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PLUS:

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Volume 12 Number 9 September 2010 cotsjournalonline.com

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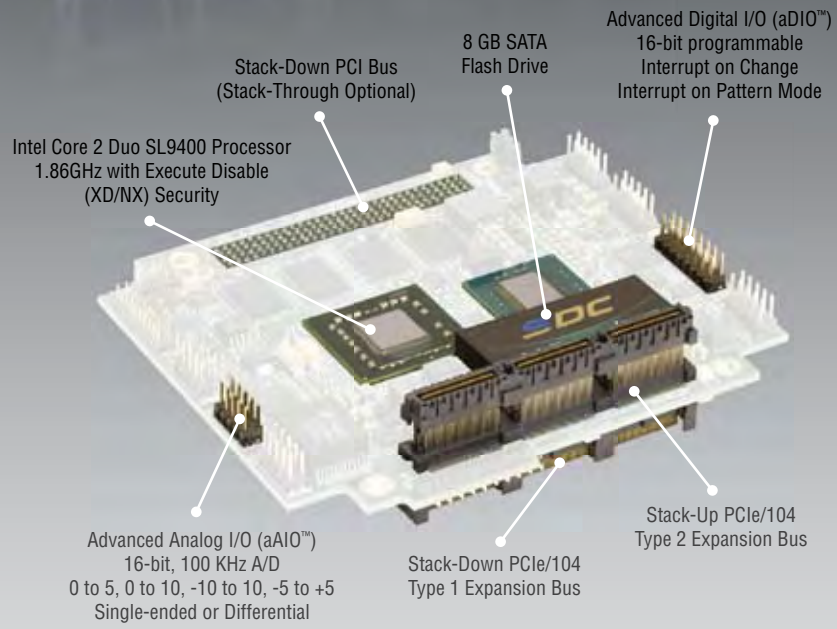

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†*See figure on left for details*
‡*See web site for details on each model*

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12 Embedded Tech Building Blocks Pave Way for a Net-Centric Future

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CONTENTS

September 2010 Volume 12 Number 9

SPECIAL FEATURE
Technology for Net-Centric Warfare

TECH RECON
MicroTCA and AMC Do Rugged Duty

SYSTEM DEVELOPMENT
Balancing Performance vs. Lifecycle Needs

TECHNOLOGY FOCUS
Rugged Stand-Alone Boxes

Digital subscriptions available: **cotsjournalonline.com**

Departments

Coming in October
See Page 68

On The Cover: Open architecture systems are key ingredients of Lockheed Martin's Aegis Combat System. Off-the-shelf fault management software ensures high availability of the system and demonstrates the applicability of open standards in mission-critical defense systems. Modernized with the open architecture Aegis Weapon System, the Guided-missile cruiser USS Bunker Hill (CG 52) guided missile cruiser USS Bunker Hill enters San Diego harbor past Point Loma as the ship returns home from a three-month deployment in April.(U.S. Navy photo by Mass Communication Specialist 2nd Class Daniel Barker)

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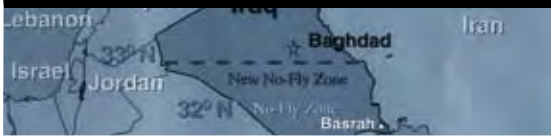

"V" is Going and Coming

So here we go. Vacation time is over and we can once again get more than two people at the same time in a room or on a conference call. That also means that business travel will increase. At least when we travel for personal reasons there's some form of pleasantness involved. Ever since the mid-seventies—most of you weren't even born yet—flying started to lose panache and stopped being fun. These days flying should be put on the list of inhuman torture. Well, guess it's time to get to work.

Recently the VITA VPX Marketing Alliance created and performed a Web survey to get better knowledge of industry awareness of the family of VPX technologies: VPX, OpenVPX and VPX REDI (Ruggedized Enhanced Design Implementation). The best place to start is explaining what the VPX Marketing Alliance is. It's a loosely coupled group of VITA member VPX technology product suppliers who are promoting the concept and awareness of these technologies for individual company and industry betterment. Additional information or a list of Alliance members can be obtained from www.vita.com/vpx or the VPX Marketing Alliance Chair: Neil Peterson, 978-487-3281, npeterson@hybricon.com.

Now the more important question: What useful information does the survey provide? Before we get to that we need to at least discuss how the survey was performed so that each of us can best determine the relevance of the data provided. Requests for survey participants were placed in print and electronically in industry publications and websites. The participants targeted were individuals that are, or might consider, using an advanced VPX technology in the future. Now, to me this is the only flaw in the development and execution of the survey. Even though there were criteria respondents needed to meet in order to participate in the survey, the fact that this was an open survey to anyone who wished to participate puts a very large bias toward respondents affiliated with VPX. A better approach would have been to select every "nth" name from a list of generic embedded designers of advanced or military embedded systems—making it more of a blind survey.

All that aside—but held in the back of our minds—the questions were well thought out and they managed to get well over two hundred respondents. Geographically, the majority of respondents came from the United States. And one might think that the next level of respondents would come from European countries, but instead the next level came from India and China. That indicates a potential shift in future embedded military system developers.

Without looking at each individual response—and the fact that no personal or corporate data was requested from the respondents—makes it difficult to do more than cite things that may be interesting to investigate. I strongly believed that VPX is strictly a military architecture, but the survey indicates that only roughly 57 percent of the respondents—with the ability to select only one primary industry—selected military/aerospace. Surprisingly, more than 40 percent of the respondents indicated that their primary use of VPX would not be in the military/aerospace industry.

There weren't any surprises in the results from the survey on questions about how users get their information to make product decisions. They weren't very different than the results of generic marketing surveys: people have supplier sites bookmarked; use search engines, industry websites, or publications to get to the supplier's site. The survey also confirms that after the initial interrogation of an interesting product, users want to have direct contact with the potential provider to actually work the process of doing a "design-in."

Most respondents had no interest in going to trade shows. Not an unexpected response, especially in the current economic climate. The leading response for shows attended were the local RTECC table top shows with more than 20 percent of respondents saying they attend regularly. That's not unexpected either since they allow for a short one-day drive and still provide face to face interaction and the opportunity to actually "kick the tires" of a product. Of the conference type shows only MILCOM and the Intel Developers Forum exceeded 15 percent.

All the other survey questions related to the respondent's knowledge of VPX technology and future development using that technology. All responses regarding VPX knowledge and development came in very high. But, as stated earlier, this needs to be considered in the context of who may have responded. This consideration is in no way intended to imply that VPX is not going to be a major player in the upcoming military embedded systems market. To the contrary, *COTS Journal* considers VPX, optical technology and stand-alone pre-integrated systems as the future direction of new design-ins.

To close out summer items, I wish to formally thank all those companies that came to San Clemente and provided us with input on market trends and technology. Combining this information with the information we ferret from the DoD, the military and the primes, enables *COTS Journal* to come up with the most reader relevant 2011 editorial calendar we can.

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The Inside Track

Air Force Reserve Contracts SDS for F-16 Trainer Upgrade

SDS International (SDS) has been awarded a multiyear contract to provide a full range of specialized operational and technical support and Distributed Mission Operations (DMO) conversions for Air Force Reserve Command (AFRC) F-16 Multi-Task Trainers (MTT) (Figure 1). Work will be performed at Fort Worth Joint Reserve Base, Texas; Homestead Air Reserve Base, Florida; and Mesa, Arizona. To support DMO conversions, SDS will implement Simulation Interoperability Standards Organization (SISO) and the Institute of Electrical and Electronics Engineers (IEEE) standards to ensure F-16 MTT interoperability in the DMO network.

Support will also include integration of Distributed Interactive Simulation and High Level Architecture into the modeling and simulation environment. New equipment and technologies will be integrated into existing F-16 MTT system architectures in order to meet the Combat Air Forces (CAF) DMO standards as prescribed by the CAF DMO Standards Development Working Group (SDWG). SDS will also provide test plans, test reports and other documentation required by the SDWG to complete the upgrade and testing of the F-16 MTTs, ensuring software and hardware modifications implement all capabilities of the current and future Mission Package levels of CAF DMO Standards.

SDS International, Fredericksburg, VA.
(703) 553-7535. [www.sdslink.com].

Figure 1
An F-16 Fighting Falcon from the 79th Expeditionary Fighter Squadron prepares to take off from Bagram Airfield, Afghanistan last December.

TTTech Forms a Strategic Alliance with Avionics Interface Technologies

TTTech North America, a subsidiary of TTTech, has formed a long-term strategic alliance with Avionics Interface Technologies (AIT) (formerly AIM-USA) to add local support for North American customers and to enable improved engagement in the U.S. Government and Space Market. This tightly coupled partnership will make use of the experienced AIT team in product design, sales, production and support from the staff previously of AIM-USA. AIT provides a suite of test and simulation products for a wide variety of avionic bus applications, including MIL-STD-1553, ARINC 429, ARINC 615A, Fibre Channel and MIL-STD-1760e. With support from TTTech, ARINC 664/AFDX, TTEthernet (Time-Triggered Ethernet) and TTP (Time-Triggered Protocol) will be added to AIT's portfolio.

AIT will remain an independent company and will continue to enhance and supply the newly combined variety of avionics products to North American aerospace customers. TTEthernet and TTP are open industry standards (SAE AS6802 and AS6003 respectively) that offer higher bandwidth compared to CAN, MIL STD-1553 and ARINC 429, with better predictability. AIT has experience bridging older avionics bus standards with emerging technologies such as taking MIL-STD-1553 to Fibre Channel and then MIL-STD-1760e for defense programs. This same path is expected for ARINC 429 to ARINC 664/AFDX and next to Time Triggered Ethernet for commercial, defense and space programs.

Avionics Interface Technologies
Omaha, NE.
(402)763 9644.
[www.aviftech.com].

TTTech Computertechnik AG
Vienna, Austria.
+43 1 585 34 34-899.
[www.tttech.com].

Saft Lithium Batteries to Power AAI's Universal Ground Control Station

Saft received an order for lithium-ion (Li-ion) batteries from AAI Corporation to supply back-up power for its Universal Ground Control Station (UGCS) (Figure 2), which controls UAVs. The 28V batteries are capable of integrated charging, an innovative feature that strengthens and simplifies the powering system. The high-energy, yet low-weight batteries have a capacity of 100 amp/hours and are made up of 16 VL 52E cells in a 2P8S configuration. The batteries will provide emergency back-up

Figure 2
AAI's new Universal Ground Control Station offers a net-centric design, all-digital Tactical Common Data Link for data transmission, increased bandwidth and data security, weapons control, easy-to-read displays and up to 30 days of digitally archived data.

power for a flight-critical function of the UGCS. In the event of a power failure, the battery will activate, allowing the UGCS to carry out its UAV control mission. The batteries accept universal AC input and provide 28V DC output. While simplifying and reducing the size of the system, the ICB function eliminates the need for an additional power source to charge the battery. ICB capability is a unique technology that Saft will apply to other systems in the future.

AAI Corp.'s UGCS architecture meets U.S. Army and joint services interoperability requirements, as well as UAS joint information exchange capabilities for command, control, communications, computers, intelligence, surveillance and reconnaissance, or C4ISR. The system is designed for U.S. joint services interoperability requirements, including simultaneous mission control of multiple unmanned aircraft.

Mercury Data Storage Subsystem Tapped for AN/TPY-2 Missile Defense System

Mercury Computer Systems will deliver systems architecture, development, qualification and integration services to Raytheon National and Theater Security Programs division for a rugged, high-speed data storage and recording subsystem to be deployed in the AN/TPY-2 Missile Defense Program. As an integral part of the Ballistic Missile Defense System, the Raytheon AN/TPY-2 provides advanced mobile, multifunction radar with long-range surveillance designed to search, acquire, track and discriminate ballistic missile threats from non-threats.

Per Raytheon's requirements, Mercury will provide a technology refresh specially architected to be as close to the original system configuration as possible. Mercury will also qualify and integrate both Mercury and third-party components, and provide software modifications to ensure full interoperability and backward compatibility.

Mercury Computer Systems
Chelmsford, MA.
(978) 967-1401.
[www.mc.com].

ViaSat Deploys COTM Gear on USAF MC-12 Liberty Aircraft

ViaSat has deployed airborne communications-on-the-move (COTM) terminals on board several dozen U.S. Air Force Project Liberty aircraft (Figure 4) to support ISR operations.

Military Market Watch

Slot-Card SBC Market Enjoys Steady Growth

While, in general, hit very hard by the industry downturn from 2008 to 2009—caused by the worldwide macroeconomic recession over the same time period—the future looks positive for slot-card single board computers (SBCs). The ISA, PCI-ISA and PCI segments were hit particularly hard, since these architectures are typically consumed in verticals such as industrial automation, instrumentation and low cost network equipment, industries that were among those most affected by the recession. Over $200 million of market value was lost by these combined segments. Growth of new ATCA and AMC CPU boards was slowed as communications infrastructure investment was postponed and contracts delayed. Even VME, which would typically be somewhat shielded due to its heavy concentration in Military/Aerospace, suffered slightly. This was not directly due to the recession, but by the rearrangement of procurement priorities at the U.S. DoD. This led to the cancellation of many sizeable programs and a general uncertainty about future investment.

That uncertainty brought much of the spending on new equipment to a standstill by the end of 2009. A recent VDC report shows that 2010 is likely to show a return to growth (Figure 3). Activity has greatly increased throughout 2010, and VDC believes that the pace of market growth will continue to increase over the next 24-36 months. One of the biggest threats to the SBC market today is replacement by single-board, active backplane board architectures, such as embedded motherboards, that are able to offer higher performance with the latest multicore processors. Single-board solutions can greatly reduce size, weight and power (SWaP) in a system as well as development costs. Both SWaP reduction and cost containment are at the top of customers' lists of requirements, so if an active backplane solution can now satisfy applications previously served by slot architectures, these are likely to be transitioned to single-board solutions. As a result, SBCs will be increasingly limited to use in the high performance segments of the embedded market. Chief among these are the communications infrastructure and military/aerospace segments, which will always have strong demand for the superior performance offered by slot architectures. For more information please contact Eric Heikkila of VDC at: erich@vdcresearch.com.

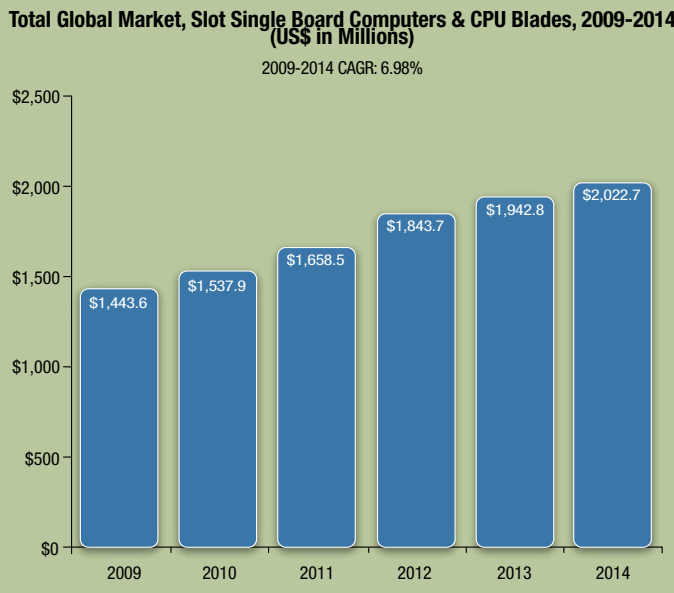

Figure 3

Growth in slot-card SBC revenue has increased throughout 2010, and VDC believes that the pace of market growth will continue to increase over the next 24-36 months.

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

Figure 4
The Air Force's MC-12 Liberty aircraft is a medium-altitude manned special-mission turboprop aircraft designed for intelligence, surveillance and reconnaissance. The MC-12 aircraft supports coalition and joint ground forces.

L-3 Integrated Systems is the system integrator for the Liberty program, which includes ViaSat ArcLight COTM terminals and secure network services. The MC-12 Liberty is a small, twin-turboprop plane, based on the Beechcraft King Air 350ER.

The ArcLight Ku-band mobile broadband system is designed to provide high-speed, beyond line-of-sight (BLOS) communications, configured in this application for data rates up to 1 Mbit/s off the aircraft to support ISR activities. The system is based on the successful ArcLight mobile satellite communication system, which has approximately 1500 terminals delivered worldwide. The ViaSat system is also providing broadband BLOS ISR and Command and Control (C2) communication links for several other U.S. military organizations.

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NATIONAL INSTRUMENTS

Special Feature

Technology for Net-Centric Warfare

Embedded Tech Building Blocks Pave Way for a Net-Centric Future

The military's drive toward Net-Centric operations requires embedded computing building blocks that marry performance and bandwidth. OpenVPX and ATCA are emerging as the leading technology choices to make a networked military a reality.

Jeff Child, Editor-in-Chief

As the U.S. military transforms itself to Network-Centric operations, every node in the networked military will be affected. Gradually, every vehicle, every aircraft, every ship, every UAV and every soldier on the ground will be able to quickly share data, voice and even video with almost any level of the DoD's operation. The goal is to get to real-time sharing of voice, video and data between soldiers, aircraft, satellites, ships, robots and UAVs, all over a global network. A variety of technology areas are part of the overall puzzle to make that happen: these include software and programmable radios, RF beamforming, ultra-wideband optical communications and IP networking on land, sea, air and space platforms. Suppliers that specialize in the key building blocks for those technologies will be showing their wares at next month's MILCOM show in San Jose, California.

