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MULTIPLE DESIGN STRATEGIES EMERGE FOR UAV PAYLOADS

PLUS:

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10 Slot-Card and Box-Level Solutions Jockey to Meet UAV Payload Needs

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On The Cover: The Global Hawk UAV remains the platform of choice for a wide variety of sensors and it meets the global need for persistent ISR. In December Northrop Grumman delivered the first production Multi-Platform Radar Technology Insertion Program (MP-RTIP) sensor to the Air Force for integration on the first U.S. Air Force Block 40 Global Hawk. The first MP-RTIP Global Hawk flight is expected to happen this spring. (Photo provided courtesy of Northrop Grumman).

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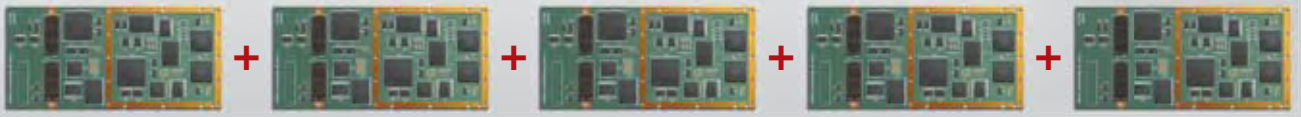

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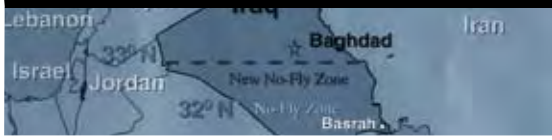

Wanted: Technology Warriors

During the Cold War and ever since, we always pushed to be the most technologically capable defense machine in the world. The old guard military leadership has the potential to let us down now. The next major assault by a foreign power will hit us where we never really felt the pain of war before. We will encounter a full frontal attack on our home front.

Through accident and trial and error our adversaries have learned that confronting us using men and hardware is just playing our game and into our strength. The next conflicts will be directed at our economy and infrastructure. We've become completely dependent on communications and the Internet. We can be brought to economic disaster in days with a cyber attack without anyone firing a single shot, or launching a single UAV. This country's strength is our economy and the ability to bring that economy into play when we face a foe.

We don't need a 6th generation fighter or the next generation aircraft carrier. We need a division of non-weapons-carrying technology superstars defending us from a technology attack and developing technology assault and counter attack weapons. These positions would not provide soldiers and future generals and admirals with the mystique of a Top Gun or a John Wayne—but are now more essential than additional elite combat troops.

Our current hardware-focused military is more than capable of dealing with the Irans, the Al-Qaedas and the North Koreas of the world. But what do we do when China says "Boo"? With the Soviet Union we had MAD (Mutual Assured Destruction). We have no such concept in place—good, bad or absurd—with China. Our hope is that China has such a financial investment in the U.S. that it would never do anything to intentionally disrupt our economy. However, China may be willing to suffer a little and take a technological shot at our economy that produces an effect similar to the hit we took from 9/11. That could be followed by a veiled threat of a more intense technological attack while they move on to Taiwan. That would cause our politicians to blink.

We need to develop a strong system for defense, recovery and attack in this new cyberspace conflict arena. To date we have numerous people stating that we are vulnerable and need to do something. We have people attempting to protect the Pentagon and military networks. We have private corporations attempting to protect their individual systems and networks. None of these efforts are coordinated or on the scale of a military development program. Future cyber attacks will be part of any conflict large or small. It is one arena where we are not the 800-pound gorilla in the room. We must expect, defend, recover and attack at all levels of cyber warfare from an attack on an individual soldier to an attack on the country's infrastructure.

We can't outsource cyber security to China or India. We need to have home grown expertise—the best in the world—and we need it now. The vast majority of the work needed in this arena will center on software and arrays of processing power to interrogate and implement needed processes. But some tactical and remote electronics installations will also be required. These remote installations are where our industry will have the greatest participation in this war.

What are the odds that Congress, the Administration, DoD and Senior Military Staff will see our vulnerability and move decisively to defend us from attack? The odds are better that once we are attacked, Congress and the Administration will follow the post 9/11 scenario and look to see who to blame for who failed to act outside their offices.

Now on a lighter note: Secretary Gates stated that he would leave the office in Q1 of 2011. Not sure if he thought he could wait out getting a 2011 budget before leaving. I wonder if he knows the words to the song "See You in September"? Or maybe he wants to hang in there until there is some vision for the end of the recent turmoil in the Middle East. If so, will he need to practice singing Auld Lang Syne for the year 20??. As Secretaries of Defense go, Robert Gates has given me the most consternation. One month I hate him. The next month I think he's the only one in DC with a brain. I guess overall that makes him very good at his job. Although I guess it depends on what month I'm in, I think I'm going to hate to see him go.

Pete Yeatman, Publisher
COTS Journal

AMD Embedded G-Series Processor: One Design, Fewer Watts, Massive Capability

AMD is ushering in a new era of embedded computing. The AMD Embedded G-Series processor is the world's first integrated circuit to combine a low-power CPU and a discrete-level GPU into a single embedded Accelerated Processing Unit (APU).

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The Inside Track

Army Contracts General Dynamics for Battlefield Handheld Computers

The U.S. Army has awarded General Dynamics C4 Systems a $2.3 million contract to provide a prototype, handheld battle command capability that will enable unprecedented network connectivity and increased command, control and situational awareness for dismounted soldiers and Marines. Two companies received contracts as part of the U.S. Army's Joint Battle Command – Platform (JBC-P) Handheld program. The devices give dismounted warfighters enhanced levels of battlefield awareness including the opportunity to visualize information that might not otherwise be available such as maps and real-time position location information.

For its prototype design, General Dynamics will provide the rugged, eight-ounce GD300 tactical computer (Figure 1) that hosts an "apps-friendly" operating system. Designed to provide dismounted users with situational awareness of events, people and structures, along with chat and texting capabilities, the GD300 also delivers position location information and access to popular military software "apps" like the Tactical Intelligence Ground Reporting (TIGR) system. When connected to a "networked device" such as the Joint Tactical Radio System (JTRS) Handheld, Manpack, Small Form Fit (HMS) Rifleman radio (AN/PRC-154), or the Iridium satellite communications handset, users will be able to make voice, video or data contact whether in close proximity or miles apart. Initial deliveries are scheduled for September 2011 when General Dynamics expects to deliver 40 prototype handheld devices for user evaluation and feedback.

General Dynamics C4 Systems
Scottsdale, AZ. (480) 441-3033. [www.gdc4s.com].

Figure 1

The GD300 tactical computer hosts an "apps-friendly" OS. The unit provides dismounted users with situational awareness of events, people and structures, along with chat and texting capabilities.

Emerson Network Power Launches Motherboard Customization Service

Emerson Network Power has introduced a customization program to specify the exact features and form factor required in an embedded motherboard. The Intel Atom processor is the first to be supported, with other Intel embedded processors being added during 2011. Users specify the processor, memory, I/O and connectors and RapiDex boards are built to the exact dimensions desired for ease of mounting in custom enclosures.

In contrast to conventional embedded board customization services, Emerson's RapiDex service is designed to enable boards to be delivered in time frames that were never possible before. With this service customers pay a small manufacturing set-up fee to receive first article boards. A simple specification procedure and a new Emerson Network Power manufacturing process enable fast execution of customer requests. Customers receive first article boards in as little as four weeks from order. On approval of these first article boards, customers can order volume shipments with a low minimum order quantity of only 100 units. Such numbers are well suited to the small quantities needed in many defense programs.

Emerson Network Power,
EmbeddedComputing
Carlsbad, CA.
(407) 241-2751.
[www.emersonnetworkpower.com].

Curtiss-Wright Controls Tapped to Provide Gear for CH-53K Helicopter

Curtiss-Wright Controls has received a contract from Sikorsky Aircraft Corporation to develop and supply the blade fold distributor units and digital air data computers for the CH-53K heavy lift helicopter (Figure 2) for use by the U.S. Marine Corps. The contract has a total potential value of $16 million if development and all aircraft production options and phases are completed. The blade fold units will process the required information to execute the folding or spreading of the main rotor blades, and provide monitoring and status communication with other CH-53K systems. The digital air data computer provides flight-critical height and speed information to the cockpit and other important helicopter systems.

Figure 2

Artist rendering of the CH-53K helicopter. The CH-53K is designed to transport heavy payloads over longer distances than its CH-53E predecessor.

The initial contract runs through 2011 with the production phase expected to start in 2013. Currently, the Sikorsky CH-53E Super Stallion is the largest and most powerful helicopter in the United States military. The CH-53K is expected to replace

the CH-53E helicopters that the Marine Corps currently deploys from amphibious assault ships to transport personnel and equipment, and to carry external cargo loads. The CH-53K helicopter is designed to transport heavy payloads over longer distances and will significantly reduce operation and support costs.

Curtiss-Wright Controls
Charlotte, NC.
(704) 869-4600.
[www.cwcontrols.com].

Saft to Supply Li-ion Military Vehicle Engine Batteries to Marine Corps

The United States Marine Corps (USMC) selected Saft to supply advanced energy storage systems for its Improved Battery System Program (IBS). Saft signed a four-year contract, worth up to $20 million, to supply high-energy and high-power lithium-ion (Li-ion) batteries to be demonstrated in military ground vehicles for engine start power and energy for extended silent watch missions.

The USMC IBS program was funded to demonstrate advanced chemistries to replace existing 6TL standard lead acid military vehicle starting batteries. Li-ion battery technology offers a number of key advantages for designers in the defense industry, including high-power and/or energy storage in a compact space and weight-saving package, high-efficiency, long calendar and cycle life (even when operating in extreme temperatures), and zero-maintenance requirements. Saft has developed a power control architecture that enables the use of Li-ion electrochemistry on a MIL-STD-1275 power bus. This architecture will be used to provide an energy storage system for Improved Battery Systems.

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

Lockheed Martin Hits Critical Design Milestone for Navy's SEWIP Program

Lockheed Martin held a successful critical design review for an electronic warfare system upgrade that will defend U.S. Navy surface combatants from evolving anti-ship missile threats. Under the Surface Electronic Warfare Improvement Program (SEWIP), the Navy is pursuing an evolutionary succession of enhancements to its AN/SLQ-32 electronic warfare system currently installed on aircraft carriers, cruisers, destroyers and other U.S. warships. A series of SEWIP block upgrades will incrementally add new defensive technologies and functional capabilities.

Figure 3

SEWIP Block 2 uses commercial-off-the-shelf electronics to provide the Navy with the latest surface ship electronic warfare (EW) capabilities.

Lockheed Martin's modular solution for SEWIP Block 2 (Figure 3) is based on its own Integrated Common Electronics Warfare System demonstrator, which operated over water for risk reduction in October 2010. This approach uses commercial-off-the-shelf electronics and provides the Navy with the latest surface ship electronic warfare capabilities, as well as enhanced flexibility to upgrade the technology to address emerging threats.

Lockheed Martin
Bethesda, MD.
(301) 897-6000.
[www.lockheedmartin.com/ms2].

Hughes Wins U.S. Air Force SATCOM Study Contract

Hughes Network Systems was awarded a $495,000 contract by the U.S. Department of Defense (DoD) to conduct an architectural study of commercial communications satellite (COCOMSAT) systems capabilities. The report, which will focus on meeting the future tactical communications-on-the-move (COTM) needs of the U.S. military, is expected to be delivered to the U.S. Air Force Space and Missile Command Center's Military Satellite Communications (MILSATCOM) Systems Directorate by July 2011.

Figure 4

Hughes research DoD COTM requirements and scenarios using processing satellite architectures such as those employed by the Hughes commercial SPACEWAY 3 satellite.

Under the terms of the agreement, Hughes will conduct research on DoD COTM requirements and scenarios using processing satellite architectures such as those employed by the Hughes commercial SPACEWAY 3 satellite (Figure 4), which today provides service to more than 400,000 Ka-band terminals in North America. Additionally, Hughes will study COTM applications using transponded satellite architectures such as those being employed by the high-capacity Hughes commercial Jupiter satellite, a 100+ Gbit/s Ka-band satellite system, which is under development for launch in 2012. The study also includes analysis of commercial satellite system acquisition processes and how they may be applied to future satellite acquisitions by the military, including various lease or buy options.

Hughes Network Systems
Germantown, MD.
(301) 428-5500.
[www.hughes.com].

Event Calendar

May 17
Real-Time & Embedded Computing Conference
Washington, DC
www.rtecc.com

May 19
Real-Time & Embedded Computing Conference
New York, NY
www.rtecc.com

May 24
Real-Time & Embedded Computing Conference
Boston, MA
www.rtecc.com

June 21
MILESTONE
Baltimore, MD
www.milestone2011.com

June 23
MILESTONE
Nashua, NH
www.milestone2011.com

To list your event, email:
sallyb@rtcgroup.com

Special Feature

Box vs. Slot Card Approaches for UAV Payloads

Slot-Card and Box-Level Solutions Jockey to Meet UAV Payload Needs

Rugged box-level systems and slot-card systems each have advantages. For UAV payload applications, the importance of both form and function drive this choice.

Jeff Child, Editor-in-Chief

A trend has been building in the past couple years where traditional embedded board vendors are adding stand-alone rugged box-level systems to their military market offerings. These complete system boxes provide a tested and enclosed computing solution that eliminates complex integration chores for customers. A key decision facing today's military system developer is that of caged cards versus an off-the-shelf box-level computer. The traditional approach is to use slot-card boards in a card cage. This means choosing a bus architecture, a rugged card cage and an SBC, plus any additional I/O boards to fulfill the requirements.

In the case of a tech refresh or tech upgrade program, the bus architecture is already given—VME being the most prevalent for military applications. More recently, for applications where size, weight and power have priority over past compatibility with legacy boards, the option of rugged box-level systems that are basically monolithic integrated computers is popular. The slot-card approach brings with it a number of merits. It offers the greatest flexibility in the I/O complement that can be supported. If an MIL-STD-1553 interface is needed, such a board can be added. The flexibility of a slot-card system is particularly useful when not all the I/O requirements are defined at the beginning of a project—a situation not uncommon in military programs. Moreover, some applications like comms and networking systems often require slots left open for the end-user for reconfiguring systems functionality in the field.

Trends in UAV Payload Designs

In the case of large UAV payloads, what's happening is that multiprocessing with arrays of big, power-hungry boards based on general-purpose processors is being replaced with more integrated boards sporting FPGAs. This system consolidation is impacting the radar, imaging processing and communications capabilities of next-gen large UAVs. At the same time, stand-alone function-specific box-level systems are in some cases replacing traditional slot-card implementations.

Figure 1 Predator MQ-1 UAVs are packed with electronics. Platforms include day/night Full Motion Video sensors, Signals Intelligence (SIGINT) and Synthetic Aperture Radar (SAR) sensor payload, avionics and data links.

Requirements for large and medium UAV platforms—like Global Hawk, Predator and Reaper—include what seems like an endless appetite for increased onboard compute density. The payloads aboard those systems are enabling ever greater autonomy for the UAV and its mission. The movement is toward more capable radar systems that fit into the same space, and in some cases more compact radar electronics to make room for other payload electronics.

Predator (Figure 1) and Reaper UAVs are packed with electronics. Platforms consist of an array of sensors to include day/night Full Motion Video, Signals Intelligence (SIGINT) and Synthetic Aperture Radar (SAR) sensor payload, avionics and data links; a ground segment consisting of a Launch and Recovery Element (LRE), and a Mission Control Element with embedded ground communications equipment; a support element; and trained personnel.

Focus on Mission Platforms

On the technology supplier side, meanwhile, the definition between box-level and slot-card offerings is starting to blur. What's happening is military embedded computing vendors are expanding their offerings to include "mission payload" style pre-integrated systems. These systems often have swappable slot cards inside them, but they're provided in an enclosure system with pre-testing and integration features already provided.

An example along those lines is the MPMC-9341 Multi-Platform Mission Computer. Developed by CWCEC's Embedded Systems group, this natural convection-cooled rugged 4-slot OpenVPX features a built-in power supply and four 3U OpenVPX system slots that can be configured to accommodate up to four SBCs for high-performance multiprocessing applications, or as a mix of SBCs and I/O modules to handle specific program I/O requirements. The MPMC-9341 uses advanced packaging techniques to provide the processing power of up to four SBCs in a rugged enclosure that measures a compact 600 cubic inches yet is able to operate and survive external air temperatures of 55°C using only natural convection. It features a rugged enclosure designed to the meet military specifications including MIL-STD-810 for environmental conditions, MIL-STD-461 for EMI, and MIL-STD-704 for power.

Beyond a computing system building block approach, some vendors are getting closer to the end application needs of the military system developer. Themis Computer's Mission and Payload System initiative, for example, includes preconfigured versions of the 3U VPX and mezzanine modules, backplanes, I/O controllers, front panels and chassis cooling options. These systems allow customers to buy true COTS systems, with a standardized option set, suitable for many Mission Computer, Display Processor, Digital Map, EW Controller, SIGINT Recorder, Bus Data and Voice Recorder, and Payload Management applications.

