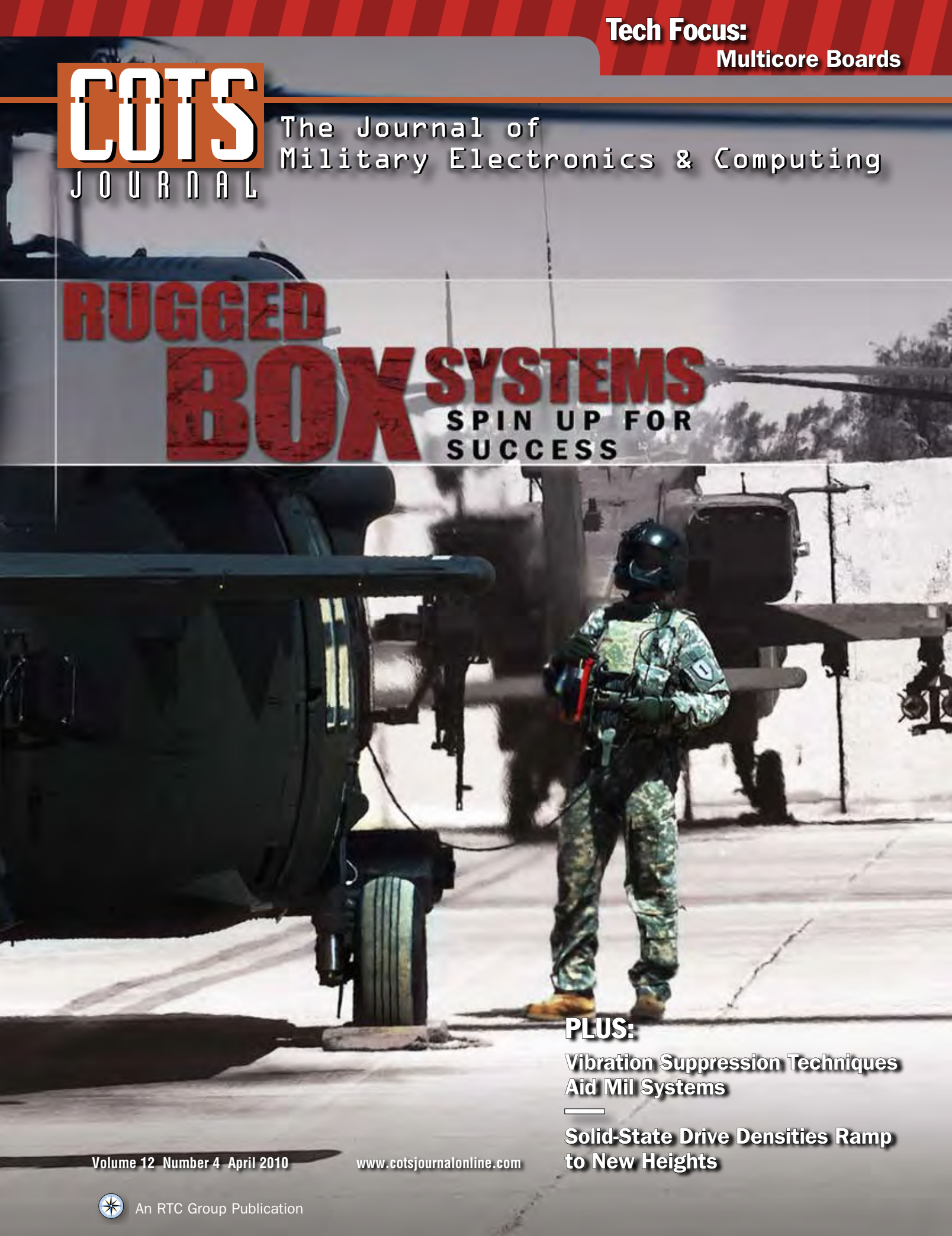
Tech Focus:
Multicore Boards

COTS JOURNAL

The Journal of Military Electronics & Computing

RUGGED BOX SYSTEMS SPIN UP FOR SUCCESS



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Volume 12 Number 4 April 2010

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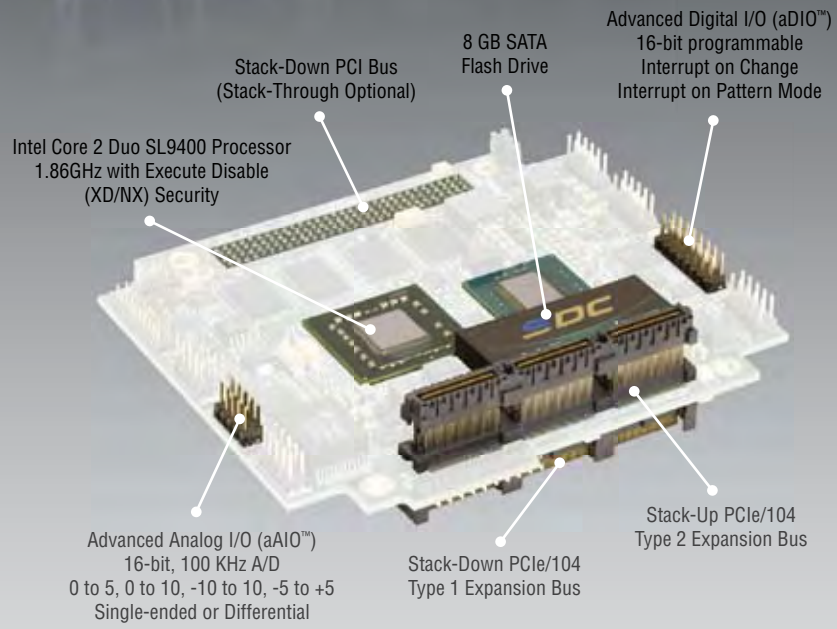

Intel Core 2 Duo Processor	1.86 GHz – 1.20 GHz
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†*See figure on left for details*
‡*See web site for details on each model*

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14
Slot-Card Systems Vie with Rugged Box Solutions

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

CONTENTS

April 2010 Volume 12 Number 4

SPECIAL FEATURE
Rugged Box-Level Systems vs. Slot-Card Solutions

TECH RECON
Shock & Vibration Testing for Embedded Boards

SYSTEM DEVELOPMENT
High-Density Storage in Military Systems

TECHNOLOGY FOCUS
Multicore Boards

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Departments

Coming in May
See Page 64

On The Cover: Rugged box-level systems are good fit for platforms like helicopters where shock and vibration are a concern. UH-60M Blackhawks embed a box-level Data Concentrator Unit based on CompactPCI boards. Here, a crew chief with Combat Aviation Brigade, 1st Infantry Division watches his helicopter as it shuts down. *U.S. Army photo by Spc. Roland Hale, Combat Aviation Brigade, 1st Inf. Division.*

COTS JOURNAL
The Journal of Military Electronics & Computing

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Publisher's Notebook

Secretary of Defense Robert Gates

Finding Our Footing Together

The last month I've been busy on the phone talking with many of you. Everyone is trying to figure out what is going on and what will happen in the Mil embedded electronics market. Getting all these calls should make me feel pretty good. Or is it that people are just so desperate that they're now calling me? One thing is clear: with the exception of SecDef Robert Gates, there isn't much information coming out of our government, and it's highly doubtful that much will in the near future. That means we're on our own with our feet planted firmly in midair.

In spite of the government—and in a few instances as a result of the government—some segments of the economy are starting to turn around. For corporate sharks this is like smelling blood in the water. And that should fuel a merger and acquisition frenzy for bargain hunters that can come up with funding or deals to acquire companies. In the Mil market this will include primes acquiring companies with special capabilities, sub-primes trying to lock up a market segment and small companies trying to become bigger.

Most companies big or small that have a major part of their business based on Mil products have been doing okay. As we do about every four years, we have run into a cycle where it's difficult to get the last person to sign off on a shipping schedule or some minor last minute detail. The government's lack of a plan and decisiveness makes everyone gun shy to sign off on anything. This then causes supplier production and component procurement delays. And when the procrastinators finally sign, they then follow with a request for emergency shipments because the product was needed months ago. So even companies that are doing fairly well are getting nervous. At the same time, they're trying to focus on doing seed work for future design-ins, and that also has system designers and suppliers in confusion.

The only two areas that the government appears to be providing a clear message on are airport security and unmanned vehicles. I already expressed my thoughts on airport security in a previous column, and thank goodness I haven't been disappointed. Instead of doing what should be done—a ground up look at the problem—we'll just throw some money and technology at the problem and the public will go away happy. We should just hire the Israelis to handle our airport security. They don't appear to lose sight of the objective and let politics or being politically correct interfere.

Unmanned vehicles, whether they're in the air, on the ground or on the sea, are going gangbusters and will continue to for years to come. Most Mil upgrade programs are also still going strong and will even do better as consternation on how to move forward with new programs continues. We should also add that government rhetoric about the demand for procurement reform—which left both suppliers and procurers in a state of confusion—is slowly dissipating. That should alleviate the anxiety many have of doing something that may shortly be determined to be wrong.

The electronics industry has always shown a lot of drive when it comes to coming up with new and leading-edge technology and products. For its part, the military has become more open to accepting newer ideas quicker, but that should not be viewed as an indication that it is going to catch up to the commercial market. "Tried and proven" will still be the backbone of military product. FPGAs and FPGAs with DSP cores will continue to gain over general processors; providing flexibility, obsolescence protection and some software transportability. UAVs provide a great opportunity for standalone non-bus-based systems providing the lowest weight and power needs. In general, new systems and upgrades requiring quantum leaps in performance will start to consider OpenVPX, and looking even further into the future, longer range projects will keep an eye on VITA's new startup effort for an optical backplane interconnect.

Secretary Gates forced the cancellation of the ground combat vehicle portion of the Future Combat Systems program in order to get a realignment of what is needed and will be needed for our potential future conflicts. By the end of this year there should be a new plan in place. The Army has released a Request for Proposal (RFP) for the Ground Combat Vehicle (GCV) of the plan with a fall response date. The May issue of *COTS Journal* will have a Target Report: Current Force and Next-Gen Mil Vehicles Eye Modernization, providing the latest available information on the Army's GCV plans.

The one common positive thread through all of this is COTS: a purchasing concept that makes an array of product solutions available to military systems designers for their unique needs. Products can range from components, to boards, to pre-integrated systems or to full subsystems or systems. The COTS concept has the added benefit of allowing for major concept changes without years of recovery during the periods when the government gets indecisive. Only a few issues that have been a concern to the readers have been touched on here, so please keep calling or emailing me. Together we'll do our best to keep our feet firmly planted on the ground. ▮▮

Pete Yeatman, Publisher
COTS Journal

Some Storage Applications Have It Really Tough!

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The Inside Track

Aonix Java VM Used on Modernized Guided Missile Cruiser USS Bunker Hill

Development tools supplier Atego has announced the successful deployment of its industry-leading Aonix PERC Virtual Machine technology in support of Lockheed Martin's Java language components used in the Aegis Open Architecture System during recent combat tests. The guided missile cruiser USS Bunker Hill (CG 52) (Figure 1), modernized with the Aegis Weapon System, completed an operational trial of its full combat system.

Figure 1

USS Bunker Hill (CG 52) was the first of 22 Ticonderoga-class guided-missile cruisers to undergo an extensive capability upgrade as part of the Cruiser Modernization Program.

Aonix PERC Ultra is used by Lockheed Martin in its Aegis Weapon System, providing deterministic, real-time performance and high productivity development. Aonix PERC Ultra additionally provides the instrumentation and VM management tools necessary to support the mission-critical real-time requirements of the Aegis Weapon System. The Aegis Weapon System includes precision SPY-1 radar and an integrated command and control system that seamlessly guides the interceptor and uplinks target track information to the missile for terminal homing. Its ability to detect, track and engage targets ranging from sea-skimming cruise missiles to ballistic missiles in space is proven.

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TCGroup and Saab Teams for Ground C2 System Deployments

Tactical Communications Group (TCG) and Saab announced successful deployments of Saab's highly scalable command and control ("C2") solution incorporating TCG's LinkPRO tactical data link processing engine. This combined solution has now been successfully fielded multiple times, and is being used to provide secure, fully integrated operational ground C2 solutions for countries in Northern Europe and Asia Pacific.

Historically, comprehensive and fully integrated ground C2 systems have taken years to develop and deploy, have not been designed to easily accommodate future military communication requirements or growth, have been very expensive for countries to procure, and have been extremely complex for users to operate. Saab's C2 solution, which incorporates TCG's LinkPRO tactical data link software, is uniquely capable of meeting today's new requirements for secure, fully integrated, state-of-the-art military communication systems, which can be quickly fielded on a cost-effective basis.

Tactical Communications Group
Tewksbury, MA.
(978) 654-4800.
[www.g2tcg.com].

Quintron Supports Recent Delta IV Weather Satellite Launch

Quintron Systems announced that it supported the recent Delta IV weather satellite launch (Figure 2) from Cape Canaveral with several critical communications systems, including a DICES voice system used by the launch pad and control room operators, closed-circuit television equipment used to monitor numerous locations during rocket preparation and launch, infrared camera systems that monitor for leaks and fires on the hydrogen fuel tanks and fittings (hydrogen flames are not visible in normal light), and a special high-speed television system to record critical areas of the rocket during initial launch phase.

Figure 2

Delta IV weather satellite launches from Cape Canaveral with several critical communications systems, including a DICES voice system.

These three satellites are orbiting observatories, known as Geostationary Operational Environmental Satellites (GOES). They will provide enhanced imagery with constant observations of clouds, atmospheric conditions and weather, enabling the better prediction of tornados, hurricanes and other severe weather warnings.

Quintron Systems
Santa Maria, CA.
(805) 928-4343.
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ViaSat Awarded $21.5 Million MIDS-LVT Lot 11 Delivery Order

ViaSat has received a delivery order valued at approximately $21.5 million for Multifunctional

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NATIONAL INSTRUMENTS™

Information Distribution System – Low Volume Terminals (MIDS-LVT) from the Space and Naval Warfare Systems Command (SPAWAR), MIDS Program Office (MPO) in San Diego, California. MIDS-LVT terminals provide greater situational awareness in combat for U.S. Navy, Air Force, Army, Marine Corps, and for U.S. defense partners by gathering information into a digital view of the battlefield. The secure, high-capacity, jam-resistant wireless (non-satellite) system connects users with both digital data and digital voice communications. Delivery of the Lot 11 MIDS-LVT units is expected to begin in March of next year and continue through February of 2012.

The MIDS-LVT Lot 11 order includes LVT(1) airborne and LVT(2) ground-based terminals under a new five-year Indefinite Delivery/Indefinite Quantity (IDIQ) contract. This new award includes LVT(1) terminal variants for F/A-18, P-3, E-2D aircraft (Figure 3) and MH-60R/S helicopters, along with terminals for the BACN program and other U.S. Navy applications. The MIDS-LVT Lot 11 order also includes LVT(2) terminal variants for various U.S. Army, U.S. Air Force and Joint Forces applications as well as terminals for Germany, Australia and Korea.

ViaSat
Carlsbad, CA.
(760) 476-2200.
[www.viasat.com].

BAE Systems to Provide Vehicle Power System for Marine Humvees

BAE Systems has received a contract to develop an onboard vehicle power management system designed to improve U.S. Marine Corps mission effectiveness by significantly increasing electric power available to ground forces. The contract calls for installation of a power management system in a government-furnished High Mobility Multipurpose Wheeled Vehicle for test and evaluation by the Marine Corps in the summer of 2010. The Marine Corps is evaluating systems from two suppliers and plans to award a contract for five to ten additional systems later this year. The system will more than triple the HMMWV's electric power output and provide exportable power to support facilities such as forward-deployed command centers and field hospitals. It also can provide mobile emergency power during natural disasters. The contract award is part of the Marine Corps' Onboard Vehicle Power program, funded by the 2009 American Recovery and Reinvestment Act.

BAE Systems will perform vehicle integration work that expands the HMMWV's power generation capability to 30 kilowatts of continuous mobile onboard power, directly supporting Marine Corps expeditionary units. The integrated, modular, scalable system generates and manages power for use on the vehicle and as an exportable power source, eliminating the

Figure 3

The MIDS-LVT Lot 11 order includes LVT(1) airborne and LVT(2) ground-based terminal variants for F/A-18, P-3 and E-2D aircraft (shown).

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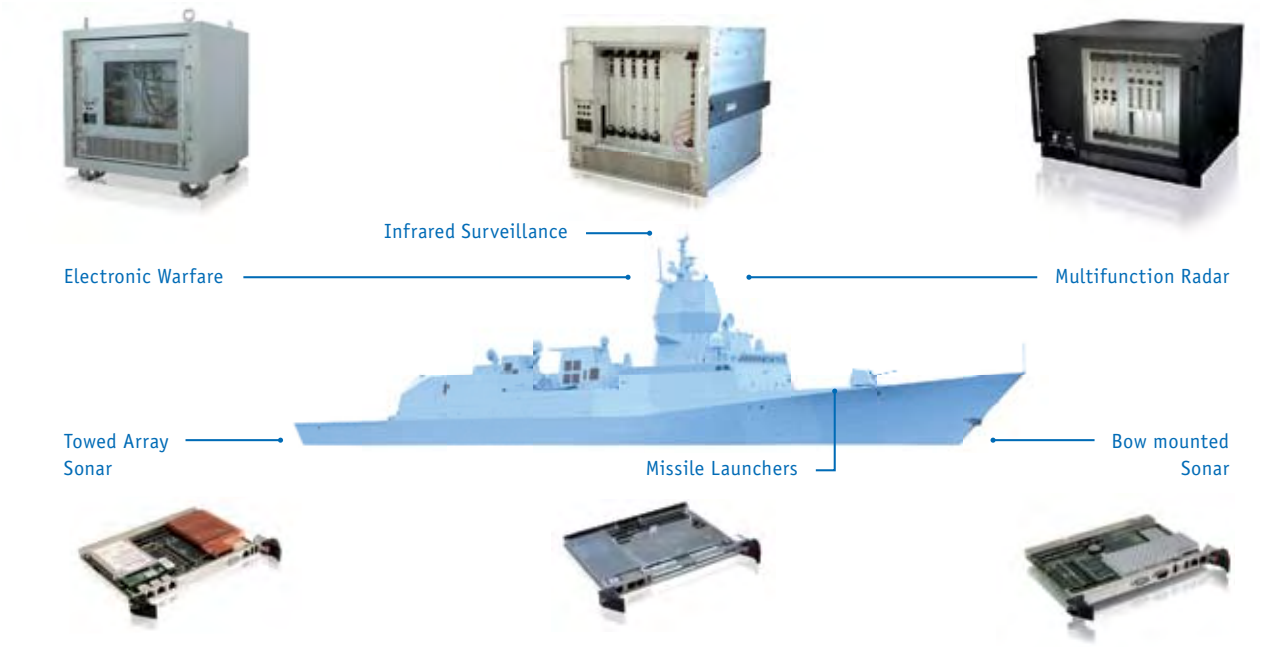

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Figure 4

Marines of Regimental Combat Team 5, Combat Logistics Battalion 5, Combat Logistics Company 115 participate in a "Humvee Push" competition with the M1114 variant.

need for towed generators and improving the HMMWV's mobility. The system also manages electrified automotive accessory systems such as water pumps, engine fans, power steering pumps and air conditioning. Electrifying these traditionally belt-driven systems improves mobility by providing more horsepower to drive the vehicle, improving fuel economy and extending engine life.