The underlying engine that fuels these requirements is current and next generation embedded computing solutions. Such solutions—in the form of single board computers, box-level systems and special-function subsystems—meet the demands for sophisticated compute-intensive radio and network nodes—each suited for a different environment, platform or user. At the same time, processing and displaying the information on all those network nodes—on aircraft, ships, vehicles or in soldiers' backpacks—is driving the need to upgrade the embedded computers and displays in all those platforms.

An Avalanche of ISR Data

Among the challenges for today's military is taking the vast amount of incoming Intelligence, Surveillance and Reconnaissance (ISR) and organizing it effectively. The goal of an end-to-end network-centric military means providing information that any level of warfighter can access and act on. Situation awareness systems are specifically

Figure 1

The Integrated Ship Network System (ISNS), a precursor to the Navy's data networking initiative called Consolidated Afloat Networks and Enterprise Services (CANES), was tested aboard the aircraft carrier USS Abraham Lincoln (CVN 72) and its escort ships.

hard pressed to deal with these issues. This avalanche of ISR data that's coming in from multiple sources is actually causing a serious challenge for situational analysis systems. In its raw form, that data is made up of massive amounts of signal and imagery data. The good news for our embedded computing industry is that the solution to handling this "information overflow" is more and more powerful embedded computing. But the other leg of the solution is more advanced applications that process and sort the data for the warfighter so he can use it in real time.

At the computing building block level, all those challenges and requirements call for embedded system architectures that can not only handle the processing load, but also move data on and off computing elements and between network nodes. With that in mind, two technology areas rise to the top of the heap as critical building blocks for net-centric processing: OpenVPX and ATCA.

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Figure 2

The C2 Server consists of a ruggedized 6U 6-slot chassis, two Promentum ATCA-2210 10 Gigabit Ethernet Switch and Control Modules and up to four Promentum ATCA-4500 series SBCs and Astute Networks' Caspian R1100 Edge Storage Blades.

ATCA for Compute Density Needs

Where ATCA shines is in a military system where compute density and raw performance are top priorities. Traditionally, military and aerospace standards-based applications were limited to mission computing and built with rugged VME or CompactPCI. The form factors are still enjoying huge military market share, but they have limits when applied to network-centric military applications. Their configurations are suited for managing heavy I/O, but their form factors limit networking and processing capability.

Today, the high-performance and bandwidth capabilities of ATCA bring the latest technologies to standards-based applications, such as command and control, aerospace surveillance, land mobile communications and maritime networks, which must collect and manage large amounts of data in real time. ATCA is the perfect fit for those requirements, because ATCA was specifically designed to address high-density network communications applications and delivers up to eight times the performance of VPX and 40 times the performance of VME or cPCI. In addition, ATCA is a broadly adopted standard that has proven its interoperability through five years of deployment in the communication segment. Among the major programs embracing ATCA is the U.S. Navy's Consolidated Afloat Networks and Enterprise Services (CANES) (Figure 1).

With ATCA it is easy to integrate new networks with legacy systems. ATCA supports AMCs to provide legacy connectivity with communication equipment that

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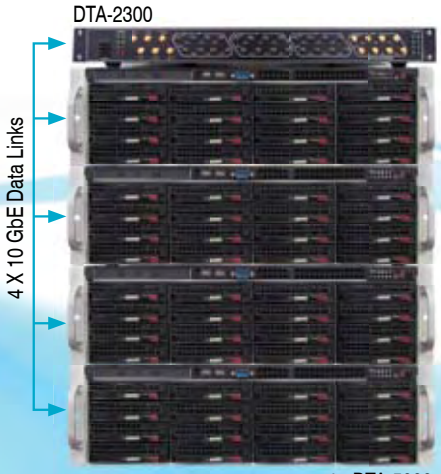

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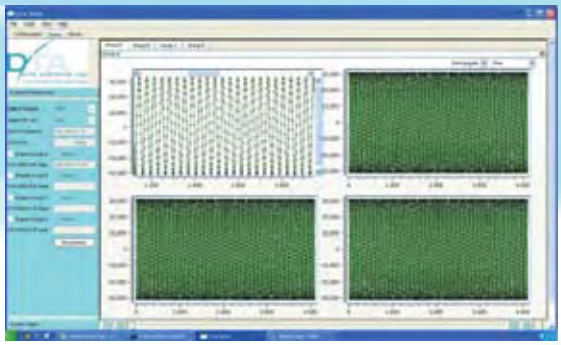

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performs functionalities like SIGINT and COMINT. A new system can come online using ATCA while maintaining interconnectivity with older systems. Military networks require technologies that provide strong authentication and easy configuration capabilities to improve security and reduce maintenance costs during the life of the network. ATCA systems provide easy-to-use API and management interfaces to configure secure and complex networks.

High-Speed Networking

Military networks host applications to keep soldiers in communication with their command units during missions and with their families at other times. Video and audio are increasingly becoming critical elements of these applications, which combine to create tremendous bandwidth requirements. Current ATCA technologies can fully support 10 Gbit of traffic on the system backplane to process voice and video traffic, while future ATCA solutions will handle 40 Gbit of traffic for video applications such as HD video.

Figure 3

The XPand1010 is a two-slot 6U VPX conduction-cooled chassis designed to enable users to develop on fully rugged, conduction-cooled cards in a small footprint development chassis. System developers can then install those same 6U VPX cards into deployable ATR or similar chassis with no changes to the modules.

A recent ATCA system solution example is RadiSys's Promentum C2 Server (Figure 2). The C2 Server leverages LCR Electronics' ruggedized ATCA chassis and Astute Networks' Edge Storage Blades in a rapidly deployable, higher performance platform with a more than 30 percent weight decrease and lower power consumption than current Rack Mount Servers (RMS). The C2 Server has been designed to meet the demanding environment requirements of MIL-STD-810 and can quickly be deployed and serviced in the field. The pre-integrated C2 Server consists of a Ruggedized 6U 6-slot AC LCR Chassis, two RadiSys Promentum ATCA-2210 10 Gigabit Ethernet Switch and Control Modules with optional COM Express module, which can support platform management functions, up to four Promentum ATCA-4500 series SBCs and Astute Networks' Caspian R1100 Edge Storage Blades.

OpenVPX for Rugged, SWaP-Limited Apps

While ATCA is suited for high-compute density, high-performance military net-based systems, OpenVPX offers the advantage of high performance computing in limited size, weight and power platforms where extreme ruggedness and harsh environment operation are

required. These include everything from military combat vehicle systems to UAVs to tactical aircraft avionics. Ratified in June by ANSI under ANSI/VITA 65.0-2010, the "meat" of the OpenVPX system specification was created to bring versatile system architectural solutions to the military market.

Based on the flexible VPX family of standards, OpenVPX designates a series of definitions for module mechanics, connectors, thermal, communications protocols, utility and power provided by specific VPX standards. The document takes those definitions and uses them to describe a series of standard profiles that define slots, backplanes, modules and "Standard Development Chassis." The goal of all this is interoperability, with the OpenVPX standard defining each allowable combination of interfaces between any given module, backplane and chassis.

Different Profiles for Different Needs

While the complete OpenVPX specification includes profile definitions comprised of a variety of factors, the switch fabric part of those profiles is among the most crucial of OpenVPX system developers' choices. Which OpenVPX fabric to use will be dictated by the application area of the system. And on an architecture level, the fabric choice will be driven by how tightly or loosely coupled the processing and memory needs to be. For applications that require shared memory, RapidIO will be the data plane of choice. In contrast, if the system requires parallel processing—where very little data exchange is required between computing nodes—a fabric like PCI Express, Gbit Ethernet or 10 Gbit Ethernet is a better choice.

A recent OpenVPX development platform offering is the XPand1010 from Extreme Engineering Solutions (X-ES) (Figure 3). This a two-slot 6U VPX (VITA 46) conduction-cooled chassis that provides system engineers with a 6U VPX desktop or lab bench platform to jump-start software or hardware development when using X-ES Freescale- or Intel-based CPU boards. The system lets users develop on fully rugged, conduction-cooled cards in a small footprint, low-cost development chassis. System developers can then install those same 6U VPX cards into deployable ATR or similar chassis with no changes to the 6U modules.

This is in contrast to the traditional model of development for conduction-cooled systems, in which early work is performed using non-rugged, air-cooled cards that are mechanically and thermally incompatible with the final deployed system. The XPand1010 hosts up to two 6U VPX conduction-cooled cards, providing fabric interconnect between the two slots, as well easy access to Gbit Ethernet, SATA, USB, DVI and serial port I/O from one or both of the installed 6U VPX SBCs. The XPand1010's design eliminates card cages, rear transition modules and large noisy fans typically found in air-cooled development chassis. ■■

Special Feature

Technology for Net-Centric Warfare

Rugged Subsystems Fuel Net-Centric Warfare Needs

Several military programs are putting rugged subsystems to work to connect the net-centric dots. Rugged router, switching and fiber optic solutions are smoothing the way.

Mike Smith, Senior Electrical Engineer
Dave Turner, Senior Mechanical Engineer
Parvus

Network-Centric Warfare (NCW) has become the U.S. Military's central concept for battlefield operations for the 21st century. The success of net-centric operations depends on the robustly networked communication "building blocks" between in-vehicle computers, wireless technologies, and Ethernet switches and routers that link together military vehicles, ships and aircraft into a highly integrated battlefield network. This linking of people, platforms and technologies into a single cohesive network creates a whole that is clearly greater than the sum of its parts. NCW enhances the U.S. Armed Forces' ability to improve situational awareness, enabling more rapid and effective decision making at all levels of military operations, allowing for greater mission success.

Figure 1

"Lightly managed" switches, such as this DuraNET 1268, serve as an ideal solution to enhance situational awareness in Size, Weight and Power (SWaP)-constrained aircraft, tactical ground vehicles and maritime assets.

Rugged Ethernet Switches and Routers

The advent of NCW has spurred the rapid development of Ethernet networking technology, as net-centric operations depend on information exchange platforms that support mature and well-tested protocols, offer data in near real time, and provide advanced roadmaps for future performance. However, rugged Internet Protocol (IP) networking subsystems must adapt to meet the unique demands of the military.

For example, many routers and switches not only offer Ethernet interfaces but provide a bridge to traditional serial communications, allowing the military to integrate legacy systems into a new IP networked environment. While consumer electronics are moving to everything-over-IP, the military still operates many legacy systems that need to be supported. By integrating rugged routers and switches with serial interfaces, a

variety of protocols necessary for NCW can still be supported. The DuraMAR rugged routers from Parvus incorporate multiple Ethernet ports that support Power Over Ethernet (POE), and serial ports that support Power With Serial (PwS) so clean isolated power and signal are carried over a single standard Ethernet or serial cable. This eliminates the need for separate power cables or power supplies, while bringing new communications capabilities to legacy serial or Ethernet devices.

To accommodate the military's current and future needs for NCW—while not adding unnecessary complexity and costs—Ethernet switches are also evolving to provide varying levels of management capabilities. Of growing popularity within military technology refresh programs are the "lightly managed" rugged COTS switches (Figure 1). These devices support a core networking feature set and provide some basic management capabilities, making them well suited for many situational awareness upgrade applications. Additionally, the "lightly managed" variety of switch is much less costly than fully managed switches—a very attractive feature for budget sensitive military groups.

Easing Net-Centric Deployment

Thanks to open architecture platforms, new stand-alone and fully integrated rugged Gigabit Ethernet switches and network router subsystems are being introduced. These rugged IP routers and switches enable a variety of applications necessary for NCW, including in-vehicle wireless Internet access, Voice over IP (VoIP) telephony, streaming video surveillance, Communications on the Move (COTM), and smart vehicle diagnostics/maintenance.

A technology trend quickly being adopted into NCW platforms is the combination of Ethernet switching, routing and security capabilities into a single networking appliance. Cisco's Integrated Service Router (ISR) product line exemplifies bringing together multiple simultaneous services such as routing, switching, mobility, security, VoIP, WAN optimization and VPN tunneling into one device. Ruggedized versions of Cisco ISRs have extended the application use of industry-leading enterprise hardware to allow the military to benefit from generous performance, high memory capacity, high-density interfaces and embedded security processing from a single rugged platform.

Figure 2

MEADS program implements a ruggedized version of Cisco Systems' 3825 Integrated Services Router (ISR), to provide the network connectivity for its Tactical Operations Center.

Lockheed Martin Space Systems Company saw the benefits offered by Cisco and chose to implement this technology into the MEADS (Medium Extended Air Defense System) program (Figure 2). MEADS is a mobile air and missile defense system that will incorporate the hit-to-kill PAC-3 Missile Segment Enhancement (MSE) Missile in a system that includes 360-degree surveillance and fire control sensors, netted-distributed battle management/communication centers and high-firepower launchers.

To support this mission, Lockheed Martin has specified the DuraNET 3825, a ruggedized version of Cisco Systems' 3825 ISR, to provide the network connectivity for the MEADS Tactical Operations Center. The DuraNET 3825 combines the powerful features available in Cisco IOS software, Catalyst Layer 2 LAN switching and flexible Layer 3 WAN routing into a single ruggedized platform. This robust IP networking device delivers the performance, availability and reliability required for scaling mission-critical applications.

Communication Data Links

Technological advancements in communication data link devices have greatly expanded situational awareness capabilities—proving to be essential "building blocks" in net-centric operations. As data links handle the moving of data across a physical link in a network, the military must ensure that data links are rugged and combat-ready. Specifically, the developments being made with man-portable Intelligence, Surveillance and Reconnaissance (ISR) communications products give the tactical, engaged warfighter direct access to airborne and ground-based sensors, fundamentally changing the commander's view of the battlefield.

The ROVER (Remote Operations Video Enhanced Receiver), a wireless video transmission system built by L-3 Communications, is widely used by U.S. and NATO forces to view real-time video from unmanned and manned aircraft for battlefield situational awareness. ROVER also provides enhanced air/ground coordination, which shortens talk-on-target for time-critical operations. ROVER comes as a complete, ready-to use system and has proven interoperability with data links in Ku-band, C-band, S-band and L-band with platforms such as Predator, Shadow, Dragon Eye, Litening Pod and

other Joint and Coalition assets.

Before Rover's capabilities, ground controllers had to rely on "visual talk-ons" to hunt for Improvised Explosive Devices (IEDs), track insurgents or follow suspicious vehicles. The ground controller would have a map he used to guide the pilots where they needed to go. With the advancements made in data link technology, the latest version of ROVER can transmit coordinate data as well, allowing all parties (ground controllers, pilots, commanders, etc.) to share the same data simultaneously in real time. This enables users on the ground to indicate or mark a target on a digital map or video signal and send the data to an aircraft—eliminating the ambiguity and difficulty a pilot encounters when trying to identify what a forward air controller on the ground sees.

Figure 3

The Excalibur UAV from Aurora Flight Sciences deploys the ACMC, which benefits from industry standards to support long-term system evolution and reliability.

UAVs Tap into COTS Subsystems

The use of Unmanned Aerial Vehicles (UAVs) in NCW has skyrocketed as drones are credited with saving soldiers' lives while improving battle space efficiency. However, with unmanned vehicles becoming a mainstay of battlefield and reconnaissance operations, equipping these aircraft with a custom, proprietary computing architecture is costly and time consuming—two unacceptable consequences for military subcontractors. By leveraging common computing architecture, UAV manufacturers are able

to reduce costs and improve efficiency.

Such was the case for Aurora Flight Sciences, a designer and builder of robotic aircraft and other advanced aerospace vehicles for scientific and military applications. By leveraging the same computing architecture in multiple aircraft, Aurora increased its reuse fraction, which means reduced costs and improved efficiency. This strategy has empowered Aurora to design and build a range of unmanned platforms (Figure 3).

Aurora began working with Parvus Corporation to develop the Aurora Common Mission Computer (ACMC) as part of Aurora Common Avionics Components program. From the outset, the goal of developing the ACMC was to use industry standards, including Ethernet, to support long-term system evolution and reliability. The DuraCOR mission computer product line from Parvus met this goal as it offered a modular COTS and open-architecture computing platform that could be adapted to its various UAVs.

Also implementing rugged mission computers to facilitate NCW is the MQ-5B Hunter—one of Northrop Grumman's latest UAVs. Currently being deployed by the U.S. Army to conduct battlefield surveillance using its multi-mission optronic payload, the Hunter flies over the battlefield gathering reconnaissance, surveillance, target acquisition and battle dam-

Figure 4

The DDG-1000 Zumwalt Destroyer uses fiber optic cabling for its high bandwidth and security advantages.

age information in real time. The Hunter then relays this information via video link to commanders and soldiers on the ground. The Parvus DuraCOR 810 computing subsystem was selected to operate as the Payload Interface Unit for the Hunter UAS. These DuraCOR 810 units monitor, control and communicate between payloads on board the Hunter, as well as control the mounted payloads that include electronics and sensors.

Fiber Backbone for Net-Centric Ops

An essential building block for any network is the method for physically connecting the various network nodes together. While twisted pair copper wiring is ubiquitous in both commercial and military application, quickly gaining popularity within this category for NCW is fiber optics. With advantages including higher bandwidth, lower weight and immunity to sparking and EMI, fiber optics offers serious benefits to the net-centric warfighter.