Configurable Payload Options

The initial conduction-cooled 3U VPX MPSI product suite includes a high-performance Intel Core i7 (Arrandale)-

Figure 2

The 10 G Series Record & Playback system is comprised of the DTA-2300, a 10 Gigabit network attached Digital IF Transceiver (software radio, up to 16 Channels), and one or more DTA-5000(s) server-based disk.

based SBC, an AMD E4690-based GPU module, an 8-Port SATA/SAS RAID Controller and XMC/PMC Carrier module, and a Mass Storage Carrier for 256 Gbyte flash or 500 Gbyte non-rugged rotating media. I/O options are extended, through the use of the XMC/PMC I/O Carrier, which hosts a wide range of I/O controllers, including MIL-STD-1553, ARINC 429, High Speed Serial, ATDS, Discrete and Analog I/O. Included in the MPSI suite is a series of third-party Software Defined Radio and FPGA Modules. Packaging options for the MPSI suite include two new Themis designed chassis systems, an 8-slot, ½ ATR high-power chassis with multiple cooling and storage options; and a 5-slot convection-cooled chassis intended for smaller footprint and lower power applications.

Stand-alone systems offer some unique advantages. GE's daqNet, for instance, is designed for acoustic data acquisition applications, and it offers improved acquisition performance due to the controlled noise environment inside the box when compared to a slot-card-based system. But it also has higher channel density—which provides a smaller footprint on space-constrained vessels such as submarines)—and easier integration. Since all command and control and data flow over Ethernet, no operating system or drivers are required. This approach also gives a lower cost per channel when compared to an equivalent slot-card-based system.

Ethernet-Based Box-Only Approach

Start-up D-TA Systems meanwhile has taken an approach of moving beyond the slot-card era completely. Its new flagship product uses 10 Gbit Ethernet as its data movement medium. The company's 10 G Series Record & Playback systems (Figure 2) can perform synchronous (phase-coherent) record and playback of radio signals from multiple antennas. A 10 G system is comprised of the DTA-2300, a 10 Gigabit network attached Digital IF Transceiver (software radio, up to 16 Channels), and one or more DTA-5000(s) server-based disk storage system. The DTA-3200 Multi-Channel Tunable RF1IF Transceiver system is optional.

The DTA-2300 offers 16-bit precision and supports sample rates up to 130 Msample/s. In the record mode, the IF signals are digitally down converted to baseband and stored as complex (I & Q) signals. The IF and BW (FIR filter decimation) are programmable. In the playback mode the baseband signals are up converted to desired IF(s). The DTA-2300 provides four 10 Gigabit links, one for each group of four channels. One DTA-5000 system is used for each 10 Gigabit link. A 16-channel system can offer a sustained throughput rate close to 3 Gbytes/s and a storage capacity of over 38 Terabytes. ■■

Special Feature

Box vs. Slot Card Approaches for UAV Payloads

System-Level Approach Wins for UAV Radar Payload Designs

A unified system-level approach for military UAV applications puts embedded heterogeneous reconfigurable computing to work providing a low SWaP solution.

Mark B. Tellez, Director of Business Development
SRC Computers

Over the last decade the use of UAVs has grown from a rarity—strictly in support of high-risk military operations—to virtually commonplace, supporting border security, drug enforcement and mapping to name a few application domains. The military market however still remains a UAV market segment that is seeing some of the most dramatic growth. The Teal Group's 2011 market study estimates that UAV spending will almost double over the next decade. As the power and versatility of UAV platforms has expanded, requests have dramatically increased for new and enhanced features and applications that push the boundaries of onboard computation. Confined by Size, Weight and Power (SWaP), developers are now seeking new ways to deliver these compute-intensive applications that military UAV customers are demanding. The ground penetrating radar aboard the MQ-9 Reaper is an example along those lines (Figure 1).

The task of delivering significant performance improvement for military UAV applications requires a heterogeneous mix of processing elements. This is due to the fact that strict SWaP constraints limit the addition of more microprocessor cores as one might do in a non-constrained computing environment. Achieving the performance predicted by Amdahl's law (see box "What is Amdahl's Law?") also requires dealing with complex issues such as data access, movement, aggregation and ease of programmability.

Figure 1

The Tactical Reconnaissance and Counter-Concealment-Enabled Radar (TRACER) aboard the MQ-9 Reaper marked the first penetrating radar flown on a fixed-wing UAV.

Unified Reconfigurable Systems

High-performance computing requirements cannot be achieved through the use of loosely coupled processing elements, I/O-based interconnect or disjointed programming environments. These components are typically developed independently for broad marketplace usage and are not tailored for optimal performance with each other. Unified reconfigurable computing (RC) systems are an excellent and increasingly popular choice in the military market to provide this heterogeneous compute environment due to their lower power consumption and extremely high computational densities compared to traditional mi-

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IPC 42312 2U SPACE SAVER SERVER

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- MIL-STD-810G compliant

croprocessors or General Purpose Graphics Processor Units (GPGPUs) while also providing tighter integration.

Some developers unfortunately take a short-sighted approach, mistakenly focusing on individual components and selecting them on stand-alone characteristics. In contrast, a unified approach enables developers to deliver optimum system performance with reduced cost by cutting the development resources and reducing overall development time. SWaP is also reduced by utilizing such an approach while simultaneously achieving a higher computational density for Intelligence, Surveillance and Reconnaissance (ISR) applications on military unmanned airframes. Improvements in programming tools have simplified the application development process as well, improving time-to-market and lowering total cost-of-solution. This article will examine the benefits of a unified system-level approach for compute-intensive military UAV applications using a COTS-based general-purpose reconfigurable heterogeneous solution.

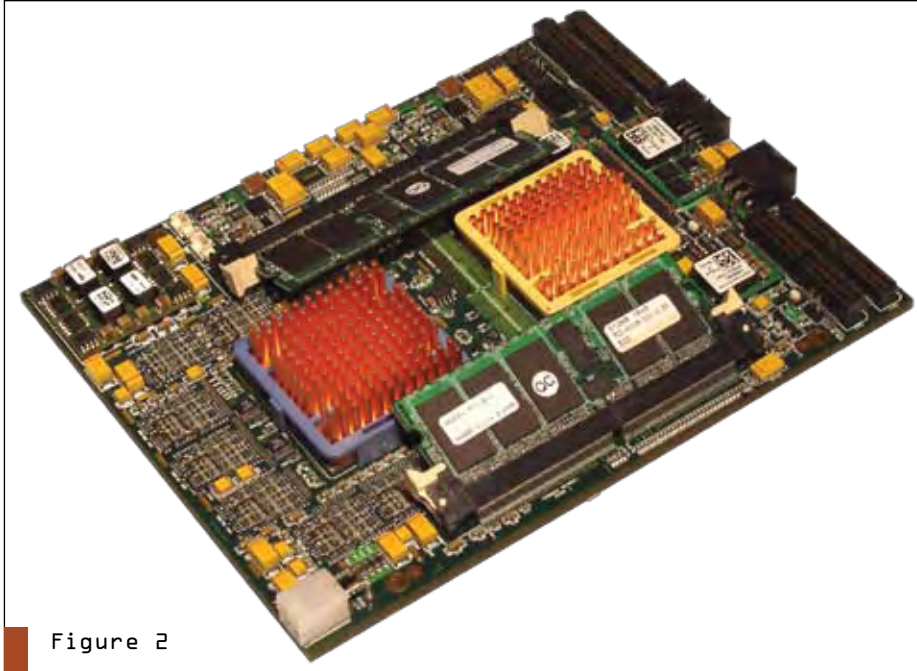

Figure 2

The SRC Series H MAP processor is designed to fit in a standard 5 ¼ inch drive bay enclosure envelope.

Payload Design: The Larger View

When tasked with the efficient deployment of SWaP-limited UAV payloads that are required to deliver truly significant performance improvements, it is crucial to take a larger view of the solution and consider a heterogeneous mix of processing elements. This view must acknowledge and address complex issues such as data access, movement, aggregation, power efficiency and ease of programmability. Since reconfigurable processing offers the highest performance per watt, it clearly becomes the leading candidate in the consideration process.

The circuit technology used in a reconfigurable computing system is the Field Programmable Gate Array (FPGA) integrated circuit. This is an explicitly programmed device that executes application-specific algorithms with very high computational efficiencies compared to general-purpose compute devices such as the CPU or a GPGPU. Even with these computational advantages, the overall system performance requirements are not achieved if data cannot be efficiently transferred to where it is needed. Providing peer-to-peer connections between all the processors, through either system memory or across a low latency interconnect like HT3 (HyperTransport 3) or QPI (QuickPath Interconnect), is the only predictable way of deriving maximum performance from the reconfigurable processors.

Another major consideration in the development and tuning of a military ISR application are the programming tools that are available for the developer. Fortunately, the current generation of tools has improved vastly over the last decade. Programmers can now take code written in ANSI standard languages such as C and Fortran and, with the help of these tools, port and optimize their code with relative ease, creating a single unified executable that can run on traditional and RC systems. In addition, by utilizing a single solution vendor for software tools and system hardware, developers can further simplify their job by ensuring all the required optimized drivers and software environments are available and fully supported.

A Better Approach

To achieve optimal solution performance all processing elements must be allowed to operate at peak capability within the system. Taking a high-performance accelerator like a GPGPU or a reconfigurable processor and adding it to a system as if it were a Network Interface Card (NIC)

What Is Amdahl's Law?

Amdahl's law is a model for the relationship between the expected speedup of parallelized implementations of an algorithm relative to the serial algorithm, under the assumption that the problem size remains the same when parallelized. For example, if for a given problem size a parallelized implementation of an algorithm can run 12% of the algorithm's operations arbitrarily quickly (while the remaining 88% of the operations are not parallelizable), Amdahl's law states that the maximum speedup of the parallelized version is 1/(1 – 0.12) = 1.136 times as fast as the non-parallelized implementation.

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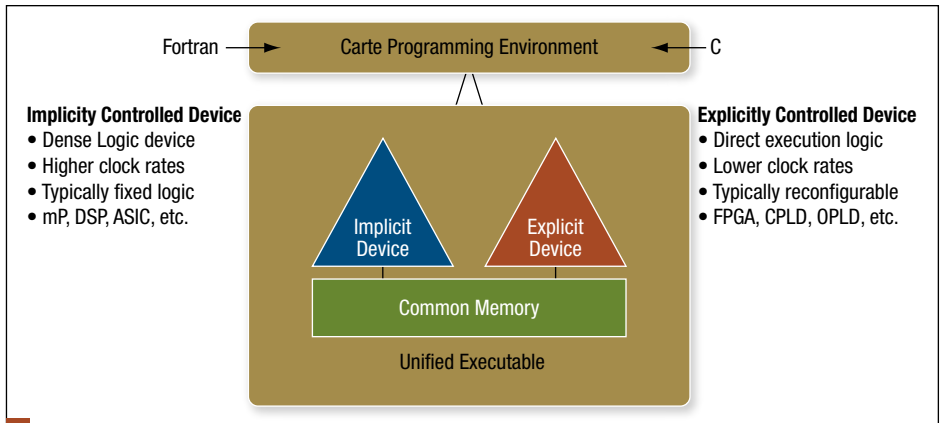

Figure 3

Illustrated here, IMPLICIT+EXPLICIT Architecture establishes a peer relationship between the explicit and implicit processors to give them the ability to access system memory contents.

card simply doesn't make sense due to additional latencies and overhead that wind up being inserted into the system. To gain maximum performance these processors must have peer-to-peer access to data and other processing components.

Over the years alternative approaches have been tried, including placing FPGAs in processor sockets. The processor manufacturers, recognizing the needs for a better interconnect, have stepped forward with the QPI and HTX (HyperTransport eXpansion) interconnects from Intel and AMD respectively. However, neither of these solutions has proven to be very successful for reasons mainly related to licensing issues and physical limitations. It has also been shown that interconnecting through the memory subsystem of the microprocessor can yield a high bandwidth low latency interconnect between peer processors. Ultimately, the interconnect chosen must satisfy the need for overall performance balanced with the constraints of the given platform.

Optimal performance also depends on the developers understanding of their application. It is usually impractical or impossible to port an entire application to an FPGA, and due to the structure of most applications, totally unnecessary. By using advanced development tools and their understanding of the application, developers can identify "hot spots." These are sections of the overall application that consume the bulk of the system's compute resources. These hot spots are further analyzed, and a variety of techniques can then be used to optimize them for maximum performance.

A Case in Point

In 2006, the U.S. Army approached Lockheed Martin with a challenge. They wanted to improve the SWaP characteristics of their proven foliage penetration (FOPEN) radar system. This incorporated dual-band synthetic aperture radar, and provided high-resolution images in all-weather, day or night conditions. The new solution was to be flown on a UAV, which would require massive reductions in SWaP while also increasing image fidelity. Traditional microprocessor-based solutions were unable to meet this challenge, so Lockheed turned its attention to FPGAs and SRC Computers' reconfigurable MAP processors (Figure 2).

The MAP processors provided a COTS solution that delivered optimal performance and much better SWaP than microprocessor-based alternatives. In the end the results were dramatic. The resulting system reduced both the weight and power consumption by 90% while achieving the desired increase to near real-time image quality.

Autonomous Access to Memory

The architecture that delivered these results was SRC Computers' IMPLICIT+EXPLICIT scheme (Figure 3). It uses the MAP processor and the SRC-developed interface to establish a

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Photography Courtesy of Lockheed Martin

peer relationship between the microprocessor and reconfigurable processors in the system. As a result, both the explicit and implicit processors have the ability to access system memory contents autonomously. In this fashion, overhead associated with having both types of processors working together on the same program is minimized. This allows the programmer to utilize the processor type that is best suited for a given portion of the overall application without concern for control handoff penalties. The SRC white paper titled "IMPLICIT+EXPLICIT Architecture" covers the architectural details in more depth and is available upon request from SRC Computers.

Traditionally reconfigurable solutions have been viewed as difficult to program, due to having to learn a proprietary or hardware description language, and being challenging to maintain or upgrade. SRC Computers' software tools and libraries using ANSI standard languages are dedicated to enabling programmers to easily extract high performance for their UAV applications. In Lockheed Martin's case, there were more than 250,000 lines of C++ code that had been developed for FOPEN. They assigned three programmers to the task of porting this application to the SRC system using the SRC Carte Programming Environment. Just three months later they finished the port, allowing Lockheed Martin to more rapidly deploy their solution to the end customer, the U.S. Army.

The result of this work was the Tactical Reconnaissance and Counter-Concealment-Enabled Radar (TRACER), a dual-band Synthetic-Aperture Radar that detects in near real-time, vehicles, buildings and other man-made objects that are buried, camouflaged or concealed under foliage. TRACER now flies aboard the MQ-9 UAV and marks the first time a penetrating radar has flown on a fixed-wing UAV.

Programming Challenges

The growth of the military UAV market has spurred an ever-increasing demand for new applications and enhancements that cannot be addressed using traditional approaches to computation. Many of the SWaP constraints of the UAV platform are increasingly turning developers toward technologies such as reconfigurable computing that deliver much greater computational densities than competing technologies.

The best way to address these growing demands is to treat the computer platform as a balanced unified system consisting of traditional microprocessors, high-performance interconnect, reconfigurable computing modules, and current generation ANSI C and Fortran-based development tools. Using this approach, developers can deliver the performance that military UAV customers are demanding in a manner that meets SWaP, budget and time-to-solution constraints. ▮▮

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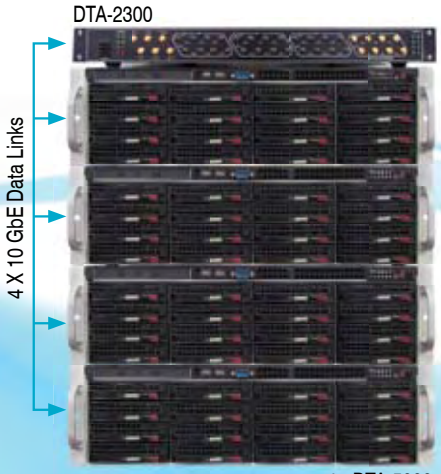

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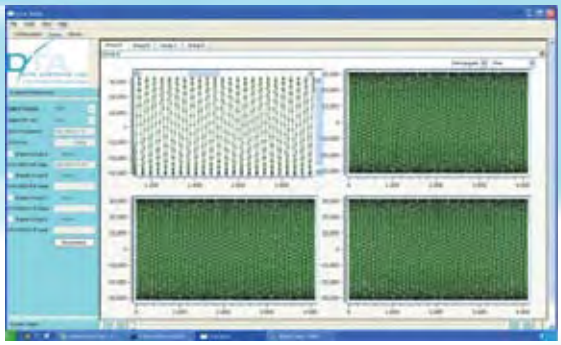

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Unified Approach Paves New Path for Military Data Storage

A new class of data storage products for military embedded systems has recently emerged. This new class of unified, scalable storage enables common storage blades to satisfy diverse storage requirements.

Greg Bolstad, Chief Systems Architect
Critical I/O

Data storage is an increasingly important component of many military embedded systems. In particular, Intelligence, Surveillance and Reconnaissance (ISR) systems generate large volumes of data that often must be recorded in real time for later analysis. These systems require high storage capacity and performance, usually with size, weight and power (SWaP) constraints. Often there are different types of storage requirements such as high bandwidth embedded data recording as well as more generic file serving and general purpose RAID storage needs. Centralizing a system's diverse storage requirements using a common and unified storage platform can dramatically reduce cost, weight/power and greatly simplify storage management. Diverse and separate storage devices are combined into a single, common and scalable storage architecture.