BAE Systems
Nashua, NH
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[www.baesystems.com].

Event Calendar

April 26-29
ESC Silicon Valley 2010
San Jose, CA
www.esconline.com

May 25
Real-Time & Embedded Computing Conference
Boston, MA
www.rtecc.com

May 27
Real-Time & Embedded Computing Conference
Philadelphia, PA
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June 8
Real-Time & Embedded Computing Conference
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Rugged Box-Level Systems vs. Slot Card Solutions

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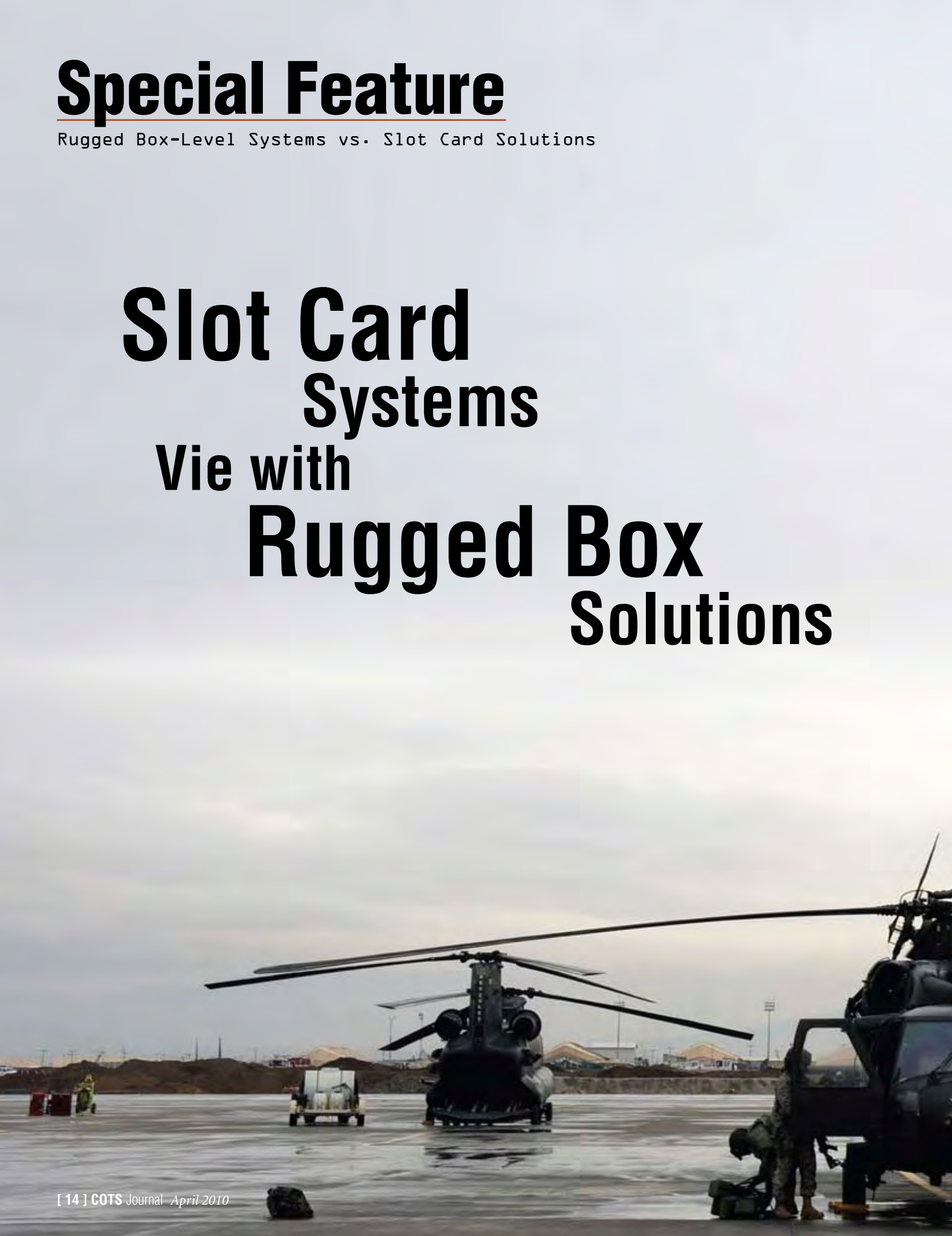

More choices of compact rugged box-level systems are emerging. As a result, military system designers are weighing the trade-offs between a slot card backplane approach versus a complete rugged box-level computing approach.

Jeff Child
Editor-in-Chief

There's no doubt that there has been a change occurring in the military embedded computing industry over the past five years or so. At the heart of that change is the rising importance of the product category *COTS Journal* coined the "stand-alone rugged box." In many ways these box-level systems resemble the end deliverable systems that prime contractor manufacturers pieced together with off-the-shelf subsystems inside it. But now these rugged box-level systems are a common COTS product offering among a wide selection of suppliers. In other words, they've become a second center of gravity alongside single board computers and slot card systems.

For years the SBC ranked as the driver of the military embedded computing market. When major vendors rolled out new SBC products—in VME, cPCI and other form factors—every couple of months, the peripheral, mezzanine and I/O products rode that wave, being sure to be compatible with whatever form factor or bus architecture the SBC vendors were supporting. That trend continues, but now integrated rugged box systems have started to move to the foreground as another choice for military system developers.

No Longer Just Custom

Rugged box-level systems typically comprise a set of modular embedded boards housed in a rugged enclosure that has its own power supply and interface ports to link to a variety of user terminals. And while the idea of offering a more complete system solution is nothing new, they used to be mostly "custom" offerings for specific customers. What's changed, however, is that the concept has really become a kind of staple in this market, where even most board product suppliers now offer rugged box systems as catalog products. That said, there are a handful of companies, Crystal Group, Octagon Systems, Parvus, Quantum 3D, Rave Computer and RTD Embedded Technologies, that were doing this long before the traditional board vendors.

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.

Figure 1

COTS Journal's Jeff Child examines a 3U CompactPCI slot card system in the back of General Dynamics C4 System's WIN-T demonstrator Humvee at AUSA Winter earlier this year.

Trade-offs of the Slot Cards Approach

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. This kind of flexibility is particularly useful when not all the I/O requirements are defined at the beginning of a project—a common situation in military programs. Some applications like comms and networking systems tend to require the slot card be available to the end-user for reconfiguring systems functionality in the field. Figure 1 shows an example of a 3U CompactPCI slot card system in the back of General Dynamics C4 System's WIN-T demonstrator Humvee at AUSA Winter earlier this year.

On the downside, this means the system integrator is sometimes left to be the first to combine some of the board-level components and will have to work out any incompatibilities. Problems like mismatched drivers, variations in pin assignments and mechanical issues are all potential hurdles to overcome. In an integrated, box-level platform the supplier has already worked out these problems.

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beginning. These include power, weight, heat dissipation and cooling strategy. The systems cable construction is also predefined as well as the basic level of operating system software. Generally speaking, a COTS rugged box system can be smaller, more power-efficient and more shock and vibration resistant than a slot card solution. These complete system boxes—which often support standard form factor boards inside them—provide a complete, tested and enclosed computing solution that eliminates complex integration chores for customers. With the rugged box product category now well entrenched, a number of vendors are on their second and third generation of products. As this happens, products with more rigorous levels of ruggedization and environmental hardiness have emerged.

Figure 2

The NightHawk RCU is an Intel Atom-based box-level system in a self-contained control unit that weighs only 4.5 lbs. It uses natural convection/radiation cooling that dissipates up to 22W at +55°C in stagnant air, or at up to 71°C with an optional low pressure fan or baseplate.

Exemplifying this trend toward increasingly rugged solutions is Aitech Defense Systems' NightHawk RCU (Figure 2). This Intel Atom-based box-level system is a self-contained control unit that weighs only 4.5 lbs. This weight reduction, combined with a slimmer profile and natural convection/radiation cooling that dissipates up to 22W at +55°C in stagnant (non-flowing) air, or at up to 71°C with an optional low pressure fan or baseplate, makes the rugged control unit ideal for a variety of military, aerospace and commercial environments. These include data concentrator and remote interface applications such as manned and unmanned, ground or airborne vehicles as well as low SWaP (size, weight and power) data concentrator unit (DCU) and remote interface unit (RIU) applications. For military tracked and wheeled vehicle applications, the NightHawk RCU can provide Condition Based Maintenance (CBM) functionality to reduce the overhead costs of preventative vehicle maintenance.

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DDR2 SDRAM as well as between 4 and 8 Gbytes of SSD memory with an optional expansion up to 250 Gbytes for extended and remote data collection and storage applications. PC I/O interfaces are available in a low-power, environmentally sealed rugged controller. With a complete set of standard PC I/O interfaces, the NightHawk also provides two Gigabit Ethernet ports, six USB 2.0 ports and four multi-function RS-232 serial ports, dual graphics/video ports, keyboard/mouse and stereo audio in/output ports as well as an I/O set specifically tailored for embedded military and severe industrial applications. Optional I/O includes MIL-STD-1553B, ARINC-429 and ARINC-708, CAN Bus, Wi-Fi and WAN ports.

Also targeting the small size direction of rugged boxes is Crystal Group's TCM2 (Tactical Computing Module). This embedded module is designed for Military shipboard, airborne and land-based applications. The TCM2 is a small-footprint (11" x 12.75" x 3"), high-performance embedded computer. It operates in extreme environments, offering extended capabilities with a temperature range of -40° to +65°C and 7.18 GRMS of random vibration. A standard 10-36 VDC power supply is included allowing it to run on conventional +12V vehicle power or +24/28 VDC, used in many military applications. It also comes with MIL-STD-461E filtering, allowing it to be integrated into existing platforms without disrupting nearby sensitive electronics.

The TCM2 embeds a dual-core 2.53 GHz Core 2 Duo CPU, up to 8 Gbytes of RAM, low-profile PCIe expansion capabilities, and two 2.5" rotational or solid-state hard drives. The TCM2 can also be configured with up to 8 additional 2.5" rotational or solid-state hard drives with the addition of a bolt-on expansion base. This effectively allows the TCM2 to offer up to 4.8 Tbytes of rotational hard drive storage or 1.28 Tbytes of SSD storage in a very small footprint, suitable for rugged embedded computing. The TCM2 also comes equipped with Military Circular MIL-C-26482 connectors, setting it apart from the existing TCM line.

Figure 3

This OpenVPX demo unit is comprised of the SFF-4 Small Form Factor conduction-cooled chassis integrated with 3U OpenVPX-compliant cards, including single board computers, expansion carrier cards and graphics controller OpenVPX-compliant boards.

Straddling the Two Approaches

While the rugged box-level approach and the slot card/card cage approach each offer advantages, there are likely to emerge implementations that take the best of both worlds. OpenVPX systems will likely take such a direction because military customers these days will expect both a high degree of pre-integration along with the ability to mix and match compatible boards. Enclosure and embedded board vendors have already started to team up along those lines. An early example was exhibited at the Milcom last fall where Curtiss-Wright Embedded Computing demonstrated a live OpenVPX system. The system (Figure 3) featured an OpenVPX backplane in a Hybricon SFF-4 Small Form Factor conduction-cooled chassis integrated with Curtiss-Wrights' small form factor 3U OpenVPX-compliant cards, including single board computers, expansion carrier cards and graphics controller OpenVPX-compliant boards. The initial SFF-4 product is designed to support I/O for airborne and ground vehicle control applications, supporting I/O for Ethernet, serial, video and 1553 or CANBUS. Different I/O complements can easily be supported with different backplanes.

Hybricon's SFF-4 chassis is the first in a family of products and is designed for rugged environments for airborne and ground mobile applications. It provides support for the first industry available OpenVPX backplane and features extended temperature, shock and vibration tolerance. It is designed for use in MIL-STD-704F aircraft and MIL-STD-1275B vehicles.

Blade-Level Box Solutions

Another trend that straddles the box and slot card approach is the emergence of bladed server systems targeted for the military market. These solutions provide slot card flexibility in the form of blade compute nodes, but in a rugged box system that is designed for rugged applications. An example along such lines is Themis' line of XR3 servers, which provide multicore processing, extensive I/O and storage options for high performance in compact, rackmountable 1U, 2U and 3U designs. Themis' new XR3 series of Rugged Enterprise Servers (RES) combines the latest Intel Quad-Core Intel Xeon processors with the ruggedized design features of the Themis RES server family. Designed to perform in environments where other systems fail, the new RES-12XR3, RES-22XR3 and RES-32XR3 (Figure 4) servers blend the latest processor technologies with Themis' proprietary thermal and mechanical design to deliver outstanding performance and reliability.

Offered in a compact 1RU, 2RU or 3RU short, light (20-inch aluminum) chassis, these new servers feature more memory—up to 144 Gbytes—and up to eight lockable and removable drives,

hot-swappable fans and hard disk drives, single or redundant power supply options, and optional front panel filters for increased reliability in field deployments. These new systems combines the Quad-Core Intel Xeon 5500 series processors (Intel Nehalem Microarchitecture), with Themis' advanced thermal and mechanical design techniques to provide users industry-leading SWAP (Size, Weight and Power), RAS (Reliability, Availability and Service), storage and I/O configurability. ▮▮

Figure 4

The XR3 line of rugged blade server systems provides multicore processing, extensive I/O and storage options for high performance in compact, rackmountable 1U, 2U and 3U designs.

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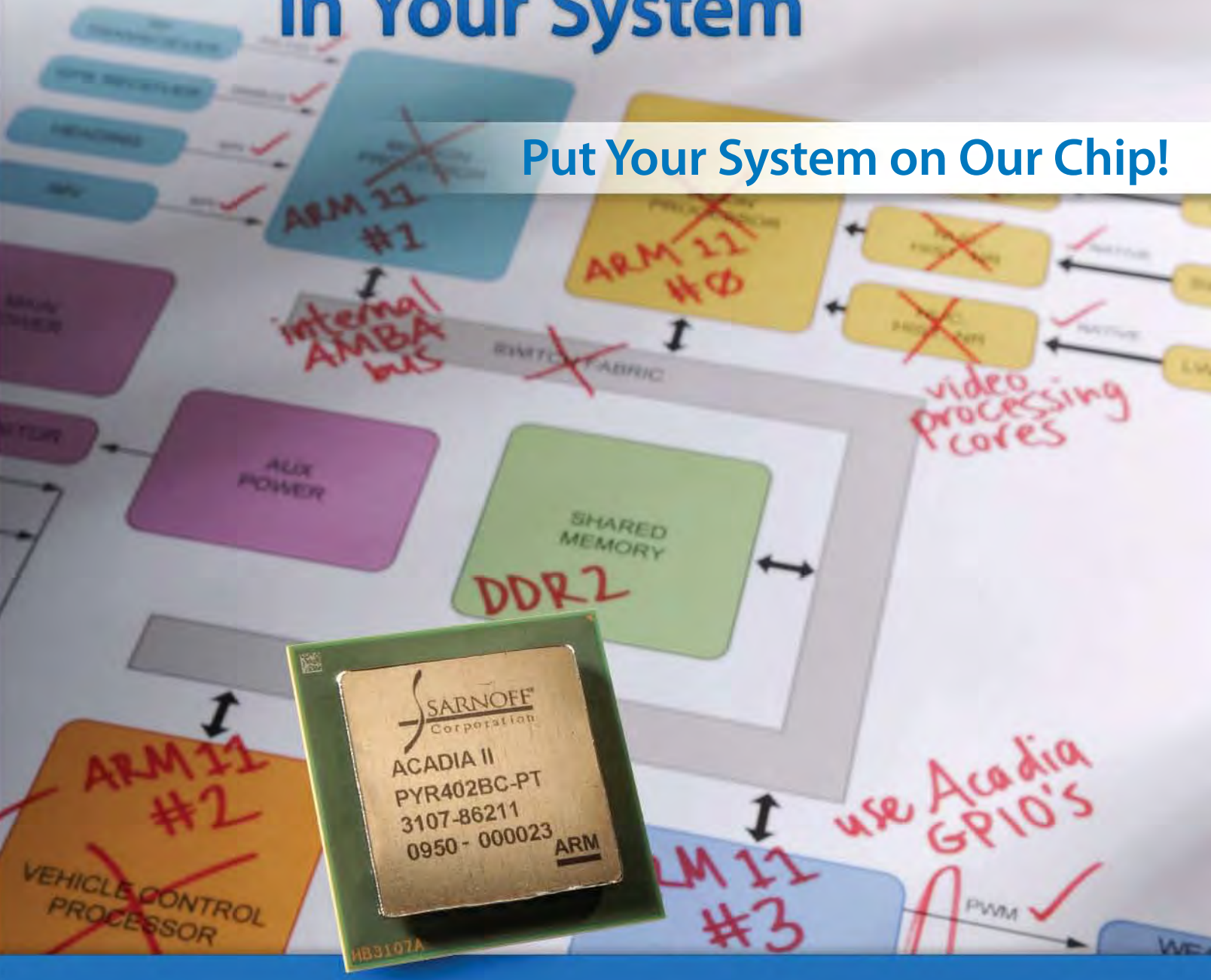

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Rugged Box-Level Systems vs. Slot Card Solutions

Many Factors Influence Slot Card vs. Module Choice

Embedded modular solutions have enabled rugged box-level systems as an alternative to backplane-based slot card systems.