Analysts at Information Gatekeepers Inc. (IGI) in Boston reported that the total market for military and commercial aircraft fiber optics—including fighter aircraft, transport aircraft, UAVs and commercial aircraft—was $306 million in 2009, and will grow to $703 million in 2013. Similarly, Parvus is seeing a notable increase in demand for fiber optic-enabled subsystems, with particular interest from the Navy. For example, The Navy's DDG-1000 Zumwalt Destroyer ship uses fiber optics cabling because of fiber's ability to maintain signal strength over hundreds of meters of length (Figure 4). Unlike copper cabling that loses signal strength over long distances, fiber optics maintains signal strength and quality.

The military's interest in fiber optics is also due to the cable's enhanced security capabilities. Because fiber optics is generated by light, it is impossible to intercept or monitor the data being transmitted. Military aircraft are also seeing the benefits of using fiber optics cabling as fiber's low weight and size makes it particularly suitable for applications within aircrafts. Fiber optic systems are currently installed on board various military aircraft platforms, including the F/A-18 Hornet, F-22 Raptor, F-16 Falcon, F-35 Joint Strike Fighter (JSF) and the EP-3E Aries. Ruggedizing fiber optics to include in military applications is necessary to ensure optimal performance in harsh conditions. Media converter modules may be used to convert existing copper ports into fiber ports. RJ-45 connectors are typically eliminated and replaced with MIL-DTL-38999 style connectors.

Wireless Innovations Push NCW Forward

While wired LAN connections aren't likely to disappear in the near term, as secure wireless (802.11 Wi-Fi) technologies mature, government contractors are beginning to capitalize on these technologies to untether the warfighter from traditional computing constraints and empower new degrees of situational awareness. The advantages of Wi-Fi are

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clear—these solutions offer military forces more flexibility and maneuverability while providing greater access to communications and information.

Rugged portable and wearable electronics increasingly have built-in Wi-Fi interfaces as mobile solutions are an efficient and flexible way to empower troops and other military personnel with vital communications, regardless of location. Wi-Fi deployments are also common on Navy vessels, such as the DDG-1000 Zumwalt Destroyer, which is equipped with wireless access points to provide secure, Wi-Fi network connectivity to its crew. Also, by using standards-based 802.11 technology, military units can roam freely and securely between wireless coverage areas. In the past, similar tactical communications often required a direct line of sight back to a communications node, which imposed limits on maneuverability and mobility.

Security for Wireless Systems

With the many advantages of wireless technologies, protecting and securing wireless communications remains a high priority. A number of security solutions can be deployed to provide a multilayered approach in securing assets from external and internal threats. For example, Cisco security solutions prevent unauthorized network access, mitigate worm attacks, and circumvent denial of service attacks. They also conform to government regulations and include commercial-grade encryption technology that has been certified for use in government and military applications. This comprehensive safeguarding of network assets enables military organizations to maximize network uptime and productivity, while minimizing threat impact.

As the military's need for more computing and networking capabilities increases, manufacturers must continue to innovate subsystem and networking technology to meet impending demands. In addition, by designing the individual building blocks of a net-centric environment to work together, net-centric operations can dramatically improve the speed-of-command on the battlefield and increase the warfighter's capabilities. ■■

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MicroTCA Evolves to Serve Rugged Military Designs

The ruggedization of MicroTCA opens new opportunities for military system designers. By leveraging the ANSI/VITA 47 spec, a variety of harsh environment parameters have been defined for MicroTCA.

David Pursley, Field Applications Engineer
Kontron

Developed to handle the extreme environmental demands of the telecommunications arena, MicroTCA provides military designers with a flexible embedded building block, offering scalable reliability and bandwidth to demanding battlefield applications. Configuration of this platform is highly adaptable, incorporating a diverse assembly of Advanced Mezzanine Cards (AMCs) to deliver modular performance options ideal for the spectrum of rugged military applications.

But while MicroTCA is being adopted for a multitude of features and advanced capabilities, it is the further ruggedization of the standard that holds the most promise for military system designers. The current range of derivative specifications was developed to reuse the same AMC printed circuit board and as much of the MicroTCA base specification as possible. The challenge for designers is to understand each option and its strategic role in highly ruggedized systems. These standardized rugged implementations leverage the ANSI/VITA 47 specification to define the environments in which the boards will perform.

In many cases a set of classifications may apply, requiring skill and understanding of the full MTCA.x specification. Determining physical parameters of the application such as shock and vibration, along with any unique thermal characteristics of the performance environment, is critical in narrowing options to the most ideal and applicable segment of the MicroTCA standard.

Figure 1

A soldier reviews networked data from a Humvee during an Army Brigade Combat Team Modernization demonstration.

Rugged Requirements and More

Military designers face demands for higher computing performance, system throughput, high availability, larger memory capacities and more sophisticated signal processing—as well as a constant focus on

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Figure 2

The AM4010 CPU board can be implemented as a single mid-size or full-size AMC. Beyond usage in ATCA systems, the AM4010 complies with the MicroTCA standard.

SWaP (size, weight and power) constraints. At the same time, they are addressing a complex set of network-centric command and control systems with diverse application requirements. Military initiatives such as the U.S. Navy's Consolidated Afloat Networks and Enterprise Services (CANES), Brigade Combat Team Modernization (BCT) (Figure 1), Joint Tactical Radio System (JTRS), Warfighter Information Network-Tactical (WIN-T), and other ground command and control applications deliver immense levels of networking capabilities. Command and individual soldiers are linked, sharing information for increased real-time situational awareness. Systems to support these programs must meet Department of Defense (DoD) mandates for security, mobility, flexibility and ruggedness, without sacrificing SWaP in the process.

As a result of these complexities, military designers are increasing reliance on open, standardized COTS form factors. This is where standards-based MicroTCA wins, meeting SWaP considerations by bringing high processing capacity, extremely high communication bandwidth and high availability to a small footprint.

Flexible Military Design Options: MTCA.0

MicroTCA was created as a complement to AdvancedTCA, preserving its most important principles such as basic interconnect topologies and management structures. Where AdvancedTCA is optimized for higher capacity applications, MicroTCA addresses applications that are more cost-sensitive and comparatively smaller in terms of physical size, capacity and performance. Single or double-width AMCs are used as its primary system components, connected directly to a common backplane without modification or carrier board to provide full-scale PCI Express, GbE, 10GbE or Serial RapidIO connectivity. Leveraging these options, along with AMCs that plug directly into the MicroTCA backplane, essentially turns the mezzanine into a blade itself. This allows skilled system architects to manage extreme applications and environments using a familiar and proven standards-based infrastructure. An example Processor AMC is shown in Figure 2.

MicroTCA can be configured to scale from small non-redundant applications or systems to systems with up to twelve AMCs with full redundancy. It is this kind of flexibility within a smaller footprint that shows so much promise for demanding military applications such as COMSEC, radar, sonar, telemetry, SDR (software defined radio), image processing and C4ISR. Designers could develop a cost-effective MicroTCA system with one or two AMCs, or create a small super computer by using all twelve MicroTCA slots for CPUs. For example, a system integrating six CPUs and six network communication cards could handle COMSEC applications moving red, black and colorless information. Implementing twelve CPUs would be ideal for the extremely demanding processing requirements of SDR, image processing or TRANSEC (transmission security) for sharing voice, data and video securely throughout the battlefield and command centers.

The specific nature of both AdvancedTCA and MicroTCA includes native support of Internet Protocol-based network topologies, ideal for network-centric military initiatives such as WIN-T. The network on a MicroTCA backplane is managed simply, with each blade connected on a standard network and appearing much like any LAN found at a typical office setting. As a result, software development is simplified compared to other architectures. Further, low-cost AMC system implementations offer direct interconnectivity between two to four AMCs via the backplane. This lean infrastructure retains a standard AMC implementation—but economizes on both cost and functionality while satisfying many military requirements such as expenditure, development time, footprint and specific performance demands.

Taking Rugged Design Further

MicroTCA boards and systems were originally developed for air-cooled, less rugged applications, but are validated for NEBS (Network Equipment Building Systems) Level 3 requirements. NEBS-compliant systems address specific thermal margins, fire suppression, emissions and the ability to remain operational during a severe earthquake. Level 3 systems are designed and tested to withstand severe environmental conditions such as extreme heat, humidity, altitude and earthquake shocks up to zone 4, or 7.0 Richter scale and higher. This is a critical design feature for non-stop telecommunications applications and highly applicable to military systems.

Further, the MicroTCA extension specifications broaden the platform's rugged application. Each rugged MicroTCA specification (MTCA.1 and MTCA.3) defines multiple "Product Classes" corresponding to a certain level of shock, vi-

bration and temperature extremes. Table 1 details these specification levels. It is up to the system designer to determine which MicroTCA specification and Product Class would meet the needs of the current program.

Air-Cooled Rugged MicroTCA: MTCA.1: MTCA.1 was ratified in 2009, and the specification defines more stringent levels and cycles of temperature, shock, vibration and humidity than MTCA.0. Ideal for exterior and mobile communications applications, this is a highly viable specification for aerospace, industrial control and outdoor applications such as transportation and communications infrastructure scenarios. MTCA.1 works in tandem with the base specification, and extends MTCA.0 into more rugged military environments as defined by ANSI/VITA 47's EAC6 environmental class and V2 vibration class.

Hardened Conduction-Cooled MicroTCA: MTCA.3: Hardened conduction-cooled MicroTCA, or MTCA.3, is likely to be ratified by PICMG later this year. This extension specification will standardize a conduction-cooled build grade allowing AMCs to meet ANSI/VITA 47's most extreme thermal, shock and vibration profiles. MTCA.3 will address military systems with no airflow in sealed environments. The AMCs are placed inside a metal "clamshell" with wedge locks, stiffening the board and providing a conductive path for thermal dissipation through the chassis. Independent third-party tests, using the same test parameters and environments applied in VPX, proved MTCA.3 will qualify to these environments. As a result, MTCA.3 offers designers another reliable and high-performance platform for conduction-cooled system applications in ground mobile and airborne environments. An example MTCA.3 board is shown in Figure 3.

Modular Flexibility and Function

MicroTCA's rapid adoption has been fueled by the ongoing evolution and versatility of AMCs. Niche-specific performance can easily be added layer by layer. For example, AMCs in a MicroTCA 1U implementation can be configured with other processor and storage AMCs for integrated security services. This is ideal for applications such as ISR, which tend to be network-centric and require high-performance processing and logging of data. Even a 3U or 4U system would maintain a very small footprint, but could implement all multicore blades to perform with as many as 24 cores. This diversity of performance and potential for extremely high bandwidth is considered MicroTCA's most powerful and unique design advantage, offering military designers an ideal option for small form factor, plug-in systems.

AMCs are developing quickly in the area of input/output, driven largely by the evolving requirements of military communications. Formats including fiber optics, serial ports and even more niche-specific I/O such as MIL-STD-1553 used in airborne applications, are becoming more readily available in AMC format. Using the right combination of AMCs, designers can quickly implement connectivity including Serial RapidIO, 1 and 10 Gigabit Ethernet (10GbE), PCI Express

MicroTCA Specification MTCA.1 and MTCA.3 Product Classes		
MTCA.1-XTx	MTCA.1-XT1	Operating temperature: -40° to +70°C
	MTCA.1-XT1L	Operating temperature: -40° to +55°C
MTCA.1-XRx	MTCA.1-XR1	Operating temperature: -5° to +55°C Operating shock: 25g Operating vibration: 3g sinusoidal
	MTCA.1-XR2	Operating temperature: -5° to +55°C Operating shock: 20g/11ms Operation vibration: 8g random (VITA 47 V2)
	MTCA.1-XR1/XT1	Operating temperature: -40° to +70°C Operating shock: 25g Operating vibration: 3g sinusoidal
	MTCA.1-XR1/XT1L	Operating temperature: -40° to +55°C Operating shock: 25g Operating vibration: 3g sinusoidal
	MTCA.1-XR2/XT1	Operating temperature: -40° to +70°C Operating shock: 20g/11ms Operation vibration: 8g random (VITA 47 V2)
	MTCA.1-XR2/XT1L	Operating temperature: -40° to +55°C Operating shock: 20g/11ms Operation vibration: 8g random (VITA 47 V2)
MTCA.3-TELx	MTCA.3-TEL-1	Operating shock: 15g Operating vibration: 1g sinusoidal
	MTCA.3-TEL-2	Operating shock: 25g Operating vibration: 8g random (VITA 47 V2)
MTCA.3-MIL-CCx	MTCA.3-MIL-CC2	Operating temperature: -40° to +55°C (card edge)
	MTCA.3-MIL-CC3	Operating temperature: -40° to +70°C (card edge)
	MTCA.3-MIL-CC4	Operating temperature: -40° to +85°C (card edge)

Table 1

The MicroTCA extension specifications MTCA.1 and MTCA.3 define multiple "Product Classes" corresponding to a certain level of shock, vibration and temperature extremes. System designers must determine which MicroTCA spec and Product Class meets the needs of their program.

and Fibre Channel. Cost and functionality is further streamlined with the advent of double-width (4U) AMCs. These address several performance categories simultaneously, for instance, combining processing power with an I/O module.

Choosing a Specification

Military systems perform under many of the same demands as the telecommunications central office, delivering high-bandwidth, non-stop availability and sophisticated data processing in punishing physical and environmental conditions. Fixed military systems, deployed in non-mobile locations with a consistent and controlled temperature such as an office, field installation or permanent shelter, are most similar to a telco implementation. Designers will find MTCA.0, the base specification of the standard, is likely an appropriate choice for these applications and environments.

When the system moves beyond a fixed performance area, designers need to review the operating environment for shock and vibration considerations. With limited vibration (excluding seismic activity) and operational shock kept below 20g, air-cooled rugged MTCA.1 may be ideal. Systems deployed in stationary or shock-isolated applications, such as an isolated rack on a wide-body aircraft, often fit this category and will usually be able to use one of the MTCA.1 product classes.

System architects working with shock parameters measured beyond 20g may need to include wedge locks in their design, indicating the need for MTCA.3—unless the system can include shock isolation or subrack installation that limits exposure to operating shocks below 20g/11ms and

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operating vibration below VITA47 V2 profiles (random with 8g PSD).

Evaluating cooling requirements and resources will further define the choice of which Product Class to use within each specification. Options within air-cooled rugged MTCA.1 may be most applicable in scenarios that allow fans to intake fresh air as a method of system cooling. Sealed systems that rely on circulated air might also benefit from this option; however, ambient temperature of the system has a dramatic impact on cooling effectiveness. For systems that incorporate restricted airflow, options within MTCA.3, or hardened conduction-cooled MTCA, would offer a more applicable option based on its ability to handle a wider fluctuation in ambient temperature. Rugged military applications that must be conduction-cooled, such as systems deployed on ground vehicles, will usually be able to use one of the product classes in hardened conduction-cooled MTCA.3

Figure 3

The OM5030 is an example of a MTCA.3 conduction-cooled MTCA system. Rugged MTCA.3-based options are being used in rugged defense applications, for example, military systems hard-mounted to a mobile platform such as an airborne air-transport rack (ATR), or military communications systems deployed outdoors.

Proven Ruggedness in Sustained Deployment

Military designers have a slate of rugged advantages in MicroTCA's high-performance, high-bandwidth small form factor. Its range of options is suitable for military designs covering intensive signal processing, secure multimedia and battlefield communications, avionics and sensor processing and more.