Storage implementations used in conjunction with embedded systems have historically fallen into two categories. One is low capacity, low performance embedded storage boards. The other is higher capacity, higher performance, but physically much larger and heavier external storage boxes or subsystems. However, current flash-based Solid State Drive (SSD) technology—combined with optimized storage controller architectures—has fueled the development of embedded storage blades that provide high levels of consistent performance, reliability and capacity.

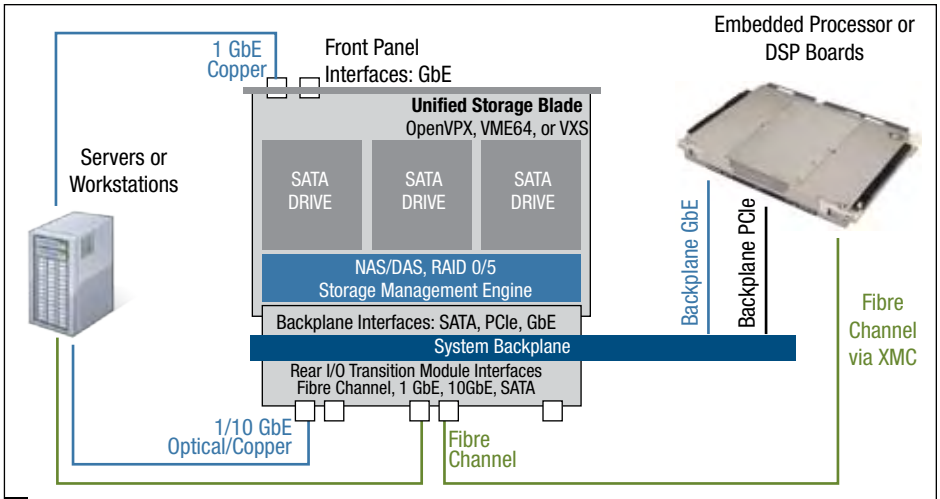

Figure 1

A Unified Storage Blade provides a complete embedded data storage solution that supports a wide variety of storage protocols and interfaces.

Unified Approach

A recent innovation in embedded storage that supports these diverse needs is the concept of unified, scalable embedded storage. The building blocks of this approach are flexible storage blades. Unified storage means that all of a system's storage needs (the various storage models, protocols and interfaces) can be supported by a single storage blade. And since these blades are scalable, multiple instances of the storage blade can be aggregated to provide higher levels of capacity and performance, while still being integrated, managed and used in exactly the same manner as a single blade.

The flexibility of a unified storage

blade architecture allows it to be used for a large variety of embedded storage applications. It is possible to replace large power-hungry external RAID and NAS boxes with a compact, simple, high-performance and high-reliability single blade solution. Some typical applications include Intelligence, Surveillance and Reconnaissance (ISR) systems and Radar/Sonar/Imaging data recording and playback.

Unified Storage Blade Architecture

The architecture and connectivity options of a typical unified storage blade are shown in Figure 1. These blades are generally in OpenVPX or VXS form factors, and contain onboard SATA drives for storage, generally flash-based SSDs. Such blades sport a high-performance storage management engine and provide support for a variety of interfaces to connect storage clients to storage blades.

The storage management engine implements a "storage stack" that controls storage and interface functionality. A unified storage stack supports both file access (Network Attached Storage - NAS) clients by hosting one or more server file systems, which are then exported to NFS, CIFS, or FTP clients. Block access (Direct Attached Storage - DAS, aka RAID/JBOD) clients are supported by providing one or more "virtual disk" or RAID targets, which are then exported to clients using iSCSI, FCoE, PCIe DAS, or Fibre Channel protocols.

RAID offers the advantage of aggregating the performance and capacity of several SATA storage devices, which provides higher capacity and better performance as compared to individual partitions. If RAID 5 is used, it offers the further advantage of parity-based data protection to prevent loss of data in the event of a drive failure.

Storage Usage Models

Data storage is divided into two main categories: Direct Attached Storage (DAS), which provides block level storage access (sometimes thought of as RAID or JBOD storage); and Network Attached Storage (NAS), which provides shared file level storage access. The difference between these two is primarily where the file system is hosted. As illustrated in Figure 2, for the DAS block access storage model, the storage client hosts a local file system. For the NAS file access storage model, a server file system is hosted within the NAS storage blade itself. NAS storage is always accessed by clients via an Ethernet network interface, using protocols such as NFS, CIFS/SMB and FTP. DAS storage is accessed using a variety of interfaces/protocols, including PCIe, Fibre Channel, Ethernet/iSCSI and Ethernet/FCoE.

Unified storage blades support both NAS and DAS operation, and typically provide both RAID 0 and RAID 5 storage capabilities. RAID 0 is a performance-centric model, which stripes data across all drives. RAID 5 also stripes data across drives, but adds a parity block for each data stripe, thus providing data protection in the event of a drive failure. Because one "drive's worth" of performance and capacity is essentially consumed for parity in RAID 5 implementations (note that parity is actually distributed among all three drives), the write performance and capacity when using a RAID 5 configuration will be reduced as compared to RAID 0.

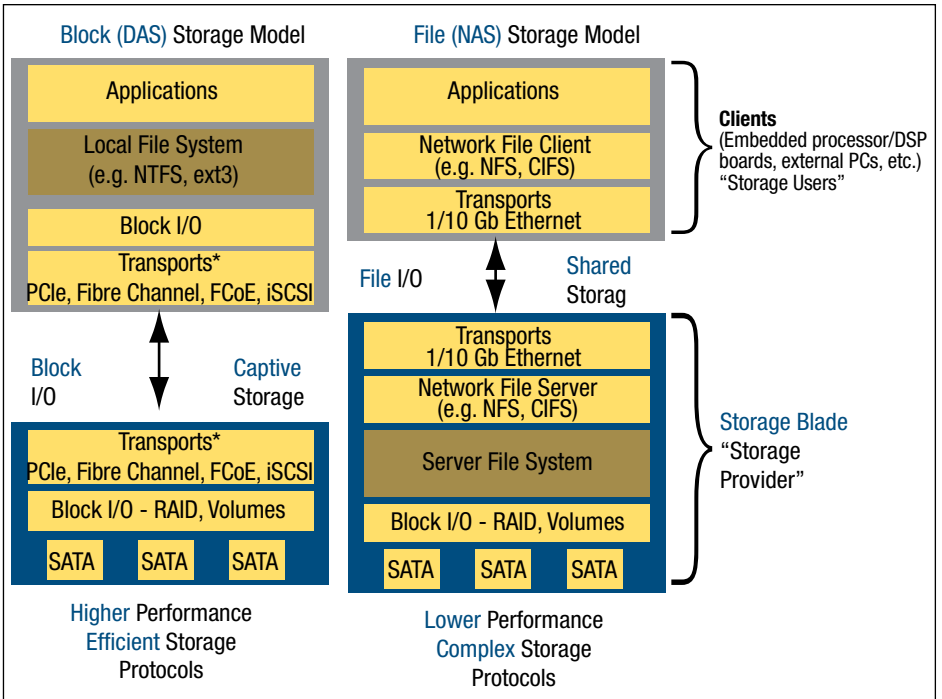

Figure 2

The key differentiator for File vs. Block Storage Access is where the storage file system is hosted—either on the storage client or the storage blade.

Storage and Scalability

Unified storage blades may also provide scalability in storage capacity and performance. Multiple blades can be aggregated, using the high-speed serial paths available in current generation OpenVPX and VXS backplanes to implement PCIe expansion paths between multiple storage blades.

Several different aggregation models

can be used, one of which is shown in Figure 3. In this configuration, one storage blade acts as the "primary" blade, with which the storage users (clients) communicate. This example shows one client using file sharing (NAS), while the other client is using block access (DAS). The primary blade then uses backplane PCIe connections to three expansion blades to aggregate the capabilities of all the blades. This makes the set of four blades appear to the storage clients as though they were a single blade.

Physical Interfaces

Storage clients can connect to storage blades using backplane, front panel, or rear transition module (RTM) connections. A variety of interfaces are typically supported.

Ethernet (NAS) – NAS operation requires an Ethernet connection between NAS clients and storage blades. Multiple options for Ethernet connectivity include front panel, backplane and rear transition module (RTM) connections. Many standard VPX and VXS systems provide 1 Gbit Ethernet connections integrated into backplanes, and these can be used to provide NAS connectivity between processor boards and storage blades.

PCIe (DAS) – PCIe connections are generally made using embedded backplane high-speed fabrics, though in some situations the connections may also be made using RTM PCIe access. Storage clients run a lightweight PCIe DAS storage driver.

Fibre Channel (DAS) – Storage clients may use standard Fibre Channel PMCs/XMCs along with the use of standard Fibre Channel initiator drivers.

Storage Protocols

NAS (Network Attached Storage) capability provides file-level access to data. This allows data storage to be accessed and shared via standard file access protocols. These include NFS, CIFS/SMB, FTP and High Performance Streaming NAS. DAS clients use block level storage access protocols to store or access data. There are several commonly used DAS

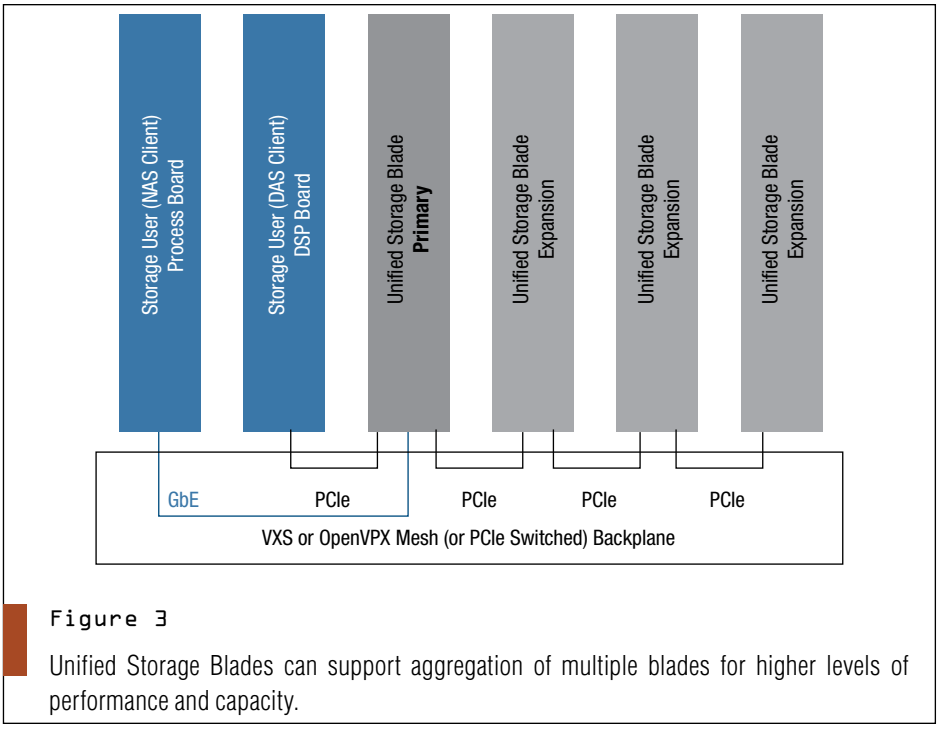

Figure 3

Unified Storage Blades can support aggregation of multiple blades for higher levels of performance and capacity.

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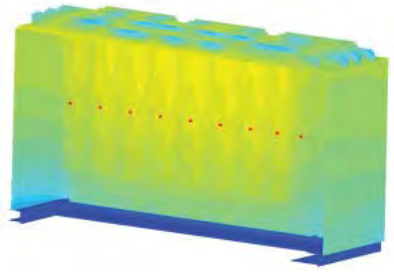

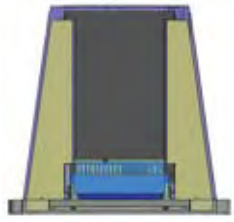

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block level protocols, including PCIe Direct Connect, Fibre Channel, Ethernet/iSCSI and Ethernet/FCoE. PCIe DAS is an extremely efficient method of adding high-performance RAID storage to PCIe enabled embedded processor boards. Storage clients use a lightweight PCIe client (host) driver that runs on the client board. Fibre Channel, meanwhile, is a multi-gigabit storage networking technology, which is the standard for storage area networks (SAN). Clients use a Fibre Channel interface and driver to connect to storage blades.

Performance Considerations

Storage blade performance is determined largely by three factors: the storage access protocol used, the storage access pattern and the choice of the physical storage media. For DAS (block access) applications, the client processor hosts a file system that is provided by the client's operating system. The client thus utilizes storage in a low level block mode. The allocation and use of these low level storage blocks is controlled completely by the client file system, thus (unlike NAS storage) DAS stored data cannot typically be shared between multiple clients. Because the DAS transport protocols are extremely efficient, data transfer rates for DAS storage can be very high, over 700 Mbytes/s.

Because NAS (file sharing) storage access is file based, NAS managed data can easily be shared among multiple clients. But data transfer rates for NAS storage are more moderate (as compared to DAS operation), due to the additional complexity of the NAS protocol stacks. A typical data transfer rate for NAS operation is 100 Mbytes/s.

Example System

An example of a unified storage blade is Critical I/O's new StoreEngine (Figure 4) storage blade. It provides simultaneous block (DAS/RAID) and file sharing (NAS) access to up to 3 Terabytes of onboard SATA-based SSD storage at rates of over 700 Mbytes/s for DAS access, and over 150 Mbytes/s for NAS access. Multiple units may be aggregated for even higher performance and larger capacities. Hardware-based RAID0 and RAID5 capabilities are built in, along with a simple but comprehensive web-based configuration and management interface. Available form factors include 6U OpenVPX, VXS and VME64.

StoreEngine provides protocol support for all major storage access protocols, including file sharing (acting as a file server) using NFS, CIFS/SMB, or FTP, as well as block level storage access (acting

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Figure 4

The StoreEngine unified storage blade provides simultaneous block access (DAS/RAID), file access (NAS) and high-speed recording access to onboard RAID 0/5 solid state storage.

as a RAID or virtual disk) using PCIe or Fibre Channel. StoreEngine supports simultaneous usage of all of these protocols, so users may "carve" up the unit's SATA SSD storage such that one portion is used for a NFS file server with RAID5, another portion used for a CIFS file server, and yet another portion exported for block level storage via PCIe or Fibre Channel. Special high-speed recording modes are also supported by StoreEngine, allowing aggregation of the units to record data at rates of over 2 Gbytes/s with aggregated recording capacities of up to 12 Terabytes using four StoreEngines.

The flexibility and performance available from the new generation of unified embedded storage blades allows them to be used for a large variety of embedded system applications, replacing large, power-hungry external RAID or file server boxes with a compact, simple, high-performance and high-reliability single blade storage solution. ■■

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System Cooling: Challenges and Solutions

Complex Systems Pose Tricky Thermal Management Challenges

As military systems grow more complex and use ever more computing, thermal management becomes more of a challenge. Aspects such as ambient temperature, altitude and power dissipation have to be factored in early in the design.

David O'Mara, Product Manager
Kontron

Today's military applications routinely push the limits of size, weight and power (SWaP) restrictions while at the same time performing with the utmost reliability in intense environmental conditions. These extreme applications also are advancing to feature ever-increasing computational performance and communication bandwidths that, in turn, have driven significant power densities at the board, chassis and platform levels.

The evolution of military system design makes it a necessity that military designers be sharply focused on innovative thermal management techniques to ensure fault-free performance. COTS board and system-level solutions are increasingly providing new subsystem capabilities and are enabling new designs that meet or exceed current mil/aero thermal requirements. However, it is essential that military designers have thermal methodology expertise that includes a thorough understanding of the environmental influences that cause systems to generate heat and how design choices efficiently and reliably dissipate that heat.

Figure 1

Global Hawk UAV lands at Edwards Air Force Base, CA after an eight-hour mission. Its onboard systems need to withstand both the conditions at altitudes of over 60,000 feet and sometimes hot temperatures on a tarmac.

Size, Weight, Power and Cooling

The challenges for military system design with regard to cooling techniques have increased along with higher performing processors, smaller system footprints and the evolution of extremely rugged environments. Battlefield settings today include severe temperatures, shock and vibration, explosive decom-

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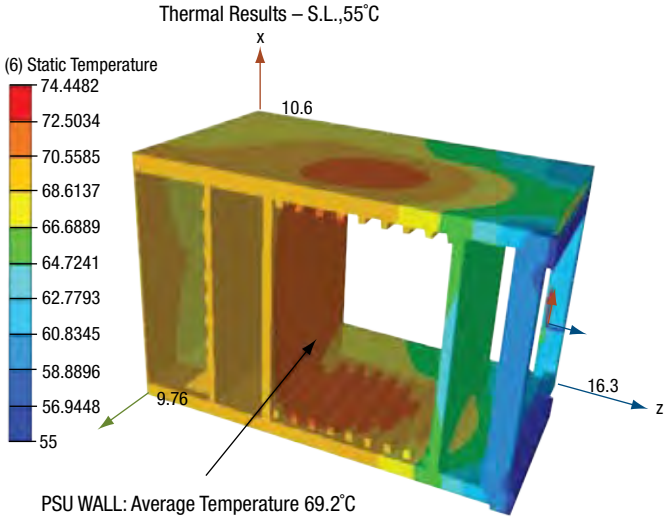

SLOT	AVE WALL TEMP (C)
1	66.2
2	67.1
3	68.7
4	69.1
5	70.1
6	71.3
7	71.9
8	71.1

Figure 2

Using Computational Fluid Dynamics (CFD) analysis, engineers can optimize the pressure and temperature characteristics of each design. Thermal modeling protocols consider thermal, electrical and environmental stresses and illustrate careful consideration to heat exchanger design, flow paths and fan selection.