Andy Mason, VP Product Development
AP Labs

Military embedded system designers are always eager to take advantage of new technologies and emerging industry standards once a critical mass of acceptance is achieved and a clear cost/performance benefit is evident. Backplane-based system architectures such as VME, CompactPCI and VPX were each developed in response to evolving application requirements and the need to standardize.

The recent availability of new standards for small form factor modules with an array of processor, I/O and low power options has led to a new class of systems solutions that do not rely on traditional backplanes. For military applications that must operate in rugged or severe environments—while minimizing size, weight and power—a module-based system may offer some distinct advantages.

System designers need to evaluate various aspects when choosing a backplane-based or module-based architecture. The weighting of these will change depending on the target application. First there's the processing requirements—single or multi-processor system. Also key are the I/O requirements—quantity and type, both external and inter-processor as well as system throughput. Size, weight, power and cooling must be factored in as well as any environmental requirements. And all these need to be weighed against the constraints of cost.

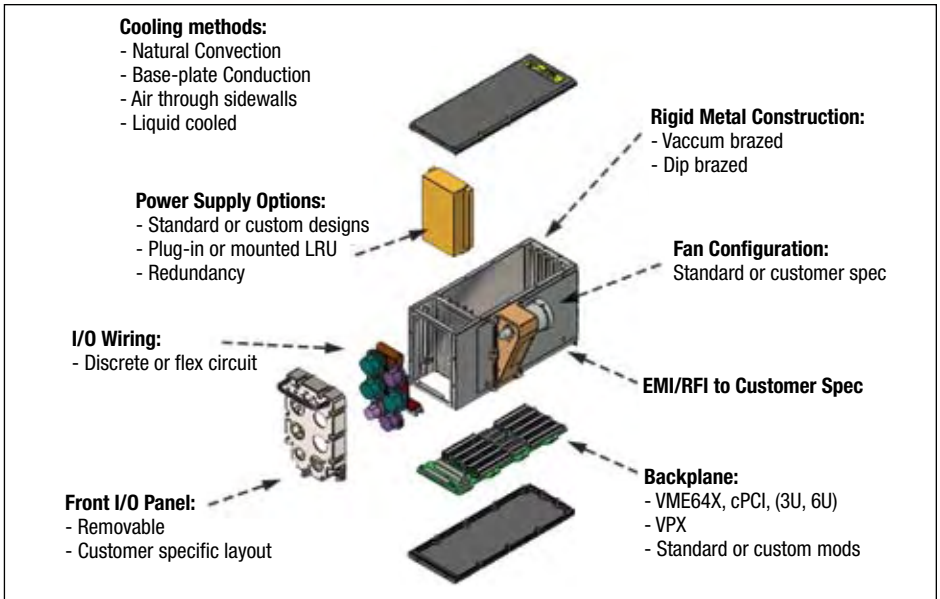

Figure 1

Exploded view of ruggedized enclosure for backplane-based systems. It is configurable to provide a variety of options for cooling, mounting and external interfaces.

Background on Backplanes

Military embedded systems have always been one of the most demanding application arenas because of the combined requirements for survivability, performance and interface flexibility. In the early 90s, the general acceptance of the VMEbus standard for military systems deployed in rugged environments led the way for the development of new embedded products and new bus standards.

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tures, VME, CompactPCI and VPX, were each developed as open standards to support interoperability to the maximum extent possible. Both the VMEbus and VPX standards are under the jurisdiction of the VMEbus International Trade Association (VITA), while CompactPCI is governed by the PCI Industrial Computer Manufacturers Group (PICMG).

The original VMEbus standard was based on a 16/32-bit bus architecture and designed to accommodate the existing Eurocard DIN connectors. Subsequent updates to the standard support wider bus widths, with the current VME64x including a full 64-bit bus in 6U-sized cards and 32-bit in 3U cards. Other updates have added hot-swapping (plug-and-play) in VME64x, configurable mezzanine cards that fit onto a single VMEbus card, and various interconnect standards for linking VME systems together.

Many Options in 3U and 6U

CompactPCI also uses 3U or 6U Eurocard-based form factors, with the boards in the system connected via the PCI bus embedded in a monolithic backplane. Originally ratified in 1995 as a passive backplane for PCI signaling, the PICMG 2.x specifications have evolved to support a variety of technologies including Hot Swap (PICMG 2.1), telephony signaling (PICMG 2.5) and switched Ethernet on the backplane (PICMG 2.16).

VPX, also known as VITA 46, uses a new high-speed connector to interface to a switched fabric backplane. The standard was defined by the VITA working group specifically with defense applications in mind, thus enabling platforms with superior performance in response to escalating application demands. VPX retains VME's existing 3U and 6U form factors and also supports PMC and XMC mezzanine cards, plus provisions for backward compatibility with VMEbus. More recently, the OpenVPX spec tightens up the definition of the many possible configurations of VPX that are possible, ensuring that board and system vendors can achieve interoperability.

While parallel bus architectures such as VME and cPCI continue to be widely used in many military applications, the emergence of switched fabric standards such as PICMG 2.16, VXS and especially VPX has raised the bar regarding system performance. Switched fabric backplanes use high-speed serial interconnects to route data between processor boards or between I/O boards and processors. The backplane and board set may be packaged in a variety of ruggedized enclosure form factors such as ATR and 19-inch rackmount. The enclosure type depends on the space availability and the environmental requirements.

Meeting Rugged Needs

As standardized backplane architectures have evolved to provide more options and a greater range of functionality, the state of the art in chassis/enclosures, cooling and ruggedization technology has also continuously evolved to provide a reliable foundation for implementing these more complex systems.

By standardizing on a chassis that is designed, manufactured and tested to meet the environmental requirements, the designer can be assured that the integrated system can withstand specified extremes of temperature, altitude, vibration, shock, salt spray, sand and chemical exposure, while maintaining a sealed and temperature controlled environment for the computing elements and electronics inside. For example, the rugged enclosure design shown in Figure 1 is configurable to provide a variety of options for cooling, mounting and external interfaces to support multi-board backplane-based systems in harsh military environments.

Module-Based Solutions

New module standards released over the past several years have supported the development of small form factor systems for deployment in rugged environments.

Of particular interest are Computer-on-Module (COM) solutions, which are complete single board computers built onto a single circuit card. Typically, the CPU, memory and I/O controllers are included on board the COM. What are not included on the COM are the standard I/O connectors that allow direct connection to storage and network peripheral devices. These interfaces are implemented using a board to board connector (or connectors) from the COM to a carrier or baseboard, which may be custom developed for a particular application.

Examples of COM standards in use today are COM Express, ETX, XTX and Qseven. These standards define the module form factor and the interface specifications of the board to board connector. The usual computer peripheral interfaces are supported such as Ethernet, SATA, IDE, USB, audio and graphics. Also, PCI and PCI Express bus interfaces are included in the interface standard to allow the addition of other peripheral interfaces on the external carrier board.

Compute Module Upgrades

COM products are generally CPU-agnostic with a variety of processor options available including CoreDuo, Pentium, Atom and PowerPC. The nature of the COM standards allows a pin-

Figure 2

Module-based systems such as this provide designers with a small-footprint, low-power, lower cost alternative to conventional multi-board VME or CompactPCI designs. These new-generation "computer brick" systems can cost as low as half that of conventional multi-board systems with comparable performance and functionality.

Figure 3

In this example, a long-term program has benefited from the flexibility of a backplane-based system in a configurable rugged enclosure, but had its starting point as a standard catalog product.

Figure 4

The Vehicle Expansion Unit (EU) has been developed for a major armored vehicle program. It's a scalable embedded computer system that combines a selection of processor, storage, power and interface options, within a compact footprint.

compatible upgrade path as new modules are released to the marketplace. This scalability can allow a system to increase processing power over time by migrating, for example, from a Core2Duo to a next-generation Quad Core module without changing the existing carrier board. Alternatively, a system may be reconfigured with an Atom processor instead of a Core2Duo if it is determined that the lower processing performance is acceptable. This would result in reduced power draw and lower cost without a design change to the carrier board.

Other small form factor standards such as PC-104, PC104+, EPIC, EBX and ITX offer some of the benefits of COMs, but do not have the means to implement tailored I/O via the COM to carrier board implementation. This generally results in a system solution that is both larger in size and less resistant to high shock/vibration environments.

Figure 5

The COBALT system incorporates one Intel Core2Duo or Atom processor with up to 4 Gbytes of DDR memory in a fanless module-based design and weighs less than 5.5 pounds.

SWaP-C (Size, Weight, Power, Cooling)

With any military electronics application, balancing size, weight and power (SWaP) with other system requirements presents one of the biggest challenges to designers. Since cooling is directly related to SWaP in many cases, the term SWaP-C is now widely used to describe these governing constraints. This is especially true for ground vehicle, UAV and manned aircraft applications, where tight spaces, operational demands and payload parameters must be factored into the final system solution. As these constraints have gotten tighter, electronics systems also are often being designed to perform multiple tasks, rather than having multiple systems dedicated to separate tasks. While a consolidation of functions can help to conserve overall space in the vehicle, it places even more demands on the primary system thereby further driving up performance, storage, cooling and reliability requirements.

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Module-Based Alternative

In addition to having to meet performance and functionality specifications while living within SWaP-C constraints, designers of military systems are increasingly required to meet ever tighter system cost targets. For backplane-based systems, the ability to leverage commercially available prequalified enclosures and a wide variety of standards-based boards has helped to mitigate some of the costs. However, for some applications, designers are now turning to a new category of module-based systems that provide significantly lower price points.

For example, the module-based system shown in Figure 2 provides designers with a small-footprint, low-power, lower cost alternative to conventional multi-board VME or CompactPCI designs. By leveraging small form factor COMs (Intel Core2Duo and Atom based) and a wide range of interface options within a small, fanless, thermally efficient enclosure, these new-generation "computer brick" systems can offer a price point as low as half that of conventional multi-board systems with comparable performance and functionality.

Solutions such as the AP Labs COBALT (Computer Brick Alternative) are best suited to reduced SWaP applications where the number of processors and amount of system I/O is in the low to mid-range. Systems with more than three processors and large amounts of system I/O are best implemented using the backplane-based architecture.

Adapting to Multiple Platforms

Systems originally designed using VME or cPCI architectures have endured over the years by accommodating upgrades with new board sets or I/O interfaces. In some cases, new system requirements demand more processing, storage or interface capability. Sometimes system upgrades originate from end-of-life board-level products, which drives a COTS refresh cycle. In many instances, the enclosure infrastructure, including backplane and power supplies, can remain unchanged when the board set or I/O subsystem is replaced.

Evolving program requirements may dictate the migration of an embedded system design to other platforms, whether they are UAVs, manned aircraft or ground vehicles. Though hardware and software modifications may be needed to adapt to the new platform, in most cases many of the key design elements can remain unchanged.

One very successful example of a long-term program that has benefited from the flexibility of a backplane-based system in a configurable rugged enclosure had its starting point with a standard catalog product. Initial testing was performed using a rugged conduction-cooled VME64x enclosure with board set consisting of off-the-shelf and developmental items. Once functionality was verified in the integration lab, the system packaging was adapted for multiple platforms—first for the Predator UAV and

later for the H60 helicopter. Each time the enclosure design was modified, careful consideration was given to issues such as SWaP, thermal, vibration, EMI and I/O routing.

A subsequent generation of the system has now been adapted for a new sensor, which allows existing platforms to benefit from the latest technologies (Figure 3).

Applications Using Module-Based Systems

Another example that illustrates an evolutionary step from conventional multi-board systems toward targeted modular platforms is the Vehicle Expansion Unit (EU) that has been developed for a major armored vehicle program. As shown in Figure 4, the EU is a scalable embedded computer system that combines a selection of processor, storage, power and interface options, within a compact footprint. The low-power, thermally efficient design supports fanless operation for up to three Intel Core2Duo or Atom processors, plus internal video server, Gigabit Switch and scalable storage options. The Vehicle EU provides a cost-effective but flexible alternative for applications that require both performance and reduced SWaP.

Some platforms have even tighter demands on SWaP. For example, smaller ground vehicles, UAVs and some aircraft installations do not have space to easily accommodate 19" rackmount or ATR trays. The newest generation of fully self-contained Computer Brick Alternative systems provides small form factor options to expand deployment flexibility. The AP Labs COBALT system shown in Figure 5 incorporates one Intel Core2Duo or Atom processor with up to 4 Gbytes of DDR memory in a fanless module-based design that leverages both scalability and lower cost. Measuring only 6.5 x 9.725 x 2.95 inches and weighing less than 5.5 pounds, COBALT can be mounted in virtually any tightly space-constrained vehicular, shipboard or airborne deployment scenario. A variety of standards-based interfaces, such as ARINC-429, MIL-STD-1553, RS-232/422, Gigabit Ethernet, GPS and GPIO can be supported in the same package size without the need for add-in boards. Since platform input power requirements fall into some distinct categories, several options are supported.

By combining reduced cost, an efficient SWaP-C profile and scalable performance options, module-based solutions can be leveraged to serve in a variety of embedded applications where space, weight, power and performance all are critical, such as mission computing, C4I, or UAV payload interface/control systems. ■■

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Special Feature

Rugged Box-Level Systems vs. Slot Card Solutions

Deployed Applications Embrace System-Level Rugged Solutions

The traditional slot cards in a ruggedized chassis are no longer the only game in town for military embedded systems. Box-level solutions are expanding their territory.

Tom Roberts, Product Marketing Manager
Mercury Computer Systems

Despite their technical sophistication, defense electronics systems must deliver uncompromised performance under difficult environmental conditions, including excessive heat, humidity, poor air quality, high altitude, shock and vibration. Embedded computers must be able to keep their electronics from overheating, even when temperatures range up to 55°C and the air is too thin to be used for cooling. At the same time, they must possess the enhanced mechanical integrity to withstand high shock and vibration forces at various frequencies.

In the recent past, requirements for rugged defense electronics systems were commonly met by ruggedizing various individual slot cards (often VME modules), then configuring them in a ruggedized chassis. In many situations, a standard, air-cooled board was given enhanced mechanical integrity to withstand high shock and vibration forces at various frequencies. This usually took the form of metal stiffening, often down the center of the module to control response to lower frequency vibration, though sometimes it was applied around the edges or across the surface. Further modifications were made to support conduction-cooling if the system was to be deployed at high altitudes or in confined spaces.

Figure 1

Early UAV implementations like the Predator MQ-1B UAV are fairly large platforms, but each succeeding generation is smaller. The challenge is to make the sensor-supporting processing power fit into a smaller Size, Weight and Power (SWaP) budget.

The Individual Card Approach

This individual card approach offered the advantage of flexibility. An integration team, usually an application-focused team from a prime contractor, could work with slot cards from multiple vendors, putting them together into a chassis-level system designed to meet their program-specific needs—the integration team could

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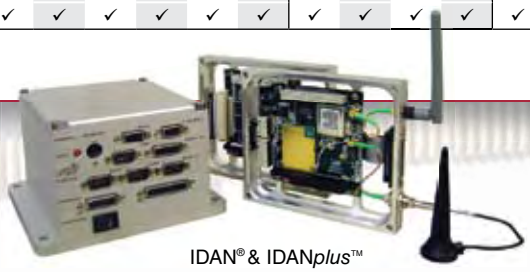

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Bus		Active Bus	PCI	PCI	ISA	ISA	ISA	PCI	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
		Passthrough Bus	ISA					ISA				ISA		PCI	ISA†
		DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
		McBSP Serial Ports	✓	✓				✓							
ANALOG	Analog Input	Single-Ended Inputs	16	16	16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

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Rugged Box Criteria for Meeting Tight SWaP Requirements

Weight under 10 pounds	This makes a good match for tactical UAVs with a total payload capacity ranging from 60 to 200 lb.
Volume under one-half cubic foot	This size will fit into a great many unmanned platforms. It is a volume target that current standard computer form factors are not able to meet.
Minimum 100 Gflops of processing power	Simple imaging systems can certainly be implemented with less than 100 Gflops of processing power, but sophisticated sensor-supporting algorithms demand at least that level of processing.
High-speed, inter-processor communication infrastructure	In distributed-processing applications, the need for a deterministic high-speed inter-processor communications fabric is paramount. Such a communications infrastructure must be scalable for varying system configurations, support any-to-any simultaneous full-duplex data flow, and provide the performance and reliability defense applications demand.
Rugged design	The ability to function in extremely harsh environments.

Figure 2

Meeting today's tighter, smaller Size, Weight and Power (SWaP) requirements calls for a rethink in rugged box-level system implementations.

select from among technologies from many card vendors. Then application software would be developed, debugged and tested on lab environment development systems.

At some point a deployable version of the system would be developed by ruggedizing the slot cards; often the ruggedization was done by the card vendors specifically to meet specifications established by the integration team. The integration team would also select a rugged chassis, again enjoying flexibility in selecting or modifying from a variety of market choices.

Downside: Time-to-Deployment

While selection flexibility is a positive characteristic, there are two main disadvantages to the individual card approach. The first is a negative effect on time-to-deployment. After the huge integration challenge of getting application software to run on multiple modules, the engineering team then faced the challenge of ruggedizing a collection of disparate boards.

Until the recent advent of the VITA 47 REDI standard, there was no formal, industry-wide method for defining levels of ruggedization. This lack of rugged standards, combined with multiple engineering approaches by vendors at the slot-card level, made integration for rugged systems very time-consuming. However, for many defense programs, an extended period of deployable systems integration was not significant because overall development time was measured in multiple years.