This platform's proven ability to handle extreme environments—along with sustained deployment in the telecommunications arena—demonstrates performance and longevity to a military market averse to risk. Continuity of deployed systems is of specific importance to military system architects, signifying a mature, readily available architecture supported by a diverse network of hardware, software and design resources. MicroTCA's comprehensive ecosystem ensures ongoing innovation, and a broad base of industry-leading suppliers keeps costs in check by effectively supporting military design's long lifecycles and logistics. ▮▮

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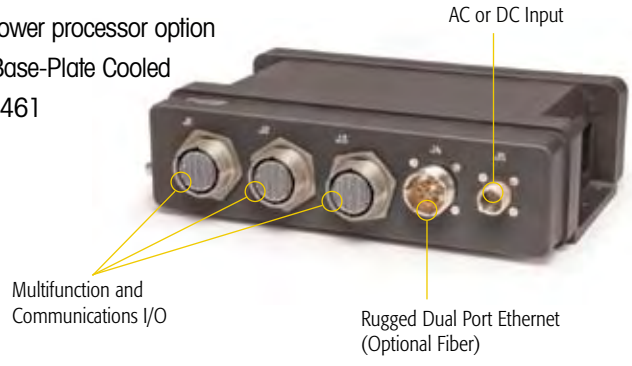

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		CMA & CMX22MVD1860HR	CMA & CMX22MVD1200HR	CMA157886PX1400HR	CMX158886PX1400HR	CMX158886PX1400HR-ECC	CMD158886PX1400HR	CMX158886PX1400HR-BRG	CMD158886PX1400HR-BRG	CME146786CX650HR	CME147786CX650HR	CML147786CX650HR	CMX147786CX650HR	CME136686LX500HR	CME137686LX500HR
Expansion Bus	PC/104 ISA Bus			✓						✓	✓	✓	✓	✓	✓
	PCI-104 PCI Bus	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓
	PCIe/104 Express Bus	✓	✓												
CPU and BIOS	CPU Max Clock Rate (MHz)	1860	1200	1400	1400	1400	1400	1400	1400	650	650	650	650	500	500
	Intel SpeedStep Technology	✓	✓	✓	✓	✓	✓	✓	✓						
	ACPI Power Management	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	2.0	2.0
	Max Onboard DRAM (MB)	2GB	2GB	512	1GB	512	1GB	1GB	1GB	512	512	512	512	512	512
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RTD Quick Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Legacy (Keyboard & Boot)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	Watchdog Timer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Solid State Hard Drive Disk Chip	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB
	Audio	HD	HD		✓	✓	✓	✓	✓		✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS	LVDS	LVDS	LVDS			TTL	LVDS	LVDS	
	PS2 Mouse/Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	RS-232/422/485 Ports	4	4	4	4	4	2	4	2	2	2	2	2	2	2
	SATA	2	2												
	USB 2.0	6	6	4	2	2	4	2	4	2	2	2	2	2	2
	Gigabit Ethernet	1	1												
	10/100Base-T Ethernet			1	1	1	1	1	1	1	1	1	1	2	1
	Parallel Port				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO (Advanced Digital I/O)	14	14	14	18	18	18	36	36	18	18	18	18	18	18
	aAIO (12-bit Advanced Analog I/O)	8	8												
	multiPort (aDIO, ECP, FDC)				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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Bus		Active Bus	PCI	PCI	ISA	ISA	ISA	PCI	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
		Passthrough Bus	ISA					ISA				ISA		PCI	ISA†
		DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
		McBSP Serial Ports	✓	✓				✓							
ANALOG	Analog Input	Single-Ended Inputs	16	16	16	32	16	16							
		Differential Inputs	8	8	8	16	8	8							
		Max Throughput (KHz)	1250	1250	500		100	1250							
		Resolution (bits)	12	12	12	12	16	12							
		Input Ranges/Gains	3/7	3/7	3/4	3/4	1/4	3/6							
		Autonomous Calibration	✓	✓											
		Data Marker Inputs	3	3	3			3							
	Analog Out	Analog Outputs	2	2	2	4	2	2							
		Max Throughput (KHz)	200	200	200	200	100	200							
		Resolution (bits)	12	12	12	12	16	12							
		Output Ranges	4	4	3	3	1	4							
		D/A FIFO Buffer	8K	8K				8K							
	Advanced Features	Channel-Gain Table	1K	1K	1K	1K	1K	1K							
		Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓							
		A/D FIFO Buffer	8K	8K	8K	8K	8K	8K							
		Sample Counter	✓	✓	✓	✓	✓	✓							
		SyncBus	✓	✓				✓							
DIGITAL	Digital I/O	Total Digital I/O	16	16	16	16	16	16	48	18/9	64	48	48	48	48
		Bit Programmable I/O	8	8	8	8	8	8	24	6/0		48	48	48	✓†
		Input FIFO Buffer	8K	8K	8K	8K	8K	8K							
		Opto-Isolated Inputs									48				
		Opto-Isolated Outputs									16				
		User Timer/Counters	3	3	2	2	2	3	3	3		10	10	10	6
	Advanced Features	Advanced Interrupts	2	2	2	2	2	2	2			2	2	2	✓†
		Versatile Memory Buffer										4M	4M	4M	8MB
		External Trigger	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓†
		Incr. Encoders/PWMs								3/9		4/8	4/8	4/8	✓†

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System Development

Balancing Performance vs. Lifecycle Needs

The Case for Blending COM Express and VPX

VPX is positioned as a key building block for net-centric military systems. Marrying COM Express with VPX solves a host of build/buy challenges and system lifecycle issues.

Jennifer Zickel, Product Line Manager
RadiSys

Many military system developers are starting to transition designs from VME architecture to the VPX standard as next-generation Mil/Aero computing systems require the performance of high-speed interconnects such as PCI Express, RapidIO and 10 Gbit Ethernet. Considering that VME is still in widespread use after thirty years, it's inevitable that the VPX systems will face the challenges of extending system lifetimes and decreasing the overall cost of VPX designs. One approach is placing Computer-on-Modules (COM) on VPX boards, allowing equipment developers to easily implement the latest computing technologies while preserving their VPX board development investments.

As systems transition from VME to VPX technology, mil/aero system designers are expecting to see dramatic performance gains delivered through tightly coupled I/O, memory and processor performance. System developers may benefit from separating the processor system from the rest of the VPX board, thereby avoiding a long design cycle that results in the release of a system with an outdated processor and compromised performance. Conversely, a product based on a fully custom design has a fixed performance level and lifetime that can force a system redesign sooner than expected. The performance needs of the system can only be realized if the processor used on the board keeps pace with the new and changing technology requirements of the application.

Using a COTS-based VPX carrier board combined with a COM Express module will ensure a ruggedized solution with a long lifecycle that includes performance, I/O and technology-insertion flexibility. COM Express can increase system longevity by offering easy technology insertion for processor performance. Other benefits include scalability between various power/performance processors. COM Express ensures more architecture stability from generation to generation as well as faster time-to-market by minimizing design and development effort.

Figure 1

Radar processing systems like this AN/MPQ-64 Sentinel mobile radar are an example of the kind of application suited for a COM Express/VPX implementation. The AN/MPQ-64 Sentinel automatically detects, tracks, identifies, classifies and reports airborne threats in a range of 75 kilometers.

Shifting toward VPX

For new designs, the VPX standard meets the performance and high-speed interconnect requirements of today's mil/aero computing systems. The thirty-year-old VMEbus architecture was defined when computing systems did not

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integrate graphics and communicated with the outside world across a common, parallel bus. VPX represents an upgrade from a backplane that offered hundreds of megabits per second to a multi-gigabyte serial backplane incorporating protocols such as PCI Express and Ethernet.

Radar signal-processing applications (ground/vehicle-based and aero-based) are ideal candidates to use a VPX-based system (Figure 1). The high bandwidth, signal processing and host computer processing combined with standards-based I/O matches a COM Express module system. The system host could use a dual or multicore COM Express module as a system host or for signal processing using SSE extensions, for example. In both cases, the COM Express module can be upgraded with a newer one in order to keep pace with radar performance demands while lowering total cost. The upgradeability and modularity of COM Express are well aligned with mil/aero demands for a standards-based interoperable product. Figure 2 shows an example COM Express computing module.

The Open VPX spec meanwhile adds a level of interoperability to the VPX standard because it defines interoperable combinations of system-level interconnects for VPX. Prior to this initiative, VPX manufacturers would design interfaces (Ethernet, PCIe and so on) on different sets of pins, yielding incompatible products. The goals for Open VPX are directly in line with COM Express, such as developing designs that go from the lab to the field with time and cost efficiencies that are repeatable because of the ease of board interchangeability.

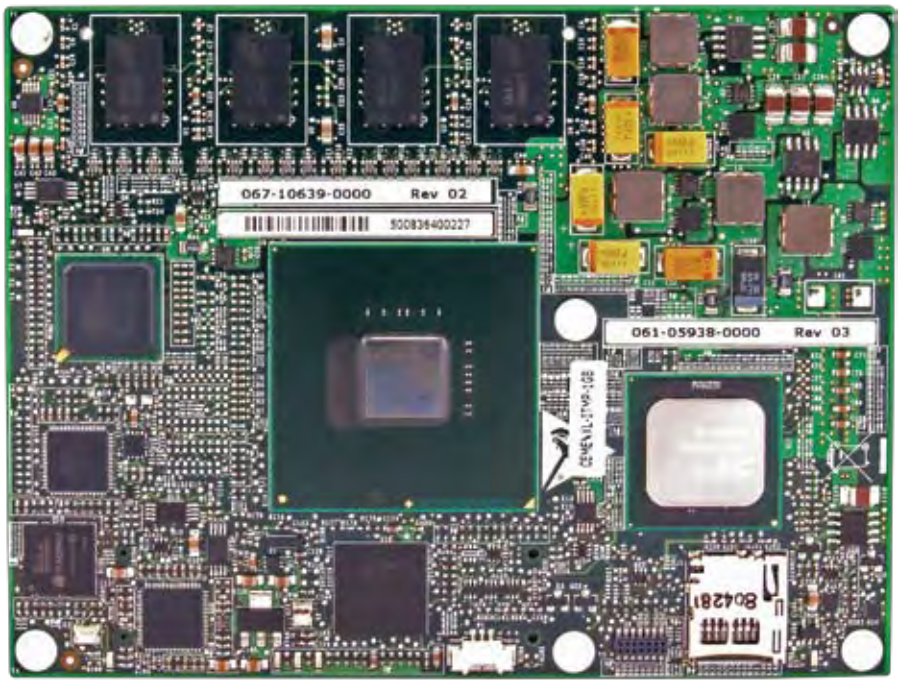

Figure 2

The extended temperature range (-40° to +85°C) version of the Procelerant CEZ5XL is a ruggedized COM Express module based on the Intel Atom processor Z5xx series. The module also features enhanced I/O via a PCI bridge and PCIe switch that provides 4x PCIe interfaces to the COM Express B2B connector.

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Open standards that enable interoperability—such as COM Express and OpenVPX—are being mandated by the U.S. Department of Defense because the use of COTS products lowers the total cost of the end system. The development time and cost, as well as production and lifetime management cost savings, can be illustrated by dividing the lifetime of the product into four phases: planning, development, release and post release, as shown in Figure 3.

Modularity Benefits

Compared to single-board VPX custom designs, the COM Express and VPX modular architectural approach offers system developers unique ways to protect their development investments, get to market faster, and reduce manufacturing and support costs. Some of these advantages are described in the following sections relative to product lifecycle stages: planning, development, release and post-release.

Product Planning: Significantly impacting developers' time-to-market is the product planning phase, when crucial decisions must be made prior to development. The use of COM Express modules can significantly speed up this phase and shorten product development schedules by providing fully validated and production-released modules at the same time the processor is released. Alternatively, a custom board design for a high-speed processor often takes 6-18 months, which may negatively impact product launch. Additionally, designers have the flexibility to develop with one COM Express module and move to another with higher performance, if needed.

Product definition: System developers do not have to spend valuable time writing specifications for the computing system. Instead, they can simply evaluate COM Express modules available from a number of COTS suppliers.

Product family planning: Military system developers can create a product family with relatively little effort by offering different product SKUs based on a range of COM Express modules. A single custom VPX carrier card can be designed to accommodate several modules supporting a range of performance levels, thermal properties and price points.

Schedule tracking: Since the computing system can be acquired, there are far fewer development tasks to track and complete, saving engineering and operations time.

Product Development

It is a challenge keeping up with the design churn associated with implementing new processor generations and increasingly complex design rules. Alternatively, adopting the COM architecture removes the processor, chipset and memory from the rest of the design. System developers can purchase modules that allow them to dial-in the right amount of performance.

Overall effort: A large part of the design is completed when a COTS COM Express module is used instead of implementing a custom design. The COM architecture and methodology enables a much broader level of reuse and reduced development expense, leading to earlier product launches and faster time to revenue.

Design risk: There is far less design risk because proven COM Express modules can be acquired at an early stage of the project. Consequently, prototyping and software development can start sooner, which lowers software development risk.

Redesign lead times: When a VPX system based on COM Express architecture must be modified to provide a different level of performance or I/O, the reengineering effort is often minimal. A majority of the design work is already done when another COM Express module with the required features can be swapped in—greatly reducing redesign lead time.

Test development: COM Express modules come pre-tested, so system developers can focus testing on the module interfaces instead of achieving 100 per-

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Release Impact

Manufacturing a custom VPX board is complex, especially considering a typical computing system has more than a hundred line items that must be stocked and inventoried. When systems are upgraded, there is often a need to recertify them, which consumes time and resources. However, certification effort can often be reduced or eliminated by using COM Express modules combined with a VPX board.

Build management: When acquiring COM Express modules, system developers only need to track one line item instead of the numerous parts associated with the computing system, greatly simplifying manufacturing.

Inventory management: Mil/Aero system developers can avoid keeping large inventories of piece parts by leveraging the production systems of COM Express module suppliers. Suppliers implement planning mechanisms designed to meet large and small orders by dynamically adjusting the size and length of production runs.

Certification effort: A system manufacturer looking for an easy technology insertion methodology can stuff an existing VPX carrier board with a new COM Express module, incorporating more advanced computing technology without having to recertify the carrier board. On the other hand, a custom, non-modular design approach may require redesign and recertification when significant changes are needed, like switching to the latest CPU.

Product Lifetime Stages

Planning
- Product Definition
- Product Family Planning
- Schedule Tracking

Development
- Overall Effort
- Design Risk
- Redesign lead times
- Test Development

Release
- Build Management
- Inventory Management
- Certification Effort

Post Release
- Change Control Effort
- Scrap Management
- Service and Repair

Figure 3

The development time and cost, as well as production and lifetime management cost savings, is illustrated here by dividing the lifetime of the system building block product into four phases: planning, development, release and post release.

Post Release

Over time, there are significant costs associated with end-of-life components,

service and repair requests and scrap material when products are upgraded.

Change control effort: Mil/Aero system developers need to ensure the components they use are available over an extended period of time or else they must inventory safety stock. Compared to supporting their own custom board, developers can shift a large portion of this responsibility to COM Express vendors, who manage issues related to parts availability for the computing system. Some COM Express vendors source products for a minimum of seven years, including revision control management.

Scrap management: When system developers design a custom VPX board to keep up with changing computing technology, some of the inventoried BOM parts may become obsolete scrap material. This can be avoided by using COM Express modules, which can be ordered as needed, eliminating the need to stock a large list of parts over many years.

Service and repair: Mil/Aero system developers can reduce service and repair burdens by using COM Express modules. Even years after product release, module vendors can make BIOS and driver upgrades or address any bugs that may surface over time.

Consider Product Lifetime Cost

Using a system based on a custom VPX carrier board and a standard COM Express module makes it easy to upgrade a Mil/Aero system quickly with minimal recertification costs. This flexibility is facilitated by the Open VPX and COM Express open standards that promote board interoperability and the use of leading-edge technology. The benefits of modularity include simplifying leading-edge technology insertions and extending product lifetime—at a much lower total cost than a single board solution.

With the fast pace of technology innovation, Mil/Aero system developers must find ways to avoid premature product obsolescence. However, this may be difficult with custom boards whose long design cycles can chip away at competitiveness, shorten the lifetime of the product or force an early redesign.

A modular COM Express and VPX-based approach delivers many product planning, development, release and post-release benefits over a single board VPX solution, especially when performance and technology need to be kept current and updated over a long period of time. VPX is well positioned to be adopted for new Mil/Aero applications—and building in upgrade flexibility through COM Express paves the way to support long product lifetime. ■■

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System Development

Balancing Performance vs. Lifecycle Needs

Evaluating Tech Upgrade Paths: OpenVPX vs RACE++

Analyzing technology refresh options always involves trade-offs between performance and legacy compatibility. The OpenVPX versus RACE++ decision raises interesting questions.

Anne Mascarin, Product Marketing Manager
Mercury Computer Systems

Many designers and developers of deployed military embedded systems require a significant leap in embedded computing performance to support rapidly advanced sensing and imaging technology. Many of them require upgrades to currently deployed systems—technology refreshes that can be put in place quickly and with minimal risk to the overall program. In these situations, module-level upgrades to existing systems can often be the best choice. Implementations based on OpenVPX can offer huge increases in bandwidth and processing power for those who feel movement to such an architecture is required. But there are other criteria that must be carefully weighed. Among these are the defense industry's pervasive financial, programmatic and logistical pressures.

In this context, an ideal comparison of technologies is the emerging OpenVPX architecture versus the old and new generation RACE++ architectures. Both performance improvement and investment protection—criteria that address the skyrocketing sophistication in sensing/imaging and defense industry pressures respectively—must be considered.

Many types of pressures, new and old, currently exist in the defense industry. Many financial pressures are driven by defense budget cuts; for example, deployed product lifecycles may be lengthened by years more than was originally intended, yet still expected to satisfy more stringent performance requirements introduced by advancing technology. Increasing validation and recertification costs are another financial burden for deployed programs.

Concurrent with cost pressures, programmatic pressures are becoming firmer. For example, Quick Reaction Capability programs (QRC) require the production of a field-testable unit within one year. Some

Figure 1

RACE++ Series rugged computing modules were used for the Lynx Block 20 synthetic aperture radar (SAR) technology upgrade on the Predator UAV.

