quantity two pieces.

Aries Electronics, Bristol, PA. (215) 781-99561. [www.arieselec.com].

XMC Card Cable Adapter Boasts 40 Gbit/s Links

The XMC mezzanine form factor is destined to follow nicely in the footsteps of the popular PMC form factor. One Stop Systems' XMC x8 Gen 2 is a host cable adapter that enables high-speed expansion over a PCIe cable. The XMC is the PCI Express version of the PMC and is installed on a CPU board in a host system. A PCIe x8 cable inserted into the cable connector on the face of the XMC expands the PCIe bus to a PCIe downstream device or expansion chassis. Gen 2 speeds provide greater bandwidth for applications demanding high-speed throughput such as video, imaging and audio devices, and requires no additional software or drivers to operate.

The short XMC form factor makes it easy to install in any carrier with an XMC connector. The XMC x8 cable connector on the bezel and the PCIe x8 edge connector are routed directly to the Pericom 5804 redrivers. Since the XMC x8 host cable adapter is based on redriver technology, there are no latency obstacles to throughput. The XMC x8 provides the latest high-speed functionality in the XMC form factor. The XMC x8 is an appropriate solution for porting PCI Express from a VXS (VITA 41.4) or CPCIe CPU board to an external drive array or expansion chassis. The XMC x8 Gen 2 host cable adapter lists for $759.

One Stop Systems, Escondido, CA.
(877) 438-2724. [www.onestopsystems.com].

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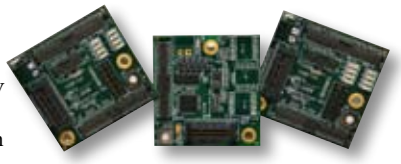
SATA Solid-State Drive Stores 416 Gbytes

Solid-State Drives have rapidly captured market share away from rotating disks dives. SSDs are also much more rugged than traditional HDD solutions. The E-Disk Altima from BitMicro Networks is a robust SATA. A 2.5-inch, flash-based solid-state drive is capable of storing up to 416 Gbytes of data, sustaining transfer rates of up to 100 Mbytes/s and can withstand shock and vibration up to 1,500 G and 16.4 G rms respectively. Mobile computing applications are set to benefit from these features since the 2.5-inch E-Disk Altima E2A3GL solid-state drive is a drop-in replacement for disks used in business laptops or rugged portable PCs. It is among the new generation of E-Disk SSDs supported by the EDSA DMC and LUNETA MFI ASICs.

With the ongoing transformation of the personal computing market from desktop PCs to laptops, the 2.5-inch E-Disk Altima SATA solid-state drive easily meets the SSD requirements of mobile computer users. It can also be used as an SSD upgrade for business-critical, enterprise-class applications that require scalable and resilient solid-state storage solutions.

BiTMICRO Networks, Fremont, CA.
(510) 743-3193. [www.bitmicro.com].

Trio of Controller Boards Rides StackableUSB



With ISA-based all but fading from view, system desigers are hungry for a straightforward bus interconncet for small systems. StackableUSB feeds that need offering PC/104-like stackability linked via USB. Micro/sys continues to expand its selection of StackableUSB line with the release of three general-purpose industrial Client microcontroller boards: the USB1132, USB1124 and USB1108. The first in this family is the USB1132, a PIC32 Industrial Client card powered by the Microchip PIC32, the USB1132 has 1.56 DMIPS/MHz performance at 80 MHz, 512 Kbytes flash and 32 Kbytes SRAM memory. Features include 16 channel, 10-bit, 500 ksps ADC, RS-232, eight programmable LEDs, digital I/O, and much more (SPI, I2C, timers). The USB1124, meanwhile, is the more energy-economical PIC24 Industrial Client microcontroller powered by the Microchip PIC24, which typically requires only 40 mA power.