The second disadvantage to working with individual cards is that it rarely results in an optimal thermal and mechanical design at the system level. Some components may be overdesigned for a given application; some characteristics, like heat dissipation, may be widely non-uniform. But this disadvantage was also acceptable as long as the functional requirements of the system were met

Conditions are changing, however, and a new set of challenges faced by defense programs have driven the rugged requirements for defense electronics to new levels. First, defense forces are meeting the need for more intelligence-gathering assets by placing sensors on unmanned vehicles (UVs)—which are airborne (UAVs), ground-based, or undersea. Early implementations of these UVs, such as the Global Hawk and Predator UAVs (Figure 1), are fairly large platforms, but each succeeding generation is smaller. The resulting challenge is to make the sensor-supporting processing power fit into a smaller Size, Weight and Power (SWaP) budget. These smaller computing packages must also be rugged enough to withstand operation within deployed UVs.

A second significant challenge is driven by changes within computing technology. New components, especially processors, are orders of magnitude faster, but they are also much, much hotter, magnifying the cooling challenge. In 1992, a 66 MHz CPU consumed about 7W of power. In an office environment it would not even need a cooling fan. Now processors will often draw over 50W, sometimes over 150W, depending upon clock speed, core type and processing load.

Taken together, defense program teams have a situation requiring that much hotter, albeit faster, components must operate with increasingly difficult SWaP restrictions. Meeting this new level of challenge requires a systems-level approach to solutions design. These system-level approaches can be divided into two tiers. First, a broad range of applications can be addressed by a more rigorous, standards-based approach. The evolution of the OpenVPX standard is proving to be a great benefit to this systems-level approach. Created to improve interoperability of COTS modules, OpenVPX achieves this goal by implementation of predefined system topologies that simplify integration of components while retaining a significant range of configuration flexibility. The result is reduced program risk and faster development.

OpenVPX Advantages

When programs reach the stage for integrating a deployable system, OpenVPX leverages the VITA 47 and VITA 48 standards. Designs can be optimized at the systems level for ruggedness and cooling, while the use of standards-based components—modules and chassis—reduces the integration effort and speeds time-to-deployment. Adhering to a systems level approach based on open industry standards gains these advantages while retaining a large degree of design flexibility.

A range of OpenVPX modules and chassis is currently avail-

able for this style of systems design. Mercury Computer Systems offers a broad choice of both 3U and 6U options, including development, rugged air-cooled and rugged conduction-cooled modules. The value of these modules is enhanced by systems integration expertise, available to support program teams in implementing standards-based, system-level rugged solutions.

However, for defense application with the most stringent SWaP constraints, a stand-alone rugged-box approach has taken shape, with computing, I/O and chassis enclosure all designed together as a single, preconfigured solution. This approach trades off some flexibility for maximum ruggedness, cooling efficiency, performance per watt and performance per cubic centimeter of space. Figure 2 shows a sample set of system specifications that help to give shape to this design avenue.

Designing that style of ultra-compact processing platform is possible if rugged characteristics are targeted from the very beginning, including interdependencies between modules and enclosures. For example, in a system constrained to such a small size, conduction-cooling provides an efficient means to draw heat outward to the walls of the enclosure. Furthermore, if each module is designed with a custom heat sink, then using a wedge-locking mechanism between that heat sink and the enclosure walls will ensure maximal heat conductivity with the positive side effect of increasing reliability across a range of environmental conditions (including shock, vibration and temperature changes).

Removing the Heat

There is still the final step in dealing with heat dissipation, removing the heat generated by 100 Gflops of processing from the enclosure. One design option is to use flow-through liquid sidewalls in the enclosure, exploiting the fact that the thermal capacity of a liquid is much greater than that of air. In addition, unlike air, the cooling capacity of a liquid is unaffected by altitude.

Figure 3

The PowerBlock 50 System provides a modular architecture that allows for flexible configurations of multiple processors and delivers over 100 Gflops of processing power in a small, lightweight package weighing less than 10 pounds.

This approach puts the final cooling burden on the platform to supply the liquid flow to take away the heat, but some platforms already support other liquid-cooled electronics. Almost any liquid can be used, provided the liquid temperature and flow rate are sufficient. Platform cooling strategies can also be very creative, such as platforms that use their own fuel, moving from storage tank to engine to cool electronics.

Ribbed Chassis for Heat Flow

Another design option for dissipating heat from the enclosure is simple conduction to the outside environment. In this technique, a ribbed chassis maximizes heat transfer to surrounding air while the metal base conducts heat directly to any supporting platform. Although this approach is much simpler to implement than liquid flow-through, heat removal efficiency is highly dependent on the surrounding temperature and altitude during operation.

Mercury offers a choice of fully integrated ultra-compact embedded computers in the Ensemble 1000 family. The PowerBlock 50 (Figure 3) and the PowerBlock 15 meet the stringent demands of sensor imaging for next-generation unmanned platforms, featuring a modular architecture that allows for flexible configurations of multiple processors, including PowerQUICC III processors, Intel x86 processors, FPGAs and graphics processing units (GPUs). ■■

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Tech Recon

Shock & Vibration Testing for Embedded Boards

Vibration Suppression Approach Boosts Server Reliability

Net-centric communications technologies are in high demand by today's military. New approaches to shock and vibration suppression are opening new solutions for system developers.

Keith Taylor, CRMS Product Marketing Manager
Kontron

Probably more than in any other industry, networking applications for the military market mandate superior uptime, performance and reliability. That's pushed manufacturers of server solutions to continually evaluate, develop and enhance integrated technologies and components to match the needs in this demanding industry. Adding to the challenge, it is incumbent on server solution suppliers to also deliver products that meet system longevity requirements of five years or longer.

Although not specifically required for military applications, systems designers may opt for carrier-grade server solutions that meet strict NEBS (Network Equipment Building Systems) requirements, which have been established for the telecommunications or central office market. Carrier-class features in these servers are very applicable for systems deployed in the extreme and space-constrained environments of military aircraft, ships and field datacenters. Servers designed to these stringent specifications help ensure highly reliable operation under rugged conditions such as wide temperature variations, high altitude and increased exposure to shock and vibration.

Figure 1

An example of systems whose environmental requirements are similar to those defined by the NEBS specifications are large aircraft-based installations like the E-8C Joint Surveillance and Target Attack Radar System (JSTARS) aircraft.

With the ability to be used as standard building blocks for a broad range of military, aerospace and government market applications, communication rackmount servers have consistently demonstrated long life reliability under harsh conditions. These NEBS-3-compliant servers can be an optimal solution for a variety of military network infrastructure systems, including switching, storage, content delivery, intrusion detection and prevention, VPN/firewall and unified threat management. The critical importance of the communication infra-

structure to today's military demands the highest quality components.

Testing and Analysis

Servers that meet NEBS standards are an excellent choice for many military applications since they are designed to endure environmental extremes far beyond that required of standard enterprise-class equipment. While these systems are likely not appropriate for ultra-extreme environments such as tanks and fighter aircraft, there are many ground-based, ship-based and even large aircraft-based installations whose environmental requirements are similar to those defined by the NEBS specifications (Figure 1). These specifications address issues that are likewise critical to military equipment including temperature and humidity, shock and vibration, fire suppression, safety and emissions and airborne contaminants.

It is crucial that military systems contractors look to experienced, trusted server suppliers for equipment designed from the start to meet these rugged requirements. Contractors that try to use equipment originally built for standard commercial installations but "hardened" in certain aspects of the design will generally find that they do not fully meet the requirements and often result in added costs and delays in their program as these deficiencies are discovered. Instead, they benefit from suppliers that can demonstrate their server's rugged design features through a rigorous testing and analysis process. Contractors can be confident that the capabilities claimed by NEBS-compliant systems are legitimate as they are backed by extensive testing conducted by an independent test lab and documented in a detailed test report.

Vibration and Reliability

Many system designers have only recently become aware that vibration can significantly affect system reliability and performance. At one time, vibration was seen as a problem that manifested itself on the purely mechanical parts of a system: fasteners coming loose, cable intermittents or disconnections, boards unseating and so forth. But a new culprit has arisen in the form of reduced disk drive and overall system performance. Since shock and vibration are such an expected part of most military installations, contractors must be sure the equipment they specify can tolerate vibration from sources like heavy equipment, vehicles, generators, engines or other types of machinery that operate in or near network installations.

So can vibration really have a noticeable impact on system performance? As part of ongoing analysis and through internal testing by Kontron engineers, it was found that systems were experiencing an unexpected performance loss when subjected to extreme temperatures. After comprehensive testing, the cause was narrowed down to the operation of the hard drives, which were experiencing excessive re-syncs of the drive's heads due to the added vibration caused by the system's fan speed increase in response to the temperature changes.

An extensive evaluation was done on how vibration affects hard drives, to identify the sources of vibration, and to determine the best solutions to reduce the negative impact vibration has on system performance. If the vibration within the system was interfering with sensitive hard

Figure 2

Vibration suppression technologies have been integrated into this communication rackmount server to ensure system performance and reliability.

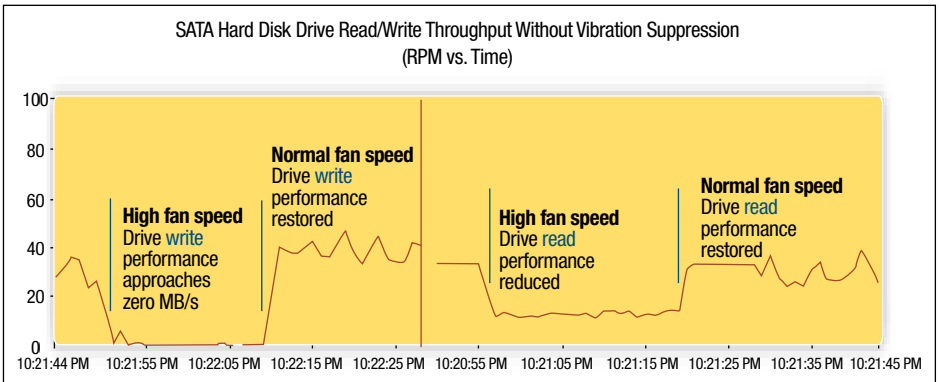

Figure 3

Without vibration suppression technology, reading performance is reduced, but writing performance is reduced to zero when fan speed is toggled between normal and high speeds. The user sees an hourglass or error message that indicates the hard disk drive is not available when performance is at zero Mbyte/s throughput.

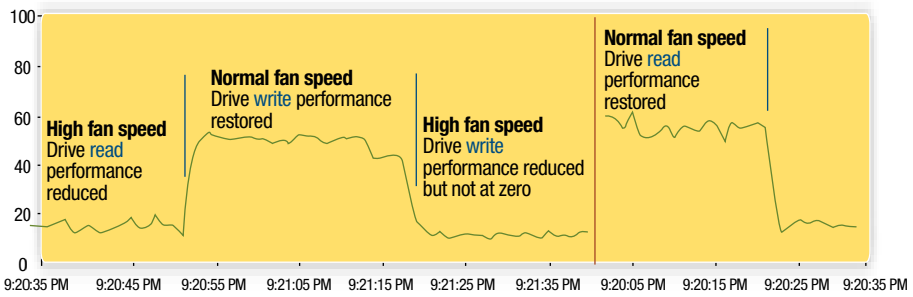

Figure 4

Integrating vibration suppression technologies shows in this test that reading/writing performance is improved and writing is no longer at zero when the fan speed is toggled between normal and high speeds. That means hard disk drives are always available and with the expected performance.

drive performance, imagine how external vibration that is commonplace in military settings could threaten systems?

The Cause and Detrimental Effects

System fans used for thermal management are the primary source of internally generated vibration. Because today's higher-power systems require increased thermal management that is typically accomplished through greater airflow, fans have had to markedly increase their rotational speeds, with some fans now spinning at over 18,000 RPM. Higher fan rotation speeds have resulted in both increased amplitude and frequency of system vibration in order to maintain system cooling specifications.

Today's hard disk drives are more sensitive than ever to vibration, which has led to greater performance issues. Hard drive sensitivity comes from their increased rotational speeds and higher bit densities making them more susceptible and vulnerable to shock and vibration. When you couple high-capacity hard drive vulnerability with higher speed thermal management system fans, it is clear that today's networking equipment must consider vibration as a real threat to system performance.

Performance issues resulting from increased vibration may not be immediately obvious. A degradation in system performance can be caused by a long list of other hardware or software problems. What pinpoints the cause of vibration is if the degradation occurs when the fans are running at high speeds, such as when the system responds to increased ambient temperatures. The user may note that as the ambient temperatures rise, the system performance falls. Or they may notice a correlation of performance loss with the operation of nearby equipment that produces significant vibration. They may further note that at certain limits the system can degrade to a point where a drive goes "offline" or worse, the system crashes. This is certainly not an acceptable response for a mission-critical system.

Vibration Suppression

For this reason, new, innovative vibration suppression technologies are now integrated into communication rackmount servers that significantly reduce the effects of vibration within the chassis. These new techniques benefit customers by allowing denser systems to operate at higher temperatures or in areas subject to external vibration thus enabling the customer to deploy their solutions in environments not previously possible. In addition, they benefit from being able to use a greater variety of hard disk types and sizes instead of being limited to a few "extra rugged" devices. It is expected that the next-generation hard drives will likely be even more sensitive to vibration given the increase in areal bit density and reduction in overall drive mass. By employing these vibration suppression technologies, servers have greater "headroom" to accommodate these new drives.

A proprietary vibration suppression approach has been developed for the company's line of communication rackmount servers (Figure 2). The approach was to significantly reduce the amount of vibration by isolating both vibration-generating devices and vibration-sensitive devices. By utilizing vibration-absorbing material, both the fans and hard drives can be isolated from direct contact with the system's metal infrastructure so they literally "float" inside the chassis. To be fully effective, vibration suppression needed to be a key requirement in the initial design methodology. For example, the design of a typical enterprise server tightly integrates a hard drive "cage" to the main chassis walls and/or floors. From a design and cost point-of-view, this may seem efficient, but it allows vibration to be transmitted directly from the chassis to the hard drives. To help eliminate this particular vibration issue, it is better to create a self-contained drive cage. Isolating the entire cage from the chassis is shown to greatly reduce vibration-induced performance loss of the drives over drive isolation alone.

More than the Sum of Components

System reliability is a dynamic equation that can change under varying operational circumstances. Troubleshooting a server design is more than the sum of its components, and simply putting off-the-shelf rubber grommets everywhere will not guarantee an optimal solution. The size, shape, number, location and most importantly the type of material selected, will all affect the magnitude of the vibration reduction. In reality, the challenge is to attenuate certain frequencies that hard drives are particularly sensitive to rather than the overall reduction in vibration. Plus, frequencies that affect system performance vary from drive to drive, so there is no simulation technique that exists that would accurately model a system's vibration patterns.

Kontron has developed a proprietary software program that accurately measures hard drive performance related to

drive type, fan speed, system configuration and external vibration sources. Using this software, server designs can be analyzed under various vibration reduction techniques, looking at the effects of system fans and the effects of vibration from the spinning hard drives on themselves and on neighboring drives. It also allows designers to analyze vibration from sources external to the system such as those often found in military installations.

Analyzing Other Components

Solving the issues associated with vibration does not stop at isolating the problematic components. In fact, isolation may not always be the best solution. The best solution may be in changing the mass of a structure for better attenuation of vibration. If the design has many smaller, lighter, independent structures, it actually may be more sensitive to vibration than one monolithic structure. Only careful experimentation and testing can identify the best solution.

Employing high-quality fans with carefully balanced blades and high-quality bearings is another step in meeting specific vibration limits. As systems become more powerful, it is important that there be a continual evaluation process of new fan and disk drive products in the industry to ensure that systems continue to deliver the best performance and reliability possible.

Before and After Comparison

Figure 3 and Figure 4 show the test results of system vibration from a server before and after vibration suppression technology has been integrated into its design. Affecting the performance and reliability of crucial military networking applications, vibration is certainly an issue that needs careful attention by contractors specifying equipment containing sensitive hard disk drives. Testing, thorough analysis and good design methodologies employed by server suppliers have enabled the development of innovative vibration suppression technologies to alleviate many of these issues. Military systems that integrate servers with these technologies can be assured of systems that operate reliably in demanding and rugged environments.

As hard drive suppliers continue to offer higher density drives, and the cost per usable gigabyte of rotational drives is expected to remain lower compared to solid-state drives for the foreseeable future, server suppliers will need to stay diligent in their development of new technologies for the reduction of vibration-induced hard drive performance degradation. For future designs, lower-vibrating fans and reduced sensitivity hard drives plus new isolation and support materials will be required so that military systems continue to reap the benefits of continued server technology advancements. ▮▮

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Solid-State Storage Drives Fly to New Capacities

The latest crop of high-density, rugged solid-state storage solutions is enabling military system developers to pack in system complexity without the burden of memory storage constraints.

Jeff Child
Editor-in-Chief

Just as computing interconnects have transitioned away from parallel buses toward serial interconnect schemes, so too have the interface technologies of the high-density storage realm. That trend is also fueled by the continued dependence on compute- and data-intensive software. With that in mind, Serial ATA has become the dominant interface technology for new storage subsystem designs. SCSI and Fibre Channel in contrast seem to be waning—although far from retreating. Meanwhile, the redundancy of RAID architectures is still a preferred way to ensure reliable mission-critical operations.

The current trend for many applications is to move from a parallel to serial interface to increase system performance, lower the cost and simplify the integration. Anticipating this trend, there is a plethora of SSDs available with interfaces ranging from USB, small cards (SD and MMC products) and SATA interface products for the military embedded market. When the application requires more storage, the most suitable choice is a pure SSD with Serial or Parallel ATA interface. Single chip drives are also reaching densities large enough for storing code and large amounts of data in any application where space is limited and durability and reliability matters.

Figure 1

An F/A-18C(N) *Hornet* conducting an arresting landing aboard the Nimitz-class aircraft carrier USS Harry S. Truman (CVN-75).

Serial ATA Flying High

In keeping with these trends, Harris selected SMART Modular Technologies to provide solid-state drives (SSDs) for use in its Mass Storage Unit (MSU) program. The new MSU, which is part of a larger F/A-18 program (Figure 1), is the first of a new family of avionics file servers. The MSU provides significant file storage for in-flight applications on the F/A-18 platform. The increased capacity and performance of today's SLC NAND flash drives enable them to support a broader range of applications with data consolidated from multiple sources. Harris selected SMART's XceedSecure 2.5-inch SATA SSD for the in-flight file server application.