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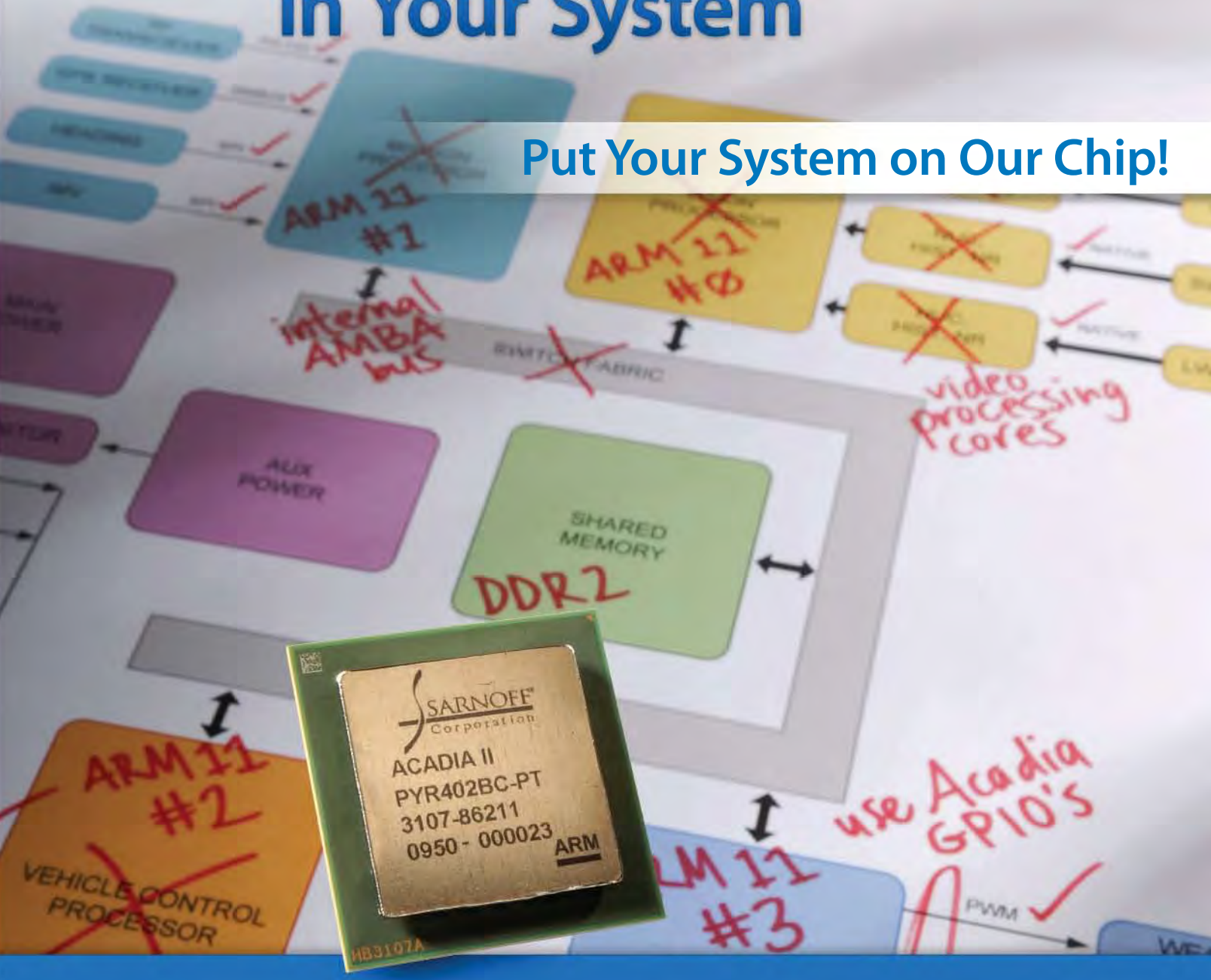

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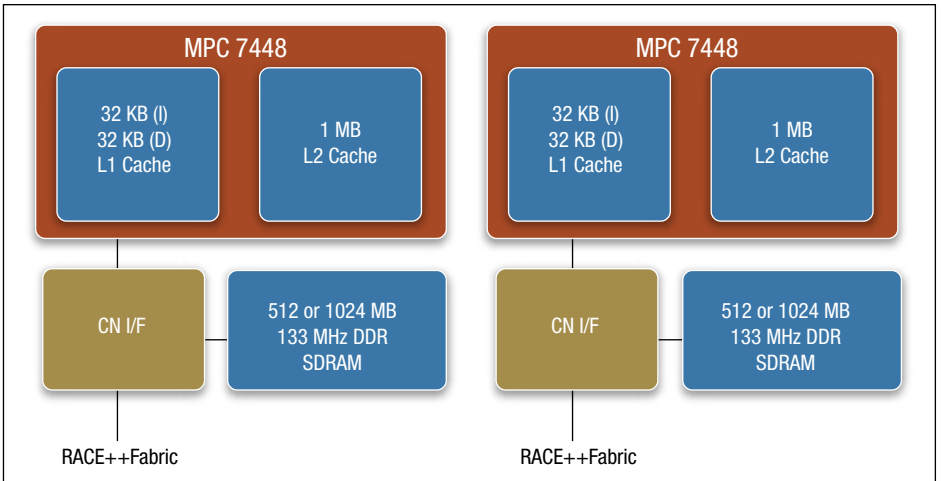

Figure 2

The 7448 generation RACE++ solution offers 1.06 GHz and 1.267 GHz versions with either 512 Mbytes or 1024 Mbytes DDR DRAM per compute node, a 1024 Mbyte cache size and two compute nodes per board.

government agencies are assessing the maturity of evolving technologies through a measure called Technical Readiness Level (TRL). A TRL level is assigned to the technology prior to incorporating it into a system or subsystem; in general, newer, unfielded technologies receive a low TRL and more mature, proven technologies receive higher TRLs.

Option Paths to Higher Performance

The RACE 1.0 family of heterogeneous multicomputing systems was introduced in 1993; it was adopted as an ANSI/VITA standard in 1995. RACE++, introduced in 1998, achieved revolutionary performance increases for stream computing system designers through a number of targeted, evolutionary refinements to the original RACE 1.0, especially in terms of bandwidth and scalability. RACE++ systems have been deployed in over 200 programs since its inception. In a recent example, RACE++ Series rugged computing modules were used for the Lynx Block 20 synthetic aperture radar (SAR) technology upgrade on the Predator UAV (Figure 1). RACE++ systems offer fabric speed in 100s of Mbyte/s range per board, and RACE++ systems enjoy a large and varied ecosystem of complementary boards.

Module-level upgrades for RACE++ systems are a very viable option for the system designer who wishes to improve performance without migrating to a completely new technology. Module-level upgrades have included the RACE++ PowerPC 7447 Multicomputer announced in 2008, and currently the higher-performance RACE++ PowerPC 7448 Multicomputer is available.

For the military system designer who feels it is necessary to move to a new architecture to achieve required performance, OpenVPX is an excellent option. The OpenVPX specification was created with a top-down, systems-level view of performance and interoperability, and it addresses the architectural issues required to define, implement and deploy highly rugged VPX-based systems. OpenVPX offers fabric speed in the 10s of Gbyte/s range per board. However, moving to a new architecture may have disadvantages beyond the obvious financial ones.

Performance vs. Investment Protection

Supporting requirements for higher performance while protecting your investment can be a hard balance to strike. An upgrade path for existing RACE++ systems is indeed available, and OpenVPX is sure to be a powerful, rugged and robust option for years to come. The answer depends on several criteria, which are specific to the program of deployment and the performance increase required. For example, for RACE++ systems, a drop-in upgrade path is available from the RACE++ PowerPC 7447 Multicomputer to the PowerPC RACE++ 7448 Multicomputer.

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The 7447 generation PowerPC Multicomputer offers an 800 MHz clock speed with 512 Mbytes of SDRAM per compute node, a 512 Mbyte L2 cache size, with two compute nodes per board. The 7448 generation (Figure 2) offers 1.06 GHz and1.267 GHz versions with either 512 Mbytes or 1024 Mbytes DDR DRAM per compute node, a 1024 Mbyte cache size, and two compute nodes per board. Clearly, a performance improvement can be achieved through upgrading to the 7448 generation.

In addition to performance improvement, upgrades are easily accomplished; the 7447 and 7448 generations of the PowerPC RACE++ Multicomputer share the same fabric between generations, and are thus compatible across generations. The 7448 generation is hardware compatible with the 7447 generation; both module generations represent the daughtercard component of a motherboard/dual daughtercard configuration for 6U RACE++ configurations. Software migration is 100 percent supported. Together, these features of the 7448 generation provide investment protection in terms of both hardware and software.

Program Example

Recently, a tech refresh program faced the question of where to upgrade from a 7447 generation RACE++ system. Two options were considered: upgrading to the 7448 generation, or migrating to an OpenVPX architecture. The tech refresh specified 10 percent more performance, and the system was upgraded with several 7448 generation daughterboards as an experiment. When the application was evaluated on the upgraded system, a 30 percent performance increase was found.

In addition to an increase in performance and investment protection, several economic benefits were noted. The overall board count for the 7448 generation boards was reduced—in comparison to the board count of the 7447 generation—because of the improved performance per board. Also, these now "extra" slots can be used for a different type of board, perhaps adding additional functionality to the system.

Several types of financial benefits were also realized. The most obvious of these is that the upgrade, consisting of the replacement of daughtercards in a RACE++ system, is clearly much less expensive—and much faster—than migrating every deployed unit to an OpenVPX platform. Also, recertification and revalidation costs were minimized through the drop-in upgrade. Migrating to a new platform would have recurred these costs in total. Finally, programmatic benefits were also provided. The drop-in upgrade, because it was based on mature RACE++ technology, helped the program maintain its high TRL level.

Depending on required performance increases, the RACE++ PowerPC drop-in upgrade may be the best option in financial, economic, programmatic and risk reduction terms. Migrating to a new and more powerful architecture such as OpenVPX is recommended for performance requirements that represent a large percentage increase over existing performance, and is application dependent. ■■

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Technology Focus

Rugged Stand-Alone Boxes

Rugged Boxes Step Up to Higher Pre-Integration

As time and cost pressures mount, military system developers are demanding ever more complete rugged box-level system solutions. Vendors are responding with new levels of pre-integration and prequalification.

Jeff Child,
Editor-in-Chief

The rugged stand-alone box—a term coined by *COTS Journal* a couple years ago—is now a prominent fixture in the embedded computing industry. These box-level systems often resemble the end deliverable systems that prime contractor manufacturers have in the past pieced together themselves—sometimes using off-the-shelf boards and enclosures. The latest twist on the rugged box-level systems trend is the evolution of so called "pre-integrated subsystems." These are defined as a set of embedded computing and I/O boards put together and delivered as a working system to provide a certain function. Often times they're aimed at being used in a military customer's larger system.

These integrated systems usually are made up of a set of modular embedded boards housed in a rugged enclosure that has its own power supply and interface ports to link to a variety of user terminals. This notion of offering a more complete system solution used to take the form of purely "custom" offerings built from the ground up for specific customers. What's changed is that these box-level systems are now wrapped together as a catalog product and services that many embedded computer suppliers are offering.

An example is Curtiss-Wright Controls' PCOTS (packaged commercial-off-the-shelf) offering. Last month BAE Systems awarded Curtiss-Wright a contract to provide two packaged PCOTS integrated processor subsystems for use in the Terrier general support engineer vehicle (Figure 1) for the British Army. The multifunction Terrier is an air-transportable, tracked, armored, engineer vehicle that performs obstacle and mine clearance, digging of trenches or fortifications for equipment and troops, route opening and maintenance and general engineering tasks. The subsystems integrate a number of modular COTS cards, additional I/O and data storage within a rugged, high-performance package to withstand extreme environments.

The trend toward complete box-level systems isn't pushed by embedded computing vendors. What's happened is that prime contractors are shifting to an ever greater reliance on embedded computing suppliers for integration expertise and a level of software development as part of those integration efforts. Driving that is the need for primes to contain their costs. Pressure to do that continues to ramp up as more and more programs are structured as fixed-price rather than cost-plus.

Figure 1

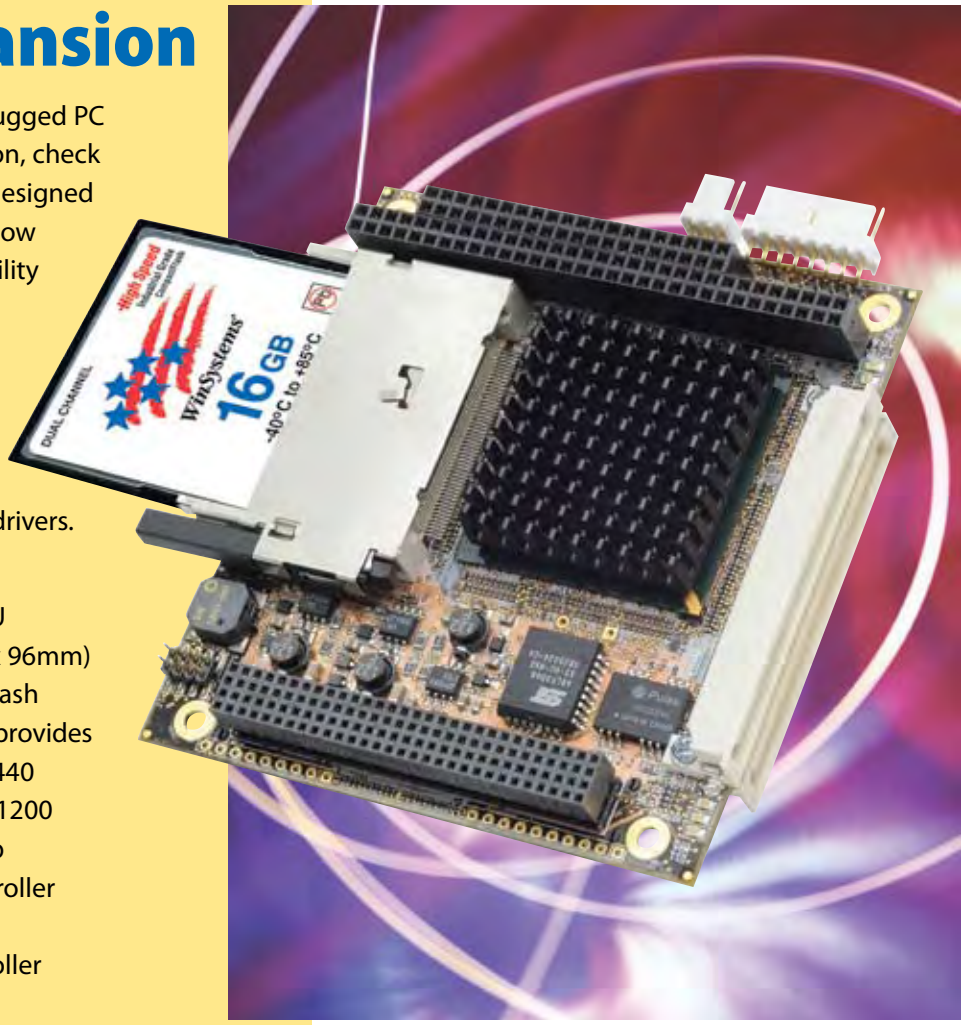
An example of a platform using pre-integrated box-level subsystems, the Terrier is the British Army's air-transportable, tracked, armored, engineer vehicle.

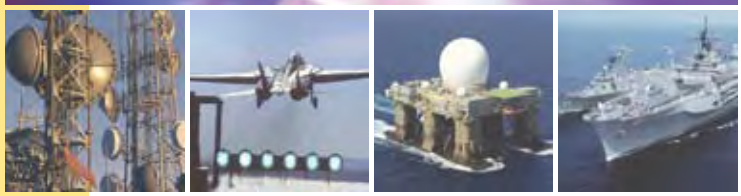
Meanwhile, DoD procurement policies are helping to drive increased interest in preconfigured subsystems from COTS vendors. The Weapon Systems Acquisition Reform Act passed by the U.S. Congress and signed by President Obama in 2009, for instance, shook up the way contracts and major weapons systems purchases are handled. In an effort to cut military spending and reduce waste, the Act demands more technology demonstration of new technologies. The policy also pushes for demonstrations earlier in the program development phase. Technologies used also have to show higher technology readiness levels (TRLs) than previously required. The demonstration phase of a program is more likely to involve multiple suppliers. That has helped drive demand for prepackaged and prequalified subsystems as primes find themselves without the time or the DoD funding to develop a prototype subsystem internally. ▮▮

Small SBC Supports HMI, Networking and I/O Expansion

If your application needs a small, rugged PC with fanless -40° to +85°C operation, check out WinSystems' PPM-LX800. It is designed for embedded, space-limited, and low power applications requiring reliability and long-term availability.

The PPM-LX800 runs Linux, Windows® XP embedded, and other x86 real-time operating systems, and comes with a wealth of on-board I/O with free software drivers.





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Technology Focus:

Rugged Box Systems Roundup

Rugged Box PC with Modular I/O Serves Cost-Sensitive Apps

The stand-alone rugged box trend has hit all levels of product types. A new I/O server industrial PC is targeted at reducing costs as an alternative to PC/104 or CompactPCI embedded computers. Field I/O signals in the IOS-7200 Industrial PC from Acromag are interfaced through an internal carrier card with related plug-in I/O modules. Working together, the rugged, fanless box computer

and conduction-cooled I/O modules provide a truly integrated system for many measurement and control projects. A low-cost Geode CPU processes the I/O signal data and manages numerous interface connections for peripherals and networking. Inserting a mix of up to four mezzanine IOS modules on the slide-out carrier card enables A/D, D/A, discrete monitoring/control, counter/timer, serial communication and FPGA computing functions.

A Windows development package provides API development software and Win32 DLL drivers, plus examples for C, Visual Basic, .Net and LabView environments. The Linux software includes a library of I/O function routines to speed code development. Both packages include demonstration programs with C source code to test and exercise the I/O module operation. An I/O Server with four IOS modules operates reliably across wide temperature ranges between -40° to 75°C (-40° to 167°F) with 0-90% relative humidity, non-condensing. Acceptable storage temperatures range from -40° to 85°C (-40° to 185°F). Power usage depends on the I/O modules used, but is typically about 30 watts. A Model IOS-7200 I/O Server PC starts at $1,695.

Acromag
Wixom, MI.
(248) 295-0310.
[www.acromag.com].

Atom-based Series of Fanless, Cable-Free Rugged I/O Platforms

A series of rugged and fanless I/O platforms based on the Intel Atom N270 are targeted for providing rugged I/O solutions to the market. The Matrix MXE-1000 and MXC-2000 from Adlink Technology are the result of combining Adlink's experience in x86 platform design, versatile I/O function development and thermal design to push fanless systems to a higher standard, including a -20° to 70°C temperature range, 5g vibration and cable-free durable structure.