Power Dissipation vs. Cooling Method

Option	Performance (Watts per inch of Pitch)*
Conduction Cooled – Passive Convection (no fan)	25
Conduction Cooling – Cold Plate	50
Conduction Cooled – Air Blown through chassis side walls (Fan or plenum)	75
Convection Cooling – Air blown (fan or plenum air)	100
Conduction Cooled – Liquid Cooled through chassis side walls	125
Conduction Cooled – Liquid flow through modules	500
Spray Cooling – direct impingement on ICs	700

*depending on ambient conditions

Table 1

Shown here are approximate power dissipation capabilities for various cooling schemes. Environmental conditions, including the three primary factors of ambient temperature, altitude and generated power, may create notable variation in these approximate values.

pression, immersion or exposure to sand and dust—just a handful of the potential variables up for consideration by designers building rugged, high-performance military systems. As a result, the SWaP protocol has transitioned into SWaP-C (Size, Weight, Power and Cooling) as a priority focus for packaging engineers solving thermal challenges of these next-generation designs.

While thermal management is an acquired and practiced skill, there are a set of general guidelines (Table 1) that are useful in helping military designers determine limitations and attributes of cooling methodologies. The optimal thermal solution for a particular application, conversely, is much better defined by its unique set of design characteristics and requirements. Each thermal equation has its own parameters and data points that must be fully evaluated before committing to an embedded computing platform or systems packaging solution. A critical starting point is defining the operational environment—airborne, naval, ground command or mobile, or all of the above—that will guide packaging engineers in determining thermal options.

Key Initial Data Points

The key initial data points include ambient temperature, altitude and the amount of generated power to be dissipated—each an essential detail in initiating development of optimal thermal techniques. Ambient temperature seems an obvious key consideration—an aircraft system sitting on the Baghdad tarmac in ambient 110°F has dramatically different thermal requirements and capabilities than one in a UAV airborne at 60,000 feet (Figure 1). Further, higher altitudes mean decreased air density, which directly affects a system's ability to conduct heat via transfer of air based on fewer available air molecules.

This applies to forced or passive convection solutions as there is simply less physical air surrounding the chassis. The question of altitude does not necessarily apply only to designs in development for UAV applications, and is valid for the range of military airborne settings. Systems performing in pressurized cabins, for example a cockpit application designed for human interface at 10,000 feet, must manage air density differently than a system placed into an unpressurized cabin on board an extended flight, high altitude UAV.

Total power generated within a system presents a more complex challenge. For example, a five-slot chassis may produce only 50W of power to be dissipated that would lead to a fairly straightforward thermal design solution. However, today's military systems show a prevalence of high-speed signaling buses such as those supported by VPX-based platforms, and as such frequently demand much higher levels of power (up to 150W per board) dissipation. The thermal design options would be vastly different between these two types of systems. Using the 50W system as an example, a passive convection system with no fan may provide sufficient thermal performance based on the environment, altitude and ambient tempera-

ture. However, when compared to a 500W system, one or more fans may be required on board the chassis in order to dissipate heat effectively.

Asking the Right Questions

Defining the three major data points of ambient temperature, altitude and power dissipation provides the majority of information necessary to begin evaluating thermal options. Other pertinent data may not relate directly to thermal considerations but is still considered essential in this portion of the design phase. For example, a customer may have initially desired a liquid-cooled chassis for a 550W system implemented in a ground mobile application. However, deeper evaluation of key data points and environmental issues may indicate that a forced air conduction-cooled chassis would meet requirements while saving development time and money.

Questions such as "Does the system use an AC power supply or DC input?" or "What type of EMI filtering does the application demand?" are important. So too are shock and vibration demands. Does the environment in an extremely rugged and demanding helicopter system warrant mounting the computing boards in an alternative layout? Performance and reliability of moving parts such as fans may be affected in this type of setting; plus the chassis itself must be able to physically withstand the conditions. Size and weight requirements may also be very limited, restricting design choices once they are taken into consideration along with performance demands and existing environmental conditions.

Heat, dust and exposure to other airborne contaminants should also be evaluated; these elements can further constrict system airflow and may demand customized attention to thermal management. For example, a shipboard system may be exposed to salt spray or other corrosive environments. This may demand a specific element-resistant coating on the chassis, which in turn may influence its thermal efficiency.

Once a design layout is planned, thermal modeling tools such as Flotherm (Figure 2) are useful in confirming thermal performance. Through advanced CFD (computational fluid dynamic) evaluation techniques, military designers can accurately predict airflow, temperature distribution and heat transfer in components, boards and ultimately, complete systems. Packaging engineers can create and test modifications easily before any equipment prototypes go into production, by viewing and understanding flow paths and the impact of heat exchanger design and fan selection.

Figure 3

The COBALT (Computer Brick Alternative) uses a passive convection approach to cooling, which provides excellent power dissipation in a fanless, sealed system. It handles operating temperatures ranging from -20° to +55°C (with Core2Duo CPU) and -40° to +71°C (with Atom CPU).

Engineering Partnerships Essential

However, taking a military design from concept to development, and then from prototype to production, requires extensive experience with military programs and specifications—going well beyond thermal expertise. Rigorous military requirements must be priority factors through custom design, thermal modeling and product development processes, and this is frequently where manufacturer support can drive a design to successful development. One manufacturer-recommended design approach is to implement all required system functionality in a chassis that has already been certified for ruggedized operation, rather than being simply listed as "designed to meet."

Providing the shortest delivery lead time and lowest cost in a proven solution is an inherent benefit of using a custom variant of an off-the-shelf chassis enclosure. For instance, incorporating a chassis manufactured to meet the standards of MIL-E-5400 Class 1 thermal performance, MIL-901D shock and MIL-167-1 vibration, assures that it can withstand specified extremes of temperature, vibration, shock, salt spray, sand and chemical exposure—all while maintaining a sealed and temperature-controlled environment ideal for its interior computing elements and electronics.

Meeting Application Needs

The technical approach for a particular enclosure may be based on many proven and validated legacy enclosures—for example, conduction-cooled, VPX, VME and cPCI-based systems that are currently in field use for both ground and airborne applications. For example, the internal arrangement of heat generating VPX cards (upstream to the cooling airflow) and power supplies (downstream to the cooling airflow) may reduce the effective heat loading on the critical VPX cards. Further, mission requirements may demand the chassis is cooled and mounted in a specific manner. Beyond mounting systems within standard racks or into ARINC style equipment trays, ideal options include custom hard mounting or perhaps shock mounting within mobile platforms. From a cooling standpoint, some applications are able to use forced air or forced convection (using

internal or external fans); however because of space, weight and environmental constraints, many UAV applications must incorporate conduction-cooling methodologies (with or without fan assist).

Ultimately, selecting the optimal thermal method or deciding on a custom solution hinges on the packaging designer's comfort level in making thermal calculations and his overall knowledge of thermal methodologies. A proven and recommended approach is to cultivate a manufacturing partnership, a means by which many OEMs have gained significant competitive advantage. This approach streamlines the design process and speeds time-to-market by combining all critical levels of expertise into a single engineering resource for military OEMs. But more importantly, while much technical science and expertise goes into solving thermal challenges, speculation based on past experience is absolutely part of the process and a critical asset from a manufacturing partnership. As a result, it is essential for packaging engineers to understand cooling and mounting options at the outset, work with manufacturer resources for greater detail on advantages and limitations of specific solutions and then build optimized systems upon a proven foundation.

Tips, Myths and Realities

All cooling methodologies benefit from the always-present effects of cooling by radiation. It is important to note that the positive effects from radiative cooling are typically ignored unless the system's overall power dissipation is low. In these lower power scenarios, the fractional contribution of radiation can be significant and should be included as part of the thermal equation. In fact, a common myth in systems packaging is that radiation plays a marginal role in cooling military electronics.

While this may hold true for higher power systems with greater power dissipation requirements, engineers should pay attention to the effects of radiative cooling in passively cooled convection systems that operate at low power. For example, a generic metallic box with dimensions of 8- x 12- x 7-inch can dissipate more than 27W by radiation effects alone in an environment of 100°F and 0 air pressure (a perfect vacuum). With the evolving range of military applications—particularly UAVs flying at extremely high altitudes with reduced air density and an absence of infrastructure to support liquid or air-cooled systems—these small, lower power systems (Figure 3) are carving a design niche driven by their efficient use of radiation as an applicable cooling methodology.

Liquid Cooling Tradeoffs

Liquid cooling is frequently assumed to be required for higher performance systems dissipating power in the range of 500W to 1 kW. This is another thermal myth and there are alternative options for systems in this range. Liquid-cooled sys-

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	Model	Summary	Analog # of Channels	Analog Throughput
High Res.	DT9824	**ISO-Channel™**, High Stability, High Accuracy, Fully Isolated USB Data Acquisition Module	4DI	4800Hz per channel
Low Cost	DT9810	Lowest cost, 10-bit, non-isolated	8SE	25kHz
	DT9812-10V DT9813-10V DT9814-10V	Low cost, up to 24 analog inputs, 12-bit, 10V range, non-isolated	8/16/24SE	50kHz
	DT9816 DT9816-A DT9816-S	Low cost, simultaneous, 6 A/Ds, up to 750kHz, 16-bit, non-isolated	6SE	Up to 750kHz per channel
	DT9853 DT9854	Low cost, up to 8 analog outputs, 16-bit, 16 digital I/O, 1 C/T, 300V isolation	—	—
Sound & Vibration	DT9837 DT9837A DT9837B	4 IEPE (ICP) sensor inputs, tachometer, simultaneous A/Ds	4 IEPE (SE) + 1 Tacho	Up to 105.4kHz per channel
	DT9841-VIB	8 IEPE (ICP) sensor inputs, simultaneous A/Ds with DSP, 500V isolation	8 IEPE (SE)	100kHz per channel
Simultaneous High Speed	DT9832	Simultaneous, 4 A/Ds @ 1.25MHz each, 500V isolation	4SE	1.25MHz per channel
	DT9832A	Simultaneous, 2 A/Ds @ 2.0MHz each, 500V isolation	2SE	2.0MHz per channel
	DT9836 DT9836S	Simultaneous, 6 or 12 A/Ds, up to 800kHz each, 500V isolation	6 or 12SE	Up to 800kHz per channel
High Speed	DT9834	High-speed, up to 16 analog inputs, 500kHz, 16-bit, 500V isolation	16SE/8DI	500kHz
	DT9834-32	High-speed, up to 32 analog inputs, 500kHz, 16-bit, 500V isolation	32SE/16DI	500kHz

DT9818 — Embedded, Isolated, Multifunction, 16 A/D @ 150kHz, 2 D/A, DIO

DT9832A — Embedded, Isolated, Simultaneous, 2MHz A/D per channel

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tems introduce a greater number of challenges into the system; systems are very heavy, costly and their mechanical complexity reduces overall reliability. This is driving designers to evaluate data points carefully and consider additional cooling options that meet or exceed the specific thermal requirements.

Many higher power systems can instead be cooled using conduction paired with forced air; however, they require multiple high-performance fans and skilled design modeling. The absence of a heat exchanger—which requires a costly and heavy infrastructure for support—is a design advantage and further avoids the challenges of liquid-based solutions. This is an especially important consideration for airborne or ground mobile combat applications where reliability and reduced weight is a premium design requirement.

Lessons in Thermal Design

It's clear that effective thermal management is a significant challenge in today's increasingly complex military systems. Considerations for power dissipations, design layouts, paths for air flow and overall thermal performance must be weighed and clarified early in order to develop the rugged systems suitable for mission-critical military situations. Packaging engineers benefit upfront with a clear understanding of each of the thermal alternatives, strong manufacturer relationships and a focus on ambient temperature, altitude and power dissipation as initial key data points.

Rugged military applications frequently require higher performance (with higher speed and density components), in tandem with smaller form factor boards for reduced system footprints. As thermal management options continue to evolve, next-generation applications will likely require further enhanced cooling solutions to meet new specifications standards or improved ruggedness capabilities. Extensive knowledge of thermal technologies and supporting design choices—whether semi- or full-custom solutions—is paramount to managing the complex cooling issues related to many of today's military systems that must operate in unique or extreme environments. ▮▮

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Tech Recon

System Cooling: Challenges and Solutions

Advanced Composite Technology Boosts Chassis Thermal Performance

The growing need to bring down size, weight and power in military systems is pushing the limits of traditional chassis designs and materials. A new composite approach offers a way to get better thermal performance than is offered by traditional aluminum enclosure designs.

Bob Sullivan, CTO
Curtiss-Wright Controls Electronic Systems
Engineered Packaging

The push for increased capabilities and performance in manned and unmanned military vehicles is driving a need for reduced Size, Weight, Power and Cost (SWaP-C)—to be able to add new capabilities without placing an undue burden on the vehicle. As the demand for more processing capability on these platforms continues to increase, thermal management has become more of a challenge.

The embedded computing industry has developed new technologies such as OpenVPX in order to address the increased performance requirements of leading-edge multiprocessing and DSP applications. The 3U OpenVPX form factor is targeting small form factor applications, including unmanned vehicles. Unfortunately, the high performance of OpenVPX often comes with a price: increased power dissipation as compared with older architectures such as VME or CompactPCI. The ability to thermally manage higher power payloads is critical in these leading-edge multiprocessing and DSP applications while decreasing size and weight.

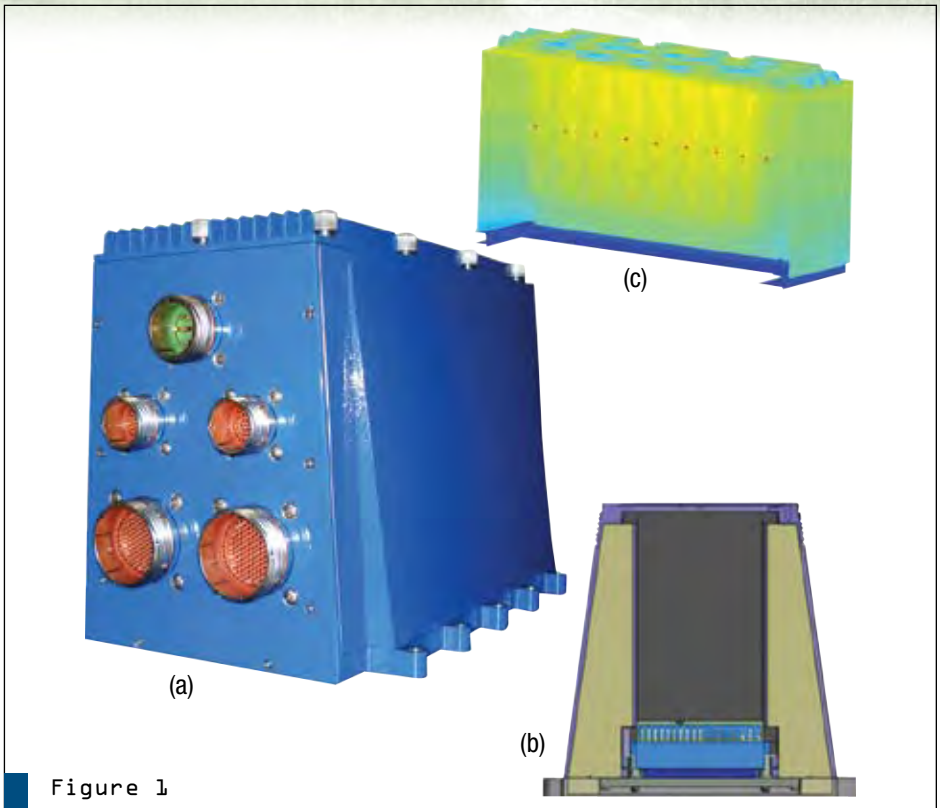

Figure 1

SFF-6 chassis with CoolWall technology (a). Cutaway view showing the two different composites (b). The thermal profile of the chassis design (c).