Rounding out the new selection is the Micro/sys USB1108 powered by an 8-bit, pipelined, 8051 general-purpose microcontroller (the Silicon Labs C8051F340). The USB1108 has 48 MIPS performance at 48 MHz, 64 Kbyte flash, 2 Kbyte EEPROM and 4352 bytes RAM. The USB1108 gives OEMs access to basic microcontroller features such as a 10-bit differential ADC, digital I/O, timers, PWMs, SPI, I2C and RS-232. The basic USB1132 starts at $165 in single quantity, the USB1124 at $145, and USB1108 at $125.

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

HD SDI Matrix Routing Switcher Has Remote Capability

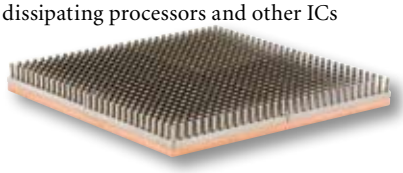
The military's drive toward Network-centric operations is driving up demands for sophisticated graphics and video displays that convey the wealth of information the network provides. Feeding that need, Sensory offers a new HD SDI matrix routing switcher that features a built-in, customizable Web page that allows for remote operation while remaining operating system independent. The 2444 from Sensoray allows for remote capability as well as simple front panel operation. Model 2444 is capable of switching SMPTE 292M and SMPTE 259M from any of the four inputs to any of its four outputs. An automatic reclocking and equalization of the incoming signal is applied to HD SDI signals from as far away as 150m and SD SDI signals from as far as 250m away.

The unit is enclosed in a simple desktop case; custom packaging dependent upon the end user's needs can be arranged for OEM quantity orders. Pricing starts at $226 with OEM pricing and customization available.

Sensoray, Portland, OR.
(503) 684-8000. [www.sensoray.com].

Low-Profile Heat Sinks Sport Copper/Aluminum Fins

Controlling the temperatures of electronic systems is a problem that keeps getting harder as high dissipating processors and other ICs make their way into military applications. A new line of extremely powerful hybrid copper/aluminum pin fin heat sinks are designed as an array of forged aluminum pin fins that are reflowed onto a copper plate. Hybrid pin fins are available in a wide array of standard sizes, with footprints as large as 8.2 x 8.2 inches.



The combination of the forging and reflow manufacturing technologies enables the creation of large footprint pin fin heat sinks that cannot be solely manufactured via forging technology. Due to their unique structural configuration, hybrid pin fin heat sinks possess the heat spreading properties of all-copper heat sinks, yet are substantially lighter in weight, and therefore highly suitable for applications that require the heat spreading capabilities of copper heat sinks without the associated weight constraints.

Cool Innovations, Concord, ON, Canada.
(905) 760-1992. [www.coolinnovations.com].

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COTS JOURNAL

Special Feature: Stand-Alone Rugged Boxes—Form and Function Match-Ups: In the defense realm a trend has been building in the past couple years where 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. This section looks at this emerging product class and outlines the problems they solve.

Tech Recon: Display Subsystem Upgrade Programs: Leveraging cutting-edge graphics chips developed for the demanding gaming market, military graphics subsystems are now able to offer complex video and graphics functionality in highly integrated board-level solutions. Cockpit display upgrades and simulation/training applications rank as two of the most demanding users of these advanced graphics technologies. Articles in this section examine the graphics solutions available in PMC, XMC and other form factors, including a product roundup of display interface products.

System Development: Exploiting the Multicore System Trend: Processor architectures sporting multiple CPU cores on the same device have moved swiftly from the exotic and into the mainstream, and some military applications have an immediate need for the level of computing muscle such devices provide. Compute-intensive applications such as radar and SIGINT fall into that category. This feature section delves into the board-level solutions available in multicore processing and how they're transforming military systems.

Tech Focus: Multicore Boards: Gone are the days when there was a long gap between the emergence of a microprocessor product line and the demand for it among the military embedded computing realm. Now with the dual-core, multicore CPU trend firmly established in the general computing market, embedded board vendors have followed up quickly with boards based on those CPUs like the Core2Duo and others. This Tech Focus section updates readers on these trends and provides a product album of representative boards.


DROWNING IN A SEA OF
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Editorial

Jeff Child, Editor-in-Chief

What's the Computer Inside?