XceedSecure high-performance SSDs range in capacity from 32 Gbytes to 256

Figure 2

The VS1-250-SSD is a Serial Attached SCSI (SAS)/Serial ATA (SATA)-based Solid-State Disk VME blade that houses one or two each 2.5-inch SAS or SATA SSDs of up to 256 Gbytes per device.

Figure 3

The MACH8 family of solid-state drives employs a flash controller that's able to address multiple flash components simultaneously to achieve 100 Mbyte/s sustainable read/write speeds.

Gbytes and include EraSure technology. EraSure technology complies with current military data elimination standards, providing multiple levels of secure erase techniques. EraSure Clear provides a fast data elimination function that enables erasing of data in seconds. EraSure Sanitize uses agency-defined or unique customer-defined sanitization procedures, allowing full media declassification. Additionally, EraSure complies with IRIG 106-07, chapter 10.8, addressing the specific needs of flash architectures and data structures, and for bad block handling, write protection and for reviewing the secure erase results to verify that all classified data has been eliminated.

SSDs for High-Altitudes

VME remains a popular form factor for military platforms, and that includes storage. Phoenix International's VS1-250-SSD (Figure 2) Serial Attached SCSI (SAS)/Serial ATA (SATA)-based Solid-State Disk VME blade delivers high-capacity, high-performance data storage for military, aerospace and industrial applications requiring rugged, secure and durable mass data storage. This 6U, single-slot module houses one or two each 2.5-inch SAS or SATA SSDs of up to 256 Gbytes per device, and can be interfaced through its front panel connector or its P2 connector. The high-speed module will sustain read/write data rates of 120 Mbytes/s with an access time of 0.5 msec.

The VS1-250-SSD has an operating temperature range from -40° to 85°C and functions at an altitude greater than 80,000 feet. The VS1-250-SSD also complies with current defense department security standards providing multiple levels of secure erase techniques. As a drop-in replacement for a traditional hard disk drive, the VS1-250-SSD offers significantly lower power consumption and eliminates seek time, latency and other electromechanical delays commonly associated with conventional rotating media. The VS1-250-SSD's performance and versatility is enabled by Phoenix Internationals state-of-the-art technology, which provides very high transfer and I/O rates, enhanced endurance and maximum data integrity. A conduction-cooled version of the unit is also available.

Harsh Environment Use

Military applications demand a higher level of reliability for their SSD needs than other applications. Serving those needs, STEC offers its MACH8 family (Figure 3) of solid-state drives. At the heart of the MACH8 family of Solid-State Drives is STEC's leading-edge flash controller, which is able to address multiple flash components simultaneously to achieve 100 Mbyte/s sustainable read/write speeds. This same controller allows the MACH8 MLC to achieve 90 Mbyte/s reads and 60 Mbyte/s writes. The MACH8 product embeds Full Data Path Protection, STEC's proprietary set of algorithms capable of protecting data anywhere within the SSD, from cache to flash.

An IOPS-intensive version is available for transactional heavy applications. The unit is a drop-in replacement for traditional 1.8-inch and 2.5-inch drives. The drive supports both Serial ATA and PATA and has optional support of purge and encryption. Superior data protection is provided through Total Drive Wear Leveling to ensure drive endurance. Two operating temperatures are supported: Commercial temperature from to 0° to 60°C and industrial temperature from -40° to 85°C.

Chip-Sized SDDs

Ultra-small "chip-sized" solid-state drives have transformed the kind of processor-based mobile military applications that are now possible. Taking that trend a step further, Austin Semiconductor has introduced a smaller, more compact 7.5 cm^3 (31 mm sq x 7.8 mm max height) rug-

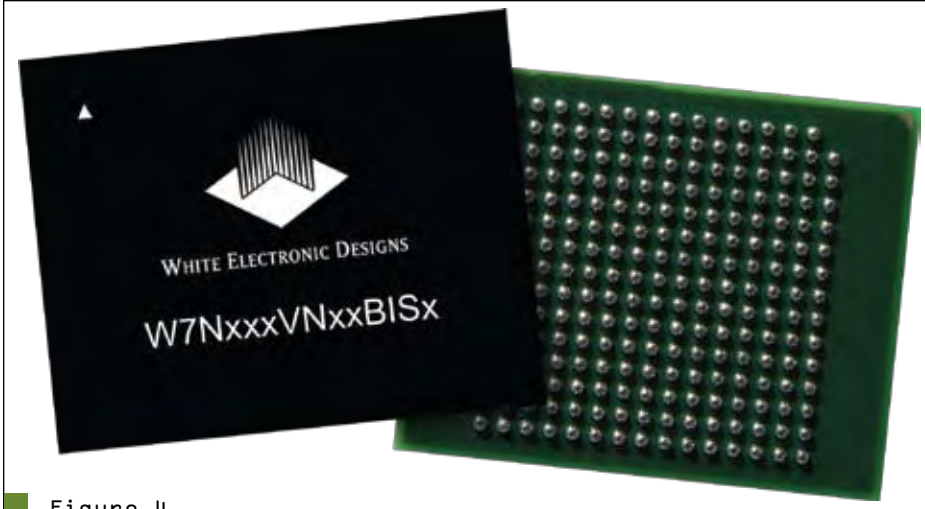


Figure 4

This Single Level Cell (SLC) NAND SSD provides compact, secure and reliable data storage in rugged and extended temp environments. The product is available as a 4 Gbyte, 22 mm x 27 mm plastic ball grid array (PBGA) package.

gedized SSD. The newly redesigned SSD supports an embedded IDE, PIO/4 interface, has MTBF of more than two million hours, and is ideal for harsh environment operation. The unit offers 0° to 70°C operation with -40° to +85°C in the future.

The solid-state disk is based on a proprietary package (die) stacking technology to create an extremely space-conscious, robust Solid-State Disk. The SSD is capable of operating in harsh, vibration-prone product platforms. The device has a SLC NAND flash controller and two stacks of NAND flash, each containing 1, 2 or 4 NAND components. Each NAND component, either a 4-, 8- or 16 Gbit device, is based on the use of single silicon and stacked silicon solutions. Total bit density is either 4, 8 or 16 Gbytes. Fast ATA host to buffer transfer rates support True IDE, PIO/4 modes. Sector buffers are 512 bytes, and ECC correction is configured as 6 bytes within a 512 byte sector. The device supports flash memory power-down logic and Automatic Sleep Mode. Wear leveling technology is built in. Burst transfer rate is 16.67 Mbytes/s and sustained transfer rate is 6.7 Mbytes/s.

Secure Erase at Chip Level

Secure erase was once a feature only available on large devices. White Electronic Designs offers a secure Single Level Cell (SLC) NAND SSD (Figure 4) that

RUNCORE SSD

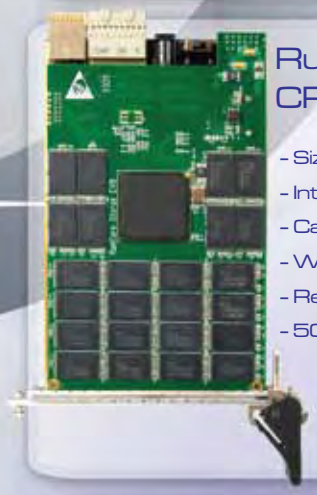
RunCore™ SSD

RunCore is a global leader in the research, development, production, and distribution of high-end solid-state storage products. RunCore SSD is founded on 10 years of research at the National University of Defense Technology and currently offers three solid-state storage series products aimed at optimizing and harnessing speed, quality, value, simplicity and power for prosumer, industrial and military solid-state drive markets.

RunCore InVincible SSD

- Size: 2.5 inch / 1.8 inch
- Interface: SATA II / PATA/
- Capacity: 8GB - 256GB (MLC/SLC)
- Wide Operating Temp: -55 -125C degree
- Fast Intelligent and hardware purge optional function

RunCore InVincible CPCIe/PXIe SSD



- Size: 16.5mm *74mm *149mm
- Interface: CPCIe/PXIe
- Capacity: 48GB - 768GB (MLC/SLC)
- Wide Operating Temp: -40 - 85C degree
- Read / Write Speed: 400MB/s/420MB/s
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www.runcore.com

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provides compact, secure and reliable data storage for embedded military applications in rugged and extended temp environments. The product is available as a 4 Gbyte, 22 mm x 27 mm plastic ball grid array (PBGA) package and supports various PATA interface protocols. A hardware and software triggered security erase feature provides enhanced security for demanding military requirements, and assurance that critical data at rest will be removed promptly when required. After the data purge command is initiated, all data is eliminated in less than 10 seconds, and options are available that also perform sanitization protocols designed to be compliant to the various government agency specifications.

Constructed using a 32-bit RISC processor as its core storage controller, this SSD provides all the important flash management techniques for delivering a highly reliable solution. Incorporated wear leveling and error correction techniques extend disk operating life. The device provides data protection in the event of a sudden unplanned power loss or disturbance and operates from a single 3.3-volt power supply. The PBGA package is constructed using eutectic tin-lead solder balls on a 1.27 mm pitch with strategically placed signals to extend device life in harsh environments. ■

Apacer Memory America
Milpitas, CA.
(408) 586-1291.
[www.apacer.com].

Austin Semiconductor
Austin, TX.
(512) 339-1188.
[www.austinsemiconductor.com].

Phoenix International
Orange, CA.
(800) 203-4800.
[www.phenxint.com].

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

STEC
Santa Ana, CA.
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Technology Focus

Multicore Boards

Multicore Processing Becomes the New Mainstream

Processors with multiple on-chip CPU cores are a solid fixture in today's mainstream computing world. This fits in perfectly with the military's desire to pack more compute density into small spaces.

Jeff Child
Editor-in-Chief

Gone are the days when processor architectures sporting multiple CPU cores on the same device were exotic and unique. They've now moved solidly into the mainstream desktop and sever realms. And many military applications have an immediate need for the level of computing muscle such devices provide. That trend has all but eliminated the gap between the emergence of a microprocessor product line and the demand for it among the military embedded computing realm. With the dual-core, multicore CPU trend firmly established in the general computing market, embedded board vendors have followed up quickly with boards based on those CPUs like the Core2Duo, i7, QorIQ and others. The product roundup here shows a representative sample of multicore boards on a variety of embedded form factors—including cPCI, AMC, VPX, VME and ATCA.

There's no doubt that the multicore transition in the microprocessor world is all but complete. The road maps of the leading processors show that all roads lead to architectures sporting multiple CPU cores on the same device. Because the trend is fundamental across all processor vendors, issues surrounding multicore processing must be faced by all high-end computing applications today or in the near future. Many military applications have an immediate need for the level of computing muscle such devices provide.

For many years microprocessor designers made clever use of the ever-increasing number of transistors that bless semiconductor fab advances. They successfully wrung the greatest possible performance increases out of their designs by refining their superscalar architectures and lengthening pipelines. Those techniques brought processors from 100 MHz of a decade ago all the way to the 1 GHz and more that we're at today. Today, for reasons like power density and other physical issues—all those techniques aimed at making single microprocessors faster no longer have the return that they once had. That led processor architects to realize that the most efficient way to leverage the Moore's Law "guarantee" of increasing transistor counts is to pack multiple processing units on the same die.

Figure 1

Aegis Modernization (AMOD) program is making use of Core2Duo-based conduction-cooled CompactPCI boards for processing needs aboard DDG-51 Arleigh Burke-class Aegis destroyers such at the USS Stethem.

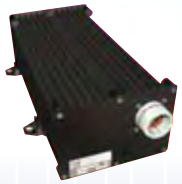
Applications that have been first to reap the rewards of multicore technology are compute-intensive applications such as sonar, radar, SIGINT and UAV control systems, along with several others. The Aegis Modernization (AMOD) program is another example. AMOD is an upgrade to the Aegis Weapon System (AWS), the automated segment of the Aegis Combat System (ACS). Using 2.16 GHz Core2Duo-based conduction-cooled CompactPCI boards for its processing needs, the AMOD upgrade is intended for DDG-51 Arleigh Burke-class Aegis guided missile destroyers such as the USS Stethem (DDG 63) (Figure 1).

While the trend toward multicore processing is nearly universal, there are two fundamentally different approaches to the trend. The more mainstream processor vendors like Intel, Freescale and AMD are moving to an SMP (symmetric multiprocessing) approach where each core runs a separate program thread. In an application that happens to have two completely unrelated threads, one of them can be waiting for I/O while another can be calculating. The other multicore approach, what academics call "tiled" processors, hasn't been as popular as SMP because of the complexity of programming such systems.

Ethernet Boards & VME SBCs Gallery

Featuring the latest in Ethernet Boards & VME SBCs technology

NightHawk RCU



Aitech's NightHawk RCU, a 1.6 GHz Intel Atom-based, self-contained control unit weighs only 4.5 lbs. This weight reduction, slimmer profile and natural convection/radiation cooling that dissipates up to 22 W at +55°C in still air, make the rugged control unit ideal for a variety of military, aerospace and commercial environments.

Aitech Defense Systems
Phone: (888) 248-3248
E-mail: sales@rugged.com
Web: www.rugged.com/nighthawk.htm

XGE4120-XMC

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- Dual Port 10GbE interface
- Full line rate throughput
- Low host processor overhead
- Low latency
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- Commercial & conduction cooled versions

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E-mail: info@criticalio.com
Web: www.criticalio.com

VPX3-685 3U OpenVPX™ Secure Ethernet Router

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Curtiss-Wright Controls Embedded Computing
Phone: (703) 779-7800
E-mail: sales@cwcembedded.com
Web: www.cwcembedded.com

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Elma ACT/Technico
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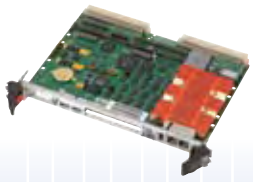
Fax: (215) 956-1201
E-mail: sales@elma.com
Web: www.acttechnico.com

iVME7210 VMEbus SBC



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- 4GB or 8GB ECC-protected DDR3-1066 (soldered)
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Web: www.Emerson.com/EmbeddedComputing

MVME7100 VMEbus SBC

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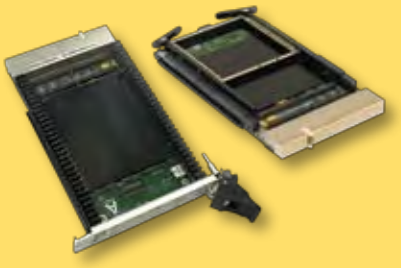
Technology Focus:
Multicore Boards Roundup

3U cPCI Couples Core 2 Duo Processor, SATA SSD

CompactPCI, particularly in its 3U flavor, has carved out a large chunk of adoption in the military realm. Aitech Defense Systems has released a new rugged 3U single-slot CompactPCI SBC that offers up to 8 Gbytes of onboard SATA flash disk storage. The C800 combines the latest low-power Intel Core 2 Duo technology featuring data processing capabilities of 1.67 GHz or 2.20 GHz and Intel's Speedstep dynamic frequency switching that provides multiple lower power and cooling options with highly integrated on-chip L1 and L2 caches as well as the Intel GM965 Express Graphic Chipset.

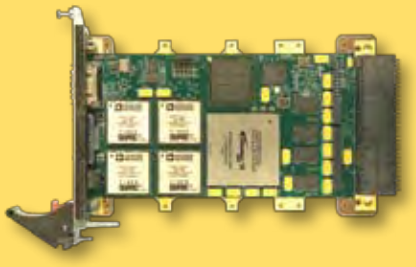


The C800's extensive I/O capabilities include automatic system/peripheral detection, two Gigabit Ethernet ports, two serial communication ports, two USB 2.0 interfaces, one SATA II interface, a high-definition stereo audio output and up to eight single-ended general-purpose discrete I/O channels that are independently configurable as input or output. An industry-standard PMC slot further extends the board's I/O functions. The C800 SBC is available in five software-compatible versions including a commercial air-cooled version for lab development, two extended temperature air-cooled formats (per PICMG 2.0 Rev. 3.0) and two extended temperature, rugged conduction-cooled formats (per ANSI/VITA 30.1-2002). OEM quantity pricing for the C800 SBC starts at $4,985.

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

FPGA and TigerSHARC Climb Aboard 3U VPX Board

FPGAs and DSPs have different strengths when it comes to the signal processing muscle they provide. BittWare has brought together the best of those worlds with a hybrid system sporting both a high-end FPGA and the TigerSHARC DSP with the release of the GT-3U-VPX (GT3X) board. The GT3X features a large Altera Stratix II GX FPGA and one cluster of four ADSP-TS201S TigerSHARC processors from Analog Devices. The front panel provides high-speed SerDes, 10/100 Ethernet and RS-232; and the extensive back panel interface supports PCI Express, Serial RapidIO, GigE and 10 GigE. The GT3X can achieve simultaneous onboard and off-board data transfers at rates exceeding 2 Gbytes/s via BittWare's ATLANTiS FrameWork implemented in the Stratix II GX FPGA.

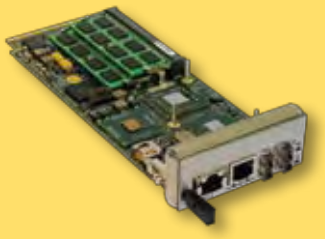


The GT3X provides a hybrid signal processing architecture that takes advantage of both FPGA and DSP technology, creating a complete solution for applications requiring flexibility and adaptability along with high-end signal processing, all on a ruggedizable platform.

BittWare
Concord, NH.
(603) 226-0404.
[www.bittware.com].

AMC Processor Module Offers Extended Temperature Option

Processor AMCs have taken their place as an established solution of the comms-centric military designs. Concurrent Technologies latest AMC is a single-width, mid-height or full-height, processor module suitable for AdvancedTCA, MicroTCA, Scope Alliance and proprietary platforms. The AM 210/x0x features a low-power dual core processor from the Intel embedded roadmap—the Intel Core 2 Duo processor operating at 2.26 GHz or 1.86 GHz and supports up to 8 Gbytes DDR3-1066 SDRAM. Commercial and extended temperature versions are now available for both processor speeds. For embedded types of applications there is an option for an onboard application flash disk (up to 8 Gbytes). The AM 210/x0x supports a variety of industry standard operating systems.