The MXE-1000 and MXC-2000 series include a specifically designed single board computer to fit the respective fanless chassis in which all heat-producing components come in direct contact with the aluminum shell. This allows

for the widest operating temperature range among all off-the-shelf fanless computers. To increases reliability and durability, all connectors and components are mounted directly onto the PCB so there is no internal wiring. In addition to general I/O connectors such as Gigabit Ethernet (GbE), COM and USB ports, the MXE-1000 series also provides dedicated GbE and 1394b interfaces to support cameras for outdoor or in-vehicle video/imaging applications. The Matrix series is currently available at list prices starting at $550 and $750 for the MXE-1000 and MXC-2000, respectively.

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

Rugged Atom-based Fanless Box PCs Is Rich with I/O

Rugged box-level computing systems are proliferating in a variety of processor platforms, and the Atom is no exception. With that in mind, the Industrial Automation Group of Advantech introduces the UNO-2173A and UNO-2173AF fanless box PCs with 1.6 GHz

Atom-based CPUs. These models are equipped with Gbit Ethernet ports, rich I/Os, 1 x Mini-PCIe socket for WLAN and 3G solutions, and Moblin (Mobile Linux) support. The UNO-2173AF has dual side I/Os including all of the ports of the UNO-2173A, but also incorporating a LVDS port (low-voltage differential signaling), a backlight control port, 5.1 channel HD audio, an additional RS-422/485 port, three additional USB ports and 1 x internal USB pin head.

Advantech not only provides energy-efficient AC/DC power units, but also power-saving features such as increased DC/DC power conversion efficiency and reduced standby power consumption. Furthermore, the UNO-2713A and UNO-2713AF provide various operating efficiency modes like: off, sleep and idle. Users can experience up to 50% reduced energy consumption through these devices.

Advantech
Irvine, CA.
(800) 866-6008.
[www.advantech.com].

Rugged Box Marries 1553 and PowerPC

The trend toward complete box-level systems has broadened to include some offerings that target specific needs like avionics. Along those lines, Ballard Technology offers its Avionics BusBox 2000 (AB2000) systems—a family of over 30 small, lightweight, conduction-cooled, embedded computers for rugged environments. These systems have many built-in standard peripherals and interfaces for various avionics databuses, as well as PMC

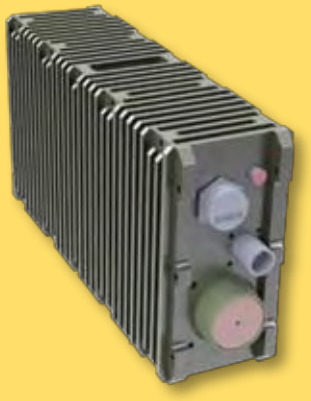
expansion capability. Typical applications for the AB2000 include data and protocol conversion, databus and network bridging, data servers, data recorders, communications, power controllers, federated controllers and multiple net-centric applications. The AB2000 is suited for helicopter, fixed wing and ground mobile platforms.

At the heart of the AB2000 is a user-programmable PowerPC processor that runs the software application and controls the various standard—serial, Ethernet, USB and discrete—and avionics databus—MIL-STD-1553, ARINC 429/708/717—interfaces. The high level of functionality implemented in the hardware interface circuitry ensures full use of the PowerPC processor for the software application. At power-on the embedded application boots from the flash memory and runs without host intervention. The tethered case is where a separate computer runs the application and controls the AB2000 over Ethernet.

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

Rugged Subsystem Integrates Dual Mezzanine Cards

Curtiss-Wright Controls Embedded Computing has introduced a new rugged, compact dual mezzanine card subsystem that enables the expansion of system functionality while minimizing space, weight and power (SWaP) burdens. The new MPMC-9020 features a built-in controller card and power supply and can be configured with one or two



PMC or XMC mezzanine cards. Weighing less than three pounds when fully populated, the MPMC-9020 provides an alternative approach for flexibly enhancing rugged deployed subsystems in SWaP-constrained environments. It's ideal for use in applications such as technology refresh/retrofit, general processing, video and image processing, and mission computing.

The MPMC-9020 requires no additional single board computer (SBC) to control its dual mezzanine slots. Its built-in controller card supports full mezzanine pin routing to the front panel, which enables the MPMC-9020 to provide the complete I/O set of the installed mezzanine module(s) to the system integrator. The MPMC-9020 system is housed in a rugged enclosure designed to meet MIL-STD-810 for environmental conditions, MIL-STD-461 for EMI and MIL-STD-710 for power.

Curtiss-Wright Controls
Embedded Computing
Ashburn, VA.
(703) 737-3660.
[www.cwcembedded.com].

8.8 Pound ½ ATR System Suits SWaP Requirements

An 8.8-pound sub-½ ATR, forced air-cooled enclosure for conduction-cooled modules is designed to reduce the Size, Weight and Power (SWaP) of deployed military systems. A fully populated XPand4200 from Extreme Engineering Solutions weighs less than 15 pounds and is suitable for C4ISR applications in vehicles such as UAVs, helicopters, planes, tanks and light armored vehicles, HMMWVs and UGVs. The XPand4200 conducts heat from conduction-cooled modules to heat exchangers, where the heat is dissipated to the ambient environment by forced air cooling. The system measures 4.88 x 6.0 x 13.5 inches.

The XPand4200 has an optional removable memory module attachment that supports the XPort6191 Solid State Disk (SSD) Removable Storage Module, with 64 Gbytes of storage capacity. With the memory module attachment the height increases to 7.62" and the weight to 11.1 pounds. Up to six conduction-cooled, 0.8" pitch 3U VPX, 3U cPCI, or power supply modules can be configured into the XPand4200. Additionally, the XPand4200 can be configured to meet custom I/O requirements with conduction-cooled PMC/XMC modules available from X-ES or third parties.

The XPand4200 supports Gigabit Ethernet, graphics, RS-232/RS-422, MIL-STD-1553, ARINC 429, as well as custom conduction-cooled PMC/XMC I/O through D38999 circular connectors. An optional front-panel USB port provides system monitoring and maintenance capabilities. There are several power supply options, supporting up to 200W from a MIL-STD-704 28V DC or 115V AC input, as well as internal EMI filtering and hold-up for up to 60 ms at 200W.

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

Rugged 3U and 6U Chassis Family Is Customizable

Every military system design has its own little unique part that needs some level of custom work. Feeding that need, GE Fanuc offers a family of rugged systems and enclosures. The system chassis are all supplied with a backplane, power supply, I/O wiring and necessary connectors. They are available with VME or CompactPCI backplanes for 3U or 6U COTS boards. These ruggedized COTS chassis are designed to support GE Fanuc systems that will be deployed in harsh environments like submarine and naval applications, sonar and radar systems, land based and avionic

and aerospace systems in combat ground vehicles and UAVs. Because all of these systems chassis use standard backplane technology like CompactPCI and VME, customers can choose just the right embedded COTS boards for their customized designs and quickly field their applications.

These rugged systems chassis are ready for system customization and include the 3-slot 3U conduction-cooled RCBC03, 3-slot 3U conduction-cooled RCBC03 with fastening footpads, 3-slot 6U conduction-cooled RCCC03, 7-slot 6U conduction-cooled RCFC07, 8-slot conduction-cooled 6U RCFC08, 12-slot ATR conduction-cooled 6U RCFC12, and the 17-slot convection-cooled 6U RCFA17 chassis.

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

Rugged Server Brings Dual Xeon to Extended Environmental Conditions

With up to 12 processing cores designed with new 32 nm technology, a new industrial server offers high performance density that makes it a fit for virtualization functionality, allowing formerly separate apps to be moved onto a single, cost-effective system. The Industrial Silent Server KISS 4U KTC5520 from Kontron is a highly robust and long-term

available open standard platform, offering up to dual Intel Xeon 5600 Series processors. It features an operating temperature range of 0° to 50°C, an operating humidity range of 10-95%, all-around IP 20 protection (optionally upgradeable to IP 52 at the front), and high shock and vibration protection, which makes the server perfect for applications where more ruggedized systems are necessary.

The server board can be fully managed remotely. The Industrial Silent Server is available with up to two Intel Xeon (5500 or 5600) series processors and up to 48 Gbytes of DDR3 ECC registered SDRAM per processor. The server paves the way for a wide range of extensions, thanks to 1x PCI Express x16 (PEG) (configurable as 1x PCI Express x8), 3 PCIe 2.0 x8, 1 PCIe x4 (using x8 slot) and 1 x PCI. Also on board are 2 x Gbit Ethernet, 6 x USB 2.0 (2 on the front) and 1 x COM (RS232).

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

Rugged Box System Provides Manpack-Sized Computing Platform

The stand-alone rugged box trend has pervaded all corners of the military embedded computing space. Many product lines have even moved on to second-generation, smaller spin-off versions. An example along those lines is Mercury Computer Systems' new, rugged, manpack-sized system. Enhancing the Ensemble 1000 Series family of computing systems, the 2-slot PowerBlock 15 has a convection-cooled or cold-plate mountable design, suitable for deployment on small platforms operating in harsh environments.

Approximately the size of an external hard drive, the portable system can be configured with any of the processing, I/O, or storage modules currently used in the award-winning 6-slot PowerBlock 50 chassis.

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

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

Rugged Box System Supports Wireless Connectivity

The stand-alone rugged box trend is perhaps the most significant new area of embedded military product development. Octagon's latest offering adds the twist of wireless connectivity. The RMB-C1 is a rugged mobile server designed for applications where severe environments and high performance meet. The unit tightly integrates the electrical, thermal and mechanical components into a complete system with no compromise to any one segment.

The RMB-C1 can be used as a central server, a stand-alone CPU, or a remote terminal. A full complement of I/O is provided: USB, CAN Bus, VGA, serial, video, audio, odometer and digital I/O ports. Additional functionality can be implemented via expansion cards in the PC/104 and Mini PCI formats. The RMB-C1's modularity enables custom functionality with COTS convenience without large up-front costs. The device supports 802.11 b/g Wi-Fi: FCC part 15.247 and is CE certified with Mini PCI interface. The unique thermal design allows for fanless operation over a -40° to 75°C range.

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

Vehicle Server Delivers Multicore Processing and Modular I/O

Box-level computers are becoming a mainstay in the defense market. Parvus has announced availability and feature enhancements for its DuraCOR 810-Duo rugged multicore mission processor subsystem. Small quantities of the DuraCOR 810-Duo are currently available for installation in technology refresh and retrofit military and aerospace platforms. The DuraCOR 810-Duo multi-platform MIL-COTS mission computer is based around the Intel L7400 Core 2 Duo processor in a modular PCI-104 expandable system architecture with non-volatile flash storage, MIL-STD power supply and environmentally sealed chassis.

The product can now be ordered with a removable Compact Flash media slot to ease secure data transfer, declassification, servicing, system software updates or storage capacity upgrades. Up to two PATA Compact Flash and one SATA 1.8" Solid-State Disk (SSD) interfaces are supported internally without occupying card slots, as well as one external eSATA interface for rugged Network Attached Storage (NAS). Locking MIL circular connectors bring out Gigabit and Fast Ethernet connections, 6 USB ports, 2 RS-232 ports, Dual Video Display (LCD/VGA), keyboard, mouse and audio signals, as well as an expansion connector for up to 79 signals from optional add-on cards.

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

cPCI-based Rugged Server Targets Avionics

Many rugged box systems make use of standards-based boards inside so users can mix and match the board sets they need. Along such lines, Phillips' RAS800 is a ruggedized Avionics Server Solution based on the CompactPCI form factor. The RAS800 is designed for harsh environment applications. The RAS800 combines a 1.5 GHz Intel Core2 Duo Processor with the Alta Data PMC-MA4 Multi-Channel,

Multi-Protocol 1553 and ARINC Avionics PMC Interface card. The RAS800 provides a wide range of Avionics I/O. Internal components are conformal coated and mechanically stabilized to provide a high level of resistance to extreme temperature, shock, vibration and humidity conditions.

The system offers one to four 1553B Channels, eight ARINC-429 Channels, seven Avionics and RS-485 Discretes. The system is compliant with MIL-STD-810, MIL-STD-461 and MIL-STD-704. The RAS800 uses D38999 connectors for I/O and one 6-pin D38999 connector for MIL-STD-704 compliant input power. Other connector configurations are available per application requirements. The RAS800 is delivered integrated and configured as a turnkey solution. Each RAS800 receives a single thermal cycle test and functional test to ensure application readiness. Additional testing can be performed as required.

Phillips Aerospace
City of Industry, CA.
(626) 855-4600.
[www.phillipsaerospace.com].

Third-Gen Box System Embeds Core 2 Duo, 4 Gbyte DRAM

The trend toward stand-alone rugged box-level systems has moved to the forefront of military system design. An early convert to that trend, Quantum 3D has announced its third-generation Thermite Tactical Visual Computer (TVC-3.0) Model 1000, in both deployable units and development kits, is now available for purchase. The 3.0 version is designed to complement the Thermite TVC-2.0 family by providing a range of higher performance models that are optimized for deployed, extended-environment, vehicle-mount and man-wearable advanced visual computing applications. Example applications include embedded training and mission

rehearsal, 3D-enabled C4ISR, sensor processing and C2 that require desktop level visual computing performance in a small form factor, conduction-cooled, mil-spec rugged system.

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

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

PC/104-based Box Systems Boast Sturdy Frames

Driven by the desire for a more complete system, stand-alone, ruggedized systems have become a go-to for military system developers who need solid, turnkey solutions. RTD Embedded Technologies makes box-level PC/104-based systems qualified for demanding applications like military vehicles. RTD's rugged HighRel line of systems is built using frames milled from solid aluminum blocks to exacting specifications ensuring that the solution is rugged and reliable. Frames for thermally sensitive components have internally

milled heat sinks and embedded heat pipes to move heat to the outside walls of the enclosure, allowing operation from -40° to +85°C without the use of active cooling. Optional shock-mount bases withstand specific shock and vibration specifications.

RTD's IDAN box-level product consists of any RTD PC/104, PC/104-Plus, or PCI-104 boards mounted in its own frame and wired to the standard PC connectors on that frame, thus eliminating the need for module-to-module wiring inside the case. This solution maintains PC/104's modularity and lets system designers configure a system as rapidly as one would configure a stack of boards. The product line is also available in a watertight version, HiDANplus, with environmental sealing and EMI suppression O-rings coupled with MIL I/O connectors. HiDANplus does inter-module communications via a custom wiring harness that is enhanced by an internal 100-pin stackable signal raceway.

RTD Embedded Technologies
State College, PA.
(814) 234-8087.
[www.rtd.com].

Atom Processor Featured in Fanless Box Computer

A fanless box computer for embedded applications supports the new generation of Intel Atom processors that includes the dual-core Intel Atom processor D510 and single-core Intel Atom processors N450 and D410. The PL-80190 from Win Enterprises can be used in a variety of embedded market segments such as print imaging, digital signage, retail and transaction solutions, thin clients, digital security, residential gateways, plus commercial and industrial control. This family of processors offers scalability to OEMs wishing to go to market with an entire product line. The rugged chassis features an integral heat sink on its top side to aid cooling.

Key features include Intel Atom N450, D410 or D510 processors (all are 1.66 GHz) and fanless operation along with advanced low power consumption. The unit supports dual 10/100/1000 Ethernet LAN interfaces, two SATA interface, mounting kit for 2.5" HDD and full-featured I/O. In addition, there is one VGA connector, one RS-232, four USB 2.0 ports along with a high-definition audio interface. In addition, it supports one Mini PCI and one CompactFlash. Linux (Fedora, MontaVista, SUSE), Microsoft Windows Embedded, Microsoft Windows XP and Microsoft Windows CE 6.0 are supported. The version with the Intel Atom D510 dual-core processor begins selling for $405 in OEM quantities.

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

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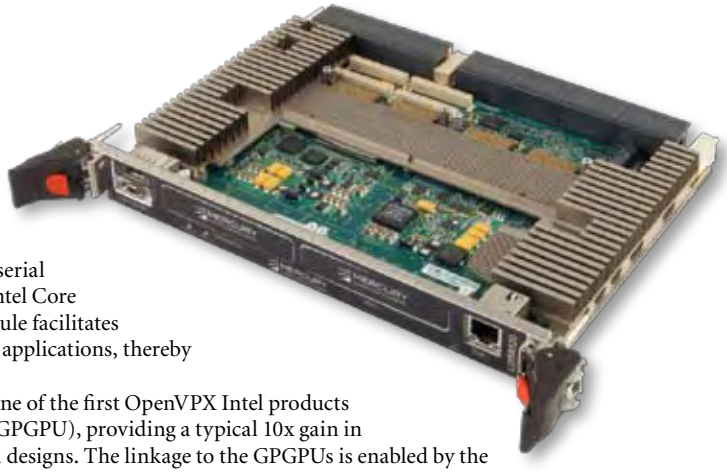
Core i7-based OpenVPX Board Targets ISR Apps

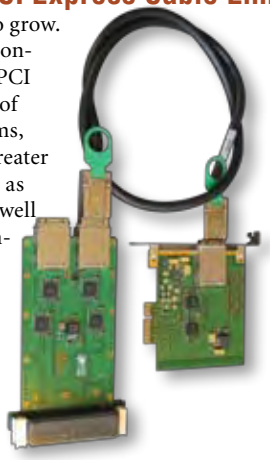


The lack of a RapidIO interface on Intel processors has pushed OpenVPX solutions in the Power Architecture direction. Overcoming that problem, Mercury Computer Systems has launched the Ensemble 6000 Series 6U OpenVPX Intel Core i7 LDS6520 Module, the first embedded computing product combining Intel's Core i7 processor family with the POET fabric interconnect. The POET (Protocol Offload Engine Technology) enables a serial RapidIO or low-latency 10 Gigabit Ethernet data plane to connect a number of Intel Core i7 processors and FPGAs. This embedded POET capability on the LDS6520 module facilitates very high-speed data connections and system scaling for Intel devices in defense applications, thereby delivering best-of-breed levels of ISR subsystem performance.