Alternative to Aluminum

Traditional electronic system packaging for military embedded systems has typically used aluminum. A different approach is to use a mixture of advanced metal composites to achieve enhanced thermal performance along with the structural characteristics that are needed for rugged applications. A thermal metallic composite core is captured within a structural metallic composite shell. The metallic composite shell has structural characteristics that are similar to aluminum, so this composite shell approach

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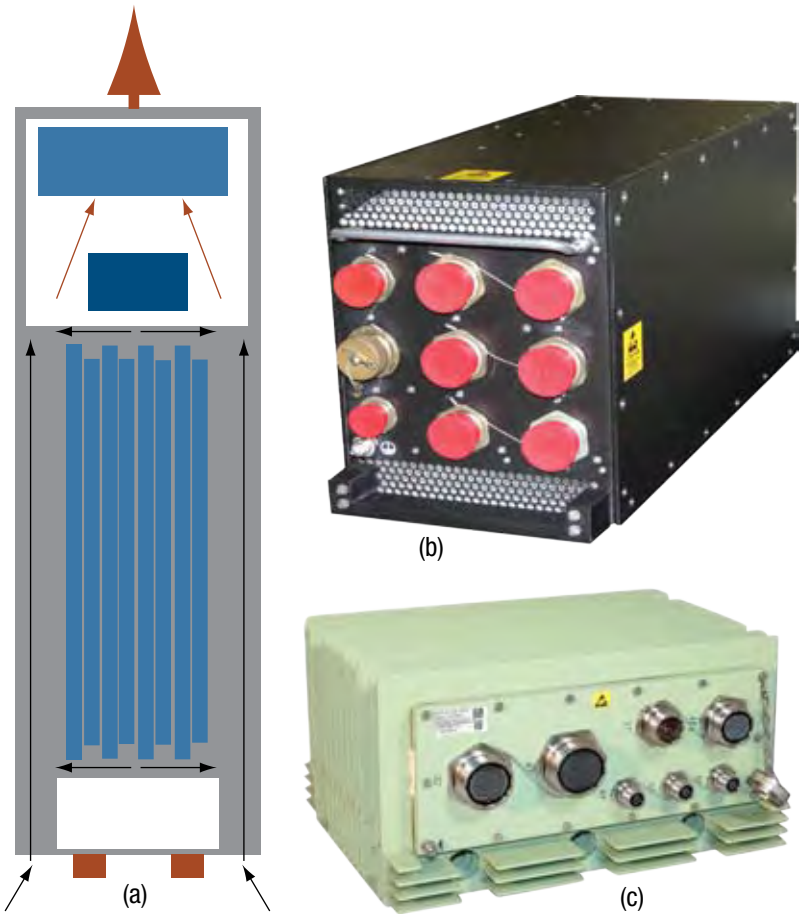

Figure 2

Forced air conduction-cooled ½-ATR enclosure with four slots of 6U cards arranged longitudinally (a). Forced air conduction-cooled 3/4-ATR tall side-load chassis with seven slots of 6U cards arranged transversely (b). Natural convection-cooled enclosure with two slots of 6U plus a one-slot 3U power supply (c).

provides superior thermal performance without compromising ruggedization.

The metallic composite materials that are used in this implementation are field proven for different applications and have been qualified for severe environments including spacecraft. A full suite of environmental testing is planned for the next generation of Curtiss-Wright's SFF-6 enclosure, which is in process now. Called CoolWall, this patent-pending technology has been developed to address needs for increased power and reduced weight by providing dramatically higher thermal conductivity at a weight that is lighter than aluminum. CoolWall can be used both to improve thermal performance and to reduce weight.

Improved Thermal Conductivity

Test results for the new base plate cooled SFF-6 chassis, shown in Figure 1 with CoolWall Technology, show a 2.4x increase in thermal conductivity at the chassis level (2.4x decrease in sidewall temperature rise) along with a 10 percent weight decrease as compared to aluminum construction. This is better performance than copper—which is commonly used as a heat spreader—but weighs 3x less than copper. Further refinements are underway, and we expect to achieve a 3x increase in thermal conductivity for CoolWall as compared to aluminum.

The composite shell technology has been initially applied in baseplate conduction-cooled small form factor chassis, targeting high power 3U VPX applications. However, the technology is not limited to chassis applications, nor is it limited to baseplate style applications. With high performance payload in baseplate conduction-cooled applications, the technology supports cooling of 2x the payload power vs. aluminum construction with a 71°C baseplate.

Thermal profile test results show approximately a 9°C temperature rise of the chassis rails at 67W/slot power dissipation. This alone is a significant breakthrough for embedded computing applications. Beyond this level, CoolWall technology continues to be refined; over time, it is expected to achieve a 3x improvement in thermal conductivity as compared to aluminum (at lower weight).

Chassis Applications

The composite shell technology is patent pending for conduction-cooled chassis applications of various types. For example, the technology will be used to enhance thermal performance of natural convection-cooled, forced air conduction-cooled, or liquid conduction-cooled chassis, as well as baseplate conduction-cooled chassis such as the SFF-6. This will allow hotter payloads to be cooled without increasing weight compared to conventional aluminum construction, and/or weight can be reduced by switching to the technology.

Applications that are highly dependent on the thermal conductivity of the chassis walls benefit most from composite shell technology, providing the largest potential gains in thermal performance or weight reduction. Preliminary assessments of CoolWall technology have been performed for several different types of chassis configurations.

Forced Air Conduction Cooled

A forced air conduction-cooled style of chassis forces air over heat sinks in chassis walls to remove heat. Preliminary thermal analysis of a forced air conduction-cooled ½-ATR enclosure with four slots of 6U cards arranged longitudinally according to Figure 2 predicts an approximately 38 percent reduction in the chassis rail temperature rise at the same power dissipation. There is meanwhile about a 37 percent increase in chassis power handling capability at 6 percent less weight. This chassis config-

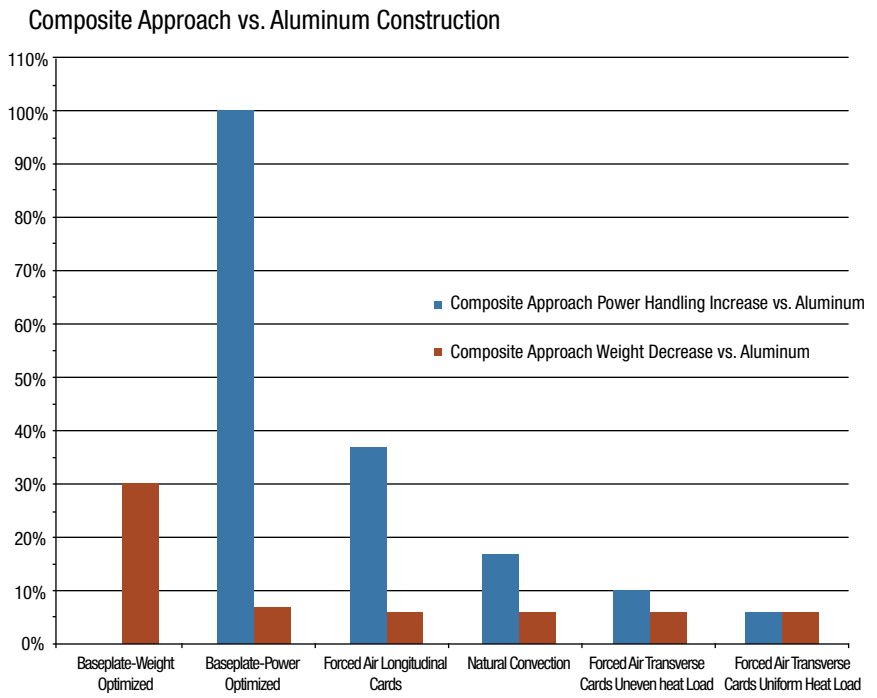

Figure 3

Graph shows a summary of the predicted power handling and weight improvements for different types of chassis.

uration is highly dependent on the thermal conductivity of the chassis walls, which is why significant thermal benefit occurs.

This type of chassis can be flexibly optimized for the application. Based on the requirements of the application, this opens up a lot of options. It can be optimized to increase the thermal performance for a higher power payload as described above. Or it can be optimized to reduce weight, to reduce fan power consumption or to improve reliability based on the lower temperatures. Some forced air conduction style chassis have air-cooled heat sinks located directly on conduction rails. These topologies do not benefit as dramatically with CoolWall, but improvements are still significant.

Preliminary thermal analysis of a forced air conduction-cooled 3/4-ATR tall side-load chassis with seven slots of 6U cards arranged transversely predicts an around 8 percent reduction in the chassis rail temperature rise at the same power dissipation. This improves to approximately 15 percent with uneven heat load due to improved heat spreading. There's a 6 percent increase in chassis power handling capability. And this improves to about 10% with uneven heat load due to improved heat spreading, at 6 percent less weight.

Another variation on conduction cooling is baseplate conduction. These chassis styles conduct heat from the chassis conduction rails to a baseplate. Analysis was also done on the baseplate conduction-cooled SFF-4 (4 payload slots plus power supply) with thinner conduction wall using the composite shell technology. This application of the technology showed a 30 percent chassis weight reduction. It also exhibited the same thermal performance as aluminum construction SFF-4.

Natural Convection Cooling

Natural convection-cooled chassis styles conduct heat to the finned outer surfaces where natural convection air currents over exterior fins and radiation cooling remove heat. This type of chassis has relatively low power handling capability due to the high thermal resistance of a natural convection heat sink as compared to conduction or forced air convection heat sink.

Tests were done using the composite shell technology in a natural convection-cooled enclosure with two slots of 6U plus a one slot 3U power supply. The analysis predicted about a 17 percent reduction in the chassis rail temperature rise at the same power dissipation. Meanwhile, there's a 17 percent increase in chassis power handling capability at 6 percent less weight. Here again this chassis configuration is highly dependent on the thermal conductivity of the chassis walls, which is why significant thermal benefit occurs. That said, it can be flexibly optimized for the application—optimizing for thermal performance, weight or lower temp suitability—in a similar way to the previous configurations.

Module Implementation

The composite shell technology can also be applied to conduction-cooled module conduction frames. (Curtiss-Wright has patents pending on these as well.) Conduction-cooled modules typically use aluminum conduction frames, but higher power modules have used copper or heat pipes because aluminum could not provide the required thermal performance. Because of its dramatically higher thermal conductivity at lighter weight than aluminum, the composite shell approach can provide significant thermal benefits for module applications as well.

Conduction-cooled module thermal frames can be flexibly optimized for the application. Based on the requirements of the application, one option is to optimize to increase the thermal performance for a higher power payload. Designers can also optimize to reduce weight or to allow operation at a higher card edge temperature. A third option, here again is the choice to optimize to improve reliability based on the lower temperatures.

Putting it All Together

The use of a new alternative approach like composite shell technology offers dramatic improvements in SWaP-C reduction for rugged conduction-cooled applications. The ability to handle higher power payloads is critical in many leading-edge multiprocessing and DSP applications using new products based on switch fabric architectures such as VPX, and CoolWall technology can be used to improve thermal performance, while reducing weight. Many lower power applications can also benefit from reduced weight, and CoolWall technology can be used to reduce weight while maintaining thermal performance.

The amount of thermal benefit is dependent on the chassis configuration and the application's thermal constraints, but in any case CoolWall still offers a weight reduction on the order of 6 percent to 30 percent in many forced air conduction applications. Figure 3 shows a summary of the predicted power handling and weight improvements for different types of chassis. ■

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System Development

Shock & Vibration Testing for Boards and Enclosures

Rethinking Shock and Vibration Testing Procedures

The performance and ruggedness requirements of military systems continue to climb. To meet those demands, fresh thinking needs to be applied to the processes for testing shock and vibration of such systems.

Chris Phillips, Sr. Test Engineer
David Turner, Sr. Mechanical Engineer
Parvus

Military systems developers are tasked with delivering rugged electronics with superior durability within increasingly tight schedules. To meet these demanding requirements, engineering procedures need to be streamlined and revamped to ensure every minute and dollar invested into a rugged COTS product design will yield a successful, deployment-ready computing subsystem. One vital element to any rugged computing design is the shock and vibration testing, as failure to accurately test and qualify systems for military-grade parameters could mean increased product timelines and development costs. To mitigate these undesirable consequences, testing procedures need to be considered during the entire product development cycle.

Hardware test engineers need to be included in the initial design of a rugged computing subsystem as mechanical engineers must deliberately design products to pass shock and vibration tests at the levels dictated by the military prime contractor / end user. In addition, since testing procedures can incur a large portion of the development costs, addressing how a rugged design can pass shock and vibration tests from the outset is critical. Many failures that occur during testing could have been anticipated if design requirements were reviewed in the beginning. A test engineer's experience will save unplanned time and costs when considered in conjunction with the mechanical and electrical design of a rugged product.

Figure 1

Shown there, the DuraNET 1268 is subjected to random shock and vibration tests.

Simulation Software Vital

Test results provide important data necessary to design the most robust subsystems possible for customers who can accept nothing less. In order to verify whether ruggedized units will perform sufficiently in extreme environments, highly accelerated life tests (HALT) and highly accelerated stress screens (HASS) are typically applied. In military and defense applications, these tests are typically defined by MIL-STD-810 and sometimes require MIL-S-901D shock test for shipboard applications. Not all customers require these regulated tests for their applications and they can be defined as required to suit the product's intended environment. Parvus, for example, has developed its own standard vibration profiles under MIL-STD-810G based on years of customer experience developing rugged COTS standard

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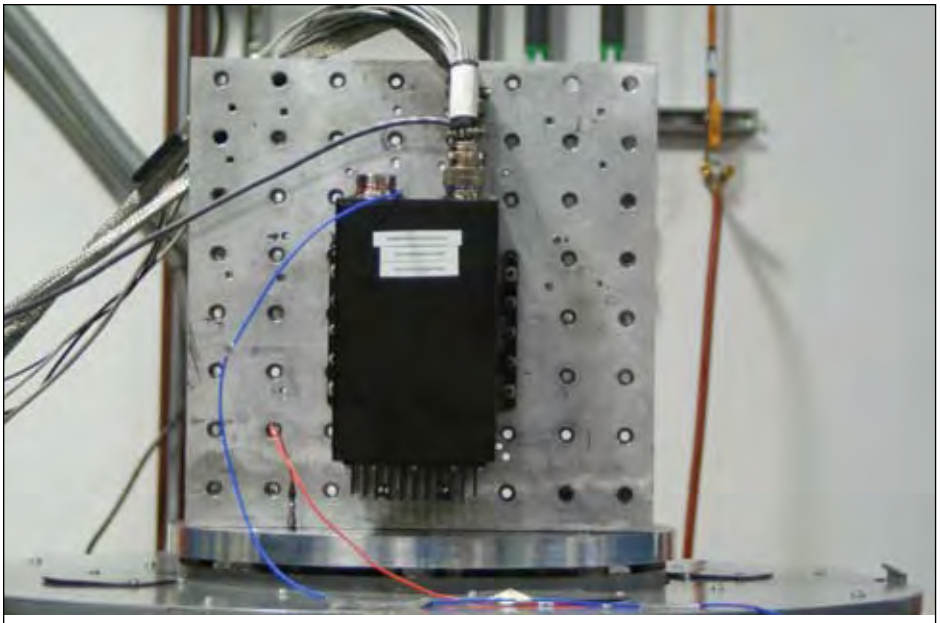

Figure 2

The DuraCOR 810 subjected to random shock and vibration tests.

Figure 3

Rugged military electronics must be designed to endure tracked vehicle conditions, such as this M1A1 Abrams battle tank.

products that meet extreme conditions in most applications.

Significant time can be spent performing engineering calculations or writing programs to review designs. These have their place in the preliminary design phase, but often analyses can be completed quickly using simulation software that will correlate to testing. Simulation programs such as Simulation Premium, a version of COSMOS that has been integrated into SolidWorks, allow mechanical engineers to subject their designs to real-world stresses including shock, vibration and even nonlinear stress analyses, helping to significantly shorten the design cycle by reducing or eliminating the need for redesign on the front end in order to get products to market faster. By running a variety of analyses, engineers can quickly determine where potential points of failure could exist when subjected to shock, thermal and vibration tests prior to physical testing.

Benefits of In-house Equipment

Vibration and shock testing can have a huge impact on a product's delivery timeline—especially if the unit has to be shipped to an off-site testing facility after every design modification. Attempting to diagnose an intermittent fault while the product is under test can be difficult under the best circumstances. By having vibration and shock testing apparatus in-house, such as a vibration table, thermal chamber and GTEM cell, engineers can get immediate results without having to wait for—and pay for—testing to be completed by an outside firm. This significantly slashes product development cycles and the overall cost of designing a rugged solution.

Recently, Parvus benefited from having in-house shock and vibration equipment when developing the DuraNET 1268, a rugged 10-port Gigabit Ethernet switch. During vibration testing, the DuraNET 1268 encountered an intermittent failure. Parvus was able to instrument the unit with automated data logging equipment to diagnose the failure (Figure 1).

Testing the Test Gear

During a vibration test, the use of typical electronic diagnostic equipment becomes difficult and impractical. It is often times necessary to perform some mechanical and electrical engineering on the test equipment itself to make it possible to instrument the unit under test. Diagnosing even simple problems is made more difficult in a harsh vibration environment.

For example, when oscilloscope probes were required to diagnose a problem with the DuraNET 1268 during qualification testing, some customization was required. Since the o-scope probes are too delicate to be installed on the product during extreme vibration testing, signals were instrumented with impedance controlled differential pairs by teeing into a cable assembly termini or soldering directly to test points on the printed circuit card. This

construction allowed the oscilloscope and its leads to be placed sufficiently far from the harsh environment to be able to function normally. These test leads must be strain relieved with tie downs, adhesives and potting compounds to remain in place while the vibration test is underway. Shielding of the test leads is also required if the signal's frequency is in-band with the vibration exciter or amplifies EMI.