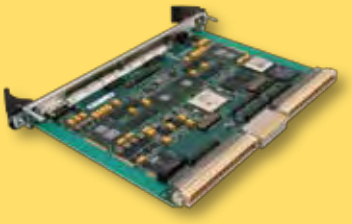


The AM 210/x0x is designed in compliance to AMC.0 (including full or mid-height front panel, full hot swap and IPMI capabilities), AMC.1 Type 8 (single x8 or dual x4 PCI Express interface), AMC.2 Type E2 (2 x Gigabit Ethernet interfaces) and AMC.3 Type S2 (2 x Serial ATA300 ports). A variant is available providing rear I/O compatibility with Scope Alliance systems. In the AMC extended options region the module also features, as a sales variant, 2 x Serial ATA300 ports, 2 x USB 2.0 ports and an RS-232 port. There is a further Gigabit Ethernet port, 2 x USB 2.0 ports and an RS-232 port accessible via the front panel. An optional onboard USB flash disk is available in a range of capacities of up to 8 Gbytes. Commercial temperature (0° to +55°C) and extended temperature (-25° to +70°C) variants are now available with either the mid-height or full-height front panel type.

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

Intel i7 CPU Rides Multiprocessing DSP Engine

The idea of using general-purpose multicore processor technology for military DSP is catching on fast. Curtiss-Wright Controls Embedded Computing offers a VME64x DSP (Digital Signal Processing) engine using the new dual-core Intel Core i7-610E processor. The new CHAMP-AV5 complements Curtiss-Wright Controls' SVME/DMV-1905 single board computer, also based on the i7 processor. As a board set these two cards represent an industry milestone in bringing the myriad advantages of Intel processor technology to the rugged deployed COTS signal processing space.



The CHAMP-AV5 multiprocessing board brings the floating-point performance of the Intel Core i7 architecture to the VME64x form factor standard. Sporting a pair of 2.53 GHz dual-core Core i7 processors, the CHAMP-AV5 delivers performance rated up to 81 Gflops. With a 17 Gbyte/s (peak) DDR3 memory subsystem connected directly to the processor, the Core i7 is able to maximize the throughput of its SSE 4.2 vector processing units. With 4 Mbytes of cache and two hardware threads per core, the Core i7 processor can process larger vectors at peak rates significantly greater than was possible with previous AltiVec-based systems.

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

6U cPCI SBC Delivers 2.16 GHz Core 2 Duo

Compute density is the goal of many of the latest military embedded computer applications. Along those lines, Dynatem is now shipping the Intel Core 2 Duo-based CRD CompactPCI/PICMG 2.16 SBC. The CRD is a 6U single-slot CompactPCI-compatible platform based on the Intel low-power Core 2 Duo processor. The CRD takes advantage of the L7400 Core 2 Duo's low power consumption as a rugged SBC. Versions supporting the T7400 2.16 GHz Core 2 Duo are also available. The CRD is a conduction-cooled module with wedge locks and a full-board heat sink for high shock/vibration environments and temperature extremes. Extended temperature and versions with conformal coating are available.

The CRD comes installed with 2 Gbyte or 4 Gbyte DDR2-400 memory, supporting ECC. Memory is BGA for the best shock/vibration spec. The E7520 Memory Controller Hub (MCH) and 6300ESB I/O Controller Hub (ICH) chips support PCIe and PCI-X expansion, respectively. Two or four onboard Gbit Ethernet ports are controlled by two PCI Express-based 82571EB dual 10/100/1000BaseTX controllers. Two Ethernet PICMG 2.16-compliant Gbit Ethernet ports are routed to the backplane. Standard conduction-cooled CRD boards have no front panel I/O due to the cooling plates. A special version has been developed with additional 2 Gbits of Ethernet routed through the front cooling plates. The two onboard PMC mezzanine card interfaces are accessed through the 6300ESB's 64-bit PCI-X bus. One of the two PMC sites also accommodates an XMC module supported by x8 PCIe. Pricing for the CRD starts at $6,938 in single quantity.

Dynatem
Mission Viejo, CA.
(949) 855-3235.
[www.dynatem.com].

Low-Power 3U VPX SBC Sports Core 2 Duo Processor

Reducing size, weight and power have moved up high on the list of priorities of military embedded systems developers. Extreme Engineering Solutions offers the XPedite7172, a high-performance Single-Board Computer (SBC) featuring the 1.8 GHz Intel Core 2 Duo processor, featuring six SATA ports and two SERDES Gigabit Ethernet ports. The XPedite7172 is a high-performance, low-power SBC ideal for military, commercial and industrial embedded computing applications.

The OpenVPX standards-based XPedite7172 features two SerDes Gigabit Ethernet port, up to 4 Gbytes of DDR2-400 ECC SDRAM, two USB 2.0 high-speed ports and two serial ports. The board supports the Ruggedized Enhanced Design Implementation (REDI) standard. Configurable as either air-cooled or conduction-cooled, the XPedite7172 is designed to meet a wide range of environmental requirements. The XPedite7172 hosts numerous I/O ports through the P2 backplane connector, supporting RTM I/O in development platforms and backplane/bulkhead I/O in deployed systems. An XMC expansion slot provides easy product customization, and an optional I/O module allows convenient front-panel access to serial, Ethernet and USB ports during lab development. The XPedite7172 is available for $7,380; variable pricing based on processor speed, memory configuration, ruggedization level and volume purchases.

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

Multicore PowerPC Climbs onto 3U CompactPCI

CompactPCI is no longer the new kid on the block for military embedded systems. GE Intelligent Platforms has announced the IMP3A, a 3U CompactPCI single board computer featuring the latest dual core QorIQ processor technology from Freescale. The IMP3A takes advantage of the QorIQ P2020 processor to deliver dual core performance in a single core power envelope. By coupling the P2020 with an extensive range of memory resources and I/O features, and implementing new features such as SATA and NAND Flash memory, the IMP3A offers innovative technologies for programs committed to the 3U CompactPCI architecture as well as a highly cost-effective technology insertion opportunity for GE's existing IMP1A/IMP2A customers. A typical application would see the IMP3A deployed as part of a control system onboard a tank, armored vehicle or helicopter.

The IMP3A supports a choice of either the QorIQ P2010 single core processor or the QorIQ P2020 dual core processor, operating at up to 1.2 GHz. Both symmetric and asymmetric processing are supported, enabling customers to scale performance through either thread-level or application-level parallelism. A PCI-X PMC expansion capability enables customers to configure the IMP3A to their requirements without exceeding the capacity of a single CompactPCI slot. Up to 4 Gbytes of soldered DDR3 ECC memory is featured for maximum system throughput and reliability, while flexible connectivity is provided with two Gigabit Ethernet channels, up to 16 GPIO ports, two SATA channels, two COM ports and USB 2.0. The IMP3A is available in five build levels from office/benign to conduction-cooled with a maximum operating temperature of +85°C.

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

Health Monitoring Featured on 6U 2.16 GHz Core 2 Duo Board

An increasing number of military applications are requiring computing that can operate autonomously. That means the system has to monitor its own health. With that in mind, General Micro System's "2nd Coming" is the industry's first 6U, 2.16 GHz Core 2 Duo, Conduction-Cooled cPCI SBC to provide full System Health Monitoring and reporting to meet all PICMG 2.9 specifications, while adding a slew of additional health monitoring and reporting system status to an external device.

The C276 supports up to 4 Gbytes of 667 MHz DDR-2 memory and vast onboard I/O. The standard I/O included are dual Gbit Ethernet on PCIe bus with TCP/IP Offloading Engine, dual IDE, quad SATA with RAID (0, 1, 5, 10 and 50) capabilities, five USB-2.0, 1 Mbyte of user/Boot flash and two serial ports. Additional standard I/O included are: one PMC/XMC site with rear I/O, 16 bidirectional Digital I/O lines and dual COM ports with RS-232/422 buffers (jumper selectable). The C276 module is fully compliant to IEEE Std. 1101.2 and ANSI/VITA 2-0 2001. The 2nd Coming operates from -40° to +85°C at the rails with relative humidity of 5-95 percent at 40°C, and may be exposed to shocks of up to 100g for 5 ms, or 40g for 11 ms in 3 axis. The 2nd Coming supports extremes; vibrations range from 5 Hz to 2 KHz for up to 30 minutes at 15g RMS in each axis.

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

VME 2eSST Card Provides PMC8640 CPU and XMC

VME's ability to marry legacy compatibility with new technologies has set it apart from other computing form factors. Along those lines, Interface Concept offers the IC-De6-VMEb, a 2eSST VME board powered either by one or two PMC8640 (or MPC8641), both available in single or dual core version. IC-De6-VMEb is a VME64x board based on the Freescale e600 processor.

Designed for applications requiring a very high level of performance, the IC-De6-VMEb board also provides a very flexible combination of interfaces offering thus the ideal open platform for demanding customers. Its embedded Ethernet switch enlarges the communication skills normally found on such a board, while the two PMC XMC slots enable it to increase the computing power and the range of available I/Os. The 2eSST capabilities of the IC-De6-VMEb provide up to 300 Mbyte/s burst transfer rate across the VMEbus. Moreover, the backward compatibility protects existing investments. The board also features two banks of DDRII DRAM, each up to 1 Gbyte, 256 Mbytes of soldered Mirror Flash and 256 Kbytes of MRAM (non-volatile memory). Also provided is a PPC 64-bit Real Time clock and 32 bit-timers, calendar clock with supercap backup along with a temperature sensor and monitoring.

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

ATCA Blade Serves Up Six-Core Intel Xeon Processors

ATCA has captured a solid niche in defense applications where large board space and heavy duty networking throughput are key. Kontron today announced that both its existing Kontron AdvancedTCA node blade AT8050 and its Kontron server board KTC5520 are available with the newly released Intel Xeon processor 5600 series. This provides TEM and network equipment providers a second feature-rich processor option for the two products that were originally designed with the Intel Xeon processor 5500 series.

The key feature differences with the Intel Xeon processor 5600 series compared to the 5500 series are: six cores instead of four; 12 threads versus 8; 32 nm technology compared to 45 nm; increased performance within the same thermal power envelope; new low-power platform consumption with LVDDR3L; and it maintains all the performance functionalities of the 5500 series plus a new hardware-based security technology called Advanced Encryption Standard - New Instructions (AES-NI). The Kontron ATCA node blade AT8050 features a single socket for either one quad-core Intel Xeon processor L5518 or the six-coreXeon processor L5638. Both options are compatible with the existing Intel 5520 chipset, which supports up to 36 lanes of PCI Express 2.0 and directly assignable I/O for virtualization (VT-d), significantly accelerating I/O traffic and lowering processor use in both native and virtualized environments. Both the Kontron AT8050 and Kontron KTC5520 will have early samples available with the new Intel Xeon processor 5600 series in Q2, 2010.

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

3U CompactPCI Card Combines Atom and FPGA

Once used mostly as glue-logic interfaces, FPGAs are now powerful enough to be used alongside general-purpose CPUs as coprocessors. MEN Micro offers a 3U CompactPCI SBC that combines low-power Intel Atom XL processors with an onboard FPGA for user-defined functions, the first SBC available to offer this capability. Depending on the application, the board can be equipped with various 45 nm-based Intel Atom XL processors, which offer a maximum power dissipation of 7W at a speed of up to 1.6 GHz. The board's specially designed heat sink enables operation across an extended -40° to +85°C (-40° to +185°F) temperature range. The board's standard front I/O includes a COM interface via a D-Sub connector as well as two USB 2.0 ports, graphics via VGA or UXGA and a PS/2 interface for a keyboard or a mouse. Further interfaces include a Gigabit Ethernet slot via PCI Express x1 and an FPGA-based Fast Ethernet slot on the RJ45 connectors.

The onboard FPGA also allows for customer-specific interfaces, such as serial interfaces, CAN bus, binary I/O, protocol converters or touch controllers to suit a user's specific application. The F11S can accommodate up to three SA-Adapters for additional I/O. The memory configuration contributes to the board's flexibility with the incorporation of up to 2 Gbytes of soldered DDR2 SDRAM, 2 Mbytes of non-volatile SRAM, a CompactFlash card and a microSD card slot in addition to the 512 Kbyte of L2 cache integrated in the processor. Pricing for the F11S starts at $1,443.

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

VPX Card Embeds Multicore UltraSPARC T2 Processor

This is truly becoming the year of VPX as vendors roll out many types of VPX products for military applications. Themis Computer has announced its new T2VPX 6U VPX board computer. The T2VPX is the first member of the company's new family of VITA 46-compliant, board-level computers. Themis' T2VPX supports the VITA 46 and VITA 65 standards, providing customers with next-generation processing performance and high-bandwidth serial switched fabrics. The board features a new system architecture that combines up to eight processor cores and 64 threads, with a VPX IO fabric. The T2VPX is ideal for compute-intensive military and aerospace applications requiring rugged computing solutions, beyond the reach of today's VME-64-based systems.

The T2VPX is based on the Sun UltraSPARC T2 CMT (chip multi-threading) processor, the industry's first "system on a chip," and runs both Linux and the Solaris 10 Operating System. Themis' new T2VPX board further proliferates Sun's advanced UltraSPARC T2 processor technologies into embedded computing markets. The T2VPX will be offered with 6 and 8 core processor options. T2VPX features and specifications include up to 32 Gbyte of DDR2 memory with ECC protection, onboard 1.8-inch HDD/SSD support, multiple Gbit and 10 Gbit Ethernet channels and more.

Themis Computer
Fremont, CA.
(510) 252-0870.
[www.themis.com].

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Rugged Router Boasts Rack-Mountable 2U Chassis

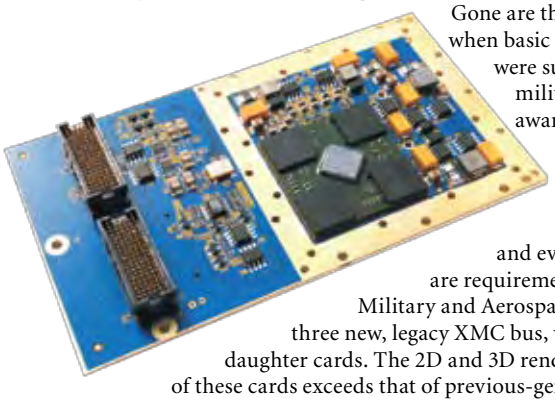
The military's drive toward net-centric operations has ramped up the need for lots of network gear. Parvus offers a ruggedized version of the 3825 Series Integrated Services Router (ISR) from Cisco Systems. Featuring mechanical packaging enhancements designed to suit shipboard / military shock and EMI environments, the DuraNET 3825 provides a robust Commercial-Off-the-Shelf (COTS) solution that extends the application use of industry-leading Cisco hardware. Designed to meet MIL-S-901D Grade B shock levels and MIL-STD-461 radiated emissions requirements, the DuraNET 3825 comes in a rugged rack-mountable 2U chassis fitted with circular MIL-DTL-38999 connectors. The unit brings out up to nineteen Ethernet and ten serial ports, including dual Gigabit Ethernet WAN uplink ports, a Gigabit Ethernet Switch port, sixteen 10/100 Ethernet switch ports, eight Asynchronous / Synchronous RS-232 ports, console and auxiliary serial ports.

The DuraNET 3825 combines the powerful features available in Cisco IOS software, Catalyst Layer 2 LAN switching, and flexible Layer 3 WAN routing into a single ruggedized platform. This robust Internet Protocol (IP) networking device integrates embedded security processing, generous performance, high memory capacity and high-density interfaces to deliver the performance, availability and reliability required for scaling mission-critical applications.

Network features include port autosensing, QoS and VLAN capabilities compliant with 802.1p and 802.1Q standards, and 802.1D Spanning Tree protocols. For ease of management and configuration, the router features the intuitive, Web-based Cisco Router and Security Device Manager (SDM) with support for Secure Shell Protocol Version 2 (SSHv2) and Simple Network Management Protocol Version 3 (SNMPv3) protocols to encrypt the management session. Select models also integrate a Cisco VPN Hardware Encryption Acceleration module and upgraded system and flash memory configurations. DuraNET 3825 units have already shipped in support of U.S. and NATO defense programs and are built to order.

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

XMC Graphics Card Family Offers 3D Support



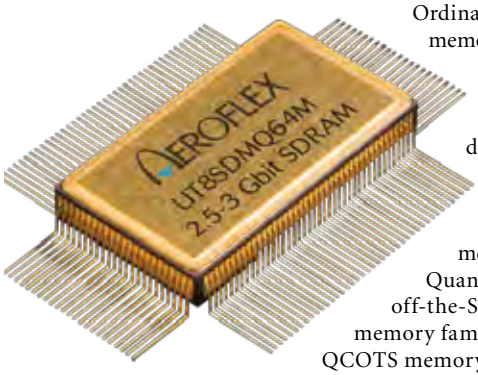
Gone are the days when basic text displays were sufficient for military situational awareness needs. Full motion video, advanced graphics and even 3D now are requirements. Wolf Military and Aerospace now offers three new, legacy XMC bus, video graphics daughter cards. The 2D and 3D rendering speed of these cards exceeds that of previous-generation ATi Radeon units by more than 10 times. Wolf's XMC-E4690 high-performance graphics cards offer 28 standard combinations of dual independent display outputs: DVI, DP, HDMI, single and dual links, LVDS, TMDS, VGA, SCART, STANAG 3350-A;B or C, NTSC, RS170, RS343A, PAL and SECAM. And the XMC-E4690-XTCC-MV offers 28 combinations of dual channel video output, and dual independent video channel inputs.

Wolf Industrial Systems, Uxbridge, Ontario, Canada.

(800) 931-4114.

[www.wolf.ca].