In addition to providing high-speed data plane connectivity, the LDS6520 is one of the first OpenVPX Intel products to provide high-speed communication links to general-purpose GPU modules (GPGPU), providing a typical 10x gain in system performance for many ISR applications compared to previous generation designs. The linkage to the GPGPUs is enabled by the PCI Express expansion plane, a component of the 6U OpenVPX multiplane architecture. The LDS6520 supports the XMCs and a dual-core Intel Core i7 Processor. It is available in air-cooled and conduction-cooled rugged versions. The initial configurations of the LDS6520 support both serial RapidIO 1.3 and serial RapidIO 2.1 to the backplane. Mercury's POET technology enables future configurations with 10 Gigabit Ethernet.

Mercury Computer Systems, Chelmsford, MA. (978) 967-1401. [www.mc.com].

OpenVPX Conduction-Cooled PCI Express Cable Link



The ecosystem for OpenVPX continues to grow. The latest example is an OpenVPX conduction-cooled PCI Express Cable Link board from PCI Systems. Enabling accelerated development of rugged conduction-cooled embedded systems, the PCIe x4 and x8 cable adapters provide greater bandwidth for high-speed applications such as video, imaging and audio devices. They are well suited to test add-on boards in a conduction-cooled chassis. The adapter board is VITA 46 CPU slot compliant with power on/cable present. It contains two PCIe x4 cable connectors on the front panel. Cabled to PCI Systems PCIe expansion board, the VPX x4 host adapter extends the PCIe bus to a downstream VPX system. The VPX CPU Slot Card is an IEEE.1-2201-compliant conduction-cooled VPX carrier card.

PCI Systems, Laurel, MD. (301) 362-1233. [www.pcisystems.com].

Rugged Module Converts from USB to RS-485/422/232

Electro Standards Laboratories offers the new Model 4176 high-speed, ruggedized USB to RS-485/422/232 interface converter. With its integrated rate buffering, the Model 4176 converts USB 2.0-compliant data from a standard PC to a serial asynchronous data interface over RS-232 or RS-485/422 networks. The baud rate is user selectable with operating speeds up to 1.5 Mbits/s for RS-232 and up to 3 Mbits/s for RS-485/422. This rugged converter operates from -40° to +85°C and features ESD protection circuitry on the USB I/O connector and all receivers and transmitters for the RS-232 and RS-485/422 interfaces.

Electro Standards Laboratories, Cranston, RI.
(401) 943-1164.
[www.electrostandards.com].

High-Density Computing (HDC) Development System

Military systems developers are re-deploying larger and higher performance systems than ever before. That's driving demand for platforms that aid development phase efforts of qualified multi-node systems. With just that in mind, Curtiss-Wright Controls Embedded Computing (CWCEC) has introduced a new family of High-Density Computing (HDC) development systems designed to speed the design of high-performance, multi-node open standards-based processor systems. These highly engineered air-cooled lab systems quickly provide system integrators with functioning hardware that speed and simplify the development of software and benchmark testing to significantly reduce time-to-deployment.

The HDC systems are integrated with multi-node processing modules such as CWCEC's CHAMP family of DSP engines and supported with CWCEC SBCs and network engines. HDC development systems house the same board content as deployed units only in open lab chassis to provide engineers ready access to the modules during the system development phase.

The HDC Development System supports 6U VPX form factor and up to 12 modules with 1" pitch. Open chassis style supports engineering access for debugging. Optional module content can include a dual core Freescale SBC, a quad PowerPC architecture DSP module, a Gbit Ethernet switch module, FPGA module and I/O modules to suit program requirements.

Curtiss-Wright Controls Embedded Computing, Ashburn, VA. (703) 737-3660. [www.cwcembedded.com].

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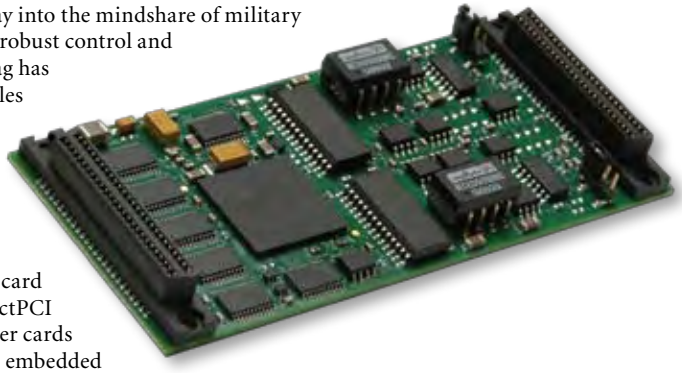
Core i7 COM Express Module Supports New Type 6 Pin-Out

Coinciding with the launch of the COM Express 2.0 specification by PICMG, Kontron presents an additional version of the Computer-on-Module ETXexpress-AI based on the new COM Express Type 6 pin-out definition. The performance of the Kontron Computer-on-Module ETXexpress-AI is scalable from the 1.06 GHz Core i7 620UE, the 2.0 GHz Core i7-620LE and 2.4 GHz Core i5 520E up to the 2.53 GHz Core i7 processor 610E. All versions support up to 2 x 4 Gbytes Dual Channel DDR3 ECC SODIMM memory modules and offer a comprehensive set of interfaces via the COM Express Type 6 connector: 1x PCI Express Gen 2 Graphics (PEG) also configurable as 2 x PCIe x8, 7x PCI Express x1, 4x Serial ATA, 8x USB 2.0, Gbit Ethernet and High Definition Audio.

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

I/O Modules Provide Two CAN Bus Interfaces



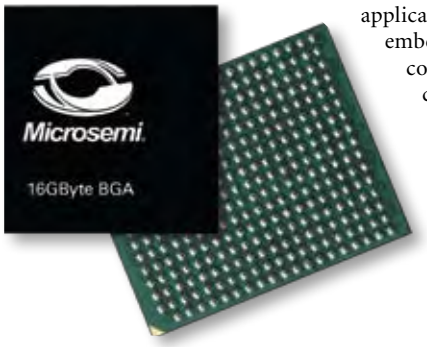
CAN bus has earned its way into the mindshare of military system designers who need a robust control and monitoring solution. Acromag has released new CAN bus modules to interface network sensors and actuators to high-performance control systems. Two versions of the CAN bus interface module are available. The IP560 is an Industry Pack ANSI/VITA-4 card that plugs into VME, CompactPCI and PCI bus mezzanine carrier cards or single-board computers in embedded systems. IOS-560 models are designed for use within Acromag's I/O Server industrial PC, a small fanless box computer, which services mobile computing, machine control and test applications. Both CAN bus interface modules feature two channels with optional isolation. Each channel has an NXP SJA1000 CAN controller with a TJA1041 transceiver. Extended temperature models support -40° to 85°C operation.

The modules support CAN 2.0B protocol compatibility and ISO 11898 compliance for Part A (11-bit) and Part B extended (29-bit) arbitration IDs. PeliCAN mode extensions provide numerous communication capabilities. An isolation option eliminates ground loop potentials and protects equipment from electrical noise, surges and spikes. The 1000V isolation barrier safely separates channel-to-channel and channel-to-host. Single quantity pricing starts at $500.

Acromag, Wixom, MI. (248) 295-0310. [www.acromag.com].

BGA SSD Provides Up to 16 Gbytes of Storage

Microsemi offers a high-density Single Level Cell (SLC) NAND solid state storage solution in a single integrated plastic ball grid array (PBGA) package. In 8 and 16 Gbyte densities, the 27 mm x 22 mm package offers a 63 percent space savings over a standard CompactFlash card of comparable density. The BGA is designed specifically for use in the rugged and demanding environments of defense and aerospace applications, providing highly reliable data storage for embedded computing such as that used in aircraft, communications and missiles. The PBGA package is constructed using eutectic tin-lead solder balls on a 1.27 mm pitch with strategically placed signals to extend device life in harsh environments.



Microsemi, Irvine, CA. (949) 221-7100. [www.microsemi.com].

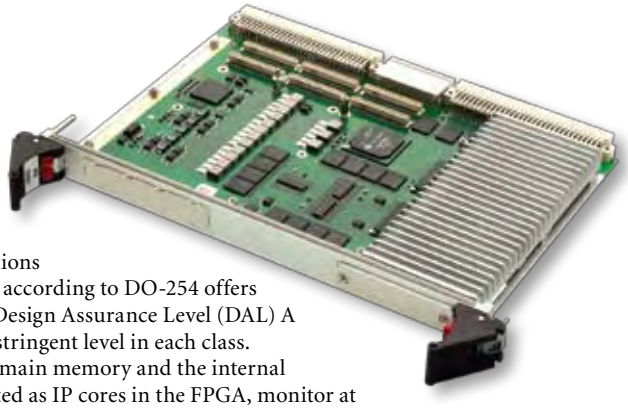
Rugged Vapor Cycle System Keeps Mobile Electronics Cool

The growing use of rackmounted electronics in military vehicles and mobile transit cases means that there is an increasing requirement for environmental control systems that can ensure the thermal survival of these critical systems in hot desert environments. Some of these rackmounted systems will not survive without inlet air temperatures replicating the air-conditioned server rooms within which their manufacturers intended them to operate. ECU-Chill, Aspen System's newly introduced environmental control unit for enclosures and transit cases, uses efficient vapor cycle cooling technology enabled by our miniature compressor to effectively cool the air in these mobile enclosures, and has become a significant enabling technology in several systems that are now fielding.

ECU-Chill measures 9 x 18.5 x 6.7 inches, weighs less than 20 pounds and has been fully ruggedized to MIL-STD 810 and 461E. At an ambient temperature of 125°F it removes 550 watts of heat from the enclosure while maintaining the internal air temperature at less than or equal to 125°F. The unit uses its own proprietary electronics to control the fans, expansion valve and the variable speed compressor while drawing a maximum of 420 watts of power at 28V DC. ECU-Chill is fully qualified and is now shipping.

Aspen Systems, Marlborough, MA. (508) 481-5058. [www.aspensystems.com].

6U FPGA-based VME SBC Boasts Triple Redundancy



For some military embedded control applications, a step above the usual levels of reliability is required. Along such lines, MEN Micro offers the A602, a 6U FPGA-based, triple-redundant 64-bit VME SBC that employs a lock-step architecture keeping software development at a minimum. With this redundant lock-step system that increases system reliability, the SEU-resistant A602 runs the same set of operations in parallel to ensure that the programming only views the hardware components once, making the new board ideal for mission-critical applications including those in the avionics market. The single-slot, COTS-based A602 developed according to DO-254 offers incomparable reliability and economical implementation with high reliability up to Design Assurance Level (DAL) A (catastrophic) in avionics and up to Safety Integrity Level (SIL) 4 in trains, the most stringent level in each class.

To ensure the highest safety standards, the 900 MHz PowerPC 750, the 512 Mbyte main memory and the internal structure of the FPGA are triple-redundant. Critical functions, like voters implemented as IP cores in the FPGA, monitor at least two of the three redundant components to provide the same result to guarantee system reliability. In the event one of the three redundant components fails, the system remains completely operational providing the required availability for highly critical systems. Standard I/O contained in the FPGA is accessible via the rear. This includes a sextuple UART, an I²C bus and an RS-232 interface that can also be led to the front. The A602 also provides two PMC slots, one accessed via the front or rear I/O that can be used with all standard PMC modules, and the other for an AFDX PMC connection via rear I/O. Operating temperature is -40° to +50°C with qualified components. Pricing for the A602 is $12,994.

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

Radiated Test System Improves Flexibility and Testing Range

Teseq has improved its ITS 6006 (Immunity Test System) for radiated EMC immunity testing by enhancing the RF power meters used in conjunction with the unit. The ITS 6006 features two updated, rugged RF power meter models, the PMR 6006 and PMU 6006, with an expanded frequency range from 1 MHz to 6 GHz and linear measurement range of -45 dBm to +20 dBm. Both models feature a large dynamic range, fast measurement, a sturdy design and a frequency range that matches the application being performed to meet the rigorous demands of EMC immunity testing. The key benefit of the ITS 6006 is that it features integrated RF switching, simplified cabling and connections and a shortened set-up time, making the system a cost-effective, integrated solution with less error sources and insertion loss. Pricing for the ITS 6006 starts at $24,500.

Teseq, Edison, NJ. (732) 417-0501. [www.teseq.com].

Broadband RF Limiters Serve 1 to 18 GHz Bandwidths

Narda, an L-3 Communications company, has introduced the LIM Series of broadband PIN diode-based RF limiters designed for air, ground, or sea-based defense applications. They handle high input power levels, have fast recovery times and are available for drop-in mounting with removable connectors. The broadband LIM Series limiters include the LIM-101, which covers 1 to 18 GHz, has flat leakage of 100 mW, a recovery time of 200 ns, and handles an RF input power of 2W CW and 150W peak, and an operating temperature range of -55° to +95°C. The LIM-201 and LIM-301 cover 2 to 18 GHz, have flat leakage of 150 mW or less, a recovery time of 100 ns and 200 ns respectively, handle an RF input power of 3W CW and 500W peak, and operate over a temperature range of -30° to +85°C.

Narda Microwave-East, Hauppauge, NY.

(631) 231-1700.

[www.nardamicrowave.com].

Two-Slot Conduction-Cooled 6U VPX Platform Rolls

As interest in OpenVPX quickly ramps, military system developers are anxious to get their projects started. Serving those needs, Extreme Engineering Solutions offers the XPand1010, a two-slot 6U VPX (VITA 46) conduction-cooled chassis. The chassis provides system engineers with an inexpensive 6U VPX desktop or lab bench platform to jump-start software or hardware development when using X-ES Freescale- or Intel-based CPU boards. The XPand1010 is unique in that it allows customers to utilize fully rugged, conduction-cooled cards in a small footprint, low-cost development chassis. Users can then install those same 6U VPX cards into deployable ATR or similar chassis with no changes to the 6U modules.

The XPand1010 hosts up to two 6U VPX conduction-cooled cards, providing fabric interconnect between the two slots, as well easy access to Gigabit Ethernet, SATA, USB, DVI and serial port I/O from one or both of the installed 6U VPX SBCs. The XPand1010's design eliminates card cages, rear transition modules and large noisy fans typically found in air-cooled development chassis. The complete XPand1010 development system includes a backplane with integrated I/O connectors, conduction-cooling system and power supply. Priced at $3,295, the XPand1010 is available immediately.

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

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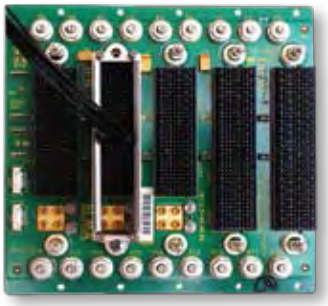
3U VPX Backplane Equipped with RF Connectors

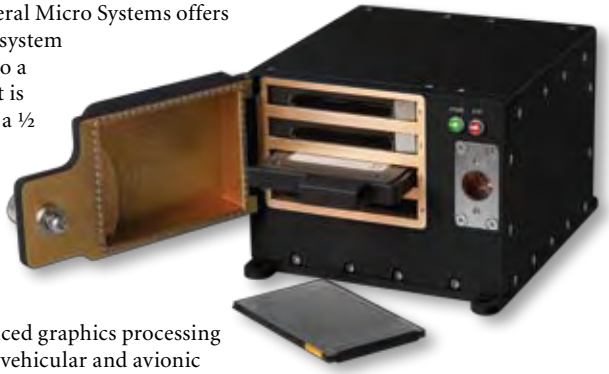
A new 3U VPX Backplane comes with connectors for RF and analog signals. The use of RF interconnects is expected to be an important issue for many military and aerospace applications where the VITA 46/65 specifications for VPX are highly targeted. The VPX Backplane from Elma Bustronic is designed to meet OpenVPX design considerations. Work is underway on a VITA 67 specification for RF signals over VPX and Bustronic plans to develop a version that will meet the specification when it is finalized. The backplane features a 5-slot mesh routing configuration with the RF connectors in three slots. The 4-cavity RF connector is installed in the lower half of the standard J2 connector. Pricing for 3U VPX Backplane including the RF connectors is under $2,500.00 depending on volume and configuration.



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

Rugged Box System Smaller Than ATR-Short

Today's level of electronics integration allows for extremely high levels of compute density into small footprints. Makers of rugged box systems are translating that advantage into system level solutions. With that in mind, General Micro Systems offers a fast, powerful, rugged computer system that packs features and options into a small, easily mounted package that is one-quarter the size and weight of a ½ ATR-Short package. With a Core2 Duo processor running at up to 2.256 GHz and 8 Gbytes of main memory, the Golden Eye II from General Micro Systems is a super lightweight, rugged system that brings high performance in harsh environments together with advanced graphics processing capabilities, making it suitable for vehicular and avionic programs. Standard configurations include: S802-R with one removable Solid State Drive (SSD) offering up to 500 Gbytes of storage, and S802-R4, which has four removable SSDs for a total of 2 Tbytes of storage. S802-R4 units are available with a combination of drive bays for removable SSD and PCMCIA slots to accommodate Army legacy systems.