The failure must be reproduced in order to understand and diagnose the problem. This process involves instrumenting the unit under test with custom equipment and repeating the environmental test. Without the in-house test capabilities of Parvus, performing these tasks at a remote test lab would be time-consuming and expensive. This allows Parvus to diagnose, repair and redesign in days not weeks. This rapid design cycle helps customers deliver rugged computing equipment to the military under the tightest deadlines (Figure 2).

Designing for Endurance

"Over-designing" a system, so it can be inserted in any military application, be it on land or air, means ensuring the system passes the most rigorous military shock and vibration tests. Typically this means a rugged system passes the tests for tracked vehicles—one of the harshest shock and vibration conditions (Figure 3). These tests include MIL-STD-810 514.6 Vibration (Jet, Helicopter, Ground Mobile and Tracked categories) and 516.6 Shock (Jet, Helicopter, Ground Mobile and Tracked categories).

When Parvus released the DuraNET 1268, it was originally launched as an avionics network switch. However, Parvus made the decision to over-design the product so it could be deployed in not only airborne (jet and helicopter), but also wheeled ground and tracked vehicle applications. A hybrid random vibration test plan was developed using relevant high and low vibe frequencies from each of these platforms.

The result was a very demanding combined application test with a 7.98 GRMS Power Spectral Density (PSD) Integral spanning 5 Hz to 2000 Hz for 1 hour on each axis. Similarly, the unit was subjected to functional shock of 40 g terminal peak sawtooth pulses on all three axes and 75 g crash hazard shock per MIL-STD-810G, all of which exceeds traditional aircraft requirements. This approach has proved beneficial for Parvus' customers as they have a high confidence of the product's reliability in a variety of military applications, and it results in far fewer RMAs during the products life cycle.

When done correctly, shock and vibration testing will allow a rugged COTS computing system to survive the environment it was designed for throughout the product's life. Keeping these testing procedures top-of-mind when designing a rugged system destined for military use will help mitigate extraneous costs and shorten delivery schedules. The ultimate benefit, however, is getting the necessary equipment on the battlefield as soon as possible to help ensure the military's success. ▮▮

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

Technology Focus

Rugged Ethernet Switch Boards

Ethernet Emerges as Mature Choice among High Speed Interconnects

Meeting needs for both networking and fabric interconnect requirements, switched Ethernet has become entrenched as the "no lose" choice for next-generation military systems.

Jeff Child
Editor-in-Chief

Ethernet could arguably be called the military's favorite interconnect fabric in compute-intensive applications like sonar, radar or any application that networks sensor arrays together. Military system designers can leverage the marriage of Ethernet with embedded computing form factors like OpenVPX, VXS, Compact PCI Express, MicroTCA and AMC. While once used only as a pure networking solution for command and control systems in the military, Ethernet is now gaining traction in numerous other military applications as an interconnect fabric in compute-intensive applications.

OpenVPX is emerging as the newest choice for Ethernet-based switched networking in rugged, harsh environment military applications. 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. OpenVPX is perfectly suited to handle the huge processing demands of today's ISR and C4I applications.

Ethernet is also deployed as multilayer switches with dual IPv4 and IPv6 forwarding to support the DoD's sweeping plans to leverage the benefits of IPv6 (Internet Protocol version 6). Offering a great mix of legacy compatibility and steady upgrade path, Ethernet continues to capture mindshare acceptance in the military as more and more programs look to Ethernet for both networking and fabric interconnect needs. As a result, the number of programs embracing Ethernet—including both new advanced systems and upgrades—is constantly on the rise.

In an example along those lines is, Eurotech subsidiary Parvus Corporation has a follow-on contract with Lockheed Martin Systems Integration – Owego to supply rugged VME Ethernet switch cards for the Navy's MH-60 R and MH-60S Seahawk helicopters (Figure 1). For more than six years, Parvus has supplied rugged VME Ethernet switches in support of the Navy helicopter program.

Rugged Ethernet switches are critical to the Seahawk's multiple missions as the switches interface with a variety of instrumentation systems used on board the helicopters. The VME Ethernet switch being delivered to Lockheed Martin is similar to Parvus' new COTS COM-8000—an ultra-rugged, conduction-cooled 6U single-slot VME Ethernet Switch card compliant with IPv6 traffic and developed for command and control / situational awareness subsystems. To meet stringent U.S. Naval Helicopter environmental and performance requirements, Parvus qualified the VME switch card to extreme temperature and vibration profiles experienced on the platform.

Figure 1

An MH-60S Seahawk assigned to the "Sea Knights" of Helicopter Sea Combat Squadron (HSC) 22 departs guided-missile destroyer USS Porter (DDG 78).

In another recent example, last fall GE Intelligent Platforms received the first in a series of orders from General Dynamics C4 Systems for a quantity of GE's rugged NETernity 3U CompactPCI CP923RC-M Ethernet Switches. The switches will be used as the communications hub for command and control systems deployed as part of the U.S. Army's Brigade Combat Team Modernization (BCTM) program. The technology provides fast, reliable data interchange between computing subsystems on a range of vehicles including unmanned air and ground vehicles. BCTM is the U.S. Army's principal modernization program.

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Technology Focus:
Ethernet Switch Boards Roundup

10 Gbit Ethernet XMC Provides Dual Front-Panel Interfaces

The military has completely embraced Ethernet both as a network technology and as a fabric interconnect scheme. With that in mind, AdvancedIO Systems offers the V1121, a conduction-cooled 10 Gigabit Ethernet (10GbE) XMC module with dual front-panel optical interfaces. The V1121 brings the benefits of open standards-based connectivity to real-time, high-bandwidth applications operating in harsh physical environments where long cable runs or

challenging electromagnetic interference (EMI) concerns preclude the use of copper-based interconnects. The V1121's programmability, supported by AdvancedIO's ExpressXG FPGA framework, enables the integration of application and preprocessing functionality directly into the 10GbE fat pipe. This capability solves challenging connectivity bottlenecks that would occur in more traditional architectures where this tight integration is not possible.

While found in many types of high-performance real-time systems, these bottlenecks are particularly prevalent in demanding C4ISR applications including situational awareness, SIGINT and network security. Built with a Xilinx Virtex-5 FPGA, it shares the same architecture as other field-proven AdvancedIO 10GbE products. The V1121 also has two SFP+ optical 10GbE interfaces, independent large banks of memory for buffering packets, and additional interfaces to facilitate synchronization and time stamping. The module interfaces to the host fabric via PCI Express. Air-cooled versions are also available.

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

VME Card Sports 24-Port Gbit Ethernet Switch

VME and Ethernet have a history of living together on embedded computing platforms. Concurrent Technologies' latest Gbit Ethernet switch board, the FP 210/024, is designed to operate alongside their range of VMEbus-based single board computers. The FP 210/024 is an

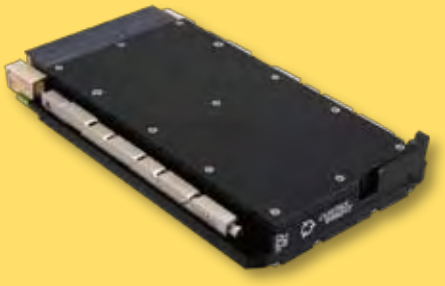
"unmanaged" embedded Ethernet switching platform that provides a low-cost, low-power switching solution for integrators. Typically consuming less than 20 watts, it offers twenty-four 10/100/1000 Mbit/s auto-negotiating Ethernet ports, twelve accessible via the VMEbus P2 I/O connector and up to twelve via the front panel with the option for two being optical. The switch core contains a wire-speed, Layer 2, Quality of Service (QoS) switch fabric. Commercial and extended temperature versions are now available, and ruggedized, conduction-cooled or air-cooled versions will be available shortly. This switch facilitates communications within a chassis as well as supporting the network outside the chassis in a variety of applications including defense.

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

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

3U VPX GbE Multi-Layer Switch/ Router Is Highly Secure

The VPX ecosystem continues to expand. The latest example is Curtiss-Wright's VPX3-683 FireBlade, available with 24 GbE SerDes ports and up to two x10 GbE XAUI ports, and is ideal for system integrators architecting secure high-performance IPv4/v6 Intra-Platform Networks (IPNs). This rugged, compact 3U VPX card, which can operate as a fully managed switch/router, provides significant performance and configuration advantages to developers building Layer 2 and Layer 2/3+



networks. VPX3-685 Secure Router is currently undergoing a stringent Federal Information Processing Standard (FIPS) 140-2 Level 2 cryptographic validation at National Institute of Standards and Technology (NIST) under the Cryptographic Module Validation Program (CMVP).

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

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

Full Wire Speed Switching on 6U VPX Ethernet Switch Offers

The military has warmed completely to Ethernet, both as a network technology and as a fabric interconnect. Elma Electronic now offers a highly innovative 6U VPX 28-port Ethernet switch that provides full wire speed switching of up to 125 Mbits/s, with 24 1 Gigabit Ethernet (GigE) ports and up to four 10 GigE ports. The new fully managed ComEth 4340a

switch, available from Elma in North America, supports Layer 2 bridging and Layer 3 IPv4/v6 Unicast and Multicast routing with Layer 2 through Layer 4 advanced traffic classification, filtering and prioritization. It is ideal for applications requiring strict data prioritization and filtering, and advanced traffic classification traffic monitoring required by demanding network applications, as well as delay-sensitive and critical environments.

The ComEth 4340a offers flexible port options: four of the 24 GigE ports and two 10 GigE ports come out the front of the switch; 16 ports are accessible via the rear of the switch and are configurable in groups of four as 1000BT or 1000Kx ports. Accessible via a browser, CLI or SNMP, the new ComEth 4340a is easily managed, and a comprehensive built-in test suite provides simple maintenance and added security. Pricing for a ComEth 4340a Ethernet Switch starts at $8,500 in single quantities.

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

6U OpenVPX 10 Gbit Ethernet Switch Targets ISR and C4I

OpenVPX is perfectly suited to handle the huge processing demands of today's ISR and C4I applications. GE Intelligent Platforms has announced the NETernity GBX460 rugged 6U OpenVPX data plane switch module, the first 10 Gbit Ethernet solution of its kind to support high throughput interprocessor communication (IPC) between 10GigE-enabled processing nodes for deployed defense and aerospace applications. With 20 (optionally 24) 10GigE data plane ports and 16 GigE control plane ports, the GBX460 supports non-blocking, low-latency data transfers across

a multiprocessing cluster at up to full wire speed, enabling new levels of performance for the most demanding ISR (intelligence, surveillance, reconnaissance) applications. It is designed to provide a high-speed interface for sensor I/O, IPC and data distribution to the back end processing clusters typically found in C4I (command, control, communications, computers and intelligence) infrastructures.

The GBX460 is an unmanaged Layer 2 switch that can support multiple OpenVPX slots/module profiles for maximum flexibility and throughput. The GBX460 meets the requirement to support a large number of 10GigE ports to maximize data throughput capabilities, and can optionally support up to four front panel 10 GigE fiber ports to enable connectivity to external networks. It is OpenVPX compatible, allowing it to easily integrate with other OpenVPX-compatible products. The GBX460 is available in conduction-cooled variants to allow deployment in harsh environments.

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

OpenVPX IPv4/v6 Switch Offers 28 Gigabit Ethernet Ports

The military has embraced Ethernet in a big way, not just as a networking technology, but as a high-speed interconnect fabric as well. The new Kontron Gigabit Ethernet Switch VX3910 offers 3U VPX (VITA 46.x) and OpenVPX (VITA 65) platforms Enterprise-Class Switching functionality with a total

of 28 Gigabit Ethernet ports and advanced management features. With its implemented Kontron Embedded Network Technology, which offers the same advanced feature set and operational interfaces across multiple form factors, it simplifies IPv4/v6 inter- and intra-platform networking.

The non-blocking fully managed L2/L3 Gigabit Switch Kontron VX3910, with its 20x Gigabit ports to the backplane, offers the highest port density for the implementation of various network topologies in 3U appliances. Four additional 2.5 Gigabit ports to the backplane simplify a redundant system architecture with multiple switches with no single point of failure. The four 1000 Base-T uplinks on the front panel, one dedicated for out-of-band management, expand the range to a total of 28 ports. The new Kontron Gigabit Ethernet Switch VX3910 is available in an air-cooled version for ambient temperatures from 0 to +55°C and in a rugged conduction-cooled version for the extended temperature range from -40° to + 85°C.

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

3U cPCI Serial Ethernet Switch for Rugged Environments

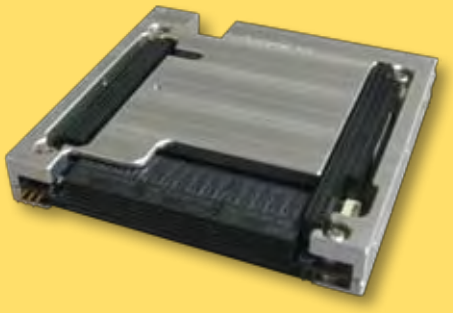
Ethernet switches can be found on most embedded form factors, and now CompactPCI Serial is added to that list. MEN Micro offers an Ethernet switch to extend its CompactPCI Serial portfolio. The G301 completes the offer of CompactPCI Serial boards for individually building up a complete system and convinces with its robustness and speed thanks to the new standard. The 3U CompactPCI Serial Ethernet Switch G301 is equipped with four Gigabit Ethernet ports via RJ45 or M12 connectors in order to comply with the fast serial PICMG standard.

Thanks to the integrated self-test mechanisms, the Gigabit Ethernet switch is a very reliable component in communication systems and supports full and half duplex, fast non-blocking store-and-forward switching and autonegotiation as well as Layer-2 switching. The G301 is fault-tolerant and restores itself automatically: If a link is temporarily unavailable, it will work again after the disturbance without any restart or reset. The board supports Power-over-Ethernet (PoE) with Power Sourcing Equipment (PSE) for up to four external devices with a total power consumption of 28W. Using a configuration EEPROM, the G301 can be exactly tailored to each application's requirements (fixed management configuration). This includes features such as 802.1p priority and port-based priority, port-based VLAN or VLAN-IDs according to IEEE 802.1q. The Ethernet switch has especially been developed for mobile communication in harsh environments and is certified for operation in the extended temperature range according to railway standard EN 50155. All components are soldered to withstand shock and vibration and are prepared for conformal coating.

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

10-Port PC104+ Gbit Switch Tested to MIL-STD-810G

As chips get ever more function-dense, board designers can pack onto small boards the functionality that used to require an entire 6U-sized card. Along those lines, Parvus has unveiled the COM-1268, a rugged 10-port PC104+ Gigabit Ethernet switch card designed for robust networking performance under extreme shock/vibe and thermal conditions common to aerospace and defense applications.



A follow-on to Parvus' 5-Port PRV-1059 10/100 switch board, COM-1268 delivers twice the port density, ten times the bandwidth, and the addition of management capabilities for local/remote control and monitoring, while retaining the small form factor of PC/104-Plus.

The COM-1268 Layer 2 GigE switch comes extended temperature rated (-40° to +85°C) and equipped with ten 10/100/1000 Mbit/s ports for networking IPv4- and IPv6-compatible computing devices. Last fall the COM-1268 PC104+ switch card successfully completed harsh MIL-STD qualification testing, including extreme test levels of 7.98 g RMS random vibration and 40 g functional shock. The switch card was temperature qualified under MIL-STD-810G for operation from -40° to +85°C (-40° to +185°F). The units were subjected to functional shock of 40 g terminal peak sawtooth pulses on all three axes, as well as random vibration of 7.98 GRMS Power Spectral Density (PSD) over 5 Hz to 2000 Hz for 1 hour on each axis.

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

PICMG 2.16 Board Offers Dual 10 Gbit Ethernet Uplinks

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

or network failure, data can be automatically re-routed to an alternate path.

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

PT
Rochester, NY.
(585) 256-0200.
[www.pt.com].

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Resolver Series Provides Precision Motion Control Accuracy

The list of military applications that demand precise motion control are many. Among these are positioning for electro-optical systems, gimbals/communication pedestals, infrared systems, vehicle transmission systems and test equipment. Potential space applications include positioning for satellite, satellite antenna, space station and space vehicle solar panel arrays. Honeywell has introduced the Honeywell Hawk Resolvers 1-Inch Series, Fully Housed Configuration, which provides enhanced accuracy (±7 arcmin) for precise motion control. With the launch of the Hawk Resolvers, Honeywell now offers two off-the-shelf versions, as well as resolvers that can be customized to meet specific end-user needs.

The resolvers offer several other competitive advantages, including a shock specification of 50 g, 11 ms, vibration specification of 15 g, 10 Hz to 2000 Hz and wide operating temperature range of -50.8° to 93.3°C (-60° to 200°F), which allow for use in harsh military and aerospace applications. Wide excitation voltage range of 2V to 15V allows customers to standardize on a resolver that meets their excitation voltage needs, simplifying sourcing and delivery, and saving time. The Hawk Resolvers meet multiple military/aerospace specifications: DO-160D, MIL-STD-202G, MIL-STD-810G, MIL-STD-81963B, MIL-STD-461F, and comply with space outgassing requirement SP-R0022.

Honeywell, Morris Township, N.J. (973) 455-2000. [www.honeywell.com].