High-Rel SDRAM MCMs Provide 3 Gbit Density



Ordinary consumer memory chips don't cut it in high-reliability applications like aerospace and defense. Serving that need, Aeroflex has added two new SDRAM members to its Quantified Commercial-off-the-Shelf (QCOTS) memory family. The Aeroflex QCOTS memory family now includes 2.5G and 3.0 Gbit SDRAM multi-chip-modules (MCM) organized 64M x 40 (UT8SDMQ64M40) and 64M x 48 (UT8SDMQ64M48) respectively. The two new SDRAM MCMs offer low power consumption at 3.3 volts, fast access time (133 MHz) with performance guaranteed via a Standard Microcircuit Drawing (SMD). Both products are assured to withstand 100 krad(Si) and are single event latchup immune (SEL) to 111 MeV-cm^2/mg. The UT8SDMQ64M40 is priced at $4,675, QML Q, in lots of 100, while the UT8SDMQ64M48 is $5,253.

Aeroflex Colorado Springs, Colorado Springs, CO.

(719) 594-8000.

[www.aeroflex.com].

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VPX-REDI SBC Enables Network Connectivity Mobile Apps

The ecosystem for VPX continues to grow and more and more vendors roll out their VPX offerings. Designed to withstand the rigors of mobile and tactical environments, General Dynamics Canada introduces the new rugged and powerful PX3030 VPX-REDI single-board computer. The PX3030 harnesses the computing power of the Intel Core 2 Duo Mobile processor and 8 Gbyte RAM to easily handle today's demanding network communications, graphics, imagery and video feeds needed for Modern Brigade Combat teams.

The board is aimed at applications such as tactical wheeled vehicles including tanks, expeditionary fighting vehicles and Stryker platforms as well as armament platforms such as mobile gun systems and cannons. Other applications include airborne command and control for combat helicopters, aircraft and unmanned aerial vehicles. Features of the board include dual Gbit Ethernet 10/100/1000 connectivity, onboard storage up to 16 Gbytes of SATA NAND, flash, six USB 2.0 and four RS-232/422 ports. The card meets VITA 47 CC4 vibration, shock and temperature specs. It's a 3U module per VITA 48.2 (conduction-cooled), Type 1, 0.85-inch pitch. Compatible software includes Microsoft Windows, LynuxOS, Linux, HHEL, VxWorks and other operating systems.

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

High-Speed, Real-Time Recording System Supports Wide Bandwidths

High-frequency real-time recording is vital in many wideband signal applications including UAVs, telemetry, communication and radar. Feeding such needs is Pentek's new Model RTS 2711 Real-Time Data Recording Instrument. This is a ready-to-run, PC-based recorder that includes a complete PC workstation running Windows XP, housed in a rackmount 4U chassis. Its extremely high-speed architecture allows simultaneous digitizing and recording of two signals at sampling rates of 500 Megasamples/sec. Since the system handles input signal frequencies up to 750 MHz, it is well suited for development and field testing in a broad range of applications. The RTS 2711 is the fastest and widest bandwidth recording instrument ever offered by Pentek, doubling the aggregate recording rate and quadrupling the attainable bandwidth of previous RTS systems.

In addition to its unusually high data rates, the Model RTS 2711 has exceptional storage capacity with a total of 4 terabytes of RAID storage to record arriving signals. The storage is actually configured as two 2 terabyte arrays with each of the arrays assigned to one of the A/D channels. All data is stored on high-performance, removable hot-swap SATA drives, accessible from the front panel. What sets the Pentek RTS 2711 apart from competing recording instruments is that it records data directly in NTFS (new technology file system) format. This means that as soon as recordings are laid down on the RAID array hard disks, they are immediately available to any Windows application for analysis or post-processing. A number of competing instruments use a proprietary file system for recording. In order to open these files in Windows applications, such as signal analysis tools like MATLAB and others, the files must first be converted to a Windows-compatible file format. This conversion can often take many times longer than the actual duration of the recording.

The RTS 2711 is a deployable instrument with the client application accessible remotely via TCP/IP messaging over Ethernet or the Internet. All system commands, status information and recorded files can pass back and forth between the client and server. As an example, a customer could have a larger system that needs to record live data at a monitoring facility. The RTS 2711 can be deployed as a server at a remote location to record signals. The recorded signal can then be accessed from the monitoring facility via the Internet. The price of the RTS 2711 starts at $58,995.

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

Processor AMC Module Is Powered Quad-core Xeon

Processor AMCs (PrAMCs) provide the computing backbone for the emerging MicroTCA architecture. Kontron has introduced the AM5030, one of the first Advanced Mezzanine Cards designed with a quad-core processor. This new double-wide, full-size AMC module features the new Intel Xeon processor LC5518. It hosts up to 24 Gbytes of ECC memory (DDR3) at 1066 MHz implemented as a 3-channel interface for the highest memory access, and is built with two 10GbE (XAUI) interfaces in accordance with AMC.2 for comprehensive networking capabilities. When used in conjunction with a 10GbE MicroTCA Carrier Hub (MCH), such as the Kontron AM4910, system designers can achieve exceptionally high-performance multicore MicroTCA platforms built for massive data throughput.

Kontron America, Poway, CA.

(858) 677-0877. [www.kontron.com].

ADC FMC Card Delivers 550 Msamples/s Output

The FPGA Mezzanine Card (FMC) form factor has quickly positioned itself as one of the key mezzanine approaches for compact signal processing requirements. Curtiss-Wright Controls Embedded Computing has announced the availability of a higher performance, faster version of its ADC510 FPGA Mezzanine Card (FMC/VITA 57) module. The ADC510 now supports two Texas Instruments ADS54RF63 ADC devices with each device supporting a sampling rate up to 550 Msamples/s and providing 12-bits of digital output. The ADC device interfaces are routed to the FMC connector to enable an FPGA on a baseboard to directly control and receive data.

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

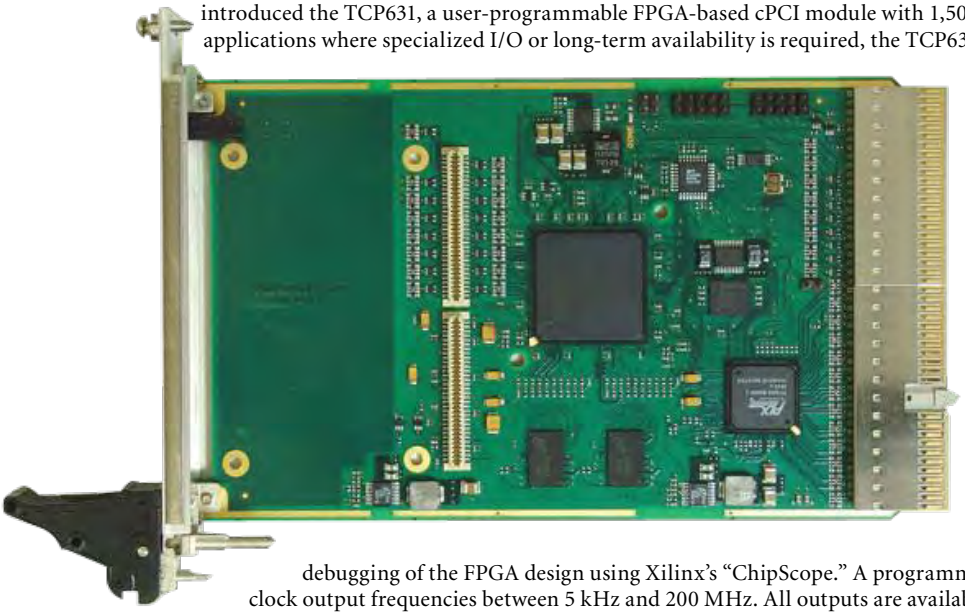
USB Device Simplifies Temperature Measurements

Test and measurement gear used to require large racks of boards. Now the same functionality can be done using small modular USB devices. An example is National Instruments' NI USB-TC01, a USB data acquisition device that measures and records temperature data from a thermocouple. The new device combines a quick and easy plug-and-play setup with the high-quality capabilities and features of NI DAQ products. The USB-TC01 thermocouple measurement device features NI InstantDAQ technology, which helps customers to instantly take temperature measurements with no set-up time or driver software installation. Additionally, the USB-TC01 features a standard miniplug connector that helps customers use different thermocouples to meet their specific application needs.

In addition to saving time and resources in system setup, the new device also exhibits the overall accuracy and reliability of more complex measurement systems. With traditional stand-alone data loggers, measurements are made independently of the PC so data can only be viewed offline. The USB-TC01 is always connected to the PC so customers can take live measurements and view results displayed instantly on the PC monitor. Priced at $99, the USB-TC01 is ideal for all types of labs and adds convenience to making temperature measurements.

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

CompactPCI Card Sports High-Density FPGA



The advent of high-density FPGAs has enabled a new level of flexibility for military board-level systems. Tews Technologies has introduced the TCP631, a user-programmable FPGA-based cPCI module with 1,500,000 or 5,000,000 system gates. Designed for applications where specialized I/O or long-term availability is required, the TCP631 provides a number of advantages including a customizable interface for unique applications and a FPGA-based design to extend product lifecycle. For flexible front I/O solutions, the TCP631 provides a PIM Module slot that allows active and passive signal conditioning. With the TPIM003-10 all I/O signals are provided on a HD68 connector. The TCP631-2x also offers rear I/O via the J2 connector. The TCP631 offers 64 I/O lines to the front I/O and 64 I/O lines to the rear I/O. All I/O lines are directly connected to the FPGA-pins, which maintains the flexibility of the Select I/O technology of the Spartan III FPGA. All I/O lines provide external ESD-protection devices. In addition, the FPGA is connected to two banks of 128 Mbytes, 16-bit wide DDR2 SDRAM.

The FPGA is configured by a serial flash. The flash device is in-system programmable via driver software over the PCI bus. An in-circuit debugging option is available via an optionally mounted JTAG header on the backside of the board for readback and real-time debugging of the FPGA design using Xilinx's "ChipScope." A programmable clock generator provides up to four different clock output frequencies between 5 kHz and 200 MHz. All outputs are available at the FPGA—in addition, one clock source is used as the local clock signal for the PCI controller. The clock generator settings are stored in an EEPROM and can be changed by the driver software through the PCI Target Controller. The configuration EEPROM of the PCI Target Controller can also be modified by the driver software to adapt address spaces and other critical parameters.

TEWS Technologies, Hastenbeck, Germany. +49 (0) 4101 4058-0. [www.tews.com].

1U Rackmount System Embeds Atom Processor

The Atom processor has brought low-power computing to a variety of form factors. WIN Enterprises is riding that wave with its PL-80120, a 1U rackmounted hardware platform designed for military network service applications. Built with Intel Embedded IA components with long-term availability, the PL-80120 supports the Intel Atom N450, D510 and D410 low-voltage processors with CPU-integrated Northbridge chipset. The device supports a high-bandwidth DDR2 SODIMM slot with memory up to 2 Gbytes. The unit includes one 3.5-inch SATA HDD and CompactFlash. PL-80120 has six GbE Copper LANs with bypass function or 5 GbE Copper LANs with bypass function and 4 10/100 switch ports, all available from the front-panel. The pricing for PL-80120 with the Intel Atom D410 single-core CPU (1.66 GHz) begins at $380 in OEM quantities.

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

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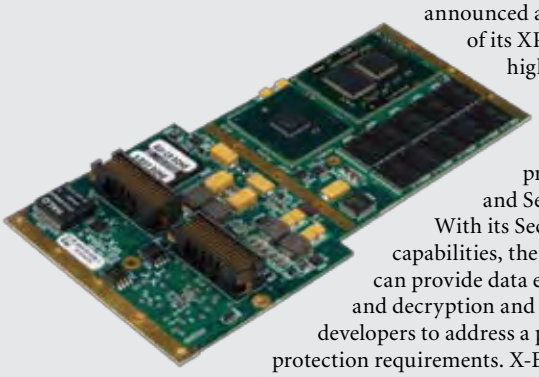
XMC Board Blends Core i7 and Secure Features

The Intel i7 represents probably the first portable/desktop processor to emerge into the consumer market almost simultaneously as it appeared on board-level embedded products. Extreme Engineering has announced availability of its XPedite7302, a high-performance XMC module featuring the Intel Corei7 processor and SecureCOTS. With its SecureCOTS capabilities, the XPedite7302 can provide data encryption and decryption and enables developers to address a program's protection requirements. X-ES has confirmed its ongoing commitment to bring new technology to the market first and lead the Intel Core i7 processor-based embedded computing market by delivering the first XPedite7302 with a production Intel Core i7 processor to a customer. SecureCOTS includes functionality that X-ES's customers can use to develop secure computing and anti-tamper capabilities for their customers.



Extreme Engineering Solutions, Middleton, WI.

(608) 833-1155. [www.xes-inc.com].

USB Avionics Databus Interface Is Pocket-Sized

USB took some time to migrate into the embedded world and longer still to be embraced as a military I/O interface. Now it's there to stay, and the latest example is Ballard Technology's portable USB 2.0 interfaces for MIL-STD-1553 and ARINC 429/717 protocols. These easy-to-use USB interfaces enable engineers and technicians to test, simulate and analyze avionics databuses using any available PC. The same device and software can be used in the lab and in the field. Typical applications include product and system development and integration, data loading, flightline maintenance and AOG support, and performance monitoring and analysis. These new USB devices make excellent replacements for plug-in cards, especially hard-to-get PCMCIA cards.

Several models are available with a variety of channel counts and capabilities for the most common aircraft databus protocols—MIL-STD-1553 (shown), ARINC 429 and ARINC 717. Units are available with up to 2 dual redundant MIL-STD1553 channels, up to 16 ARINC 429 channels or up to 4 ARINC 717 channels. A multi-protocol version is also available with 12 ARINC 429 channels and 4 ARINC 717 channels. Weighing less than 5 ounces, these rugged little USB peripherals use the same powerful 5th generation technology as Ballard's PCI and PCI Express cards.

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

10 Gbit Ethernet PCI Express FPGA Accelerator Card

A low-profile PCI Express FPGA accelerator card features a 10 Gbit Ethernet interface directly coupled to a Xilinx FPGA. The PCIe-180 from Nallatech is targeted at Signal Intelligence, Network Security and Algorithm Acceleration applications. The PCIe-180 features an onboard Xilinx Virtex-5 user FPGA directly coupled to a high-bandwidth, flexible memory configuration that includes ECC and parity protection. Five independent banks of DDR-II SRAM provide up to 10 Gbyte/s of sustained, random access memory bandwidth. A single bank of DDR2 SDRAM memory provides 4 Gbyte/s of deep storage local to the user FPGA. The PCIe-180 is tightly integrated to the Host platform via a x8 PCI Express connection supporting sustained bandwidths of up to 2.2 Gbyte/s. Optimized VHDL memory controller IP cores and reference designs are included as part of the standard product deliverables along with driver and API source code for 64-bit Linux operating systems.

The PCIe-180 complies with the "low-profile" half-height, half-length PCI Express mechanical specification. This enables compatibility with almost all high-density server and blade center platforms from leading OEMs such as HP, IBM, DELL, CRAY and SGI. Depending upon configuration, pricing for the PCIe-180 starts at $2,995 in volume production.

Nallatech, Camarillo, CA. (805) 383-8997. [www.nallatech.com].

Serial RapidIO GEN-2 Switch Rides OpenVPX/VITA-65

With the OpenVPX well on its way to final ANSI approval, a flurry of OpenVPX of products is feeding the OpenVPX ecosystem. Curtiss-Wright Controls Embedded Computing has announced the availability of the new OpenVPX/VITA-65-compliant VPX6-6902 Serial RapidIO (SRIO) switch card. This rugged 6U VPX board, available in both air- and conduction-cooled versions, combines Ethernet and SRIO switching in a single slot for management, control and dataplane switching in high-performance embedded military systems. Supporting both Gen-1 SRIO (1.25, 2.5, 3.125 Gbaud) and Gen-2 SRIO (5.0, 6.25 Gbaud), the VPX6-6902 enables systems integrators to quickly and easily architect small to large high-performance systems that adhere to the VITA-65 OpenVPX systems specification.

SRIO is a next-generation data-plane interconnect and combines extremely high data rates with low system latency. Eclipsing existing Generation 1 SRIO switches, the VPX6-6902 doubles the available bandwidth with SRIO Gen-2 technology, offering up to 20 Gbit/s throughput on each of its 28 4-lane ports. The VPX6-6902 is designed to form the interconnect backbone of extremely high-performance mission computing environments, and simplifies systems design with features designed for redundant and fail-safe architectures.

Curtiss-Wright Controls Embedded Computing, Leesburg, VA.

(703) 779-7800. [www.cwcembedded.com].

Capacitive Touch Switches Up Transparency, Lower Reflectivity

An advanced capacitive touch switch technology detects variations in position and command, eliminates air gaps and reduces the number of layers required. This technology from Optrex America offers the highest standards of optical performance with exceptional ease of design for human machine interfaces, handheld terminals, gaming, medical equipment, and point-of-sale and mobile applications. The capacitive touch screens respond to fingertip input control without requiring application of any pressure. The structures are very robust and the sensor elements will not wear out. Lifetimes are approximately 100 million touches.

Optrex's new capacitive touch switch solutions provide clarity and ease of design. Improved visibility results from less reflectivity and higher transparency of the image displayed through the touch panel and allows for a thinner touch screen in front of the LCD (up to 0.5 mm - 0.7 mm thick in the viewing area). Transparency is a minimum of 95% and reflection is less than 15%. The capacitive touch screens also have a wide operating temperature range, -20° to +70°C. Touch screens utilizing Optrex's technology are more compact, lighter in weight, more durable (including better resistance to liquids) and easier to clean. Display solutions incorporating Optrex's capacitive touch technology are currently available for demonstration and new product designs. Sample pricing is $50.00 for T-55343 (3.5" transmissive); $66.00 for T-55149 (3.0" transflective); and $70.00 for T-51963 (3.5" transflective).

Optrex America, Plymouth, MI. (734) 416-8500. [www.optrex.com].

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Diagnostic Tool for Long-Term Monitoring of CAN Systems

The new CANobserver from IXXAT enables the physical and logical long-term monitoring of CAN, CANopen and DeviceNet systems. For this, the device is permanently integrated into the network and continuously monitors and records the data transfer for up to several years. Sporadic negative impacts, such as external EMC interferences or a slowly deteriorating signal quality caused by worn plug connections, can be detected by the physical layer diagnosis and logical frame monitoring in a timely manner. Thus, the CANobserver is able to inform the system operator before any communication error occurs. An Ethernet interface is used to connect the CANobserver to the PC, which also enables the operation of the device by an easy-to-use Web interface.