Golden Eye II in its S802-R configuration measures only 5.25 x5.2 "x2 inches, and weighs just 2.5 pounds. The unit literally can replace four 6U cards offering equivalent or better performance, and its peak drain on the system's power bus never exceeds 25 watts. GMS's patent-pending cooling design enables its systems to easily operate in environments from -40° to +85°C. Because of its small footprint, about one-quarter the size of a standard ½ Air Transport Rack (ATR)-Short, it is well suited for UAVs and vetronics applications. Golden Eye II was designed for rugged, military applications and is compliant to MIL-STD-810F, MIL-STD-704E and MIL-STD-461E. Completely validated and certified, it also uses GPS for time stamping every data packet within the stringent Army requirements of less than one micro second. Single unit price (S802-R) starts under $10,000.

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

CPU Cooler Boosts Airflow, Water Block and Heat Dissipation

A CPU cooler is designed to provide an extremely efficient cooling solution for CPUs from Intel and AMD. The Hydro Series H70CPU cooler from Corsair is an evolution of the Hydro Series H50, with several significant upgrades that enable it to deliver even greater cooling performance. These upgrades include a double-thickness (50 mm) radiator with higher heat-exchanging capacity and a pump/cold plate unit with increased efficiency. The H70 also features two 120 mm speed-switchable cooling fans in a push-pull configuration to provide increased airflow at low noise levels.

Like the H50, the Hydro Series H70 provides the benefits of water cooling in a sealed and pre-filled unit, with no maintenance required. The low-profile cold plate is extremely space efficient, and is very low in mass compared to heat pipe-based solutions, putting less stress on the system's motherboard. The H70 includes mounting hardware for most common AMD and Intel CPUs, and, unlike some competitive CPU coolers, includes all necessary fans for high-performance operation. The Corsair Hydro Series H70 CPU Cooler is supplied with a two-year warranty, and is backed by Corsair's customer service and technical support.

Corsair, Fremont, CA. (510) 657-8747. [www.corsair.com].

COM Express Module Supports Multimedia

A fanless COM Express form factor module offers a complete, multimedia-capable platform for a variety of military embedded applications. Available with a choice of Via C7 or Via Eden processors, the Via COME7N80 from Via Technologies also integrates Via CN896 North Bridge and VT8251 South Bridge chipsets providing a flexible and comprehensive computer-on-module product. The COM Express specification integrates core CPU, chipset and memory on the module, providing support for extensive connectivity options, including USB, audio, graphics and Ethernet, through board-to-board connectors to an I/O baseboard. The Via COME7N80 features the Type 2 COM Express standard, three PCI and three x1 lane plus a x16 PCIe slot and up to 2 Gbytes of DDR2. In addition, the module features 10/100 Ethernet, up to eight USB 2.0 ports and up to four SATA devices.

VIA Technologies Fremont, CA. (510) 683-3300. [www.viaembedded.com].

1U Network Appliance Serves Up Quad-Core Xeon

1U form factor systems are carving out an impressive niche in military applications. The CAR-4003 from American Portwell is a 1U Communications Appliance based on the quad-core Intel Xeon processor X3400 or L3400 (formerly codenamed Lynnfield) or Intel Core i5 or Core i3 processor. The CAR-4003 supports four DIMM slots with high-speed 1333 MHz dual-channel DDR3 ECC memory; dual x8 PCI Express Gen2 slots (8 Gbyte/s bi-directional) for connecting expansion modules; expansion capabilities include two PCIe x8 interfaces for a modular bay for Portwell's ABN/NIP module product family; fiber and copper port connections including dual-port 10G readiness (Intel 82598EB, Intel 92599ES with SFP+ Interface and Intel 82599EB 10Gbase-T Copper Interface) and PCIe Gen2 Quad Port GbE and SFP (Intel 82580) module.

In addition, the CAR-4003 provides Intelligent Platform Management Interface (IPMI) v2.0 functions for remote management, including IPMI over LAN, IP over KVM (iKVM), Serial Over LAN (SOL) redirection, Event logging and OS independent Hardware Health Monitoring. IPMI helps lower the overall costs of server management by enabling customers to save time, maximize IT resources and potentially manage multivendor environments in the same way. The IPMI consists of a main controller called the baseboard management controller (BMC) and other management controllers distributed among different system modules that are referred to as "satellite" controllers. Users can access IPMI functionality through the command line with the IPMItool utility either in-band or out-of-band. Additionally, users can generate an IPMI-specific trap from the Web interface, or manage the server's IPMI functions from any external management solution that is IPMI v1.5 or v2.0 compliant.

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

IP Display Engines Target Networked Video Connectivity

Targeted at networked video connectivity solutions for mission-critical systems, a new family of video receivers is designed specifically for viewing stations and specialized processing appliances on high-performance video networks. The vDisplay family of IP engines from Pleora is comprised of compact, purpose-built hardware that allows high-resolution video streams on GigE (Gigabit Ethernet) networks to be displayed directly on monitors, in real time, without the need for a PC. They can also be used for real-time video capture in specialized processing appliances. Pleora will initially offer the vDisplay HDMI-Pro IP engine. The HDMI-Pro engine converts streaming IP video to standard HDMI/DVI (High-Definition Multimedia Interface/Digital Visual Interface) formats for real-time display on off-the-shelf monitors.

Pleora Technologies, Kanata, Ontario, Canada. (613) 270-0625. [www.pleora.com].

Non-Volatile DDR3 Module Offers 8 Gbyte Densities

A non-volatile system (NVS) memory family delivers densities up to 8 Gbytes providing flexibility to system architects and designers to tailor non-volatile memory for specific application requirements. AgigA Tech, a subsidiary of Cypress Semiconductor, now extends the market's portfolio of battery-free non-volatile memory solutions with the Agigaram product family. The technology merges NAND Flash, DRAM and a battery-free ultracapacitor power source into a highly reliable non-volatile memory system. When used as a write cache in enterprise-class applications, Agigaram provides a performance-boosting building block while guarding against power failures and consequent loss of critical data. The DDR3 products deliver data transfer speeds up to 1,333 megatransfers per second (MT/s).

AgigA Tech, Poway, CA. (858) 375-4530. [www.agigatech.com].

Sound and Vibration Software Supports IEPE Modules

A new software application for sound and vibration measurement provides an easy-to-use interface for individual channel configuration and display for performing vibration analysis. The VIBpoint Framework Application from Data Translation now supports the company's DT9837 and DT8837 series of sound and vibration measurement products. Functions include: spectrum/spectral display, power/magnitude, RMS/peak, dB/linear and more. This hardware/software combination supports both USB and Ethernet (LXI-compliant) vibration analysis and monitoring applications including noise emission monitoring, predictive maintenance, and shock analysis.

VIBpoint Framework Application supports all the features of the hardware modules including discovery and selection of available hardware, configuration, loading and saving of hardware configurations as well as individual configuration of each channel for analysis and display. It supports the hardware's per channel FFT parameter configuration including: spectrum/spectral density, power/magnitude, RMS/peak, dB/linear and more for maximum vibration analysis flexibility. It also includes the FFT averaging modes for linear, exponential and peak and it can save, display or analyze data with Excel. A 14-day free trial of VIBpoint Framework Application is available for download or a license key can be purchased for $995.

Data Translation, Marlboro, MA. (508) 481-8620. [www.datatranslation.com].

PCI/104-Express Board Incorporates Qseven Modules

A new PCI/104-Express module incorporates industry standard Qseven modules. The Xtreme/CPU from Connect Tech was designed based on Qseven modules provided by Congatec. The Xtreme/CPU Features a PCI/104-Express form factor with 4 x1 PCIe lanes, two SATA interfaces, two each RS-232 and RS-422/485 connectors, four USB 2.0 ports, one Gigabit Ethernet connection, LVDS and VGA Video. Additionally, Xtreme/CPU gives instant access to a full range of PCI/104-Express add-on cards, and incorporating Qseven creates an I/O platform with a scalable CPU. Simply changing the Qseven module provides users with instant access to Atom-based products that are easily upgradeable to take advantage of future advancements of the Atom.

Connect Tech, Guelph, Ontario. (519) 836-1291. [www.connecttech.com].

SAS Solid State Drive Uses Multi-Level Cell Tech

A new development in flash memory is a serial-attached SCSI (SAS) solid-state drive (SSD) equipped with enterprise-grade multi-level cell (E-MLC) NAND flash technology. The 2.5-inch XceedIOPS SAS SSD from Smart delivers superior endurance in enterprise environments due to the use of the latest 34nm E-MLC NAND flash technology. Specified endurance for E-MLC flash is 30,000 program/erase (P/E) cycles, whereas competing commercial MLC (C-MLC) technologies typically demonstrate only 1,500 to 5,000 P/E cycles. Endurance is further enhanced by an advanced wear leveling algorithm combined with advanced data management hardware, delivering the industry's lowest levels of write amplification while also significantly boosting performance. As a result, the Smart XceedIOPS SAS SSD family of products will deliver a minimum of five years of operational life in environments that write up to 10x the device's total data capacity per day.

Specifically optimized for high-performance enterprise storage and server systems, the XceedIOPS SAS SSD achieves up to 26,000/20,000 IOPS random read/write and 250/230 Mbyte sustained read/write. Available in 100, 200, and 400 Gbyte capacities, the new XceedIOPS SAS SSD offers high reliability and data integrity due to extensive error-correction and detection capabilities, multi-level data-path and code protection, data-fail recovery, and data-integrity monitoring. Designed to fit the restricted power envelope of enterprise storage environments, the XceedIOPS SAS SSD incorporates staggered power-on support. In addition, the new XceedIOPS SAS SSD supports long data sector (LDS), which allows host transfer sizes of 512, 520, and 528 bytes.

SMART Modular Technologies, Newark, CA. (510) 623-1231. [www.smartm.com].

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Rugged Keyboard Is Built for Harsh Environments

Stealth Computer has released a new rugged, vandal-resistant keyboard with built-in trackball mouse and adjustable backlit keys. The Stealth model KYBX-400 series keyboard is an industrial grade keyboard with a built-in optical trackball that is environmentally sealed to NEMA 4, 4X, IP65 specifications. Stealth's hardened keyboard features 71 full-travel polymer keys with silent tactile feedback for fast and accurate data input functionality. The 38 mm optical trackball is sealed to IP65 specifications and offers an advanced resolution of 800 dpi. Stealth's KYBX-400 series keyboard also features NVIS-compliant red adjustable backlighting, which makes this keyboard ideal for military, aviation or vehicle applications where night vision goggles are worn. The Stealth model KYBX-400-DT-BL-TB-USB has a list price of $695.

Stealth Computer, Woodbridge, Ontario, Canada. (408) 907-9151. [www.stealth.com].

2U System Supports Xeon, Core i7 and 32 x GbE LAN

A 2U rack mounted hardware platform designed with a redundant power supply is well suited for network-centric military applications. Built with Intel Embedded IA components with warranty of longevity, the PL-80160 from Win Enterprises supports Intel quad-core processors with Intel Hyper-Threading technology, including the Xeon, Core i7, Core i5, Core i3 and Pentium Dual-Core processors.

The platform supports four unbuffered ECC or non-ECC DDR3 1066/1333 MHz DIMM sockets with memory up to 16Gbyte. In order to provide the best network performance and utilization, the powerful storage interfaces include one 3.5" SATA HDD and CompactFlash. The optional onboard Cavium Nitrox PX cn16xx security co processor supports multi-security protocol commands that can offload the CPU thus increasing overall system throughput performance. This platform affords 8 Gbit Ethernet and max to 32 Gbit Ethernet ports via PCI-E by8 on the front panel. To prevent network problems when the platform shuts down, PL 80160 supports two segments of LAN bypass function through WDT and GPIO pin definitions. OEM quantity pricing for PL-80160 begins at $1,391.

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

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Special Feature: FPGA: Military's New Favorite Processor Once used merely as glue-logic, FPGAs are now complete systems on a chip. And now that many of them even have general-purpose CPU cores on them, the military is hungry to use FPGAs to fill processing roles. As the signal processing capabilities of FPGAs continue to climb, they've become key enablers for waveform-intensive applications like sonar, radar, SIGINT and SDR. This feature section delves into the solutions available in this area and explores how they're transforming military processor-based systems.

Tech Recon: Building Secure, Trusted Embedded Systems Tighter ITARS enforcement, greater network security dangers and fear about tampering are just some of the forces driving embedded computing suppliers to bulk up their expertise in building trusted embedded systems for their military customers. Articles in this section examine the latest trends along those lines, including an update on new initiatives in software and hardware security standards.

System Development: Training Systems Trends & I/ITSEC 2010 Product Preview Military simulation and training systems have taken on a whole different character as PC-based platforms take center stage. Articles in this section analyze the technologies behind that trend. Also featured is a preview of the products and papers to be showcased at the Interservice/Industry Training, Simulation and Education Conference (I/ITSEC).

Tech Focus: PXI, VXI and LXI Boards For complex, high-performance military systems, the PXI bus form factor and its older cousin VXI have become staples as instrumentation and test solutions. Now the LAN-based LXI form factor is the latest stepchild in this space to emerge on the scene. This Tech Focus section updates readers on the latest trends in these technologies along with a focused product album of representative boards in these architectures.

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Editorial

Jeff Child, Editor-in-Chief

R2-D2 and the Robot Frontier

There's no doubt military robots—or unmanned ground vehicles (UGV) as they're more often called—have proven an incredibly valuable life-saving resource in combat operations in Iraq and Afghanistan. And while UGV technology has nowhere near matched the level of maturity that UAVs have, they've come a long way over the past several years. As I've said before in this column, the military robotics market and its needs are very particular and can't necessarily wait for advances in other segments of the robotics market to fuel its forward progress. Industrial robotics in manufacturing, for example, is a pretty established and mature field of technology. Likewise, the consumer robotics segment—including entertainment and household robots—is accelerating rapidly and is well entrenched in regions like Japan. And clearly military UAV technology is no longer in its infancy and is now firmly into its adolescent stage. But the segment of defense robots designed to perform tasks on the ground—whether in wheeled vehicular form or small man-portable form—is in many ways still at the starting gate. A Star Wars R2-D2 is a long way off.

That's not to say there aren't established, proven UGV products getting the job done. The Small Unmanned Ground Vehicle, built by iRobot partner Boeing, has enjoyed huge success. This summer Boeing and iRobot received its fifth order to provide Small Unmanned Ground Vehicles (SUGV) to the U.S. Army. The recent order called for 94 new model 310 SUGV robots, plus spares, for a total value of $14.6 million. The 35-pound 310 SUGV systems provide the dismounted Explosive Ordnance Disposal (EOD) technicians the ability to perform recon during missions involving unexploded ordnance and IEDs. The SUGV forms part of the Army's Early Infantry Brigade Combat Team Capability Package (Early IBCT) within its BCT Modernization program.

Despite examples like SUGVs, the military is far from where it wants to be in terms of the unmanned ground vehicle segment of military robotics. One of the challenges of these technologies is that they're so specific to the types of environments and tasks they're designed for. Far more field testing and development is required for unmanned ground systems, unlike UAVs where a large amount of simulation can do some of the job.

With that in mind, there's been a number of government sponsored events to not only test the unmanned ground vehicle technology, but also to leverage robotics expertise from academia and the general public. An example along these lines is the 2007 DARPA Urban Challenge. That event required teams to build an autonomous vehicle capable of driving in traffic, performing complex maneuvers such as merging, passing, parking and negotiating intersections. Building on the success of the 2004 and 2005 Grand Challenges, this was the first time autonomous vehicles interacted with both manned and unmanned vehicle traffic in an urban environment.

In a similar spirit, the U.S. Army last year kicked off its first Robotics Rodeo. The event was conceived as a forum for scientists and engineers from government and industry to demonstrate new and innovative unmanned ground systems to the U.S. Army user and research and development communities. Unlike the DARPA Challenge events, the Robotics Rodeo is not a competition or sole-source justification. Instead it's more of a market research event to explore whether new technologies could potentially benefit Army robotics programs. Soldiers see the new technologies, ask questions and provide honest feedback to the industry representatives.

The 2010 Robotics Rodeo is scheduled for October 12 -15 at the Maneuver Battle Lab at Fort Benning, Georgia. This event is divided into two opportunities for demonstration: the Extravaganza and the cleverly acronymed Robotic Technology Observation, Demonstration and Discussion (RTOD2). According to the website, registration to the Extravaganza is open to the public, and registration is required prior to the event. RTOD2 is closed to the public, and vendors will be required to submit an application to participate. If the application is accepted, the vendor will be invited to demonstrate at RTOD2 and the Extravaganza.

The idea of the Extravaganza is to provide a single point of contact for networking opportunities among Soldiers and industry and government representatives. By making use of RTOD2, industry technology suppliers can demonstrate component technologies and gain recognition and visibility in the robotics field. The event serves as a central focus for Army senior leaders and OEMs and as a contact point for industry partners. All demonstrating technologies must be at Technology Readiness Level 6 or higher. That means systems must be completed or qualified through testing and demonstration, not research and development.

It's encouraging to see the military looking broadly to collect best of breed input on robotics technology. This particular segment has far more dots to connect than other robotics market segments. This goes for not just the robot end products themselves but also modular embedded computer and off-the-shelf motion control subsystems that are perfect for these systems. Many of the early UGV prototypes employed PC motherboards before they moved to more rugged embedded computers like PC/104 for their embedded brains. R2-D2 won't happen overnight, but the road has to start somewhere. ▮▮

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