Multifunction Module Blends Analog and Digital I/O

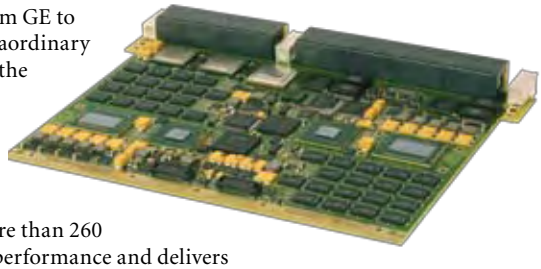
Gone are the days when every function needed its own module in a military system design. Sealevel Systems has expanded its SeaI/O family of data acquisition devices with the new SeaI/O-570 multifunction module. The module provides eight single-ended 16-bit analog inputs, eight optically isolated digital inputs and eight Form C relay outputs. The module's A/D inputs are independently software selectable for +/-5 VDC or +/-15 VDC ranges and feature high input impedance, allowing easy connection to a variety of sensors. The eight isolated inputs are rated for 5-30 VDC and provide 3500 VDC external isolation, while the SeaI/O-570's eight Form C outputs are configurable as normally-open or normally-closed and can switch DC loads up to 24W.

Ordering options allow connection to a host device via Wireless (802.11b/g), Ethernet (Modbus/TCP), RS-485 (Modbus/RTU), USB or RS-232. Field removable terminal blocks are standard, facilitating fast, flexible field wiring. SeaI/O modules operate from 9-30 VDC, and power can be input via terminal block or DC jack. Both table mount and DIN rail mounting options are available, and installation is made easy using Sealevel's software configuration tools. Standard operating temperature range of SeaI/O modules is -20° to 70°C and extended temperature range (-40° to +85°C) is optional. SeaI/O-570 prices start at $399.

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

6U VPX Multiprocessor Board Delivers 260 Gflops Performance

Applications such as ISR, radar, sonar, and image and sensor processing all have something in common: an almost endless appetite for high-performance real-time processing. With that in mind, GE Intelligent Platforms has announced the DSP280 rugged dual socket quad core 6U VPX multiprocessor, the fifth new product from GE to harness the extraordinary performance of the 2nd generation Intel Core i7 chip set. The dual quad core platform is capable of more than 260 Gigaflops peak performance and delivers main memory bandwidth of up to 21 Gbytes/second per CPU node.



The board's HPEC architecture can scale from one to many processor nodes per enclosure via RDMA-enabled 10 Gigabit Ethernet and Double Data Rate (DDR) InfiniBand dual port NICs, delivering up to 1.8 Gbytes/second data rates per channel with memory-to-memory latencies of approximately 1µs. The board's 16 Gbytes of ECC memory, along with 16 Gbytes of solid state disk, can obviate the need for traditional hard disk drives. Support for 3D high-resolution graphics further enhances the utility and flexibility of the DSP280, widening its potential application footprint.

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

300W U-Frame Power Supply Has Optional Fan Covers

Advanced Power Solutions (APS) has announced a series of high density switching power supplies in the industry standard 3.2 x 5.00 x 1.50-inch U-Frame package. The APS303 series is designed to power OEM and Industrial applications offering high density / high efficiency in a bolt-to chassis U-Frame package with either terminal strips or Molex Connections. Single and Dual Outputs ranging from 5~60 VDC are available in standard and custom configurations. Optional Fan covers make this power supply easier to integrate into OEM / Industrial applications. The supply features Inhibit, Power Good, 12V Fan output and Fan Fail signals. The supplies are safety approved UL/cUL60950 / EN60950 / CE Mark (LVD) with Class B Emissions. Pricing is $85.00 each for 100 piece quantities.

Advanced Power Solutions, Livermore, CA. (925) 456-9890. [www.advpower.com].

56V UPS Modules Serve as Battery Replacements

Maxwell Technologies has introduced a 56V UPS ultracapacitor module designed specifically to address the short-term ride-through and bridge power requirements of uninterruptible power supply (UPS) systems for mission-critical installations. They are available in capacities 52F, 65F, 87F and 130F. The Maxwell 56V UPS module can be relied upon to perform for up to 15 years in a data center with no maintenance or conditioning. The non-toxic ultracapacitor modules cost-effectively replace batteries. Therefore they provide UPS system integrators and customers the lowest total cost of ownership alternative to lead-acid batteries for short-term ride-through and bridge power applications.

Maxwell Technologies San Diego, CA. (858) 503-3300. [www.maxwell.com].

Rugged Ethernet Switch System Offers 24 Ports of GigE, 4 Ports of 10 GigE

Ethernet has become a main staple of military system development. Curtiss-Wright Controls Embedded Computing has introduced the newest member of its SwitchBox ready-to-deploy military network system family. The SwitchBox 684 is a lightweight rugged modular system that delivers 24 Gigabit Ethernet (GbE) ports and a choice of 4 ports of 10 GigE fiber or 2 ports of 10GibE copper interfaces. The SwitchBox 684, based on CWCEC's high-performance VPX6-684 FireBlade 6U OpenVPX card, is ideal for building Intra-Platform Networks (IPNs) for air, land and sea vehicles. It's housed in a rugged low-profile enclosure that weighs only 10 lbs. and measures 2 x 11 x 11.5 inches. Switchbox 684 provides system designers with unmatched flexibility for distributing fully integrated systems in vehicles. CWCEC's SwitchBox products are autonomous field replaceable units that are easily configured and simple to connect to existing subsystems. They can significantly reduce development costs and Time-to-Integration (TTI), freeing system integrators to focus on the optimal partitioning and segmentation of their application's network.

The SwitchBox 684 switch provides 24 ports of GigE (10/100/1000MB/s) + 4 ports of 10Gbyte/s (10Base-S) uplink fiber or 2 ports of 10 Gbytes/s copper interfaces packaged in a rugged stand-alone chassis. All of the SwitchBox 684's 10 GbE ports support full auto-negotiation and auto MDI/MDIX crossover to simplify integration. Furthermore, the switching core provides a full-speed, non-blocking architecture for full wire-speed performance on all ports. This switch, designed for reliable operation in harsh environments, up to 70°C, uses natural convection cooling and requires no active cooling components.

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

Double-Width PrAMC Sports Intel Core i7 Processor

The Intel i7 processor has made its way onto nearly every military embedded computing form factor available. The Processor AMC is among them now that Kontron has announced its double-width AdvancedMC processor module AM5020. Equipped with an Intel Core i7 Mobile processor and Intel Hyper-Threading technology, the new Kontron AM5020 provides up to 2.53 GHz of dual-core performance to run parallel, multi-threaded applications on MicroTCA integrated platforms.

With support for PICMG AMC.1/.2/.3 sub-specifications, the Kontron AM5020 provides eight PCI Express lanes to the backplane configurable as 2 x PCIe x4 or 8 x PCIe x1, guaranteeing high throughput for I/O-intensive applications. Four GbE interfaces, two on the front panel and two on the backplane in accordance with AMC.2, provide comprehensive networking capabilities. Users can choose between an onboard 2.5-inch SATA drive and/or up to 32 Gbytes of SATA flash memory, which is securely fastened to the PCB. In addition, four SATA channels are routed to the AMC connector (AMC Port 2, 3, 12 and 13), enabling applications with a high amount of storage capacity and RAID. The Kontron AM5020 also features a DVI-D interface at the front combined with two USB interfaces, two Gbit Ethernet and a serial port via RJ45.

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

Atom-Based 1U Platform Provides External PCI Card Access

A 1U rackmount platform with the Intel Atom D510 dual-core or D410 single-core processor, includes six GbE LAN ports and an externally accessible PCI slot. The PL-80300 from Win Enterprises provides externally accessible PCI card support for the D410 or D510 Atom Pineview low-voltage processors plus the Intel 82801HM Controller, external access to the PCI card slot and a maximum of six GbE LAN ports via PCI-E x1. In addition, the unit includes USB 2.0, a 3.5-inch SATA HDD bay, CF socket, mini-PCI slot and Console port.

Recommended operating systems for PL-80300 include Windows XP Pro and Windows 7. Linux version support includes: Fedora 13, Debian 5.0.6 and openSUSE 11.3. The system supports 32-bit and 64-bit software. The 100-unit price with Dual-Core Atom D510 processor costs $459.

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

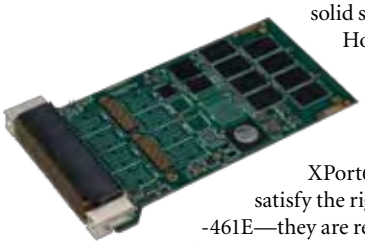
Voltage Controlled Oscillator Delivers 3830 MHz

Crystek's CVCO55CC-3830-3830 VCO (Voltage Controlled Oscillator) operates at 3830 MHz with a control voltage range of 0.5V~4.5V. This VCO features a typical phase noise of -108 dBc/Hz at 10 kHz offset and has excellent linearity. Output power is typically +7 dBm. Engineered and manufactured in the USA, the model CVCO55CC-3830-3830 is packaged in the industry-standard 0.5- x 0.5-inch SMD package. Input voltage is 8V, with a max current consumption of 35 mA. Pulling and Pushing are minimized to 1.0 MHz and 0.2 MHz/V, respectively. Second harmonic suppression is -15 dBc typical. The CVCO55CC-3830-3830 is ideal for use in applications such as military digital radio equipment, fixed wireless access, satellite communications systems and base stations.

Crystek, Ft. Myers, FL. (239) 561-3311. [www.crystek.com].

One Terabyte of Solid State Storage in Single 3U VPX Slot

A Terabyte of solid state storage in a single 3U VPX slot is the boast of the newly available conduction- or air-cooled 3U VPX XPort6172 Solid State Disk (SSD) from Extreme Engineering Solutions. The basic module provides up to 512 Gbytes, or a half Terabyte (½ TB), of solid state storage with data encryption. However, 1 Terabyte in a single 3U VPX slot is achievable by mounting the XPort6103 512 Gbyte XMC SSD onto the XMC site of the XPort6172. The XPort6172 and XPort6103, individually or combined, satisfy the rigors of MIL-STD-810F and -461E—they are ready for the harshest deployments.



The XPort6172 supports 256-bit AES encryption, utilizing the 123 NIST- and CSE-certified Enova Technology X-Wall MX-256C encryption chip. Additionally, the XPort6172 supports "zeroization" (enhanced erase) and satisfies DoD NISPOM 5220.22 and NSA/CSS 9-12 specifications. Also available is ATA Secure Erase support and optional declassification via hardware or software control. The XPort6172 provides best-in-class performance, with up to 200 Mbytes/s sustained sequential read performance and 120 Mbytes/s sustained sequential write performance and 100,000 program/erase cycles. Operating temperature range is -40° to 85°C.

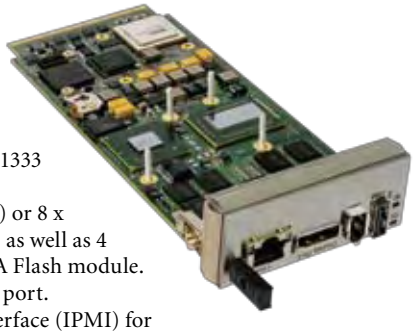
Extreme Engineering Solutions, Middleton, WI. (608) 833-1155. [www.xes-inc.com].

Fanless Embedded Computer Has Twelve COM Ports

An industrial and rich I/O fanless embedded computer comes with enhanced RF functions and LVDS and VGA dual display geared specifically for applications such as intelligent transportation, factory automation, home security, environmental monitoring and research. The MXE-1200 from Adlink includes a rugged fanless operation from -20° to 70°C, 5 Grms vibration resistance, an Ethernet port and 6-36 VDC wide range power input. Featuring rich I/O and RF support, two of the 12 COM ports can be configured to RS-232, RS-422 or RS-485 via a BIOS setting. The remaining COM ports are either RS-232 RS-422, or RS-485. The MXE-1200 series also includes with a mini-PCIe socket, a USIM socket, and a pre-installed SMA-to-IPEX antenna cable to support expansion of wireless communication capabilities. Single quantity pricing starts at $828.

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

AdvancedMC Board Serves up 2nd Core i7 Microarchitecture



A new AdvancedMC (AMC) high-performance processor board benefits from the recently introduced 2nd generation Intel Core processors. The AM 31x/x0x AMC single board computer from Concurrent Technologies features the 2nd Generation Intel Core microarchitecture, with the choice of the Intel Core i7-2715QE processor, Intel Core-i7 2655LE processor, Intel Core i7-2610UE processor or the Intel Core i5-2515E processor. The AM 31x/x0x also incorporates the Intel Series 6 Express chipset, and up to 8 Gbytes of DDR3-1333 ECC SDRAM, all within a single-width AMC form factor.

The AMC.0/.1/.2/.3-compliant SBC offers eight PCI Express lanes (AMC.1 Type 8), configurable as 2 x (x4) or 8 x (x1) ports, and supporting Gen 1 or Gen 2 data rates. There are two 1000Base-BX channels (AMC.2 Type E2) as well as 4 x SATA (AMC.3 Type S2) interfaces. Bootable Flash memory can be supported via an optional onboard SATA Flash module. The front panel features a Gigabit Ethernet port, a DisplayPort interface, additional RS 232 port and USB 2.0 port.

The AM 31x/x0x features a dedicated microcontroller providing the Intelligent Platform Management Interface (IPMI) for PICMG system management features. This Module Management Controller (MMC) provides an administrator with the ability to monitor, manage, diagnose and recover systems. The AM 31x/x0x also supports full hot-swap capabilities for monitoring and controlling of the board. The AM 31x/x0x is available in single width, mid and full height formats and is also available in two temperature grades: 0 to +55°C (N-Series), and -25° to +70°C (E-Series). Operating systems currently supported are Windows 7, Windows XP, Windows Embedded Standard 7, Linux and VxWorks.

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

Sine Reference Oscillator Rides PC/104

Data Device Corporation (DDC) has introduced the SB-36350CX series of sine reference oscillator PC/104 cards featuring a high efficiency transformer isolated output to directly drive high inductive loads. The SB-36350CX cards feature software programmable voltage and frequency along with short circuit protection to support a wide range of applications including industrial and military test systems, aircraft, ships, displays, robotics and ground vehicles. The cards are conformal coated and operate over a temperature range of -40° to +85°C. The card provides high efficiency 5VA Sine output, software programmable voltage/frequency and can directly drive high inductive loads without an amplifier. Short circuit protection is also supported.

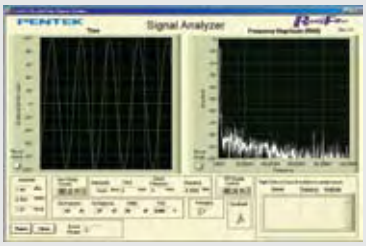
Data Device Corp., Bohemia, NY. (631) 567-5600. [www.ddc-web.com].

CompactPCI Serial SBC Brings Serial Interfaces to Rugged Computing

A SBC is based on the newly ratified PICMG CPCI-S.0 CompactPCI Serial specification that was announced at Embedded World 2011. The G20 from MEN Micro uses the 64-bit Intel Core i7 processor with a base processing speed of 2.53 GHz that supports Intel Turbo Boost Hyperthreading technology to provide a maximum speed of 3.20 GHz. In addition to the standard, fast 8 Gbyte DDR3 ECC SDRAM soldered against shock and vibration, a CompactFlash and a microSD card slot connected to the G20 via one USB interface can extend memory capacities.

A CPU-independent microprocessor in the G20 based on the Intel Advanced Management Technology (AMT) allows remote access via an integrated Ethernet controller, even when the computer is in soft-off or stand-by state. This is especially useful in systems where the operating system has crashed or the hard disk is defective, since an error diagnosis with repair can be carried out remotely as long as the system has standby voltage. Standard front I/O includes two PCIe-driven Gigabit Ethernet and two USB 2.0 interfaces as well as two DisplayPorts that can be used as an HDMI or DVI connection via an external adapter. A total of eight PCI Express links in the front and back of the G20 enable fast communication. For user-specific applications, the rear I/O also provides eight USB ports, six SATA ports, a Display or HDMI port as well as a PEG x8 port and five PCI Express x1 links. MEN Micro also offers the GM1 CompactPCI Serial mezzanine module that leads four of the possible eight Ethernet interfaces specified in the standard to the backplane where they are implemented on CompactPCI Serial connector P6 assembled on the GM1, saving costs and increasing system flexibility. Pricing for the G20 is $2,097.

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



Board Support Package Speeds FPGA System Development

Pentek has announced new features for its ReadyFlow board support package (BSP) to simplify embedded development for its Cobalt, Xilinx Virtex-6-based FPGA module family. Enhancements include a Command Line Interface that allows the hardware to run out-of-the-box without having to write any code, and the introduction of a turn-key Signal Analyzer for data display, validation and monitoring. ReadyFlow provides users of Pentek's Cobalt module family with a variety of tools to help them at all stages of application development. There are numerous C-callable functions to handle initialization and test, data movement and communications and control of all board resources.

The new Command Line Interface of pre-compiled executables is specific to the hardware features of the board it supports. It allows single-command control of parameters such as the number of enabled channels, clock frequency, data transfer size and the like. The Command Line Interface is callable from within a larger user application, providing a convenient way to configure the hardware. Operating parameters can be dynamically changed while the application is running to address application conditions. The single developer license fee is $2,500 and allows royalty-free use of application and example code for multiple projects, and includes lifetime support.