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

Hypervisor Supports Debug and Processor Virtualization

The latest version of the Hypervisor from Wind River Systems is aimed at making it easier to consolidate systems and adopt virtualization and multicore technology in embedded devices. New features of Wind River Hypervisor include support for the latest Intel microarchitecture "Nehalem"-based processors, such as the Intel Xeon processor 5500 series as well as Intel Core i5 processor and Intel Core i7 processor utilizing advanced virtualization hardware assist capabilities. Integration with Wind River's operating systems is provided including the latest versions of VxWorks and Wind River Linux, while also supporting other operating systems for greater flexibility. The product offers additional capabilities for inter-virtual machine communication, including support for multicore/multi-OS interprocess communication (MIPC), and virtual network and serial ports.

Wind River Systems, Alameda, CA. (510) 748-4100. [www.windriver.com].

150W DC/DC Converter Is Chassis Mountable

The military's desire to pack a lot of computing muscle into small spaces is fueling the need for high-density power components to drive those electronics. Along such lines, Calex Manufacturing offers the HCM Series of high power density chassis mount DC/DC Converters. These 150 watt rugged, encapsulated DC/DC converters are ideal for harsh industrial and COTS military applications. All 10 models in the series offer a wide 4:1 input range, from 9 to 36 VDC and 18 to 75 VDC, making the units ideal for 24 volt industrial, 12 and 24 volt battery applications and 48V power sources. The output voltages available are 3.3, 5, 12, 15 and 24 volts DC. All models are isolated input to output.

Calex, Concord, CA. (925) 687-4411. [www.calex.com].

USB Data Acq Module Works in Harsh Conditions

An ultra-high-resolution USB data acquisition module for portable test and measurement is designed for use under the harshest conditions. The highly accurate front-end design of the USB-powered DT9824 from Data Translation allows users to simultaneously sample up to four fully isolated 24-bit inputs, guaranteeing complete signal measurement protection from all environmental or system noise. The company states that the design of the DT9824 with a temperature coefficient of ±0.05 µV/°C, and a common-mode rejection ratio (CMRR) of greater than 150 dB, delivers results that are twenty times better than other data acquisition solutions. Advanced technology makes the DT9824 a suitable choice for chromatography, seismic, weigh scale and medical uses, along with other measurement applications where accuracy and stability are paramount. Each analog input on the DT9824 is galvanically isolated from any other input and has its own return path, further enhancing noise immunity.

This ISO-Channel technology utilizes galvanic isolation methods to guarantee 1000V isolation between any input channel to any other input channel and ±500V to earth ground. ISO-Channel vastly increases reliability by implementing a separate isolated return path for each 24-bit A/D converter used by the four input channels, all operating in parallel. The benefit to the user is total isolation of all input/outputs from each other and from digital ground. Key features include four simultaneous analog inputs at throughput rates up to 4800 Hz with a high-resolution 24-bit analog input subsystem. There are optional signal sampling ranges of ±10V with programmable gains of 1, 8, 16 and 32 for even greater resolution. Single-value and continuous conversion modes provide input flexibility and the unit is totally self-powered through USB. There are also 16 (8 in, 8 out) opto-isolated digital lines for correlating measurements. A rugged enclosure helps ensure noise immunity in a 1U, ½ rack small profile—and a comprehensive software CD is included for making measurements quickly and easily. The DT9824 is priced at $1,695.

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

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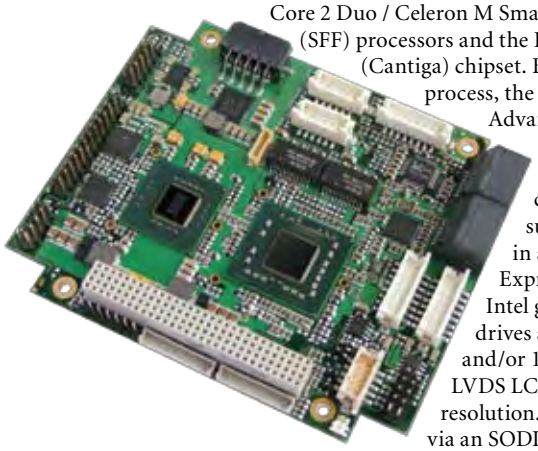
PCI/104-Express SBC Sports Core 2 Duo CPU

A PCI/104-Express single board computer is based on the Intel Core 2 Duo / Celeron M Small Form Factor (SFF) processors and the Intel GS45 Express (Cantiga) chipset. Based on the 45nm process, the ADLGS45PC from Advanced Digital Logic sets a new standard with managed thermals, combined with superior performance in an embedded PCI/104-Express form factor. The Intel graphics controller drives a CRT to 2048x1536 and/or 18/24/36/48-bit LVDS LCD to 1600x1200 resolution. Memory is added via an SODIMM204 socket that will accept up to 2 Gbytes of DDR3-1066 DRAM. In addition to ACPI/APM functions, the ADLGS45PC has the following features: 8x USB 2.0, 2x RS232/422/485 COM ports, PS/2 Keyboard and Mouse, LPT, AC97 Sound / 7.1 HDA and 2x 10/100/1000MBit LAN. The ADLGS45PC also includes four onboard SATA 3 Gbyte ports with RAID 0/1/5/10 support.



Advanced Digital Logic, San Diego, CA.

(858) 490-0597. [www.adl-usa.com].

Rugged Transit Rack Cases in 4U and 12U

A family of transit rack cases for safe and reliable transport of electronic systems in rugged environments come in 4U and 12U heights. The cases feature superior shock/vibration and extreme environment protection. Compliant to MIL-STD 810F and rated to IP65, the cases from Optima EPS are stable in temperatures from -40° to +158°F. They combine the resilience of a rotomolded case with a stainless steel 19" rack frame supported on anti-vibration mounts.

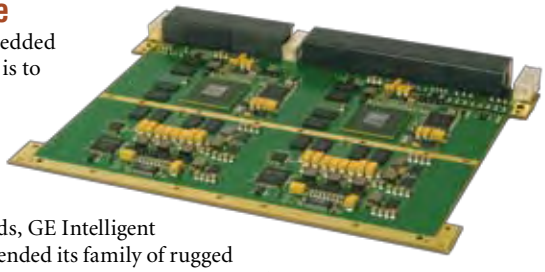
The transit cases have an enhanced sway space between the inner frame and outer case to prevent contact with container shell. Pricing for the cases is under $1,500 each depending on size, volume and configuration.

Optima EPS, Lawrenceville, GA.

(770) 496-4000.

[www.optimaeps.com].

OpenVPX GPGPU Board Offers 750 Gflops Performance



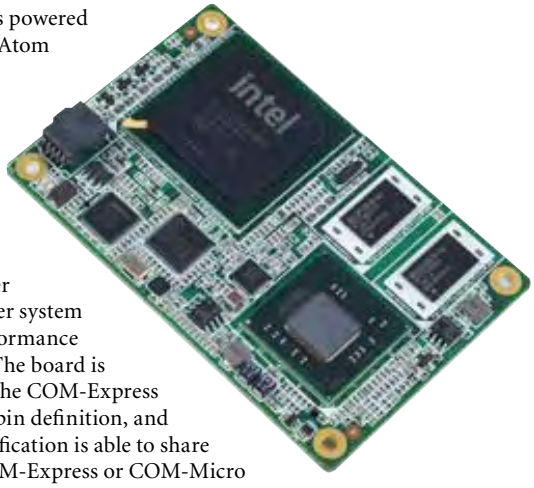
The latest embedded computing trend is to employ graphics processor technology in a general purpose processing role. Serving such needs, GE Intelligent Platforms has extended its family of rugged GPGPU (general purpose computing on a graphics processing unit) solutions with the announcement of the 6U OpenVPX NPN240 multiprocessor. The NPN240 features two NVIDIA CUDA-capable GT240 96-core GPUs, enabling it to deliver up to 750 Gflops peak per card slot (depending on the application). Multiple NPN240s can be linked to single or multiple hosts to create multi-node CUDA GPU clusters capable of thousands of Gflops.

Providing a highly computationally dense platform, the NPN240 is ideal for demanding applications that are constrained in terms of size, weight and power. Typical applications include stream processing of high-resolution images for deployed airborne surveillance. The OpenVPX- and VITA48/REDI-compliant NPN240 is interoperable with other OpenVPX-compatible COTS boards to ease integration and reduce development time. Each CUDA-capable GPU node includes local DDR3 SDRAM as well as a 16-lane PCI Express gen2 interface to the system backplane, providing maximum data throughput direct to GPU memory. Air-, spray- and conduction-cooling build options are possible to allow deployment in the harshest military and aerospace environments.

GE Intelligent Platforms, Charlottesville, VA.

(800) 368-2738. [www.ge-ip.com].

Atom COM Modules Feature 84 x 55 mm Size



Reducing size, weight and power ranks high on today's list of military requirements. Advantech's newest COM CPU module, the SOM-7562, measures only 84 x 55 mm in dimension and is powered by the new Intel Atom N450 processor, with integrated onboard graphic and memory controller (GMCH) on a single chip, enabling even better power reduction, smaller system designs and performance improvements. The board is compliant with the COM-Express type 1 standard pin definition, and with slight modification is able to share with current COM-Express or COM-Micro carrier boards. The board is particularly suited for personal handheld or portable defense applications.

Advantech, Irvine, CA.

(800) 866-6008.

[www.advantech.com].

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Index

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Special Feature: Target Report: Current Force and Next-Gen Mil Vehicles Eye 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: ATCA Finds Niche in Military Comms Although designed originally for the telecommunications market, ATCA has slowly and quietly gained numerous project wins in a variety of comms-oriented military systems. This section explores the latest ATCA system solutions available and what in particular about them is attractive to military system developers.

System Development: Military Batteries and Power Conversion Today the choice of power supplies, power converters and batteries can rank as a make or break decision in embedded military computer systems. With more and more computing stuffed into smaller spaces, power has direct implications on the size, cooling and mobility of a system. Articles in this section examine technology trends affecting military batteries, DC/DC converters, power supply module bricks and slot-card power supplies (VME, cPCI and others).

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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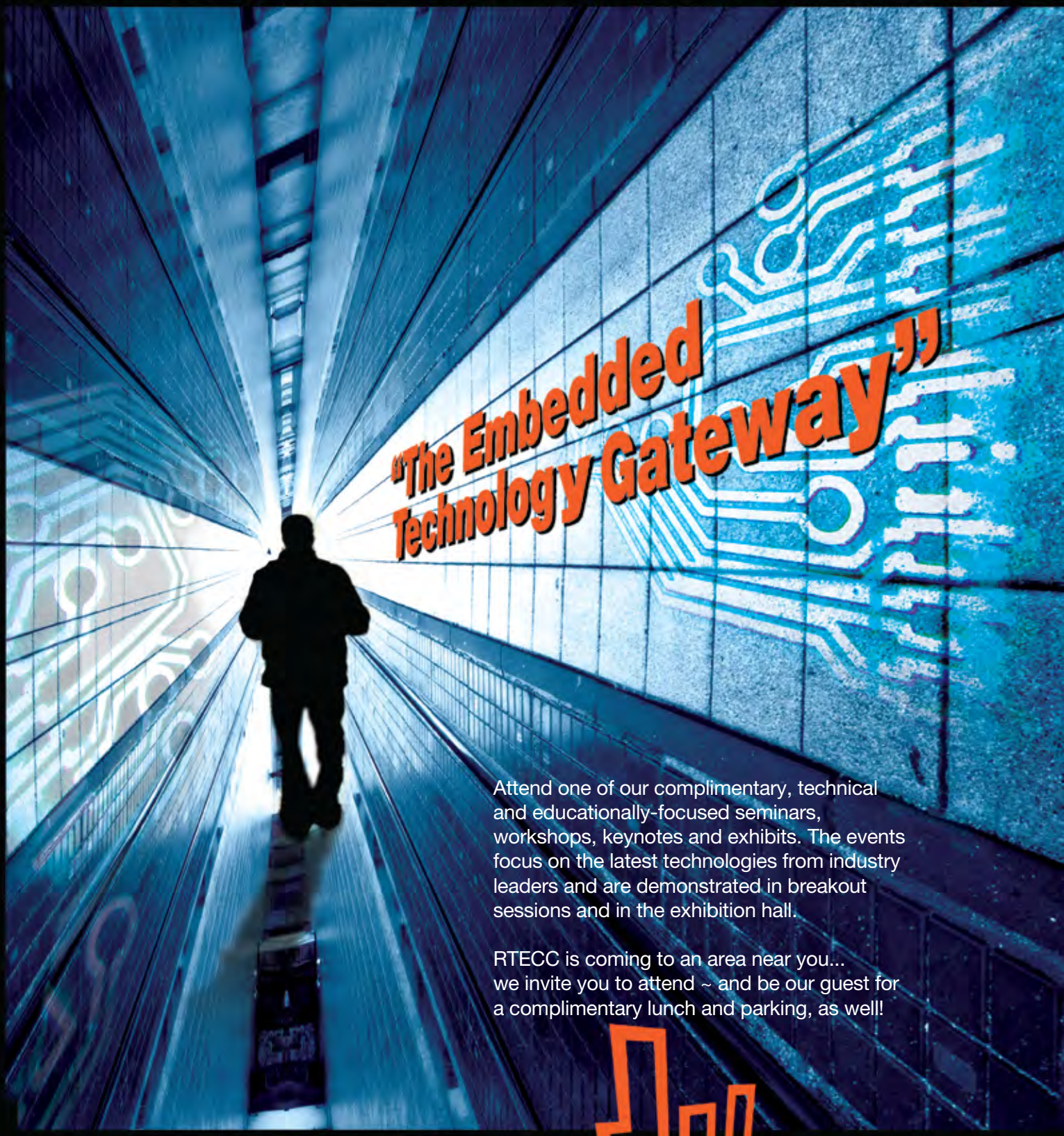

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Editorial

Jeff Child, Editor-in-Chief

Connecting the Net-Centric Dots

At one of the keynote panels at last year's MILCOM conference in Boston, I remember a panelist saying that for the DoD, the "Network" is no longer merely a force-multiplier. It has now become a battlefield necessity. I will forgive myself for not remembering which panelist said that—particularly since I recall he said he was quoting someone else. The point is that for our military—just as in the civilian world—networks, information sharing and broad scope communications technologies are now firmly considered a vital part of day to day operations.

All that said, the military has many more dots to connect to achieve the level of net-centric vision it has set out for itself. That vision calls for real-time sharing of voice, video and data between soldiers, aircraft, satellites, ships, robots and UAVs, all over a global network. The ultimate goal is a network that promises a complete "sensor-to-shooter" cycle that's nearly instantaneous. Technology areas fueling those goals include software and programmable radios, ultra-wideband optical communications and networking in space. While many pieces of that puzzle are doable and even fielded today, there's a long way to go to reach anything approaching that end goal.

Certainly there are a number of programs that make up the bones and muscles of net-centric operations—everything from WIN-T to JTRS to satellite networking platforms. And numerous UAV payloads make up part of the military's intelligence, surveillance and reconnaissance (ISR) continuum. Even at the level of ground vehicle networking on-the-move, it doesn't really matter what wireless technology is ultimately used as long as the systems on board link to Ethernet. And on the IT side of DoD operations, IP (Internet Protocol)-based information sharing has won out over other concepts.

But while all those bottom-up technologies are falling into place, there are a number of challenges ahead to get closer to the kind of net-centric ISR that meets the future vision. Last month, Davi M. D'Agostino, director of Defense Capabilities and Management for the GAO, made a testimony to the House Armed Services Subcommittees on Air and Land Forces and Seapower and Expeditionary Forces reviewing some of those key challenges. Even though the DoD is rapidly increasing its ability to collect ISR data in Iraq and Afghanistan, its capacity for processing, exploiting and dissemination is limited and has not kept pace with the increase in collection platforms and combat air patrols.

D'Agostino cited how the number of combat air patrols flown by the Air Force's Predator and Reaper unmanned aircraft systems has increased from 13 to 36 since 2007. And the 2010 Quadrennial Defense Review Report says it will continue to expand the Predator and Reaper combat air patrols to 65 by fiscal year 2015. But all that new data collection ups the burden on the Air Force's ground processing systems.

Another issue is the bandwidth challenge of transmitting data from ISR collection platforms to ground stations where analysts process, exploit and then disseminate intelligence to users. This requires high-capacity communications bandwidth, but bandwidth can be limited in a theater of operations by the satellite and ground-based communication capacity. An insufficient amount of bandwidth affects the ability to send, receive and download intelligence products that contain large amounts of data.

Robust 10 Gbit Ethernet technologies—from mobile network routers to rugged embedded Ethernet switches—will help increase those network capacities once deployed. The bandwidth appetite will keep increasing, however. Intelligence info from ISR geospatial data has high bandwidth requirements—the higher the resolution of data the longer the transmission time via a given bandwidth. DoD officials say that limited bandwidth is a continual challenge in Iraq because of the warfighter's reliance on geospatial data. Others have reported an ever growing need for communications bandwidth in combat operations.

Another challenge is getting the DoD branches in synch on information sharing across the defense intelligence community; progress has been uneven among the military services. For over 10 years the DoD has had plans for its Distributed Common Ground/Surface System (DCGS)—an interoperable family of systems that will enable users to access shared ISR information. The military services have been directed to transition their service-unique intelligence data processing systems into DCGS, but each of the military services is at a different stage. The Air Force and the Navy each plan to have a fully functional version of DCGS by the end of fiscal years 2010 and 2013, respectively, and the Army does not expect to have a fully functional system until 2016. The Marine Corps has not yet established a completion date for the full operational capability of its DCGS.

This ambitious effort to get the military up to full networked mode has been compared to the Manhattan Project. Like the Manhattan Project, there's a whole host of formidable technical problems—many never considered before. But unlike that WWII effort to build the first atomic bomb, Net-Centric Operations does not require any big technology leap. In fact, many of the wireless and networking techniques have and will be leveraged from the commercial and consumer markets. The more difficult challenge it seems is the connecting of the many dots that will make a fully networked military a reality. ▮▮

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