When I participate in any kind of press meeting or briefing, I'm the guy who always asks a question—or many questions. I ask questions to satisfy my naturally curious nature, but also because I feel it's respectful to the people putting on the event to give them the courtesy of expressing interest in what they're taking about. It always kind of shocks me actually when I look around and see that few of my colleagues from competing publications have anything to say at such events.

I guess I've become somewhat predictable over the years. Anyone who knows me knows what question I always ask when the subject at hand is about any kind of end-user deliverable or major subsystem. By and large, my question is predictably: "What's the computer inside?" By that I mean what kind of embedded computer, microprocessor, microcontroller and so on is inside controlling the system. What form-factor computer? What computer architecture? What core operating system? And so forth.

As someone with an engineering background myself, I'm interested in more than just generalities about technology. I want to know about the products—boards, components, software—inside and why they were chosen As the premier magazine covering electronics and embedded computer technology as it applies to the military, covering technology is at the heart of what *COTS Journal* does.

In the past couple years a handful of magazines have stepped into this area of covering technology, but none have that particular focus we have directly at readers like you who are engineers and high-level decision makers with technical knowledge. Part of that means tailoring stories to the technical level that engineers are interested it. But that's only part of it. If you notice, those other publications do make an attempt to cover technology, but they don't combine that with any significant coverage of products.

And as some of our competitors have cut their page counts, they've often shrunk their product coverage to an "afterthought" section of one or two pages. We, in contrast, commit to six pages or more of products per month so that readers get a clear idea of what's really happening each month. New products, whether it's a single board computer, a power supply, a rugged box-level system or an FPGA, are often what energize an engineer to take their military system design in a certain direction or plan his or her next design, or decide what programs to pursue.

By maintaining this level of product coverage—along with coverage of technology trends and issues—I also get the added bonus of seeing what direction the product designs themselves are going in. About five years ago, for example, it was obvious that the most prevalent microprocessor designed into new single board computer products was the Intel Pentium M. And then in the past couple years I've been seeing that the Intel Core2 Duo has usurped that position as the most designed in CPU on new embedded board products.

Now I'm just starting to see that the Intel Atom processor could be next up. In the past, the Freescale PowerPC family of processors always had an advantage over Intel's offerings when it comes to power dissipation. However recently, Intel has been closing that gap with Freescale, and now the emergence of the Atom means there's no longer a reason to suffer with high power dissipation as a trade-off for using an Intel Architecture platform. And while the PowerPC enjoys a longer legacy in military designs, it's hard to resist the ease of software integration that Intel Architecture platforms allow. Many military system developers these days like to start their development work using Linux and then usually migrate to some kind of RTOS for the deployed system. Taking that route is much more straightforward using Intel-compatible platforms than with others.

The Intel Atom processor Z5xx series provides a variety of design options with 2.0 or 2.2W power levels, two package sizes, and industrial as well as commercial temperature ranges. Based on 45nm Hi-k next-generation Intel Core microarchitecture, the Atom processors have power management features making them ideal for thermally constrained and fanless embedded applications. And for the military, a key point is that the Atom has embedded lifecycle support. Military system designers were reluctant to consider the Atom until the assurance of 15-year part availability was offered. The single-core Atom processors work with the Intel System Controller Hub (SCH) US15W, which integrates a graphics memory controller hub and an I/O controller hub into one package. The resulting platform has a combined thermal design power under 5W.

The first wave of Atom-based embedded computing boards has been, naturally, in the small form factor segment—both standard and non-standard—of the embedded computer world. But lately we're seeing the Atom is starting to move on to CompactPCI and VPX. The Atom's low power makes it suited for the kind of Size Weight and Power (SWaP)-constrained applications—small UAVs, UGVs, portable comms gear and so one—that are so critical these days. What could hold back the Atom is its limited I/O support. For applications where multiple channels of storage interfacing, networking and so forth are required, the current Atom versions aren't the optimum choice. So until that problem is overcome, the Core2 Duo may maintain its dominant spot among new embedded computer designs.

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