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

COM Express Atom-Based Module Offers Low Power, High Graphics

A new COM Express Type 2 module is based on the Atom E6xx processor series and the Intel Platform Controller Hub EG20. All components are specified for the industrial temperature range of -40° to +85°C. The Conga-CA6 from Congatec has a power consumption of less than 5 watts and a compact size of 95 x 95 mm. The conga-CA6 module is available as a 600 MHz, 1.0 GHz, 1.3 GHz and 1.6 GHz option with 512 Kbyte L2 cache and can access up to 2 Gbytes of rugged soldered DDR2-RAM. Memory access, sound and graphics are all integrated directly into the processor. The new integrated 3D-enabled graphics engine has received a 50 percent performance boost and can accommodate up to a 256 Mbyte frame buffer. The graphics support DirectX 9.0E as well as OpenGL 2.0; video applications benefit from hardware decoding in MPEG-2 and MPEG-4, while graphics output is via 24-bit LVDS channel or SDVO. Pricing starts at $300 in OEM quantities.

Congatec, Cardiff-by-the-Sea, CA. (760) 635-2600. [www.congatec.us].

ARM-Based Embedded Computer Consumes Only 2W

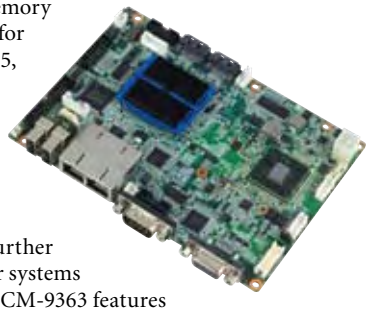
The RE2 board from Blue Chip Technology is an ARM Cortex A8-based embedded computer. It features an OMAP 3 processing core, which also integrates a C64x up to 520 MHz DSP. The RE2's power dissipation is typically only about 2W at 720 MHz.

A display kit is available, providing all the display-specific cables and interface electronics to handle the signal, backlight and touch screen requirements for an off-the-shelf range of TFT panels ranging from 3.5 to 7 inches. Features include 256 Mbytes LPDDR SDRAM and 512 Mbytes NAND Flash, both soldered on board, plus an optional NAND Flash MicroSD card. Video output is available through a 24-bit RGB TTL connector or a DVI port, and a 4-wire touch screen controller and audio codec interface are also provided. Comms capability comprises a 10/100 Ethernet port, quad USB 2.0 host ports, one USB 2.0 device port, dual RS-232 and a single RS-485 port. Bluetooth, Wi-Fi and a Camera Interface are also provided.

Blue Chip Technology, Chester, Cheshire, UK. +44 (0) 1829 772000. [www.bluechiptechnology.co.uk].

3.5-Inch SBC Serves up 1.8 GHz Dual-Core Atom CPU

Advantech has announced a new 3.5-inch SBC using the latest Intel technology: PCM-9363 with Intel Atom N455 1.66 GHz and the dual core D525 1.8 GHz processors with ICH8M chipset.



The processors integrate DDR3 memory supporting up to 4 Gbyte capacity for D525 and 2 Gbyte capacity for N455, and graphic controller supporting Intel Gen 3.5, DirectX 9.0c and MPEG2 hardware decoder. The Thermal Design Power (TDP) rating including processor and ICH8M chipset is only 9W for the N455, and 13W for the D525, further enabling power reductions, smaller systems and performance improvements. PCM-9363 features a single 12V DC power input design, which makes it easier for power integration. PCM-9363 also supports a DC power hot-plug protection design that can protect unstable DC voltage spikes from damaging the board. Current pricing for this item is $275 per unit.

Advantech, Irvine, CA. (949) 798-7178. [www.advantech.com].

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DC/DC Converters Combine Conduction Cooling, Small Footprint

Martek Power has announced significant additions to its Powertron JL Series of open-frame DC/DC converters. They are conduction-cooled units developed by Martek in response to an increase in applications where the power supply is mounted inside a sealed enclosure. Originally designed for onboard passenger information systems, JL DC/DC converters are rated up to 50W and offer full EN50155 compliance as well as the ability to accept the wide range of typical railway input voltages. Outputs can be specified between 5 and 110 VDC, and the units have a footprint of just 135 x 85 mm including the mounting plate. With efficiencies approaching 90 percent, the conduction-cooled versions help to minimize any temperature rise within the host equipment. All converters in the JL Series are designed for continuous operation at ambient temperatures of up to 75°C without de-rating.

Martek Power, Torrance, CA. (310) 202-8820. [www.martekpower.com].

Mini-ITX Embedded Board Based on 2nd Generation Intel Core Family

A new Mini-ITX form factor embedded system board is designed to provide high performance and flexibility for functional expansion and is suitable for non-backplane defense applications. The WADE-8012 from American Portwell supports the Intel Q67 chipset and the latest 2nd generation Intel Core processor platform, formerly codenamed "Sandy Bridge," in an LGA1155 package, integrated with the memory and PCI Express controller supporting two-channel DDR3 memory and PCI Express 2.0 lanes to provide high graphics performance.

The 2nd generation Intel Core processor family features a brand new monolithic design, which provides greater performance while still maintaining power efficiency. The Intel Q67 chipset continues to push innovation with an architecture designed to deliver quality, performance and industry-leading I/O technologies on platforms powered by the dual-core/quad-core Intel Core processor. Combining the Intel Q67 chipset with a processor from the 2nd generation Intel Core processor family, it enables Portwell's WADE-8012 Mini-ITX embedded system board to deliver smart security, cost saving manageability and intelligent performance for business platforms.

The WADE-8012 Mini-ITX embedded board includes many practical features, such as support for next-generation SATA hard drives based on the new SATA 6 Gbit/s storage specification; configuration of six SATA (two SATA 6.0 Gbit/s and four 3.0 Gbit/s ports) connectors; RAID 0/1/5 and 10; support for the latest PCIe 2.0 (one PCI Express x16 slot) device for double speed and bandwidth, which enhances system performance; two long-DIMM memory slot for DDR3 SDRAM up to 8Gbytes; up to 8 USB 2.0 ports (4 on rear I/O and 4 on board); VGA / HDMI / DVI-D; and two Gigabit Ethernet.

American Portwell, Fremont, CA. (877) 278-8899. [www.portwell.com].

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OpenVPX Backplane Does Twisted-Ring Routing

Elma Bustronic offers a new 3U 6-slot OpenVPX backplane with a twisted-ring routing topology. Compliant to VITA 65 specifications for OpenVPX, the 6-slot backplane has configurable thin pipe links for distributed Gigabit Ethernet to slot 1 through slot 5 and two fat pipes for rear I/O. In slots 1-5 any or all of the P1 thin pipes (x2 channels) assigned to the control channel star can be reconfigured as rear I/O by removing zero ohm SMT shunts. In slots 1-5 all P2 differential pairs are available on the rear side for I/O. The 3U OpenVPX Backplane features a 12-layer stripline design and utilizes standard FR-4 PCB material. Pricing for the 6-slot OpenVPX Backplane is under $1,400 depending on volume and configuration.

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

Rugged 3U VPX SBCs Boast Hyperthreading Dual-Core CPUs

OpenVPX provides a unique mix of ruggedness and extreme data throughput—both critical requirements for network-centric communications, high-definition avionics displays, mission and controls systems computers, data concentrators and condition-based maintenance (CBM) applications. Feeding those needs, Aitech Defense Systems now offers a 3U VPX product family based on the low-power Intel Core i7 processor that enables extremely high computing within very compact environments. The new Core i7 can process data using two cores and four threads via Intel's hyperthreading technology.

Based on the latest in OpenVPX serial fabric architecture technology, the new 3U VPX family includes the C870 SBC with a Core i7 dual-core processor configured to run at either 2.53 GHz for high performance, 2 GHz for low-power or at 1.33 GHz where ultra low power is required. As standard, the board provides up to 4 Gbytes of DDR3 SDRAM with ECC operating at 1066 MHz, 4 Mbytes of BIOS Flash and 8 Gbytes of onboard SATA SSD for mass storage. Standard onboard I/O is also plentiful with four GbE ports (two 1000Base T, two 1000Base BX/KX), two SATA II ports, four USB 2.0 ports and eight discrete I/O lines as well as two UART ports and HDMI/DVI and CRT interfaces for graphics requirements.

As part of the 3U VPX family of products, the OpenVPX-compliant CM870 is a low-power, rugged PMC/XMC carrier board designed to plug into an adjacent 3U backplane slot in order to expand system functionality by enabling the addition of I/O, graphics and SSD memory PMC/XMC cards. Both the SBC and carrier card are single-slot modules and are available in air- and conduction-cooled formats, per ANSI/VITA 46.0-2007 and ANSI/VITA 65.0-2010 respectively. The carrier card weighs less than 0.7 lbs in both formats, while the air-cooled SBC weighs 0.66 lbs and the conduction-cooled version weighs 0.7 lbs.

Aitech Defense Systems, Chatsworth, CA. (888) 248-3248. [www.rugged.com].

PoL DC-DC Converters Suited for FPGA Power Loads

Murata Power Solutions has introduced the OKI-T/36W series of SMT point of load (PoL) DC-DC converters. Offered in the same DOSA standard SMT pinout as the company's OKY-T/3 and -T/5, the 24Vin OKI-T/36W series further extends Murata Power Solutions' point of load product offering. With a wide input voltage range and a programmable output voltage, the OKI-T/36W series is ideal for use in higher voltage applications requiring a low voltage source to power loads such as FPGAs and microprocessors. The OKI-T/36W-W40 features a wide input range of 19-40 VDC and selectable output voltage between 5.021 and 15.5 VDC. Power output is 36W at 12Vout. This highly efficient PoL converter also features under voltage lock out (UVLO), output short circuit protection, over-current and over temperature protections and an On-Off control.

Murata Power Solutions, Mansfield, MA. (508) 339-3000. [www.murata-ps.com].

PoE Managed Rack Mount Ethernet Switch Provides 26-Port

Aaxeon Technologies has released its LNP-2602GN 26-Port PoE (Power over Ethernet) Managed Industrial Rack Mount Ethernet Switch. The new LNP-2602GN features 24 x 10/100BaseTX power and 2 x 10/100/1000T/Mini-GBIC Combo ports with all 24 10/100BaseTX ports capable of providing Power over Ethernet (PoE). Along with the standard model, the LNP-2602GN is also available in an extended operating temperature model (LNP-2602GN-T) that can withstand temperatures of -35° to 70°C. The LNP-2602GN allows users up to 24 PoE ports for applications needing numerous PoE connections like multiple IP surveillance cameras. The LNP-2602GN also boasts many other important features like LLDP (Link Layer Discovery Protocol), which allows the switch to advise its identification and capability on the LAN, and security features like IEEE 802.1x RADIUS, to remotely authenticate users.

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

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COTS JOURNAL

Special Feature: Target Report: The GCV and Mil Vehicle Modernization Changes by the DoD and U.S. Army to vehicle requirements will necessitate rethinking previously planned electronics. The DoD has scrapped the vehicle portion of the Army's Future Combat Systems and moved its funding to successor programs including the Ground Combat Vehicle (GCV) and the Early Infantry Brigade Combat Teams (E-IBCT) program. Onboard communications and control electronics are still expected to multiply in sophistication for both next-generation and Current Force fighting vehicles. Articles in this section explore the latest requirements and how these changes may be influenced by technology and the latest products available.

Tech Recon: Military Success Stories for CompactPCI and ATCA Although both were designed originally for the telecommunications market, ATCA and CompactPCI have each earned a solid niche of the military embedded computing landscape. ATCA has slowly and quietly gained numerous project wins in a variety of comms-oriented military systems. And CompactPCI, particularly in 3U conduction-cooled flavor, has won an impressive number of defense system design-ins. This section explores some of the success stories of ATCA and CompactPCI and examines what in particular about them is attractive to military system developers.

System Development: Subsystems and Displays for Command Control Leveraging cutting-edge graphics chips developed for the demanding gaming market, military graphics subsystems are now able to offer complex video and graphics functionality in highly integrated board-level solutions. Command and Control systems have embraced these capabilities and now rank among the most demanding users of these advanced graphics technologies. This section includes articles that examine the graphics solutions available in CompactPCI, COM Express, PMC, XMC, VME, VPX and other form factors, as well as a product roundup of display interface products.

Tech Focus: FPGA Processing Boards As the signal processing capabilities of FPGAs continue to climb, board-level configurable computing solutions have grown to become key enablers for waveform-intensive applications like sonar, radar, SIGINT and SDR. Such systems have an insatiable appetite for more digital signal processing muscle. This feature section delves into the solutions available in this area and explores how they're transforming military signal processing systems.

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COTS

Editorial

Jeff Child, Editor-in-Chief

No Decision Time Like the Present

As this column goes to press, we're days away from a looming shutdown of the Federal Government. As agencies prepare to organize their shutdown process, employees are getting the word as to whether their job is considered "critical" enough to be exempt. As I write this, a friend of mine who's an engineer for the Air Force told me that he's been notified that he's a non-exempt federal government employee. Unless the shutdown is somehow avoided, as a non-exempt federal government employee, he'd be furloughed without pay. "Thanks for nothing Congress," he said. Ironically, for their part, members of Congress are paid during a shutdown. How is that fair?

I'm not going to wade deep into the politics of the situation, but I'm simply amazed at the lack of decisiveness that's keeping opposing sides from coming to an agreement. Both the Democrats and the Republicans are after budgets cuts, but with their different views on the amount at only $30 billion away from each other, you'd think they could get into the ballpark of compromise. This lack of decisiveness isn't anything new. In the defense industry, the procurement wheels were sluggish all last year—as decisions to pull the trigger on already funded programs seemed to take an agonizingly long time. Many companies from our military embedded computer market that I've talked to over the past year have felt the effects of such delays as they trickle down the procurement food chain.

From what I've seen there's a pattern for success among companies—both technology suppliers and primes contractors—for dealing with these environments. Those that come out on top are the ones that are proactive and clever and anticipate what their customer needs before their customer asks for it. An example that comes to mind is General Dynamics C4 Systems and its EDGE Innovation Network initiative. EDGE is an open-environment initiative where industry and academia collaborate—with government input—to enhance the delivery cycle of new technologies and innovative capabilities to warfighters. The idea is to pool subject matter expertise, advanced product portfolios and equipment, facilities and laboratories for developing and testing technologies, products and systems at faster cycle times than are currently possible on funded programs.

Meanwhile, there's no doubt that military prime contractors are placing an ever greater reliance on companies in our industry that supply embedded computing technology. Two factors are driving that. First, there are more programs these days that are structured as fixed-price rather than cost-plus. Second, procurement policies are requiring demonstrations earlier in the program development phase. That means primes have to show higher Technology Readiness Levels (TRLs) than previously required. All that's helped drive demand for box-level packaged systems as primes find themselves without the time or the DoD funding to develop a prototype subsystem themselves.

The concept of Technology Readiness Levels (TRLs) was originally developed by NASA, and later the Army and Air Force science and technology research organizations started using them to determine when technologies are ready to be handed off to product developers. TRLs are measured on a scale from 1 to 9, beginning with paper studies of a technology's feasibility and culminating with a technology fully integrated into a completed product.

Another important tool for helping facilitate better technical decisions are face to face meetings between technology suppliers and design engineers building military platforms. These in the form of prime contractor-hosted Industry Days have become key events. There are just not enough opportunities like that for military system developers to interact face to face with suppliers that provide critical embedded electronics and computing technologies. Taking that format a step further, *COTS Journal* is getting directly involved in leveraging the event experience within our parent company. With that in mind, the RTC Group is gearing up for a three-city tour with a new military electronics design conference dubbed MILESTONE. *COTS Journal* will serve as media sponsor and also official "host" of these targeted events.

These MILESTONE shows provide a great venue to showcase products along with face to face information sharing. That's combined with conference sessions that include presentations from suppliers on technology trends and design issues. The first of these launches June 21st in Baltimore, with the next following on June 23 in Nashua, NH. In mid-November, MILESTONE will take place in the Los Angeles area. (See the link on our website for details.)

There's something to be said for keeping the momentum going—no matter what the state of the economy or government is at any given moment. The winners—as individuals or companies large and small—always seem to be those that are in the right place when opportunity hits. A sign of true character is to keep moving forward even as forces beyond your control create turmoil. Here's hoping that by the time you read this, a shutdown either didn't happen or is over by now. Most of all, I hope my Air Force engineer friend is back at work doing the indispensable work of building our military's technology future. ▮▮

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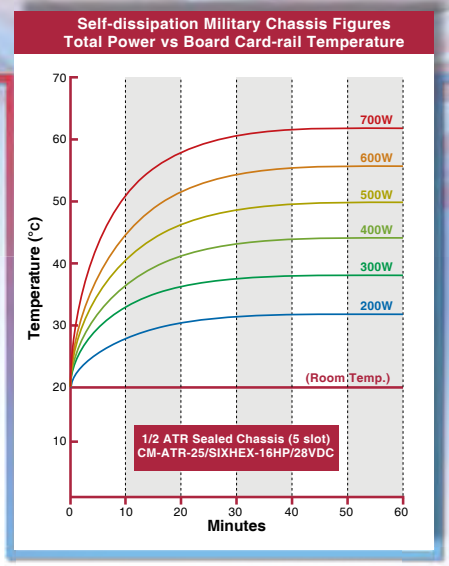

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